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Should Malaysia give nuclear power the green light?

The Edge, Malaysia



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03
OUTLOOK |
SDGs will not be met by 2030

04
SOCIAL |
Important to measure multidimensional poverty

05
POLITICS |
Trump's new policies will impact refugees and sustainability initiatives in Malaysia

SHOULD MALAYSIA GIVE NUCLEAR POWER THE GREEN LIGHT?

With the data centre boom and goal to transition to greener energy sources, the country is once again considering nuclear energy as an option. There is, however, much to study regarding its cost effectiveness, safety and the availability of talent and other resources. **PG6**

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COVERSTORY

Should Malaysia give nuclear power the green light?

STORIES BY KIRAN JACOB AND ARIS RIZA

IAEA GUIDE FOR COUNTRIES CONSIDERING NUCLEAR POWER

MILESTONE 1
Ready to make a knowledgeable commitment to a nuclear power programme

PHASE 1
Considerations before a decision to launch a nuclear power programme is taken

PHASE 1
Preparatory work for the contracting of a nuclear power plant after a policy decision has been taken

PHASE 3
Activities to implement the first nuclear power plant

FIRST NUCLEAR POWER PLANT PROJECT

Pre-project activities

Project development

Final investment decision
Contracting
Construction

Operation decommissioning

Commissioning

At least 10 to 15 years

It is no secret that Malaysia is going all out to become a data centre hub. It is also no secret that these facilities are energy guzzlers. In fact, it is estimated that there will be an increase of 7.7GW in electricity demand from data centres alone by 2030, according to the government.

How will Malaysia deal with these high-power needs? According to Deputy Prime Minister Datuk Seri Fadillah Yusof, who is also the energy transition and water transformation minister, given Malaysia's growing energy demand, the nation is exploring all potential solutions for its energy needs, which include nuclear power.

Proponents argue that nuclear energy provides a consistent and large-scale power source that can support the country's economic growth without adding to carbon emissions. This is important to remember because Malaysia is aiming for net zero emissions by 2050.

Notably, the United Nations' 28th Conference of the Parties saw more than 20 countries committed to tripling nuclear energy by 2050. This was in recognition of the role that nuclear energy plays in reaching net zero.

There are no solutions, however, for the long-term management of the storage of high-level radioactive waste, which can remain hazardous for thousands to millions of years. Owing to uranium's highly radioactive nature and half-life of 4.5 billion years, the only way to dispose of this highly radioactive material is to store it in deep geological repositories, according to the World Nuclear Association (WNA).

Moreover, disasters such as the Fukushima nuclear accident have caused many countries to rethink the role of nuclear power in their energy mix. This includes Malaysia, which took a no-nuclear stance in 2018.

MyPower Corp CEO Siti Safinah Salleh says it is understandable that nuclear power raises safety concerns about the effects of radiation, operational safety and radioactive waste, as well as costs.

"These are important issues for all of us. Regardless of the decision, as a progressive society, we should equip ourselves with the knowledge and be prepared, given that nuclear energy may be developed in the region and already powers many other countries," she says.

In this regard, MyPower, a special agency under the Ministry of Energy Transition and Water

Transformation (Petra), is conducting a feasibility study to evaluate nuclear as an alternative energy source. The study revisits previous research by the Malaysia Nuclear Power Corp (MNPC), which ceased operations in 2018.

The study includes reviewing the latest advancements in nuclear technology, conventions on peaceful nuclear energy use, safety, security and safeguard regulations, as well as stakeholder considerations and public opinion.

"Nuclear is a low-carbon energy source being explored for Malaysia to meet rising electricity demand and achieve long-term net zero greenhouse gas emissions. The study is a preliminary assessment of the considerations for nuclear power generation within the overall energy mix," says Siti.

"The findings from the study will be one input for the government to make an informed decision on the policy and way forward for a nuclear power programme. Basically, this is a commitment to put in place a strategic plan and allocate resources to prepare the foundation for any potential nuclear power development, subject to further decisions and approvals."

According to Siti, the feasibility study is in the final stages, with the release of its findings pending government approval.

"Rest assured, preparing for nuclear power is a process that takes many years, with multiple over-sights and engagements," she says.

Once completed, the country must establish a Nuclear Energy Programme Implementation Organisation (Nepio) to conduct further detailed studies, says Sherifah Noor Khamseah, a nuclear and innovation advocate. It is Nepio that will conduct further detailed studies to make an informed decision on nuclear energy.

ASEAN INTERESTED IN NUCLEAR POWER

Meanwhile, a Petra spokesperson says Malaysia supports enhanced collaboration within Asean, particularly in areas such as developing nuclear regulations, building technical expertise and capacity as well as sharing knowledge and experiences. This comes in response to several countries in the region having expressed interest in nuclear power development.

Indonesia has plans to build new nuclear power plants with 4.3GW capacity, according to news reports. Currently, the Philippines is home to the only nuclear power plant in Southeast Asia. The plant was built

four decades ago and has been left idle. Now, the country is revisiting nuclear power and aims to have its first nuclear power plants operational by 2032, with an initial capacity of 1,200MW, according to the Philippines Energy Plan.

Siti says nuclear power is likely to be discussed during Asean energy meetings this year. She hopes Malaysia, as the Asean chair in 2025, can facilitate a balanced dialogue on the peaceful use of nuclear energy through Asean's Nuclear Energy Cooperation Sub-Sector Network.

NUCLEAR NEEDED FOR ENERGY TRANSITION?

Malaysia aims to complete the retirement of coal-fired power plants by 2044. Currently, these power plants, which typically generate more than 1GW, provide more than 40% of electricity in Peninsular Malaysia.

The country is focusing on increasing the share of renewable energy in its power generation mix to replace coal. It has committed to raising renewable energy composition to 70% of its total generation capacity by 2050, according to the National Energy Transition Roadmap (NETR).

Nuclear power is absent from the road map, though.

According to the road map, installed capacity of coal is expected to be gradually reduced over the years from 29% in 2025 to 0% by 2050. Solar energy, hydrogen and bioenergy are then expected to be ramped up, from 26% in 2025 to 69% in 2050, and natural gas from 42% to 29%.

Dhana Raj Markandu, senior analyst at the Institute of Strategic & International Studies (Isis) Malaysia, notes that energy transition plans tend to focus on installed capacity, which is the total number of power plants built, but actual power generation varies according to the source.

Dhana was general manager of project development at the MNPC from 2012 to 2019.

Simply put, in terms of installed capacity, 1MW of coal power is not equivalent to 1MW of solar power because solar energy production is limited to daylight hours and weather conditions. Moreover, Malaysia risks overreliance on natural gas as it phases out coal from the energy mix.



"Nuclear is a viable replacement for the huge chunk of coal that we use now. It gives us more diversity for how we want to roll out those energy transition plans."

Dhana Raj, Isis

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"As we take our coal plants off the system, and if we don't add anything else new into it, we'll just ramp up solar. Then what's going to happen is we're going to start driving our gas plants more," says Dhana.

The energy lost from decommissioned coal plants must be replaced with a source that provides stable and continuous power.

Nuclear power presents itself as a "like for like" replacement for coal, says Dhana. This is because the power source provides large-scale, reliable and emissions-free energy without requiring extensive changes to existing energy infrastructure.

"[Nuclear is] a viable replacement for the huge chunk of coal that we use now. It gives us more diversity for how we want to roll out those energy transition plans so that we are not limited to just those resources," says Dhana.

Depending on the reactor type and plant, an average nuclear plant produces 1Gw of energy, according to the US Department of Energy.

Nuclear power can also utilise existing transmission infrastructure, which reduces the need for extensive new investments in grid expansion, says Dhana. In theory, a 1Gw coal plant can be replaced by a 1Gw nuclear plant with minimal grid adaptation.

"Nuclear energy complements renewable sources by providing a steady and reliable energy supply, especially during periods when renewables fall short. In addition, the long lifespan and high energy density of nuclear reactors make them an economically competitive solution over time," says Dr Rosli Darmawan, director general of the Malaysia Nuclear Agency (Nuclear Malaysia).

Meenakshi Raman, the president of Sahabat Alam Malaysia, says, however, that the country's energy transition should stick to renewable sources such as solar, wind and geothermal. This is because the high economic and environmental costs of nuclear power far outweigh its potential benefits.

She stresses that Malaysia should focus on improving renewable energy technologies such as battery storage, which is a more affordable and faster solution than nuclear power, as nuclear power plants take years to construct and involve massive costs.

Energy efficiency and conservation should be a top priority for high energy-consuming industries, she says.

HIGH UPFRONT COSTS BUT LOWER OPERATIONAL COSTS?

Minister of Science, Technology and Innovation Chang Lih Kang has said Malaysia lacks both the expertise and funding to begin nuclear energy development and support a nuclear energy-based power grid, according to reports.

Currently, universities such as Universiti Tenaga Nasional (Uniten) and Universiti Kebangsaan Malaysia offer nuclear-related academic programmes. Existing programmes need to be ramped up, however, if Malaysia is to develop a full-scale nuclear programme, says Sheriffah.

Nuclear Malaysia aims to foster a skilled workforce capable of meeting the demands of the nuclear industry through capacity-building workshops, internships and continuous professional development courses.

Nuclear power plants require significant capital investments. For instance, the total investment cost for France to build six nuclear plants in late 2020 was at least €56 billion, according to WNA.

Meanwhile, the Bangladesh Power Development Board officially started construction of its first reactor in 2022, completing the 1,200MW reactor in October 2024, with another 1,200MW on the way. The estimated cost for both amounted to US\$13 billion, according to its 2022 financial report.

Dhana says the significant upfront capital costs of nuclear power are a major factor deterring countries from investing in it. However, nuclear power plants have relatively low operational and fuel costs compared to fossil fuels.



"Malaysia should encourage banks to update their green loan policies to support nuclear financing."

Sheriffah, nuclear advocate

On the other hand, coal and gas plants have high operational costs due to fuel price volatility, notes Isis' Dhana. Gas and coal prices fluctuate according to international supply and demand, geopolitical factors and economic conditions.

He adds that nuclear reactors use uranium, which has low and stable fuel costs, as even large reactors need to refuel only once every 18 months. Even then, only about one-third of uranium is changed at a time. Moreover, nuclear plants are designed for lifespans of 60 to 80 years.

If Malaysia decides to adopt nuclear power, the government must set up a clear and transparent system for purchasing nuclear reactors and managing the nuclear supply chain, says Sheriffah. This will help improve governance in the electricity sector and ensure affordable energy costs for the people.

Regardless, nuclear power remains a long-term commitment for the country. Dhana says it will take 12 to 15 years from decision-making to operational deployment. This includes pre-planning, construction, commissioning and regulatory approvals.

Sheriffah suggests that Malaysia could update its green bond framework to include nuclear projects. This would enable the country to finance the construction of new nuclear power plants and support its supply chain.

Malaysia should also encourage banks to update their green loan policies to support nuclear financing, she adds.

But nuclear energy is a significant investment that private companies cannot bear alone, says Wong Weng Yew, founder and chief peering officer of Open DC Sdn Bhd, which designs and constructs data centres. Government involvement is essential to mitigate risks and encourage industry participation.

He says government intervention will be necessary, especially in the early stages, to facilitate adoption and ensure financial feasibility. A joint partnership model could help distribute risks between stakeholders.

Wong views nuclear power as a long-term solution because of its reliability, cost stability and minimal carbon emissions. Integrating nuclear energy into Malaysia's data centre industry will be key for Open DC to achieve its carbon neutrality goals.

But, first, a clear nuclear energy road map outlining a strategic plan for the next few years from the government is needed, says Wong. This is because government guidance is crucial for industry players to prepare for nuclear integration.

"We are happy to engage with the agencies to discuss concerns and how we go about adopting nuclear energy as part of our energy mix. It's a long process, but it's a necessary process. We should start as quickly as we can to embark on this journey ... It's hard for us to embark on this journey without specific guidance from the government," says Wong.

STILL EARLY DAYS FOR SMALL MODULAR REACTORS

Minister of Economy Rafizi Ramli says the country is looking at small modular reactors (SMRs), which he describes as smaller, safer and more affordable.

"All technology options were considered [in the feasibility study]. For SMRs, there are almost 90 designs in various stages. The assessment was narrowed down to those that are most advanced in the development progress, namely in regulatory approval stages," notes MyPower's Siti.

SMRs allow for phased deployment, enabling gradual integration into Malaysia's energy grid, says Nuclear Malaysia's Rosli. SMRs also offer enhanced safety features, require reduced land and water usage, and have the ability to serve smaller, decentralised energy systems. He says these qualities align well with Malaysia's geographic and economic landscape.

But there is still some way to go for SMRs to

UNANSWERED ISSUE OF LONG-TERM DISPOSAL

Malaysia should keep the door to nuclear energy closed, says Meenakshi Raman, president of Sahabat Alam Malaysia. Between the massive financial investment required and the long-term risks that radioactive material and wastes bring, she stresses it is simply not worth it.

"The cost of nuclear far outweighs any benefit that it would bring, particularly from the standpoint of radioactive waste management," says Meenakshi.

Nuclear waste is not a temporary issue and will need to be managed for thousands to billions of years. She argues that this is an issue that needs to be addressed, and so far no real answer has been given.

"From what we know, nowhere around the world has nuclear waste been properly stored and managed. Even in France, the US and so on. Much of the waste sits around in sites, waiting to be managed and disposed of properly. It's like disasters waiting to happen," says Meenakshi.

Uranium's radioactive nature and half-life of 4.5 billion years mean this highly radioactive material needs to be stored in deep geological repositories. This is something that is not done in most reactors.

All radiation exposure carries health risks, says Meenakshi. She recalls Bukit Merah in Perak, where a rare earth mining company disposed of its waste in the Kledang Range. This waste includes radioactive metals such as thorium, which has a half-life of 14 billion years, and uranium. Although the mining plant shut down in 1994, the radioactive waste site remains unresolved.

Dhana Raj Markandu, senior analyst at the Institute of Strategic & International Studies (Isis) Malaysia, says storing highly radioactive wastes on-site is widely practised globally. Final disposal solutions are usually considered only when the country can afford to do so.

The only exception, Dhana notes, is Finland, which last year announced the building of a final depository in collaboration with Sweden. He adds that this cross-border collaboration is something to expect in the future. Even with four nuclear plants in Finland, the cost of disposal is simply not economically viable for a single country to manage.

According to the World Nuclear Association, 97% of waste produced by nuclear plants has low or intermediate levels of radiation, which it says can be safely disposed of in near-surface repositories. Only highly radioactive wastes require deep repositories.

A large, 1Gw reactor produces 25 to 30 tonnes of highly radioactive waste a year. In 2020, France reported that only 0.2% of all radioactive wastes by volume were considered to have high levels of radiation.

The Asean region can develop a shared final disposal solution akin to Finland's collaboration with Sweden, Dhana says. Until then, the only solution is to store it on-site until another solution emerges.



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Wong, Open DC

become a reality. Dhana says SMRs are still undergoing testing and Malaysia is unlikely to be the first adopter of an unproven technology. If Malaysia were to wait for SMRs, nuclear adoption in the country may be delayed by up to a decade.

"There's a lot of first-stage movers that are exploring SMRs. If it's an option that Malaysia wants to explore, then we have to wait for the technology to reach a certain level of maturity, because, for a country like Malaysia, we're not going to go and buy a first-of-its-kind," says Dhana.

He says large reactors are the more feasible option, as they come with established technology, known risks and operational data.

Looking to the future, fusion technology offers virtually limitless energy with minimal environmental impact, says Rosli. It remains in the experimental stage, however, with commercial viability not expected for decades.

"A thorough reactor technology assessment study should be conducted to select the most appropriate technology for the country," he notes.