The Economics of Nuclear Power

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DIFFERENT ELECTRICITY POWER SOURCES

Can nuclear power make a comeback after 20 years, during which time hardly a single new plant has been commissioned among the developed world's countries?

In the absence of any government action, the answer depends on the costs of nuclear compared with its alternatives. Because nuclear plants involve high capital costs, they must be run almost continuously to be economical. This puts them into direct competition with coal-based power plants.

Gas-based generation plants, on the other hand, are less capital intensive, but their fuel is dearer and therefore the electricity produced is generally more costly. Despite that, they do play an important role as a provider of peak supply. Gas turbines can also be engineered to respond quickly to changing market conditions, backing off when demand and prices fall and rapidly firing up to take advantage of demand and price surges.

Hydro plants also involve high capital costs, and they can only store enough water in their dams to run one quarter of the time. Again, they operate to take advantage of peak demand periods.

Other power sources: wind, solar panels, etc., are uncompetitive except in very remote locations or at very low energy share levels. Their reliance on the Sun and the wind makes them intrinsically unreliable.

The costs of different power plants are shown in Table 1. These include three different estimates for nuclear power, with costs varying from the low $50s to the upper $60s per MWh. Coal in Eastern Australia comes in at under $40 per MWh and natural gas at about $44. The costs in Table 1 exclude taxes, subsidies and other regulations designed to alter choice of power generating technologies or mitigate greenhouse gas emissions.

As it is 30–60 per cent more expensive than coal-based generation, and somewhat more costly than gas, in the absence of government intervention, nuclear power does not have a future in Australia in the medium-to-long term. Nuclear is, on the other hand, significantly more cost effective than wind and all other exotic alternatives.

Table 1: Generation costs of different power plants ($/MWh)

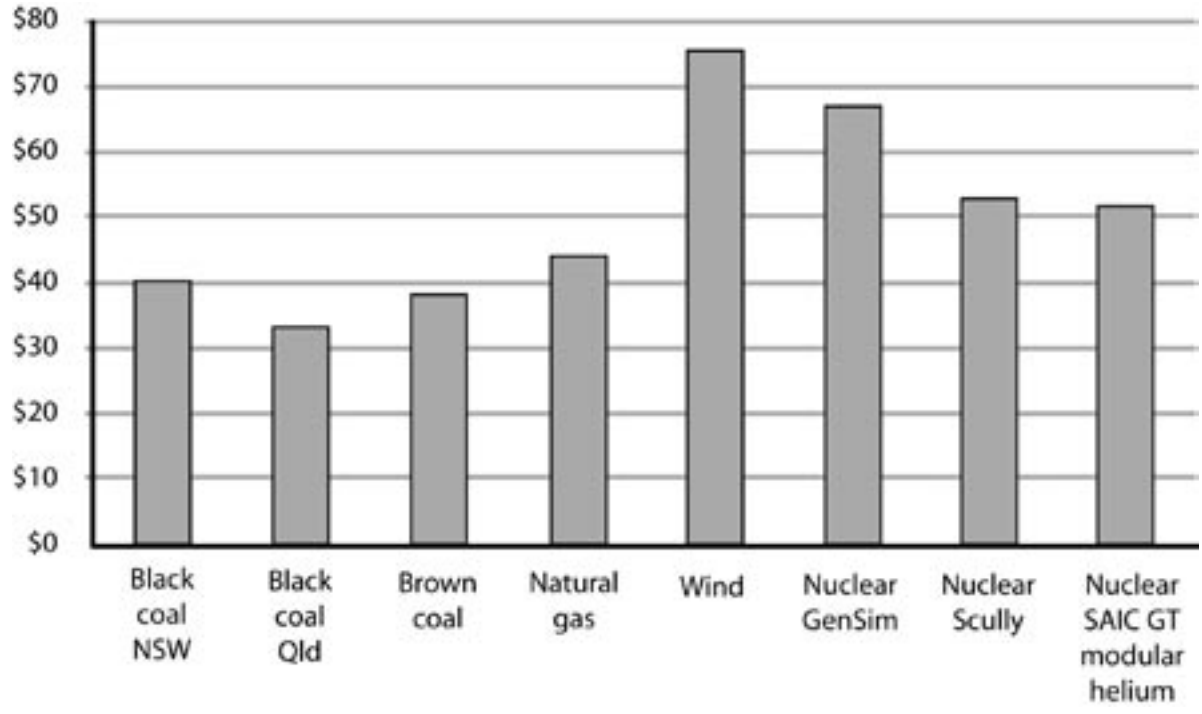
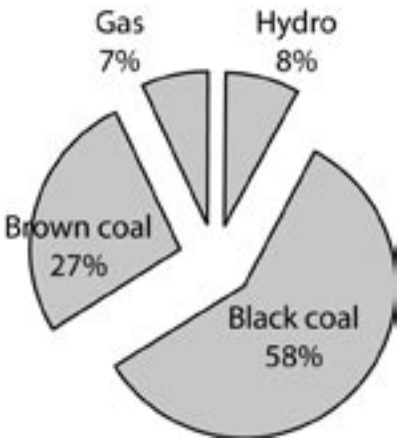


Figure 1: Australian Electricity Fuel Shares



Compared with coal, natural gas and hydro generators have greater value because they are more flexible and can start and stop much more easily. Wind is the opposite—its unreliability is a detriment per se and, in addition, it imposes costs elsewhere on the system because other plant must be made available as a back-up.

Figure 1 illustrates the share of the different fuels in Australian electricity generation. As can be seen, coal dominates. At present, the various exotic renewables have a negligible market share. Nuclear power is presently illegal in Australia.

ENERGY TAXES AND REGULATION

Of course, governments have long played an active hand in the choice of power technologies. While they have, on the one hand, increasingly left the decision of where and when to build a power station up to the private sector, they have intervened in the market in other ways. Responding, in particular, to a desire to reduce the emissions of greenhouse gases, governments have put in place an expanding raft of regulations, taxes and subsidies designed to alter the choice of power technologies in favour of those that produce lower rates of greenhouse gases.

Major Australian tax and regulatory measures are:

- the Federal Government's Mandatory Renewable Energy Target (MRET), which by 2010 requires about 4.5 per cent of power sourced from exotic renewable sources (such as wind and waste products) at a cost that is more than double the commercial cost. This will cost consumers $380 million per year.
- Queensland's 13 per cent gas target, which requires gas to supply at least 13 per cent of the State's electricity. This will increase the cost of that State's power bill by an estimated $68 million per year.
- The NSW Government's Greenhouse Gas Abatement Certificate (NGAC) scheme, which imposes taxes on the production of coal-fired power and, once fully phased-in, will have a tax effect on NSW consumers of around $222 million per year.

Total government taxes and subsidies to bring about reductions in greenhouse gases amount to some $800 million per year.

These are only the more direct and measurable policies aimed at mitigating the production of greenhouse gases. Governments already mandate minimum energy savings on appliances, and have imposed (or are considering imposing) charges on water, parking, and building design aimed at reducing greenhouse gases.

CARBON TRADING

State and Federal Governments have stated a target of reducing greenhouse gas emissions by 60 per cent within 45 years. At a bare minimum, the adjustment would require much more aggressive carbon taxes than those presently in place, or a carbon trading scheme like that currently operating in Europe. The European Union's Greenhouse Gas Emission Trading Scheme started operating in January 2005. Under the scheme, the 25 EU member nations are given carbon emissions quotas that are assigned among the EU's total of 12,000 power plants and heavy-industry factories. Each of these quotas is then reduced gradually in line with the EU's Kyoto commitment.

If carbon taxes or tradeable rights become a permanent feature of the electricity supply cost structure, the cost structures of the different fuels are going to change markedly. Those with virtually no carbon per energy output (wind, hydro, nuclear) will be favoured over those with relatively little carbon (gas) and high carbon (coal).

Table 3 builds on Table 1 by showing the additional costs involved if the different emission factors for the coal and gas plants were to be increased by the costs of carbon credits (which are presently trading at about Euro 16 per tonne of CO_2).

Table 3 demonstrates how the implementation of EU-type mitigation scheme would significantly alter the cost ranking.

If the current EU carbon price were to emerge from a carbon trading scheme in Australia, nuclear power would ostensibly be the lowest cost source of future energy in Australia. This would be the case even if the existing, more arbitrary taxes, such as energy saving regulations and the various quasi-Kyoto taxes in place at ▶

Table 2: 2010 Costs of Greenhouse Gas Support Measures

	MRET	NGAC	Qld 13% Gas	Commonwealth subsidies	State subsidies
$M	380	222	68	124 (2006/7)	32 (2004/5)

present, were abandoned. Nuclear's relative advantage would grow if the Kyoto signatories were to tighten their emission levels (as they must do if the Protocol is to have any effect in meaningfully reducing greenhouse gas emissions). Thus, if the carbon price were to double, nuclear energy costs would be only about 80 per cent of coal-derived electricity.

Nuclear power's post-carbon tax cost advantage would remain, even if the cost of spent fuel storage (currently running at $3 per MWh) were added in.

The case for nuclear power—in a carbon-constrained world—is even stronger in other countries which do not have Australia's vast endowment of low-cost, high quality coal. Clearly, concern about climate change and the need to reduce greenhouse gas production will result in a dramatic change in the power industry worldwide, and the main beneficiary would be nuclear.

Exotic renewables, such as wind, will remain a small but costly token to the deep Green ideology.

Carbon trading would require a highly complex policy structure. However it would be administrable. Its main effect would be to increase electricity and gas prices by at least 50 per cent (a carbon tax would have a very similar effect). This would be accompanied by a considerable loss of wealth through writing off the value of Victoria's brown coal and NSW and Queensland's low-grade black coal.

The outcome of such measures would be much higher energy costs. If a very steep reduction in greenhouse gas emissions is required, the alternative to a nuclear option would be either astronomically higher energy costs or a drastic curtailing of electricity use.

Secondary implications of a nuclear-powered Australia would mean a loss of our comparative advantage in raw materials processing. This would mean the migration from Australia of the aluminium, iron and steel, and chemical industries and a less serious loss of competitiveness for other industries that use these industries' outputs. Aside from the relative reduction of living standards that this would entail, it is hard to envisage the consequent industrial restructuring that would need to take place. This would inevitably involve considerable disruption as some industries declined and other, less energy-intensive, ones emerged.

Finally, all of this may have a negligible effect on global warming, even if carbon dioxide emissions are associated with greenhouse warming. Australia's loss of output would be offset by expansions in output in developing world countries that are not required to reduce carbon dioxide emissions. Indeed, given the fact that Australia's coal-based electricity is highly efficient and co-located with the power inputs, it is likely that the outcome will be even higher emissions, albeit not in Australia, of the targeted greenhouse gases.

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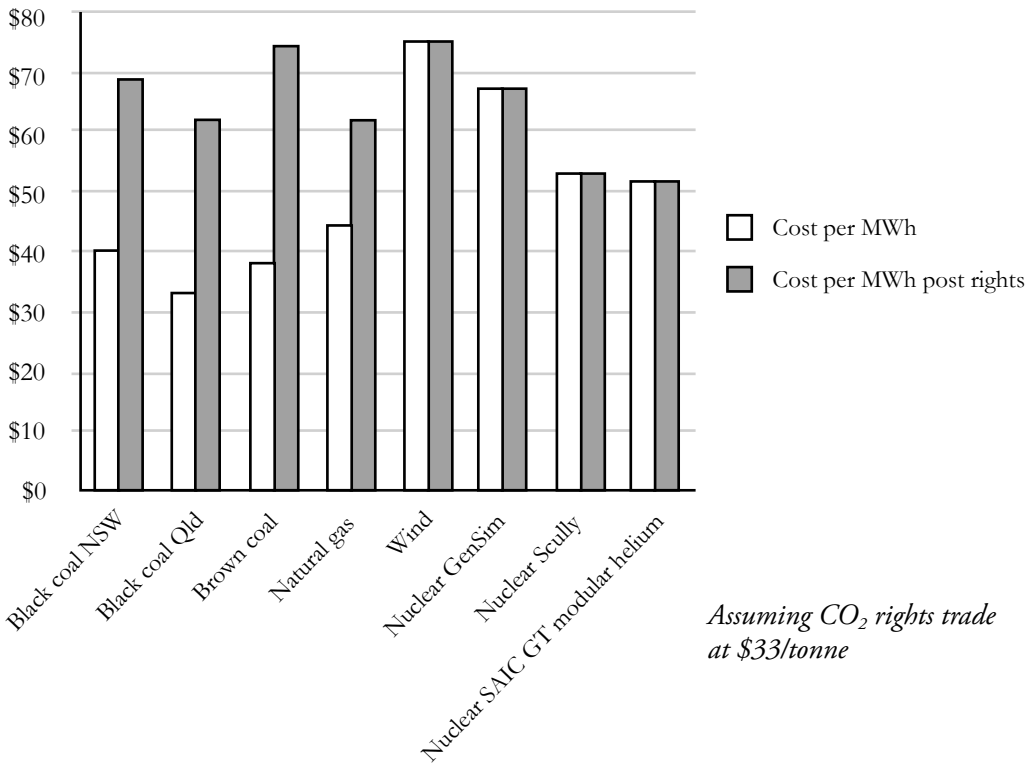
SUMMARY

If Australian Governments were to require a 60 per cent reduction in the country's greenhouse emissions, nuclear power would need to play a major role. Indeed, it is difficult to envisage how a 60 per cent reduction target can be achieved other than by all, future, large base-load power stations being nuclear.

Such a policy would need to be effected by a carbon tax or a system of vesting tradeable rights to carbon dioxide emissions. A tradeable rights regime could assign capped and possibly non-tradeable emissions to existing power plants. Auxiliary means would be needed to encourage cost-effective measures on the part of the incumbent plants to reduce carbon dioxide emissions.

Table 2: Comparative Costs of Power



Assuming CO_2 rights trade at $33/tonne