

ASEAN Energy Booklet Volume 2

Nuclear Energy Development in ASEAN



Do we need nuclear energy in ASEAN?



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Energy transition involves shifting from fossil fuels and accelerating the development of renewable energy (RE). Through the ASEAN Plan of Action for Energy Cooperation (APAEC) Phase II, the region aims to achieve a 23% RE share of total primary energy supply by 2025. As the region continues its journey towards sustainability, increasing the region's share of cleaner energy technologies is absolutely fundamental.

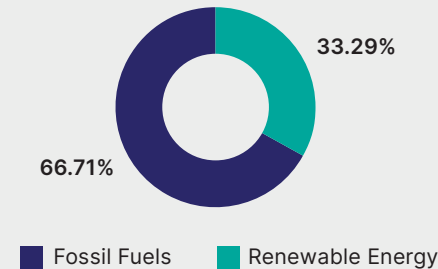
Why nuclear matters in energy transition?

The AMS have pledged strong commitments to reducing carbon emission, as reflected in the increasing renewable energy share of 33.29% in installed capacity in 2022. **While Variable RE (VRE) is very good for emissions reduction but poses stability challenges due to its intermittency.** Nuclear power however, provides low-carbon electricity while also maintaining system stability. Nuclear energy has the **lowest GHG emissions per kWh of electricity among other technology**, ranges from 5.1 – 6.4 gCO₂eq/kWh (IAEA, 2022). According to the 7th ASEAN Energy Outlook, the ASEAN region is considering the introduction of about **5.2 GW of nuclear power capacity by 2050** (ACE, 2022)



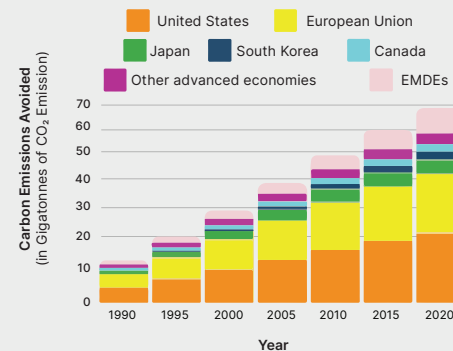
Energy transition in ASEAN

Fossil vs Renewables Installed Capacity in 2022



In 2022, around 34.3% and 28.9% of the generated power in the ASEAN region was from coal and gas, respectively, while renewable energy only took up around 33.29%. The region needs to accelerate the development of cleaner energy generation by using its diverse resource potential.

Nuclear power's global impact on emissions reduction

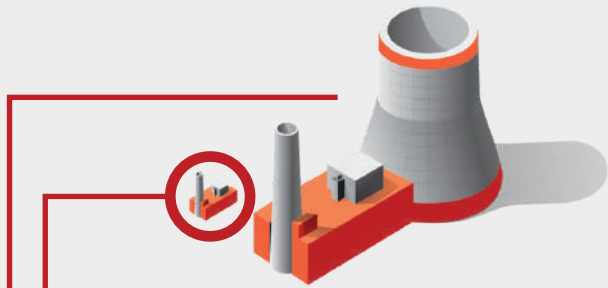


Emphasising its vital role in achieving global climate goals and sustainable energy transitions, the IEA's 2021 report on nuclear power highlighted **the emission reduction from nuclear power utilisation, which has avoided approximately over 65 gigatons of CO₂ emission since 1971.** The data emphasise the vital role of nuclear power in achieving global climate goals and sustainable energy transitions.

What are the recent developments of nuclear power technologies?

There are two methods in harnessing nuclear energy, namely nuclear fusion and fission. While nuclear fusion technology is still in the development phase, nuclear fission technology has been widely used for generating electricity. Nuclear fission technology is usually classified on the basis of capacity and type of reactor

Based on Installed Capacity



Small Modular Reactors (SMRs)

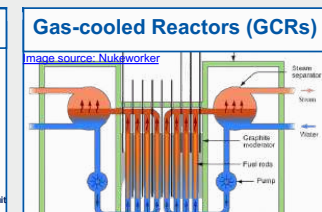
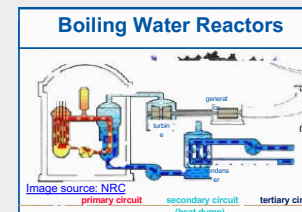
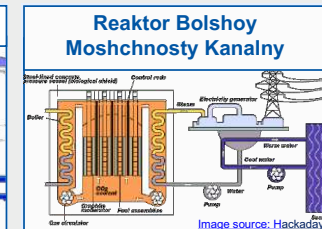
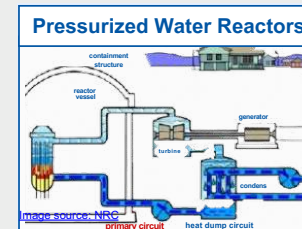
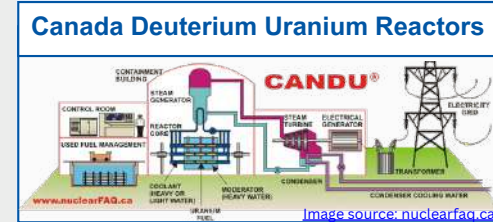
- Capacity: Up to 300 MW
- Potentially lower upfront investment costs
- Modular design for easier shipment, installation, and faster construction.

Medium/Large-Scale Reactors

- Capacity: 400 – 1750 MW
- Provides substantial base load electricity
- Smaller carbon footprint compared to other base load technologies

Based on Types of Operable Reactors

These are the nuclear technologies that are currently operational or are still under development, with diverse range of designs used in nuclear energy generation.



What are the key success in developing nuclear technology?



Learning from advanced countries that use nuclear technology in their energy mix, here are the important milestones in developing nuclear power.

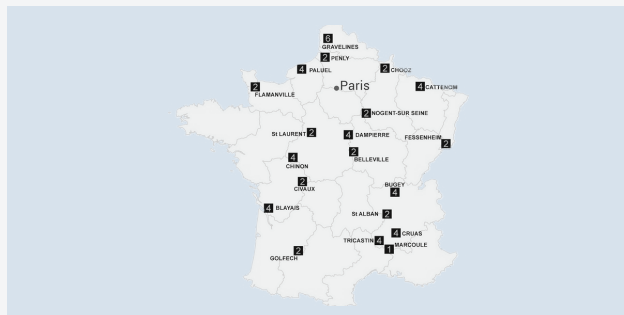
Establish a strong political will towards nuclear power and relevant institutions through research, regulatory measures, etc.

Establish related policies and laws to support nuclear development

Establish derivative energy policies and regulations for the use of nuclear power

Build nuclear power plants

France



Creation of French Alternative Energies and Atomic Energy Commission (1945)

Development of the initial nuclear energy plan (1952) and launching of the first plutogenic reactor (1956)

The 1973 oil crisis increased France's oil bill by 400% within two years

Development of the Messmer Plan in 1973 (Construction of over 13 NPPs)

Japan



Funded nuclear research program (1954)

Development of Atomic Energy Basic Law and Establishment of Atomic Energy Organisations (1955-1956)

Operation of Tokai Nuclear Power Plant as the first NPP in Japan (1966)

Establishment of Energy Policy Law (2002) to move away from fossil fuels

Inclusion of nuclear power generation in the latest PDP

China



Establishment of China Institute of Atomic Energy of the Chinese Academy of Science (1950)

Establishment of the National Nuclear Safety Administration (1984)

Grid integration of the Qinshan Nuclear Power Plant (1991)

Establishment of Energy Development Strategy Plan, 2014-2020 in 2014 to cut reliance on coal and promote clean energy (2014)

Plans to increase nuclear capacity to 70GW by 2025 as reflected in the draft 14th Five-Year Plan (2021)

How is the progress of nuclear energy development in ASEAN?



The progress of nuclear energy development in ASEAN has been characterised by organisations, existing reactors, plans and regulations and policies among member countries.

MYANMAR

In October 2023, signed an MOU with **Russia's ROSATOM** to cooperate on nuclear infrastructure assessment and enhancement.

LAO PDR

Signed several MOUs and agreements with **Russia's ROSATOM**.

INDONESIA

Established nuclear regulatory agency, **BAPETEN** and research agency, **BRIN**. In the process of establishing NEPIO to prepare for NPPs development for its first nuclear reactor by 2035

MALAYSIA

Focused on research reactor **Triga Puspati Reactor (RTP)** with a **National Nuclear Technology Policy 2021-2030**

CAMBODIA

Signed agreements with the government of **Russia and China** on nuclear energy cooperation.

PHILIPPINES

In the Philippine Energy Plan 2023 - 2050, the country sets the nuclear capacity target at **1,200MW by 2032**, 2,400MW by 2035 and at least 4,500MW by 2050.

Activities and undertakings in support of these targets are indicated in the **Philippine Nuclear Energy Program Roadmap 2023 - 2050**. Further, the Philippines likewise signed the **Agreement for Cooperation Concerning Peaceful Uses of Nuclear Energy** or the 123 Agreement with the United States which was put into force last 02 July 2024.

VIET NAM

Established **VINATOM and Vietnam Atomic Energy Agency**. Developed **Da Lat** research reactor in 1963 and suspend **Ninh Thuan** since 2016 due to country economic condition. Planned to develop **small-scale nuclear reactor** post 2030 (PDP8 2021 - 2030, with a vision towards 2045).

SINGAPORE

Considering nuclear as a long-term option for net-zero emissions by 2050.

THAILAND

Focused on research reactor, **Triga Mark III** and planned nuclear power plants by 2036, with **Thailand's Office of Atom for Peace** as regulatory agency and **Thailand Nuclear Institute of Technology** as a research agency.



BATAAN NUCLEAR POWER PLANT (1984)

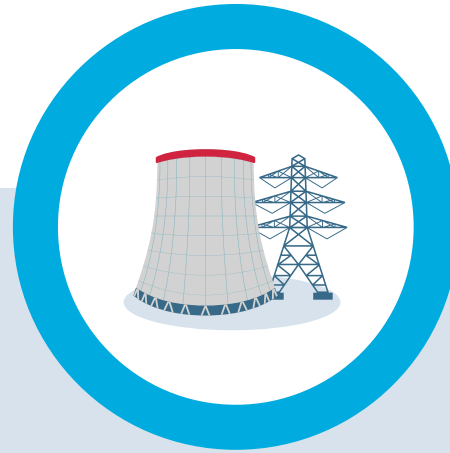
As mandated by Executive Order 164 signed in 2022, the Philippine Nuclear Energy Program Inter-Agency Committee (NEP-IAC) shall recommend the use and viability of the mothballed 621 MW Bataan Nuclear Power Plant (BNPP).

Currently, the Department of Energy (DOE) is facilitating the finalization of the proposed Memorandum of Understanding (MOU) on the Feasibility Study of the BNPP Rehabilitation with the Korea Hydro and Nuclear Power Co. Ltd. (KHNP)."

What challenges does ASEAN face in developing nuclear power plants?



The four main challenges relate to infrastructure, finance, technical questions, and societal concerns



Infrastructure & Technical

- Some ASEAN Member States (AMS) straddle the tectonic belt of volcanoes known as the **"Pacific Ring of Fire"**
- **Nuclear waste management** requires advanced technologies and long-term planning to ensure environmental and public safety.
- Establishment and enhancement of **safety infrastructure**.

Policy & Regulation

- **"Nuclear Phase-out" policies** in advanced countries with nuclear in the energy mix, post-Fukushima incident
- The electricity policies are **non-inclusive to nuclear power**
- **Strict regulations** and customary to ensure compliance with **international safety standards** (IAEA, 2022)

Financial

- **High upfront cost**, high fuel price (especially for importing countries)
- **Limited access to financing or financing schemes** and gaining traction/ attractiveness of nuclear projects from a financial institutional point of view.

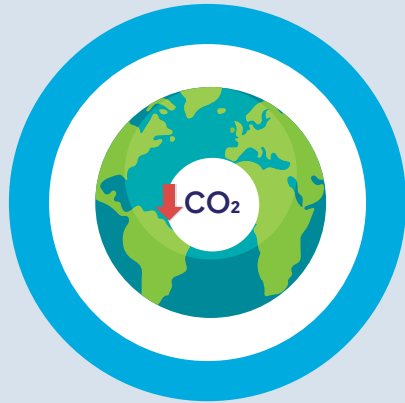
Social

- **Nuclear literacy** to overcome public perception in nuclear energy's safety and reliability
- **Limited human resource** capabilities on nuclear

What are the enablers and drivers needed to deploy nuclear energy in ASEAN?

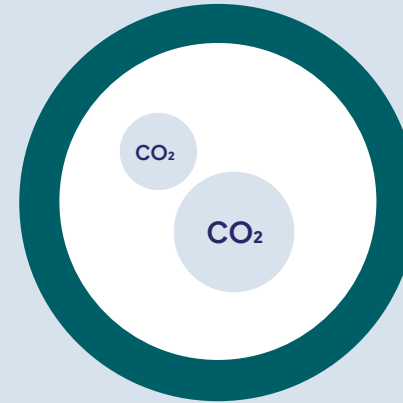


In ASEAN, the synergy between environmental commitments, space efficiency, regulatory infrastructure development, and technological progress are propelling the adoption of nuclear energy solutions.



Countries' Commitment to Net-Zero Emissions (NDCs)

The AMS are moving towards net-zero emissions (NZE) as part of their **Nationally Determined Contributions (NDCs)**, driving interest in nuclear energy.



Small Physical Footprint

Nuclear power offers a **small physical footprint**, impacting the surface less than other energy sources. A single nuclear reactor requires significantly **less land** compared to alternative clean energy options.



Establishment of Nuclear Research Agencies and Regulatory Authorities

Half of the AMS have established dedicated **nuclear energy research agencies and regulatory bodies**, indicating a growing readiness for nuclear energy adoption.



Advancing Nuclear Power: Innovation and Workforce Development

New and emerging technologies offer exciting possibilities for nuclear power growth, as experts suggest. Through nuclear growth, **human resource on nuclear technical capabilities** would be developed.

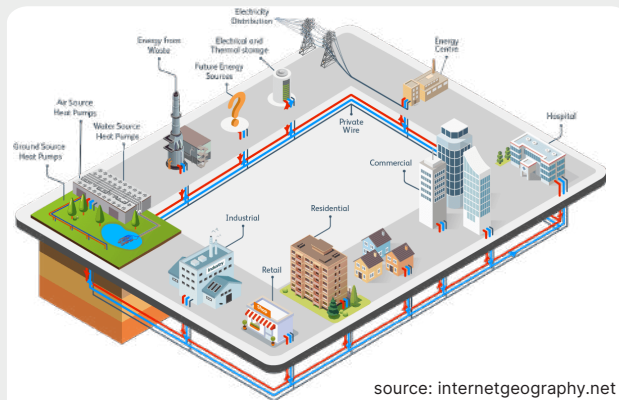
What opportunities could arise from nuclear energy development in ASEAN?



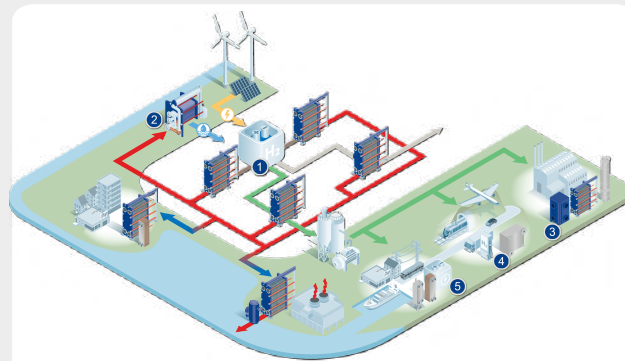
The development of nuclear energy in ASEAN could offer several opportunities across various sectors:

1. Providing flexible and reliable electricity with low-carbon emissions, contributing to the decarbonisation of the power generation sector.
2. Potential of using generated heat from Nuclear Reactor for other application other than power, such as district heating, hydrogen production, and water desalination.

District Heating



Hydrogen Production



Water Desalination



What are the next steps for ASEAN to continue developing nuclear energy?



The next steps for nuclear energy development in ASEAN involve a comprehensive approach that addresses key considerations and challenges. Here are some important actions and considerations in advancing nuclear energy in ASEAN:



Establish Legal and Regulatory Frameworks for Nuclear Safety

Legal and regulatory frameworks are required to ensure the safe operation of nuclear power plants in the future.



Increasing Nuclear Literacy and Capacity

Increase nuclear literacy through workshops, capacity buildings, and trainings.



Establish Nuclear Energy Planning Coordination

Establish NEPIO to better coordinate efforts among the many organisations and individuals that have roles in the nuclear energy planning and execution process.



Integrate Enabling Policies and Regulation on Nuclear Power in the National and Regional Energy Planning

Consider nuclear power generation in the long-term national power/generation development plan, along with the implementation roadmap and regional Measurement, Reporting, and Verification (MRV) framework



Promoting Regional and International Collaboration

Foster regional and international cooperation as forum/information exchange to learn the best practices and update on the current trends, technology, and other important aspects of NPP development.



Financing Mechanism and Investment Plan

Establishing a suitable and attractive financing mechanism and clear investment plan for nuclear infrastructure development should enable higher nuclear utilisation in ASEAN.

ACE studies & projects to increase nuclear literacy in ASEAN



Through targeted studies and projects, ACE aims to elevate awareness and knowledge regarding nuclear technologies, applications, and safety measures among ASEAN member states. These initiatives play a pivotal role in fostering informed discussions and decision-making around nuclear energy, thereby contributing to regional energy security and sustainability goals



ASEAN Nuclear Energy Portal



Engagement with the Global Cooperation on Nuclear Energy Partnership India and Korea Nuclear Association



Civilian Nuclear Energy Factsheet (2020)



Policy brief on Small Modular Reactor (SMR) Deployment towards a Low-Carbon ASEAN Economy (2022)



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Acknowledgements

- This publication has benefitted from the overall guidance of ACE's Executive Director, Dr. Nuki Agya Utama, and ACE Manager, Beni Suryadi.
- This publication was led by Rully Hidayatullah, prepared by Marcel Nicky Arianto and Putri Aprilia Maharani from the Power, Fossil Fuel, Alternative Energy, and Storage (PFS) Department.
- ACE colleagues, Nadhilah Shani, Prihastya Wiratama, Akbar Dwi Wahyono, Indira Pradnyaswari, Aldilla Noor Rakhiemah, Rizky Aditya Putra, and Tung Phuong provided helpful reviews and feedback.
- Publication was supported by Rinda Rufaidah of ACE Communications Team and design was supported by Bayu Surya Prayogie of ACE Communications Team and Rumaysha Aliffi Shanika of ACCEPT II Team.

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Version : July 2024

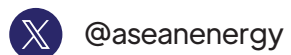
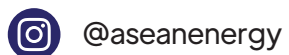


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