



# International experience of countries introducing nuclear energy

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# Global Nuclear Energy Landscape

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## Philippines Nuclear Revival to Replace Coal



## Second Barakah Unit Commences Commercial Operation



## France to Build 14 Nuclear Reactors by 2050



## EU Needs “Colossal” Investment in New Nuclear Says Commissioner




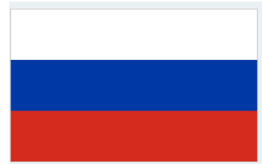








## The Netherlands Decides to Build Two New Nuclear Units



## US DOE Establishes \$6billion Program to Preserve America’s Clean Nuclear Energy Infrastructure



Country	Status
 <p><b>United States</b></p>	<ul style="list-style-type: none"> <li>World's largest fleet - 30% of global total nuclear electricity generation from 93 reactors - efforts to extend the life of existing reactors</li> <li>Bipartisan support for advanced nuclear and significant government \$ for SMRs including funding for two demonstration units</li> <li>Nuclear energy will be a key low carbon source for future</li> </ul>
 <p><b>United Kingdom</b></p>	<ul style="list-style-type: none"> <li>Large NPP new build: EDF Energy with a 66.5% stake in HPC, China General Nuclear at 33.5% (Sizewell C: EDF to take 80% stake and CGN to take 20% stake / Bradwell B: EDF to take 33.5% stake and CGN to take 66.5% stake) Note: CGN involvement under review</li> <li>March 2022, UK Government acquiring 20% stake in Sizewell C</li> </ul>
 <p><b>France</b></p>	<ul style="list-style-type: none"> <li>70% of total electricity generated from 56 reactors; world's largest net electricity exporter</li> <li>Full-scope fuel cycle capabilities except natural uranium</li> <li>February 2022 pledge by President Macron to construct up to 14 new reactors and fleet of SMRs</li> <li>One reactor is currently under construction – EPR at Flamanville</li> </ul>
 <p><b>Russia</b></p>	<ul style="list-style-type: none"> <li>Russian Federal Target Programme envisages a 45-50% nuclear share in electricity supply by 2050 and 70-80% by the end of the century</li> <li>Continued export of nuclear technology a major policy objective of the Russian government</li> </ul>
 <p><b>China</b></p>	<ul style="list-style-type: none"> <li>As part of goal of replacing coal-fired plants with clean energy by 2060, China is planning at least 150 new nuclear reactors over the next 15 years</li> <li>China will surpass U.S. as world's largest generator of nuclear power by the middle of decade</li> <li>Reactor exports expected</li> </ul>

Country	Status
 <p><b>Republic of South Korea</b></p>	<ul style="list-style-type: none"> <li>• 24 operating reactors; 4 under construction</li> <li>• 2017 policy to phase out nuclear power over a 45-year period</li> <li>• New President Yoon Suk-yeol (elected March 2022) has committed to abolishing phase-out policy</li> </ul>
 <p><b>Canada</b></p>	<ul style="list-style-type: none"> <li>• 15% of current electricity comes from 19 reactors</li> <li>• SMR focus with the release of both an “SMR Roadmap” (2018) and “SMR Action Plan” (2020) setting out next steps for deployment of SMRs in Canada; certain provinces leading</li> <li>• Ontario Power Generation with two demonstration projects – USNC Micro Reactor and BRWX-300</li> </ul>
 <p><b>Japan</b></p>	<ul style="list-style-type: none"> <li>• 10 reactors back on line of 30 operable</li> <li>• Plan for 20-22% of electricity generation from nuclear by 2030</li> </ul>
 <p><b>India</b></p>	<ul style="list-style-type: none"> <li>• 23 operable reactors</li> <li>• Largely indigenous programme, including fuel cycle</li> <li>• March 2022 announced plans to commence construction of a fleet of 10 new reactors in the next 3 years</li> </ul>
 <p><b>European Union</b></p>	<ul style="list-style-type: none"> <li>• 26% of electricity in the EU generated from nuclear power</li> <li>• 13 of 27 EU countries operate nuclear power plants</li> <li>• EU Taxonomy on Sustainable Investments to include nuclear energy</li> </ul>

# Global Nuclear Energy Landscape (cont.)


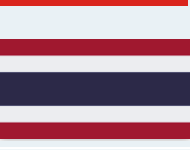



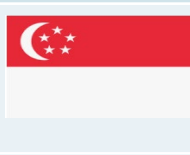





## EU nuclear countries – new build plans

## EU non-nuclear countries – new build plans

<b>Belgium</b>		<b>Austria</b>	
<b>Bulgaria</b>	✓	<b>Croatia</b>	Part owner of Krško NPP in Slovenia; plans for new reactor at NPP
<b>Czech Republic</b>	✓	<b>Cyprus</b>	
<b>Germany</b>		<b>Estonia</b>	Undertaking IAEA Milestones Approach
<b>Spain</b>		<b>Greece</b>	April 2022 - In talks with Bulgaria re joint ownership of new NPP in Bulgaria
<b>France</b>	✓	<b>Ireland</b>	
<b>Hungary</b>	✓	<b>Italy</b>	?
<b>Netherlands</b>	✓	<b>Latvia</b>	April 2022 – Collaboration with US Government on nuclear infrastructure development
<b>Romania</b>	✓	<b>Lithuania</b>	Previously had nuclear energy; Visaginis NPP project
<b>Slovenia</b>	✓	<b>Luxemburg</b>	
<b>Slovakia</b>	✓	<b>Malta</b>	
<b>Finland</b>	✓	<b>Poland</b>	Government large NPP programme and SMR programme Private sector SMR programme
<b>Sweden</b>	✓	<b>Portugal</b>	
		<b>Denmark</b>	

# South-East Asia - embarking nuclear energy countries

Country	Current Policy
	<b>Vietnam</b> <ul style="list-style-type: none"> <li>Decision to postpone plans for construction of two NPPs with Russia and Japan taken in 2016</li> <li>March 2022 - nuclear back on the agenda</li> </ul>
	<b>Thailand</b> <ul style="list-style-type: none"> <li>Active nuclear energy programme pre-Fukushima</li> <li>2017 IGA between China and Thailand on cooperation in the peaceful use of nuclear energy</li> <li>Agreement with Rosatom on supply of cyclotron complex for Thailand Institute of Technology</li> </ul>
	<b>Laos</b> <ul style="list-style-type: none"> <li>2016 MoU between Laos Ministry of Energy and Rosatom in the field of nuclear energy for peaceful purposes</li> </ul>
	<b>Cambodia</b> <ul style="list-style-type: none"> <li>2017 IGA between Cambodia and Russia on cooperation in field of peaceful use of nuclear energy</li> <li>2017 MoU with China National Nuclear Corporation on cooperation in peaceful use of nuclear energy</li> </ul>
	<b>Malaysia</b> <ul style="list-style-type: none"> <li>Pre-feasibility studies complete</li> <li>2018 decision to stop nuclear energy programme</li> </ul>
	<b>Singapore</b> <ul style="list-style-type: none"> <li>Ministry of Trade and Industry of Singapore pre-feasibility study in 2010-2012; monitored nuclear energy ever since</li> <li>March 2022 Energy Market Authority – nuclear could supply 10% of Singapore's electricity by 2050 – fission SMRs and fusion</li> </ul>
	<b>Indonesia</b> <ul style="list-style-type: none"> <li>MoUs and feasibility studies with Rosatom, CNNC, KEPCO, JAEC</li> <li>Plans for a floating ThorCon thorium molten salt reactor by 2030</li> </ul>
	<b>Philippines</b> <ul style="list-style-type: none"> <li>February 2022 Executive Order to include nuclear energy in the Philippines' energy mix</li> <li>Private sector initiatives underway for SMR deployment</li> </ul>
	<b>Sri Lanka</b> <ul style="list-style-type: none"> <li>Nuclear power included in Sri Lanka national energy strategy; member of “No New Coal Compact”</li> <li>IAEA Phase 1 INIR Mission currently in progress</li> </ul>

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## Introducing Nuclear Energy

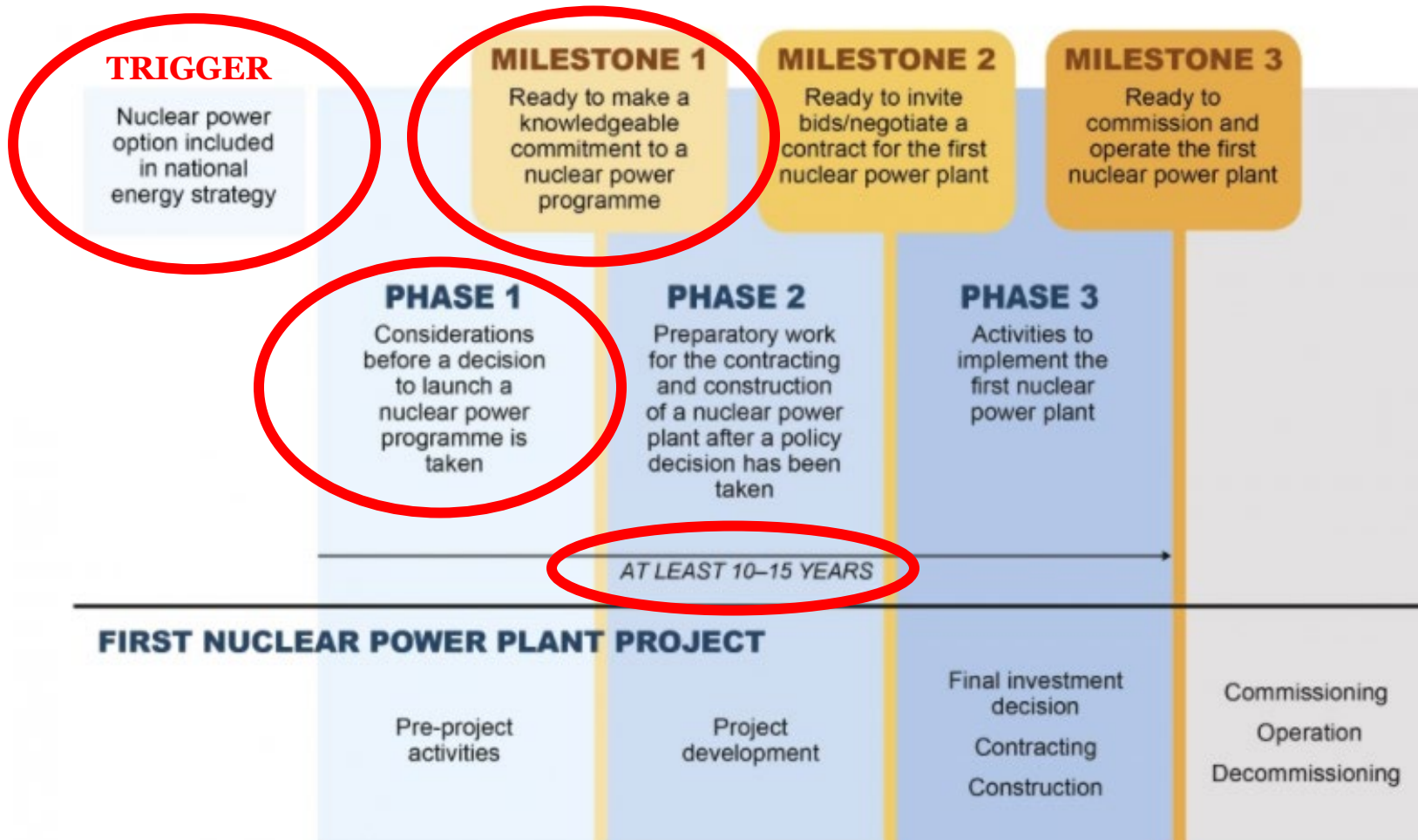
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- **Embarking/newcomer nuclear countries:** 50 IAEA Member States have expressed interest in introducing nuclear:<sup>\*</sup>
  - **23 are in a pre-decision phase** and engaged in energy planning activities
  - **27 are pursuing the introduction of nuclear power:**
    - 17 in a decision-making phase, i.e. those actively preparing the infrastructure without having made a decision (Algeria, Bolivia, Chile, El Salvador, Ethiopia, Indonesia, Kazakhstan, Morocco, Niger, Philippines, Senegal, Sri Lanka, Sudan, Thailand, Tunisia, Uganda, Zambia)
    - 10 in a post-decision-making phase, i.e. those having taken a decision and building the infrastructure, or having signed a contract, and are preparing for or have already started construction (Bangladesh, Egypt, Ghana, Kenya, Jordan, Nigeria, Poland, Saudi Arabia, Turkey, Uzbekistan)
- **IAEA Guidance:** The International Atomic Energy Agency has developed guidance in the form of the “Milestones in the Development of a National Infrastructure for Nuclear Power” (the “IAEA Milestones Approach”) to assist governments in:
  - Evaluating nuclear energy
  - Implementing a national nuclear energy programme

<sup>\*</sup> IAEA Technology Review 2021

## NUCLEAR POWER INFRASTRUCTURE DEVELOPMENT








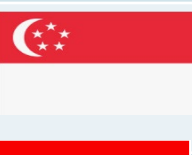



*\*10-15 years is indicative only and Australia, with our advanced economy, stable legal and political systems and existing nuclear infrastructure, will likely be able to compress this time frame*

## Infrastructure issues

<b>1. National Position</b>	<b>2. Nuclear Safety</b>
<b>3. Management</b>	<b>4. Funding and Financing</b>
<b>5. Legal Framework</b>	<b>6. Safeguards</b>
<b>7. Regulatory Framework</b>	<b>8. Radiation Protection</b>
<b>9. Electrical Grid</b>	<b>10. Human Resource Development</b>
<b>11. Stakeholder Involvement</b>	<b>12. Site and Supporting Facilities</b>
<b>13. Environmental Protection</b>	<b>14. Emergency Planning</b>
<b>15. Nuclear Security</b>	<b>16. Nuclear Fuel Cycle</b>
<b>17. Radioactive Waste Management</b>	<b>18. Industrial Involvement</b>
<b>19. Procurement</b>	

# Why countries utilise the “Milestones Approach”

- **IAEA:** Developed by the International Atomic Energy Agency in 2009
- **Established framework:** An established and well-utilised international framework/methodology; precedents and benchmarks
  - UAE Programme: Utilised the Milestones Approach and was the first country to have all three Phases reviewed by the IAEA
  - Guidance materials
- **Comprehensive:** Systematic and comprehensive approach
- **Coordination:** Includes coordination with all stakeholders
  - **First step:** Establish a Nuclear Energy Program Implementing Organisation (a “NEPIO”) to coordinate and facilitate the work – Government and industry stakeholders represented
- **Informed decision-making:** Equipping political leadership of country with comprehensive information on nuclear energy to facilitate informed decisions
- **Trigger:** Nuclear energy considered an option in national energy policy
  - Does not commit a country to proceed with a nuclear energy programme – always a sovereign decision
- **Peer review services:** Integrated Nuclear Infrastructure Reviews
  - 30 INIR Review Missions conducted by the IAEA since 2009

Country	Current Policy
	<p><b>Vietnam</b></p> <ul style="list-style-type: none"> <li>• <b>IAEA INIR Phase 1 Mission in 2009</b></li> <li>• Decision to indefinitely postpone plans for construction of two NPPs taken in 2016</li> <li>• Vietnam has previously considered proposals from Russia and Japan to build 2,400 and 2,200 Mwe of nuclear capacity respectively</li> </ul>
	<p><b>Thailand</b></p> <ul style="list-style-type: none"> <li>• <b>IAEA INIR Phase 1 Mission in 2010</b></li> <li>• 2017 IGA between China and Thailand on cooperation in the peaceful use of nuclear energy</li> <li>• Agreement with Rosatom on supply of cyclotron complex for Thailand Institute of Technology</li> </ul>
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Thoughts for Australia

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## Create nuclear energy optionality

- Must start now to create nuclear optionality in the late 2020s – perfect timing to procure successfully commercialised SMR technologies
- Order books are already filling up
- The earlier we start the better positioned we will be

2

## Commence and utilise the IAEA Milestones Approach

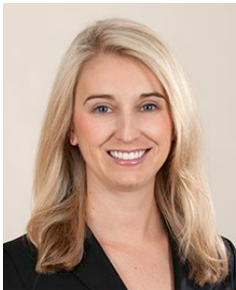
- Not a commitment to anything other than social engagement and informed policy-making
- Australia would not be starting from scratch
- Should be applied efficiently (IAEA Milestones Approach is currently under review , including for SMRs )

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## Opportunities to be explored

- Maintain Australia's global leadership (on issues such as nuclear security and safeguards) and regional leadership
- “Like-minded” country collaboration – SMR focused
- Strategic bilateral partnerships
- Domestic and regional supply chain capabilities
- Strategic consideration of Australia's position in and contribution to the nuclear fuel cycle
- AUKUS needs and synergies

# Questions?



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