Southeast Asia's Nuclear Energy Future:

Promises and Perils

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Southeast Asian nations are embarking on a pursuit for nuclear energy. While this promises to help satisfy the region's growing energy thirst in a more cost-efficient and climate-friendly way, nuclear power also has its perils. The specter of proliferation looms large and the potential for nuclear accidents remains high in a region prone to natural disasters and averse to strong institutional safeguards and export controls. Policymakers will have to be vigilant in mitigating these threats in order to ensure the region's safe passage through its nuclear future.

Electricity in Southeast Asia is primarily sourced from coal, oil, natural gas, and hydro-power.[1] While the region is awash with energy resources, rising demand has placed a strain on them. Southeast Asia has been a net oil importer for some years, and significant natural gas reserves are often located far from demand centers and hence require massive infrastructure investments.[2] Given this gloomy picture, the region is turning to alternative sources, including nuclear power, to satiate its growing appetite for energy. Several regional trends suggest that this trend will accelerate in the decades to come.

Regional Trends

More Southeast Asian states will likely pursue nuclear energy over the next few decades. Rising energy demand and soaring energy prices, coupled with increasing consciousness about climate change and the relative unattractiveness and unavailability of alternative energy sources, will combine to create a strong impetus to embark on a nuclear path.

Projected image of Vietnam's nuclear plant
Source: Vietnamnet

The twin drivers of growing energy demand and climbing energy prices will push Southeast Asian nations toward nuclear energy in the future. Increasing energy prices, according to the Asia Pacific Energy Research Center (APERC), are sustained by at least three structural factors: first, growing energy demand in most economies despite price increases; second, the unwillingness of major players to expand production and export capacity coupled with intensifying resource nationalism in oil and natural gas producing economies; and, third, a worsening geopolitical situation in the Middle East.[3] Despite price decreases in the short run, all three factors are unlikely to ebb in the long run, and energy prices will thus continue to increase. And if the prices of conventional energy resources continue their upward turn, the demand for alternatives like nuclear energy will rise. Nuclear power is much more cost-efficient compared with fossil fuels, costing approximately 1.76 cents per kilowatt hour compared to coal (2.47 cents), natural gas (6.78 cents) and oil (10.26 cents).[4]

Corresponding to increasing prices, there will also be a greater thirst for energy, particularly as the region emerges from the recent economic downturn. Southeast Asia's recovery after the Asian Financial Crisis in 1998, coupled with robust economic reforms and burgeoning industrialization, has expanded regional economic growth rates since 2001. This in turn sharply boosted energy consumption in the region– for instance, in the period from 2001 to 2003, consumption increased by eight percent.[5] If the region's economies continue the growth trend of the last decade, rising energy consumption will put more pressure on conventional sources and place even more urgency on investing in alternatives like nuclear energy. Despite the fact that the global economic downturn has put a dent on this growth, Southeast Asian economies are still expected to bounce back strong in 2010 and will likely continue on a trajectory of sustained economic growth.[6] In fact, the International Energy Agency's World Energy Outlook 2009 projects that Southeast Asia's primary demand could expand by 76% between 2007 and 2030 and at an annual growth rate of 2.5% – a pace "much faster than the average rate in the rest of the world".[7]

The region's increasing awareness of global climate change may also cause it to turn toward low emission energy alternatives like nuclear energy. Nuclear energy has a very

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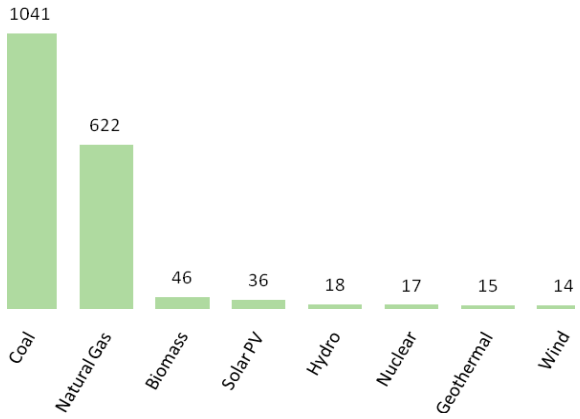
low carbon footprint, producing minimal levels of carbon dioxide (mostly during certain processes used to build and fuel the plants) comparable to geothermal, hydropower and wind energy.[8] And while Southeast Asia has relatively low per capita emissions of carbon dioxide compared to the developed world (4.2 tons per capita is expected by 2030 in contrast to 23 tons in the United States), APERC's Institute for Energy Economics expects a whopping fourfold increase in total carbon-dioxide emissions (the main greenhouse gas) from 2002 to 2030 produced by energy production and consumption in Southeast Asia.[9]



Nuclear Energy's Low Carbon Footprint (in tons of CO2 equivalent per gigawatt-hour)
Source: Nuclear Energy Institute. "Nuclear Energy Plays Essential Role in Climate Change Initiatives". Policy Brief*, September 2009.*

If Southeast Asian states act on this alarming trend, they may consider nuclear power as a path to stabilizing greenhouse gas emissions. There are already growing signs of such climate change consciousness in Southeast Asia. For instance, the 'Singapore Declaration on Climate Change, Energy and the Environment', which Southeast Asian states inked at the third annual East Asia Summit in 2007, specifically states they will, as part of their commitment to "urgently act to address the growth of global greenhouse gas emissions", "intensify ongoing cooperation to improve energy efficiency, and the use of cleaner energy…by…cooperating for the development and use of civilian nuclear power".[10]

The increasing consensus on nuclear power as a form of defense against climate change is bolstered by nuclear power's relative availablility in comparison to other forms of low emission alternate energy. For instance, Indonesia has learned that natural gas requires too much supply infrastructure – a major structural problem that probably will not be remedied in the near future.[11] Other options, like coal in Thailand or hydro-power in the Greater Mekong sub-region, have recently raised the specter of environmental damage and dislocation, and in some cases have generated widespread protests.[12] And while they may appear promising in theory, countries are beginning to grasp that energy sources like solar energy can only function as marginal power generators in reality.[13] Nuclear power, by contrast, can produce energy on a much wider scale and offers cost competitiveness, accessible fuel supply, and limited environmental impact. These factors are likely to contribute to nuclear power's attractiveness.

Country Outlooks

Though Southeast Asia is already beginning to tilt toward nuclear energy because of the aforementioned trends, the outlooks of individual countries have thus far remained rather uneven. Country wise, Indonesia, Vietnam and Thailand are the "advancers" who have already floated proposals for the erection of 16 nuclear reactors, while the Philippines, Malaysia, Cambodia and Myanmar are the "aspirants" that are considering the nuclear option. It is possible that by 2025, all seven "advancers" and "aspirants" could possess some form of nuclear facility. The five "abstainers" – Brunei, Cambodia, East Timor, Laos, and Singapore, for various reasons, will most likely abstain from nuclear energy, absent any tectonic geopolitical changes in the region that may compel nuclear ambitions.

Vietnam, Indonesia and Thailand are the most serious about nuclear energy in Southeast Asia. All three have set goals of possessing a functioning nuclear energy program by 2020, and the International Atomic Energy Agency (IAEA) has concluded that they are very advanced in developing the capabilities necessary for constructing such a program. Their motive thus far, as mentioned earlier, has been purely energy-centric[14] - all three are trying to ease a growing gap between rising electricity demand and the declining availability of other non-nuclear alternatives in a cost-effective fashion in light of stratospheric energy prices.

Country	Planned No.	Planned MW	Proposed No.	Proposed MW
Indonesia	4	4,000	-	-
Thailand	-	-	4	4,000
Vietnam	-	-	8	8,000

Advanced Southeast Asian Nuclear Efforts
Planned = Approvals, funding or major commitment in place, mostly expected in operation within 8 years
Proposed = clear intention or proposal but still without firm commitment.

The aspirants are countries that are considering the nuclear option but are either not that enthusiastic about it, are not yet deeply invested in it, or face significant obstacles that may thwart a potential pursuit. Malaysia and Cambodia have both shown signs of considering the nuclear option in theory.[15] However they probably will not take concrete steps in that direction anytime soon since the former has sufficient oil and gas reserves for now, while the latter is focused on developing its infrastructure and investing in other forms of renewable energy like hydro-power in the short term. Resource-rich Myanmar does not need nuclear energy for power generation purposes, but is at the early stages of trying to build a small research reactor with Russian assistance.[16] While the Philippines may embark on the project in a few years, it is still reeling from its failed experience with nuclear energy in the 1980s, when its 630-megawatt Bataan nuclear plant was embroiled in corruption allegations under former president Ferdinand Marcos.[17] That alone will make nuclear energy a difficult sell in the Philippines.

However, the resultant nuclear power generation for both advancers and aspirants, it must be stressed, will only make a small dent on total projected power demand in these countries. For instance, the Electricity Generating Authority of Thailand's (EGAT) plan to construct a 4,000 MW nuclear plant by 2020 will be only a fraction of the expected total energy demand, which is around 56,000 MW, while Indonesia's National Atomic Energy Agency's (BATAN) plans for 6,000 MW of nuclear energy by 2025 will be a trickle relative to the projected 59,000 MW total.[18] However, these efforts could also be precursors to much greater country commitments to nuclear energy in the future should they prove effective or should energy demands become even more urgent.

Abstainers in Southeast Asia are nations that, for various reasons, are unlikely to pursue nuclear energy in the near future. For Singapore, the complication is technical: it lacks the necessary space for the required safety stand-off range of a nuclear site from urban areas (30 kilometers).[19] Neither Brunei nor Laos see a need for nuclear energy in the short-term – the former has a wealth of other resources like oil and natural gas, while the latter has significant proven hydro-power capabilities.[20] East Timor has barely established the necessary infrastructure for internal electricity generation, and can thus ill-afford to think about its potential for nuclear power generation.[21]

Overall, as the nuclear timeline below illustrates, a futuristic assessment of energy portfolios shows that at least three and up to seven Southeast Asian countries could possess some form of nuclear power generation or begin using nuclear power by 2025.[22]

Country	Estimated Nuclear Timeline
Cambodia	As early as 2020
Indonesia	Between 2017 and 2020
Malaysia	By 2023
Myanmar	By 2014
Philippines	By 2025
Thailand	By 2020
Vietnam	By 2020

Nuclear Timeline of Selected Southeast Asian States
*Note: Singapore, Laos, Brunei and East Timor are excluded because they are likely to abstain.

An Unclear Nuclear Future

There are several sources of anxiety as more Southeast Asian nations strive toward a nuclear future. In particular, the environmental and proliferation hazards associated with nuclear power, combined with the lack of strong regional policing and global norm adherence, are worrying trends that ought to concern policymakers going forward.

The environmental and safety dimension of nuclear power is especially salient in Southeast Asia. Since the region is prone to extreme natural disasters, nuclear power experts and managers will have to deal with the challenge of seismic hazard and the risk of radiation leakage in the future. While most plants are designed to withstand these natural disasters, much will depend on how adequate their safety standards are in areas such as radiation protection, predisposal management, and emergency preparedness and response, and how vigorously these standards are enforced.[23] According to APERC, the main concern as nuclear energy expands its reach in Southeast Asia will be "safety issues arising from fuel handling and the operation of nuclear power".[24]

History offers several cautionary tales about nuclear safety, such as the Three Mile Island incident in the United States (1979), the Chernobyl disaster in the former Soviet Union (1986), and the Tokaimura and Kashiwazaki incidents in Japan (1999 and 2007). Though Chernobyl was the result of a mechanical error (a chain reaction got out of control), detailed investigations into the Chernobyl and Tokaimura incidents clearly found that they could have been

ameliorated or avoided entirely if there with better education, training, quality control and safety standards.[25] And the Kashiwazaki case, where nuclear reactors were placed above a fault plane prone to earthquakes, indicates the importance of knowing the geographical terrain before positioning nuclear facilities.[26]

Such problems are not merely historical or hypothetical for Southeast Asia. For instance, Indonesia's decision to locate its first nuclear power plant on a site near Mt. Muria, a dormant volcano, has already raised eyebrows among engineering safety experts and evoked comparisons to the Kashiwazaki case.[27] The concern is even more palpable because Jakarta is particularly susceptible to natural disasters owing to its location in the "Ring of Fire" – an area where large numbers of earthquakes and volcanic eruptions occur in the Pacific Ocean. Furthermore, Southeast Asian industries are notorious for their poor quality control standards, and some countries like Vietnam face a shortage of necessary technical expertise.[28] These indicators are worrisome given the sensitive operating conditions for nuclear processes.

Indonesians protest government plans to build a nuclear plant near Mt. Muria
Source: Greenpeace

The specter of proliferation will also loom large as more countries pursue nuclear power. As more Southeast Asian countries have their own fuel enrichment capacity, they will also possess the ability to build nuclear weapons indigenously if they wish to do so. This in turn increases the risk that nuclear weapons, or the uranium and plutonium used to make them, will fall into the hands of non-state terrorist groups or rogue regimes, which can then use them to construct deadly bombs.[29] The oft-cited example of this is the A.Q. Khan network, where the father of Pakistan's nuclear program, Abdul Qadeer Khan, sold critical nuclear technology to Libya, Iran and North Korea. There is also clear evidence that suggests Al-Qaeda not only possessed a detailed knowledge of nuclear weaponry, but attempted to acquire nuclear material on the black market.[30]

While this concern is a legitimate one, most Southeast Asian nations have not shown intent to pursue a nuclear weapon or proliferate. Experts find it highly unlikely that either Indonesia or Vietnam will move toward a bomb because they have what is termed a 'responsive view on weaponizing' – they will only veer toward a weapon if they see neighboring countries doing so first.[31] Vietnam, for its part, has also displayed clear intent in this regard by recently agreeing to return weapons-grade uranium from its Da Lat research reactor to Russia for processing via the U.S.-led Global Threat Reduction Initiative.[32] On proliferation, the only real concern is Myanmar, where eyebrows were raised earlier this year about the possible transfer of nuclear expertise from North Korea when a North Korean ship known to have transported weapons in the past appeared to be sailing for Myanmar in July.[33]

A North Korean ship named Kang Nam (below) was caught sailing for Myanmar in July this year, raising fears of nuclear proliferation.
Source: BBC news

The more pressing concern for Southeast Asia as it moves forward will be the risk of a targeted and devastating terrorist attack on nuclear facilities. This is particularly salient in the case of Indonesia and Thailand, which are both known transit points for transnational terrorists, such as those belonging to the Al-Qaeda linked Jemaah Islamiyah (JI) network. Though JI has been weakened over the last few years by a wave of arrests and prosecutions, the twin hotel bombings in Indonesia earlier this year, along with the persistence of other structural factors conducive to terrorism, indicate that the group still has the capacity for spectacular attacks on key infrastructure.[34]

The third anxiety is that, unlike Europe, Southeast Asia does not possess strong regional regulatory frameworks on nuclear energy to prevent and contain the risks emanating from nuclear power. Indeed, it is difficult to conceive of an equivalent of the European Union's European Atomic Energy Community (EURATOM) Treaty emerging in Southeast Asia in the near future. The closest the region came to an organization of that ilk was when the Philippines proposed an "ASIATOM" in the 1990s, but that idea was quickly discarded due to fears that it would impinge on national sovereignty.[35]

The region does have its fair share of treaties and declarations – like the Southeast Asia Nuclear Weapons Free Zone (SEANWFZ) that calls for the safe and peaceful use of nuclear energy and the safe disposal of radioactive material;[36] or the Singapore Declaration on Climate Change, Energy and the Environment that commits signatories to civilian nuclear power cooperation that ensures safety, security and nonproliferation. But these regional initiatives have generally lacked institutionalization. This is partly because the main regional entity in Southeast Asia – the Association of Southeast Asian Nations (ASEAN) – operates more informally through consensus and consultations rather than across-the-table negotiations that yield enforceable rules and laws. The result is an avoidance of, or aversion to, legally binding agreements.[37] While the signing of the ASEAN Charter in November 2007 promised to make the grouping a more institutionalized, rules-based organization through the establishment of a human rights body and a greater utilization of dispute settlement mechanisms, this is still a long-term project.

This lack of regional oversight is compounded by a weak and uneven commitment to global norms. For all the criticism leveled at international agreements, signing key treaties and conventions related to nuclear energy and nuclear power is a powerful marker of a nation's commitment to responsible energy use. Currently, only a few Southeast Asian countries have ratified all the three basic relevant UN documents – the UN Convention on the Physical Protection of Nuclear Material, the UN Convention on Early Notification of a Nuclear Accident, and the UN Joint Convention on the Safety of Spent Fuel Management and Safety of Radioactive Waste Management. If more countries begin handling nuclear power and refuse to be wedded to global norms relating to their use, there will be less legal accountability for potentially irresponsible actions and less confidence about how they will be managed.

Country	Safeguards Agreement	Additional Protocol	CPPNM*	Joint Convention*
Brunei	Yes	No	No	No
Cambodia	Yes	No	No	No
East Timor	No	No	No	No
Indonesia	Yes	Yes	Yes	Yes
Laos	Yes	No	No	No
Malaysia	Yes	No	Yes	No
Myanmar	Yes	No	No	No
Philippines	Yes	Yes	Yes	Yes
Singapore	Yes	No	No	No
Thailand	Yes	No	No	No
Vietnam	Yes	No	No	No

ASEAN Nations' Membership in International Nuclear Agreements
*CPPNM = Convention on the Physical Protection of Nuclear Material
*Joint Convention = Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Water Management

Source: Tanya Ogilve-White. "Non-proliferation and Counter-terrorism Cooperation in Southeast Asia". Contemporary Southeast Asia*, April 2006, Vol. 28, No. 1.*

Charting a safe passage through a nuclear future

Despite these potential dangers, ASEAN policymakers can take several measures to chart Southeast Asia's safe passage into its nuclear future.

First, Southeast Asian nations' spotty commitment to international agreements on nuclear security must be addressed. All ASEAN members should sign and ratify key global agreements, at the very least the three basic relevant UN documents – the UN Convention on the Physical Protection of Nuclear Material, the UN Convention on Early Notification of a Nuclear Accident, and the UN Joint Convention on the Safety of Spent Fuel Management and Safety of Radioactive Waste Management. Though this is a first step, it is a necessary benchmark to illustrate their adherence to global standards on the regulation, management and exercise of nuclear power and would soothe any international anxieties.

This should be complemented by efforts at the national level. Particular attention should be paid to export controls, since they are either weak or non-existent in most Southeast Asian countries and raise fears about the transfer sensitive technology to rogue regimes. In her study of the region, Tanya Ogilve-White soberly concludes that "with the exception of Singapore, Southeast Asia's export control systems remain unsophisticated and weak".[38] These must be strengthened, and all ASEAN states must, as former ASEAN

Secretary General Rodolfo Severino has suggested, ensure that "their national laws and regulations remain open to ASEAN scrutiny" for verification purposes.[39]

While it is unrealistic to expect ASEAN to achieve the same level of cohesion as the EU on nuclear power, several measures can be taken to boost regional oversight and capacity. For instance, ASEAN should strengthen cooperation with the International Atomic Energy Agency (IAEA), focusing on how ASEAN can better ensure enforcement of regional agreements like SEANWFZ by continuing to work toward institutionalizing regional measures like an early warning system for nuclear accidents and a regional emergency preparedness and response plan, which were both proposed in 2007.[40]

Southeast Asian nations should also enlist international help for expertise if they do not have the technical capacity required for handling nuclear power. Countries with greater experience – such as the United States, France, or Russia, may be willing to provide training and assistance since securing nuclear material is in their interests as well. Australia, for instance, has provided help with nuclear safeguards and export controls to several Southeast Asian countries and offered financial assistance to strengthen the IAEA's Nuclear Security Fund Initiative to help thwart nuclear terrorism in the region.[41]

Nuclear power plant symbol

Even if these measures are taken, the fact that nuclear power will gain salience in Southeast Asia in the coming decades means that nuclear dangers and accidents will become more likely. But if ASEAN states, other willing nations, and multilateral organizations work together, they can manage and minimize these perils in order to avert potentially catastrophic disasters from happening while simultaneously tapping the potential of nuclear energy. Only then can the region's safe passage into its nuclear future be assured.

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