Is Nuclear Technology the Answer to Asia's Energy Future?

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The use of nuclear energy will, and should, continue to grow within the Asian region. However, it is not, and cannot, be the sole answer to the increasing demand for energy in Asia. The answer to Asia's energy future will come from increasing nuclear and renewable energy, increasing energy efficiency and decreasing the consumption of, and reliance on, fossil fuels. This essay will seek to demonstrate this argument by addressing four separate components. The first will examine the resources that currently provide Asia's energy and those which are predicted to provide Asia's energy in the future. Secondly, this essay will examine energy security, the lack thereof within the Asian region, and whether nuclear energy can provide greater energy security. The third component of this essay will examine the risks associated with nuclear energy and will primarily focus on nuclear terrorism and nuclear weapons. Lastly, this essay will argue that to increase energy stability, to meet increasing demand and to enable greater regional security, Asia must diversify its energy sources, reduce fossil fuel consumption and enhance efficiency.

Current energy consumption in Asia is overwhelmingly generated by the use of fossil fuels (International Energy Agency 2012, 6). In 2011, within the Asia-Pacific region, the sources of primary energy were as follows: over 50 per cent came from coal, 30 per cent from oil, roughly 10 per cent from natural gas (all fossil fuels), 3 per cent from nuclear energy and approximately 7 per cent from renewable technologies (British Petroleum 2012, 23). At current levels of global consumption, Asia accounts for 44 per cent of total world consumption of energy, 40 per cent of oil consumption, 37 per cent of natural gas consumption and roughly 67 per cent of global coal consumption (British Petroleum 2011). The overwhelming majority of this energy consumption comes from imported sources, and it is this import orientated Asian energy market that makes it so exposed to market fluctuations. The International Energy Agency (IEA) reported that in 2012, China was the second largest net importer of crude oil, followed by Japan, India and South Korea (IEA 2012, 23). Japan was also the largest net importer of natural gas, South Korea fifth, and China, Japan, South Korea, India and Chinese Taipei were the five largest net importers of coal(IEA 2012, 15). Further exacerbating the reliance on imported sources, the Asia Development Bank projects that energy demand for Asia will increase by 50 per cent every decade for three decades between 2000-2030 (Asia Development Bank 2009). Of this massive energy increase, fossil fuels are expected to contribute roughly 90 per cent — 35 per cent from oil, 30 per cent from natural gas and 26 per cent from coal (Ito, Li & Komiyama 2005, 3955).

This expected increase in Asia's consumption of fossil fuels will only continue to deepen Asia's energy conundrum. As Asia consumes more energy to meet its massively growing demand, its reliance on fossil fuels exacerbates potential for mass energy shortages and abrupt price fluctuations. It is estimated that 1114 trillion barrels of oil remain and that production peaked in 2010; between 2006 and 2015 some 37.5 million barrels of oil will be required per day (Prasetyono 2008, 214; IEA 2007). However, the largest oil producers recently announced a plan to increase their production to a combined 25 mbd to 2015, creating a looming energy catastrophe as a further 12.5 mbd of oil will still be needed to meet demand (IEA 2007). This continuing reduction of reserves, increasing prices and market volatility, is forcing states to examine alternative forms of energy and diversification of the energy supply. Further compounding Asia's reliance on fossil fuels is the fact that both gas and coal consumption are predicted to grow considerably, taken from dwindling global reserves that offer less than 100 years of different demand (British Petroleum 2004; Ito, Li & Komiyama 2005, 3956-7). The energy demands of Asia are, and are expected to remain, sourced from traditional fossil fuel technologies. But the continuing reliance on what is a non-renewable and finite

resource has resulted in significant Asian energy insecurity.

The significant increase in fossil fuel consumption in conjunction with possible shortages as a result of decreasing reserves has resulted in a serious Asian energy insecurity dilemma (Hippel, Suzuki, Williams, Savage & Hayes 2011, 6721). The energy security definition used throughout this essay is taken from the International Energy Agency (2007, 2), which defines energy security as the provision of reliable, affordable energy sources. The oil that provides such a large component of Asia's energy supply is Dubai Crude, sourced exclusively from the Middle East. The massive Asian reliance on Dubai Crude has directly led to a significant increase in the price of the resource, stretching the market and increasing its volatility (Lai 2009, 6). In 1996 the price per barrel of Dubai Crude was only US$18.5; by 2000 it was US$26.2; in 2005 it was US$49.4; and by 2011 it reached US$106.19 (Lai 2009, 6; Statista 2013). Furthermore, the Middle East is a politically unstable region, where conflicts and political turmoil do, and are likely to continue to, disrupt supply (United States Energy Information Administration – China, 2012). The reliance on Dubai Crude is, in part, due to Asian oil refineries, most of which are unable to process anything other than the lighter Middle Eastern crudes (Asian Development Bank 2012, 57; United States Energy Information Administration – Japan 2012; United States Energy Information Administration 2012 – China). As a result, not only will the price of Dubai Crude continue to increase, but also if the flow of oil from the Middle East were disrupted, Asia could experience abrupt energy shortages, as it would be unable to replace it with another form of oil.

The disruptions and risks associated with oil shortages can be demonstrated by the impact of the 1973 and 1979 oil crises on the Japanese economy. Due to Japan's heavy reliance on oil imports, the sudden reduction in production and the resulting spike in prices drastically exposed its energy insecurity and resulted in the state's first two negative growth rates since World War II (Vivoda 2012, 135). The shortages resulted in social upheaval and energy shortages, triggering a concerted effort to diversify Japan's energy sources, enhance efficiency, and increase its nuclear energy sector, subsequently reducing Japan's oil use by 30 percent between 1973 and 2005 (Sudo 2008, 148).

To evade the Japanese experience, many Asian states are seeking to develop energy industries that provide greater reliability and price stability (Murphy & Fackler 2003). If fossil fuels are increasingly volatile in their price and the Middle East is highly susceptible to production disruption, what is the energy answer? The fossil fuel energy economy is so closely interlinked that shortages or fluctuations in one specific energy source would have significant implications for all others (IEA 2012, 1). However, nuclear energy is considerably less susceptible due to its lower consumption and relatively larger stockpiles (International Atomic Energy Agency 2001, 23). Only 31 states currently possess nuclear energy industries, many of which possess very small energy capacities (*Ibid*). As such, if a shortage in fossil fuels did occur, a dramatic increase in nuclear energy consumption would be highly unlikely, primarily due to the small nuclear capacity (*Ibid*). However, in its 2001 examination of uranium supplies to 2050, the International Atomic Energy Agency (IAEA) offered a sobering assessment of uranium resources. It stated, "as we look to the future, presently known resources fall short of demand," adding that in the future, nuclear energy sectors will be required to rely on very high cost sources to meet energy demands (*Ibid*, 11-12). Alternative assessments of uranium deposits suggest that current speculative reserves of uranium may be able to supply another 500 years of current consumption (Nuclearinfo 2013). Whilst this may or may not eventuate, recent innovation in nuclear energy efficiency and production continues to move rapidly. Advancements in the use of Thorium, which is three to four times more abundant than Uranium, to generate nuclear power could dramatically enhance the rollout of future nuclear energy facilities (IAEA 2005, 3; Nuclearinfo 2013). Continuing developments in the recycling of spent nuclear fuel to produce energy in emerging nuclear reactor technology may provide yet another source of energy (IAEA 2005, 5).

Given the greater relative stability of its energy supply, price consistency and expected resource stockpiles, it is not surprising that Asia is significantly investing in nuclear energy in an attempt to create greater energy security. Of all the nuclear power plants under construction throughout the world, 57.5 per cent are located within Asia (Asian Development Bank 2012, 94). States such as Pakistan and India have already sought to improve their energy security through the adoption or enhancement of nuclear energy programs (Basrur, Collin & Kemburi 2012, 9). A range of other Asian states are now investigating or investing in the development of domestic nuclear energy programs because of their provision of greater energy security (Basrur, Collin & Kemburi 2012, 9). Yet whilst nuclear energy may provide Asian states with a greater source of energy security, the risks associated with nuclear energy

production also present a series of complex security threats to Asian states and their citizens.

Central to the future role of nuclear energy is an examination of the risks associated with what is a highly contentious form of energy. Nuclear energy may be able to enhance Asia's energy security, yet it is also associated with catastrophic environmental accidents, serious health risks, nuclear weapons, nuclear terrorism and highly toxic waste that lasts for thousands of years (Lovelock 2003, 12; Evans 2011; Zhenqiang 2009, 37; IAEA 2001, 11-12). Thus the question for Asia is, do the improvements in energy security counteract the potential risks associated with an expansion of nuclear energy facilities and an increase in nuclear material? Nuclear energy programs, by their very nature, increase the risks of nuclear weapon proliferation and nuclear terrorism and have been labeled 'bomb starter kits' (Bunn & Malin 2009, 179; Lewis and Zimmerman 2006, 38-39; Evans 2011).

The process that enables energy to be generated from nuclear reactions can simultaneously be used as the beginnings of nuclear weapon development (Bunn & Malin 2009, 179). In their famous and contentious articles for *The New York Times*, George Shultz, Henry Kissinger, William Perry and Sam Nunn (2007, 2008, & 2010) argued that the use of nuclear material in the production of energy significantly increases the risks and complexities of securing radioactive material for clandestine and illegal use (Rhodes, R. 2009, 1). The four elder statesmen were referring to the recent historical precedent for both the clandestine development of nuclear weapons and the illegal sale of nuclear material and knowledge to state and non-state groups (Bernstein 2010, 44-46; Norris & Kristensen 2010). Whether through the targeting of nuclear facilities, the use of a 'dirty bomb', or the actual construction and detonation of a nuclear weapon, nuclear terrorism presents a real and dangerous threat to all regions of the world (El Baradei 2009; Bernstein 2010, 44-46). Within the Asian region, many states have ongoing conflicts with non-state groups. Pakistan and India, who both have nuclear energy programs and nuclear weapons, are amongst the worst states in the world for non-state actor attacks against the state (Miller and Sagan 2009, 12). Furthermore, recorded incidents of the unsafe disposal of Indian radioactive material, a high degree of state corruption, and a Pakistani precedent of nationals illegally selling nuclear material to non-state groups, not only increase the risk of nuclear sabotage or terrorism in these two state but across the entire Asia region (Nandakumar 2010, 11; Miller and Sagan 2009, 12; Bernstein 2010, 45).

Any attack using nuclear material or targeting nuclear facilities would have long term ramifications for the victims, the environment, the state and nuclear programs throughout the region (Norris & Kristensen 2010). Nuclear weapon proliferation presents serious and destabilizing risks to the Asian region. Three of the four states not signatories to the Nuclear Nonproliferation Treaty, the world's most widely ratified nuclear abolition treaty, are nuclear armed states within the Asian region: North Korea, India and Pakistan (Miller and Sagan 2009, 15; Dhanapala 2010, 258). Due to an actual or perceived risk of clandestine nuclear weapon development, the proliferation of nuclear energy programs within Asia could jeopardise the immediate and long-term security of the region (Acton & Perkovich 2009, 136). Nuclear weapons within Asia continue to play a role within conflicts. In April 2013, North Korea claimed that nuclear war with South Korea was 'unavoidable' (Meredith 2013). Since the mid-1980s nuclear weapons have been involved in at least six different military incidents between India and Pakistan (Ball 2006, 56). Indeed the academic Desmond Ball compared US/USSR military incidents and India/Pakistan military incidents and concluded that nuclear war is more likely between India and Pakistan than it ever was during the Cold War (Ball 2006, 56).

As a whole, however, Asia continues to take steps to mitigate the threats of nuclear terrorism and weapon proliferation. The Southeast Asian Nuclear Weapons Free Zone Treaty (SEANWFZ), which came into force in 1997, has successfully restricted the clandestine or otherwise construction of nuclear weapons and has sought to control the proper disposal of radioactive waste (Nuclear Threat Initiative 2013). SEANWFZ member states are also compelled not to assist any other state procure nuclear weapons for any means (Nuclear Threat Initiative 2013). Additionally, all but three states within Asia are signatories to the Nuclear Non-proliferation Treaty, and only three states are not signatories to the Comprehensive Nuclear-Test-Ban Treaty, both of which significantly reduce the chance of nuclear weapon proliferation (CTBTO 2013; UNODA 2013). Asian states have also taken steps to reduce the threats posed by nuclear terrorism with all states in the region — with the exception of Bangladesh — becoming signatories to the International Convention for the Suppression of Acts of Nuclear Terrorism (United Nations Treaty Collection 2013). Additionally, under the legally binding parameters of United Nations Security Council Resolutions 1540 and 1977, all Asian states are required to enforce measures to prevent non-state actors acquiring nuclear

weapons (Council on Foreign Relations 2013). Developments in Thorium use and the use of nuclear waste in the production of nuclear energy will continue to play further roles to reduce the threats posed by nuclear terrorism and weapon proliferation by curbing deposits of radioactive material (Bunn and Malin 2009, 176; Miller and Sagan 2010, 128). Whilst these international conventions will not completely mitigate the risks posed by nuclear energy programs, they do demonstrate an Asian willingness to cooperate and to initiate systems to significantly reduce such risks.

Nuclear energy is not 'the' answer to Asia's energy future; it is only part of the answer, insomuch as no one single strategy or form of energy can solve Asia's energy insecurity entirely. Indeed, the very concept of a singular answer to the increasing vulnerability of Asia's energy future is overly simple and ultimately flawed. No single energy source will be able to account for the projected enormous increase in Asia's energy demands, whilst also providing sufficient energy security. Significant reduction in the reliance of fossil fuels through the use of other energy sources and a greater emphasis on energy efficiency is the answer to Asia's energy future (Asian Development Bank 2012, 58; IEA 2012, 2-3). Expert predictions suggest that fossil fuels, in particular coal, will continue to provide the overwhelming majority of Asia's increasing energy demands (IEA 2012, 6; United States Energy Information Administration 2011; Symons 2008, 120). However, this will do little to mitigate the increasing threat of Asian energy insecurity, and does not amount to an 'answer' to Asia's energy future, only a continuation of its current calamity. New generations of coal power plants and continuing investment in carbon capture and storage may prove to significantly increase energy efficiency and reduce carbon emissions, but they are unable to produce more coal in what will continue to be a volatile market (IEA 2012, 5). In an investigation of energy security, Jae-Seung Lee (2010, 222) argues that renewable technologies, more than any other energy form, provide the greatest degree of energy security. Domestically produced renewable energy is not at risk of international market fluctuations and unlike nuclear energy does not present security threats (Lee 2010, 222; IEA 2012, 14). Globally, and within Asia, the coming decades will see a continued increase in renewable energy production and consumption (Lee 2010, 222; IEA 2012, 14). However, to create renewable energy, states must first possess renewable forms of energy to harness, and in Asia this is not always the case. Renewable energy forms do not yet posses the ability to provide considerable amounts of energy supply (IEA 2012, 7).

Energy efficiency is a component of the future of Asia's energy production that all states are able to execute, and according to a 2005 World Bank report (2005, 6), it is the most effective way of establishing energy security. A range of other reports support this claim, arguing that improving energy efficiency can, particularly within developing states, enhance energy security by reducing import requirements, improving energy delivery and reducing exposure to possible supply reduction (United Nations Economic and Social Commission for Asia and the Pacific 2007, xix; Feinstein 2002; Mathur 2008, 18). A recent investigation into improving energy efficiency in Sri Lanka found that increased energy efficiency resulted in an immediate improvement in the state's energy security (Limmeechokchai & Selvakkumaran 2013, 498). However, and consistent with the multi-dimensional answer proposed in this essay, the report also found that long-term energy security was best established when energy efficiency was implemented in conjunction with a diversification of energy sources (Limmeechokchai & Selvakkumaran 2013, 500-502).

Increasing energy efficiency, subsequently reducing fossil fuel imports, and increasing the role of renewable and nuclear energies is the answer to Asia's energy future. The expected continuing consumption of fossil fuels to meet the massively growing energy demands of Asia will only exacerbate current energy insecurity in the region. This overwhelming reliance on fossil fuels, further depleting finite energy resources, will continue to create a more volatile energy market and increases Asia's energy insecurity. Fossil fuels will continue to provide a large component of Asia's energy, but this must be quickly reduced. Nuclear energy, despite the risks associated with nuclear terrorism and nuclear weapons, must be increased in order for Asia to develop greater energy security. Renewable technologies and a focus on energy efficiency are also instrumental energy factors that will both reduce fossil fuel reliance and provide greater stability. The answer to Asia's energy future is thus a reduction in the use of fossil fuels, a continuing expansion of nuclear energy and an increased emphasis of the development of renewable energies and energy efficiency. Only through energy diversification and a reduction of fossil fuels will Asia find energy security whilst also sufficient means to meet its ferocious appetite for energy.

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Written at: The University of Melbourne
Written for: Sow Keat Tok

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About the author:

The author/s of this content have been verified by E-international Relations, but wish to remain anonymous.