Research Papers of the Parliamentary Library Service, no.5/2006
Northern Territory Library

Nuclear power & the greenhouse effect

Fourth in the series on the *Debate on Nuclear Policy in Australia, 2005-2006*

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Published by the Parliamentary Library Service, Northern Territory Library 2006

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ISSN 1833-8771

National Library of Australia Cataloguing-in-Publication entry:

Lloyd, Brian.

Nuclear power & the greenhouse effect: fourth in the series on the debate on nuclear policy in Australia, 2005-2006.

Bibliography.
ISBN 9780977563449.

ISBN 0 9775634 4 8.

1. Nuclear energy - Environmental aspects - Australia. 2. Nuclear energy - Government policy - Australia. 3. Greenhouse effect, Atmospheric - Australia. I. Title. II. (Series : Research papers of the Parliamentary Library Service ; 5/2006).

333.79240994

Abstract

This paper examines current arguments on whether nuclear power can be a way to reduce reliance on coal-fired electricity production, and so reduce greenhouse-gas emissions. This is a pressing question: the world is in the throes of acknowledging that climate change is a reality, and it is clear that it is even now experiencing the consequences of global warming. At the same time, Australia must come to terms with the implications of climate change for its own situation, both for its climate and in its role as a major exporter and user of coal. Through this it has achieved the dubious distinction of being the world's highest *per capita* emitter of greenhouse gases. For Australia and the world, the choice of replacement power-generating technologies will have a profound impact into the future.

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Introduction

This is the fourth in a series of papers describing the current nuclear policy debate in Australia. This paper looks at whether nuclear power can be an effective means to reduce reliance on coal-fired electricity production, and thus reduce greenhouse-gas emissions — most of all carbon dioxide (CO_2). As noted in the series introduction, this is a most pressing question. The world is in the throes of recognising that climate change is a reality, and is considering its consequences (Stern, 2006). At the same time, Australia is attempting to come to terms with the implications of climate change for its own situation. Present concerns over water are a case in point. But Australia must also consider its position as a major exporter and user of coal, through which it has achieved the dubious distinction of being the highest *per capita* emitter of greenhouse gases in the world (Lloyd, 2006, p.10 *ff*).

How much we see nuclear power as a solution to this problem is important. Much depends on the choice of power generating technologies, made by countries across the world, in place of the heavily greenhouse-gas emitting technologies — primarily coal — that currently form the backbone of power generation. These decisions will have significant effects — intended or otherwise — for years to come. They will also have a direct impact on demand for, and therefore the price of, uranium. Prices will, in turn, have consequences for trade-offs to be considered in any expansion of the use of nuclear power, including the need to balance environmental costs, such as the production of radioactive tailings from uranium mining and refining, against the environmental and economic benefits of reduced greenhouse gas emissions and increased mining revenue. Nor is this by any means a 'zero-sum game': it may be that other forms of energy production may be candidates, in good standing, to fill the void left by the demise of coal.

As for other papers in the series, these arguments are drawn from selected submissions to an inquiry of the House of Representatives Standing Committee on Industry and Resources (HRSCIR), the *Inquiry into the Strategic Importance of Australia's Uranium Resources*. Arguing in favour of a constructive role for nuclear power in reducing greenhouse emissions, under the heading 'For', are submissions by the Uranium Information Centre (UIC), the Australian Nuclear Scientific and Technology Organisation (ANSTO), and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Under the heading 'Against', arguing against the proposition, are submissions by the Medical Association for the Prevention of War (MAPW), Friends of the Earth (FoE), and anti-nuclear activist Richard Broinowski. These are followed by a section entitled 'Correspondences', which draws links between the arguments that have so far been considered and those aired in the news media, and then by a Discussion and Conclusion, which consider the merits of arguments and draw deductions about the present state of debate on this matter.

'For'

Proponents of an increased Australian nuclear engagement, such as the UIC, say that the wider use of uranium-fuelled nuclear power can significantly reduce greenhouse gas emissions. They borrow the language of their traditional opponents to describe nuclear power as an 'alternative and greenhouse-gas-friendly source of energy generation' (Uranium Information Centre, 2005, p.6). It has been widely recognised that nuclear power, hitherto, has been more costly than conventional power-generating technologies. Proponents argue that changed conditions in connection with the Kyoto agreement will modify nuclear power's cost relative to other technologies, making it cost-competitive:

> In the context of the Kyoto Protocol, a carbon cost of at least one US cent per kWh needs to be factored for coal generation, and at least half that for gas ... This would effectively increase costs by 20 to 30%. By comparison nuclear energy has zero cost for carbon emission. Nuclear power plants are the single most significant means of limiting increased greenhouse gas concentrations while enabling access to predictable and economic electricity (Uranium Information Centre, 2005, p.14).

Nuclear proponents argue that under this new dispensation, carbon-generating technologies — primarily coal-fired electricity generation — will be played-down in plans for future electricity generation: they will certainly cease to occupy their current, pivotal role. Having achieved, in prospect, this 'removal' of coal from the equation, proponents then down-play the usefulness of other alternatives, apparently wishing to leave nuclear power as the 'last man standing'. The view is, first, that nuclear energy production is 'already competitive with other forms of energy … even without a cost for carbon' (Uranium Information Centre, 2005, p.14). Second, it is said to be cheaper than wind power, more reliable and predictable, and does not require back-up capacity (Uranium Information Centre, 2005, p.14). Nuclear proponents appear to pay special attention to wind power as a competing alternative to coal, signalling perhaps that this is considered one of the more credible alternatives to nuclear power.

To nuclear proponents, the case for a greater role for nuclear power becomes more urgent as demand for energy increases across the world. It is said, for example, that 'electricity consumption is forecast to grow from a current annual 15,000 billion kWh to almost 24,000 billion kWh by 2025' (Uranium Information Centre, 2005, p.3). To the UIC, the prospect of energy scarcity is made more dramatic by an already existing 'energy crisis', in which 'at least one third of the world's population has no access to reliable and affordable energy': the challenge is to 'meet this demand without exacerbating global warming' (Uranium Information Centre, 2005, p.6). A worldwide expansion in nuclear power generation is, then, the only viable way to meet this dual imperative of rising consumption and broadening access. Central to this is the view that nuclear power is 'environmentally benign', that 'all its wastes [are] contained and managed' and that it 'accounts for virtually no greenhouse gas emissions' (Uranium Information Centre, 2005, p.6). The UIC maintains that greenhouse gas emissions are lower for nuclear electricity generation than they are even for wind or biomass-generated electricity — and considerably less than for solar and hydroelectric generation (Uranium Information Centre, 2005, p.6). Hence,

nuclear power plants are the future single ‘most significant means of limiting increased greenhouse gas emissions while enabling access to economic electricity and providing for energy security’ (Uranium Information Centre, 2005, p.4). Confirming this, they suggest that even the present use of nuclear reactors to generate electricity avoids ‘2.5 billion tonnes of carbon dioxide emissions on an annual basis’ or, expressed differently, ‘every 22 tones of uranium used … saves one million tones of carbon dioxide emissions relative to coal’ (Uranium Information Centre, 2005, p.4). ANSTO, in its submission to the HRSCIR, echoes this by quoting International Atomic Energy Agency (IAEA) estimations that 'each nuclear power plant saves the emission of around 10 million tonnes of CO_2 annually’, and making a direct connection between Australian uranium exports and reductions in ‘global greenhouse gas emissions at the present time’ (ANSTO, 2005, pp.1, 2).

In summary, the view from nuclear proponents is that current pressures — particularly those arising from the combined influence of concerns over CO_2 emissions, rising global energy demand, and issues over the equitable distribution of access to energy — all lead to the inescapable conclusion that nuclear power is the solution to present and future energy problems. As home to the world's largest uranium reserves, Australia has a special part to play in supplying the world with this ‘alternative’ fuel and, as a result, uranium in turn has a special part to play in Australia's economy.

They also argue that as a supplier of uranium Australia can offset the negative economic impact of reduced demand for its coal — currently Australia’s biggest export — by increasing the volume of its exports. In so doing, Australia would not only make a contribution to reducing greenhouse gas emissions world-wide, but would contribute to its own economic well-being. Then, uranium would be an ‘important “hedge” for the balance of payments’ that would ‘offset the negative impact on Australia's coal exports of any international move to reduce global carbon emissions’ (Uranium Information Centre, 2005, p.12). The ultimate effect is that ‘any fall in coal-fired power generation’ will stimulate demand ‘for alternative fuel sources such as uranium’, thus creating a desirable overlap between self-interest and altruism for Australia as a uranium exporter (Uranium Information Centre, 2005, p.12).

'Against'

Nuclear opponents reject this proposition that the world’s predicament over climate change necessarily leads to policies in favour of greater use of nuclear power. They rebut proponents’ arguments on all points: on the relative affordability of nuclear power; on the supposed absence of greenhouse emissions; and on nuclear power as an environmentally ‘benign’ agent. In addition to meeting proponents on these arguments, however, speakers on this side of the debate also introduce new topic areas not raised by the affirmative case. These particularly focus on the economic constraints on nuclear power; questions over the practicability of increasing nuclear power generation to the levels suggested; and raising questions over how much energy will be used: in contrast to apparently simpler questions, from the other side, of

how to meet an apparently given, projected demand. These represent a significant extension in the scope of the debate, and raise important questions that will, ultimately, need to be addressed by speakers on both sides of the debate.

It is clear, then, that basic elements of the greenhouse / nuclear power debate, offered thus far, are contentious. In answer to claims over greenhouse-gas emissions, nuclear opponents suggest that nuclear power generation is, in fact, a greater generator of greenhouse gases than the alternative energy sources to which it has been compared. When the whole nuclear fuel cycle — involving mining, milling, plant construction, and waste handling and storage — is taken into account, for example, nuclear opponents suggest that nuclear power generation creates greenhouse gases at rates of 'between 1.5 and 3 times as much carbon dioxide per kilowatt-hour' than wind power (MAPW, 2005, p.10).

A more subtle argument is that in those countries that have placed a heavy reliance on nuclear power generation, there have been greater outputs of CO_2 from other parts of the energy economy. In France, for example, 'nuclear strategies have actually led to or are at least accompanied by high consumption patterns that lead to high CO_2 emissions' (Schneider, 2001, p.[9]).[1] This pattern is underscored by the inability, historically, of nuclear-reliant economies to replace energy inputs from fossil fuels, to any significant degree, with those from nuclear power. In France, in fact, 'oil consumption in the transport sector … increased far more than the annual consumption substituted [for fossil fuels] by nuclear energy in the electricity sector' (Schneider and Froggatt, 2004, p.17). In general, 'regions and countries which are high nuclear electricity producers are … also high CO_2 emitters', due to what critics describe as nuclear power's distorting effects on domestic energy economies, coupled with an inherent lack of flexibility (Schneider, 2001, p.[9]). Specifically, this has in France resulted in an oversupply of electricity, with flow-on effects in terms of 'dumping' of production in other countries, and a set of attitudes amongst consumers — and producers — that runs counter to concepts of energy conservation and demand reduction (Schneider, 2001, p.[9]).

The distinction between electricity supply and other parts of the domestic energy equation is another important element in the argument against nuclear power as a solution to climate change. The argument is that nuclear power, as a specifically electricity-generating technology, can only cater to one component of overall energy demand, and can only therefore replace *part* of current greenhouse-gas emitting technologies. Elsewhere, Richard Broinowski, author of another submission to HRSCIR, argues that 'only one third of greenhouse gases are caused by the production of electricity, and only 15 to 20 per cent of that is from nuclear power' (Broinowski, 2005). The logical consequence, it is argued, is that it would therefore require 'a huge number of reactors to make any difference on the energy mix' (Broinowski, 2005). Similarly, MAPWR proposes that in, view of the mix of energy sources and applications in modern economies, targets set for a reduction in global CO_2 could not be met by emission

reductions on electricity alone, and that 'even massive expansion of nuclear power could not by itself be sufficient' to produce the desired effect (MAPW, 2005, p.9).

Nuclear opponents also challenge claims made on cost — an important determinant of uptake in power-generating technologies — suggesting that nuclear power is 'one of the most expensive means of generating electricity', 2-3 times more costly than wind, hydro or natural gas (MAPW, 2005, p.9). Doubts over nuclear power's economic attractiveness are underscored by it being 'one of the most protected and heavily-subsidised industries in the world' (MAPW, 2005, p.10). Indeed, nuclear doubters say it is due to this feature of nuclear power — to the high cost of 'the nuclear kWh' — that nuclear utilities in Europe have not been able to achieve economic sustainability but, rather, 'have moved between scandal and … bankruptcy' (Schneider and Froggatt, 2004, p.20). As a consequence, it is said, the UK Government has, in the past, been obliged to contribute a '€ 6 billion restructuring package to stop the privately owned nuclear generator British Energy, from going into liquidation' (Schneider and Froggatt, 2004, p.20).

On both scores — cost and CO_2 reduction — nuclear opponents bring a distinctive emphasis to the discussion on greenhouse gas reductions through their focus on energy consumption as a *variable* rather than a given. This counters the pro-nuclear picture of a broad up-swing in demand for energy leading, inevitably, to world-wide up-take of nuclear energy. They argue that close analysis of the economics of energy shows that nuclear power suffers a competitive disadvantage in relation to other measures, since:

> new reactors are economically simply not competitive with other greenhouse gas abatement strategies and notably advanced energy efficiency strategies (Schneider, 2001, p.[8])

Out of various projected scenarios, it is argued, 'the lowest CO_2 emissions are in the low consumption scenario ... in other words, it is much more efficient to bring consumption down than to bring nuclear power up' (Schneider, 2001, p.[8]). Indeed, 'every dollar invested in energy efficiency displaces 7 times as much emitted CO_2 as a dollar invested in nuclear power', but with the difference that there is 'essentially no downside' in environmental terms from the pursuit of a goal of lower energy consumption (MAPW, 2005, p.11).

This emphasis on reducing consumption has some significant consequences for the debate. First, it puts in a different light claims by nuclear proponents that renewable energy technologies are insufficiently mature to meet projected demand. Rather, renewable energy sources are 'a feasible and practical alternative ... if coupled in a coherent and coordinated strategy with demand reduction and increased energy efficiency' (MAPW, 2005, pp.10-11). Indeed, 'efficiency potentials are enormous' in most countries (Schneider, 2001, p.[12]). Nuclear opponents point to rapid take-up and development of renewable energy technologies where they have been fostered by government policy. In Germany, for example, different price structures apply for electricity generated by renewable sources in order to encourage its production (Schneider,

[1] Page references for unpaginated sources appear in square brackets.

2001, p.[11]). EU targets that specify that renewables provide 12% of domestic energy needs by 2010 are cited as a significant development in this regard (Schneider, 2001, p.[11]).

In short, nuclear opponents make quite a different style of argument than one may have anticipated. We may have expected that nuclear proponents would be the ones to seek higher ground on energy economics, but in this case the opposite appears to be true. That said, voices on this side of the debate also invoke more 'traditional' arguments against nuclear expansion, arguing that an attempt to use nuclear power to meet the 'unmodified energy demand' assumed by their counterparts would create significant difficulties in terms of community acceptance, and environmental and security risks (MAPW, 2005, p.11). If they are found persuasive, these arguments make it possible to see comparisons between nuclear and its alternatives in quite a new way, for they disturb previously held assumptions about differences in generating capacity, and place, instead, a greater emphasis on modifying patterns and profiles of electricity demand in the light of pressing imperatives.

Correspondences

News sources agree that a shift in attitudes towards global warming — notably the willingness of political conservatives to take it seriously — has been crucial in sparking the present debate on nuclear policy (Davidson, 2006; Shanahan, 2005b). The reaction has been mixed. Many sources, especially those of a partisan pro-nuclear persuasion, 'take it as read' that nuclear power is a way to resolve Australia's current problems with greenhouse gas emissions ("ACCI urges nuclear power rethink", 2005; Kemeny, 2005). Indeed, this has been a line consistently advanced by members of the federal government (Murphy, 2005; Shanahan, 2005a; Wilson, 2005).

However, there are also a number of accounts that are skeptical about the government's apparently 'sudden' interest in climate change, and its use of it as a rationale for an expanded nuclear involvement for Australia. In some eyes government had hitherto shown 'scant interest' in climate change (Garrett, 2005). Other sources observe that the present situation reflects

> a reversed world where John Howard concedes global warming is not a myth and environmentalists and Labor politicians want a debate on nuclear energy. (Shanahan, 2005b)

In the face of evident critical comment, however, the Prime Minister has held to his refusal to ratify the Kyoto protocol: to do so would be in his view 'selling out the interests of Australian industry and jobs' (Peters, 2005). As already discussed in the introduction to this series, this puts the government in a dilemma: inaction on climate change is unlikely to be sustainable, but the costs of signing Kyoto may, by virtue of its economic consequences in the short-term, threaten the government's present run of electoral popularity (Lloyd, 2006, p.10 *ff*).

In formulating a response to this dilemma it seems that Prime Minister Howard may, as on a number of other elements in the debate, be looking to his counterparts in the US and, in

particular, to the UK. Amongst these three key members of the 'coalition of the willing', Tony Blair has taken key steps on climate change. First, Blair has taken the lead, of the three, in acknowledging the reality of climate change — reportedly after being privy to the latest scientific information about the progress and effects of climate change in the environs of the UK (Gottliebsen, 2005). Second, Blair has come out, most strongly of the three, in favour of new nuclear power plants as a way to reduce emissions (Webster, 2005). It appears that, as is John Howard, Tony Blair is looking to nuclear power as a means to avoid cutting the Gordian knot: to reduce emissions without paying the price of a 'fall in living standards': an outcome few democratically-elected governments would willingly countenance (Gottliebsen, 2005).

News sources also point out, however, that local conditions in Australia provide some further challenges for a government wishing to take this line. There is no exact counterpart in Britain of the division between states, territories and the federal government, and certainly no match for the particular situation obtaining in Australia, in which key states have substantial interests in coal, which may put them in direct conflict with proposals which seek alternatives (Milne, 2005). Of course, that the federal government is a Liberal one, while those of the states and territories are Labour, may be an added complication. There are reports of other countervailing tendencies which express opposition to nuclear power due to the perception that it cannot be cost-competitive with coal, but these points of view, too, seem in some senses being overtaken by events, whether they are voiced from dissenters within the federal government (Price, 2005), or by the governments of the states (Doherty and Murphy, 2006). It seems that positions on both sides of politics must accept that there are slender prospects of being able to continue with 'business as usual'.

Discussion

As for other areas of the nuclear debate, debate over nuclear power as a solution to greenhouse gas emissions is marked by a pattern of claim and counter-claim. On one hand, nuclear proponents propose nuclear power as a simple, logical choice that will allow energy production to meet expected increases and demand while avoiding the catastrophic potential of the present reliance on coal. In their view, we have the ability to manage the waste products generated by the nuclear fuel cycle in ways unmatched for fossil fuels. Opponents, for their part, argue that nuclear power generation is too expensive, too inflexible, and involves too many other dangers, to be considered as a true contender for replacement of the greenhouse-intensive technologies used today.

There are a number of areas where further information is needed to clarify these matters: in particular, as to the interaction between cost and greenhouse emissions, showing methods of calculation, and things either counted in or counted out. Certainly, nuclear proponents could say more about obvious difficulties with bringing nuclear power plants into production: a problem area left virtually untouched by nuclear proponents, even by those speaking from within the nuclear industry itself.

On the other hand, it appears that nuclear opponents could consider, more realistically, scenarios for the transition from fossil fuels to a future reliance on renewable energy technologies. Could these replacement technologies meet demand in a sufficient time-frame to prevent a dramatic short-fall in production, and could they, therefore help us avoid the economic sacrifices that would entail? For the reality is that cheap energy has been the predicate for economic growth for quite some time now (See, for example, Barnaby, 1974, p.2). Without that, we would see significant, rapid diminutions in prosperity.

What, then, of nuclear proponents' gestures toward equitable access to energy? Are renewable approaches able to provide sufficiently inexpensive energy to countries where demand is not met? Or is it the case, as the industry would have it (ANSTO, 2005, p.[3]), that nuclear power generation is best placed to satisfy demand and therefore underwrite broader development, both in an economic and technical sense? Here proponents' arguments appear a little stretched. Nuclear facilities require an advanced technological infrastructure that — by definition — under-developed countries do not have. Investment in obtaining them for the sake of a nuclear power generating capacity has the potential to divert money that could go to other fundamental needs. Indeed, this is exactly the scenario what we've seen in some countries, although often for the covert purpose of acquiring nuclear weapons.

By contrast, nuclear opponents propose renewable power sources as inherently 'decentralised, diversified,' and 'small scale', with 'low capital cost, short lead times, high flexibility, low grid costs and phenomenal social acceptance' (Schneider, 2001, p.[10]). These are possibly the attributes of more appropriate technologies for energy-poor — and thus under-developed — economies. This is just one example of the way the differences presented here — in this case between monolithic, capital-intensive nuclear installations and relatively decentralized energy production based on renewables — reinforce a sense of a battle between paradigms: the wider models into which these proposed solutions, from either side, fit and make sense.

It can be argued that the views of nuclear proponents seek to continue with — even to rescue — contemporary orthodoxies on energy production and consumption, orthodoxies which extend into and are consistent with wider thoughts about how economies work. The nuclear industry envisage — in effect — a situation in which energy consumption is continually ramped up, underscoring the pattern of economic development, based on cheap energy, witnessed in the twentieth century — particularly in its second half. By contrast, nuclear opponents take quite a different approach, treating *levels* of energy consumption as problematic rather than a given. This difference represents one of the great underlying divides in the debate over nuclear policy. It is here that we see, in high relief, sentiments divide up along political lines, because these different ways of seeing in the energy landscape are linked, intimately, to political sentiments about whether corporate or distributed, de-centralised systems are better and, consequently, sentiments about the economic systems they presuppose and support.

Conclusion

In considering the debate over the role of nuclear power in the world's greenhouse predicament, we can propose a range of future scenarios. In one, we adopt nuclear power generation to the greatest possible extent. In a second, we continue our use of nuclear power over an interim period until we get the settings right for a broader use of renewable energy, thus cushioning economies from the effects of a more rapid transition. In a third, we transition from nuclear and fossil fuel generation at the same time, in a wholesale move to renewable technologies. From the arguments covered in this paper, it would seem that the first scenario brings with it the prospect of the financial, environmental and political problems, particularly those arising from the persistent fact of radioactive waste. The third scenario appears to hold out the prospect of a bumpy ride ahead in an economic sense, and of a battle against parties with vested interests in both nuclear and fossil fuel industries. Consequently, it is the second scenario that appears most credible, entailing a less radical program of change and, as a result, some further insurance against economic decline. Within the scenario, however, there is clearly room for discretion as to the exact settings within a blend of energy generating technologies. Central to this will be decisions about how quickly other energy-producing technologies can be brought into full production, and the levels of investment that will be devoted to them.

For present arguments, then, the burden falls on both sides to put their best foot forward, and to nominate an appropriate role for each energy technology within what is likely to be a mixed regime. Speaking pragmatically, the scenario currently being proposed by some nuclear proponents — where nuclear power directly replaces our current reliance on coal — is likely to be frustrated by real-world complexity. It is likely that more fundamental changes than this — to our energy economy — are inevitable, and that no one energy-producing technology will ever occupy the dominant position enjoyed by coal until now, when our heavy reliance on it has become impossible.

All of this affects Australia in no small way, both as a supplier and as a consumer of energy. If Australia were to embark on a policy direction that could not, ultimately, be sustained — whether due to environmental, political or energy constraints, or to those created by climate change itself — it would be exposing itself to considerable risk and, as a result, there is a pressing need to weigh all scenarios with serious and sober attention.

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