Submission to the Garnaut Climate Change Review

1. Introduction

As a world leader in low-emission technologies in the energy sector, AREVA welcomes the Garnaut Climate Change Review and its initial findings as published in the interim report in February this year.

We agree with the base assumption of the interim report that there is growing evidence that reducing greenhouse gas emissions from human-related activities can help mitigate climate change. Given the high risks associated with climate change, it makes sense that the world act rapidly to reduce anthropogenic greenhouse gas emissions.

The world population is set to increase from[1] 6.7 billion today to over 9 billion in 2050, with almost all the growth in the emerging economies. One of the great global challenges is to address the immense need for development, and development requires energy. The International Energy Agency's 2007 World Energy Outlook[2] takes as its reference scenario that the world's primary energy needs will increase by over 50% from 2005 to 2030, with a corresponding rise in energy-related emissions. Energy supply is currently the sector that contributes most to global anthropogenic greenhouse gas emissions, with over a quarter of total emissions in 2004[3]. In particular, emissions from power generation are set to increase by two thirds by 2030, making up almost half of global energy-related emissions[4]. To achieve stabilisation of greenhouse gas concentration in the atmosphere at 450 ppm, the World Energy Outlook estimates that global energy-related emissions would need to be cut to around 23 Gt by 2030, down from 27 Gt in 2005, and 19 Gt less than the reference scenario predicts for 2030.

In order to achieve such drastic cuts in energy-related emissions, the majority of the international studies have insisted on a portfolio of technology options. The 2007 report[5] by the Intergovernmental Panel on Climate Change (IPCC) cites amongst those technologies currently commercially available: "improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; early applications of carbon dioxide capture and storage (CCS) (e.g. storage of removed CO_2 from natural gas)". The Stern Review[6] states that "the electricity sector would have to be largely decarbonised by 2050, through a mixture of renewables, CCS, and nuclear". The World Energy Outlook states that "emissions savings come from improved efficiency in fossil fuel use in industry, buildings and transport, switching to nuclear power and renewables, and the widespread deployment of CO_2 capture and storage (CCS) in power generation and industry."

2. A global resurgence in nuclear power

In response to the dual challenges of energy security and climate change, many countries worldwide have over the past few years confirmed significant new nuclear power programs. Life cycle analyses have concluded that nuclear power is a low-emissions technology across its life cycle, with its emissions comparable to most renewable technologies (see Figure 1).

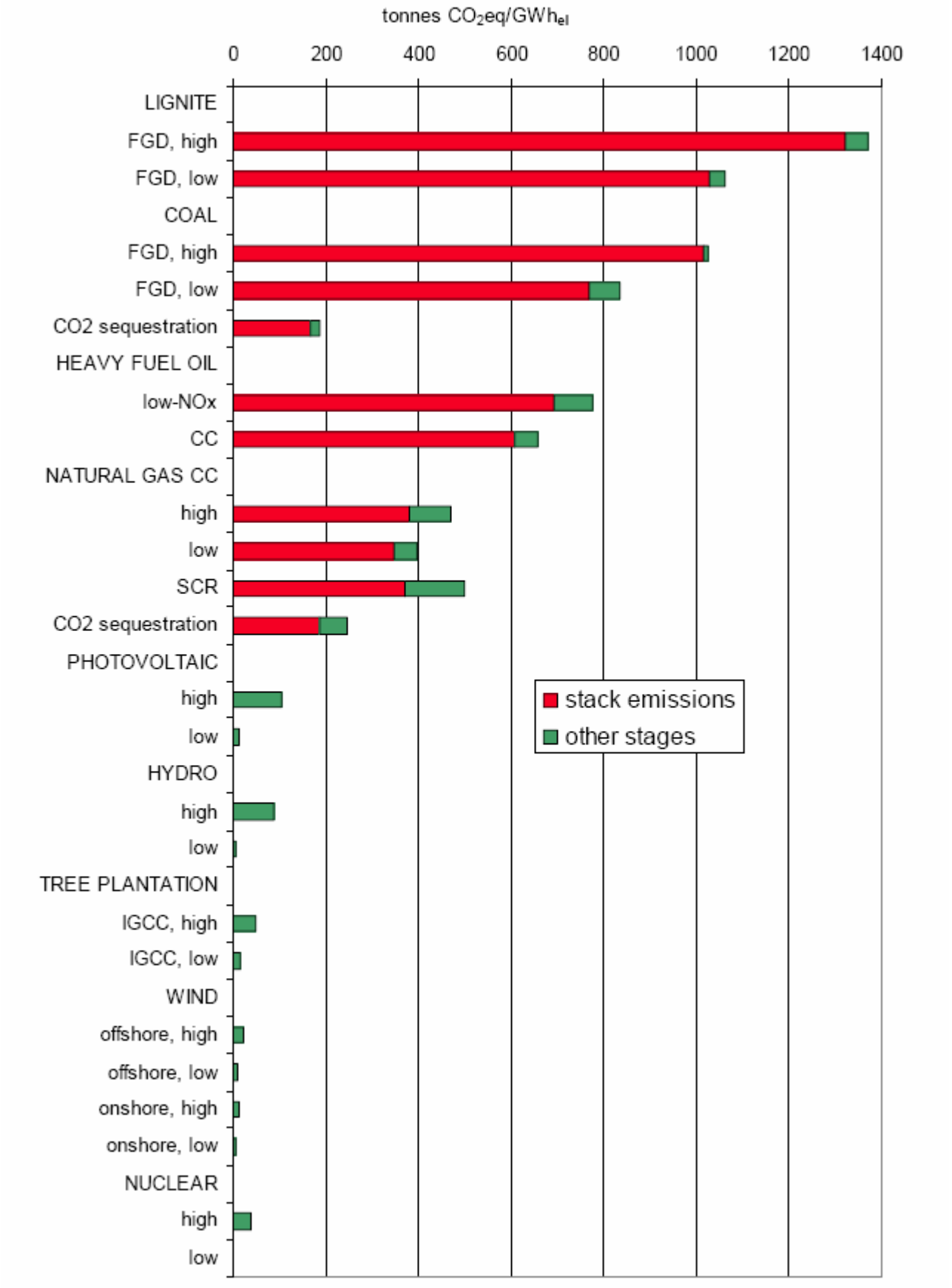


Figure 1: Greenhouse gas emissions from alternative electricity production systems (tonnes of carbon dioxide equivalent per GWh of electricity generated)[7]

AREVA estimates that over 340 GWe of new nuclear power will be constructed between now and 2030, which combined with life extensions will result in over 600 GWe of installed nuclear capacity by 2030, up from 370 GWe today (see Figure 2). This would avoid over four billion tonnes of CO_2-equivalent emissions per year relative to coal.

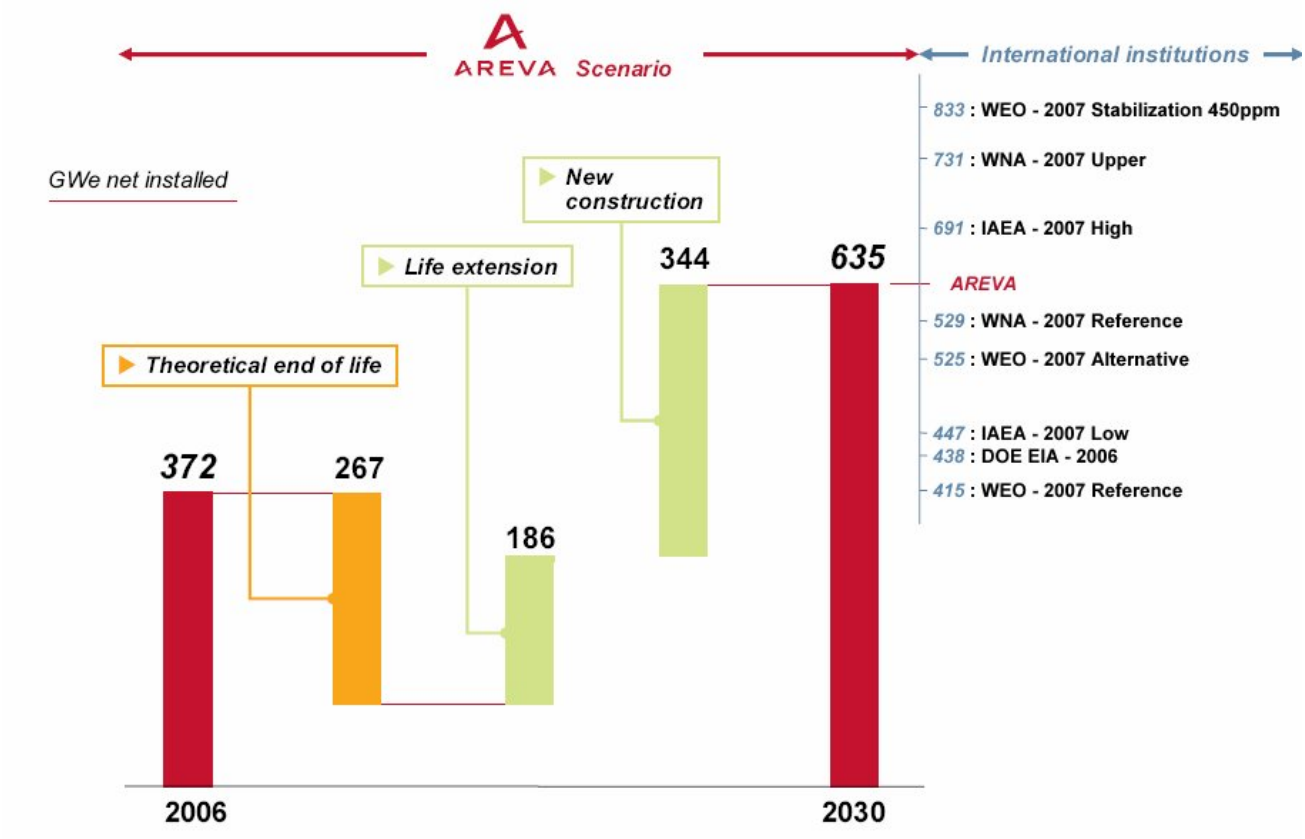


Figure 2: AREVA's 2030 scenario for installed nuclear capacity[8]

3. A unique responsibility in global climate change mitigation

Australia's status as a politically stable and developed country endowed with a large proportion of most of the primary energy resources gives it a unique responsibility towards global energy security and global climate change mitigation, through its decisions on the use and export of primary energy resources, and on the development, use and export of clean energy technologies.

Nuclear power is fuelled by uranium, and Australia possesses almost one quarter of the world's known uranium resources, more than any other country (see Figure 3). In the 2006-7 financial year, it exported just over 9500 tonnes of uranium oxide, earning 660 million dollars, and contributed about one fifth of the world's uranium production[9]. With the positive forecast for the uranium market, and smaller projects coming online in South Australia and the Northern Territory over the next few years, earnings could rise to[10] over a billion dollars by the 2009-10 financial year, corresponding to 13,000 tonnes of uranium oxide exports. Yet Australia's share will have dropped to just 16%.

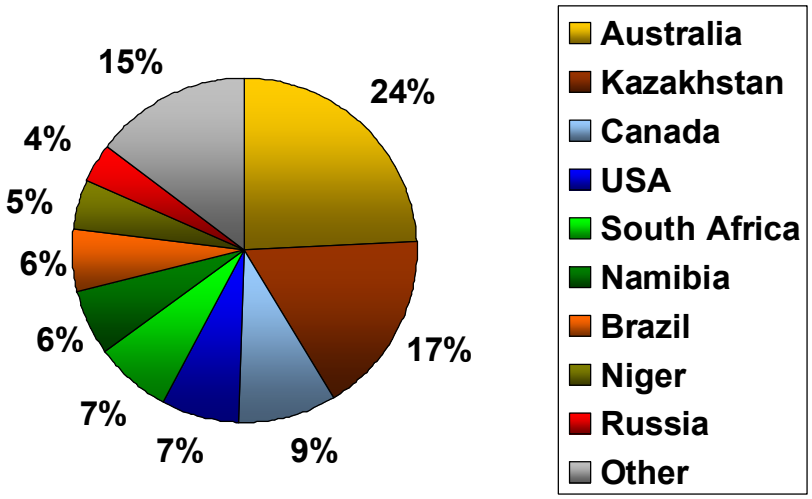


Figure 3: Reasonably Assured Resources plus Inferred Resources, to US$ 130/kg U at 01/01/05[11]

A worldwide installed nuclear capacity of 600 GWe in 2030 will require an annual supply of over 120,000 tonnes of uranium oxide. In proportion with possessing one quarter of the world's uranium resources, Australia could be supplying annually 30,000 tonnes of uranium oxide by 2030. The Olympic Dam expansion project in South Australia could result in an additional annual production capacity of up to 10,000 tonnes of uranium oxide after 2013. To make up the 7,000 or so additional tonnes, Australia will need to open up uranium mining, particularly in the uranium-rich states of Western Australia and Queensland.

The abandon of the "no new uranium mines" policy enacted at the Federal Australian Labor Party conference in April 2007 is positive for the development of nuclear power worldwide, as it implies bipartisan support for uranium mining in one of the key uranium-supplying countries. However, State policies that prohibit uranium mining still remain, notably in Western Australia and Queensland. Removal of the remaining barriers to uranium mining in Australia would ensure security of supply for countries seeking to develop nuclear power but who possess limited indigenous uranium resources. In short, it would allow other countries to pursue a low-emissions electricity mix thus supporting global climate change mitigation, while bringing significant economic benefits to Australia.

One of the key criticisms that has been raised over the past 18 months in Australia against the expansion of uranium mining is the ability to guarantee that Australian uranium is used exclusively for peaceful purposes.

Nuclear power is one of the most heavily regulated energy sources, with regulations applying to every aspect of its fuel cycle, from mining of the primary resource – uranium – to waste management and the decommissioning of facilities. These regulations, although implemented nationally, are coordinated at a global level by the International Atomic Energy Agency (IAEA), an independent, intergovernmental organisation set up in 1957 within the United Nations. One of the missions of the IAEA is to verify that every nation complies with their commitments under the Treaty for the Non-proliferation of Nuclear Weapons (1970) and other non-proliferation agreements, to only use nuclear materials and facilities for peaceful purposes.

In addition to the international safeguards system administered by the IAEA, Australia requires individual bilateral safeguards to be concluded with each country to which it exports uranium. In the

case of export to a Non-Nuclear Weapons State (such as Japan) as defined under the Non-proliferation Treaty, Australia insists that IAEA safeguards must apply to all current and future activities in that country, and that the IAEA's Additional Protocol is in force. In the case of export to a Nuclear Weapons State (the UK, the US, France, Russia, and China), the Australian bilateral safeguards agreement requires that Australian Obligated Nuclear Material (Australian uranium and any material derived from this) be covered by IAEA safeguards, and that certain downstream processes or transfers to third countries do not take place without the prior consent of Australia. In either case, Australian Obligated Nuclear Material may under no circumstances be used for military purposes[12].

The other argument that has been raised against the expansion of uranium mining is that Australia will be required to "take back" nuclear waste by virtue of having exported uranium. Common practice internationally is that the location at which electricity is produced from the uranium is the location at which the resulting waste must be disposed. Some countries, such as Finland, have even passed legislation to ensure that all nuclear waste produced in Finland must be disposed of in Finland.

It should be noted that Australia has been exporting uranium since the 1980s to both Non-Nuclear and Nuclear Weapons States without any safeguards breaches, nor being required to "take back" the resulting nuclear waste.

4. Addressing Australia's own emissions

The international community has wholeheartedly welcomed Australia's recent ratification of the Kyoto Protocol. Australia must build on this engagement, together with its contribution to the Asia-Pacific Partnership on Clean Development and Climate, and to the Major Economies Process on Energy Security and Climate Change, to ensure that an efficient post-2012 international framework can be established and deliver significant emission reductions.

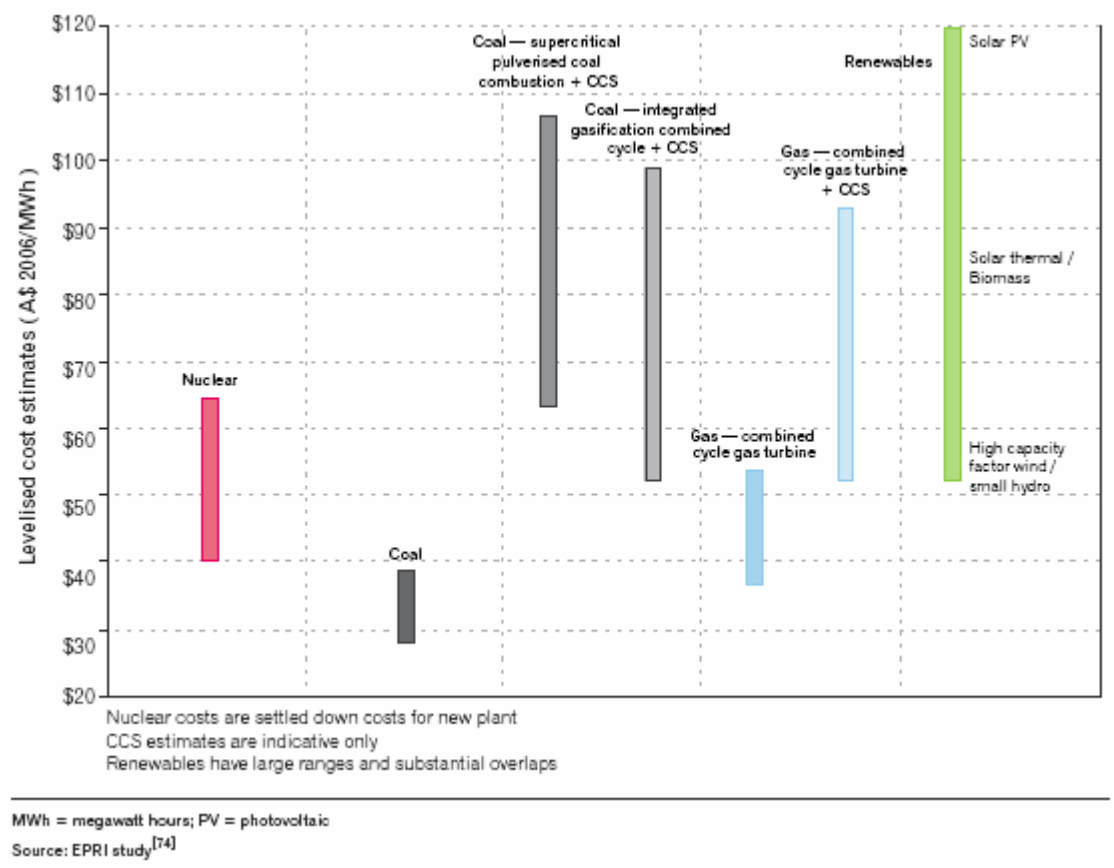
In this context, and as an increasingly key player on both the international and regional scenes, Australia should ensure that decisions on its own energy mix are taken on a genuinely factual basis, and that the door is left open to all clean energy options.

The current Federal government appears to have ruled out nuclear power as one of those clean energy options. Several arguments have been used, such as safety, non-proliferation, and waste. These issues have been dealt with comprehensively in recent international and Australian studies, such as the 2006 report[13] by the UMPNER (Uranium Mining, Processing, and Nuclear Energy Review) taskforce, and will not be further addressed here.

One argument that is perhaps more country-sensitive than others is that of the economics of nuclear power. A study commissioned by the UMPNER taskforce showed that, at a moderate commercial risk (a weighted average cost of capital of between 8% and 10%), nuclear power could fall within the cost range of 40 to 65 dollars per MWh of electricity generated (see Figure 4). Australia's plentiful coal supplies mean that this would still be uneconomic compared to cheap coal generation. However, the UMPNER report stated that nuclear power could become economic even at low to moderate prices for carbon emissions of 15-40 dollars per tonne of CO_2-equivalent emissions.

Nuclear power's particular cost structure means that though it is more expensive to build it will produce less expensive power over the course of its 60-year lifetime. In the United States, nuclear power is currently the cheapest form of electricity generation at under 17 USD per MWh of electricity generated, with almost all of the 104 plants currently operating having either renewed or considering renewing their operating licences[14]. In Europe, the French utility EDF has estimated

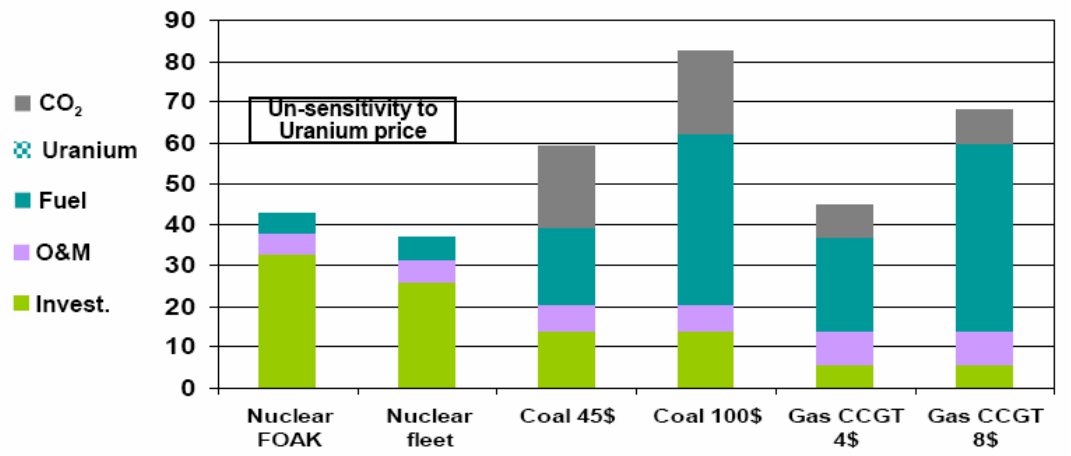
that the new nuclear generating capacity of Flamanville 3 (under construction) would provide electricity at 46 euros (2006) per MWh. This cost remains comparable to or less than other fossil fuel options considered even before including carbon pricing (see Figure 5).



MWh = megawatt hours; PV = photovoltaic

Source: EPRI study[74]

Figure 4: Levelised cost ranges for various technologies[15]



	Nuclear FOAK	Nuclear fleet	Coal 45$	Coal 100$	Gas CCGT 4$	Gas CCGT 8$
Invest. overnight	€2,500/kWe	€2,000/kWe	€1,100/kWe	€1,100/kWe	€505/kWe	€505/kWe
Efficiency	36%	36%	46%	46%	59%	59%
Lead time	7 years	6 years	3 years	3 years	2 years	2 years
Load factor	90%	90%	90%	90%	95%	95%
Service life	60 years	60 years	35 years	35 years	25 years	25 years
WACC, pre-tax	8%	8%	8%	8%	8%	8%
Fuel cost	$40/lb U3O8	$60/lb U3O8	$45/t	$100/t	4$/MBtu	8$/MBtu

Source: CM-CIC Estimates, based upon DGEMP

Figure 5: Comparison of costs in euros per MWh by generation technology[16]

Commercially ready nuclear plants are available now and may help Australia transition towards a low-emissions electricity mix while waiting for other low-emissions technologies to become industrially viable.

To tackle the growing needs of Australia in water supply, nuclear power could also contribute actively, producing clean and affordable electricity for desalination via reverse osmosis: a 200,000 m^3 per day installation would consume less than 5% of the production of a typical 1 GWe nuclear plant.

Another argument used to rule out nuclear power as a low-emissions technology option is that it is simply "not an acceptable option" in Australia at present. The issue of public acceptance for new technologies – whether it be in energy supply or any other sector – can only be dealt with by encouraging a rational approach to risk management. The more serious consequences of climate change have a high probability of occurring and as such present a high risk. Australia, like many other nations, should be considering all the technology options that are available in an effort to mitigate this risk.

In the words of Lord Nicholas Stern[17]: "The conclusion to be drawn from the analysis of the costs and risks associated with developing the various technologies, from the uncertainties as to their rates of development, and from the known limitations of each, is that no single technology, or even a small subset of technologies, can shoulder the task of climate-change mitigation alone. If carbon emissions are to be reduced on the scale shown to be necessary for stabilisation [...], then policies must encourage the development of a portfolio of options; this will act both to reduce risks and improve the chances of success."

About AREVA

With manufacturing facilities in 43 countries and a sales network in more than 100, AREVA offers customers reliable technological solutions for CO_2-free power generation and electricity transmission and distribution. We are the world leader in nuclear power and the only company to cover all industrial activities in this field.

Our 65,000 employees are committed to continuous improvement on a daily basis, making sustainable development the focal point of the group's industrial strategy.

AREVA's businesses help meet the 21st century's greatest challenges: making energy available to all, protecting the planet, and acting responsibly towards future generations.

www.areva.com

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[1] UN (United Nations), Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2006 Revision*, http://www.un.org/esa/population/publications/wpp2006/wpp2006.htm, accessed 4 April 2008
[2] OECD (Organisation for Economic Cooperation and Development) / IEA (International Energy Agency), *World Energy Outlook 2007*, 2007
[3] IPCC (Intergovernmental Panel on Climate Change), *Climate Change 2007: Synthesis Report*, November 2007
[4] OECD/IEA 2007 op. cit.
[5] IPCC 2007 op. cit.
[6] N. Stern, *Stern Review: Report on the Economics of Climate Change*, Cambridge University Press, 2006
[7] World Energy Council, *Comparison of Energy Systems using Life Cycle Assessment*, July 2004
[8] AREVA, *2007 annual results*, February 2008
[9] ABARE (Australian Bureau of Agricultural and Resource Economics), *Australian Commodities*, Vol 15. No. 1, March 2008
[10] Ibid
[11] OECD/NEA (Nuclear Energy Agency) and IAEA (International Atomic Energy Agency), *Uranium 2005: Resources, Production, and Demand*, 2006
[12] See the Australian Safeguards and Non-proliferation Office website, http://www.asno.dfat.gov.au for further details
[13] Commonwealth of Australia, *Uranium Mining, Processing, and Nuclear Energy – Opportunities for Australia?*, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, December 2006
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[15] Ibid
[16] P. Lambert-de Diesbach, CM-CIC Securities, Presentation given at *The revival of nuclear energy: a challenge for Europe*, a CERES/Confrontations Conference, 27-28 March 2008, http://www.confrontations.org/spip.php?article295
[17] N. Stern op. cit.