Lee Kuan Yew School of Public Policy

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A Policy Brief - Challenges Facing Asia

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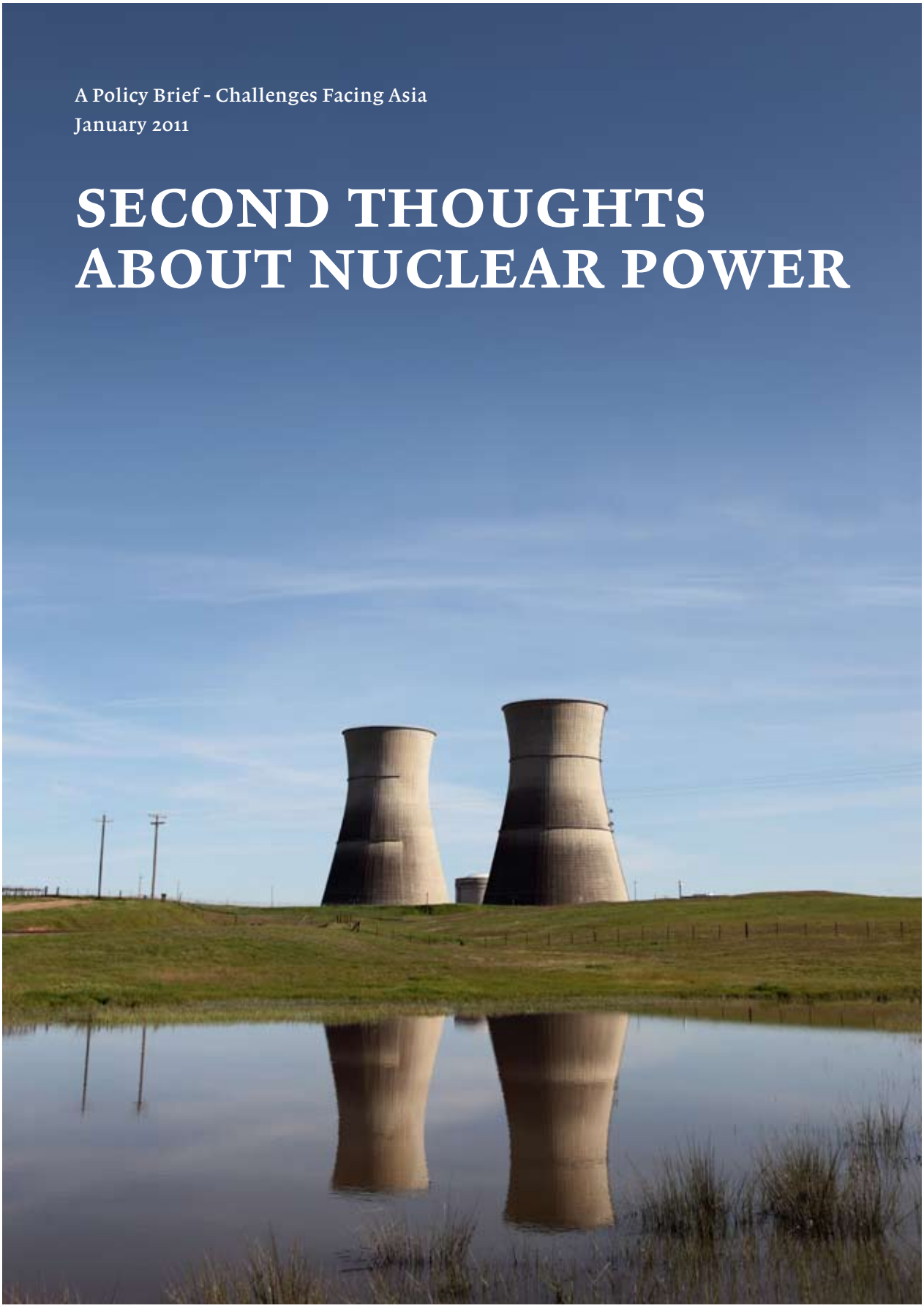
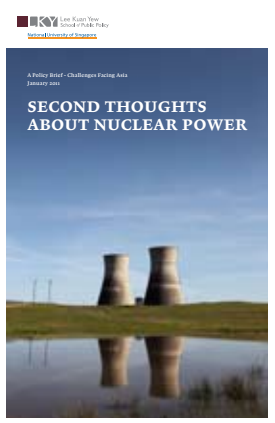
SECOND THOUGHTS ABOUT NUCLEAR POWER





About the publication

The information in this Policy Brief is based on research by Benjamin K. Sovacool and is published and edited by Research Support Unit (RSU), Lee Kuan Yew School of Public Policy, National University of Singapore.

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Dr. Sovacool researches on energy security, energy policy and poverty. His work primarily investigates the different scales, sectors, technologies, countries, and synergies involved with the security of energy fuels and technologies (on the supply side) and energy services and behavior (on the demand side). His research explores how energy security and policy challenges differ by scale, sector, and country, with a special focus on countries in the Asia-Pacific. Part of this agenda includes how energy security has synergies with poverty and the millennium development goals, climate change mitigation, and climate change adaptation and resilience.

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SECOND THOUGHTS ABOUT NUCLEAR POWER

THE POWER CRISIS:

One of the greatest challenges faced by policymakers across the globe is how to provide a reliable, affordable, sustainable, secure and low carbon electricity supply. The problem is particularly relevant in Southeast Asia, where millions (more than one billion if you include China and India) of people live without access to electricity. Southeast Asian policy makers are pressed to come up with solutions, given energy experts expect electricity demand to double throughout the region in the next 20 years. To develop strategic, long-term plans policymakers need to know the facts behind the energy alternatives.

IS NUCLEAR POWER THE ANSWER?

As the constraints of coal and the possibility of peak oil have emerged, as economies have been victims of energy price volatility, and the reality of global warming has started to hit home, nuclear power has again been presented as a solution to the world's energy needs. This renaissance has been backed by strong institutional supporters such as the US Department of Energy, International Energy Agency and International Atomic Energy Agency. East and Southeast Asia already have 109 nuclear power plants in operation, 18 in construction and plans for a further 110[1]. Nuclear power is burgeoning in regional developing countries, with Thailand, Vietnam, Malaysia and Indonesia all planning nuclear plants for completion by 2020.

But can nuclear power provide what we are all looking for: a reliable, affordable, sustainable, secure and now low carbon source of electricity? This paper takes a close look at the full nuclear fuel cycle and suggests we think twice about a nuclear future for Southeast Asia.

THE ARGUMENTS

CONVENTIONAL THINKING:

Nuclear power is currently the lowest cost option for new, low carbon electricity generation resources.

THINK TWICE:

When the full nuclear fuel cycle is considered - not only reactors but also uranium mines and mills, enrichment facilities, spent fuel repositories, and decommissioning sites - nuclear power proves to be one of the costliest sources of energy. Nuclear plants are capital intensive and high capital costs result in higher charges by electricity generators. This either ends up with high costs for customers, significant government funds being expended on subsidies, or both. The Keystone Centre[2], an independent think tank, estimated in 2007 that operating costs for new 1,100-MW plants would be 30c/kWh for the first 13 years (while the plant is being paid off) and 18c/kWh thereafter, making nuclear power the fourth most expensive source of energy. These costs exclude borrowing fees and interest, decommissioning and early retirements, waste storage, unexpected delays and the necessary building of transmission and distribution networks required to carry atomic power to the customer.

Another study[3] of construction costs of nuclear power facilities across 5 countries found that quotes by industry were unreliable, conservative and that construction was subject to costly project overruns which sometimes doubled the cost of building the plant.

Southeast Asian policymakers who ignore decommissioning costs of nuclear reactors and uranium enrichment facilities, do so at their peril. Since most Asian nuclear programmes are new, decommissioning costs for Asian governments are largely unknown. Historical data from the US and UK indicate huge decommissioning costs of US$300 Million to US$5.6 Billion per facility. Assessment of decommissioning by the US Accounting Office has found decommissioning costs have exceeded plant revenues by more than US$4 Billion[4].

CONVENTIONAL THINKING:

Nuclear power could stabilize the cost of electricity by reducing dependence on natural gas which is subject to price volatility.

THINK TWICE:

Nuclear power is reliant on uranium availability and uranium prices like those of oil and natural gas are highly volatile. This means that uncertain uranium prices can have a grave impact on plant operating costs. Such price movement is hard to anticipate when, some of the countries now responsible for more than 30% of the world's uranium production: Kazakhstan, Namibia, Niger, and Uzbekistan[5], are politically unstable.

CONVENTIONAL THINKING:

Total uranium reserves are sufficient for more than 600 years at the current consumption level using today's reactors, and at a cost less than US$80-US$130/kg.

THINK TWICE:

To plan for long term energy solutions, fuel availability needs to be assessed beyond 2020, when future plants in Asia will be operational. The IAEA expects that primary supply of uranium (all newly mined and processed uranium) will meet only 4-6% of total demand in 2025 and secondary supply (highly enriched uranium, enriched uranium inventories, mixed oxide fuel, reprocessed uranium and depleted uranium tails) will meet 8-11% of world demand[6]. The implication is clear: a huge shortfall will likely exist between uranium supply and demand. Even on optimistic assumptions of fuel availability, global reserves of uranium will only support a growth in nuclear power of 2% and only be available for 70 years.

A recent study[7] showed that no new deposits of uranium have been found since the 1980's and all increases in uranium mining have been at known deposits. China and India have very limited domestic supply of uranium and Chinese analysts expect China to be 88% dependant on foreign sources of uranium by 2020. Lack of certainty about the availability of uranium is likely to fuel price spikes which will increase the production costs of nuclear energy.

CONVENTIONAL THINKING:

Nuclear energy is a "clean, green" energy.

THINK TWICE:

The nuclear fuel cycle involves some of the most dangerous elements known to humankind. These elements include more than 100 dangerous radionuclides and carcinogens such as strontium-90, iodine 131 and cesium -137, which are the same toxins found in the fall out of nuclear weapons.

In addition to questions about the safe handling of such elements, the nuclear fuel cycle presents numerous other environmental risks.

WATER

Nuclear energy is highly water intensive. Nuclear plants use 25-50% more water per unit of electricity generated than fossil fuel plants with equivalent cooling systems, such that during periods of drought many nuclear facilities either cannot operate or induce water shortages. The average US plant operating on an open–loop cooling system withdraws 216 Million litres of water every day and consumes 125 Million litres of water every day. Nuclear plants and uranium mining also contaminate water and the methods used to draw the water and exclude debris through screens kill marine and riparian life, setting in place a destructive chain of events for ocean/river systems.

LAND USE AND WASTE STORAGE

About 10 000 tonnes of spent nuclear fuel is discharged each year from existing nuclear facilities, since nuclear plants convert almost all of their fuel to waste (only 15% can be reprocessed[8]).

On average each plant will produce 30 tonnes of waste a year and this waste can be radioactive for up to 250, 000 years. The lowest available estimate for the storage of 1 tonne of nuclear waste is US$35,000 per year, so that's a minimum cost per facility of over US$1 Million per year for the conceivable future.

The main problem caused by nuclear waste however is where to store it, since even nuclear waste processed in storage casts takes 10, 000 years before it will reach levels of radiation considered safe for human exposure. With five waste streams that can contaminate and degrade land, suitable sites for storage are hard to find. Recent plans to store US nuclear waste in the Yucca Mountains, a remote desert location in Navada, were shelved due to political challenges.

CO_2 EMISSIONS

It is true that the carbon footprint of electricity generated by nuclear energy is less than that of coal, natural gas and oil fired facilities. However, when emissions from uranium mining, milling and spent fuel conditioning are added to the emissions associated with plant construction, operation and decommissioning, a typical reactor emits about 66g of CO_2 equivalent for every kWh of electricity produced. This figure, which is more than any single source of renewable electricity, is likely to increase significantly as more energy intensive uranium enrichment is required once high quality uranium ores are exhausted. The Oxford Research Group[9], have estimated that by 2050, nuclear electricity will have the same carbon footprint as natural gas.

CONVENTIONAL THINKING:

These days nuclear energy is safe, nuclear energy presents no health risk to the public or the industry workers.

THINK TWICE:

In addition to the catastrophes at Three Mile Island and Chernobyl, there has been at least one nuclear incident and US$332 Million awarded in damages every year for the past three decades. Although the nuclear industry say it has learned from its mistakes and that new technology and oversight have made plants much safer, 57 accidents have occurred since the Chernobyl disaster in 1986, two thirds taking place in the US. The French Atomic Energy Agency (CEA) has concluded that technical innovation cannot eliminate the risk of human errors in nuclear plant operation[10] and an interdisciplinary team from MIT have estimated that given the expected growth scenario for nuclear power from 2005 – 2055, at least four serious nuclear accidents will occur in that period[11].

Some may say nuclear energy is an accident waiting to happen.

SECOND THOUGHTS ABOUT NUCLEAR POWER

THE FUTURE:

Planning our energy future is difficult. Nuclear, renewable and fossil fuel based energy sources each have trade-offs; security verses reliability, affordability versus carbon emissions, capital intensity versus environmental impact to name a few.

When looking to the future, however, it is important to see the whole picture. According to our research, the vision of a nuclear powered Southeast Asia is not a pretty one. It is a future replete with depleted water systems, land guttered by nuclear waste storage sites, rapidly escalating electricity tariffs, and the destructive carbon emissions from uranium mining and processing. High construction and borrowing costs, project blow outs and uranium price volatility will leave insufficient funds to make the necessary improvements to electricity transmission and distribution infrastructure required to meet targets for electricity access and to meet the electricity demands of industry. If one of the four serious nuclear accidents predicted for the next 45 years were to happen in Southeast Asia, millions of people could be at risk to acute radiation exposure, debilitating injuries, and premature death. In the likely scenario that nuclear plants run out of fuel, they will need to be decommissioned at crippling cost to developing economies.

Nuclear power is not a viable option for Southeast Asia. It is unsafe, unreliable, and unaffordable. Southeast Asian policymakers have the opportunity and obligation to pursue energy policies that enhance and strengthen development and security in the region. In doing so they should reject plans to build nuclear power plants and invest in existing renewable energy technology.

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