Submission

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INQUIRY INTO THE ECONOMICS OF ENERGY GENERATION

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SUBMISSION TO

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INQUIRY INTO THE ECONOMICS OF ENERGY GENERATION

Australian Nuclear Association (ANA)

The Australian Nuclear Association (ANA) is an independent incorporated scientific institution made up of individuals drawn from the professions, business, government and universities, with an interest in nuclear scientific and technical topics. The ANA provides a forum for presentation, exchange and dissemination of information on the peaceful uses of nuclear science and technology through the holding of regular technical meetings and national and international conferences. This submission has been approved by the ANA Executive Committee.

Nuclear Power – A Mature Technology

Nuclear power is widely used for baseload electricity generation around the world, although not yet in Australia. Nuclear reactors for generating electricity are a mature technology. The industry has over 14,700 reactor-years of experience in operating civilian nuclear reactors since the world's first commercial nuclear power station was opened in England in 1956. International experience demonstrates that large nuclear power reactors are reliable generators of baseload electricity with high availability.

There are 434 nuclear power plants operating in 30 countries, producing 14% of global electricity (Jan 2012). Countries with a significant reliance on nuclear electricity include France with 74% of electricity produced from nuclear power in 2010, Ukraine with 48%, South Korea with 21% and USA with 20%; the European Union has 35%. In addition, 61 nuclear power reactors are under construction and 156 nuclear power reactors are on order or planned with approvals, funding or major commitment in place (World Nuclear Association, 2012).

The Fukushima accident in Japan in March 2011 caused a decrease in the number of operating reactors and a delay in new constructions. However as world energy demand continues to increase and countries seek energy security and to limit emission of greenhouse gases, nuclear is expected to still be an attractive option for many countries once the lessons of the Japan accident are understood and incorporated into designs and operational procedures.

Electricity Production in NSW and Australia

Electricity production in Australia and in NSW is very highly dependent on fossil fuel, particularly coal, Table 1. Whereas coal provides about 41% of electricity world wide, NSW relies on coal for 88.8% of its electricity production. This very high dependence on one fuel for electricity is not good for energy security or for limiting emission of greenhouse gases.

Table 1. Fuel Shares of Electricity Production

	World (2009) note 1	Australia (2008-09) note 2	NSW (2008-09) note 3
Coal/Peat	40.6%	76.7%	88.8%
Oil	5.1%	1.0%	0.4%
Natural Gas	21.4%	15.0%	3.6%
Nuclear	13.4%	0%	0%
Hydro	16.2%	4.7%	5.6%
Other (wind, solar, biofuel, waste, heat)	3.3%	2.7%	1.6%

note 1 2011 Key World Energy Statistics, International Energy Agency OECD/IEA 2011
note 2 Energy in Australia 2011, Published by ABARES produced for Department of Resources, Energy and Tourism, 2011
note 3 Australian Bureau of Statistics, 1338.1 - NSW State and Regional Indicators, Sep 2010

Nuclear Power Economics

In many countries, nuclear electricity is already cheaper than other forms of baseload electricity generation. Although the costs of nuclear electricity in Australia can really only be known when there is a fully commercial proposal to build several nuclear power plants, the large reserves of low-cost coal means that electricity from coal in NSW would be cheaper than electricity from nuclear unless or until coal is penalised for its emission of carbon dioxide.

In its 2006 report to the Prime Minister, the UMPNER Taskforce estimated that nuclear electricity would be 20-50 percent more expensive in Australia than coal fired power if pollution including carbon dioxide emissions is not priced (UMPNER 2006). This was based on an Electric Power Research Institute (EPRI) review commissioned by the UMPNER task force to examine recent studies that compared the cost of using different technologies, including nuclear energy.

A more recent study by Nicholson, Biegler and Brook (2011) compared five technologies available today to produce baseload electricity with low emission of greenhouse gases. The five technologies were: coal (both pulverised fuel and integrated gasification combined cycle) with carbon capture and storage (CCS); combined cycle gas turbine with CCS; Generation III nuclear reactors; and solar thermal backed by heat storage and gas turbines. They undertook a meta-review of authoritative peer-reviewed studies of levelised cost of electricity (LCOE) and life-cycle GHG emissions for these technologies. Nuclear energy was found to be the cheapest option and best able to meet the IPCC timetable for greenhouse gas abatement. Solar thermal was the most expensive, while CCS would require rapid major advances in technology to meet that timetable.

A recent OECD study (OECD 2010) on projected costs of generating electricity compared 2009 data for generating baseload electricity by 2015 as well as costs of power from renewable sources. The study comprised data for 190 power plants from 17 OECD countries as well as some data from Brazil, China, Russia and South Africa. The study used levelised lifetime costs with carbon price internalised (OECD only) and discounted cash flow at 5% and 10%, as previously. It showed that nuclear power was very competitive at $30 per tonne CO_2 cost and low discount rate. However, the precise competitiveness of different baseload technologies depended very much on local circumstances and the costs of financing and fuels (World Nuclear Association, 2011).

A recent study by EPRI (2011) provided cost, performance, and technology status for eight central-station power generation technologies for the USA. The report looked at fossil- and nuclear-based technologies and four renewable-resource based technologies. Nuclear plants were generally more expensive to construct, but less expensive to operate. Higher construction costs were mainly associated with safety and security requirements, including both design/construction requirements and the lengthy licensing process. Low operating costs are a result of lower fuel costs (on a per kWh basis). The study concluded that nuclear plants in the USA can be cost effective when construction costs are kept in check and when they are operated at high capacity for many years. US planning for new nuclear generation continues, but faces challenges in financing stemming from high capital costs, long lead times in licensing and construction, and rising cost projections.

These studies demonstrate that nuclear can be competitive with coal if coal plants have to limit or pay for carbon emissions. The cost of electricity from all fossil fuels will increase if the fossil fuel plants have to pay for carbon capture and storage or for carbon credits/taxes. When the costs of managing greenhouse emissions are included, the cost of nuclear electricity is expected to be economically competitive with electricity from fossil fuels in Australia. Nuclear should therefore be considered on economic grounds as an option for future electricity production.

Nuclear Safety

The ANA recognises that there is public concern in NSW around the development of nuclear power in the State. Although fears are understandable, they are misplaced. Nuclear power would be amongst the safest and least environmentally damaging ways to generate our electricity.

All industries suffer accidents. However, apart from the accident at Chernobyl in the USSR in 1986, there have been no deaths recorded due to accidental exposure to radiation from any commercial nuclear power reactor. The Chernobyl accident would not have occurred if there had been effective safety regulations and most of the consequences would have been prevented if the reactor had had a containment structure. The importance of containment was clearly demonstrated by the core-melt accident at Three Mile Island (TMI) in 1979, which did not cause any radiation injuries or result in a significant radioactive release to the environment. No-one will ever again build a nuclear power station of the Chernobyl type.

At Fukushima in March 2011, a very large tsunami caused core melt accidents at three 40-year old reactors. The reactor containments were at least partially effective, and none of the more than 20,000 deaths from the tsunami is attributable to radiation from the damaged reactors.

Modern containment buildings are massive steel-reinforced concrete structures, which are designed to withstand the impact of the largest credible external events. All nuclear reactors at

coastal sites will in future be subject to rigorous safety assessment of the risk of damage from tsunamis.

The commercial operations of a nuclear industry in NSW would not involve any risk of the diversion of materials into the production of nuclear weapons. Materials suitable for weapons would not be handled at any stage and all operations would be fully under Australian regulatory supervision.

Technology is available to dispose of radioactive waste so that its capacity to contaminate the environment would be far less than that of the naturally occurring ore body from which the uranium originally came.

Energy Security

Installing nuclear power plants improves energy security. Nuclear fuel is easy to stockpile, low fuel costs lead to relative insensitivity to fuel price variations and refuelling occurs only periodically (typically one-third of a power reactor core is replaced every 12–18 months). The ease of fuel management is important to countries concerned with energy security. With 23% of the world low cost uranium (2007), Australia would be self sufficient in sources of uranium.

The high dependence in NSW on coal for generating electricity (see Table 1 above) is one reason why Australia is a high per capita emitter of greenhouse gases. Having a nuclear component in Australia's electricity supply would provide additional energy security by diversifying the technologies used to supply electricity.

Greenhouse Gas Emission

Nuclear power is a low emitter of greenhouse gases and air pollution. Nuclear power plants emit virtually no greenhouse gases, but some greenhouse gases are emitted in mining, ore processing, construction of power stations and transport of materials and equipment – as they are in other mining and energy industries. The greenhouse gas emission from the whole nuclear fuel cycle is 10 to 100 times less than the emission from natural gas and coal (UMPNER 2006).

While renewable sources of energy such as hydro, wind, solar, biomass and geothermal will make increasingly important contributions to electricity generation, many of these sources are limited by their dilute and/or intermittent nature. For Australia to meet its future greenhouse gas targets, low carbon baseload technologies like nuclear need to be included in the energy mix.

Conclusions and Recommendations

Nuclear power is a proven, economic, mature and safe technology for the generation of baseload electricity with minimal emission of greenhouse gases.

Having nuclear power in Australia would increase energy security and help Australia meet its greenhouse gas emission targets.

The ANA **strongly recommends** that nuclear power be included as a viable option in plans for NSW's energy future.

The ANA **recommends** that legislative and policy issues be resolved, including repeal of the NSW Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986 No. 194, so that

commercial nuclear power plants can be proposed, built and operated, consistent with meeting environmental, safety and planning criteria.

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