Sustainable
Development Commission

Is nuclear the answer?

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Part one

Energy futures

Energy consumption throughout the world is continuing to grow from year to year, as it has done for many decades. But some of the traditional sources of energy are becoming scarcer, and the consumption of fossil fuels is causing our climate to change faster than most people imagine. Every country in the world faces very tough decisions on energy policy in the years ahead. The old certainties are long gone; new pressures demand urgent attention.

1. Climate Change

The most pressing of these is climate change. Every year we release more and more carbon dioxide and other "greenhouse gases" into the atmosphere. The debate about whether this is changing our climate is now over – it absolutely is. The debate now is about what we need to do to reduce those emissions, and how fast we need to do it. Scientists warn of a temperature "threshold": any increase above an average 2º centigrade by the end of this century could trigger "irreversible" changes in the climate. In which case, there would be nothing much we could do to halt the "climate chaos" we would have unleashed.

Governments have gradually been getting to grips with this grim reality over the last decade, and to its enormous credit, the UK Government has often found itself leading the way. We have committed ourselves to:

> **a 12.5% cut in greenhouse gases (on 1990 levels) by 2010 as our share of Europe's mandatory target under the Kyoto Protocol;**

> **a 20% cut in CO_2 by 2010;**

> **an aspiration to reduce levels of CO_2 by 60% by 2050, with real progress towards that target by 2020.**

Given current evidence of how fast the climate is changing, even that 60% may not be enough.

So it's absolutely right for the UK to set itself ambitious targets, even if many European countries are underperforming. Even if the Bush Administration is doing nothing. Even if China, India and other developing countries have yet to address their own rapidly rising emissions.

2. Security of supply

At the same time, there are growing concerns about how we're going to meet our own energy needs in the future – particularly in terms of electricity generation. The recent stand-off between Russia and the Ukraine regarding supplies of gas has reinforced just how critical this challenge now is.

Today, coal provides for around 30% of our electricity and nuclear for around 20%. Most of the rest comes from gas-fired power stations, with only a small proportion coming from renewables. But many of our coal and nuclear power stations are going to have to close over the next 15 years, and it's by no means clear how all that "capacity" is going to be replaced to ensure "that the lights stay on".

Let alone replaced in a way that doesn't increase emissions of CO_2.

It's in that context that there has been a surge of interest in the potential for a new generation of nuclear reactors to help fill that gap. The nuclear industry has advanced its own cause with renewed vigour, and all sorts of commentators have dusted down their prejudices to declare themselves 100% for or 100% against nuclear.

“One thing is clear, however: it is only a proper understanding of sustainable development that will enable us to make the right decisions in this area.”

3. The energy review

In January this year, the Government announced another review of energy policy:

Our Energy Challenge: Securing Clean, Affordable Energy for the Long-Term.

This comes just three years on from the last Energy White Paper, which was thought at the time to have dealt with all relevant issues, leading some people to be very suspicious of the Government’s real motives in going over old ground in this way.

However, as far as the Sustainable Development Commission is concerned, we welcome the Review on the understanding that:

- **It will be explicitly conducted within the Government’s own framework for sustainable development (see below);**
- **It will be conducted transparently and with due regard paid to all shades of opinion;**
- **It will be seen as the start of a process of engagement with the general public on long-term energy futures for the UK.**

Anticipating that the focus of this new consultation would be on the nuclear option, the Commission decided early last year that we would review the latest evidence base on all the key nuclear issues – cost, waste, decommissioning, security and so on. All of those issues are discussed, one by one, in the next section.

Together with this document, we are simultaneously publishing the eight different studies that we commissioned, together with our own summary and analysis of those findings, *The Role of Nuclear Power in a Low Carbon Economy*.

Our purpose in undertaking this substantive piece of work is to highlight both the complexity of the issues raised (there is much less “black and white” about the nuclear question than most people would have you believe – and many more grey areas in between), and the importance in seeking answers to the questions in a genuinely open-minded and rigorous way.

The Commission decided to address this challenge as a journey of exploration: first, analysing the core problems; then reviewing the evidence as regards the pros and cons of nuclear power; then weighing up public perceptions and different ethical approaches; then assessing the viability of alternative approaches; then coming to our own conclusions – and, finally, offering our advice to Ministers in that spirit of genuine enquiry.

As a group of sixteen individuals, brought together from different sectors and walks of life by our passion for and expertise in sustainable development, it would be surprising if we had all ended up in exactly the same point at the end of that journey. And we didn’t, as you will see.

But nor will the experts. Or our MPs. Or environmentalists. Or the Cabinet. Or the general public. This is difficult territory, with no absolute rights or wrongs.

4. Sustainable development

One thing is clear, however: it is only a proper understanding of sustainable development that will enable us to make the right decisions in this area.

Sustainable development is all about improving people’s quality of life today without damaging the prospects of people tomorrow. In the Government’s Sustainable Development Strategy, *Securing the Future*, this is how it’s interpreted:

New framework goal for sustainable development

The goal of sustainable development is to enable all people throughout the world to satisfy their basic needs and enjoy a better quality of life, without compromising the quality of life of future generations.

For the UK Government and the Developed Administrations, that goal will be pursued in an integrated way through a sustainable, innovative and productive economy that delivers high levels of employment; and a just society that promotes social inclusion, sustainable communities and personal wellbeing. This will be done in ways that protect and enhance the physical and natural environment, and use resources and energy as efficiently as possible.

Securing the Future

The Strategy is based on five overarching Principles and we have used those Principles as the basis for all our analysis and for our Recommendations. In so doing, a number of preliminary conclusions are immediately apparent:

1. This new Review should in no way be seen as setting aside the principal conclusions of the 2003 Energy White Paper. The Commission wholeheartedly supported the conclusions in the White Paper then, and continues to support them today, with its primary focus on energy efficiency, renewables, and combined heat and power (CHP).

2. We are deeply disappointed that the new consultation document (*Our Energy Challenge*) fails to frame the questions it asks within the Government's own sustainable development strategy. This already makes it a far less valuable exercise than it should have been.

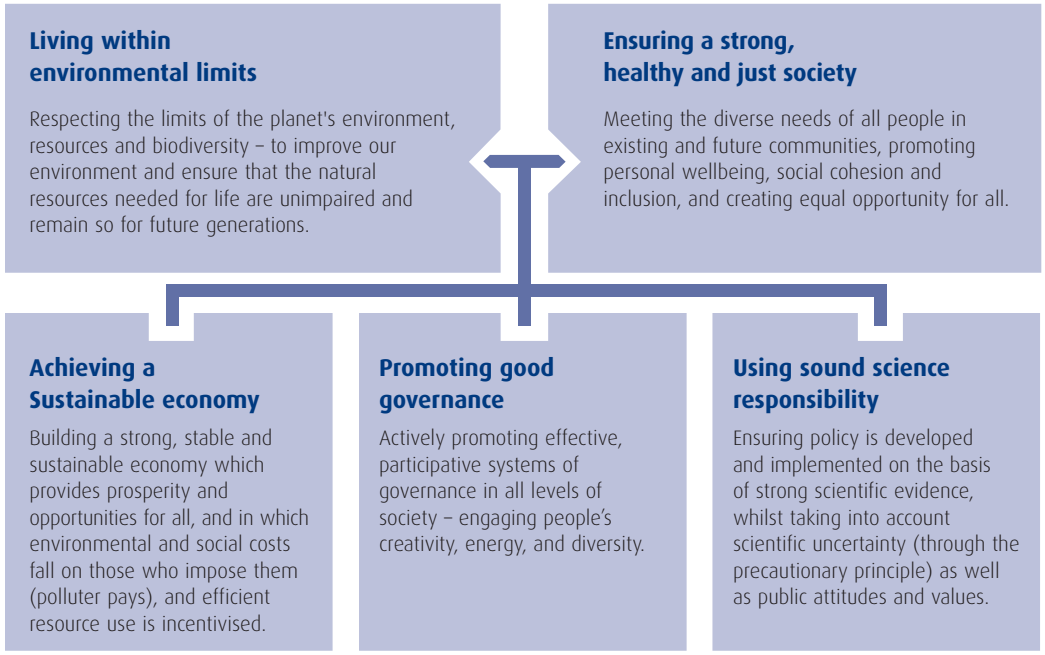
3. The **new** Review focusses more on **supply** than on **demand management**. When contemplating the nuclear option, this may very well obscure reality. People forget that whilst nuclear power provides around 20% of our electricity, that's only 8% of the UK's **total energy needs**. Over half the gas we use in the UK, for example, is for heating and cooking in our homes, and nuclear power will obviously do nothing to replace this need.

4. Such an approach may also divert attention away from the single most important aspect of any energy strategy: it is **energy efficiency** that will make or break that strategy. With or without nuclear power.

It is the view of the Sustainable Development Commission that this Government has signally failed to deliver the kind of Energy Efficiency Strategy that will be needed to underpin a genuinely sustainable energy future for the UK. Whilst it has had some success through the Energy Efficiency Commitment, the savings made have been woefully inadequate in the face of rising energy demand – as revealed in its own Review of the Climate Change Programme. Achieving higher energy standards in our homes and offices has been an area of particular weakness.

Energy efficiency must therefore remain the absolute lynchpin of any future energy strategy. *Our Energy Challenge* demonstrates little if any understanding of this priority.

Guiding principles



Securing the Future – delivering UK sustainable development strategy

5. We want to put this conclusion up front for one simple reason: as politicians get all steamed up about "nuclear vs. renewables", and our media roll out this mischievously polarised debate, the all-important priority of energy efficiency will invariably be ignored. This tends to be the way the debate is 'framed', and the real challenge (how do we free ourselves of our dependency on fossil fuels as the impacts of accelerated climate change worsen) is often ignored.

But from a genuine sustainability perspective, it matters little if a unit of electricity is generated from a wind turbine or from a nuclear reactor if it is then shamefully wasted through inadequate regulation, poor design or thoughtless lifestyles.

We will return to the consequences of making an absolutely priority of energy efficiency in Part 4.

> **"Energy efficiency must therefore remain the absolute lynchpin of any future energy strategy."**

Part two

The nuclear option

1. Introduction

1.1 The Commission's research is based on the assumption that if a decision is made to invest in a nuclear replacement programme, then it makes most sense to do so by committing to a number of new reactors – perhaps as many as 8 or 9. Although there are some experts who do not support this approach, experience in other countries shows that this is the most realistic way of keeping down construction costs.

1.2 We looked at two scenarios at different points in our research: replacement of **existing** nuclear plant, which would mean a programme generating around 10,000 MegaWatts (or 10GW); or an **expanded** programme which would roughly double current capacity – at 20,000 MegaWatts (or 20GW).

1.3 We were disconcerted at a number of points in our enquiry to see just how little hard-edged information is as yet in the public domain. Especially as regards a new generation of nuclear reactors. For those seeking any kind of "objectivity" in their appraisal of different energy supply options, this is both problematic (in that few "factual statements" can necessarily be treated as incontrovertible fact, let alone "gospel truth") and frustrating.

1.4 ***Our Energy Challenge*** **offers no information whatsoever on what any new nuclear programme might look like, presumably on the grounds that this would be premature. Unfortunately, people are therefore being asked to comment on the potential contribution of a new nuclear programme without any of the key aspects (regarding reactor design, cost, waste management, liability issues, security issues, and so on) having been addressed.**

2. Nuclear power's contribution to reducing emissions of CO_2

It's clear that nuclear power could, in principle, play a big part in substituting for some of the fossil fuel generating plants (coal or gas) that might otherwise be needed to help fill the generation gap.

Assuming that we're talking primarily about gas-fired plants, then a replacement programme for our existing nuclear programme (at 10GW) would displace about 6.7 million tonnes of carbon (MtC) every year once all the plants were up and running. That's equal to around a 4% cut in annual CO_2 emissions from 1990 levels.

An expanded programme (at 20GW) would displace around 13.4MtC, equal to an 8% cut. And if it's coal-fired plants that are being displaced, then the savings are substantially higher.

This would represent a major contribution, and there's little point in opponents of nuclear power denying that reality. Everybody acknowledges that it's going to be an enormous challenge to hit that 60% target by 2050 – let alone an even tougher target if that's what the Intergovernmental Panel on Climate Change indicates may be necessary in its Fourth Assessment Report in 2007. Nuclear power could, in principle, deliver part of the required reduction in emissions, which is why it's perfectly legitimate for there to be a full examination of all the options available at this time.

The basic fuel used in a nuclear reactor is enriched uranium. Unlike coal, oil or gas, this releases zero CO_2 when it's used, which is the principal reason people have come to the conclusion that we must have nuclear power in our electricity mix to help reduce overall emissions of CO_2.

However, this does not make nuclear a "carbon-free" source of electricity, as is often claimed. A lot of energy is consumed both during plant construction and at different points in the nuclear fuel cycle, from the mining of the uranium ore through to fuel processing and to final decommissioning and waste management.

Calculating just how much CO_2 is emitted by plant construction and the nuclear fuel cycle is a controversial business. Our evidence suggests an average of around 4.5 tonnes of carbon for every GW of electricity the reactor generates – in comparison to 97 tonnes from existing gas-fired power stations. However, this figure does not include any future emissions from either decommissioning or waste management, as these are almost impossible to estimate at the moment.

So, not a huge figure, but **not** zero. We should therefore beware of people who seek to obscure this fact by describing nuclear power as "carbon-neutral" or "zero-carbon". "Low carbon" is the only proper description.

There's then the issue of timing.

Even if the Government short-cuts proper process to "give the green light" to a new nuclear power programme, we estimate that the earliest the first reactor would come on stream would be around 2015. Thereafter, we assume a maximum "build rate" of 1GW a year, as the capacity of the construction industry will most likely be restricted.

What that means is that a new nuclear power programme would make no difference at all to achieving our 20% CO_2 reduction target for 2010, and will make only a limited impact by 2020 when we should, in the words of the Energy White Paper, be making significant progress towards our 60% reduction target for 2050. This is a major problem. It is of course true that we must pay equal attention to the next thirty years after 2020 (through to 2050), but given our growing concerns about climate change, we must be well on our way towards our longer-term targets by 2020 through other non-nuclear options.

If we don't achieve the dramatic energy efficiency gains we need by then, and if we don't bring on enough renewables by then, and if we don't re-design our distribution network by then to accelerate the uptake of small-scale energy generation, and if we don't make enough progress in terms of transforming our own lifestyles and mindsets by then, our view is that the amount of nuclear power available to us from that point on may well prove to be of secondary importance from the perspective of climate change.

Those comments do not of course apply to the issue of long-term energy security, which is addressed on page 11.

3. Safety

Although nuclear safety remains a big issue in terms of public perception, the evidence shows that UK civil nuclear reactors have a very good safety record. There is little reason to suppose that a new generation of nuclear reactors will not be built to the same demanding health and safety standards.

As far as low-level radiation is concerned, the protection of both employees and the general public is covered in the UK by a strict legal framework. The amount of radiation discharged through the operation of the reactors themselves is actually very small; it is the re-processing of the spent fuel that causes the problems (accounting for 83% of all the radiation attributed to the nuclear industry across the EU), although actual radiation doses are small.

That record won't necessarily allay public anxiety. Chernobyl remains a powerful symbol of just how serious and long-lived the consequences of a nuclear accident can be, however "remote" such a risk is.

That kind of risk also weighs heavily on investors who know only too well that this is an industry measured as much by its weakest link as by years of unblemished safety.

4. Nuclear waste

This is recognised as one of the biggest of the dilemmas faced by advocates of a new nuclear power programme. Existing government policy is that there should be no new reactors built until there is an acceptable solution to the problem of nuclear waste. Public opinion strongly endorses that position, and would be outraged by any breach of it. But what exactly is meant by "acceptable", and who exactly will define it?

Our evidence confirms that only Finland has as yet come up with a long-term solution as to what to do with its high-level nuclear waste (HLW) that seems to command reasonable public support. Yet the industry has long insisted that there's no technological barrier to finding an acceptable solution, and that the problems are all political or economic. They feel very strongly that it would be entirely wrong to deprive both

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this and future generations of the benefits of nuclear power through an exaggerated and largely “unscientific” set of concerns about nuclear waste.

It is also true that the volumes of HLW are indeed small. It’s the intermediate level and low level waste that make up 98% of the total **volume** of waste in the UK – but only 10% of the total amount of radioactivity.

It is important, however, to note that spent nuclear fuel (which contains both plutonium and uranium) is not actually classified as waste here in the UK as we have a policy to reprocess that spent fuel as an “economically viable resource”. If reprocessing were to cease (and there are many experts, even inside the industry, who believe that is now inevitable), then there would be more HLW to deal with.

The Committee on Radioactive Waste Management (CoRWM) will be reporting to government in the summer, with recommendations as to the best means of disposing of nuclear waste. If its recommendations are accepted, the Government will then have to determine a process for selecting the most appropriate site – a process which has caused huge controversy in the past and will no doubt do so again in the future.

Only at that point, in our opinion, will the UK Government be able to claim that it has an acceptable solution – even if that claim is still emphatically rejected by the communities most directly impacted.

There are critical **ethical** issues here, which are addressed in the next Part. And there are critical **economic** issues. Evidence to CoRWM has already put a “ball-park” price tag of £13 bn on the most rigorous solution for dealing with **existing** waste – that of deep geological storage.

Firm estimates cannot yet be made for levels of waste arising from any new nuclear programme, although our evidence indicates that the volumes of waste arising from new reactor designs could be substantially less than from our existing nuclear reactors.

5. Decommissioning

Again, there is widespread public concern about dealing with our existing “nuclear legacy”, both in terms of safety and cost. The most recent assessment from the Nuclear Decommissioning Authority suggested that an accelerated decommissioning programme will cost approximately £56 bn. Much of this relates to military facilities or nuclear power plants that no longer generate electricity (such as Dounreay), but our evidence still suggests costs of between £1.3 bn and £1.8 bn for the decommissioning of each of our existing power plants – largely because little consideration was given to decommissioning in the design of these reactors.

However, it’s important to point out that such costs may not add much to the price paid for each kilowatt hour of electricity generated by a nuclear reactor. The evidence also suggests that new reactor designs (where decommissioning will be designed in from the start) will entail substantially lower costs in this area.

Nonetheless, these very large sums of money have a significant ethical dimension: unless the actual users of the electricity generated by a nuclear reactor pay explicitly and in full for the total costs of the decommissioning of that reactor, then it is clear that one of the key aspects of sustainable development (in terms of “intergenerational equity”) is being set aside. We return to this point in the next Part.

6. The economics of nuclear power

It remains as hard today to calculate the full costs of nuclear power as it has been at any time over the last forty years. Because of the historical links between our military nuclear programme and our civil nuclear programme, secrecy was endemic, and keeping UK citizens in the dark or even deliberately deceived about the costs of nuclear power was standard practice prior to the semi-privatisation of the industry in the 1990s.

Over and above the secrecy problems, it is very difficult to get any accurate assessment of cost. Capital costs (for construction) are huge; operating costs are low. Fuel cycle costs depend entirely on what technologies are being used. As we've seen, the costs of decommissioning and waste management are very difficult to estimate. And the way nuclear power is financed (with or without government support) has a huge bearing on final costs.

Making comparisons (in pence per kilowatt hour generated) is therefore fraught with difficulties.

The new evidence we commissioned for this study suggests that it's going to be very difficult to estimate total costs of a new programme based on any new reactor design. All we have to go on are industry estimates, and our evidence clearly demonstrates, on the basis of historical performance, that considerable scepticism is warranted in assessing the reliability of estimates from the industry itself – or indeed from governments that are not acting in a genuinely impartial way.

Our evidence emphasises the uncertainties in arriving at a definite cost (per kilowatt hour) for nuclear power that would allow straightforward comparisons with other energy technologies.

The results from eight recent studies precisely demonstrates the nature of the problem. The wide divergences between cost expectations are attributed mainly to:

> **differences in the assumptions about capital costs,**

> **differences in assumptions about discount rates and/or the cost of capital (including different financing assumptions).**

(The data are presented using the original currency units to avoid the complications of currency conversion and the distortions this would represent.)

The cost of nuclear power (in pence (or cents) per kilowatt hour) is heavily dependent on capital costs, which account for around 60-75% of total generating costs. This makes the cost of nuclear new-build very sensitive to both project overruns and to the cost of capital – the interest or "discount" rate charged on investment capital. This interest rate is likely to be higher for nuclear than for other energy investments if nuclear is perceived as a "riskier" investment. This may well be the case given the uncertainties that exist around knowing a realistic capital cost for a new reactor before one is built.

Organisation/Department	**Range of costs** (N.B. In original currency units)
1 Performance & Innovation Unit (Cabinet Office)	2.5-4.0 p/kWh
2 Interdepartmental Analysts' Group (DTI/Defra)	2.6-4.0 p/kWh
3 Energy White Paper modelling work (DTI)	3.4-3.7 p/kWh
4 Royal Academy of Engineering (UK)	3.26 p/kWh
5 Massachusetts Institute of Technology (USA)	4.9-7.9 USc/kWh
6 Nuclear Energy Agency/International Energy Agency	3-5 USc/kWh
7 University of Chicago (USA)	5.2-7.1 USc/kWh
8 Scully Capital Services (USA)	3.4-3.7 USc/kWh

Details on all these studies are provided in our evidence base (Paper 4 – *Economics of Nuclear New-Build*)

This means that while the figures quoted in the table above may well represent a range of achievable costs **if all goes well**, they do not capture the real uncertainties that exist in current UK circumstances, including the long-term costs of waste disposal and decommissioning. Our evidence indicates there is a no independently verifiable way of knowing the *realistic* capital cost of a new UK reactor before one is built.

The Commission continues to see nuclear power as a high-cost option. But so too are subsidised wind-power programmes or carbon capture and storage. Once built, nuclear reactors have a valuable role in the generation mix as base load providers producing low carbon electricity at low operating costs for many years.

“The new evidence we commissioned for this study suggests that it's going to be very difficult to estimate total costs of a new programme based on any new reactor design.”

> **Once built, nuclear reactors have a valuable role in the generation mix as base load providers producing low carbon electricity at low operating costs for many years.**

In the UK's liberalised energy market, it is investors who will ultimately have to make those judgements. But our evidence suggests that nuclear power will find it difficult to compete in those liberalised markets without substantial public subsidy, and without the Government taking on some kind of liability in the event of any serious accident or for the long-term costs associated with waste disposal and decommissioning.

The industry seems to have an unwarranted expectation of continuing to be subsidised. This would appear to be confirmed by the recommendation from the Chief Executive of the Nuclear Industry Association that HM Treasury should guarantee a minimum price for nuclear electricity over the forty year lifetime of each reactor – presumably to prevent nuclear power being rendered "unprofitable" because of a decline in wholesale electricity prices or in the event of new technologies coming forward during that time that turn out to be cheaper. This gives some indication of just how brazen the industry is likely to be in pursuing its own self-interest, albeit in the name of the national interest.

That said, it is of course open to our Government (subject to EU rules) to provide that level of support – as part and parcel, for instance, of any Climate Change Programme to reduce emissions of CO_2. There is no reason, on the face of it, why nuclear should not be treated on exactly the same basis as any other low carbon technology, if that's the basis on which the Government makes subsidies available.

However, were any government to contemplate the use of taxpayers' money (or consumers' money, through an additional levy on our electricity bills) for this purpose, it would then be compelled to demonstrate that such a subsidy incontrovertibly represented better value for money for the taxpayer than a similar level of subsidy for other low or zero carbon options.

7. Proliferation risks

Proliferation remains a matter of high public concern, and justifiably so. As can be seen from the historical record, it is impossible to guarantee, over time, that any civil nuclear programme will not be developed into a military capability.

As a matter of record, the International Atomic Energy Agency tells us that we might well have ended up with between thirty and forty nuclear weapon states were it not for the Treaty on the Non Proliferation of Nuclear Weapons, and that more states have actually abandoned potential nuclear weapons programmes than have gone on to develop them.

But as we've seen recently with North Korea and Iran, dealing with states that withdraw from Treaties or potentially act in breach of them, is a hugely delicate and controversial challenge. Many believe there is no satisfactory answer to the risk that an expansion of nuclear power programmes will increase the risk of more countries acquiring nuclear weapons capability.

And it would not prove easy for the UK to argue that nuclear power is a critical aspect of its own strategy for reducing emissions of greenhouse gases while simultaneously claiming that a country like Iran should not be permitted to follow the same course of action. Under the terms of the Framework Convention on Climate Change, we are legally obliged to help other countries develop appropriate carbon abatement technologies through technology transfers.

8. Security issues

This is obviously a matter of much greater concern to governments since we all became swept up in "the war against terror". High levels of security at nuclear power stations are regularly reviewed against current intelligence on terrorist groups, though it has to be pointed out that this has not stopped Greenpeace demonstrating on a number of occasions how easily some of these defences can be breached.

As regards the threat of a head-on attack, the industry and the UK Government are as one in asserting that modern reactors are very unlikely to be breached even by a crashing commercial airliner, and that standard shut-down procedures would minimise or eliminate altogether the risks of any serious damage being done. Other commentators remain deeply sceptical of our ability to foresee future terrorist threats, and are at least as concerned about the risks entailed in the movement of reactor-grade fuel or spent fuel during the nuclear fuel cycle, raising fears of their potential misuse in some kind of "dirty bomb".

Whatever one feels about the acceptability of this kind of risk (which is by definition all but unquantifiable), no one disputes the high level of security-related expenditure required (on an ongoing, permanent basis) to minimise and manage those risks.

9. Opportunity costs

We believe there are four different kinds of potential opportunity costs as they relate to nuclear power – in other words, what other courses of action or opportunities might be blocked off as a consequence of going for the nuclear option:

1. **Investment in renewables/energy efficiency**
2. **Political leadership**
3. **Infrastructure**
4. **Economic development**

9.1 Potential impact on investments in renewables/energy efficiency

Somewhat to the surprise of some Commissioners, our evidence shows that there is unlikely to be much impact from a new, privately financed nuclear programme on the availability of capital from investors to fund renewables or other low-carbon technologies. This is reassuring, although we are struck by the fact that there are already serious problems in securing enough capital for the UK's ambitious off-shore wind programme.

However, we **are** concerned that support for a new nuclear programme could compete directly with existing public policy measures on energy efficiency. A levy on consumers' bills to support new nuclear might be offset by government by a reduction in the targets for future periods of the Energy Efficiency Commitment, to help keep prices down. This would reduce carbon emission savings from the domestic sector. The same impact might also be seen with the Renewables Obligation.

9.2 Potential impact on "share of political leadership"

We are much less sanguine on this score. Were it to be decided to proceed with a new reactor programme (once an "acceptable" solution to the waste issue has been found), there is no doubt that this decision would command a substantial slice of political leadership – from whichever party is then in power. Political attention would shift, and in all likelihood undermine efforts to pursue a strategy based on energy efficiency, renewables and more CHP – not least because any such decision is very unlikely to win widespread public support, as of now, as we'll see in the next Part.

"Security is obviously a matter of much greater concern to governments since we all became swept up in "the war against terror".

> **A new nuclear programme would commit the UK to nuclear technology, and to the large-scale, centralised supply infrastructure needed to benefit from it, for at least fifty years.**

This may be seen as a rather crude "either/or" analysis: if investors can pursue both options simultaneously, why shouldn't politicians be equally capable of doing the same?

We would be more confident of their capacity in this regard had we seen a full-on effort being made over the last three years to deliver on the Energy White Paper. But we haven't. Performance has been patchy, inadequately supported in both human and financial terms, and subject to constant inter-departmental incoherence.

Worse yet, even the speculative prospect of an expanded nuclear power programme in the future is already being treated by some politicians as a "get out of jail free card", and by some energy users as reassurance that the pressure for increased energy efficiency will soon be eased.

Getting market incentives, fiscal instruments and regulatory interventions effectively aligned to drive forward a strategy based on efficiency and renewables is a genuinely demanding political exercise, with multiple stakeholders to be brought on board, conflicts to be reconciled and compromises to be made. How much simpler (it is now being argued by some) to drive through a programme of new reactors.

9.3 Potential impact on the UK'S distribution network

Having secured far more ambitious energy efficiency gains than the Government has even begun to contemplate, the Commission's long–term vision of a genuinely sustainable energy future would see much more of our reduced energy needs either generated locally (through major new investments in micro-generation technologies of different kinds, including micro-wind turbines, solar water heaters, micro-CHP systems, biomass boilers, ground-source heat pumps, photovoltaics and so on), or through large-scale renewables such as off-shore wind and, possibly, tidal barrages and tidal stream technologies. We believe substantial investment will be needed in both, and in our distribution network to deliver these prospective benefits.

This raises the difficult issue of "network lock-in". A new nuclear programme would commit the UK to nuclear technology, and to the large-scale, centralised supply infrastructure needed to benefit from it, for at least fifty years. In the near term, that will divert investment away both from the kind of network reinforcement needed to cope with high levels of micro-generation, and from new transmission lines (or "interconnectors") needed to take advantage of large-scale off-shore wind and other renewable technologies.

In the long run, we have no doubt that there will be significant advances in all sorts of decentralised energy technologies, and there is a high risk that our dependence on centralised supplies may "lock out" these alternatives. Decisions made to support nuclear would have few knock-on benefits elsewhere in our energy economy (transport, heat, use of gas in our homes etc), in contrast to the kind of alternative approaches mapped out in the next Part. Even if we did bring forward a nuclear programme, we'd **still** have to address all those other difficult issues as well.

9.4 Potential impact on economic development

As Commissioners, we look out on a world in which **every** nation (from the richest to the poorest) is imminently going to have to come to terms with the same challenges the UK faces: an end to cheap fossil fuels; dramatic changes in the production and use of energy to confront the threat of climate change; the growing importance of energy security. In that global context, we ask ourselves a simple question: how many of those nations are going to address those challenges predominantly through nuclear power?

The contrast here is with some of the alternative technologies we briefly profile in Part 4: energy efficiency; large-scale renewables and micro-generation (both of which will inevitably prove to be far more important to most countries than nuclear power); energy from waste and biomass, which will be of huge importance throughout the world, but particularly in developing countries; carbon capture and storage – potentially a multi-billion dollar industry in which UK companies including BP, Shell and Scottish and Southern Energy are already making huge investments. The export potential in all of these areas could be substantial.

The UK was once the world leader in wind power. These days, Germany and Denmark have taken on this title due to significant investment over the last fifteen years. To many people, it does seem bizarre if not perverse that we could be about to downplay yet again the importance of so many of the technologies that will drive future growth and business success in the vast majority of countries.

10. Security of supply

Although nuclear power is often described as a "domestic energy source", offering the prospect of rock-solid security of supply over time, that isn't strictly accurate. Given that we do not have any uranium deposits of our own, it still has to be imported, raising questions about both **availability** of supply over time and short-term **security** of supply.

However, both the costs of treated uranium used in reactors and the volumes required are relatively small. Contrary to some reports, our evidence suggests that there are unlikely to be any major concerns over the long-term availability of raw uranium; as demand increases, exploration for new resources will resume and new mines will be opened. There are some concerns over the security of uranium supplies over the next decade, but this is due to a shortage of investment in new mines rather than a lack of uranium resources.

However, the **quality** of the ore extracted will remain a big issue (the lower the concentration of uranium in the ore, the more energy is required to process it), as will the substantial environmental and social impacts of any mining operations.

These issues should not be underestimated. The historical record of mining companies in setting aside land rights of indigenous people and in causing massive pollution to both surface and ground waters, is a disgraceful one. With new reserves as likely to emerge in countries like Russia and Kazakhstan as in "established" producer countries such as Australia and Canada, investors in any new nuclear programme in the UK would need to ensure that their supply chain was as socially and environmentally responsible as for any other industry.

All that said, there is no doubt that nuclear power offers substantial long-term benefits to any government seeking to reduce the risks entailed in purchasing oil, gas or coal from countries that do not necessarily inspire confidence as to their future stability or integrity. The stand-off between Russia and the Ukraine has provided a sobering lesson for many western governments. Again, it would be folly to underestimate the contribution that nuclear power could make to filling the "generation gap" **if** it comes down to a choice between imported hydrocarbons and nuclear power.

However, it is important to remind people at this stage that we are still only talking about a total of 8% of the UK's total energy needs coming from any replacement nuclear power programme. It is clearly not the case that "only nuclear power can address the challenge of energy security for the UK", as is sometimes claimed both by politicians and industry representatives.

"There are unlikely to be any major concerns over the long-term availability of raw uranium; as demand increases, exploration for new resources will resume and new mines will be opened."

Part three

Making judgements

1. Public opinion

Nuclear power remains an extremely controversial area of public policy. Government interventions must therefore be particularly sensitive to public opinion and to the way in which the public is likely to respond. Sensitive not just to the substance of any decisions taken, but to the way in which it takes them and subsequently seeks to pursue them. Rebuilding trust around such discussions is critically important.

Ministers already know they would have a massive challenge on their hands were they to decide to pursue the nuclear option. Most surveys show that there is currently little explicit support for a new programme of nuclear reactors, especially when compared directly with renewable technologies. However, it is also true that rising concerns about climate change may well persuade many more people that a new nuclear programme is now inevitable if we are to restrict emissions of CO_2. The most recent MORI poll (commissioned by the Tyndall Centre) showed that more than 50% of people would support more nuclear power if it could be demonstrated that it reduced the threat of climate change.

Our evidence should remind Ministers that they would be well-advised to reflect both on the fiasco of the GM controversy in the late 1990s and on the way in which the nuclear debate in the UK has been "framed" in the past.

The GM debate clearly demonstrated what happens when a government is determined to push ahead with an "unpopular" technology at all costs, dismissing all concerns on the part of the general public as insubstantial "perceptions" – making the contrast with the much harder "facts" embodied in the "scientific evidence" to which they as decision-makers had exclusive access.

Which makes it all the more important to revisit earlier nuclear controversies, and to analyse what it was that lay behind those controversies. As our research on public perceptions puts it: "the record suggests that on nuclear–related issues such as economic viability, the challenges of secure waste management, radiation uncertainties, and the commercial implications of prospective regulatory pressures, wider public understandings have in the past proved more realistic than many of those of the industry or government."

The analysis goes on to suggest that it wasn't just the technology itself (the nuclear reactor and its associated fuel cycle), but the whole set of government and industry institutions on which the technology depended that made people so intensely suspicious of what was being proposed. The nuclear industry seemed to require special, unexplained "privileges" to justify its existence.

It would be as well for the current Government to avoid any processes that push nuclear power back into that particular reputation status. It did not help, in that regard, that the Government has just asked the Health and Safety Executive to carry out a new study into licensing procedures for nuclear power stations – at the same time as professing to have a completely open mind on nuclear.

It is for that reason that the Commission is still recommending to Ministers that the current Energy Review should be seen primarily as just the start of a process to consider long-term energy options for the UK. It should come forward with broad-brush recommendations as to any new strategic developments (on carbon capture and storage, for instance, or micro-generation, or indeed nuclear power) that it feels are now in the national interest.

These should then be the subject of a further period of proper public consultation. Very careful thought should be given, before the end of the Review, as to how that consultation process should be designed and funded to maximise public engagement and optimise conditions for public trust and confidence in any ensuing decision. As our research points out: "truly sustainable energy policies seem likely to benefit from going with the grain of wider public concerns, rather than from rubbing up against them."

2. Ethical considerations

Almost all decisions about complex technologies, however clinical and "fact-based" they may appear at one level, have an ethical dimension – in terms of prospective "winners and losers", impacts on lifestyle, culture and society, and so on. But the debate about nuclear power is uniquely charged with such considerations.

Going right back to the definition first used in the Brundtland Report in 1987 ("development that meets the needs of the present without compromising the ability of future generations to meet their own needs."), the concept of sustainable development has consistently stressed the obligations of one generation to all future generations, both in terms of access to nature's resources, systems and services, and in terms of not "dumping" the direct or indirect costs of development on those who have no share in the benefits of that development. Justice between generations (or "intergenerational equity") is another way of describing it.

Nuclear technologies pose complex ethical dilemmas in this regard. High-level nuclear waste remains dangerously radioactive for hundreds of thousands of years; nuclear reactors will need to be "mothballed" for decades whilst decommissioning takes place. A proportion both of the risks and of the ongoing costs associated with waste management and decommissioning will therefore fall on citizens who were neither party to the decisions taken to build the reactors in the first place, nor beneficiaries of the electricity that flowed from those reactors during their lifetime.

In some ways, a clear acknowledgement of this ethical dilemma is implicit in the Government's own decision not to proceed with a further generation of nuclear reactors unless and until an "acceptable" solution has been found to the problems associated with existing volumes of nuclear waste. To add to those volumes of waste without such a solution being to hand would indeed be ethically unacceptable on every count.

For some Commissioners, with the very limited information on future waste management and decommissioning strategies that we have available to us today, it is simply not possible to be true to the principles of sustainable development whilst approving a new generation of nuclear reactors.

For other Commissioners, by contrast, current knowledge is sufficient to persuade them that the hazards associated both with waste management and decommissioning will remain acceptably low, and that it is not unreasonable to ask future generations to bear some small part of the costs entailed in our generation doing what we feel we have to do to reduce emissions of CO_2 – for the benefit of future generations, it has to be said, as well as of our own.

For many people in the UK, it's clear that they can see no way out of the current set of energy dilemmas (climate change, rising prices, security of supply issues, declining North Sea assets) without having recourse to the nuclear option. Some feel genuinely enthusiastic about this option, especially those who have never "lost faith" with the potential of nuclear power; for others, nuclear is rather more the "least worst option", no cause for celebration in itself, but a gritty necessity given where we now find ourselves at the start of the 21st Century.

After all, if there really was no alternative, then any government would be duty-bound to pursue some kind of nuclear option – however risky, costly and unpopular that might prove to be.

But what if there is an alternative strategy, a very different "least worst option" that obviates the need for the nuclear option?

Though we have commissioned no additional research for this part of our report, we are drawing here on a well-established body of modelling work already carried out for the Government in the run up to the 2003 Energy White Paper, as well as on our own work done at the same time and on further research findings that have emerged since 2003.

> **"The most recent MORI poll (commissioned by the Tyndall Centre) showed that more than 50% of people would support more nuclear power if it could be demonstrated that it reduced the threat of climate change."**

Part four

Alternative options

> **Across the economy as a whole it is estimated that we could reduce energy use by around 30%.**

1. Introduction

A huge amount of work has gone into modelling countless different scenarios over the last few years. The Commission has reviewed many of these, not with a view of coming to any fixed conclusion as to which might be "the best", but simply to test for degrees of robustness, both technologically and financially.

(A summary of the principal sources on which we've drawn can be found in our evidence base: see Paper Two – *Reducing CO_2 Emissions: Nuclear and the Alternatives*).

In this respect, the UK is very fortunate. Many studies have demonstrated how we can dramatically reduce total energy consumption. We have huge wind power resources, and substantial tidal, wave, biomass and solar resources. Recent work by the Energy Saving Trust estimates that microgeneration could provide 30 – 40% of the UK's electricity by 2050.

Of course, it's not quite as easy as that. Technological potential is one thing; economic viability quite another. Theoretically, we could seek to achieve a completely zero carbon society over the next twenty years, but the cost would be astronomical. The economic and social damage that would be inflicted on people would clearly run counter to the meaning of sustainable development outlined earlier in this paper.

2. Energy efficiency

As we made clear on page 4, we believe that energy efficiency should be set absolutely at the heart of whatever long-term energy strategy the Government now brings forward. The case for this is eloquently argued in the Government's own *Plan for Action on Energy Efficiency*, published in April 2004 (as part of its follow up to the 2003 Energy White Paper), identifying the efficient use of energy as "the most cost-effective way" to meet all four of the Government's energy goals:

- **"Reducing carbon emissions: using energy as efficiently as possible is the most cost-effective way to manage energy demand, and thus to address our carbon emissions.**
- **Ensuring security of supply: by reducing demand on the gas and electricity distribution networks, energy efficiency helps to develop improved resilience and will reduce our dependence on imported energy supplies.**
- **Maintaining competitiveness: by helping consumers to reduce their energy bills, energy efficiency helps UK businesses to be more productive and competitive.**
- **Tackling fuel poverty: improving the energy standards of homes has an important role in reducing spending on fuel by those in fuel poverty."**

The Action Plan went on to assert that "across the economy as a whole it is estimated that we could reduce energy use by around 30%. To deliver this we need, over the next two decades, to roughly double the rate of energy efficiency improvement seen in the past thirty years."

Since the publication of the Energy White Paper, a number of studies have emerged in the UK confirming this approach, but simultaneously lamenting just how slow the Government has been to make a serious priority of its own Action Plan – let alone the much more ambitious approach that many experts now believe is required.

Based on our own research, the Commission sees no reason why we should not set our sights much higher in terms of improvements in energy efficiency. For instance, the final report from the Sustainable Consumption Round Table (due out end April) puts great emphasis on the importance of designing products so as to reduce energy consumption at source. The realisation that leaving electronic and electrical devices on stand-by requires the equivalent of a 1500 MW power station has woken people up to the importance of product design, but not to the fact that some new products (domestic air conditioning, for example) are constantly exacerbating the overall demand management challenge.

We are concerned that a surprisingly large number of MPs and civil servants would appear to have consigned the potential for such efficiency gains to the "too difficult" category, requiring as it does a wide range of effective interventions in the marketplace to influence both individual and corporate behaviour. Exactly on what evidence that pessimism is based is something of a mystery, as many other countries would appear to have done much better than us on energy efficiency, and the Government itself acknowledges freely that our own efforts in this regard have until now been inconsistent and inadequate.

3. Renewables

The UK has some of the best renewable energy resources anywhere in the world. This is particularly the case offshore, where the theoretical potential of marine renewables and offshore wind power is considerable. We are deeply disappointed at the way in which the current energy review (*Our Energy Challenge*) seems intent on talking down this potential, treating renewables more as an add-on than the principal driver of a genuinely sustainable energy supply strategy.

We have studied three recent reports on the potential of renewables in the UK, from the Institute of Electrical Engineers (IEE), the Tyndall Centre, and the Government's own Interdepartmental Analysts' Group (IAG) in its work for the 2003 Energy White Paper.

All have sought to assess what is called the "practicable renewable resource" which is very different from the "theoretical resource" – the theoretical maximum available before spatial, infrastructure and environmental considerations are taken into account. Such calculations still need to be treated with caution, but they give a good sense of the scale of the different resources.

All three studies indicate an enormous potential for renewables in the UK. Without taking geothermal energy into account, both the IEE and the Tyndall Centre assessed our practicable resource at around 85% of current electricity production. The IAG is more modest in its projections: with costs held at between 5p and 7p a kilowatt hour (which represents a substantial increase on current electricity prices) it assesses the practicable resource for 2025 at around 68% of current electricity production. (Further details of all the studies can be found in our evidence base, Paper Two).

Whilst some of us remain pretty sceptical about projections of this kind, one would expect the total practicable resource to increase over time in line with technological developments. For instance, although the potential for **biomass-based technology** is included in the above figures, the new report from the Biomass Task Force has already come to some rather more ambitious conclusions about the practicable resource in this area.

Technological breakthroughs could prove to be particularly important with technologies such as **photovoltaic cells**, which convert sunlight directly into electricity. The theoretical potential here is enormous, though still limited by economic considerations.

However, PV costs have been falling by around 5% per annum over the last few years, and there are significant economies of scale still to be realised. When launching the Energy White Paper in 2003, the Prime Minister reminded his audience (quoting from the White Paper) that solar energy alone "could meet world energy demand by using less than 1% of land currently used for agriculture". Yet investment here in the UK has been pitiful in comparison to Germany and Japan. California recently announced ambitious plans to install 1 million roofs with solar arrays; San Francisco recently voted in a $100 million bond for solar and wind power in their city.

"The UK has some of the best renewable energy resources anywhere in the world. This is particularly the case offshore, where the theoretical potential of marine renewables and offshore wind power is considerable."

> **It is worth bearing in mind that all renewable technologies also have some environmental costs – and cause some CO_2 to be emitted in their manufacture.**

Where is the equivalent sense of purpose and technological dynamism here in the UK?

We're not advocating that we should go down such paths unthinkingly. It is worth bearing in mind that **all** renewable technologies also have some environmental costs – and cause some CO_2 to be emitted in their manufacture. For instance, were the UK Government to pursue the possibility of **large-scale tidal barrages** (and we believe it should certainly re-open consideration of their potential), it would undoubtedly prove extremely controversial with a number of environmental organisations because of the potential impact on biodiversity.

Though not technically a "renewable" option in the same way as solar or wind, **energy from waste** is also included in the above figures – and is also very controversial. The potential resource here is significant, and we are concerned that environmental opposition to energy from waste has simply not kept up with the degree to which the technology has moved on from the kind of mass burn incinerators that inflicted so much damage on the environment in the past. These days, energy from waste, particularly at smaller scale, represents a viable and cost effective source of electricity production that could be introduced with minimal pollution and minimal impact on recycling or waste minimisation strategies.

4. Further options

4.1 Microgeneration

"Unfortunately, the UK has a poor record with microgeneration technologies, a term which includes small-scale renewables and micro-CHP. In every technology grouping – be it solar water heaters, biomass or small-scale wind – we lag behind our international competitors, often by a very wide margin. (Our forthcoming report, *Committing to Microgeneration*, goes into much greater detail on this).

Recent work for the DTI by the Energy Saving Trust highlights the long-term potential of microgeneration to make a serious contribution to UK energy supply. By 2050, it believes that microgeneration could contribute 30-40% of the UK's electricity needs, representing a 15% decrease in CO_2 emissions. Most of this potential is from micro-CHP and the use of domestic fuel cell technology.

4.2 Combined heat and power (CHP)

The UK currently has a target for 10GW of electricity from good quality CHP by 2010. However, progress against this has been disappointing, with little more than 50% of this target achieved to date. CHP substantially improves the efficiency of electricity generation and transmission, saving CO_2 in the process.

Virtually all the scenarios we considered see an expanded role for CHP as a way to bring forward rapid reductions in CO_2 emissions using currently available technology. The Commission intends to look at this issue in more detail, as we believe there is still huge potential for more use of community heating schemes and CHP in commercial buildings. (The potential of micro-CHP is covered above under Microgeneration.)

4.3 Carbon capture and storage (CCS)

Many of the technological processes behind CCS are already well established in the oil and gas industry. For example, the separation of natural gas into CO_2 and hydrogen is well understood, as is the injection of CO_2 in old oil fields (as part of 'enhanced oil recovery'). However, there is still a huge amount of development work needed to bring these processes together, and to bring down costs so that conventional fossil fuel plants using CCS become a viable option for electricity generation. (Cost estimates based on today's technologies are in the range of $50 to $300 for each tonne of carbon emissions avoided).

The theoretical potential of CCS is limited only by the supply of fossil fuels and appropriate storage sites for the CO_2. In the UK, we have a number of viable storage options, including disused oil and gas fields and, potentially, coal seams or saline aquifers. The current Review should generate evidence to indicate the size of the technically and economically deliverable contribution that CCS could make to UK generation over different timescales.

There are still a number of major concerns that will need to be addressed – namely the security of stored CO_2, long-term ownership and responsibility for the stored CO_2, negotiation of disposal of 'waste' at sea or sub-sea, possible environmental impacts, and cost – but CCS seems to have significant potential and is attracting increasing interest from governments and industry.

The international perspective makes the case for exploring the potential of CCS even more compelling. Fast-growing countries such as China and India currently have plans for very large numbers of new coal- and gas-fired power plants over the next few decades. There is a growing realisation that unless such countries are offered viable ways of dealing with the associated CO_2 emissions, those plants are likely to result in huge increases in emissions. The UK is in a good position to develop those technologies, making use of our substantial offshore experience, and the benefits of such work would be widespread.

The Commission welcomes the surge of interest in CCS, but believes this should not obscure the overwhelming problems still associated with any major role for coal in the long run. Coal is still the highest CO_2 emitter as well as a major source of other air pollutants, and causes the death of thousands of miners every year in accidents and through ongoing health problems. CCS for coal has a potential role to play as a 'bridge technology', but should not be seen as a long-term "sustainable" alternative.

4.4 Hydrogen

Many would argue that we should simultaneously be investing a great deal more in various hydrogen-based technologies (particularly the fuel cell), not primarily as a source of electricity in its own right, but for storage purposes and for alternatives to the internal combustion engine.

Fuel cells are already available commercially, but their cost is still a huge barrier to widespread adoption – they currently cost about £2,000 per kilowatt, about ten times too expensive to be commercially viable in cars.

Our studies have not gone into any depth on the potential for hydrogen. Over and above the problems associated with the development of fuel cells (which most experts believe will take several more years to crack), there is the whole question of how to produce the hydrogen itself. It requires a lot of energy to extract the hydrogen from water (through electrolysis), and the only way to make hydrogen genuinely "carbon-neutral" is to use renewable energy for that purpose.

Given how much renewable power we now need for direct electricity generation, this seems a very big ask. By the same token, plans for using nuclear power to produce the huge quantities of hydrogen that would be required if fuel cell technologies replace the internal combustion engine, face precisely the same dilemmas surfaced in Part Two of this document.

Our Energy Challenge puts it as follows:

"Unless there is a great increase in the amount of carbon-free energy available to produce hydrogen in the UK, its main benefits will be to reduce demand for oil rather than to reduce carbon emissions. Much work also needs to be done on fuel cell technology, hydrogen storage technology, and hydrogen distribution before hydrogen cars can compete with conventional vehicles on performance, cost and convenience."

But it's right that we should continue to push ahead as energetically as possible, with further research into all aspects of a hydrogen-based transport economy.

"Coal is still the highest CO_2 emitter as well as a major source of other air pollutants, and causes the death of thousands of miners every year in accidents and through ongoing health problems."

> **Any responsible government should be preparing its people for the inevitability of diminishing access to oil and gas, and to the rapidly rising prices that will accompany this transition.**

5. The overall picture

One would need to be extremely pessimistic not to be heartened by the diversity and scale of the alternatives available to us. It is a regrettable aspect of those campaigning for a renewed nuclear power programme that they feel they have to disparage the potential for renewables, energy efficiency, CHP and so on. The very close links between the nuclear lobby and campaigns against wind power are particularly disturbing.

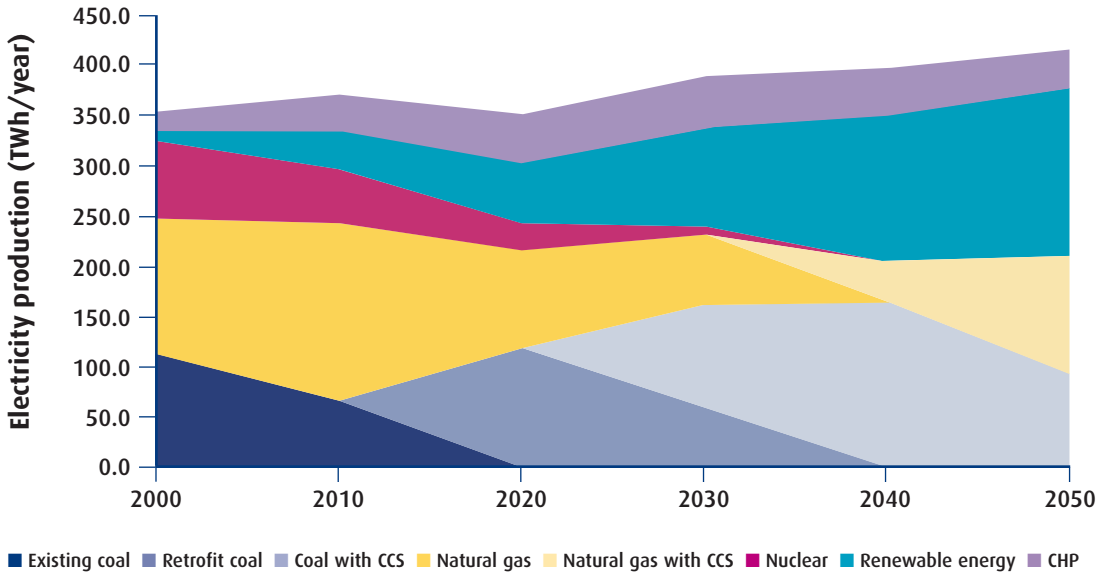
Regardless of what may eventually be decided about nuclear power, we should be pursuing **all** of these options as purposefully and urgently as possible. Although this piece of work has avoided any consideration of the debate about diminishing supplies of oil and gas (the so-called "peak oil" debate), even the most basic of precautionary approaches tells us that the days of cheap fossil fuels are rapidly waning. Whether global oil production peaks in the next five years, or the next ten, or the next fifteen, is in effect immaterial: any responsible government should be preparing its people for the inevitability of diminishing access to oil and gas, and to the rapidly rising prices that will accompany this transition.

That's what the debate on "security of supply" should really be focussing on, and it is startling to us to see just how complacent and detached from reality the Government remains on this critical area of concern.

The good news is that the UK has the theoretical potential to supply a substantial proportion of our current consumption of electricity from a broad range of renewables in the long-term. And we could increase our use of CHP and bring forward the development of carbon capture and storage technologies to make the use of fossil fuels less damaging on an interim basis.

This broad approach is reflected in the DTI's own work on modelling different carbon abatement technologies through to 2050, published in June 2005. To reduce our CO_2 emissions by 60% by 2050, whilst the economy continues to grow at an average of 2.2% per annum, will require both dramatic improvements in energy efficiency and substantial reductions in emissions from power generation.

The DTI's report presents a series of scenarios through to 2050, some assuming a new nuclear programme, and some assuming no new nuclear programme. The base line "no new nuclear" scenario looks like this:



It may well be that this is putting too many of our eggs in the CCS basket – given the current lack of robust evidence for the scale of its potential contribution, and especially if supplies of gas are themselves subject to much greater instability in the gas supply market at some stage in the not too distant future. Here again, the Commission would argue that this merely strengthens the case for accelerated investments in energy efficiency, CHP, renewables and microgeneration.

It will by now be abundantly clear that any combination of alternatives of this kind hardly constitutes "an easy option". Historically, governments have tended to favour large-scale, centralised energy supply solutions. They are nervous of more fragmented, 'distributed' solutions, with the emphasis on the very small-scale and on demand management rather than supply.

That remains the clear preference of many politicians, regardless of their feelings about nuclear power. Aggressively driving down energy demand will be difficult and controversial. Many environmentalists will be appalled at the prospect of large-scale tidal barrages, or the widespread use of tidal stream technologies; after all, many are still not reconciled to the imminent development of huge off-shore wind farms. Deriving more energy from waste (however advanced the technologies may now be) remains unacceptable to most local communities. Carbon capture and storage remains largely unproven, apart from a few encouraging prototype schemes. And we've had real difficulties in the UK maximising the potential of CHP in the way so many other countries have succeeded in doing.

We also want to stress, at this stage, that we have focussed almost exclusively in this publication on the situation here in the UK. The situation looks very different in France, China, Germany, India, the United States and so on. Even those Commissioners least persuaded of the case for nuclear here in the UK, acknowledge that it is not appropriate to make blanket judgements relating to **any** use of nuclear power in **any** country, where comparisons between a nuclear option and the full range of available alternatives will be equally complex.

We are nevertheless very impressed by the recent announcement on the part of the Swedish Government to totally eliminate Sweden's dependence on oil by 2020 without building any new nuclear power stations. That plan deserves close scrutiny in the current Energy Review.

The headline conclusion of this section is that we believe that there is a range of different ways for the UK to meet its CO_2 and energy security objectives without relying on a new generation of nuclear power plants. Indeed, the Sustainable Development Commission categorically rejects the assertion made by a number of independent experts and advisors to government that there are no such alternatives.

That alternative may not be as persuasive or compelling to some as the nuclear option, but an alternative it indisputably is, and needs therefore to be re-appraised on exactly the same basis and with the same degree of rigour and impartiality as the nuclear option.

> **"The good news is that the UK has the theoretical potential to supply a substantial proportion of our current consumption of electricity from a broad range of renewables in the long-term."**

Part five

The Sustainable Development Commission's advice to Government

1. Reaffirming the common ground

In the introduction to this publication we described the process we have been through as a "journey of exploration", based on the eight comprehensive research reports and our summary analysis (*Nuclear Power in a Low Carbon Economy*) that accompany this publication. Commissioners have devoted a lot of time to undertaking this journey, not least because we are so determined to ensure that the process by which any decision is arrived at in this area is properly transparent, rigorous and inclusive. We needed to meet those criteria in terms of our own process.

We've completed that journey reaffirming that we have complete unanimity on the following conclusions:

The accelerating pace of climate change is a massive concern – indeed, climate change is probably the most serious issue our civilisation has ever had to face. Current measures to reduce emissions of greenhouse gases are completely inadequate.

At the same time, rising energy costs and concerns about the UK being able to secure access to supplies of energy in the future, demand much greater clarity about our long-term energy strategy.

The starting point for this must be energy efficiency. There is still a vast potential for promoting energy efficiency in all sectors, with great benefit to the economy and consumers. We could halve the energy consumption of our homes and offices using existing energy efficiency measures and CHP. As yet, the Government has failed to get on top of this challenge, worsening all our problems in terms of future energy supply choices.

The potential for renewables in the UK is enormous. Despite some important developments, our current approach remains half-hearted. It is critical that the Government should now invest far more (both politically and financially) in renewables, including small-scale, 'microgeneration' technologies.

The rationale for a long-term energy strategy, based on energy efficiency, renewables and the cleaner and more efficient use of fossil fuels (including CHP) was authoritatively established in the 2003 Energy White Paper.

Since then, the Government has explored the possibility that a programme of Carbon Capture and Storage (CCS) would reinforce the viability of the White Paper's approach, as would an accelerated investment programme in microgeneration technologies.

The Sustainable Development Commission is absolutely clear that the primary responsibility of the UK Government, at this point, is to drive forward that strategy with far greater urgency and purposefulness than it has demonstrated to date.

It must simultaneously turn its attention to policy areas that are currently completely at odds with its own climate change objectives, particularly road transport and aviation. Electricity represents only one third of the UK's total energy consumption, so it's wrong to focus exclusively on electricity supply.

However, it is still a wholly legitimate question to ask whether or not even a flat-out non-nuclear strategy of that kind provides a sufficient response to the increasingly serious problems of climate change and energy security.

Nuclear power is clearly one of the technologies that could generate large quantities of electricity, contributing materially to reducing CO_2 emissions and adding to the diversity of the UK's energy supply.

2. Alternative positions on nuclear power

Having established that common ground, and in the light of the extensive research we have carried out over the last nine months, the SDC has debated three diverging positions:

Position 1

Nuclear power continues to perform badly when assessed against key sustainable development principles. In considering the range of alternative options that are still available to us here in the UK, it should therefore **not** be pursued as part of the country's response to the twin challenges of climate change and energy security. The non-nuclear strategy outlined in the 2003 Energy White Paper should now be pursued with much greater vigour and urgency.

Position 2

There are very serious problems associated with nuclear power, in terms of potential risks, high costs and ethical dilemmas. The information currently available on many of these issues (nuclear waste, choice of reactor design and so on) remains inadequate, making it impossible for the UK Government to give "the green light" to a new nuclear programme **at this time**. The Government should therefore re-double its efforts to implement the Energy White Paper, setting much clearer targets for delivery. At the same time, it should urgently seek clarity on key issues relating to nuclear waste, reactor design, long-term costs, handling of liabilities, and so on.

Position 3

The continued use of massive amounts of coal and gas for power generation is incompatible with securing a low-carbon future for the UK. Renewables can displace a significant proportion of fossil fuel power, and a serious energy efficiency programme can reduce the need still further. **But there will remain a gap**.

If the Government can satisfy itself and the public that a new generation of nuclear reactors can be built at a reasonable cost and to the highest standards of operational safety, and that an acceptable solution to the problems of waste disposal and decommissioning can be found, then a new nuclear power programme **should** be brought forward to help fill that gap.

In essence, these three positions equate quite simply to:

"NO"; "NOT NOW"; "POSSIBLY"

Eight Commissioners favour Position One. Five favour Position Two. Two favour Position Three. The Chairman did not cast a vote.

> **"The Sustainable Development Commission is absolutely clear that the primary responsibility of the UK Government, at this point, is to drive forward that strategy with far greater urgency and purposefulness than it has demonstrated to date."**

> **A non-nuclear strategy could and should be sufficient to deliver all the carbon savings we shall need up to 2050 and beyond, and to ensure secure access to reliable sources of energy.**

3. Advice to ministers

3.1 IN VIEW OF OUR OWN MAJORITY CONCLUSION, OUR ADVICE TO THE GOVERNMENT IS THAT THERE IS NO JUSTIFICATION FOR BRINGING FORWARD PLANS FOR A NEW NUCLEAR POWER PROGRAMME AT THIS TIME, AND THAT ANY SUCH PROPOSAL WOULD BE INCOMPATIBLE WITH ITS OWN SUSTAINABLE DEVELOPMENT STRATEGY.

3.2 However, it is worth elaborating a little on how we have reached that conclusion, as we fundamentally disagree with all those (inside and outside government) who argue that we no longer have any choice and that a new nuclear power programme is an absolute necessity. Our research indicates they are clearly wrong about there not being a choice, as is reflected in our own deliberations.

3.3 The majority of members of the Commission believe that, given sufficient drive and support, a non-nuclear strategy could and should be sufficient to deliver all the carbon savings we shall need up to 2050 and beyond, and to ensure secure access to reliable sources of energy.

3.4 The relatively small contribution that a new nuclear power programme would make to addressing these challenges (even if we were to double our existing nuclear capacity, this would give an 8% cut on total emissions from 1990 levels by 2035, and would contribute next to nothing before 2020) simply doesn't justify the substantial disbenefits and costs that would be entailed in such a programme.

3.5 As the Sustainable Development Commission, we have laid great stress on the **intergenerational** aspects of this decision-making process, particularly with regard to the disposal of nuclear waste and decommissioning. We are also very concerned that a new nuclear power programme could lock the UK into an inflexible, centralised electricity-generating system for the next fifty years – at exactly the time that the potential for more decentralised, small-scale approaches is growing all the time.

3.6 Despite that view, the majority of members of the Commission also believe it is right for the Government to continue to assess the potential contribution of new nuclear technologies for the future, as well as pursuing answers to our nuclear waste problems as actively as possible.

3.7 Developing a sustainable non-nuclear energy strategy will not be simple. We need to stop believing in easy fixes. Ministers will need to think much more creatively about working directly with citizens to help change our energy-related behaviours, as is so clearly mapped out in the Government's Sustainable Development Strategy.

3.8 Above all, we will need a focussed low-carbon **innovation strategy**, with public funding dramatically increased to the levels of our international competitors. This should be combined with long-term targets for absolute reductions in CO_2 emissions to provide certainty to the business community and stimulate private investment. Uptake should then be encouraged through the smart use of fiscal incentives, targeted regulations, and an expanded role for emissions trading schemes.

3.9 Following this pathway would make the UK a leader in low-carbon technologies. If we take full advantage of this, we will enhance our economic competitiveness while upholding the fundamental principles of sustainable development.

4. Advice regarding next steps

4.1 Acting on the assumption that the current Review (*Our Energy Challenge*) is indeed a genuinely impartial process, dispassionately reviewing the evidence available to Ministers (including our own research) rather than rationalising a pre-determined decision with a tokenistic consultation exercise thrown in for good measure, we strongly recommend that one of the principal outcomes of the Review, as regards nuclear power, should be to formulate distinctive positions (broadly along the lines of the Commission's positions outlined above), and then to indicate which of those positions the Government is minded to pursue in due course.

4.2 Given the critical importance of this decision, and regardless of which position the Government declares it is minded to pursue, systematic engagement with the general public should be seen as a precondition of transparent and effective policy–making in this area. The history of the nuclear industry is littered with hasty, partisan and secretive studies leading to expensive mistakes and public hostility.

4.3 Once the Review has been published, outlining the Government's broad intentions, at least nine months should then be set aside for a range of much more substantive consultative and engagement processes, carefully planned in advance and presided over by independent experts and advisors. Any attempt to force top-down solutions on the British public at this stage, with a process fixed by Government to fit pre-determined outcomes, will lead in all probability to widespread mistrust and hostility.

4.4 These engagement processes should also take on board consideration of any conclusions arising from the CoRWM Report, which is due at almost the same time as the Energy Review itself. It may also prove possible to consult on some of the interim findings of the Stern Review on the Economics of Climate Change.

4.5 It is our strong recommendation that this engagement process should not be based on a narrow 'pro' or 'anti' nuclear power debate, but should be set within a more compelling context of what it will mean to plan for and deliver a low-carbon future for people in the UK. Widespread ignorance of the scale and urgency of the changes ahead are deeply unhelpful both to policy-makers and to the business community.

4.6 During that time, the Government should seek to fill some of the yawning research gaps that have become apparent in our own investigations (including the technical and economic potential for CCS for the UK), and should start to develop a comprehensive response to the recommendations of the CoRWM Report.

4.7 The Government should then reflect on the outcomes both of its engagement with the general public and any new research findings, with a view to bringing forward a White Paper in 2007.

4.8 In conclusion, a proper transparent process is **all-important**. There are many siren voices urging Ministers to pursue a fast-track approach to this decision, dispensing with proper consultation, and short-circuiting a proper Parliamentary process. This would be extremely foolish, and would inevitably (and justifiably) result in a backlash against whatever the Government eventually decides is the right way forward for the UK at this critical time.

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