Comments Pertinent to a Public Hearing on the Review of A Nuclear Material Transfer Agreement With China

By the Joint Standing Committee on Treaties,
Parliament of Australia.

Submitted by Craig Lawrence AM,[1]
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October 6, 2006

The Committee's Inquiry looks at an important aspect of Australia's expanding rôle in the global energy market. Specifically, this inquiry is considering two new bilateral agreements:

1) Agreement between the Government of Australia and the Government of the People's Republic of China on the Transfer of Nuclear Material
2) Agreement between the Government of Australia and the Government of the People's Republic of China for Cooperation in the Peaceful Uses of Nuclear Energy

This submission addresses the potential impact of these agreements in a broader strategic framework. A review of global energy patterns is essential to understanding the implications of bilateral agreements between Australia and the People's Republic of China.

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[2] Future Directions International Pty. Ltd., Australia's Centre for Strategic Analysis, is a not-for-profit Approved Research Institute with Deductible Gift Recipient and Income Tax Exempt Charity status. It was established in 2000 under its founding Chairman, and now Governor-General of Australia, Major-General (rtd.) Michael Jeffery AC CVO MC (now Patron of FDI). Its current Chairman is Mr Jerry Ellis, Chancellor of Monash University, and former Chairman of BHP. FDI's head office is located at 18 King's Park Road, West Perth 6005, Western Australia. Tel. (08) 9486-8399; fax (08) 9486-7344. www.futuredirections.org.au.

In the context of forming long-term energy relationships with other nations, it is first necessary to understand the future energy demands of Australia. Future Directions International (FDI) has already made a significant contribution to the national energy debate. Exactly one year ago today, FDI launched a landmark study entitled *Australia's Energy Options* in the Federal Parliament after providing a number of briefings on the strategic implications of the report to senior bureaucrats, government ministers and members of a number of political parties, including the Leader of the Opposition. *Australia's Energy Options* outlined a number of choices available to Australia to formulate a strategic approach to energy. The study was met with much interest and a positive response from the Australian policy making community.

Australia's Energy Options was offered free of charge to all politicians in each of the parliaments of Australia.

Recommendations put forward in *Australia's Energy Options* covered the entire energy spectrum and addressed a number of energy sources from within a strategic framework.[3]

Key recommendations relating specifically to the nuclear life cycle include:

> ***It is now time for Australia to undertake a complete review of new nuclear technologies, such as thorium-based and pebble-bed reactors.***
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> Government policies opting out of conventional nuclear power generation were feasible, and may have been desirable, until this point. The safety, environmental friendliness, efficiencies, and potential benefits of new forms of smaller reactors for the decentralisation of power generation cannot be ignored. In the Australian environment, they could provide remote area power sources "leapfrogging" the need for increasingly costly investment in a massive national grid. Australia must now undertake a complete review of new, safer nuclear power generation options offered by thorium-based reactors and pebble-bed reactors. Our proven, large resources of thorium and uranium could give the country a major strategic advantage.
>
> ***Federal and State governments should undertake a complete review of the entire nuclear life cycle.***
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> Australia must, in parallel with a study of new nuclear technologies, reconsider all aspects of the nuclear life cycle. This includes the extraction and refinement of both thorium and uranium as well as the question of responsible nuclear waste storage. Australia is uniquely positioned to participate in all of these tasks. Even without Australia's involvement, this industry will continue to grow and expand. From a security perspective, as well as a strategic point of view, it is better to have legislative control over the safeguards to ensure that world's best practices are established, maintained and enforced. Australia is a nation stable both geologically and politically. It could play a key international strategic role in the nuclear life cycle, including extraction, refinement, and the storage of nuclear waste generated from Australian sources.

Since the launch of *Australia's Energy Options,* the nuclear debate has significantly shifted, leading to a broader discussion on the various components of the nuclear life

[3] *Australia's Energy Options* Executive Overview and Report Summary are attached as Appendix B.

cycle and Australia's international rôle as a key uranium supplier, of which this inquiry is one such component. Also, over the past year there has been a convergence of scientific opinion and political opinion on the issue of climate change and the belief that it is linked in some measure to fossil fuel emissions. While there is still disagreement about the appropriate action, significant political will exists to address the issue through new consideration of nuclear options.

There are currently 440 nuclear reactors worldwide, with around 103 located in the US and 59 in France.[4] It is likely that the international dispersal of domestic nuclear power plants will be much greater in 2050 than it is today, mirroring the globalisation of industry and manufacturing. India plans to expand its nuclear capacity 10-fold by 2022, and 100-fold by mid-century. China plans to reach an installed capacity of 40 gigawatts (from 6.5 gigawatts in 2005) by 2020, accounting for four percent of total domestic energy supplies.[5] Some analysts have even projected that China and India will have over 1,000 nuclear reactors each by the middle of this century. [6]

In the current global environment, with greater agreement on climate change, nations such as China and India are rapidly expanding their nuclear power capabilities, with India looking heavily toward the development of thorium-based reactors as well as expanding its uranium-based reactor capacity. Pakistan, too, is expanding its uranium-based nuclear generation of electricity. In addition, a number of other countries already possessing significant nuclear power capabilities are maintaining or adding to their existing nuclear power plants. With demand for uranium set to continue in coming years, the current high spot price for uranium of $53.25[7] is set to increase, putting further pressure on new reserves and existing production facilities.

In this global environment, demand for uranium will continue, regardless of Australia's involvement in the industry. It should also be noted that the nuclear industry, at all stages, is likely to continue to grow, with or without Australia's participation. The question must then be asked as to where does Australia see itself within the 21st Century energy paradigm.

While crude oil may be the dominant energy source at the moment, a convergence of factors including concern for the environment, high current prices of crude oil, high risk of supply disruption due to volatility of the Middle-East, as well as the emergence of new, more efficient and less-pollutant technologies, do not preclude a rapid shift to other energy sources. Such a transition may only be a few years or possibly decades away.

Uranium is one of many energy supplies Australia possess. It is important that there is innovative and flexible policy making to position the nation for any potential change in energy patterns. Discussion by Prime Minister John Howard about Australia being a potential "energy superpower" may not be inaccurate, particularly if oil becomes merely

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[4] Uranium Information Centre, World Nuclear Power Reactors 2005-06, Melbourne, September 21, 2006 online: http://www.uic.com.au/reactors.htm.
[5] For further information and references, see Appendix C.
[6] Nigel Wilson, Nuclear Stations Powering Up, *The Australian*, April 23, 2006.
[7] Robin Bromby, Floodgates Open in Uranium Search, *The Australian*, September 21, 2006, p 29.

one of a number of energy inputs. Indeed, other nations, such as Canada[8] and Kazakhstan, are considering their own energy reserves, and the way in which they may be developed as export industries and politically significant tools of change. Canada, which has a mature domestic nuclear program already, has committed to building two new reactors and refurbishing a number of existing reactors in order to satisfy its energy requirements.[9]

There are also at play a number of different dynamics in current energy patterns. In the short-term, Australia will become increasingly dependent on imported energy. It is estimated that Australia's self sufficiency in energy is expected to drop to somewhere between 20 percent and 50 percent.[10] While China is a significant consumer of most forms of energy which Australia produces, the option of increased exports of uranium will dominate the political cycle. To what extent is this sustainable in the long-term under current frameworks? What effects will increases in demand for uranium in the region have on traditional markets? Will the current debate about uranium mining and export of raw materials be in the long-term national interest?

Nuclear energy technologies that are cited in mainstream debate are often based on old models and paradigms. It is important that the Australian Government and public be aware of the dynamic nature of the nuclear energy debate, and the ongoing developments that affect the safety, efficiency and life-cycle of nuclear processes. Uranium has long occupied public debate due to technological and historical reasons, particularly in light of the Cold War, however with the progress of globalisation and the development of advanced technologies the time is right for consideration of future directions.

Thorium-based power generation is one such development which could have significant implications in all areas of the debate. A new thorium-based reactor — which was announced in *Australia's Energy Options* — could transform the debate about uranium mining and existing agreements with China.[11] Like uranium, thorium is found in Australia in significant quantities and could duplicate the economic benefits associated with the uranium industry. It is estimated that Australia possesses 25 percent of the world's thorium reserves, the greatest single reserve in the world.[12]

Thorium reactors — one of many "new, 'green' nuclear technologies", including "pebble bed" modular reactor technology — present significant potential benefits in comparison to current energy production processes. Thorium reactors would pollute less than any existing major form of power generation; would not create a spin-off of weapons-grade fissionable material; and at least one reactor — a thorium-based system being developed privately in California — applies temperature dependant criticality theory to the thorium

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[8] Prime Minister Steven Harper, *Speech to the Economic Club of New York,* September 20, 2006, New York, Online: http://www.pm.gc.ca/eng/media.asp?id=1327.

[9] Karen Howlett, Ontario to build two new reactors, *Globe and Mail*, June 6, 2006.

[10] Anthony Bergin & Sam Bateman, *Future Unknown: The Terrorist Threat to Australian Maritime Security*, The Australian Strategic Policy Institute, April 2005, p. 33.

[11] *Australia's Energy Options,* Future Directions International, 2005, p 13.

[12] As quoted in: Uranium Information Centre, "UIC Nuclear Issues Briefing Paper # 67", November 2004, http://www.uic.com.au/nip67.htm.

fuel cycle.[13] The thorium core produces heat for a decade without refuelling. The rate of fission in the core is controlled by the heat of the fuel, so the rate of fission in the core (and the criticality of the reactor) decreases as core temperature increases. This resolves many operator safety issues. The thorium cycle produces scant plutonium and the minor actinides because there is as little uranium 238 in the core as design allows.

Perhaps the most important feature of thorium reactors is that the fuel can be configured to fission plutonium and minor actinides so this waste in the spent fuel from the uranium-plutonium cycle can be fissioned away.[14] The construction of a pilot thorium plant appears imminent. With significant reserves of thorium, India is investing in the development of such technology.

Work on a new thorium reactor was discussed for the first time in *Australia's Energy Options* and FDI was given first-hand access to the initial details of the project, largely due to Australia's dominant holdings of thorium. The potential near-term availability of such environmentally-sound nuclear technology changes the entire debate about nuclear energy in Australia and has the potential to transform the debate over international energy concerns.

Domestically, the prospect of small (community-sized), cheap, and safe new-generation reactors offers enormous potential for dispersed and extensive water desalination, as well as for conventional power generation, and the means to cheaply process raw materials. Such technologies — and there are others in different areas available to Australia — could have a profound impact on Australia's capability to plan population trends, infrastructure development, and, through the production of fresh water from seawater, new agricultural prospects.

The strengths of these technologies are equally attractive to other countries which face similar strategic challenges in the future. Domestic development of such industries would not only demonstrate a viable working model to the global community, but would foster the skills and expertise within Australia that could create an important export industry. Like uranium, Australia has abundant supplies of thorium, and considered developed of this potential could result in an industry that Australia can market to the world. There would be a number of advantages in this approach, not the least of which is creating a more secure and sustainable energy trade.

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[13] In addition to the US research, India and France are actively working on new thorium-based reactor development, based, in large part, on concepts proven during the 1950s, but put aside in favour of uranium-based reactor technology which had the "dual-use" capability of producing fissionable material for nuclear weapons. The 21st Century thorium reactors, however, benefit from additional new technology which enables the creation of small, low-temperature reactors which can, as part of their fuel cycle, consume "waste" from conventional nuclear reactors, thereby significantly reducing the world's existing deposits of toxic spent uranium waste.

[14] The reactor will use a non-thermal neutron spectrum. The neutrons are managed by the matrix material in which the fissile and fertile materials are dispersed. Because there is no need for water to moderate the neutrons, the reactor can be designed to be compact. It fits into a shipping container. The operating range for the reactor is 400-500° C. The reactor in some applications is started with an advanced neutron generator in which deuterium fuses with deuterium. The temperature dependant criticality concept permits a compact reactor to be critical at operating ranges and subcritical if that range is exceeded.

Nonetheless, the current energy debate with regard to fissionable nuclear materials is inexorably tied to security issues, primarily those embodied in the Nuclear Non-Proliferation Treaty (NPT). Thorium and other such new technologies have the potential to sideline much of the debate with regard to uranium's potential weaponisation. By creating a "cradle to grave" modular system, Australia could spearhead a responsible, clean and efficient global energy paradigm that would have the added effect of increasing our international standing, effectively creating an "energy superpower". Australia has the capacity to be a world leader in safe nuclear applications, and could be a model of excellence in the international energy arena.

In the short-term, the NPT raises a number of issues with regard to Australia's uranium industry. Like many existing security arrangements, the NPT was the product of political consensus during the Cold War, and was a response to that era's particular strategic requirements (see Appendix C). The global situation in 2006 however, is very different from that of 1968 when the treaty was signed. The static, bi-polar configuration of Cold War politics is giving way to a multi-polar configuration of modernising nations. Many of these nations are rapidly developing to a point where without continuous, safe supplies of energy, they cannot continue to maintain strong levels of economic growth. Countries such as India, which possess a stable democratic system and a vibrant national economy, are integral to regional prosperity and security. The US' growing cooperation with India as a regional partner, and recent agreements regarding the exchange of nuclear technologies presents a further transformation of international energy relations, and the suggestion for a new consideration of nuclear proliferation frameworks. It is unlikely that the current NPT will have new signatories or a general reaffirmation by existing members in coming years, particularly in light of the India and US agreement.

It is not just the rising power of China and India which requires a rethinking of future energy possibilities. Indonesia and Vietnam are also embarking on fledgling nuclear programs designed to meet growing energy needs. Russia has commenced development on a floating nuclear power station which it hopes to market to other countries. China and South Korea have expressed interest in its application, as did Indonesia and South Korea prior to the 2005 *tsunami*.[15] Russia hopes to raise its current share of nuclear power production from 17 percent to 25 percent by 2030, requiring construction of a number of new reactors.[16] The long established European energy industry is also likely to experience significant change over the next decade, as many nuclear power stations reach the end of their operational lives and require replacing. According to the World Nuclear Association, 16 countries have current proposals to build 107 new reactors.[17] Thus the interest in nuclear power is not restricted to a handful of specific nations as was the case during the Cold War; particularly in light of the repositioning of nuclear technology within the environmental debate. This global trend needs to be reflected in new frameworks and energy partnerships.

Nuclear technology has also significantly advanced. Fuel reprocessing and efficiency has been substantially improved and new station designs make the chances of a critical meltdown markedly less. The by-products and wastes from these new designs also

[15] Russias floating nuclear stations stuns ecologists, *The Sydney Morning Herald*, June 11, 2005
[16] N-Boost for Russia, *The Sydney Morning Herald*, May 19, 2006
[17] N-Boost for Russia, *The Sydney Morning Herald*, May 19, 2006

substantially reduce the chances that materials could be used in a military instance. Similarly, a "cradle to grave" fuel-leasing programme, where supplier nations, such as Australia, would take back spent nuclear fuel for re-processing from user nations, could create a safer, and less contentious, energy trade.

The Australian Government's current consideration of the *Review of A Nuclear Material Transfer Agreement With China* raises a number of important issues relevant to Australia's strategic future and international security. It is in Australia's long-term interest to see a prosperous and stable region, of which China is a key component. However, a key requirement for this growth is energy. As a nation abundant in a multitude of energy reserves, Australia could be leading the global approach to energy relations and spearheading new initiatives that reflect the requirements of the current context. Much of the stigma surrounding current arrangements is a product of history, and does not take into account current technological and political factors.

At the time of writing, it appears the US Senate is likely to pass legislation governing a new nuclear cooperation deal with India.[18] This further raises questions regarding the dual nature of Australia's rôle as an important trading partner of India, while remaining signatory to the NPT. With regard to the US, shifts in policy are expected to occur in relation to Climate Change. It is important that Australia pursues policies which are in the best interests of its own people and reflect the changing power structures of the post-Cold War world. Intelligent promotion of Australia's natural assets and creating a responsible, safe and clean energy regime are not mutually exclusive goals. In fact, they are integral to ensuring a prosperous Australia in the 21st Century and beyond.

[18] Change N-policy and supply uranium, India tells Howard, *The West Australian*, September 25, 2006, p10.

Appendix A

Biographical Summary

Craig Lawrence AM, Future Directions International CEO & Executive Director

Craig Lawrence was educated at the University of Western Australia, and holds the degrees of Bachelor of Commerce, and Master of Business Administration. He is a FCPA. In 1979 he was awarded the MGICA Australian Building Society National Scholarship, and was appointed a Member of the Order of Australia in 2006.

He is the Executive Director and Chief Executive Officer of Future Directions International. FDI is an independent, not-for-profit institute established to conduct comprehensive, integrated research and analysis of important medium to long term issues facing Australia.

Since 1970 he has served the Commonwealth Government, the State Government of Western Australia, local government, the community, and business in a number of capacities.

He began his business career in the finance and commercial sector. He spent 14 years as Assistant General Manager (Finance and Marketing) of the West Australian Building Society. He was Managing Director of Perpetual Trustees Western Australia from 1982-1989. Between 1989 and 1992 he was the Group Chief Executive Officer and Director of Perpetual Trustees Australia Limited.

He served as the National President of the Trustee Companies Association of Australia, and State President of the Trustee Companies Association in both New South Wales and Western Australia.

In 1993 he was appointed by the State Government of Western Australia as Chairman of Commissioners of the City of Perth. In that capacity he oversaw the division of the City into 3 new towns. He also served local government as the Chairman of Commissioners of the Towns of Victoria Park, Vincent and Cambridge. He was the Chair of the City of Perth Superannuation Fund.

In 1997-1998 he continued his service to local government as the Chairperson of the Inquiry Panel into the City of Wanneroo. He was also a Board Member of the East Perth Redevelopment Authority.

He has served the Government of Western Australia in a number of positions. Craig was the Chairman of the State Supply Commission of Western Australia that developed and implemented the “Buying Wisely “policy for the State. He served as the Deputy Chair of the Rottnest Island Board, and also as Chair of its Finance and Projects Committee.

In 2003 he was appointed a Member of the Commonwealth Government Panel of Independent Business Representatives (Tenders and Sale of Assets).

Craig was the Executive Director of Crime Stoppers Western Australia Ltd from 2000-2004. In Western Australia Crime Stoppers helps solve more than 10% of the state’s

solved crimes, and its programs are widely acclaimed both nationally and internationally. During his tenure Western Australia receive more than 50 percent of the Crime Stoppers International Awards made within Australia.

In August 2000 he was appointed a Director of Crime Stoppers Australia Ltd, the national representative body. He served as the national Chairman of Crime Stoppers from 2001-2003.

He was a Community Representative at the NDLERF National Alcohol Workshop in 1992, and a Speaker at the Crime Stoppers International Training Conference in 2003.

In 2004 he was appointed by the Minister for Justice and Customs as a Member of the National Community Crime Prevention Grants Committee.

In 2005 he was appointed a member of The National Consultative Committee for International Security Issues (NCCISI).

Craig has been actively involved in the community for many years. He was a member and director of the Rotary Club of Applecross for 10 years. Over a period of 5 years he served two terms as councillor of the Royal Automobile Club of Western Australia. In 1994 he was invited to become Chairman of the Kings Park Centennial Enhancement Committee.

His other voluntary community interests include acting as Chairman of the Australia Day Council of Western Australia from 1995-1999. He is currently a member of its Advisory Committee.

Appendix B

Australia's Energy Options: Executive Overview

Australia stands at a crossroads with regard to its strategic energy options. Decisions made today must be within the context of global energy markets. Australia must develop a framework which establishes balanced energy, strategic, and security policies. Future Directions International considers five areas to be critical, and energy decisions should be based around a framework involving these interrelated issues.

Oil and Natural Gas

Australia, and the world, faces a decline in significant new reserves of oil. And while Australia enjoys considerable reserves of natural gas, imported oil is increasingly critical for Australia, particularly for transportation requirements. Greater fuel efficiency for motor vehicles and the option to convert readily to natural gas — as an alternative transport fuel — can assist in addressing this problem. Australia must encourage exploration, protect existing supplies — especially those on the North West Shelf of Western Australia — and promote the development of unconventional hydrocarbons such as oil shale and coal liquefaction. It must also, for the sake of security of supply in avoiding single-source dependence, ensure a variety of providers of oil imports in the future.

Coal

Coal remains a critical energy source for Australia into the foreseeable future. It has abundant coal reserves. With new technology, the industry can now address coal's traditional pollution problems. Coal can be made much cleaner by the use of such technologies as ultra-clean coal and new methods of carbon sequestration. Australia must take a leadership role in the international application of these new technologies.

Nuclear Life Cycle

The world is inevitability turning to new, safer, and cleaner nuclear energy technologies to supplant, and indeed replace, reliance on oil, gas, and coal for electrical power generation. From an economic — as well as a strategic — point of view Australia has much to gain from looking at this issue. Australia must now embrace a complete review of new nuclear technologies as well as the entire nuclear life cycle. A debate is required before a clear strategic policy and framework can be established, including that for waste generated from Australian sourced uranium.

Alternative Energy Sources

Alternative energy sources such as solar and wind are important in addressing environmental concerns. However, with current technology, neither wind nor solar power can adequately replace, or even compete with, existing fossil fuels. Nonetheless, one form of renewable energy, biomass, has great potential, especially in assisting the production of transportation fuel. With a strong agricultural industry, Australia must leverage its competitive advantage and accelerate the use of this fuel source.

Regulatory system

The generation, transmission and distribution of electricity are fundamental necessities for Australian consumers, business, and governments. Time is running out to make changes which will allow the market to solve structural problems. These problems now threaten the long-term viability of the national electricity system. We support the continuing role of governments' regulatory function, however, where the market is able to efficiently solve energy-related issues it should be allowed to do so without interference.

Australia's Energy Options: Report Summary and Recommendations

There is abundant evidence — highlighted in this report — that Australia, and most nations of the world, have viable options to improve the stability, security, volume, ecological quality, and economic competitiveness of energy supply. Options, however, require decisions and leadership if they are to be exercised, and decisions and leadership require public and political consensus. *Australia's Energy Options* lays the foundation for a policy debate and identifies the options which are emerging for Australia as a result of local and global conditions, and result of developments in science and technology, and the marketplace.

Australia is not running out of energy sources. However, its continued economic growth and wellbeing, as well as its strategic independence, is dependent upon important decisions being taken on future sources and types of energy, and on the infrastructure needed to develop, sustain, and distribute it. A disconnect between the strategic dimensions of energy policy, market dynamics and long-term solutions is becoming evident. This is not to criticise the basis of prior decisions but rather to highlight the fact that we find ourselves at strategic crossroads. Energy decisions made — or not made — today will impact on the future of Australia's energy usage over the next 20 to 30 years.

Australia, and the entire world, is facing an energy options transition period driven by the cost of energy, concern over greenhouse gases, and the need for energy security. While individual state priorities may differ, the imperatives for nations to act today cannot be overstated. Australia is part of this global energy framework and ignores it at its peril.

Australia's Energy Options

This report calls for immediate action by Australia to develop a comprehensive strategic energy policy. Future Directions International (FDI) considers that neither Australia nor the world is running out of energy sources. Increased demand and tight supply chains are, however, pushing the cost of energy upwards. This increase in cost is likely to spur new investment in, and expansion of, new energy projects. While a number of new alternative energy projects are now becoming viable, it is likely that fossil fuels will remain critical in the short to medium term. It is also likely that nuclear energy will play a much more important role in the years ahead. Renewable forms of energy, while increasing in popularity, cannot alone solve energy problems. While major industrialised countries will continue to experience growth in demand for energy, the greatest level of increase in

energy demand will come from emerging industrial economies, particularly the People's Republic of China (PRC) and India.

For these reasons we recommend the following issues as worthy of consideration when formulating a new national energy policy:

Oil and Natural Gas

Australia should insulate itself from sudden transport fuel shortages by encouraging oil shale and coal liquefaction projects and greater exploration as well as promoting greater fuel efficiency options for motor vehicles and ensuring the option to readily convert to natural gas as a transport fuel.

Australia is extremely vulnerable to disruption of its energy supply, particularly fuel necessary for transportation. This is especially relevant given the high, and growing, reliance on imported oil. There are a number of demand side solutions which can reduce reliance on imported oil. Greater fuel efficiency for motor vehicles and ensuring the option to convert readily to natural gas — as an alternative transport fuel — can assist in addressing this problem. Australia's exploration efforts need to be redoubled so to identify local sources of hydrocarbons. In defence parlance, Australia has very limited strategic depth of energy supply. This vulnerability could become critical if there was an international crisis, such as a blockade of the Persian Gulf. Given Australia's large supplies of brown coal and oil shale, it makes sense to nurture extraction industries, in particular from brown coal. It is essential that the necessary skills, technology, investment and expertise, for both coal liquefaction and oil shale extraction, are attracted to Australia. This would ensure that in a crisis situation Australia would have the ability to ramp up local production. Assisting these industries to establish a presence in Australia, while at the same time recognising environmental concerns, would give the Federal Government options in the case of an international emergency.

Australia's vital offshore oil and gas platforms install and implement sophisticated surveillance technologies and the Federal Government provides a rapid response capability for such facilities to protect against either hostage situations or intentional destruction. In addition, however, an enhanced program of incident response exercising should be instituted by Defence and security organisations.

Australia needs to consider the vulnerabilities of domestic energy supplies as well as those transported from overseas. For Vital National Installations (VNI) such as offshore oil and gas platforms, natural gas pipelines and major oil refineries, there remain a number of vulnerabilities which need to be reviewed. Growing reliance on imported oil means that the relative importance of certain VNI is actually increasing over time. It should be noted that, in recent years, there have been a number of improvements in all areas of VNI protection. Despite this, offshore oil and gas platforms, critical to Australia's economy, remain relatively unprotected in some areas. While maritime surveillance has improved, it remains possible that terrorist or sabotage units could take control of one, or more, offshore oil and gas platforms, as has happened recently in Nigeria.

Coal

Investment in ultra-clean coal, and other associated forms of clean coal technology, should be prioritised so that coal can continue as an important power source.

Australia should take greater advantage of existing coal reserves and utilise ultra-clean coal (UCC) and other technologies which make using this fuel source cleaner. Abundant coal resources have been a major export earner. However, the fact that some of Australia's coal resources are less pollutant than others should be turned to Australia's advantage. Carbon sequestration is but one example of how the coal industry can adapt itself to continue to be relevant in the 21st Century. Moreover, Australia needs to focus more on the development of UCC technologies, which would contribute to minimise environmental concerns as well as helping ensure that the Australian coal industry could benefit from some vertical integration, or value-added, aspects of the market. Furthermore, by participating in the new climate agreement — the Asia-Pacific Partnership for clean development, energy security, and climate change — Australia will help emerging economies and be able to transfer such technologies as UCC which will further improve the environmental impact of existing industries in the Asia-Pacific region. Australia should take a leadership role in UCC and carbon sequestration technologies and assist emerging economies, such as the PRC and India, who rely heavily on coal.

Nuclear Life Cycle

It is now time for Australia to undertake a complete review of new nuclear technologies, such as thorium-based and pebble-bed reactors.

Government policies opting out of conventional nuclear power generation were feasible, and may have been desirable, until this point. The safety, environmental friendliness, efficiencies, and potential benefits of new forms of smaller reactors for the decentralisation of power generation cannot be ignored. In the Australian environment, they could provide remote area power sources "leapfrogging" the need for increasingly costly investment in a massive national grid. Australia must now undertake a complete review of new, safer nuclear power generation options offered by thorium-based reactors and pebble-bed reactors. Our proven, large resources of thorium and uranium could give the country a major strategic advantage.

Federal and State governments should undertake a complete review of the entire nuclear life cycle.

Australia must, in parallel with a study of new nuclear technologies, reconsider all aspects of the nuclear life cycle. This includes the extraction and refinement of both thorium and uranium as well as the question of responsible nuclear waste storage. Australia is uniquely positioned to participate in all of these tasks. Even without Australia's involvement, this industry will continue to grow and expand. From a security perspective, as well as a strategic point of view, it is better to have legislative control over the safeguards to ensure that world's best practices are established, maintained and enforced. Australia is a nation stable both geologically and politically. It could play a key international strategic role in the nuclear life cycle, including extraction, refinement, and the storage of nuclear waste generated from Australian sources.

Alternative Energy Sources

Federal and State governments should consider implementing appropriate zoning concessions for biomass refineries, as well as specifically targeted tax incentives for primary producers producing biomass inputs within an economically feasible distance from these refineries.

Australia has a significant agricultural industry. This gives it the option to pursue to a greater extent fuel sources derived from agricultural production. Australia has the ability to take advantage of global energy market conditions to participate and contribute to the development of new, agriculturally-based biomass refineries. These refineries, as Brazil has shown, can provide both electric power and liquid forms of energy for motive power, often using waste from existing agricultural production. As with the new forms of nuclear power, renewable power from biomass is assuming new potential in the 21st Century. Dedicated refinery capacity for biomass in its various forms must be considered at a commercial level within the coming decade.

Appendix C

Evolving Amphyctionies of the 21st Century: How Nuclear Weapons Regulatory Modalities Structure Strategic Frameworks: India, the US, Australia, and Regional pressures

Future Directions International (FDI) Research Manager, Andrew Pickford, presented the following paper on July 3, 2006, at a conference in Delphi, Greece, hosted by the European Cultural Centre of Delphi. The conference, *Cultural Amphictyony 2006: The role of the United Nations in the 21st Century*, ran from July 1-6, 2006. The paper considers changing global energy demand and supply patterns as well as the possibility of the emergence of new organisations, or amphyctionies, in the Indian Ocean Region. Australia's position in this new global energy framework is also reviewed. The paper also discusses the potential for thorium-based energy to become a key energy source in the coming century and possible Australia-US-India collaboration. Importantly, the paper draws upon the FDI landmark report *Australia's Energy Options* which continues to contribute to energy debate in Australia.

Abstract:

Existing international organisations, including the United Nations (UN), and treaties, such as the Non-Proliferation Treaty (NPT), reflect types of power structures which will become increasingly disconnected from reality. The five permanent members of the UN Security Council — the United States, the United Kingdom, Russia, France and China — are all victors of World War II as well as official nuclear weapons states under the NPT. However, in the coming decade, new nuclear technologies — required to meet the expanding domestic energy requirements of nations such as China and India — are forcing states to reconsider their approaches to existing amphyctionies, such as the NPT. Yet, before these amphyctionies become redundant, existing nuclear weapons regulatory modalities will continue to structure strategic frameworks. As part of this process it appears that the Indian Ocean Region may become the site of the unravelling of a number of existing institutions and treaties as well as the potential place where new amphyctionies are created.

International relations and international security are nearly always seen through the prism of existing treaties, conventions and international organisations. That is why any discussion on nuclear weapons proliferation inevitably revolves around the Non-Proliferation Treaty (NPT) which was crafted against the backdrop of the Cold War. This leads to the question: is an amphictyony formulated in the 1960s relevant for today's challenges? Will the NPT exist in, say, 2060? Why are amphyctionies created in the first place? What are the alternatives?

This paper is not criticising the NPT, as broadly speaking it has been a great success and has achieved its goals. However, a review of the NPT inevitability looks backward. The continued relevance of the NPT requires an understanding of the contextual issues driving national-level policy making on a number of inter-related subjects. In the 21st century concerns over nuclear proliferation now sit aside energy security[19] and the threat of global warming. Each of these

[19] Energy security is set to become an increasingly critical issue. Every day around 40-million barrels of oil cross the world's oceans on tankers. Projections indicate that this number could increase to 67-million barrels by 2020. Daniel Yergin, The *Global Context*, testimony to the US House of Representatives Committee on Energy and Commence, May 4, 2006.

issues is subject to numerous interpretations. Nonetheless these three issues are influencing national strategic priorities as ever before. Accordingly, the NPT is increasingly being treated as a legacy treaty, rather than as a tool to achieve future security, peace and prosperity.

Contemporary discussions on the NPT do not take into account:

- historical and economic forces,
- changes in the global power structure since 1945 and 1968,
- technological trends which have, throughout history, placed various weapons and their ultimate countermeasures within a time-based contextual relevance, or
- increased energy demands of the 21st Century by so-called "developing countries".

While current amphyctionies, such as the NPT, structure strategic frameworks, new realities must be considered. In the short-term, the governments of Australia, the US and India will talk, and act, in terms of current international regulations and rules which are laid down in the NPT. However, as time passes, it is possible that the NPT will not continue in its current form, or even exist by 2020.

There is a risk of thinking that current amphyctionies are permanent and will never change. All societies throughout history are guilty of this to some extent. The Great Amphictyonic League, responsible for the Oracle at Delphi, lasted more than 1,200 years and was based on common principles. The operating principles of this well-known amphictyony were not prescriptive. Yet, even this famous amphictyony became outdated and eventually ceased to exist. In comparison, the League of Nations was an extremely brief experiment. Other organisations have had even shorter life spans; indeed, they are tools appropriate to the tasks and challenges of their time.

Interestingly, the Delphi Amphictyony prohibited members of the organisation from sabotaging water supplies when individual members went to war. A set of underlying, or universal, values also saw the cessation of military hostilities between members when the Olympic Games were in session.

In the contemporary era, the NPT was created from an international effort to constrain the acquisition and use of nuclear weapons. Unlike traditional conflict waged by armies in ancient times, a nuclear exchange would be immediately catastrophic. In terms of the original aims of the NPT, it has generally experienced great success. Ten years ago — after the NPT signatories agreed to make the treaty permanent — it appeared as if the treaty was close to achieving its aim. And despite a relatively small number of cases when the treaty was violated by member states, it must be remembered that the NPT was extremely successful and signed by all but three nations: Israel, India and Pakistan.

It made sense when technology and global power resembled the written text. However, during the 1990s, after the "peace dividend" was spent, conflicts which were frozen during the Cold War re-emerged, and did not necessarily feel constrained by accords to which they were not party. Technologies which kept societies apart fuelled globalisation and levelled the playing field.

In 2006, so-called "developing nations" and non-traditional nuclear powers are challenging the relevance of the treaty, especially with the strategic emergence of India. This was partly due to the effect of the end of what academics term the "post-Cold War" period. More importantly, it is increasingly because of the underlying philosophy of the NPT. The treaty attempted to stop time in 1968, just as the UN attempted to stop time in 1945. Without the politics of current debates over restructuring the UN Security Council, the composition of the five major powers would be markedly different, as would an "official" NPT nuclear state.

Historically, attempting to limit the spread of technology, particularly nuclear technology, is rarely, if ever, successful. Given the necessary resources all cultures and groups can quickly gain a command of technology and will frequently improve it. The International Strategic Studies Association, based in Washington DC, has completed important work on strategic relations and nuclear issues for over three decades. In 1989, its publication, *Defense & Foreign Affairs,* noted that:

"Two major technologies increasingly dominate the strategic balance in the world; technologies which for the past three decades had been the province only of the superpowers or global powers: the submarine and the ballistic missile. Submarine proliferation has occurred gradually, and it takes few of us by surprise. Only the clear trend toward acquisition of nuclear-powered submarines by the so-called developing states comes as a shock to analysts in the major powers. This should not be so, but we have conditioned ourselves to thinking that anything with the word "nuclear" attached to it is reserved for the major powers. In reality it is only the cost which constrains the developing states from acquisition of any of these items. And, of course, today we must redefine our concepts of "developing states"."[20]

And while in 1968 very few countries had a capacity to run nuclear programmes, the capability to produce nuclear weapons, or nuclear power submarines, is today very different. In 2003, estimates suggest as many as 35-40 countries could, if they chose, produce nuclear weapons.[21] Over the last few decades, the economic cost of acquiring nuclear technologies declined. As this occurred "developing states" such as the China and India, plan for major strategic expansion and industrialisation which will require a large, continuous supply of base-load electricity generation.

Based on "clean sheet" analysis of their future energy needs — without the presence of an established environmental lobby — nuclear power became a key part of the planned energy mix in a number of "developing states", especially in China and India. India plans to expand its nuclear capacity 10-fold by 2022, and 100-fold by mid-century.[22] By 2020 China plans to reach an installed capacity of 40 gigawatts (from 6.5 gigawatts in 2005) accounting for four percent of total domestic energy supplies.[23]

This rapid shift towards nuclear power in China and India is being echoed worldwide. The International Atomic Energy Agency forecasts worldwide nuclear generation capacity to grow between 22 percent and 44 percent from 2006 to 2025.[24] In a number of industrialised nations nuclear power is being repositioned as a "green" power source which does not produce any greenhouse gases. On May 25, 2006, US Pres. George W. Bush stated "Let's quit the debate about whether greenhouse gases are caused by mankind or by natural causes; let's just focus on

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[20] Early Warning, *Defense & Foreign Affairs*, Volume XVII, Number 10, October 1989, Page 3.

[21] Mohamed Elbaradei, Director-General of the International Atomic Energy Agency, "Towards a Safer World", *The Economist*, October 18-24, 2003, pp 51 -52.

[22] IAEA Director General Dr. Mohamed ElBaradei, Nuclear Power: Preparing for the Future, March 25, 2005, http://www.iaea.org/NewsCenter/Statements/2005/ebsp2005n004.html

[23] On May 12, 2006, China connected its largest nuclear generator to the national power grid reflecting a continued drive towards increasing nuclear power in the energy mix. Once complete, Tianwan Nuclear Station in Lianyungang City, Jiangsu province, will have an installed capacity of 2,120 megawatts. When it enters full operation the plant will increase China's nuclear power capacity by 30 percent, from 7,000 megawatts to 9,000 megawatts. The design is based on Russian pressurised technology and forms part of the 11th five-year plan of 2006-2010. China's largest nuclear generator joins power grid, *People's Daily Online*, May 16, 2006, http://english.peopledaily.com.cn/200605/15/print20060515_265723.html

[24] Global Uranium Resources to Meet Projected Demand, The International Atomic Energy Agency, June 2, 2006, http://www.iaea.org/NewsCenter/News/2006/uranium_resources.html

technologies that deal with the issue. Nuclear power will help us deal with the issue of greenhouse gases."[25]

The increase in fossil fuel prices makes nuclear power a more attractive solution for domestic energy needs internationally. A number of countries are planning to maintain, or increase, the use of nuclear power in their energy mix. This transition has been made urgent as after Chernobyl in 1986 there have been virtually no new nuclear reactors built in the west. Furthermore, a number of the existing 440 nuclear reactors worldwide are now reaching the end of their operational lives, which is set to cause major gaps in base-load electricity generation capabilities. While new forms of energy have assisted in diversifying the energy mix it has not altered the fact that nuclear power satisfies a significant component of base-load electricity demand.

Plans for new domestic nuclear power programmes include:

- **Britain:** On May 17, 2006, British Prime Minister Tony Blair raised the prospect of a new generation of nuclear power plants which would be needed to address declining indigenous fossil fuel sources, ageing nuclear power plants[26] and concern over greenhouse emissions.[27]
- **Russia:** On May 17, 2006, it was announced that Russia was planning to commission at least two nuclear reactors a year beginning in 2010. Sergei Kiriyenko, head of the Federal Atomic Energy Agency, stated that the programme would start with the construction next year of a new nuclear power plant with four reactors near St Petersburg, adjacent to the existing nuclear plant in Sosnovy Bor.[28]
- **Indonesia:** Indonesia is planning its first nuclear power plant on Java by 2015 which will have a capacity of 1,000 megawatts in the first phase with capacity increasing to 4,000 megawatts.[29]
- **Vietnam:** Vietnam plans to begin operating its first nuclear power plant between 2015 and 2020 with an output between 1,400 and 4,000 megawatts.[30]

As the demand for energy, and nuclear energy, has progressively increased, it is important to remember that the nuclear industry was itself a product of a conflict which finished in 1991. Consequently, nuclear power technologies initially were selected because of the needs of 1950s nuclear weapons programmes and not the industrialisation of nations such as India and China. "In the 1950s, during the Eisenhower Administration in the United States, it was decided to go with the uranium option [over such energy forms as thorium] because of the capability of the reactors

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[25] President George W. Bush, "President Discusses Energy During Visit to Nuclear Generating Station in Pennsylvania", Limerick Generating Station, Pottstown, Pennsylvania, May 24, 2006, http://www.whitehouse.gov/news/releases/2006/05/20060524-5.html

[26] At present Britain's 12 nuclear plants provide 22 percent of the nation's electricity. If these plants are not replaced there will only be three stations functioning by 2020.

[27] Peter Wilson, Blair turns N-power switch to go, *The Australian*, May 18, 2006, page 9.

[28] In 2006 nuclear power accounted for around 17 percent of Russia's electricity generation. The Russian Government has set a target to raise its share to 25 percent by 2030. Kiriyenko said that Russia would have to build a total of 40 new reactors to fulfill the goal. N-boost for Russia, *The Sydney Morning Herald*, May 19, 2006, http://www.smh.com.au/news/world/nboost-for-russia/2006/05/18/1147545460857.html

[29] Indonesian minister says country to have major nuclear plant by 2015, *Forbes Online*, May 14, 2006, http://www.forbes.com/home/feeds/afx/2006/05/14/afx2744330.html

[30] Tatsuo Ikenaga, Vietnam and Indonesia look to nuclear power, *World Peace Herald*, http://www.wpherald.com/storyview.php?StoryID=20051129-043843-3095r

to produce fissionable output, in other words, output that's suitable for nuclear weapons."[31] Only with the confluence of high fossil fuel prices and the emergence of nuclear power designed purely for commercial applications has the focus shifted away from Cold-War style nuclear power plants. This has seen the development of new thorium-based reactors which could provide an answer to nearly all proliferation concerns. The new forms of nuclear power will be discussed later.

Aside from Cold-War priorities bureaucratic inertia also slowed the change to new energy sources. Public servants' work revolves around existing institutions, technologies and treaties. It makes sense to think in terms of what your career is based on. Propositions to alter, change, or even remove an institution, will result in protests that has very little to do with the issue itself. This will ensure that debate is focused on the access to, and control of, contemporary nuclear technology. However, this fails to take into account the fact that energy related technologies, as well as their military applications, are always evolving. And despite resistance by bureaucracies, as well as those with a great deal personally invested in the current non-proliferation regime, there is no reason why this amphictyony, the NPT, will survive the fate of now defunct organisations.

To last 1,200 years, like the Great Delphic Amphictyony, organisations must be flexible and based on shared values rather than a limited list of states holding specific technologies.

In 2006, significant global changes are threatening the viability of the NPT as the cornerstone of non-proliferation. These shifts have been occurring since the high-water mark of the NPT in 1995, but in recent years have been accelerated. It was geopolitical concerns which led the US to look towards India as a strategic partner and saw the US and India craft a nuclear deal which changed the *status quo*.[32] Dr Philip Zelikow, Counselor to the US Secretary of State, outlined the underlying rationale of elevated US-India relations as creating an "anchor" in South Asia, just as Japan and England became US allies and "anchors" of the Eurasia landmass post World War II.[33]

The US deal to supply India with nuclear technology — in return for separating its military and civilian facilities and the opening of India's civilian nuclear capacity under international inspection — has inevitably weakened the NPT. The bilateral deal would make India a "special case" which sits outside the NPT, but opens a number of its nuclear power plants up to safeguards demanded by the treaty. Somewhat in a contradiction of sorts, nuclear weapons modalities, in this case the NPT, structured the strategic framework which would undermine the long-term viability of the treaty.

Before these issues are examined it is useful to consider the separate, but related, issue of global warming and the emergence of a new grouping of nations known as "The Asia-Pacific Partnership on Clean Development and Climate". This group was launched by US President George W. Bush on July 27, 2005, and then solidified at the inaugural ministerial meeting in Sydney, Australia on January 12, 2006.[34] Running contrary to the prescriptive nature of Kyoto the new organisation worked on the basis of a "non-binding" compact to develop cost-effective and cleaner technologies. Not only does this grouping contain six nations comprising over half of global GDP, it includes Australia, India and the US. The Asia-Pacific Partnership is critical in

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[31] Gregory Copley, Energy experts look to alternative Aust source, *Australian Broadcasting Corporation*, April 13, 2006 http://www.abc.net.au/lateline/content/2006/s1616273.htm

[32] *The Economist*, "Dr Strangedeal", March 11, 2006, p 9.

[33] Dr Philip Zelikow, The US-India Strategic Partnership: The Nuclear Deal and Beyond, *The American Enterprise Institute*, http://www.aei.org/events/filter.all,eventID.1331/transcript.asp

[34] See: Asia-Pacific Partnership on Clean Development and Climate, Inaugural Ministerial Meeting - Sydney, January 2006 http://www.dfat.gov.au/environment/climate/ap6/index.html

understanding the new strategic environment as it was unveiled 9 days after the US and India had announced their historic nuclear agreement.[35] In the 21st century, energy security, nuclear proliferation and global warming concerns are to be dealt with through new institutions reflecting the shifting focus of economic activity away from the Atlantic and towards Asia.

In this environment — where large and fast growing Asian nations would expand their use of nuclear power — assured access to uranium has become more important. In February 2006, the US raised the prospect of a *Global Nuclear Energy Plan* (GNEP)[36] which would deal with proliferation concerns as well as the increased energy needs of nations expanding their domestic nuclear industry.[37] The GNEP envisages a "cradle-to-grave"[38] fuel-leasing programme that would incorporate taking back spent nuclear fuel for re-processing from user nations, which could only operate nuclear power plants.[39]

Suddenly two Commonwealth countries — both former British colonies — Australia and Canada, have become significant energy players. Between them they account for half of the world's production of uranium from mines[40] and hold 42 percent of known recoverable reserves. On May 18, 2006, Australian Prime Minister John Howard made this point to a joint sitting of the Canadian Parliament, in Ottawa, Canada:

"In the energy area which is of course allied to climate change, Canada and Australia have much in common. We are the holders of the largest uranium reserves in the world and both of us must work together in relation to the recently proposed global nuclear energy partnership which seeks laudably to control proliferation, but we must as the holders of these vast uranium reserves, ensure that that particular partnership does not work against the interests of countries such as Canada and Australia."[41]

On May 19, 2006, one day after the Australian Prime Minister addressed Canada's Parliament, both he and the Canadian Prime Minister Stephen Harper reiterated that they would closely monitor the development of the US proposed GNEP and opened the option of Canada joining The

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[35] Amit Baruah, "India, U.S. clinch deal on nuclear separation", *The Hindu*, March 3, 2006, http://www.thehindu.com/2006/03/03/stories/2006030310640100.htm

[36] The US Department of Energy website describers the GNEP: "As part of President Bush's Advanced Energy Initiative, the Global Nuclear Energy Partnership (GNEP) seeks to develop worldwide consensus on enabling expanded use of economical, carbon-free nuclear energy to meet growing electricity demand. This will use a nuclear fuel cycle that enhances energy security, while promoting non-proliferation. It would achieve its goal by having nations with secure, advanced nuclear capabilities provide fuel services — fresh fuel and recovery of used fuel — to other nations who agree to employ nuclear energy for power generation purposes only. The closed fuel cycle model envisioned by this partnership requires development and deployment of technologies that enable recycling and consumption of long-lived radioactive waste." http://www.gnep.energy.gov/

[37] Components of the GNEP were released during 2005. However, the policy did not become codified until January 2006. For a review of the GNEP see: Peter Baker & Dafna Linzer, "Nuclear Energy Plan Would Use Spent Fuel", *The Washington Post*, January 26, 2006, page A01.

[38] US Energy Secretary Sam Bodman at the 2005 Carnegie Endowment for International Peace, Non-Proliferation Treaty lecture, raised the "cradle-to-grave" concept on November 7, 2005. http://www.carnegieendowment.org/static/npp/2005conference/presentations/bodman_remarks.pdf

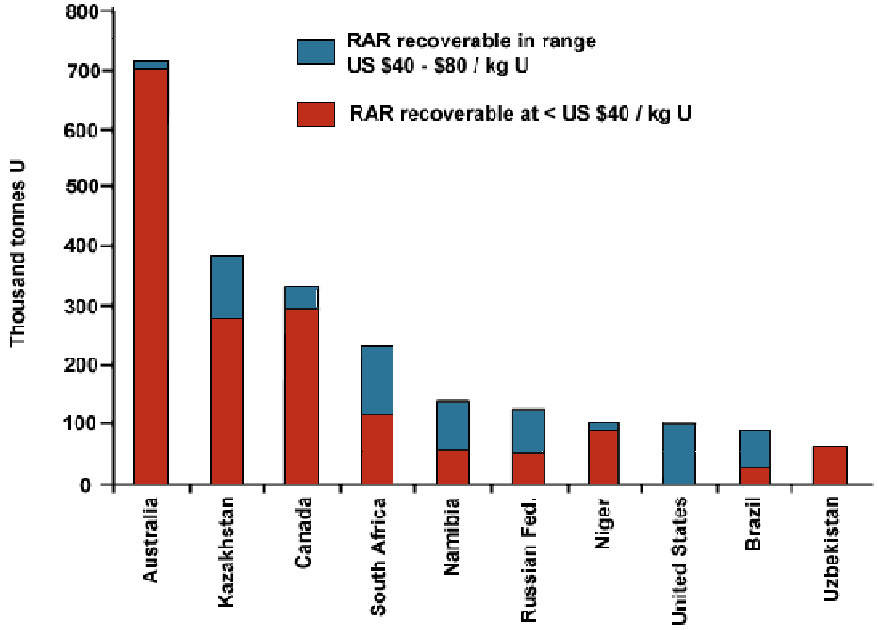
[39] Steve Lewis, "PM wants in on N-Pact", *The Australian*, May 13-14, 2006, page 7.

[40] "World Uranium Mining", Nuclear Issues Briefing Paper 41, *Uranium Information Centre*, July 2005 http://www.uic.com.au/nip41.htm

[41] The Hon. John Howard, Prime Minister of the Commonwealth of Australia, address to a Joint Sitting of Canadian Federal Parliament, Ottawa, Canada, May 18, 2006, http://www.pm.gov.au/news/speeches/speech1943.html

Asia-Pacific Partnership on Clean Development and Climate.[42] While Canada and Australia are not often associated as joint players on the world stage, they have considerable institutional experience working together on issues such as consular services for each other's citizens[43] and at the United Nations[44] as well as sharing common heritage, language and institutions which would make collaborating on uranium and nuclear issues a viable proposition.

Known Recoverable Resources of Uranium[45]



RAR: Reasonably Assured Resources

In June 2006, questions remain over the possibility of a Canadian-Australian uranium suppliers group and more broadly on the viability of the GNEP. A number of nations have expressed concern over the strategic implications of the GNEP where the US could maintain long-term control over the nuclear fuel cycle. Critics of the GNEP argue that it depends on yet to be proven technology and may undermine existing institutions. Also, the US Congress still has to approve the proposed US-India nuclear agreements which will confirm India as a "special case" outside the NPT and agree to fund the Asia-Pacific Partnership. These issues may be further clouded by US Congressional mid-term elections which are to be held in November 2006, meaning that Presidential and Congressional interests may diverge sharply.

In spite of these political uncertainties, the intersection of energy security, nuclear proliferation concerns and global warming leads to an insightful clue regarding interaction between Australia,

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[42] The full text of the press conference can be found at: http://www.pm.gov.au/news/interviews/Interview1944.html

[43] Canada provides consular services for Australia in 22 countries and Australia provides consular services for Canada in 20 countries.

[44] Canada and Australia operate collectively at the United Nations through CANZ (Canada-Australia-New Zealand).

[45] Information and charts from: "Supply of Uranium", UIC Nuclear Issues Briefing Paper # 75, Uranium Information Centre, September 2005, http://www.uic.com.au/nip75.htm *Reasonably Assured Resources plus Inferred Resources, to US$ 80/kg U, 1/1/03, from OECD NEA & IAEA, Uranium 2003: Resources, Production and Demand, updated 2005 by Geoscience Aust.*

India and the shape of future amphyctionies in the 21st century. Discussions between these three nations revealed the extent to which the NPT dictated the strategic framework, but also showed how new amphyctionies, such as the Asia-Pacific Partnership for Clean Development and Climate and the GNEP, could act as a conduit for new strategic relationships. Similarly, an emerging amphyctiony, the Shanghai Cooperation Organisation — originally established to combat terrorism in Central Asia — is now emerging as a Chinese centred grouping where energy security concerns are a key denominator. At the most recent meeting of the SCO on June 15, 2006, Russian President Vladimir Putin urged the formation of a "SCO energy club" as it involves some of the biggest energy exporters and importers.[46]

There may also be a different trajectory to the nuclear power and proliferation debate. Research on alternative nuclear technology utilising thorium, instead of uranium, could hold the answer for many of the questions left unanswered by the GNEP. Thorium is an ideal energy source material. It has a high energy density and its nuclear burning discharges nothing to the air, water or land. Its waste stream lacks the large amounts of plutonium and long life wastes produced by the fission of U235 near to U238. This means that there is no weapons-grade U235 or plutonium output, and at the same time there is less, and yet more manageable, waste by a dramatic degree.[47]

On October 6, 2005, Future Directions International, an Australian-based strategic level think-tank, launched a study titled: *Australia's Energy Options* in the federal parliament of the national capital, Canberra. The report called for a full and open debate on nuclear power and highlighted the benefits of new thorium technology.

Thorium, in the context of the early stages of the Cold-War, was dismissed as a power source as it did not produce the desired by-products of plutonium.[48] Yet, in today's environment, it has all of the attributes which may make it a favoured energy source as early as the 2020s or 2030s. In addition, India, which presently sits outside of the NPT and has broad nuclear ambitions, holds large reserves of thorium, second only to Australia. As a consequence, India is undertaking significant work on indigenous thorium technologies.[49] It should be remembered that it was international sanctions which led South Africa to develop the Pebble-Bed Modular Reactor as an answer to limited domestic energy suppliers as well as coal liquefaction technology for transport fuel supplies.

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[46] Rowan Callick, Shanghai group's power play, *The Australian*, June 16, 2006.

[47] *Australia's Energy Options*, Future Directions International, October 2005.

[48] For a detailed overview on the potential of thorium see: Rina Garner, Thorium: The New Alternative Energy, ABC Online, http://www.abc.net.au/melbourne/stories/s1616020.htm

[49] M.R. Srinivasan, "Nuclear power for the 21st century", *The Hindu*, April 18, 2005, http://www.hinduonnet.com/thehindu/thscrip/print.pl?file=2005041803851000.htm&date=2005/04/18/&prd=th& "It is because of the large energy potential of thorium that India has embarked on a large programme for thorium utilisation. An important step in this effort is the rapid construction of a series of fast reactors using the plutonium in the spent fuel of the first stage PHWRs. Research and development are under way to use metallic fuel in fast reactors, in place of the oxide fuel to used in the PFBR, which promises to breed new nuclear fuel faster. Another method of using thorium as an energy source is the development of Accelerator Driven Systems (ADS) where a sub-critical nuclear reactor is used to generate power."

World Thorium Resources
(economically extractable)

Country	Reserves (tonnes)
Australia	300,000
India	290,000
Norway	170,000
USA	160,000
Canada	100,000
South Africa	35,000
Brazil	16,000
Other countries	95,000
World total	1,200,000

US Geological Survey, Mineral Commodity Summaries, January 1999[50]

The Future Directions International report, *Australia's Energy Options*, considered the strategic implications of thorium technology being developed in the US and what it may mean should thorium surpass uranium as the preferred fuel source for the 21st century:

Research currently underway at the University of California aims to remove some of the technical challenges which had in the past limited thorium conversion reactors from becoming a reality. The focus of this research involves both reducing the temperature needed for the reactor to function, and adding a reliable, safety feature, such as a self-regulating attribute. As these features become operational, the reactor can be made small, compact, and have a high power density because the self-regulating attribute is an autonomous property of the fuel itself. An energy source such as this would have a number of practical applications, not least the safe, reliable generation of electricity, even down to community or industrial project level.

These small thorium reactors could produce high-temperature, low-cost steam to drive electric power turbines. And as with PBMR [Pebble-Bed Modular Reactor] technology, the steam could be used for process heat applications such as desalinisation and other water purification functions, or for the synthesis of hydrogen.

The thorium-based reactor project uses newer technology than the PBMR. As recently as March 4, 2005, and March 30, 2005, for example, its pioneers — Charles S. Holden and Dr Tak Pui Lou, both based in the San Francisco area, and engaged in the thorium reactor project with the University of California — filed provisional patents protecting an alloy which comprises an inert metal matrix for the ceramic thorium fuel. Quite apart from the direct generation of electricity, or heat for water desalination, Holden's Thorenco LLC company indicates[51] that the small, thorium-based reactors would be able to generate the hot steam needed in the field to steam out the hydrocarbons from the oil shale in the Western United States, or the tar sands of Canada, or the

[50] As quoted in: Uranium Information Centre, "UIC Nuclear Issues Briefing Paper # 67", November 2004, http://www.uic.com.au/nip67.htm.

[51] Holden, Charles S., Executive Summary, Thorenco LLC's Proprietary Inert Metal Matrix for a Thorium Fuelled Reactor Allows for Significantly Cleaner Nuclear Energy Production. Thorenco LLC, June 24, 2005.

very heavy crude oil from Venezuela's Lake Maracaibo area. In this respect, the reactors could also assist in releasing the fossil fuel potential of Australia's own oil shale deposits.

Echoing the calls of the Future Directions International report, on June 6, 2006, the Australian Prime Minister John Howard announced an inquiry into "Uranium Processing and Nuclear Energy in Australia". [52] Australia's current involvement in the global nuclear industry is limited to three uranium mines. Any policy change to allow enrichment, nuclear power, waste storage or reprocessing could align Australia more closely with the US-proposed GNEP. While a nuclear debate takes place domestically within Australia, the international ramifications of a policy change could impact on new amphyctionies. In fact, the broader global context which the Australian nuclear inquiry is taking place only crystallised in early 2006. It was during the Australian Prime Minister's May 2006 visit to the US and Canada that it became evident proliferation issues, energy security and climate change could not be untangled and would be addressed simultaneously.

Interestingly, the terms of reference of the nuclear inquiry of the Australian Government allude to the interrelated issues of energy security, the threat of global warming and proliferation concerns. Media attention in the early stage of the debate over the nuclear fuel cycle is already making reference to growing energy demand from China and India[53] and the potential for thorium as an alternative to existing uranium-based nuclear technology.[54] While the nuclear inquiry is not due to report until the end of 2006, it is likely that a national nuclear debate will cover issues associated with the NPT and the proposed US-India deal to supply India with nuclear technology.

From a geopolitical perspective — considering the implications of a successful US-India strategic partnership and approval of the nuclear deal by US Congress — assured uranium supply will become increasingly important. This issue was not overlooked within Australia. Consequently, at the Australian strategic policy making level, there is significant interest in the elevation of India as a partner of the US and a renewed effort to nurture the often-neglected Australian-Indian relationship.

In this new strategic environment strong US-Australia relations and improving Australia-India relations may place a premium on shared, new technology, safe supply of enriched uranium and thorium and practical measures to address global warming rather than the longevity of the NPT. This could see the formation of new amphyctionies, made up of an informal grouping of nations including the US, Australia, India and perhaps Canada and Britain, where the US would not necessarily be the dominant nation. This contrasts with the "hub-and-spoke" system of alliances the US crafted post-World War II when Washington was the central and dominant power.

The stakes of proliferation are indeed high; however, so are the concerns over climate change and energy security. Regardless of the actual threat posed by these three policy issues, decision makers will act according to electoral imperatives and national interests which may not prioritise the survival of the NPT. If this occurs, new organisations — such as the GNEP and the Asia-Pacific Partnership for Clean Development and Climate — as well as new thorium technologies could form the basis for new amphyctionies centred on the Indian Ocean. There are already signs of the emergence of the Chinese-based Shanghai Cooperation Organisation as an energy grouping. Following the rise of India as a strategic power it appears possible than an alternative

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[52] Full details of the inquiry can be found at: http://www.pm.gov.au/news/media_releases/media_Release1965.html

[53] For example see: Torrance Mendez, Nuclear Answer to Water Crisis, *The West Australian*, June 10, 2006, p 14.

[54] Australian Broadcasting Corporation, Physicist suggests thorium as uranium alternative, *The World Today*, June 7, 2006, http://www.abc.net.au/worldtoday/content/2006/s1657467.htm

energy *bloc* — sharing technology, uranium and thorium — links New Delhi with a number of other English-speaking nations.

In conclusion, discussing the future of the NPT can be very emotive and it must be noted that many of the scenarios outlined in this paper are speculative. However, as with all historical periods experiencing major geopolitical realignment, the amphyctionies in place after upheaval infrequently resemble that at the beginning of major change. Regardless of the current international framework, both the shift in economic activity from the Atlantic to Asia and the distribution of natural resources such as thorium and uranium will see so-called "developing states", especially India, challenging the 1945 and 1968 *status quo*. These changes to the international system may not necessarily be confrontational. However, it will undoubtedly be driven by the terms of the NPT. As in the past, an outdated amphyctiony may form the framework for the formation of new amphyctionies.