

# **CAN A NEW NUCLEAR PROGRAMME BE JUSTIFIED?**

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## The background

No new nuclear power station has been built in Britain since Sizewell 'B', consent for which was given in 1987. Indeed, there has been a worldwide lull in the ordering of nuclear stations after a period in the late 1970s and the 1980s when many were built.

During the oil 'crises' of the 1970s and early 1980s, hopes were high for nuclear power and plans for a massive expansion were made in many countries. For example, an OECD projection in 1974, based on national nuclear programmes, suggested that installed nuclear capacity in the OECD area might expand from 42 GW in 1973 to nearly 1000 GW in 1990. In the event, there was considerable expansion but on a much smaller scale than those ambitious projections. Installed capacity in 1990 was about 262 GW, or one quarter of the projection<sup>i</sup>.

In the 1990s, the rate of increase slowed sharply. According to the US Energy Information Administration, world installed nuclear capacity in 2003 was 368 GW, of which just over 300GW was in OECD countries. Most of the increase in the 1990s was in four countries – Japan, France, South Korea and China. In the United States, by far the world's biggest nuclear generator, where nuclear generating capacity doubled in the 1980s, it has since declined slightly. In Western Europe outside France, nuclear capacity has been about constant since 1990. The share of nuclear electricity in world electricity generation, which was only 2 per cent in 1971, climbed sharply to about 17 per cent in the 1980s but has since declined slightly to 16 per cent. As a share of world primary energy consumption, nuclear power has remained at about 6 per cent for the last ten years<sup>ii</sup>.

The use of nuclear fission power to generate electricity has caused controversy in many countries, some of which have deliberately eschewed the construction of any civil nuclear reactors. The share of nuclear generation in total electricity generation thus varies considerably among countries, as Table 1(overleaf) indicates. At one extreme, France generates 78 per cent of its electricity from nuclear. At the other, 13 of the 30 OECD countries have no nuclear capacity.

There have recently been signs of revived interest in nuclear power outside the countries that have continued with nuclear construction programmes in recent years. As oil and gas prices increased in 2005, that may have raised long term price expectations for energy sources that compete with nuclear so that investment in nuclear power stations seemed relatively more attractive. Nuclear has also come to be seen as a way of reducing the carbon emissions associated with fossil fuel generation and of diversifying energy supplies. A number of countries that have not had nuclear construction plans in recent years seem to be reconsidering the economic and environmental aspects of nuclear power and one European country (Finland<sup>iii</sup>) has commissioned a new nuclear power station.

**Table 1: Nuclear generation as a percentage of total electricity supplied, 2005: OECD countries\***

Belgium	55
Canada	15
Czech Republic	32
Finland	27
France	78
Germany	30
Hungary	39
Japan	30
Korea	38
Mexico	4
Netherlands	4
Slovak Republic	56
Spain	23
Sweden	51
Switzerland	40
United Kingdom	20
United States	20
OECD total	24

- OECD countries account for about 85 per cent of the world's nuclear capacity. OECD countries not listed have no nuclear generation

Source: OECD Nuclear Energy Agency

### **The British government and nuclear power: a change of mind?**

In Britain, a White Paper on energy policy, published in February 2003<sup>iv</sup>, seemed lukewarm towards a new programme of civil nuclear power stations. It did '...not rule out the possibility that at some time in the future new nuclear build might be necessary' (para 1.24) but the 'fullest public consultation' and a new white paper would be prior requirements. During the subsequent two-and-a-half years, however, the government's enthusiasm for nuclear power grew. In November 2005, the government announced an energy review, to include study of a new nuclear programme, to be conducted by the Energy Minister, Malcolm Wicks, and to report by mid-2006<sup>v</sup>. It is not certain the review will recommend investment in nuclear power but there seems to be a high probability it will do so.

The main reason for the change of heart may well have been the growing realisation that Britain was unlikely to meet the ambitious government targets for

a reduction in carbon emissions, going beyond those required by the Kyoto climate change agreement<sup>vi</sup>. Around the turn of the century, the government's target of a 20 per cent reduction in such emissions by 2010, compared with 1990, might have seemed achievable: in 2000 the reduction, compared with 1990, was 7 per cent. However, much of the reduction in the 1990s was a consequence of a large-scale but one-off switch from coal to gas in electricity generation (the 'dash for gas'), as a long-standing government ban on the use of gas for power generation was lifted. Since 2000 carbon emissions have started to increase again: in 2004 they were only 4 per cent less than in 1990<sup>vii</sup>.

There now seems to be no chance that the reduction in carbon emissions by 2010 will be anywhere near the 20 per cent target. The Kyoto target of a 12 1/2 per cent reduction by 2008-12 may also be missed despite an ambitious and heavily subsidised government energy efficiency and renewables generation programme. Consequently, the government is looking around for energy sources that are apparently free of such emissions, such as nuclear power<sup>viii</sup>. Of course, new nuclear stations take many years to build so they can make no real difference to emissions in the near term. But the government is suffering some embarrassment, having earlier proclaimed that it wanted to give a lead to other countries in reducing emissions. It presumably believes that a new nuclear programme would at least give the appearance of doing something in the short term and might actually reduce emissions in the long term.

Another reason why the government is reviving nuclear power as an option may be that some commentators are expressing concern about the increasing dependence of Britain on overseas sources of gas and oil supply, now that output from the British North Sea is in decline. In reality, import dependence and security are not closely linked<sup>ix</sup>: excessive dependence on an indigenous source of supply can cause security problems, as was the case with British coal in the past (see below). But the popular concern about dependence on Russian gas and Middle East oil may be one reason why the government thinks nuclear power, which has a poor public image, might become more acceptable. In its 2003 White Paper the government had argued persuasively that import dependence need not be a concern. But delays in liberalisation of continental European energy markets and consequent high gas prices in Britain may have caused the government to re-think<sup>x</sup>.

Putting political considerations aside, can a new programme of building nuclear power stations in Britain be justified? The future of nuclear power is a subject that produces emotional reactions on both sides of the argument but there are some important economic principles that can help us form a conclusion. Discussion of these is best preceded by a brief history of nuclear power in Britain.

### **A brief history of nuclear power in Britain**

In Britain, as in the United States, the first civil nuclear power programme (announced in 1955) was developed from the military programmes of World War Two<sup>xi</sup>. Britain had a world 'first' when, in 1956, the world's first nuclear power station to provide electricity for a grid system, Calder Hall, was opened<sup>xii</sup>. A period of considerable optimism about nuclear power ensued as the first British-designed reactors (Magnox) were being built. There were some remarkable predictions – for instance, that electricity would become 'too cheap to meter' – and some leaders of the nuclear industry claimed that within a few years most new generating plant would be nuclear, with much lower costs than coal-fired plant. In this optimistic atmosphere a second nuclear power programme was begun in the mid-1960s, again based on a British reactor design - this time the Advanced Gas Cooled Reactor (AGR). There was a third programme in the early 1980s when the first Thatcher government announced that it expected one nuclear power station a year to be ordered from 1982 onwards. But, in the event, only one power station (Sizewell 'B', a Pressurised Water Reactor based on an American design) was built under this 'programme'.

By the early 1990s, Britain's venture into civil nuclear power was generally regarded as a dismal failure<sup>xiii</sup>. Most stations went well over budget, construction times far exceeded original estimates and there were technical problems in operation. Instead of the low-cost technological triumph that had been predicted, Britain was saddled with a collection of high-cost, troublesome nuclear power stations that were unsaleable at the time the rest of the electricity supply industry was privatised following the 1989 Electricity Act. Eventually the industry appeared to be rescued by its privatisation (except for the Magnox stations) in 1996: just before, and then again after privatisation, efficiency increased and output rose. There were, however, problems again in 2003 after the introduction of new trading arrangements in electricity when British Energy, the privatised nuclear power company, found itself unable to operate profitably as wholesale electricity prices fell and the government arranged a rescue.

The reasons why Britain's experience of building nuclear power stations was so poor are complex. Commentators often point to the failure to standardise design, to construction problems, to strained labour relations and to the failure of one of the consortia set up to build the stations. But a more fundamental problem was that nuclear power station construction in Britain (and in many other countries) was not the consequence of energy market forces: nuclear was a power source promoted and subsidised by the state. Governments of both major political parties had energy policies that severely restricted competition among fuels and government action resulted in monopolies - of information, in the product market and in the capital market<sup>xiv</sup> - that were against the interests of consumers. More specifically,

a monopoly of information about nuclear power in two state organisations that collaborated closely – the Atomic Energy Authority (AEA) and the Central Electricity Generating Board (CEGB) – centralised decisions

about nuclear power, prevented competition in ideas and made it impossible for outsiders to challenge estimates of nuclear costs<sup>xv</sup>;

the product market monopoly enjoyed by the nationalised electricity supply industry, combined with the government's protectionist energy policy to produce a situation in which there was little incentive to keep down costs. The government virtually determined the industry's choice of generation fuels – principally coal and nuclear power – and the costs of protection were passed on to electricity consumers and taxpayers; and

the absence of capital market pressures for efficiency reinforced the effects of the product market monopoly. Given that electricity supply was nationalised, there were no private shareholders to put pressure on managers and there was no prospect of takeover.

### **The present situation in historical perspective**

In some respects, the present situation in Britain seems much more propitious than the old nationalised regime for cost-effective investment in electricity generation (and other parts of the electricity industry). The industry is now in private hands so, in principle at least, the old monopolies – of information and in the product and capital markets – no longer exist to distort investment plans. At the same time, it is claimed there have been cost-reducing developments in the technology of nuclear generation which, for example, mean it is possible to build more compact nuclear reactors that produce much less waste per unit of output than their predecessors. The reactor designs are, it is said, available 'off-the-shelf', so if they are used the changes in design that plagued the first and second British nuclear programmes should be obviated.

In these circumstances, and if the recent increase in fossil fuel prices feeds through into long-term price expectations, nuclear power is likely to seem a more attractive investment to private companies than it has done for many years. Whether that means the economics of nuclear generation are now sufficiently favourable that generators and electricity suppliers would be willing to commit to building new nuclear plant, as compared with (say) gas-fired plant, is not yet clear.

Indeed, it is not certain that investment in electricity generation will be left to decisions by electricity generators, nor even that some of the generators want to be left to make their own decisions. A serious complication is that, though the old form of energy policy that protected indigenous coal and nuclear power has gone, in the last few years the government's presence in the energy market has been increasing and politicisation of the market has re-appeared. The government has once again begun to try to 'pick winners' and to support them<sup>xvi</sup>, relying mainly on the argument that it must step into the market to ensure that

carbon emissions are reduced. As already mentioned, there is an extensive and expensive programme of support, mainly directed at 'renewable' sources of energy, and energy 'conservation' programmes, though it also benefits owners of Combined Heat and Power plants<sup>xvii</sup>.

Such support programmes inevitably give incentives for others to seek favours from government. As regards nuclear power, a nuclear power lobby seems to have persuaded the government that it, too, is a 'winner' and should be supported by some means as yet unspecified and perhaps not yet determined. In the words of Malcolm Wicks, the minister conducting the latest energy review, nuclear investment 'would require some special relationship between the market and the state'<sup>xviii</sup>. Supporters of nuclear power argue that, at the least, it is essential to replace existing nuclear power stations (which in 2004 provided about 20 per cent of the electricity generated in Great Britain) if government long term carbon emissions targets are to be met. Closures of the relatively small Magnox stations have been under way for some years. The last Magnox (Wylfa) is due to close in 2010, the last AGRs (Torness and Heysham 2) in 2023 and Sizewell B in 2035 though, in practice, the lives of some or all may be extended provided safety cases can be made.

### **Benefits from new nuclear plant?**

Even though the pressure for a new nuclear programme appears to be coming from an interest group that is seeking some form of government support, the case should not be dismissed on those grounds alone. The case presented by the lobbyists could be right. It is possible that more nuclear building would produce sufficient 'external' benefits (benefits that could not be realised by the generators but would be of advantage to the community as a whole) in terms of energy security and environmental gains. Can these claims be sustained?

#### *Energy security*

Taking security first, one claim is that energy markets do not provide adequate security and that government must necessarily be involved. Security, it is said, has some characteristics of a 'public good' in which markets will under-invest because providers of security cannot appropriate all the benefits: for example, if I invest in a stand-by electricity generator and use it in a crisis I take some demand off the rest of the electricity system and thereby benefit others. However, it is unrealistic to assume that 'optimal' security is on offer and can be provided by a real-world government. In practice, both markets and governments will provide security imperfectly compared with the ideal<sup>xix</sup> and so a judgment has to be made about which will be better.

The advantage of leaving security provision to the market is that both producers and consumers have powerful incentives to provide security: it is an important characteristic of any energy product. In general, suppliers are likely to diversify

sources of fuel, technologies and locations and give market incentives to cut demand in order to enhance security. More specifically, the recently liberalised British gas and electricity markets give suppliers strong incentives to maintain security because otherwise they would face high costs in time of shortage. Government, on the other hand, lacks information on what consumers want in terms of security and how security can best be provided. It is all too likely to be swayed by extraneous considerations. Even the threat of government intervention can undermine private security provision.

Certainly, government attempts at security provision in Britain have a poor record. For decades, from the late 1950s to the 1980s, British governments claimed one of the reasons they were supporting the British coalmining industry was to enhance security of supply. Whatever the real reasons – which undoubtedly included fear of the mining unions – the effect was to make energy supplies less secure. The coal industry's monopoly power, granted by government, made it more prone to strikes and threats of strikes. From the 1950s to the 1980s indigenous coalmining was the main source of energy insecurity. Neither OPEC oil producers nor other overseas energy suppliers managed comparable disruption. Since support for British coalmining was sharply reduced and coal imports have surged, there has been no sign of the previously-predicted insecurity from overseas suppliers of oil or coal. Similarly, since privatisation of gas and electricity, security has been maintained.

As far as nuclear power is concerned, if private generators wish to invest in nuclear power to diversify their sources of generation fuel in an effort to enhance security, there is every reason to let them do so. Whether they would take such action is uncertain. One of the peculiar characteristics of nuclear power is that, because of public fears, a serious nuclear accident anywhere is likely to halt nuclear programmes (and perhaps shut existing reactors) everywhere: certainly the accidents at Three Mile Island in the United States in 1979, and at Chernobyl in what is now the Ukraine in 1986, provoked a strong reaction against nuclear power. A standardised design of nuclear power plants would make such reactions all the more likely. Letting private investors, who are risking their own money and who are making incremental decisions about individual power stations, evaluate such risks is one thing. A government-promoted nuclear programme, using customers' or taxpayers' money in an ostensible attempt to improve security, is a much less attractive prospect.

### *Environmental issues*

What of the environmental effects of nuclear power, given that the relatively low carbon emissions associated with building and operating nuclear plant appear to have been one of the reasons for the government's decision to reconsider nuclear power?

As is the case with many environmental issues, there is considerable uncertainty over the environmental impact of nuclear power stations, despite their relatively low carbon emissions. There are unresolved questions about how best to dispose of radioactive waste products from nuclear power stations, some of which products have such long lives that they would require monitoring for hundreds of years<sup>xx</sup>. As explained above, a new generation of nuclear power stations would most likely have more compact reactors, producing much less waste per unit of output than existing reactors. Nevertheless, disposal is still a serious problem.

Accidents and terrorist incidents are the other major issues. Nuclear power installations are potential targets for terrorists. As regards major accidents, calculating their probability is virtually impossible, given that, fortunately, they have so far been few. But one needs to weigh in the balance, when considering the environmental effects of nuclear stations, how likely is another accident like Three Mile Island or Chernobyl, considering that the latter led to loss of life, damage to health, the sterilisation of a large area of countryside for many years and emissions of radioactive products to countries outside the former Soviet Union. Presumably one of the reasons that private companies seem rather wary of investment in nuclear power is that they find it difficult to quantify the possible effects on their business of accidents and they are uncertain of the future waste disposal requirements (far ahead though they may be) they will have to meet.

#### *Government promotion of nuclear power*

Given all the uncertainties explained above, the case for government promotion of nuclear power seems weak. The argument for intervention on security grounds is unconvincing and, to make the environmental case, one has to ascribe overwhelming importance to the need to minimise carbon dioxide emissions, glossing over the other environmental issues associated with nuclear power generation<sup>xxi</sup>.

But there is a broader and very significant issue associated with a new government-promoted nuclear power programme. As explained above, the government has already embarked on a policy of 'picking winners' in the energy market: renewables are being subsidised by government, as are CHP producers, and energy 'efficiency' schemes. Both on the supply and the demand sides there is now extensive interference with energy market decisions to the extent that the energy market liberalisation so painfully established over many years is under threat. If nuclear power is also promoted by government, a large part of the energy market will be subject to government 'fix'. Suppliers of gas and coal will be left out in the cold but, on grounds of consistency, they may well want to put their own case for some kind of favoured treatment. The danger is that, under an enhanced 'picking winners' regime, the government would have so much control that it would be primarily responsible for both security of energy supply and

environmental improvements, thereby displacing and perhaps undermining private provision<sup>xxii</sup>.

Thus, a government nuclear power programme cannot be seen in isolation. It would have its own external effects, resurrecting many of the problems that plagued the British energy market in earlier postwar years. A return to a protectionist energy policy would restrict competition in product markets, adversely affect efficiency, raise prices, probably reduce security of supply and disadvantage all energy consumers. As far as the nuclear industry itself is concerned, there would presumably be some centrally-directed nuclear plans that would revive the old problems of information monopoly and lack of competition in ideas. The chances are strong of reversion to an environment in which cost-effective investment in electricity generation (and elsewhere in energy markets) is unlikely despite the presence of private shareholders.

### **How to proceed?**

The belief that 'picking winners', in energy markets or elsewhere, can be successful is one example of the fallacy of central planning. Politicians and civil servants lack both the information and the incentives to make such a policy effective<sup>xxiii</sup>. A completely different approach to the issue of whether or not Britain should have a new nuclear programme – and indeed to other energy market investment decisions – is required in which these decisions are left to energy producers, suppliers and consumers.

But what of the fears about environmental effects of energy use, particularly the danger of damaging human-induced climate change from carbon dioxide emissions, that now so dominate discussion of energy issues? There are reasons to be sceptical about the predictions of dire effects from future climate change if carbon dioxide emissions are not restricted. There is great uncertainty about whether significant warming will occur, if it does what the effects will be and, if adverse effects are likely, what would be the consequences of different policies (including doing nothing and letting people adapt). But there is an underlying problem in energy markets that results from the absence of property rights in the earth's environment. Markets require appropriate institutions, including clear and secure property rights, if they are to function properly so the absence of these particular property rights is a significant feature of energy markets.

A case can be made for putting in place some general economic instrument that substitutes for these property rights by placing a value on carbon emissions, such as the carbon trading scheme recently instituted by the EU<sup>xxiv</sup>. Such schemes can cause market uncertainty if they do not have a clearly-specified long-term framework. Nevertheless, carbon trading schemes, especially if extended to include transport, can be an improvement on premature and expensive 'big bang' measures such as government-supported energy

investment programmes. Instead, they permit adaptation as time passes and provide an insurance policy **in case** global warming turns out to be a genuine threat.

The value placed on emissions in a carbon trading scheme would vary over time and would be an indicator of how seriously the global climate change 'problem' appears at any point in time. Because the value of carbon would be incorporated in prices, there would be a basis for investors in energy markets – including power generators contemplating building nuclear power stations – to determine whether or not to go ahead, based on their expectations of prices and other variables, without any need for direct government action to combat possible climate change. Existing support schemes for renewables and other forms of energy would be unnecessary. Nor would government subsidy for a new nuclear programme be justified. Any required support for renewables, nuclear or other energy sources would be provided implicitly by the carbon trading scheme. There would be no need to pick winners, and no adverse effect on security of supply which more direct government involvement might bring about.

Some awkward decisions about future nuclear power station construction would still have to be made and could usefully be addressed by the government's new review. The British planning system often places obstacles in the way of large construction projects, particularly when citizens are not keen on a particular facility (such as a nuclear power station) being in their vicinity. A practical issue is how, if the government wishes to retain the present planning regime, with its many problems<sup>xxv</sup>, a nuclear building programme could take place without such massive delays that costs would be greatly inflated. Furthermore, the issue of long term nuclear waste storage needs to be settled if there is to be any prospect of new construction.

On more fundamental issues, even if nuclear power appeared an attractive investment with a carbon trading scheme in place, neither private investors nor governments might feel comfortable with more nuclear stations because of the possible 'environmental' effects specific to nuclear power – consequences of possible accidents, terrorist incidents and waste disposal issues. Nevertheless, addressing the climate change issue via a carbon trading scheme would be a big step forward because it would mean the issue would be treated in a way that complements present liberalised energy markets rather than compromises them. Expensive and inefficient centrally-planned investment programmes in non-fossil energy sources and a return to politicised energy markets would be avoided.

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<sup>i</sup> Colin Robinson, *The Power of the State: economic questions over nuclear generation*, Adam Smith Institute, 1991, Chapter 2.

<sup>ii</sup> BP Statistical Review of World Energy, June 2005.

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- <sup>iii</sup> 'Never mind the fallout from Chernobyl, the Finns believe in the atom', *The Times*, 21 November 2005.
- <sup>iv</sup> Department of Trade and Industry, *Energy White Paper: Our energy future – creating a low carbon economy*, Cm 5761, February 2003
- <sup>v</sup> See, for example, 'Anti-nuclear lobby "holding back fight on climate change"', *The Times*, 30 November 2005.
- <sup>vi</sup> The government's target of reducing carbon dioxide emissions by 20 per cent, compared with 1990, by 2010 compares with its Kyoto commitment of a 12.5 per cent reduction by 2008-12. *Energy White Paper*, op cit, para 2.14. The government has a longer term goal of 'putting ourselves on a path' to cut carbon dioxide emissions by about 60 per cent by 2050: *Energy White Paper* para 1.18.
- <sup>vii</sup> 'Carbon emissions and energy consumption in the UK', Department of Trade and Industry, *Energy Trends*, March 2005.
- <sup>viii</sup> Nuclear power generation is not free of carbon emissions, when examined over its whole life cycle, because there are substantial emissions involved in extracting and processing uranium fuel, in building power generation plants and in dealing with waste products. However, most studies suggest life cycle emissions from nuclear power are likely to be considerably lower than from fossil fuel generation unless large amounts of energy have to be used in extracting very low-grade uranium.
- <sup>ix</sup> Diversified sources of supply are the main element in security provision. See Eileen Marshall and Colin Robinson, *The Economics of Energy Self-Sufficiency*, Heinemann Educational Books, 1984
- <sup>x</sup> One problem is that gas prices in continental Europe are generally linked to oil prices through escalation clauses in contracts and do not necessarily reflect supply and demand conditions in gas markets.
- <sup>xi</sup> For a fuller account of the history see Robinson, *The Power of the State*, op cit
- <sup>xii</sup> Calder Hall, operated by the Atomic Energy Authority (AEA) not the nationalized generator, the Central Electricity Generating Board (CEGB), preceded the first programme, as did another AEA station of similar size at Chapelcross. Each consisted of four reactors, with a total net output capacity of 200 MW at each station.
- <sup>xiii</sup> Robinson, op cit, especially Chapters 1 and 6
- <sup>xiv</sup> Robinson, op cit, especially Chapter 1
- <sup>xv</sup> The problems of centralisation and information monopoly were stressed in an early IEA paper by Duncan Burn, *The Political Economy of Nuclear Energy*, Research Monograph 9, IEA, 1967
- <sup>xvi</sup> For critiques of this policy see Colin Robinson, 'Gas, Electricity and the Energy Review' in Robinson (ed), *Successes and Failures in Regulating and Deregulating Utilities*, Edward Elgar, 2004; Eileen Marshall, 'Energy regulation and competition after the White Paper' in Robinson (ed.) *Governments, Competition and Utility Regulation*, Edward Elgar, 2005 and David Simpson, 'The Economics and Politics of Wind Power', in Robinson (ed.) *Regulating Utilities and Promoting Competition*, Edward Elgar (forthcoming) 2006.
- <sup>xvii</sup> Marshall op cit and Simpson op cit
- <sup>xviii</sup> *The Times*, op cit
- <sup>xix</sup> Colin Robinson and Eileen Marshall, 'The Regulation of Energy: Issues and Pitfalls', in D.Parker and M.Crew (eds.) *International Handbook on Economic Regulation*, Edward Elgar (forthcoming) 2006.
- <sup>xx</sup> Robinson, *The Power of the State*, op cit, Appendix 1
- <sup>xxi</sup> For a discussion of the case against drastic action to curb carbon emissions, see Robert J.Bradley Jr. *Climate Alarmism Reconsidered*, Hobart Paper 146, Institute of Economic Affairs, 2003. A good discussion of the cases for and against action to combat climate change is in House of Lords Select Committee on Economic Affairs, *The Economics of Climate Change*, two volumes, HL Paper 12-I, Session 2005-06.
- <sup>xxii</sup> Marshall, op cit
- <sup>xxiii</sup> Robinson and Marshall, op cit

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<sup>xxiv</sup> On the EU scheme see Charles Nicholson, 'Emissions trading: a market instrument for our times', in Colin Robinson (ed.) *Governments, Competition and Utility Regulation*, op cit. On the property rights issue as applied to climate change see Robinson and Marshall, op cit.

<sup>xxv</sup> Mark Pennington, *Liberating the Land: the case for private land-use planning*, Hobart Paper 143, IEA, 2002.

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