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The Hidden Costs and Risks of Nuclear Energy: The Way Forward

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As global resolve to address climate change seems to have strengthened in recent years, so too has enthusiasm grown for nuclear energy. Increasing demand for energy has led many countries, particularly those in the rapidly developing Asia-Pacific, to consider nuclear energy as the power supply of choice. Several countries around the world, including those in 'sensitive' regions such as the Middle East, have plans under way to host nuclear energy programmes for the first time. These have contributed to predictions of a 'nuclear renaissance'. However, such predictions may not be entirely valid, as this policy brief argues.[1] While the inherent geopolitical risks of nuclear energy – due to the absence of effective global rules on sensitive nuclear technologies such as uranium enrichment and spent-fuel reprocessing – are well established, issues of socioeconomic feasibility and sustainability have remained underexplored thus far. At the crux of those issues is that of cost, and more significantly, the issue of hidden costs and risks which has not been given sufficient consideration by many countries – whether they have existing nuclear capabilities or currently seek to develop them. This policy brief argues that efficient management of nuclear energy would need to factor in these hidden high costs. In any case, Southeast Asian countries may nevertheless be better off channelling their resources towards harnessing renewable sources of energy, given the pre-existing concerns – the region's geophysical conditions, its poor culture of safety and its relative inexperience with nuclear energy management – which have to be considered in addition to the hidden costs.

Nuclear Energy's Upfront Costs and Benefits

Pro-nuclear experts would contend that criticism against nuclear energy – especially with regard to its socio-environmental impacts – is an over-reaction due to the lack of awareness of the technological progress made thus far. Modern reactors have evolved significantly since incidents such as Three-Mile Island and Chernobyl, to become safer, with stringent containment features such as multiple layers of defence to guard against a core meltdown. Moreover, nuclear energy is perceived to be a clean source of energy as it does not release carbon dioxide and is said to be cheaper than other alternative energy sources such as renewable energy. These assertions have thus made the use of nuclear energy attractive to developing countries. That said, however, the costs and risks of sustaining a nuclear power plant (NPP) are still underestimated and not factored in fully by countries that have developed or plan to develop NPPs.

Nuclear Energy's Hidden Costs and Risks

There are several hidden costs and risks that energy planners may fail to factor in when pursuing their nuclear energy plans. Firstly, despite technological advancements that have made nuclear reactors significantly safer, the cost of modern nuclear technology is largely based on estimates.[2] For instance, Generation-III nuclear reactors remain unproven commercially since they have not progressed beyond the pre-commercial stage, and consequently, there is no operating experience gained as yet. The even newer Generation-IV nuclear reactor technologies are either still in the R&D phase or have been plagued by partial technical failures. As such, nuclear power generation would still require a backup source as a contingency, and thus hidden costs would be higher than estimated.

Secondly, the costs of risk management strategies are high. Capital costs, in particular, constitute a full 60 per cent of the total cost of nuclear-generated electricity, compared to 25 per cent for operation and maintenance, and about 15 per cent for the fuel cycle.[3] Natural uranium costs make up merely 5 per cent of this overall equation. In view of this, it is important to understand the investment risks and limit them to acceptable levels in order to facilitate new projects and contribute to an investment climate conducive to nuclear industries.

Thirdly, there is a tendency to underestimate the various costs associated with nuclear energy. This is due to several factors[4]: (1) limited availability of data that mostly originates from the UK and the US; (2) the inclination of nuclear planners to select manufacturers

[1] This policy brief is based on ideas and perspectives shared at a Workshop on Nuclear Energy and Human Security in 2010 organised by the Centre for Non-Traditional Security (NTS) Studies, S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University (NTU).

[2] Diesendorf, Mark, 2009, 'Economics of Renewable and Nuclear Energy', *Report on the Workshop on Nuclear Energy and Human Security*, Singapore: RSIS Centre for Non-Traditional Security (NTS) Studies, p. 10. http://www.rsis.edu.sg/nts/resources/policy_briefs_and_reports/RSIS_NTS_Nuclear_Energy_160610.pdf

[3] Matsui, Kazuaki, 2009, 'Nuclear Energy and Economic Costs', *Report on the Workshop on Nuclear Energy and Human Security*, Singapore: RSIS Centre for Non-Traditional Security (NTS) Studies, p. 9. http://www.rsis.edu.sg/nts/resources/policy_briefs_and_reports/RSIS_NTS_Nuclear_Energy_160610.pdf

[4] Diesendorf, 2009, 'Economics of Nuclear and Renewable Electricity', p. 10.

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which provide unrealistically low cost estimates or use accounting methods that actually shrink capital costs while overestimating the operating capacity of NPPs; and (3) the actual costs for NPPs decommissioning are 15 times what has been regularly publicised.

Fourthly, and particularly in terms of addressing the likelihood of nuclear proliferation and nuclear terrorism executed by rogue actors, there is the issue of managing nuclear waste or spent fuel. Spent-fuel reprocessing is of particular importance in this respect because of the dual-purpose nature of spent fuel – it can be used to provide additional fuel for nuclear plants but it can also be exploited to generate fissile material for nuclear weapons. While there have been technological advancements in processing spent fuel, a concern that has yet to be addressed – even among developed countries – is its storage. Storage would require a location that is 'geologically stable … and be politically acceptable to the governing state (and to its neighbours) in terms of proximity to populations [sic] centres and to the movement of spent fuel itself'.[5] Storage locations would be of particular importance to countries that do not have the capacity to invest in reprocessing technologies. This would indeed be a potential impediment for developing countries initiating a nuclear programme from scratch.

Multilateral efforts on nuclear security have for the most part been piecemeal and offer little support for new players entering the nuclear energy arena. For instance, while the Convention on the Physical Protection of Nuclear Material (CPPNM) has been adopted, it has been more a series of patchwork arrangements than a concrete, focused effort to achieve an overarching international agreement on nuclear security. In light of these developments, there also needs to be a balance between nuclear energy growth and proliferation resistance, which is best determined by countries themselves.

Fifthly, it is important to take into account the proportion that nuclear energy comprises in a country's energy mix. Large investments in nuclear technology which result in a small output that meets a fraction of total demand may not make economic sense. Nevertheless, nuclear energy could possibly be an attractive option for large energy consumers such as the US and China, even if it is a small percentage of the energy mix. However, for a relatively small consumer, there is a need to weigh investments and economic viability carefully before jumping onto the nuclear bandwagon. It is also important to take into account other socio-environmental and intangible costs. While nuclear energy is carbon free, the entire nuclear fuel cycle is not. Nuclear fuel mining and enrichment processes would require the use of fossil fuels, which would lead to significant carbon emissions into the atmosphere.

Conclusion and Recommendations

Given the high costs of nuclear energy, it may be more feasible to pursue renewable energy sources, which may cost just as much but come with risks that are far less detrimental to communities; renewable energy sources would also be more beneficial in the long run, particularly for countries in Southeast Asia whose geophysical conditions, poor culture of safety and relative inexperience with nuclear energy management may complicate nuclear energy implementation. What is therefore needed is greater awareness and engagement from various sectors in weighing the costs and benefits of various alternative energy sources. There is, however, little doubt that Southeast Asian countries are keen to take up the nuclear energy option. Nevertheless, before they play the nuclear energy card, it would be best for them to be well-equipped and prepared to face the ensuing challenges. Policymakers should therefore seek to:

- develop a comprehensive and in-depth understanding of the various hidden costs and risks associated with nuclear energy. This involves cooperation with various sectors (e.g., civil society and business communities) which would be able to inform policymakers of externalities stemming from proposed nuclear power programmes.

- adopt a sustainable and diverse energy portfolio which considers a whole range of possible alternative energy sources, in which nuclear energy remains a viable option, and whose risks need further research and to be better understood in order to devise sound policies to improve the regulation of its expanding use.

If countries are able to afford the costs and would like to proceed with nuclear energy plans, they must:

- obtain the support of the various stakeholders involved, i.e., the public, private and civil society sectors.

- ensure that the nuclear industry adopt high safety standards.

- substitute processes involving highly enriched uranium (HEU) with low-enriched uranium (LEU) to reduce the possibility of nuclear proliferation.

[5] Pomper, Miles, Ferenc Dalnoki-Veress, Stephanie Lieggi, Lawrence Scheinman et al., n.d., 'Nuclear Power and Spent Fuel in East Asia: Balancing Energy, Politics and Nonproliferation', *The Asia-Pacific Journal: Japan Focus*. http://www.japanfocus.org/-Ferenc-Dalnoki_Veress/3376

- cooperate and coordinate with other countries on nuclear security (in terms of nuclear materials and facilities).

- provide economically competitive nuclear power with the assurance of reliable fuel supplies, and perhaps, spent-fuel take-back/ take-away (cradle-to-grave fuel cycle services).

- commit to civil nuclear energy use via the reduction of 'proliferation and spent-fuel' burden, and related international negotiations.

About the Authors

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The Centre for Non-Traditional Security (NTS) Studies at the S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University (NTU), was inaugurated by the Association of Southeast Asian Nations (ASEAN) Secretary-General Dr Surin Pitsuwan in May 2008. The Centre maintains research in the fields of Food Security, Climate Change, Energy Security, Health Security, as well as Internal and Cross-Border Conflict. It produces policy-relevant analyses aimed at furthering awareness and building capacity to address NTS issues and challenges in the Asia-Pacific region and beyond. The Centre also provides a platform for scholars and policymakers within and outside Asia to discuss and analyse NTS issues in the region.

In 2009, the Centre was chosen by the MacArthur Foundation as a lead institution for the MacArthur Asia Security Initiative, to develop policy research capacity and recommend policies on the critical security challenges facing the Asia-Pacific.

The Centre is also a founding member and the Secretariat for the Consortium of Non-Traditional Security Studies in Asia (NTS-Asia). More information on the Centre can be found at www.rsis.edu.sg/nts.