BRIEFING PAPER

CHATHAM HOUSE

ENERGY, ENVIRONMENT AND DEVELOPMENT PROGRAMME EEDP CC BP 07/03

JUNE 2007

Transforming our energy within a generation

Walt Patterson, Chatham House

Summary

- Climate security and fuel security are two aspects of the same problem, the need to reduce dependence on fossil fuels.
- Energy is not a single issue but many, with widely differing attributes and policy options.
- Energy is not about commodities but about infrastructure.
- Climate is an energy issue; energy is an infrastructure issue; therefore climate too is an infrastructure issue, demanding policies to match.
- Transforming our energy starts with transforming how we think about it, and can start immediately.

Why transform our energy?

The consensus grows impressive. Top climate scientists, European Union heads of state and other senior politicians, the governors of California and many other US states, city mayors, chief executive officers of major corporations, insurance companies, pension funds and other financial groups, leading print and broadcast media, stars of popular culture and many international and non-governmental organizations all now concur: if we hope to minimize dangerous climate change while still keeping the lights on, we must do something about energy, urgently.

In February 2007 the Intergovernmental Panel on Climate Change, previewing its Fourth Assessment Report, declared that 'warming of the climate system is unequivocal', and that 'most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations'. Governor Arnold Schwarzenegger of California and the governors of Arizona, New Mexico, Oregon and Washington state launched a Western Regional Climate Action Initiative, to reduce carbon emissions, set up an emission-trading system, and support efficiency and renewable energy. London Mayor Ken Livingstone unveiled a Climate Change Action Plan to make the UK capital the greenest city in the world. Australia, hitherto aligned with the US administration in rejecting Kyoto Protocol measures against climate change, announced that it would ban the sale of inefficient traditional incandescent lamps by 2009. Within a month the EU summit called for a similar phase-out.

In March 2007 the summit meeting of EU heads of state agreed a binding target of 20% of EU energy use from renewables by 2020, and a target to reduce EU greenhouse gas emissions by 20% by 2020. The UK government introduced a Climate Change Bill setting clear legally binding targets to reduce carbon dioxide emissions. In the US a business-oriented coalition including investors who manage a combined $4 trillion signed a letter to US President George W. Bush, asking the US to curb greenhouse-gas emissions and create a market-based emissions trading system.

Many more examples come readily to hand. The common thread running through this ferment of concern is energy – what we do with it, where and how we get it, and how we pay for it. But even as energy policy grapples with the challenge of climate change, another problem is looming. In December 2006 Russia threatened to cut off supplies of natural gas to Belarus, demanding a much higher price than Belarus had been paying. The episode was a rerun of a similar confrontation in early 2006, when Russia cut off supplies to Ukraine. Both episodes threatened the transit of gas to western Europe, underlining the vulnerability of the European Union to interruption of gas imports for political reasons. Western oil and gas companies have found themselves under intense pressure from the Russian government to give the state-owned monolith Gazprom controlling stakes in projects such as the Shell development of Sakhalin. Meanwhile China is becoming a major player in oil and gas development, not only in central Asia but farther afield, such as in Sudan. Pressure on global hydrocarbon resources from customers such as China and India, coupled with increasing politicization of the 'market', has put 'energy security', so described, high on the agenda for OECD and non-OECD countries alike.

According to the International Energy Agency, in the Reference Scenario of its *World Energy Outlook 2006*,

> *On current energy trends, carbon-dioxide emissions will accelerate. Global energy-related carbon-dioxide (CO2) emissions increase by 55% between 2004 and 2030, or 1.7% per year, in the Reference Scenario. They reach 40 gigatonnes in 2030, an increase of 14 Gt over the 2004 level. Power generation contributes half of the increase in global emissions over the projection period. Coal overtook oil in 2003 as the leading contributor to global energy-related CO2 emissions and consolidates this position through to 2030. Emissions are projected to grow slightly faster than primary energy demand – reversing the trend of the last two-and-a-half decades – because the average carbon content of primary energy consumption increases. Developing countries account for over three-quarters of the increase in global CO2 emissions between 2004 and 2030 in this scenario. They overtake the OECD as the biggest emitter by soon after 2010.*

In its Alternative Policy Scenario,

> *the policies and measures that governments are currently considering aimed at enhancing energy security and mitigating CO2 emissions are assumed to be implemented. This would result in significantly slower growth in fossil-fuel demand, in oil and gas imports and in emissions. These interventions include efforts to improve efficiency in energy production and use, to increase reliance on non-fossil fuels and to sustain the domestic supply of oil and gas within net energy-importing countries.*

Unfortunately, 'significantly slower growth' of fuel-use and emissions falls far short of the dramatic actual cuts needed to mitigate the climate threat. Yet the IEA scenarios typify projections by governments and companies around the world. They all reach the same dismaying conclusion, implicitly if not explicitly: we cannot reconcile climate security with energy security.

This is a counsel of despair. What is missing is a unifying vision that brings together all these disparate issues and possible measures to address them, to assess their overall effect. We need to reappraise how we think about energy – to redefine what we are doing, and rephrase the issues appropriately, to understand better both the problems and the opportunities.

Transforming energy language

'Energy policy' is less than four decades old. Until the end of the 1960s governments had 'fuel policy', or sometimes 'fuel and power policy'. As far as can be ascertained, the earliest significant use of the expression 'energy policy' was the Energy Policy Project sponsored by the Ford Foundation in the US from 1971 onwards. Its terms of reference were sweeping, its output copious and authoritative, its findings prescient and controversial; but its focus was still mainly on fuels and electricity. In October 1973 the Organization of Petroleum-Exporting Countries, OPEC, quadrupled the world price of petroleum. The consequent 'oil shock' coincided with problems with supplies of natural gas, coal and electricity in several OECD countries. Within a few weeks newspaper headlines were proclaiming an 'energy crisis', using 'energy' as a convenient shorthand for fuels and electricity. The usage took hold immediately. What had been a Ministry of Fuel and Power, as in the UK and other countries, became a Department of Energy, so-called, and its responsibility became 'energy policy'. But its interests were still essentially centred on supplies and prices of fuels and electricity, considered as commodities.

Moreover, calling all fuels and electricity 'energy' implied that they were more or less interchangeable. One immediate priority of the new 'energy policy' was to find 'a substitute for oil'. A major beneficiary of this policy objective was nuclear power, notably in France and Japan. Governments and commentators alike appeared to overlook the obvious inconsistency. Even for a basic service such as heating, switching from oil heating to electric heating entails changing also the end-use technology of every individual user. For transport, most vulnerable to disruption of oil supplies, no amount of nuclear electricity can replace petrol. This misleading use of the term 'energy', confusing and blurring together its many different and distinct manifestations, distorts and weakens so-called 'energy policy' to this day.

In any energy context more complex than a bonfire, you use fuel or electricity to run an energy technology – lamp, motor, computer, the list is effectively endless. The technology delivers the service – comfort, illumination, motive power, refrigeration, information, entertainment and so on. The fuel or electricity by itself is useless. Moreover almost any particular energy technology now requires fuel or electricity of a particular specification to match it. A high-compression internal combustion engine may require high-octane unleaded petrol; an electric motor may require 50-hertz alternating current electricity; no alternative will readily suffice. Changing the fuel or electricity entails changing the technology, and vice versa. In many contexts, moreover, an obvious trade-off arises. If you improve the technology, you can get better, more reliable service while using less fuel or electricity. But the traditional language of energy policy concentrates on flows of fuels and electricity, treated as commodities in short-term batch transactions. What it calls 'energy technologies' are those that produce and deliver these commodities – not the end-use technologies that deliver the services we actually want. Energy statistics measure so-called 'energy production' and 'energy consumption'. They characterize end-use technologies according to so-called 'energy efficiency', as if their most important attribute is how well they use fuel or electricity, not how well they deliver the service.

Different services require not only different and distinct fuels or electricity, but different and distinct end-use technologies. Neither fuels nor electricity nor end-use technologies can readily substitute one for another. Calling everything 'energy' obscures the essential fact that 'energy policy' is trying to deal not with one single issue but with many separate and distinct issues. Some of these issues, to be sure, appear seriously intractable. Others, by contrast, may be resolved by comparatively manageable policy measures, on manageable timescales. If we confuse the difficult energy issues with the not-so-difficult, we may make a challenging problem insoluble.

Transforming energy issues

Start with a crucial point routinely overlooked. Both climate security and energy security are not about 'energy' but about fuel, specifically fossil fuel. The climate issue is more particularly about coal. On the timescale that matters for climate security – that is, to mitigate carbon dioxide emissions within half a

century, to a level that planetary systems can tolerate – coal use around the world will not be restrained by availability or price. Mitigating fossil carbon dioxide from coal will require other measures. By contrast, the fuel security issue is about the hydrocarbons, oil and natural gas, particularly about supplies imported from potentially unpredictable suppliers. Such supplies are vulnerable to both alarming price increases and actual disruption, as recent events demonstrate all too clearly. Unlike world use of coal, world use of oil and natural gas may be curtailed by price or politics, or both, possibly abruptly. The consequence might benefit the atmosphere but dislocate human affairs. Moreover some possible measures to address hydrocarbon security, such as making liquid fuels from coal, would aggravate climate problems. Nevertheless, whichever fossil fuel we consider, the obvious step would be to reduce its use, reducing both emissions of fossil carbon dioxide and vulnerability to disruption. That, however, is easier said than done, for several reasons, again various and distinct, that policy must address.

A variety of obstacles impedes measures to constrain dependency on fossil fuels, whether for reasons of climate or of fuel security. Despite the accumulating weight of evidence, not everyone is convinced that either climate security or fuel security is a threat warranting collective action, national or international. A number of major companies and entire nation-states derive much if not most of their revenue from producing and selling fossil fuels; they are understandably reluctant to see their sales and revenue diminish. Many of those convinced that the climate threat is real nevertheless fear that effective countermeasures to reduce dependency on fossil fuels will damage national economies. Others accept the threat, but see no feasible technological alternatives to present energy practice. Some believe that technological alternatives may indeed be feasible, but consider them too expensive. Those who think the expense is warranted may yet doubt that the requisite changes can take place fast enough. Most people outside the climate-energy policy circuit have other things to think about. They simply cannot be bothered. That in itself is a severe challenge to policy-makers. All these obstacles are real but different. They affect policy in different ways, places and contexts, and should not be blurred together. Policy needs to address the obstacles individually, as appropriate.

It should also distinguish explicitly and carefully between the short term and the long term. Above all, it should recognize the profound distinctions between categories of energy service, how they are provided now and how they might be provided in the future. If we are to redesign our energy systems within a timescale that will prevent dangerous climate change, we need to move beyond the prevailing fixation on fuels and electricity. We need to identify and distinguish the systems – the complete systems – that deliver the different energy services we desire. A complete system includes the end-use energy technology, the fuel or electricity to run it, and the natural ambient energy of the surroundings. Only by taking this whole-system approach can we find the best ways to upgrade the systems, the investments involved and the policies to foster these investments.

Buildings

The most important energy technology of all, worldwide, is still not generally acknowledged as such. Buildings intervene in natural ambient energy flows, and make the interior more comfortable – warmer when outside is too cold, cooler when outside is too hot. Such comfort is the most important energy service of all, enabling humans to survive and even thrive almost everywhere on earth. In all but the most severe conditions comfort can be provided mostly by the structure of the building itself. Particularly in the last half-century, however, far too many buildings in far too many places around the world, from houses to skyscrapers, have been constructed under the influence of cheap fuel and electricity. As a result the structures are flimsy and inadequate, unable to deliver comfort without major additional inputs from fuel and electricity, which may now no longer be cheap, reliable or environmentally desirable.

Efforts are at last under way to rectify this long-established malpractice. In 2003 the European Union enacted a Directive on the Energy Performance of Buildings. It was to come into force by January 2006, with three years' further leeway for certain Articles. In April 2007 the UK government announced its timetable for implementing these Articles, which runs to January 2009. Given its importance for both climate and energy security in the EU, the entire process does not convey a sense of urgency. As long ago as 1979 the International Institute for Environment and Development published *A Low-Energy Strategy for the United Kingdom,* a landmark study led by Gerald Leach, whose centrepiece was a detailed analysis of buildings in the UK, their energy performance, their requirements for fuel and electricity, and the abundant opportunities for improvement. Progress in upgrading the built infrastructure, and its energy performance, is still glacial, not only in the UK but worldwide. Almost three decades later, for instance, both the International Energy Agency and the EU Directorate on Transport and Energy consider that the buildings sector still offers the greatest cost-effective

savings. According to the Association for the Conservation of Energy, no proper dossier of the state of the building stock in the UK now exists. Data on the commercial stock are woeful, and the English House Condition Survey, probably the best source, is now so out of date on its basic assumptions as to be actively misleading in parts. But the potential continues to be vast. The Environmental Change Unit at the University of Oxford, in its report *40% House*, published in 2005, demonstrated that straightforward policy measures, unheroic, economic and politically uncontroversial, such as improved insulation, doors and windows, could upgrade buildings enough to cut carbon dioxide emissions from the UK housing sector by 60% by 2050. Similar policies could be adopted, particularly throughout urban areas, in much of the world.

Illumination

Another energy service of near-universal importance is illumination – providing light both inside buildings and outside, when daylight is absent or inadequate. The requisite system includes a lamp and its mounting, electricity to run the lamp, a circuit to deliver the electricity and a generator to produce it. In 2007 every component of illumination systems is now in flux, technically, financially and environmentally. The incandescent lamp, for over a century the traditional end-use technology for electric light worldwide, is at last being challenged. An incandescent lamp converts less than 10% of electricity into light, leaving the rest as heat. If the electricity comes, say, from a remote coal-fired power station, as is often the case, the system turns less than 5% of the coal energy into light. Yet this extraordinarily ineffective system remains the standard for illumination everywhere, even in the twenty-first century.

It need not be, either technically or economically. Compact fluorescent lamps (CFLs) have been available and affordable for at least two decades, delivering performance five times better and lifetimes in years, not weeks; and they are now being joined by light-emitting diode (LED) lamps, with even better performance and durability. In 2006 the International Energy Agency published a report entitled *Light's Labour's Lost: Policies for Energy-Efficient Lighting.* It pointed out that 19% of world electricity generation is for lighting. The carbon dioxide produced is equal to 70% of global emissions from passenger vehicles, and is three times more than emissions from aviation. According to the report, a global switch to efficient lighting systems would trim the world's electricity bill by nearly one-tenth, and cut carbon dioxide emissions far more than any cuts thus far achieved through wind and solar power. Moreover, the report focused on lamps and fittings alone – not on the rest of the electricity system. There, too, substantial improvement is readily available, and indeed already in train, as outlined later in this paper.

Motive power

The energy service of motive power arises in two quite different contexts, with systems to match. One is stationary – motors of every kind and size, in every sort of premises, domestic, commercial, industrial, running tools, appliances, fans, pumps, lifts, an endless assortment of technologies. Most stationary motors of whatever size now run on electricity, except those whose function is actually to turn electricity generators. Such motors mostly run on fossil fuels: petrol, diesel and natural gas for smaller generators, coal or natural gas for larger. Stationary electric motors require quite specific forms of electricity, with appropriate attributes such as direct or alternating current, suitable voltage, frequency and so on. With the wrong electricity a motor will not work and may be destroyed. Once again the whole system must be in place and operating to deliver the motive power. Most stationary electric motors except the smallest have to be connected to the rest of the system through a device to control start-up, shutdown and operation with different loads, a 'drive'. As the American energy visionary Amory Lovins and his colleagues pointed out in their classic study of room for technological improvement, *Factor Four*, motor drives are usually over-specified, as are motors themselves, too large for the routine operation desired, to allow for overloading; as a result the motor operates well below optimum performance most of the time. Modern control technologies such as variable speed drives, to produce better operation and reduce losses, have been available for decades; but most electric motors still do not have them.

Stationary electric motors pose particular problems, and offer ways to deal with them, both at the motor itself and in the rest of the electricity system, discussed later in this paper. But the motors or engines that cause most concern for climate and fuel security are those that power transport, on land and sea and in the air, delivering the energy service of mobility for people and goods. Cars and other road vehicles, trains, ships and aircraft all include engines. Some modern trains use electric motors; but other transport technologies all burn various categories of fossil fuel directly, in internal combustion engines with pistons or turbines. As a result, providing mobility raises issues of climate and fuel security similar to those arising for other energy services. As a policy

issue, however, mobility is in a different class of complexity from other energy issues.

Particularly in the past half-century, we have laid out much of the social organization and economic activity, including the built infrastructure, of the planet, under the influence of cheap hydrocarbon fuels, especially petrol, and internal combustion engines for transport. Transport now requires secure and immediately available supplies not just of hydrocarbon fuels in general but of specific fuels with specific attributes, to match the engines in existing fleets of vehicles and other modes of transport. In the short term, interruption of supplies, for whatever reason, can now lead rapidly to serious social breakdown. In the longer term, even if we take advantage of opportunities to upgrade the performance of cars, aircraft and other transport technologies, the growth rate of mobility around the world, and society's growing dependence on it, represent a challenge for which no policy remedies come readily to hand. The energy dimension of transport catches headlines, but the problems of moving people and goods go much deeper than fuel use alone. Precisely for that reason, however, transport policy should be kept separate and distinct from energy policy. Policy-makers must not allow the daunting intractability of the global transport issue to blind them to comparatively accessible opportunities to improve other energy systems delivering other energy services. Indeed making such improvements could buy time to tackle the intractable.

Cooling

At the other end of the scale of complexity, for instance, is the energy service of cooling, including refrigeration. At its simplest, cooling is an aspect of comfort; as noted earlier, a well-designed building can keep the interior comfortably cool without requiring fuel or electricity at all, except in extreme circumstances. But many buildings are too flimsy to withstand high external temperatures, and have to include additional cooling or air-conditioning. The commonest form of air-conditioner is an electric heat pump, a device that collects heat at a low temperature and discharges it at a higher temperature, cooling the interior of a room by pumping heat out of it. Heat pumps also function as refrigerators, deep-freezes and chillers, everywhere from domestic kitchens to supermarkets to cold stores to ocean-going 'reefer' ships.

As the climate changes, achieving comfort in many places may rely more on keeping people cool than on keeping them warm. But running traditional air-conditioners with electricity from fossil fuel will exacerbate matters. As already noted for other energy services, policy-makers must henceforth weigh options including the whole system, starting with the building itself, which may offer the best opportunities for improvement.

Electricity

Of all the energy systems on which human society now relies, one group in particular is long overdue for a comprehensive upgrade. Electricity systems all over the world are still based on a common technical model now more than a century old. This traditional electricity is based on large central-station generators, most of which operate either intermittently or at only partial load most of the time. The central-station generators that use fuel waste two-thirds of the fuel energy before it even leaves the power plant. The system necessitates long lines of network, in which line losses cost another significant fraction of the energy flowing. The configuration is inherently vulnerable to disruption, by mishap or malfeasance, over a wide area and almost instantaneously. It assumes that every end-use technology, from space heater to microchip plant, is essentially equivalent, requiring the same high quality of electricity. The system produces and delivers high-quality electricity as required by sensitive end-use technologies, much of which is then used for undemanding services such as heating and cooling. The generators are almost all at least two, and more often four or five orders of magnitude larger than most of the end-use technologies on the system. Most of these are inherently intermittent or variable; but the system's large fuel-based generators are inherently inflexible. We could hardly make the mismatch more complete if we actually tried.

As detailed in *Transforming Electricity* and *Keeping The Lights On*, both by the present author, we can now do much better, technically, economically, and environmentally, benefiting both climate and fuel security. The key is to recognize that electricity is not a commodity, nor a fuel. It is a process, taking place simultaneously and instantaneously throughout an entire system, including generator, network and end-use technology or 'load'. Electricity is a process in infrastructure. You can have electricity without fuel, but not without infrastructure. Without infrastructure electricity as we use it does not even exist. The better the infrastructure, the less fuel we need for the electricity process to deliver the service we actually want, whether it be comfort, illumination, motive power, cooling or the services of electronics.

Electricity, moreover, you can generate and use anywhere, in a wide variety of ways, at every scale

from minuscule to gigantic. In particular you can generate it close to where you want to use it. We now have the option of clean, efficient modern generating technologies able to produce electricity, heat and cooling as we want, when and where we want them, more reliably and with less environmental impact. Such decentralized electricity could progressively supplant the obsolete central-station model, benefiting both security and environment. As yet, however, we are failing to seize this opportunity. We have been sidetracked into a preoccupation with a so-called 'electricity market', treating electricity as a pseudo-commodity for which the objective of the regulators is a low unit price. This misses the point completely. Electricity is not a commodity issue but an infrastructure issue. What matters is investment in electricity system assets – not just generation and networks but also, and most importantly, end-use technologies.

As we examine our energy systems and the different services they provide, electricity illustrates a principle that becomes ever harder to ignore. Energy systems of every kind are arrays of physical assets – mostly infrastructure. Transforming energy systems means transforming infrastructure. That means investment. When traditional energy policy talks about infrastructure it means pipelines, power stations and other technologies to deliver fuels and electricity. For climate security and fuel security, however, what really matters is the energy service infrastructure – the buildings, appliances and other technologies that give us comfort and illumination and the other services we want. We have long known, in many cases for decades, how to make all these end-use technologies better; but we have not bothered. Now, before it is too late, we have to get to work.

Transforming energy policy

Who makes energy policy? How can they make it more effective, to reinforce climate security and energy security? Governments make crucial aspects of energy policy, using taxes and other financial instruments, regulation, standards, information, education, procurement and international diplomacy. Companies make their own internal energy policy, affecting investment, operations and business plans. Individuals may not make energy policy, but they make choices, as to which energy services to use, when and how; the cumulative effect of these individual choices determines the pattern of energy use throughout society.

Unfortunately all these inputs to energy policy are still preoccupied mainly with fuels and electricity and their delivery infrastructure, not with end-use energy technologies, nor with the energy service infrastructure. In 2003 the International Energy Agency produced an authoritative report, thereafter much quoted, entitled *World Energy Investment Outlook*. IEA executive director Claude Mandil summed up its main finding thus: 'If present trends continue, the world will need to invest $16 trillion over the next three decades to maintain and expand energy supply', of which $10 trillion would be for electricity supply. Mandil added: 'To the best of my knowledge, no previous attempt has been made to build such a comprehensive picture of future energy investment, worldwide, in all parts of the energy supply chain.' True as this may be, it signally fails to recognize that the energy supply chain, so described, stops short just before it reaches the most important part of the system. As we have seen, the most immediate and wide-ranging opportunities for creative and effective investment for climate and fuel security arise not in the supply chain but in the technologies that use the fuels and electricity.

Investment and incentives

Policies to encourage the appropriate investments need to begin by recognizing that different categories of service involve different technologies, skills and business arrangements, and indeed different timescales. That may appear obvious; but traditional energy policy has long insisted that the single key to so-called 'energy efficiency' is higher prices for fuels and electricity, no matter what the context – a 'one size fits all' approach long since demonstrably ineffectual. Moreover, as noted earlier, 'energy efficiency' at best describes only how well energy technology uses fuel or electricity, not how well it delivers services. We need to re-examine the incentives that prompt investment by various participants in the various parts of energy systems, if we want to bring them into line with society's long-term desire for climate security and fuel security.

Some policy-makers advocate creating government departments and even global institutions to oversee energy policy. This notion, tried with at best limited success as far back as the 1970s, goes directly counter to the viewpoint that what matters most is the energy service infrastructure. Present-day government and indeed international arrangements for energy agencies are competent primarily with respect to fuels and electricity. But their competence has never really extended, for instance, to buildings, nor to lamps, motors, electronics and other end-use technologies. Centralizing energy policy goes in precisely the wrong direction. On the contrary, energy policy, properly construed, ought to permeate all government

departments, and be incorporated in every aspect of policy, much as environmental policy has been proclaimed to do. Indeed the central government department that should have most influence on energy policy is the treasury or ministry of finance; its crucial role will be discussed later in this paper. Otherwise, however, energy policy should be not more centralized but more decentralized. Even policy decisions taken centrally, such as those concerning building standards, have to be agreed, implemented and enforced at a local level to be effective. Only thus can policy deal effectively with the wide and disparate range of systems and services, the relevant issues, problems and opportunities now on society's agenda.

Decentralized energy policy should not, however, be disconnected. On the contrary, decentralizing policies into appropriate areas makes coherence all the more important. Incoherence has hitherto been the norm. Regulators, for instance, strive to make the unit price of electricity as low as possible, while government spokespeople exhort voters to switch off computers and unplug televisions. Governments promote renewable generation while planning authorities stymie project after project. Customs and excise impose tariffs on imports of high-performance lamps and other fittings and appliances from low-cost exporters such as China, to protect higher-cost industries in OECD countries. Again and again, promising initiatives are nullified within government itself, by inadequate follow-up, feeble enforcement or official obstruction. Effective energy policy ought to demonstrate what used to be called 'joined-up government', in which those responsible for different aspects of the government agenda not only talk but also listen to each other, and function accordingly.

In 2007, as the IEA report anticipated in 2003, the key international forces driving energy investment are still those arising from anticipating a relentless increase in the use of fossil fuels. They encourage investment in ever more difficult, remote hydrocarbon developments, in extreme offshore conditions and with awkward sources such as tar sands; in pipelines across unforgiving terrain, also fraught with political risk; and in dramatic expansion of traditional coal-fired electricity generation, especially in fast-growing countries including China, India and Brazil, but also in OECD countries such as the US. On the other hand, a growing number of insurance companies, pension funds and other major investors have begun to query the risks associated with investment in traditional fuel and electricity supply, including environmental and climate risk.

The World Bank and the regional development banks have long tended to support large centralized projects, partly on the basis that transaction costs are more manageable than they would be for smaller-scale projects. They might learn instead from Nobel Peace Prize laureate Mohammed Yunus, founder of the Grameen Bank in Bangladesh, and move towards multiple microcredit projects in decentralized local infrastructure, to deliver energy services directly to users. The track record of microcredit for achieving its objectives, individually modest but cumulatively impressive, is much more persuasive than that of energy megaprojects.

The investment criteria of the development banks are set by the national governments that back them. The onus, therefore, is on national governments to shift incentives for investment, not only international but also domestic, away from increasing supply of fuels and electricity, toward upgrading energy-service infrastructure. The government department with the most leverage is the ministry of finance or treasury. The tax treatment of investment in infrastructure, in physical assets, ought to be the centrepiece of real energy policy. But consider one salient detail. If you invest in an asset whose output you will sell, say a power station, government treats it as a business investment, and offers a lenient tax regime. If, however, we all invest in, say, high-performance freezers, to make the power station unnecessary, government will give us no comparable tax relief. This single fiscal assumption distorts energy investment essentially worldwide, favouring more fuel and electricity supply instead of better end-use infrastructure. Many governments offer short-term ad hoc benefits for local energy-infrastructure investment – subsidies, grants, write-offs and so on, for insulation, solar panels, wind turbines, micro-cogeneration and other assets. But these benefits are not integrated into a coherent and comprehensive long-term policy. They should be, with the treasury taking the lead.

Policies and measures

At the same time, other government departments should implement other relevant measures. The ministry responsible for housing and other buildings, for instance, should not only set down stringent energy performance criteria in regulations for new buildings, but should enforce these regulations vigorously. At the moment, building regulations, however stringent they may be in theory, far too often remain in theory rather than being put into practice. Here again the problem may be centralized bureaucracy. Building regulations would be better administered locally and on a decentralized basis. In the same way, minimum standards of performance for

end-use technologies might be established centrally, but enforced locally.

Above all, governments should use their own enormous purchasing power to reshape both markets and infrastructure. In the UK, for example, the government itself has a vast estate of buildings that are its own responsibility – everything from schools to prisons. The quality of these buildings is mostly substandard, and often appalling. The Sustainable Development Commission has revealed that not only is the public estate mediocre in energy performance terms, it is actually going backwards; 14 government departments are running buildings that were less efficient in 2006 than in 2000. The National Audit Office has produced a report showing that four out of five projects covering new buildings or major refurbishments are failing to meet the government's own official standards, according to the Building Research Establishment Environmental Assessment Method. The government could immediately launch a programme to upgrade its own buildings to much higher standards – better insulation, doors and windows, better lighting, better appliances and electronics, probably even on-site generation of electricity and heat. Such a programme would be a valuable pump-priming exercise for energy service companies. It would bring down the unit cost of innovative technologies. It would create skilled jobs all over the country. It would dramatically reduce greenhouse-gas emissions. It could even reduce or indeed eliminate so-called 'fuel poverty'. It would be a spectacular international public relations coup for the government. And of course, properly managed, it would save taxpayers money. Imagine what such an approach could accomplish worldwide.

A logical proposition sums up the way we should now be thinking. It goes like this:

- *Climate is an energy issue.*
- *Energy is an infrastructure issue – not a commodity issue, an infrastructure issue.*
- *Therefore climate is an infrastructure issue.*

If policy-makers recognize that climate security and fuel security both depend on upgrading infrastructure, especially end-use infrastructure, we shall swiftly reach a critical turning point in the evolution of human energy systems. We cannot transform entire systems within a generation; infrastructure has too much inertia. But we can start immediately. We can transform the way we think about our energy, how we get it and how we use it. Once we start this transformation, we may even surprise ourselves. We may find ourselves with richer opportunities than we can yet imagine.

Walt Patterson is associate fellow in the Energy, Environment and Development Programme at Chatham House. His latest book, *Keeping The Lights On: Towards Sustainable Electricity*, is published by Chatham House and Earthscan in July 2007.

References

Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

Environmental Change Unit, University of Oxford, *40% House*, 2005. *http://www.40percent.org.uk/.*

International Energy Agency, *Light's Labour's Lost: Policies for Energy-Efficient Lighting* (Paris: IEA, 2006).

International Energy Agency, *World Energy Investment Outlook* (Paris: IEA, 2003).

International Energy Agency, *World Energy Outlook 2006* (Paris: IEA, 2006).

International Institute for Environment and Development, *A Low-Energy Strategy for the United Kingdom* (London: IIED, 1979).

National Audit Office, *Building for the Future: Sustainable Construction and Refurbishment on the Government Estate*, London 2007.

Patterson, Walt, *Keeping The Lights On* (London: Chatham House/Earthscan, July 2007).

Patterson, Walt, *Transforming Electricity: The Coming Generation of Change* (London: Chatham House/Earthscan, 1999).

Sustainable Development Commission, *Sustainable Development in Government,* London, 2006.

Weizsäcker, Ernst von, Amory B. Lovins and L. Hunter Lovins, *Factor Four: Doubling Wealth – Halving Resource Use* (London: Earthscan, 1997).

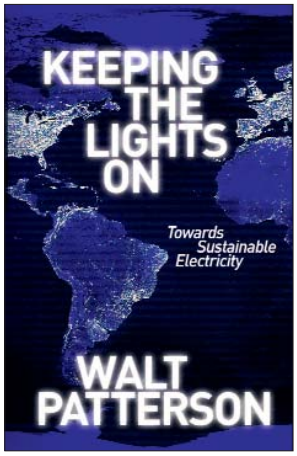
Climate change research at Chatham House

Climate change is no longer an 'environmental protection' issue but one intimately connected with a wider world. Given the scale and urgency of the challenge, many of the decisions critical for global climate security and the effective transition to a low-carbon, high-efficiency economy will take place *outside* the field of climate change. It is the decisions made in the areas of foreign and trade policy, security and geopolitics, energy policy and investment that will have an influence on the global response to climate change.

Chatham House, as a leading international affairs think-tank, can play a unique role in analysing the wider forces that will shape the overall effectiveness of the international response to climate change. One aim of the Energy, Environment and Development Programme (EEDP) at Chatham House is to reframe the debate on climate and to make the connections between climate change and other international issues. The purpose of this briefing paper series is to highlight the analysis being undertaken by EEDP to better understand the linkages. Other papers in the series include:

- **How climate change is pushing the boundaries of security and foreign policy (Cleo Paskal)**
- **Climate change: the leadership challenge (Beverley Darkin)**
- **Incentives, risk and decision-making in mitigating climate change (William Blyth)**
- **Linking trade, investment and climate change policies (Richard Tarasofsky)**

KEEPING THE LIGHTS ON
Towards Sustainable Electricity
Walt Patterson



We are making a mess of energy. What we're doing with it is leaving people in the dark and endangering the planet. But we could do much better. *Keeping The Lights On* shows how. In immediate, accessible everyday language it describes a different way to think about energy, what we want from it and how we get it.

We can begin with electricity - how we use it, produce it, and pay for it. Traditional electricity is a century old, obsolete and overdue for improvement. But we keep getting it wrong. The decisions that governments and companies are now taking are making matters worse, missing opportunities all over the world.

That could change rapidly. Electric options are burgeoning. Innovative technologies, novel finances and healthier business relations offer cleaner, more convenient, more stable systems, pointing the way to sustainable electricity services. But the evolution is much too slow. Too many governments, too many companies, too many people cling stubbornly to out-of-date assumptions and mindsets.

***Keeping The Lights On* challenges these sterile and damaging misconceptions, with an exhilarating vision of a brighter future. We can make energy use more reliable, more equitable, and more sustainable, for ourselves and our children, starting with electricity, starting now.**

Co-published by Chatham House and Earthscan, July 2007
Distributed in North America by the Brookings Institution Press
ISBN 978-1-844407-456-3 208 pages Hardback £19.99/$36.95

Praise for *Keeping The Lights On*

'This is such a timely book. Combining extraordinary historical insight with the sharpest analysis of where we are now, Walt Patterson carves out the most applied and practical of "road maps" as to where we need to go if we are to deliver a genuinely sustainable electricity system for the future. As we go into a period of considerable turbulence, primarily because of the impacts of climate change, *Keeping The Lights On* will undoubtedly be seen as a very well-informed Guidebook.' **– Jonathon Porritt CBE, Chair, UK Sustainable Development Commission**

'Fashions come and fashions go in the energy world. Security of supply, climate change and market liberalisation have all vied for our attention. It's good to have one voice that's stayed constant over thirty years of turbulence and change. *Keeping The Lights On* distils Walt Patterson's thinking over the last three decades. As ever, he provokes us to re-examine our own thinking about energy policy. Essential reading as we face up to new challenges.'
– Professor Jim Skea OBE, Research Director, UK Energy Research Centre

'A very important and timely book. Walt Patterson persuasively challenges traditional assumptions about how we think of energy and electricity, and presents an exciting vision of an innovative and sustainable future.'
– Nick Mabey, Chief Executive, E3G (Third Generation Environmentalism), former senior advisor in the UK Prime Minister's Strategy Unit

'Walt has got this exactly right. It should be compulsive reading, if not compulsory reading, for all politicians and other players that determine or have a role to play in energy policy, and more importantly in tackling climate change.' – **Allan Jones MBE, Chief Executive Officer, London Climate Change Agency**

'The great free thinker on energy systems.' – **George Monbiot**

Energy, Environment and Development Programme

The Energy, Environment and Development Programme (EEDP) is the largest of the research programmes within Chatham House, one of the world's leading independent institutes for the analysis of international issues.

The EEDP seeks to advance the international debate on energy, environment and development policy and to influence and enable decision-makers – governments, NGOs and business – to take well-informed decisions that contribute to achieving sustainable development. Independent of any actor or ideology, it does this by carrying out innovative research on major policy challenges, bringing together diverse perspectives and constituencies, and injecting new ideas into the international arena.

The EEDP's work is divided into three key areas: International governance of environment and development; energy – security and development; and business and sustainable development. The Programme works with business, government, academic and NGO experts to carry out and publish research and stimulate debate on international issues in these three thematic areas.

The EEDP regularly hosts workshops and meetings which provide an independent and non-confrontational forum where experts from different perspectives are able to network and meet to freely exchange views and experiences. Meetings are often held under the Chatham House Rule of confidentiality to encourage a more open exchange of views. The impact of the EEDP's work is recognized internationally and its research output is widely read throughout the 'policy community'.

If you would like further information about EEDP or to join the Programme's e-mail list for notifications of publications and events, please email eedp@chathamhouse.org.uk or visit the Institute's website at www.chathamhouse.org.uk/eedp.

Energy, Environment and Development Programme
The Royal Institute of International Affairs
Chatham House
10 St James's Square
London SW1Y 4LE

T: + 44 (0) 20 7957 5711
eedp@chathamhouse.org.uk
www.chathamhouse.org.uk/eedp