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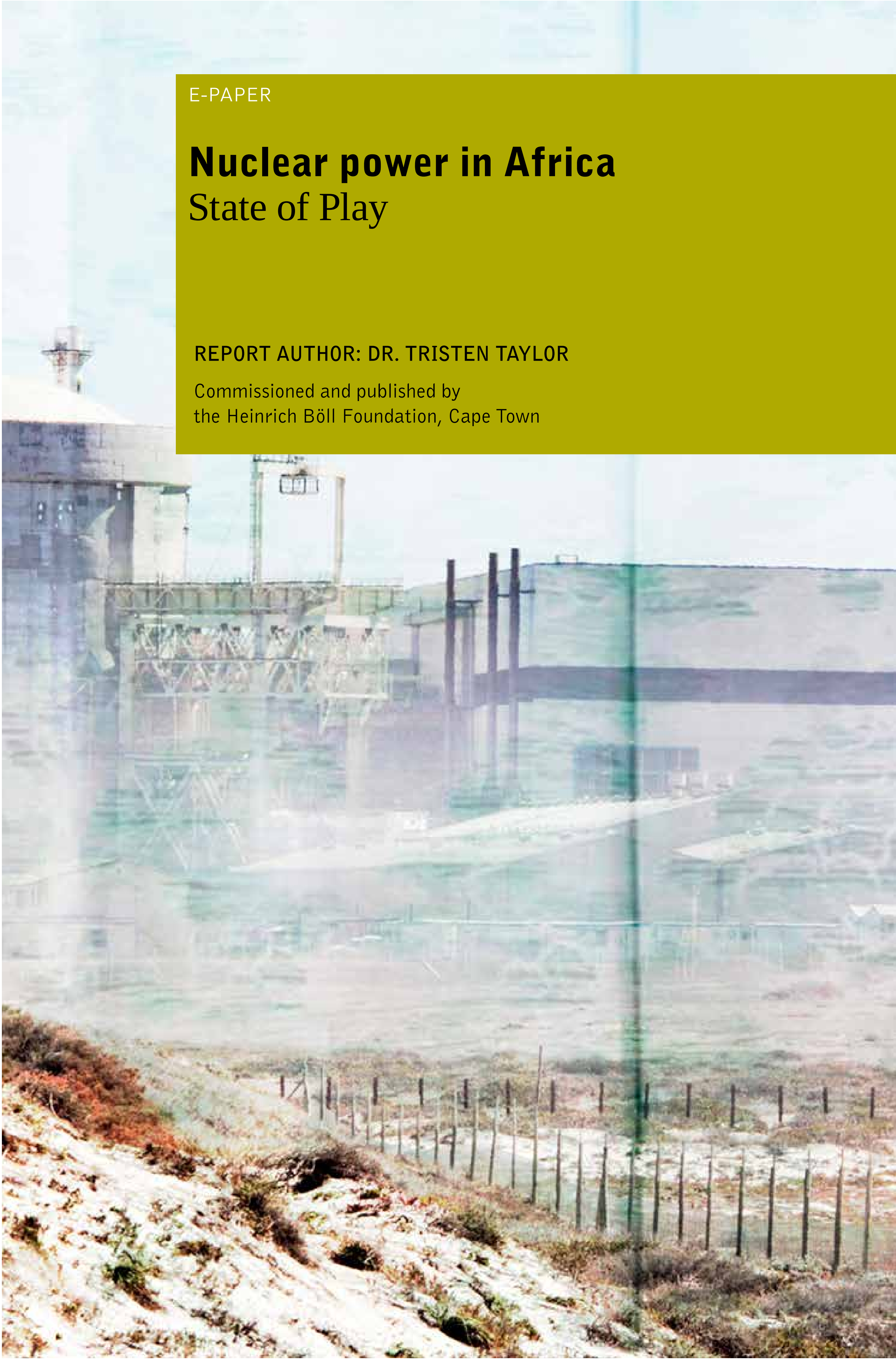

E-PAPER

Nuclear power in Africa
State of Play

REPORT AUTHOR: DR. TRISTEN TAYLOR

Commissioned and published by
the Heinrich Böll Foundation, Cape Town

About the author:

Dr. Tristen Taylor is a freelance journalist and researcher published in Business Day, Financial Mail, Christian Science Monitor, NRC, Süddeutsche Zeitung, Africa Confidential, Sunday Times, Daily Maverick and Mail & Guardian. He is a member of the International Press Institute. He is a research fellow in philosophy at Stellenbosch University. https://thanatos.co.za

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Acronyms and abbreviations

BAERA: Bangladesh Atomic Energy Regulatory Authority

BOOT: Build-own-operate-transfer

BOO: Build-own-operate

CfD: Contract for difference

CNNC: China National Nuclear Corporation

EIA: Environmental impact assessment

EPREV: Emergency Preparedness Review

GW: Gigawatt

IAEA: International Atomic Energy Agency

IFI: International finance institution

KEPCO: Korea Electric Power Corporation

kW: Kilowatt

kWh: Kilowatt-hour

MW: Megawatt

MWe: Megawatt electric

MWh: Megawatt-hour

MWt: Megawatt thermal

NEPIO: Nuclear energy program implementing organization

NuPEA: Nuclear Power and Energy Agency

PBMR: Pebble Bed Modular Reactor

RAB: Regulated asset base

SESA: Strategic Environmental and Social Assessment

SMR: Small modular reactor

FOREWORD

By Keren Ben-Zeev, Heinrich Böll Foundation, Cape Town

As the world scrambles to meet growing electricity needs while adhering to net zero targets, nuclear energy is once again in focus. Citing the claim that nuclear is a 'clean' energy source, in November 2024, during COP 29 in Azerbaijan, 31 countries pledged to triple their nuclear energy capacities by 2050.[1] [2]

Although sceptics point out that the nuclear industry has been predicting its own revival for the past 25 years,[3] recent shifts are noteworthy. In June 2025, the World Bank announced the lifting of its long-standing ban on financing nuclear power projects.[4] Other international financial institutions (IFIs) may follow, as discussions within the Asian Development Bank suggest.[5] These significant changes follow multiple deals announced over the past two years, with major technology companies pledging billions to nuclear energy projects.[6] Over the past five years, countries that have long held strong stances against nuclear have also reversed their positions, with both Japan and Germany indicating openness to the technology.[7] By some measures, investments in nuclear energy

1 World Nuclear Association, "*Six More Countries Endorse the Declaration to Triple Nuclear Energy by 2050 at COP29*," November 13, 2024, https://world-nuclear.org/news-and-media/press-statements/six-more-countries-endorse-the-declaration-to-triple-nuclear-energy-by-2050-at-cop29.

2 It should be noted that this is a highly improbable target. To contextualise, achieving this target would require 60 GW of new nuclear to be added to the grid annually between now and 2050. Even in the 1980s – nuclear energy's historical peak – only GW 30 could be added each year. Herold et al; Boll Fakten: Atomenergie;

3 Financial Times, "*Are We on the Brink of a Nuclear Revival?*" YouTube video, 29:59, April 17, 2025, https://www.youtube.com/watch?v=GXhk3HIFYuc.

4 Max Bearak, "World Bank Ends Its Ban on Funding Nuclear Power Projects," *New York Times*, June 11, 2025, https://www.nytimes.com/2025/06/11/climate/world-bank-nuclear-power-funding-ban.html.

5 Jamie Smyth, "Asian Development Bank Considers Lifting Funding Ban on Nuclear Power Projects," *Financial Times*, June 16, 2025, https://www.ft.com/content/27f869c5-17a8-4d57-bb76-f9ac9ea13697.

6 Brad Plumer, "Amazon, Google, and Microsoft Turn to Nuclear Energy to Power Data Centers," *New York Times*, October 16, 2024, https://www.nytimes.com/2024/10/16/business/energy-environment/amazon-google-microsoft-nuclear-energy.html; Goldman Sachs Research, *The Push for the 'Green' Data Center*, December 17, 2024, https://www.goldmansachs.com/pdfs/insights/goldman-sachs-research/the-push-for-the-green-data-center/aidatacenters.pdf

7 Justin McCurry, "'An Act of Betrayal': Japan to Maximise Nuclear Power 14 Years after Fukushima Disaster," *The Guardian*, February 12, 2025, https://www.theguardian.com/world/2025/feb/12/japan-nuclear-power-plan-emissions-targets-fukushima ; Julian Wettengel, "Economy Minister Confirms End of Germany's Resistance to Nuclear

are increasing, though they remain a fraction of what is invested in renewables.[8] In May 2025, a series of executive orders signed by President Donald Trump directed US regulatory agencies to streamline licensing processes for nuclear reactors and power plants, aiming to shorten approval timelines from several years to 18 months.

Although not new, the growing interest in nuclear is also manifesting across the African continent. Despite Africa's exceptional solar and wind resources, announcements of nuclear power plant projects and cooperation agreements continue to proliferate. Egypt is constructing its first plant, South Africa is working to expand its existing nuclear capacity despite a series of setbacks, and Ghana has recently received bids. Meanwhile, Rwanda, Kenya, Nigeria, Uganda, Tanzania, Algeria and Morocco have all signed nuclear technology cooperation agreements with various partners.

Despite this hype, nuclear power programmes take decades to develop and are frequently beleaguered by false starts. Given that – alongside other drawbacks – nuclear power is too slow and costly, the Heinrich Boell Foundation believes that it is not a solution to the climate crisis or energy poverty, and will certainly not advance a just transition.[9] It is thus committed to supporting its partners across the continent to resist these dangerous distractions. This report was commissioned to try to distinguish hype from reality and provide a realistic assessment of which African countries' nuclear plans are likely to materialise in the coming two decades.

Power at EU Level," *Clean Energy Wire*, May 23, 2025, https://www.cleanenergywire.org/news/economy-minister-confirms-end-germanys-resistance-nuclear-power-eu-level.

8 Goldman Sachs Research, "*Is Nuclear Power Set for a Revival?*, accessed June 26, 2025, https://www.goldmansachs.com/insights/articles/is-nuclear-power-set-for-a-revival. argues that in 2023 and 2024 investment in nuclear power rose to over US 60bn. This is contested by Schneider (2024), *The World Nuclear Industry Status Report 2024*, https://www.worldnuclearreport.org/IMG/pdf/wnisr2024-v4.pdf which estimates that in 2023 under US 50 billion. was invested. For the same period investment in REs was over US 600 billion.

9 HeinrichBöllStiftung, "*Neither Climate Nor Jobs*," November 5, 2021, HeinrichBöllStiftung Cape Town, 33 pp., accessed June 26, 2025, https://za.boell.org/en/2021/11/05/neither-climate-nor-jobs.

While the report is not comprehensive, it has attempted to take a systematic approach to this assessment – an admittedly difficult task. As the report shows, although establishing nuclear power plants demands significant time, money and effort, assessing the credibility of their prospects is extremely difficult and ultimately depends on subjective judgements. One significant finding of the report is that while it purports to facilitate the safe development of nuclear power, the International Atomic Energy Agency's (IAEA's) Milestones Approach is undermined by its reluctance to criticise member states or issue clear assessments regarding countries' progress. Consequently, it is difficult to estimate which phase a country is at, and whether or not a milestone has been achieved seems to be a political decision, not an objective assessment. Nonetheless, the report uses countries' participation in the IAEA's milestone roadmap as an indication of the seriousness with which nuclear power is being pursued.

Not all African countries were included in this report and the data is valid up to February 2025. The selection of countries examined is based on an initial qualitative scoping and is not exhaustive. Future updates of this report could re-examine these countries, particularly given constantly changing developments: for example, in early 2025, Namibia indicated an interest in nuclear power. In an attempt to provide reliable assessments, the report limited the sources it consulted to those considered credible.

Alongside country assessments, the report explores key dimensions of the continent's nuclear pathways: the most probable vendors, potential financing and contractual options, common narratives promoting the technology, and the geopolitical dynamics behind some countries' cooperation announcements.

In exploring vendors and their offerings, the report shows that a nuclear build offers more than a one-time lucrative deal for a vendor. Accompanying agreements for fuel, maintenance, repairs and training mean that once a vendor is chosen, client countries are likely to be locked into decades-long financial obligations – and geopolitical dependencies – given that nuclear vendors are more often than not state-owned. Given their size and recent construction experience, the report posits that Russian, Chinese, or South Korean actors are more likely than Western ones to be preferred as vendors for future nuclear power station builds in Africa.

The report also aims to debunk several persistent myths about nuclear energy in Africa. For example, the case of Bangladesh demonstrates that, with generous vendor financing, even poorer countries can procure nuclear power despite the high costs. The report further challenges the assumption that having uranium deposits automatically enables commercially viable prospects for 'beneficiation' and a domestic nuclear fuel industry. Developing such industries is not only prohibitively expensive but also requires geopolitical diplomacy and the goodwill of current uranium producers – who, as noted earlier, seek long-term fuel supply agreements rather than one-off deals.

An examination of small modular reactors (SMRs) concludes that despite many decades of hype resulting in little, African governments (like others) are seriously considering them – or at least using their empty promise of 'problem-free' nuclear power (cheaper, safer, faster) to justify investments in the technology. Recent reports outline the repeated and unsuccessful efforts to build small nuclear plants at lower prices than large builds, which allow for some economies of scale.[10] Moreover, SMRs pose significant proliferation risks.[11]

The growing interest in nuclear power on the continent is driven by anything but rational energy planning. Instead, geopolitical interests, the imagined prestige of nuclear energy, and a desire to project power are motivating African governments to indulge in nuclear dreams. Yet rather than signalling an 'advanced society', this pursuit is a costly and dangerous diversion from renewable energy solutions, which offer faster, cheaper, and safer ways to address energy poverty.

The report concludes that despite the hype, nuclear power will remain an unlikely proposition for most African countries in the next decade or two. Paradoxically, however, as renewable energy and storage costs decline and technologies improve, policy shifts in international finance institutions, alongside geopolitical power plays, could expand African countries' opportunities to develop nuclear energy. To resist these developments, civil society should focus on monitoring countries' energy budgets and their allocations to nuclear power-related expenditure, while advocating for the reinstatement of IFI bans on nuclear power project financing. Although the IAEA Milestone Approach is flawed, civil society can use it to question countries' preparation and readiness for safely operating nuclear power plants.

10 Heinrich Böll Stiftung (Prague Office), "Modular Reactors in 2024 – Ambitious Goals, Missing Technologies," March 17, 2025, https://cz.boell.org/en/2025/03/17/Modular-reactors-in-2024-Ambitious-Goals-Missing-Technologies.

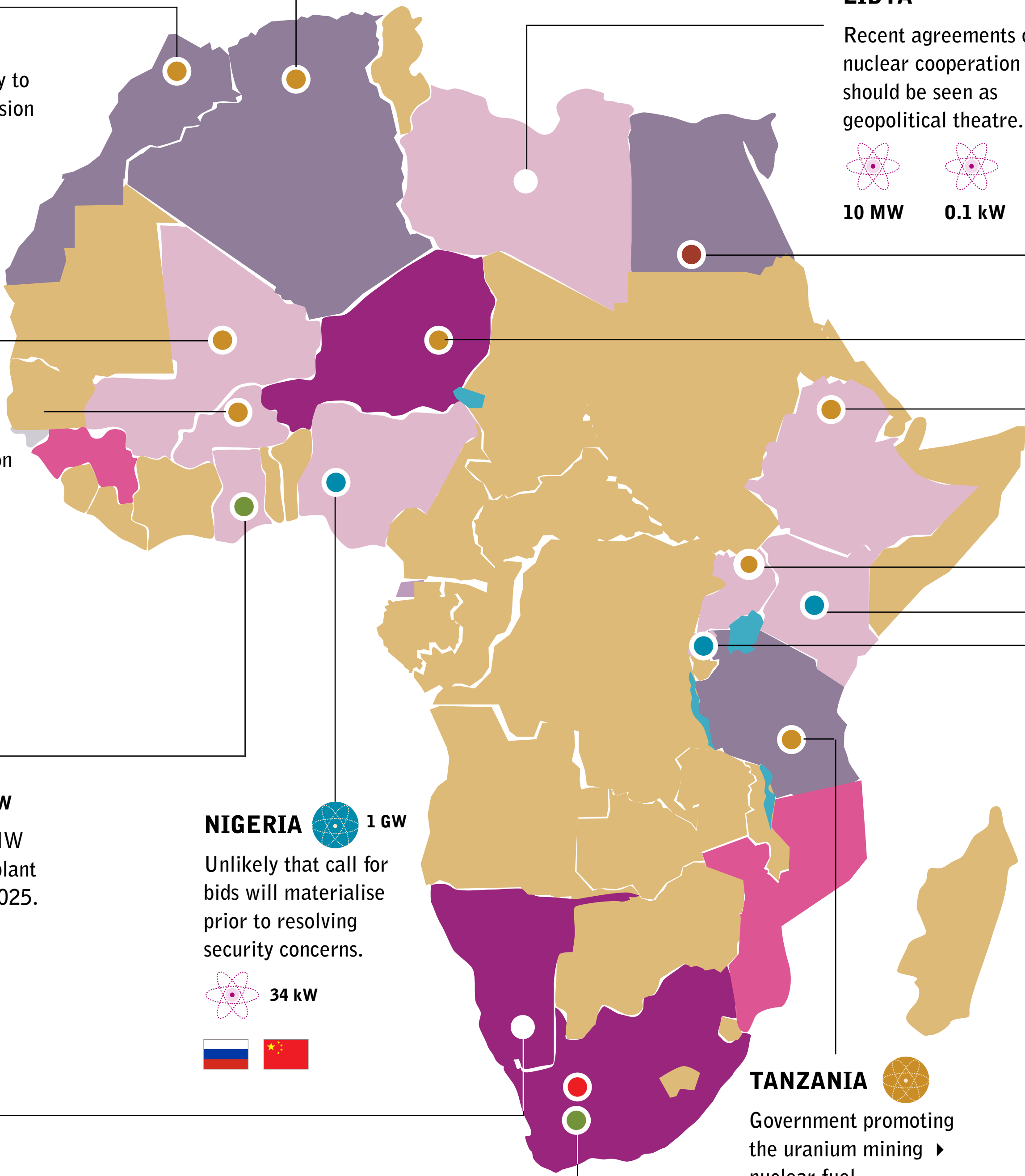
11 Sustainability Directory, "*What Are SMRs Proliferation Risks and Safety Protocols?*" 23 April 2025. https://energy.sustainability-directory.com/question/what-are-smrs-proliferation-risks-and-safety-protocols/

KEY FINDINGS

COUNTRY	POSSIBILITY of being in a position to acquire a nuclear reactor within 10 - 20 years	MAIN FINDINGS
Egypt	Certain	• Construction began at the El Dabaa 4.6 GW plant in 2022. Final commissioning date is 2030, which is optimistic.
Ghana	High	• Results of a tender for a 1000 MW conventional power plant is expected in 2025. • Strong and possibly viable interest in small modular reactors from the US, including a recently established small modular reactor training centre in collaboration with the US. • If Ghana can successfully acquire a small modular reactor and in a straightforward process, this could be a game changer for the continent.
South Africa	High	• Strong possibility South Africa will call for bids for multiple reactors in 2025. • Renewed interest in small modular reactors.
Nigeria	Medium	• Security issues are a significant hurdle before the country could call for bids: insurgency and conflict are the main underlying factors. • The International Atomic Energy Agency would have to report positively on the safety and security situation. • Acquiring a new research reactor is an easier option.

Kenya	Medium	• Financial and human resource limitations prohibit calling for bids for nuclear power, unless a vendor provides pre-contract financing and development. • As the cabinet voted to dissolve the Nuclear Power and Energy Agency in early 2025, prospects for a commercial reactor are low. • Acquiring a research reactor is likely.
Rwanda	Medium	• Focused completely on small modular reactors. • Signed a deal with Canadian company Dual Fluid Energy for the construction of a demonstration first-of-a-kind small modular reactor. • Experience suggests that investments in small modular reactors will fail.
Algeria	Low	• A long way to go before nuclear power to run desalination plants could be constructed. • Solar power is more likely to be used than nuclear for desalination.
Morocco	Low	• The crown is unlikely to make a political decision on nuclear power soon.
Tanzania	None	• The government is promoting the false proposition that uranium mining could lead to nuclear fuel manufacture.
Uganda	None	• Announcements of implausibly massive nuclear build (ranging between 15.6 to 24 GW) suggest that there are no viable plans • Lack of capacity to acquire nuclear plants..
Mali, Niger, Burkina Faso and Ethiopia	None	• Acquisition of nuclear power plants is highly unlikely due to conflict and war. A raft of recent agreements on nuclear cooperation signed should be seen as geopolitical theatre.

NUCLEAR IN AFRICA: STATE OF PLAY



MOROCCO

The Crown is unlikely to make a political decision on nuclear soon.

2 000 kW

MALI and **BURKINA FASO**

Recent agreements on nuclear cooperation should be seen as geopolitical theatre.

LIBYA

Recent agreements on nuclear cooperation should be seen as geopolitical theatre.

10 MW 0.1 kW

GHANA 1 GW

Results for a 1000 MW conventional power plant tender expected in 2025.

30 kW

NIGERIA 1 GW

Unlikely that call for bids will materialise prior to resolving security concerns.

34 kW

TANZANIA

Government promoting the uranium mining ▸ nuclear fuel manufacturing myth.

NAMIBIA

In 2022 produced approximately 5 613 t of uranium, ~ 11.4% of world production.

SOUTH AFRICA

In 2024 Koeberg Unit 1 was granted a 20 year license extension. A decision on extending the lifetime of Unit 2 expected in late 2025.

Strong possibility that country will call for bids for multiple reactors in 2025.

1.8 GW [New capacity]

Research reactor due to be decommissioned in 2030.

In 2022 produced 200 t of Uranium, ~0.4% of world production. None in 2024 although sales from stockpiles continue and capacity remains.

20 MW

(UP TO FEBRUARY 2025)

ALGERIA

A long way to go before NPPs could be constructed. Solar power more likely to be used than nuclear for desalination.

1 MW

15 MW

BEFORE 2010

EGYPT

4.6 GW

Construction began at the El Dabaa 4.6 GW plant in 2022. Target commissioning dates: 2026 for first reactor, others by 2030.

Four VVER-1200 reactors built by Rosatom.

22 MW

NIGER and ETHIOPIA

Recent agreements on nuclear cooperation should be seen as geopolitical theatre.

In 2022 produced approximately 5 613 t of uranium, ~4.1% of world production. In 2024 no uranium was exported due to the political situation.

UGANDA

Announcements of implausibly massive nuclear plants (15.6 - 24 GW) suggest no viable plans.

RWANDA

Construction of a demonstration first-of-a-kind SMR planned to start in 2026 with commercial production by 2034 (highly optimistic).

Experience suggests that SMR investments fail.

KENYA

Unlikely to call for bids in near future.

Nuclear Power and Energy Agency dissolved in early 2025, suggesting setback for country's institutional infrastructure.

Acquiring a research reactor is likely.

Sources:
https://www.iaea.org/sites/default/files/20/07/research-reactors-in-africa-2020.pdf
https://www.nuclear-free.com/uranium-article/articles/africa-supplier-for-the-wealthy-north.html
https://www.wiseinternational.org/uranium-mining-in-africa/#_ftn17
https://www.dmre.gov.za/Portals/0/Resources/Publications/Mineral%20Economics/Mineral%20Economics%20Bulletins/MB%202025/Mineral%20Economics%20Bulletin%20Volume%206%20Issue%204%20of%204%202024.pdf?ver=L-1kcdIXczhE70Ww2rqtsw%3D%3D

NUCLEAR POWER STATION STATUS

- Operational
- Under construction
- High likelihood
- Medium likelihood
- Low/ no likelihood

COUNTRIES WITH URANIUM

- Uranium deposits currently not exploited
- Active uranium mining operations
- Uranium mining operations discontinued
- No uranium

RESEARCH REACTORS

- RESEARCH REACTOR
- PLANNED RESEARCH REACTOR

INTERNATIONAL COOPERATION PARTNERS

Flags show countries which signed nuclear cooperations between 2010 and 2025.

1. INTRODUCTION

The primary question this paper seeks to answer is which African countries are in a position, in terms of both ability and desire, to acquire a nuclear power plant in the next ten to twenty years. In order to do this, the report analyses both historical and current events within the nuclear domain. The countries assessed are South Africa, Ghana, Kenya, Tanzania, Uganda, Algeria, Morocco, Nigeria, Rwanda, Mali, Ethiopia, Burkina Faso and Niger. There is also an assessment of Egypt, where Russia is building Africa's only new nuclear power plant: the El Dabaa plant, which should be completed in 2030.

The decision to build a nuclear power plant is always a political one rather than an economic or technical one. There are a variety of reasons why countries want nuclear power, such as prestige, that have little to do with cost or the need for electricity generation. No country is forced to have nuclear power. Much the opposite, a nuclear programme requires considerable time, money and effort. What is required is serious intent, which is a matter of sustained political will.

Nuclear power has always required governments to take enabling decisions: for example, dealing with radioactive waste, setting up a credible regulatory body and providing accident insurance. Increasingly, governments are required to play a direct role in ensuring the electricity generated from a nuclear power plant is sold at a price guaranteed to cover costs. The successful acquisition of a nuclear power station requires commitment across government departments and over decades.

Section 1, *Report methodology and limitations*, discusses what tools and methods were used in the research. One major research impediment is that the nuclear industry and national governments tend towards secrecy and there is limited information in the public domain.

Section 2, *In context: Finance, contracts, vendors and lessons*, looks at the possible funding models and ownership structures that may be employed in Africa.

Section 3, *Key questions*, looks at three topics that will influence the possibilities of nuclear power stations being constructed in Africa. The first topic addresses the issue of development and shows that poor countries can acquire nuclear power stations. The second looks at how small modular reactors could influence the development of nuclear power in Africa. The third critically examines the notion that because a country has uranium reserves it should engage in the nuclear fuel cycle.

The fourth and final section, *African country nuclear profiles*, analyses each assessed country's prospects of acquiring a nuclear power station and/or research reactor. The countries are ranked according to their prospects: certain, high, medium, low or none.

2. REPORT METHODOLOGY AND LIMITATIONS

Researching the nuclear sector is particularly challenging due to the industry's secretive nature and a lack of information in the public domain. The information that is in the public domain may not be completely reliable.

Signed intergovernmental agreements regarding cooperation on nuclear issues are a case in point. They are routinely signed and their contents are kept secret, especially when undemocratic countries like Russia and China are involved. The information available is often a description of the agreement instead of its contents: for example, Rosatom's description of its 2019 agreement with Uganda is:

> The agreement meets all modern requirements for such documents and lays the foundation for practical cooperation between Russia and Uganda in the peaceful uses of nuclear energy. In particular, it implies joint work in such areas as: creation of nuclear infrastructure, production of radioisotopes for industrial, healthcare, agricultural use, as well as education and retraining.[12]

Similarly, the existence of a signed memorandum of understanding between a vendor and a country is not a clear sign that a nuclear plant will be built. Such agreements are routinely signed but very few actually result in the acquisition of a reactor.

Even significant developments, such as launching a tender process or announcing a winning bid, do not necessarily signal imminent construction. Numerous factors can derail progress between a bid and a finalised contract. These factors can include political shifts, changing economic circumstances and legal challenges: for example, a 1977 contract between Sweden and Turkey for a 600 MW plant was cancelled in 1979 due to financing issues.[13] As discussed

12 Elena Teslova, "Russia, Uganda Sign Deal on Civil Nuclear Energy," *Anadolu Agency*, 20 August 2019, https://www.aa.com.tr/en/energy/nuclear/russia-uganda-sign-deal-on-civil-nuclear-energy/26676

13 International Atomic Energy Agency, *Alternative Contracting and Ownership Approaches for New Nuclear Power Plants*, IAEA-TECDOC1750 (Vienna: IAEA, 2014), https://www-pub.iaea.org/MTCD/Publications/PDF/TE-1750_web.pdf.

more fully in Section 4, South Africa cancelled in 2009 a nuclear acquisition programme due to financing issues.

Some projects have even been abandoned after construction began: the Kursk Nuclear Power Plant in Russia (2012) and the Virgil C. Summer Nuclear Power Station in the United States (2017).

To assess whether a country's nuclear aspirations align with its capabilities to pursue and complete a nuclear build, this report examines each country's historical and current nuclear engagements. This includes the construction of a timeline that highlights key nuclear developments such as vendor agreements, the establishment of regulatory and research institutions, site selections and International Atomic Energy Agency assessments. The timeline is accompanied by an overview weaving together these events with political and nuclear power specific assessments.

While a variety of sources have been relied on for constructing the timelines, a key source is the World Nuclear Association, particularly in relation to which vendor was or is preferred. Other key sources include the IAEA and various national nuclear authorities. Apart from avoiding criticism of an anti-nuclear bias, the primary reason why the report uses industry sources extensively and does not address the merits of nuclear power itself is that countries interested in acquiring nuclear power already believe in the validity of these sources.

In effect, the nuclear industry and government officials are given the benefit of the doubt because, as stated previously, the decision to acquire a nuclear reactor is a political one. What the report assesses is the seriousness of the push for nuclear reactors plus the technical ability of each country to acquire a reactor.

Each profile also makes an effort to assess progress along the IAEA's Milestone Approach roadmap. However, one finding of this report is that while the Milestone Approach is a useful and significant tool, it is not a definitive guide, partly because the IAEA is not a neutral regulatory body and its prime duty is to promote nuclear power. Hence, the multi-dimensional research approach.

In Section 2's discussion of vendors and in Section 3's examination of key questions, the report shows that vendors can fast track a country through the IAEA's milestones.

What this means is that a country may seriously pursue acquiring a nuclear reactor even though it has not met the appropriate IAEA milestone (see Box 1 and Figure 1).

The pursuit and construction of research reactors is significant. While not all countries with research reactors have nuclear power plants, those that do possess research reactors have a domestic skills base, which translates into being better prepared to acquire commercial nuclear power plants. The intent to acquire a research reactor is suggestive of the intent to acquire a nuclear power plant (see Box 2, page 24).

One method often used to assess a country's readiness for a nuclear power plant is the size of its electricity grid. The rule of thumb is that a nuclear power plant should not exceed 10% of the country's grid capacity.[14] The reason is that if a nuclear power station goes off-line, there is enough non-nuclear capacity (plus generation and transmission capacity) to prevent the national grid from collapsing. In addition to grid capacity, the interconnectivity and reliability of the grid are important factors.

Although grid capacity is useful for short-term assessments, the IAEA's milestones roadmap shows that it is only one of many requisite developments and one that can be addressed through grid expansion, as was the case in Bangladesh. In 2014, one year before the country signed a contract with Rosatom to build a nuclear power station, Bangladesh's ageing and unreliable grid had a nominal installed capacity of 11.5 GW and the country had experienced a nationwide blackout. Despite this, Rosatom's build began. By 2023, Bangladesh's grid capacity had grown to 23.4 GW. As such, grid size is not a defining element in this report's analysis.

Not all African countries are included in this report. The selection of countries examined was based on an initial qualitative scoping and is not exhaustive. Countries such as Zambia, Malawi, Zimbabwe, Namibia and Burundi were excluded due to significant internal financial, technical and/or administrative obstacles that make a nuclear build unfeasible.

This report also seeks to give insights into the costs of nuclear power for Russian, Chinese and South Korean reactors. As stated above, the nuclear industry is notoriously secretive and reliable information regarding Russia and China is especially difficult or impossible to obtain. As cost projections have historically and consistently proven to be highly optimistic, this report uses the stated costs for recent and current builds.[15] The stated costs are sourced primarily from the media and the nuclear industry. However, these should be treated with caution and there is a significant possibility that the actual costs are considerably higher.

Please note that the data cut-off point is February 2025. Events after this date are not recorded.

14 Mycle Schneider, *The World Nuclear Industry Status Report 2024*, accessed January 24, 2025, https://www.worldnuclearreport.org/IMG/pdf/wnisr2024-v4.pdf.

15 Sovacool, B.K.; Gilbert, A.; Nugent, D. 2014. Risk, innovation, electricity infrastructure and construction cost overruns: Testing six hypotheses. *Energy*, Volume 74, 2014, Pages 906-917, ISSN 0360-5442. Accessed February 26, 2025

Box 1: The IAEA and its Milestones Approach[16]

Also see Figure 1 overleaf

Building and operating nuclear power stations requires not only substantial financial and human capital, but also a robust framework of institutions, laws and international agreements. Typically, nuclear power station development requires cooperation with one or more established nuclear powers and the IAEA.

To guide countries through this complex process, the IAEA introduced in 2007 the three-phased Milestones Approach, which is a roadmap that outlines 19 nuclear infrastructure areas that should be developed if a nuclear power programme is to be safe. The process can be characterised as follows:

Phase 1 focuses on a country's preparation to make an informed policy decision regarding the pursuit of nuclear power. Reaching Milestone 1 indicates that a country is ready to make the decision.

Phase 2 guides country preparations towards Milestone 2: readiness to invite bids and/or negotiate contracts for its first nuclear power station. In this phase, legal and regulatory frameworks are established.[17]

Phase 3 provides guidance during the construction of a nuclear power plant. Achieving Milestone 3 verifies that the country is ready to begin operating the facility.

The IAEA estimates that reaching the three milestones requires approximately 10 to 15 years. Over this period, the IAEA both assists and assesses a country's progress through Integrated Nuclear Infrastructure Reviews, which are on-site evaluations that yield recommendations and Country Programme Frameworks, which are agreements on priority areas for technical co-operation.[18]

While the Milestones Approach is a useful and significant tool, it is not a definitive guide. In researching this report, it became apparent that there are not clear assessments or proclamations from the IAEA of when a country achieves a milestone. Therefore, it can be difficult to estimate which phase a country is in. Furthermore, the IAEA, as a diplomatic institution, does not criticise member states, which impedes a full understanding of its assessments.

16 International Atomic Energy Agency, *Milestones in the Development of a National Infrastructure for Nuclear Power,* IAEA Nuclear Energy Series No. NG-G-3.1 (Rev. 1), IAEA, Vienna (2015), https://doi.org/10.61092/iaea.hff3-zuam; Housni, H., Amrous, N., Daoudi, N., Malzi, M.J.,"Country profiling through IAEA Milestones Approach: A comprehensive analysis of the Moroccan nuclear infrastructure," *IFAC-PapersOnLine*, Volume 58, Issue 13 (2024): Pages 751-756, https://doi.org/10.1016/j.ifacol.2024.07.572.

17 International Atomic Energy Agency, "*Milestones Approach*," accessed January 24, 2025, https://www.iaea.org/topics/infrastructure-development/milestones-approach;

18 Ibid; International Atomic Energy Agency, "*Country Programme Frameworks*," accessed January 24, 2025, https://www.iaea.org/services/technical-cooperation-programme/country-programme-frameworks.

THE IAEA'S MILESTONES APPROACH

including select phased activities

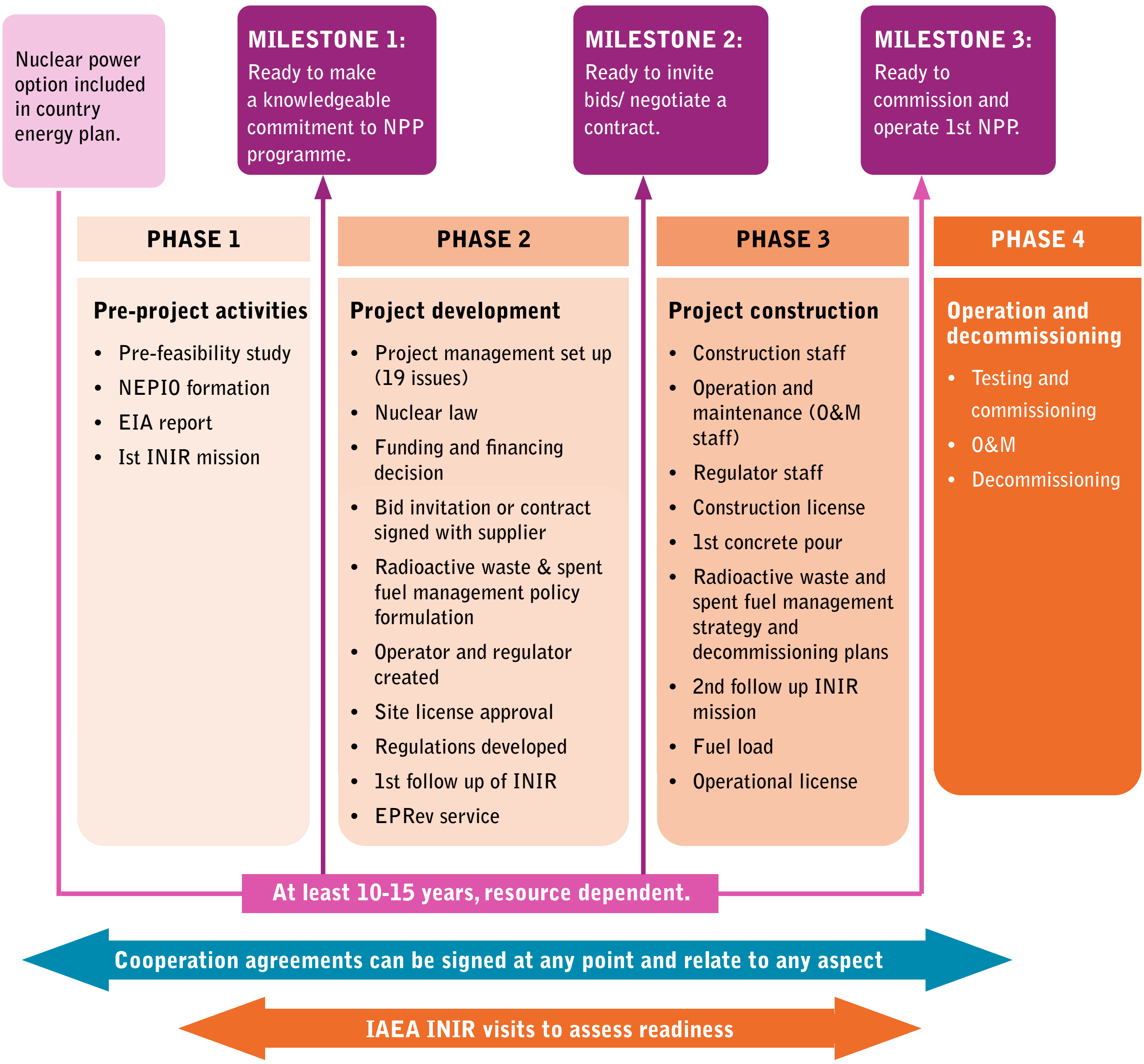


Figure 1: The IAEA's Milestones Approach, including select phased activities.

Sources: IAEA 2015. Selection of phased activities from Islam, S. et al, 2021.[19]

19 IAEA, Vienna (2015), https://doi.org/10.61092/iaea.hff3-zuam ; Islam, Md.S., Faisal, S.I., & Khan, S. 2021. Development and strengthening of the nuclear and radiation safety infrastructure for nuclear power program of Bangladesh. *Nuclear Engineering and Technology* 53(5): p.1705–1716. Accessed at https://www.sciencedirect.com/science/article/pii/S1738573320309359 ;

National position	Electrical grid	Radioactive waste management
Legal Framework	Emergency planning	Management
Regulatory Framework	Safeguards	Stakeholder engagement
Funding and financing	Nuclear Safety	Site and supporting facilities
Radiation protection	Nuclear security	Environmental protection
Procurement	Industrial involvement	Human resource development

Figure 2: The 19 nuclear infrastructure issues that must be developed as part of the Milestones Approach.

Source: https://www.iaea.org/topics/infrastructure-development/milestones-approach

Box 2: Research Reactors

Research reactors are often overlooked in discussions about commercial nuclear power, yet they serve as critical indicators of a country's readiness and commitment to nuclear energy. These reactors take years to build, cost hundreds of millions of dollars and often precede commercial nuclear power stations by decades. The choice of vendor for a research reactor also suggests the same vendor may eventually be chosen to supply a commercial reactor.

Research reactors play several roles. They help to develop the domestic skills base essential for running commercial nuclear power plants and can also serve to gain public support for nuclear energy. While their use for the production of medical radioisotopes is argued to be an economic contribution, research reactors are necessary for the development of nuclear weapons programmes. Both South Africa and Libya's covert weapons programmes involved research reactors.

Algeria, Morocco, Nigeria, Egypt, Ghana and South Africa have operational research reactors, while those in Libya and the Democratic Republic of Congo are currently shut down. Countries with functioning or planned research reactors tend to be more advanced in their nuclear ambitions.

Recent builds include Jordan's 5 MWt Research and Training Reactor, which was built by South Korea's Atomic Energy Research Institute (KAERI) and Daewoo for US$173 million.[20] The 15 MWt Kijang Research Reactor in South Korea, also being built by KAERI, is expected to reach criticality in 2027 at a total cost of US$574 million.[21]

20 World Nuclear Association, "Nuclear Power in Jordan," March 28, 2024, https://world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.

21 World Nuclear News, "Korea Starts Construction of New Research Reactor," May 3, 2023, https://world-nuclear-news.org/Articles/Korea-starts-construction-of-new-research-reactor.

3. IN CONTEXT: FINANCE, CONTRACTS, VENDORS AND LESSONS

3.1 Financing and Contractual Arrangements

Despite the nuclear industry's claims to the contrary, nuclear power is not cheap and its real cost has consistently increased over the history of the technology.[22] Reported costs of recent Chinese, Russian and South Korean completed or near completion builds are between US$5 billion and US$7 billion per reactor. Noting that these costs can't be verified completely due to a lack of publicly available data, the range should be considered a minimum and not a maximum.

Wealthy nations like the United Kingdom and the United Arab Emirates can adopt financing models that rely on consumers' future payments (see Box 3, page 26), but this is not an option for low-income countries, which must secure financing upfront. Some multilateral development banks such as the African Development Bank have explicit policies prohibiting funding for nuclear energy due to frequent delays and cost overruns.[23] Additionally, private investors tend to avoid nuclear projects due to their high-risk profiles.

While outside the data cut-off for this report, the current situation at the World Bank is worth noting. In June 2025, the US and other countries successfully overturned the World Bank's 2013 ban on funding nuclear power plants. That said, the last time the World Bank funded a nuclear power project was in 1959.[24]

22 Schneider, M. et al., *The World Nuclear Industry Status Report 2024* (Paris: Mycle Schneider Consulting, September 2024), fig. 58, "The Declining Costs of Renewables vs. Traditional Power Sources," https://www.worldnuclearreport.org/IMG/pdf/wnisr2024-v2.pdf.

23 World Nuclear Association, "Financing Nuclear Energy," last updated March 21, 2025, https://world-nuclear.org/information-library/economic-aspects/financing-nuclear-energy.

24 Max Bearak, "*World Bank Ends Its Ban on Funding Nuclear Power Projects,*" The New York Times, June 11, 2025, https://www.nytimes.com/2025/06/11/climate/world-bank-nuclear-power-funding-ban.html.

Therefore, vendor financing and not international, private or market-based financing will shape future nuclear deals in emerging economies. Ultimately, national governments financially back their vendors: i.e., the Russian state is the backstop for Rosatom.

The IAEA notes that the ability to offer financing has become a critical competitive advantage for nuclear exporters, particularly in low-income countries that lack sufficient creditworthiness to access international capital markets.[25] In these cases, vendors often step in with pre-construction loans, partly to help recipient countries meet IAEA milestones.

Beyond geopolitical considerations, vendors have strong commercial incentives to make these deals viable: for example, Russia's state nuclear company, Rosatom, had export revenue of over US$18 billion in 2014 and optimistically claims a foreign order portfolio exceeding US$200 billion.[26] Vendors do not merely sell a power plant, they export an entire nuclear ecosystem. Over a plant's potential 80-year lifespan, the host country remains dependent on the vendor for fuel, maintenance, parts, upgrades, testing, training and decommissioning. Vendors often assist in developing regulatory and supporting infrastructure as well.

If countries such as Russia, South Korea and China want to maintain and grow their domestic nuclear industries, they will have to export their technologies. In order to facilitate export deals, import-export banks and similar institutions are very likely to provide financing. The main relevant financial institutions are: the Export-Import Bank of China, the China National Nuclear Corporation, the Export-Import Bank of Korea, the Korea Export Insurance Corporation, Russia's Bank for Development and Foreign Economic Affairs and the Russian Agency for Export Credit and Investment Insurance.

Deals between African countries and vendors are likely to follow one of two models.

- Build-own-operate (BOO) – The vendor builds, owns and operates the plant with no transfer of ownership.
- Build-own-operate-transfer (BOOT) – Ownership is eventually transferred to the host country.

In both models, the vendor runs the plant, while the host country purchases electricity for domestic distribution. While the BOOT model hasn't yet been implemented, the model is politically preferable as it offers the potential to develop a domestic nuclear skills base.

25 International Atomic Energy Agency, *Contracting and Ownership Approaches for New Nuclear Power Plants*, 2024, 38, https://www-pub.iaea.org/MTCD/publications/PDF/TE-1750_Rev1web.pdf.

26 Intefax, "Rosatom foreign order portfolio exceeds $200 bln, export revenue $18 bln in 2024", February 13, 2025, https://interfax.com/newsroom/top-stories/109775/

Box 3: How Wealthy Countries Finance Nuclear Energy – the case of the UK's Nuclear Power Plants[27]

1. Contract for Difference – Hinkley Point C:

EDF Energy started building in 2018 the Hinkley Point C nuclear plant (3200 MWe) in the UK. Using a contract for difference (CfD) model, the British government guarantees a strike price of £92.50 per MWh. If the wholesale electricity price falls below this, consumers pay the difference. If it rises above, the operator pays the excess to consumers. A key risk for the operator is construction cost overruns, which can render the agreed price economically unviable. As a result, EDF had to write-off €12.9 billion of its investment in 2023 and has said it will not use the CfD model again.[28]

Construction is now expected to be completed in 2032, seven years later than the forecast at the time the contracts were signed. Costs have ballooned from £18 billion to between £31–£35 billion (in 2015 money). According to a former CEO of EDF, the plant's EPR design is "too complicated, almost unbuildable".[29]

2. Regulated Asset Base – Sizewell C:

Under a regulated asset base (RAB) arrangement, investors own the asset and receive a guaranteed rate of return on the money they invest. Institutional investors such as pension funds were the target in the UK. Instead of fixing electricity prices, this model ensures owners receive a stable income regardless of costs. As nuclear economist Stephen Thomas puts it, noting that power would be sold under a different form of CfD, "The power price would be whatever it took to generate the guaranteed annual income to the owners."[30]

Despite transferring risk to consumers, the UK has struggled to attract RAB investors for the proposed Sizewell C plant (3200 MWe). Both EDF and the UK government plan to take equity stakes, reflecting mounting difficulty in securing outside investment. Under this model, a combination of UK consumers and taxpayers will pay for any cost overruns.[31]

27 Section based on Neil Overy, "SA Government's Nuclear Model Is Flawed and Not Economically Viable," *BusinessLIVE*, November 21, 2024, https://www.businesslive.co.za/bd/opinion/2024-11-21-neil-overy-sa-governments-nuclear-model-is-flawed-and-not-economically-viable/. and correspondence with Stephen Thomas.

28 Alex Lawson, "EDF takes €12.9bn hit after Hinkley Point C delays and cost overruns", *The Guardian*, February 16, 2024, https://www.theguardian.com/uk-news/2024/feb/16/edf-hinkley-point-c-delays-cost-overruns

29 Steve Thomas, "Nuclear power and Net Zero: Too little, too late, too expensive," *Scientists for Global Responsibility*, Feburary 9, 2024, https://www.sgr.org.uk/resources/nuclear-power-and-net-zero-too-little-too-late-too-expensive

30 Personal communication with Steve Thomas.

31 Thomas, "Nuclear Power and Net Zero."

3.2 Vendors

Significant changes have occurred within the nuclear industry over the past decade and a half. Primarily, this is marked by a shift in countries that are building nuclear reactors: for example, South Korea is building two, Turkey four and Bangladesh two. In China, 28 reactors are under construction with a total capacity of 29.64 GW.[32] In comparison, the UK and European Union's combined three plants under construction are way over budget and years overdue.[33] The focus in the EU and the US is on lifetime extensions of reactors beyond their design life.

Above and beyond this shift in the nuclear market, the timeline analysis of each country shows that China, South Korea and Russia are the most likely vendors for new nuclear builds in Africa. It is important to note that the Korean, Russian and Chinese vendors are massive state-owned companies. This section provides an overview of these countries' nuclear industries and their recent projects.

3.2.1 Russia

The Soviet Union commissioned the world's first electricity-producing nuclear power plant in June 1954. Following the bloc's collapse, Russia inherited much of its nuclear infrastructure and consolidated it under Rosatom.

Rosatom is a state-owned corporation that oversees every stage of the nuclear fuel cycle through more than 450 subsidiaries. Rosatom is not only responsible for building and operating nuclear plants, it is also active in uranium mining, fuel fabrication and nuclear medicine. The company also operates a fleet of nuclear-powered icebreakers.[34]

In 2020, Rosatom commissioned the world's first floating nuclear power station. Equipped with two 35 MWe KLT-40S small modular reactors, the floating power station supplies heat and electricity to the remote north-eastern region of Chukotka.[35] Rosatom effectively functions as a one-stop shop for nuclear technology and services (*See Figure 6: Rosatom's integrated offer)*.

Today, Russia is the global leader in nuclear power plant exports. While four reactors are under construction domestically, Rosatom is also building 19 large-scale reactors across seven sites in six countries:[36]

32 World Nuclear Association, "Nuclear Power in China," August 13, 2024, https://world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power

33 International Atomic Energy Agency, PRIS Database, September 18, 2024, https://pris.iaea.org/PRIS/WorldStatistics/UnderConstructionReactorsByCountry.aspx.accessed

34 Rostatom, "*About US*," accessed December 3, 2024, https://rosatom.ru/en/about-us/

35 Rosatom, "*SMR prospects*," accessed December 3, 2024, https://rosatomnewsletter.com/2024/04/25/smr-prospects/

36 World Nuclear Association, "Nuclear Power in Russia," September 7, 2024, https://world-nuclear.org/information-library/country-profiles/countries-o-s/russia-nuclear-power; accessed; IAEA, "Russian Federation," 15 June 2025, https://pris.iaea.org/PRIS/CountryStatistics/CountryDetails.aspx?current=RU

- India (4)
- China (4)
- Iran (1)
- Bangladesh (2)
- Egypt (4)
- Turkey (4)

Rosatom's flagship Generation III+ 1198 MWe pressurised water reactor, the VVER-1200, includes a core catcher. The VVER-1200 has a 60-year design life. The latest version, the VVER-TOI is claimed to be more reliant on passive safety measures but has not been sold to an export market yet. Two VVER-TOI reactors are under construction in Russia.[37] [38]

The company's order book also reflects aspirations to be a major producer of SMRs. According to the company's website, Rosatom's current order book has 33 large-capacity reactors in ten countries, plus six SMRs for Uzbekistan. In June 2024, Rosatom signed a memorandum of understanding with the Republic of Guinea to explore the provision of floating power ships equipped with RITM-200 small modular reactors, which evolved from the KLT-40 design. Given the nebulous nature of nuclear memorandums of understanding, the likelihood of the power ships arriving is considered remote.[39] [40]

Rosatom is also looking to build two 55 MW land-based RITM-200N reactors in the Russian Republic of Sakha (Yakutia) to supply the mining industry. The forecast commissioning date is 2028.[41]

Russia's build of four VVER-1200 reactors at the Akkuyu plant in Turkey marks a turn in how nuclear plants are sold. The deal for the Akkuyu plant was signed in 2010. Rosatom started major construction in 2018 and, according to the agreement, the first unit was estimated to come online in 2025 and the last in 2028. Sanctions against Russia have proven to be challenging and the plant will likely be over budget. Rosatom provided financing of US$20 billion.[42] [43]

37 Rosatom, "*Modern Reactors of Russian Design*," accessed July 19, 2025, https://www.rosatom.ru/en/rosatom-group/engineering-and-construction/modern-reactors-of-russian-design/

38 Caroline Peachey, "*VVER-TOI: the latest evolution*," Nuclear Engineering International, November 19, 2021, https://www.neimagazine.com/advanced-reactorsfusion/vver-toi-the-latest-evolution-9261505/?cf-view

39 Joe Edwards, "Russia Plans Wave of Floating Nuclear Power Stations," *Newsweek*, June 11, 2024, https://www.newsweek.com/russia-plans-floating-nuclear-power-stations-guinea-1910408.

40 Rosatom, "*Global Presence*," accessed September 18, 2024, https://rosatom-europe.com/global-presence/.

41 Rosatom, "*Rosatom and the Republic of Sakha (Yakutia) Have Signed an Agreement on Yakut Small Modular Reactor Nuclear Power Plant Capacity Loading*," June 6, 2024, https://atommedia.online/en/2024/06/06/rosatom-i-respublika-saha-yakutiya-podp/.

42 World Nuclear News, "Turkey and Russia Discuss State of Nuclear Projects," July 19, 2024, https://www.world-nuclear-news.org/Articles/Turkey-and-Russia-discuss-state-of-nuclear-project.

43 Incidentally and back in 2011, a Russian icebreaker powered by a KLT-40M reactor had to make an emergency return to the port of Murmansk after springing a leak in the reactor coolant system, which resulted in the loss of 6,000 litres of reactor coolant. Zuzanna Krzyżanowska, "*Turkey: first nuclear power plant under Russian rules*," Centre for Eastern Studies (OSW), 28 April 2023, https://www.osw.waw.pl/en/publikacje/analyses/2023-04-28/turkey-first-nuclear-power-plant-under-russian-rules.

In addition to financing and building the plant, Rosatom will own and operate the plant. Turkey has committed to buying electricity from Rosatom. The Akkuyu plant appears to be the first to operate on the build, own and operate model.

The Turkish Electricity Trade and Contract Corporation is obligated to purchase 70% of Units 1 and 2's output, and 30% of Units 3 and 4's output, for 15 years after commissioning at an average price of US$0.1235 per kWh. This translates into an estimated revenue for Rosatom of US$35.2 billion.[44] [45]

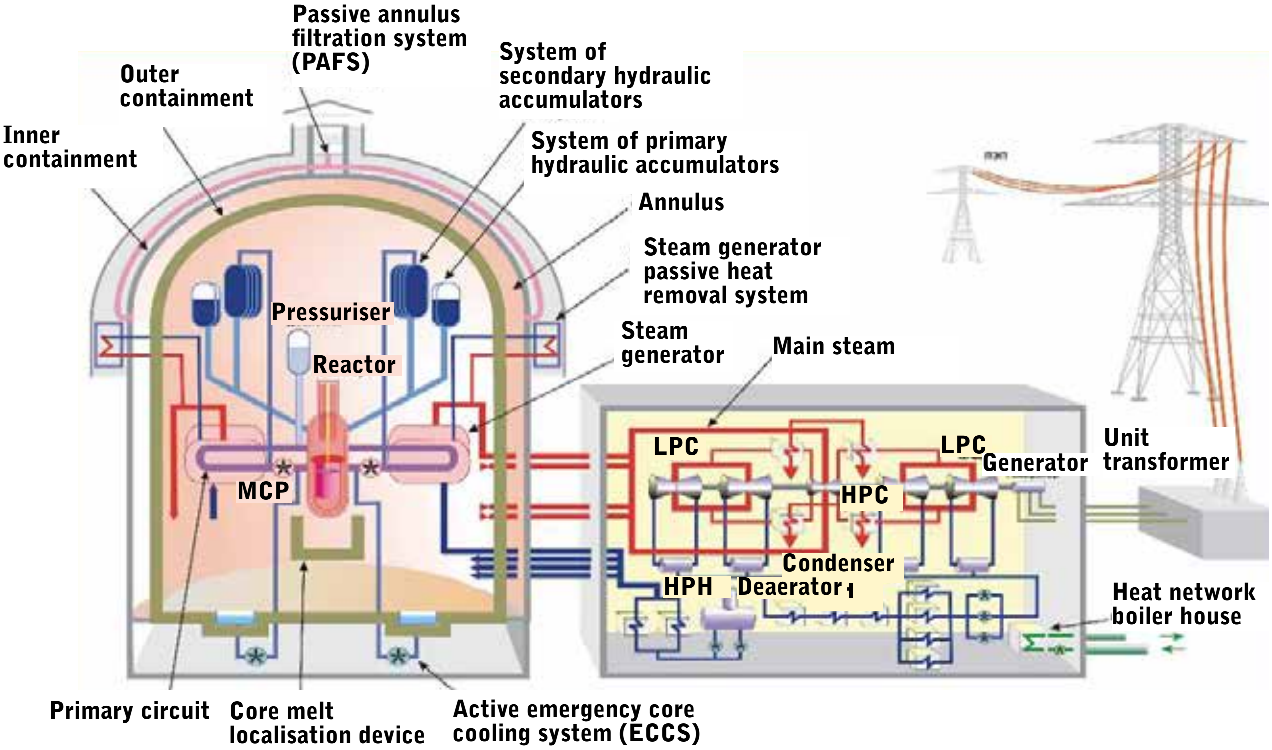


Figure 3: Russia's flagship reactor, the VVER- 1200

Source: https://www.oecd-nea.org/mdep/events/conf-2017/presentations/s5/6.%20BEZZUBT-SEV%20Valery%20S._%20Commissioning%20of%20new%20nuclear%20power%20units%20in%20Russia..pdf

44 Schneider, M. et al., "*The World Nuclear Industry Status Report 2024,*" p. 197.

45 Turkish Minute, "*Russia's Rosatom to Sue Siemens over Delay of Equipment for Akkuyu Nuclear Power Plant Construction,*" January 6, 2025, https://www.turkishminute.com/2025/01/06/russias-rosatom-to-sue-siemens-over-delay-of-equipment-for-akkuyu-nuclear-power-plant-construction2/.

3.2.2 China

As with most things in China, the scale is striking: the country operates 57 nuclear reactors with a combined capacity of 55 GW, the vast majority built in the last 15 years. An additional 29 reactors are currently under construction.[46] China produces more electricity from nuclear power than any country except the United States and uses a wide variety of reactor designs. That said, nuclear power accounts for about 5% of total electricity generation in China. In the US, nuclear accounts for 18%.[47]

China's nuclear sector began in the 1950s with strong support from the Soviet Union, and its nuclear weapons programme in 1955. Civilian nuclear power followed later, starting with the domestically designed 308 MW Qinshan plant in 1987 and the French designed 1888 MW Daya Bay plant in 1994.[48]

Despite its rapid domestic nuclear build programme, China has not been a major exporter of nuclear technology in the past. There are three key historical reasons for this:

- Technology transfer agreements with countries like France and the US often included export restrictions. For instance, the deal with Westinghouse for the AP1000 design prohibited the sale of the technology abroad.
- China's primary focus has been on domestic nuclear expansion.
- Russia's dominance in global nuclear exports has limited China's market share.

However, China is now positioned to exploit the export market. China has moved beyond technology share. The country has developed a large heavy manufacturing base (forging reactor vessels, pipes, turbines, steam generators, etc.) that is both domestic and export focused. The main players are China First Heavy Industries, Shanghai Electric Group Company, China National Erzhong Group, Dongfang Electric Corporation, Harbin Electric Corporation and Shandong Nuclear Power Equipment.

China's flagship reactor is a Generation III 1180 MWe pressurised water reactor, the Hualong One. This is an indigenous design and is free from export restrictions. The Hualong One is designed for both domestic deployment and the international market. China holds full intellectual property rights. The design life is 60 years.[49]

46 International Atomic Energy Agency, "*People's Republic of China*," PRIS Database, June 15, 2025, https://pris.iaea.org/PRIS/CountryStatistics/CountryDetails.aspx?current=CN.

47 U.S. Energy Information Administration, "*China Continues Rapid Growth of Nuclear Power Capacity*," May 6, 2024, https://www.eia.gov/todayinenergy/detail.php?id=61927.

48 Daxue Sun, "*A Brief History of the Chinese Nuclear Industry,*" accessed july 15, 2025, Institute of Science & Technology, https://istonline.org.uk/resources/a-brief-history-of-the-chinese-nuclear-industry/

49 Wikipedia, "*Hualong One*," accessed July 15, 2025, https://en.wikipedia.org/wiki/Hualong_One

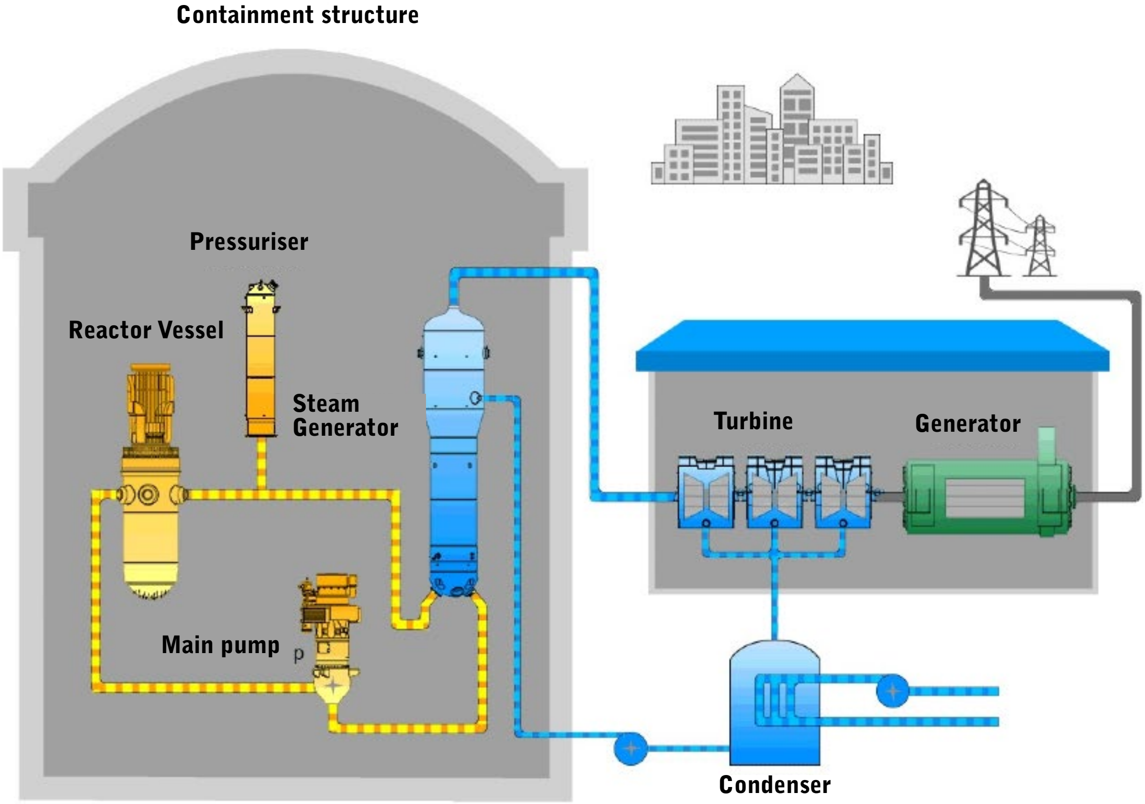


Figure 4: China's flagship reactor, the Hualong One

Source: https://www.gov.uk/government/consultations/generic-design-assessment-of-general-nuclear-system-limiteds-uk-hpr1000-reactor/generic-design-assessment-of-general-nuclear-system-limiteds-uk-hualong-pressurised-water-reactor-uk-hpr1000-consultation-summary-document

China has already demonstrated export potential with the Karachi Nuclear Power Complex in Pakistan, where it built two Hualong One reactors at a reported cost of nearly US$10 billion. Construction began in 2015 and 2016, and the plants were commissioned in 2021 and 2022. According to reports, 82% of the financing came from the China Exim-Bank. In 2023, another contract for the construction of a new Hualong One reactor was signed. According to Voice of America, the value of the contract is US$4.8 billion. The World Nuclear Association suggests that the China National Nuclear Corporation will finance 85% of the construction costs.[50] [51] [52] [53]

50 Gul, A. "*Pakistan Signs $4.8 Billion Nuclear Power Plant Deal With China,*" VOA; June 20, 2023, https://www.voanews.com/a/pakistan-signs-4-8-billion-nuclear-power-plant-deal-with-china/7144967.html

51 World Nuclear Association, "*Nuclear Power in China,*" August 13, 2024, https://world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power#nuclear-technology-exports.

52 Gul, "Pakistan Signs".

53 World Nuclear Association, *World Nuclear Performance Report 2024*, August 2024, pg. 42. https://world-nuclear.org/our-association/publications/global-trends-reports/world-nuclear-performance-report-2024.

A planned project in Argentina, however, collapsed in 2022 primarily due to a lack of localisation, which made the deal less appealing to Argentina.[54] In Romania, China won a bid for a plant in 2014 but the deal was cancelled in 2020. A change in the Romanian government brought in a new administration sceptical of China.[55]

China is also investing in small modular reactor technology. The Linglong One (also called the ACP100), with a design output of 385 MWt (approximately 125 MWe), is under construction in Hainan province. Though originally slated to begin in 2017, the project was delayed by regulatory approvals and first structural concrete was not poured until 2021.[56] Commissioning is now expected in 2026, though this date remains uncertain. Cost estimates are unreliable: Global Times, a Chinese state-owned media outlet, cites an improbably low figure of US$702 million.[57]

Beijing sees China-Africa relations as geopolitically pivotal. Political, financial, diplomatic and economic links are deep. China is sub-Saharan Africa's largest trading partner. Twenty percent of the region's exports go to China and 16% of its imports come from China. The total trade was worth US$282 billion in 2023. China holds US$134 billion, about 17% of sub-Saharan Africa's external public debt.[58] China's plans for exporting nuclear plants to Africa thus rest upon a solid foundation.

54 Bernhard, Isabel "Why Argentina's Nuclear Power Project With China Has Stalled," *The Diplomat*, December 14, 2022, https://thediplomat.com/2022/12/why-argentinas-nuclear-power-project-with-china-has-stalled/.

55 Andreea Brînză, "China Will No Longer Build Reactors 3 and 4 at the Cernavoda Nuclear Power Plant," *Romanian Institute for the Study of the Asia-Pacific*, May 7, 2020, https://risap.ro/china-nu-va-mai-construi-reactoarele-3-si-4-de-la-centrala-nucleara-de-la-cernavoda/.

56 Reuters, "China Launches First Commercial Onshore Small Reactor Project," July 13, 2021, https://www.reuters.com/world/china/china-launches-first-commercial-onshore-small-reactor-project-2021-07-13/.

57 Tao Mingyang and Chu Daye, "*New Nuclear Technology Sees Vast Export Potential*," Global Times, July 27, 2023, https://www.globaltimes.cn/page/202307/1295190.shtml#:~:text=Each%20 Hualong%20One%20reactor%20 costs,of%20 small%20 pressurized%20water%20 reactors.

58 Chido Munyati, "Why Strong Regional Value Chains Will Be Vital to the Next Chapter of China and Africa's Economic Relationship," *World Economic Forum*, June 25, 2024, https://www.weforum.org/stories/2024/06/why-strong-regional-value-chains-will-be-vital-to-the-next-chapter-of-china-and-africas-economic-relationship/.

3.2.3 South Korea

With nuclear power providing 30% of the country's electricity from 26 reactors, South Korea has an advanced nuclear sector and large industrial base to support it. Through a multitude of agreements, Westinghouse has been a major partner in the development of the country's nuclear power. South Korea represents a Western alternative to Russia and China. If an African country does not wish to enter the Chinese or Russian nuclear and/ or political ecosystem, South Korea is the obvious choice.

South Korea is currently expanding its domestic fleet by two additional reactors and is actively pursuing nuclear exports through its national utility, the Korea Electric Power Corporation (KEPCO). South Korea's flagship reactor for both domestic and export markets is the APR-1400, a Generation III design with a capacity of 1455 MWe.[59]

In December 2022, South Korea announced its intention to commit US$310 million annually to SMR research and is currently developing two indigenous designs. Several major South Korean companies are also entering the SMR space, including SK Inc., SK Innovation, HD Korea Shipbuilding & Offshore Engineering, Hyundai Engineering & Construction and Doosan Enerbility.[60]

Doosan Enerbility, in particular, has partnered with the US-based NuScale Power to manufacture the VOYGR SMR, which is the only design currently approved by the U.S. Nuclear Regulatory Commission. The VOYGR reactor has a 77 MWe capacity and is modular, theoretically allowing scalability up to 924 MWe using 12 units. Doosan has built a dedicated factory for VOYGR component manufacturing and the Export-Import Bank of Korea is offering financing to support international sales.[61] [62]

To date, KEPCO's only overseas conventional nuclear power plant build is the Barakah plant in the United Arab Emirates, which consists of four APR-1400 reactors. Barakah stands out as an example of a reasonably fast large-scale nuclear deployment: achievable when a country has ample financial resources, a limited need for public approval and chooses not to develop a domestic nuclear industry.

Before 2009, the UAE had no nuclear infrastructure or regulatory framework. South Korea played a central role in building both, under a deal initially valued at US$20 billion, later reportedly reaching US$30.2 billion. South Korea and the UAE agreed to jointly operate the plant and South Korea is expected to earn an additional US$20

59 Wikipedia, "*APR-1400*," accessed July 15, 2025, https://en.wikipedia.org/wiki/APR-1400#Design

60 World Nuclear Association, "Nuclear Power in South Korea," May 3, 2024, https://world-nuclear.org/information-library/country-profiles/countries-o-s/south-korea#technology-amp-rampd.

61 Hyeon-woo Oh and Woo-Sub Kim, "Doosan Enerbility to Supply SMR Parts to NuScale Power," *The Korea Economic Daily*, May 26, 2024, https://www.kedglobal.com/energy/newsView/ked202405260003.

62 NuScale, "NuScale Power Signs Agreement with Doosan Enerbility and Export-Import Bank of Korea, Highlighting Global Supply Chain Development Opportunities," April 25, 2023, https://www.nuscalepower.com/en/news/press-releases/2023/nuscale-power-signs-agreement-with-doosan-enerbility-and-export-import-bank-of-korea.

billion over the plant's lifetime for fuel supply, equipment, maintenance and other services. Construction of the first unit began in 2012 and the final unit was commissioned in 2024.[63]

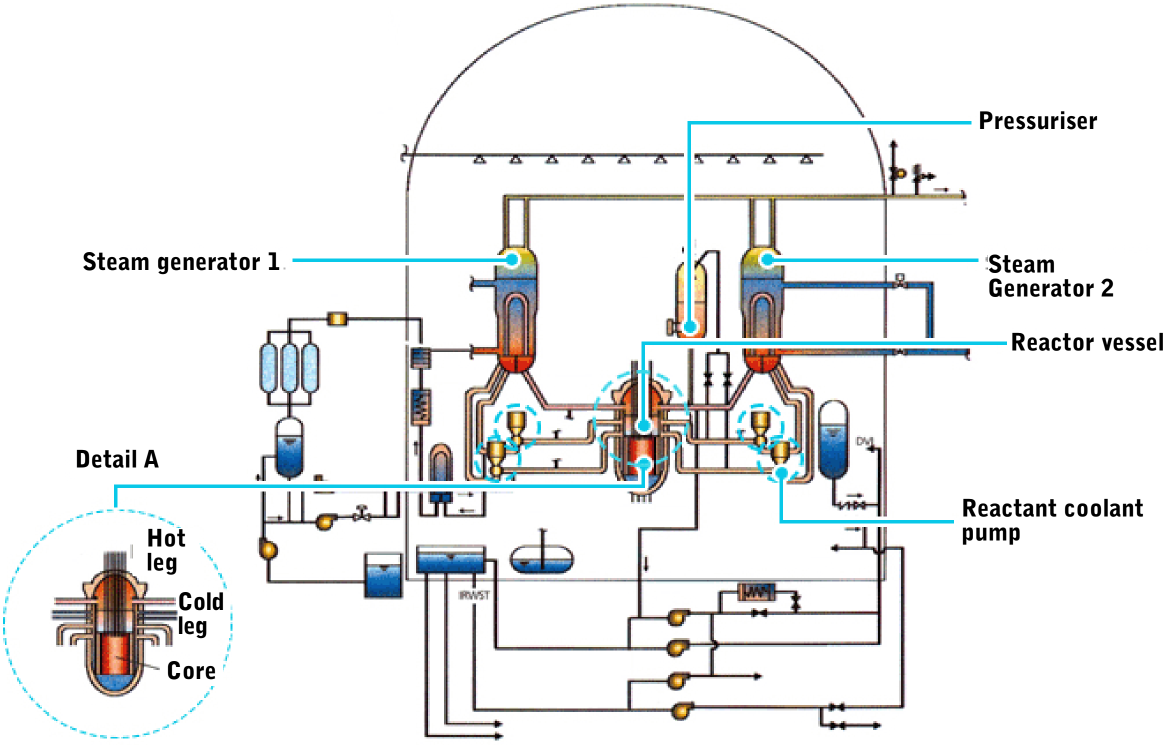


Figure 5: South Korea's flagship reactor, the APR-1400

Source: https://home.kepco.co.kr/kepco/EN/G/htmlView/ENGBHP00202.do?menuCd=EN07030202

63 World Nuclear Association, "Nuclear Power in the United Arab Emirates," Sept 5, 2024, https://world-nuclear.org/information-library/country-profiles/countries-t-z/united-arab-emirates

4. KEY QUESTIONS

4.1 Can Poor Countries Build Nuclear Power? The Case of Bangladesh

Bangladesh's nearly completed 2400 MW Rooppur nuclear power plant offers a case study on how low-income countries can acquire a nuclear power plant. Rooppur Unit 1 was initially scheduled to come online by the end of 2024 but has been delayed to 2025 due to issues with transmission infrastructure. Unit 2 is expected in 2026.

Although construction at Rooppur started in 2017, the processes necessary to begin construction took decades to implement. In 1999, the government made a serious commitment to nuclear power, the first agreement with Rosatom concerning the plant was in 2009 and the final contract was signed in 2015.

The value of Bangladesh's contract with Russia is US$12.65 billion and includes fuel for the first few years. Bangladesh pays 10%, while Russia finances the other 90% on generous terms. The interest rate is variable but capped at 4%, repayable over 28 years with a 10-year grace period. Russia's loan is a line of credit. The amount Bangladesh draws down from the line of credit depends on the final construction cost.[64]

Russia took on a turnkey contract: if construction costs exceed US$12.65 billion, Rosatom has to pay the difference.[65] So unless there are fine print clauses, which is possible but unknown at the present, US$12.65 billion is the most solid number currently available. While nuclear power stations are often beset by construction delays, Rooppur's build seems to have been relatively reasonable and may only be two years overdue.

Beyond construction, Rosatom has locked Bangladesh into a long-term nuclear ecosystem. Over the next 80 years, Russia will supply fuel, parts, maintenance, training and support. Rosatom's integrated offer is an appealing option for countries seeking a comprehensive entry into nuclear energy.[66]

64 World Nuclear Association, "Nuclear Power in Bangladesh," May 13, 2024, https://world-nuclear.org/information-library/country-profiles/countries-a-f/bangladesh.

65 Sovacool et al. "Risk, innovation, electricity infrastructure"

66 Rosatom, *Rosatom Integrated Offer: NPPs*, 2023, https://atommedia.online/wp-content/uploads/2023/09/ip-aes-bm.pdf.

The Rooppur build has been mired by allegations of corruption. As early as 2015, Transparency International Bangladesh raised concerns regarding inflated costs. At the time, the plant was costed at around US$4 billion, just under a third of the concluded contract value.[67] [68] [69]

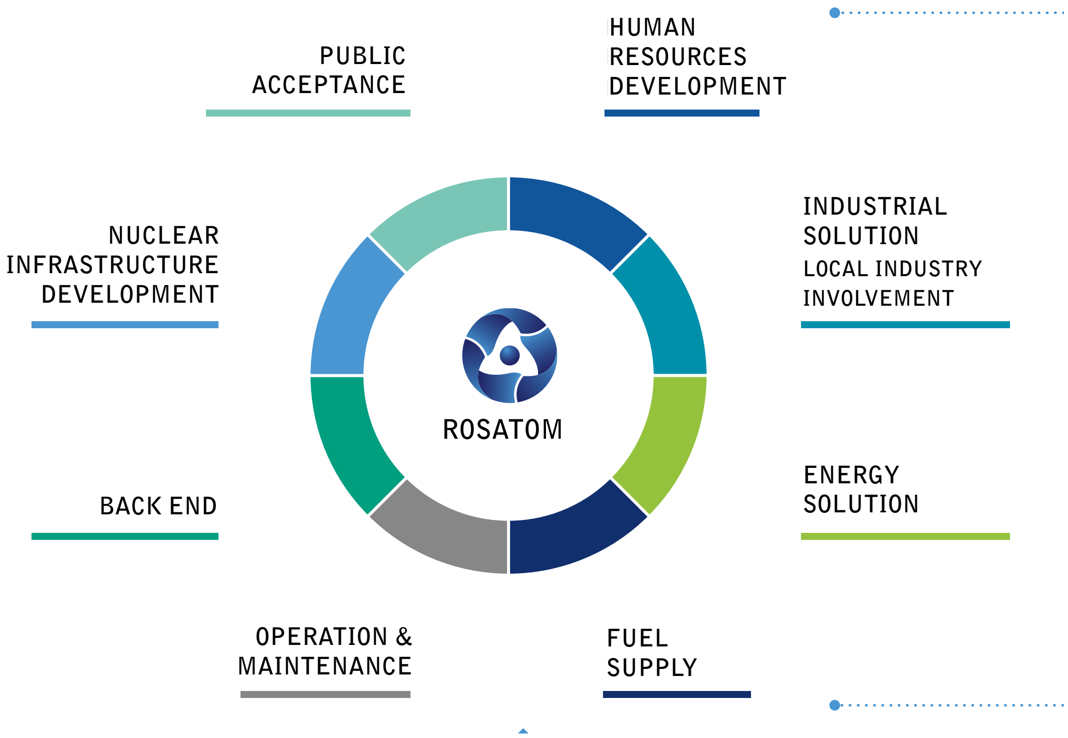


Figure 6: Rosatom's integrated offer

Sources: https://atommedia.online/wp-content/uploads/2023/09/ip-aes-bm.pdf

67 *The Daily Star,* "Power and Energy: A System Designed for Corruption," December 2, 2024, https://www.thedailystar.net/business/news/power-and-energy-system-designed-corruption-3766336

68 *New Age, "ACC Probe Sought into Allegations against Hasina, Family,"* September 8, 2024, https://archive.ph/20241008091832/https://www.newagebd.net/post/country/244299/writ-seeks-probe-into-rooppur-scam-against-hasina.

69 Transparency International Bangladesh, *Press Release on Rooppur Nuclear Plant,* December 27, 2024, https://www.ti-bangladesh.org/articles/press-release/4825.

Timeline

1961 East Pakistan announces plans for nuclear power.

1963 Rooppur site, 140 km west of Dhaka, is selected.

1973 Bangladesh Atomic Energy Commission is established.

1986 The 3 MW Triga research reactor becomes operational. General Atomics (US) is the vendor.

1999 Government renews commitment to a nuclear power station at Rooppur.

2001 Nuclear action plan is developed.

2005 to 2008 China becomes the preferred vendor.

2009 Agreement signed with Russia for a 1000 MWe VVER plant for approximately US$2 billion.

2010 Legal Framework for cooperation on nuclear power and research is signed with Russia.

2011 A new deal with Russia for two 1000 MWe reactors replaces the first agreement. The IAEA conducts an Integrated Nuclear Infrastructure Review.

2012 A nuclear energy bill outlines the establishment of the Bangladesh Atomic Energy Regulatory Authority (BAERA).

2012 Agreement signed with Russian regulator to train BAERA staff in Russia.

2013 BAERA is established.

2013 Russia loans Bangladesh US$500 million to finance preparatory activities (e.g. engineering services) for a nuclear build. AtomStroyExport, a Rosatom subsidiary, is contracted to do the work.

2015 Final contract for two VVER-1200 reactors signed.

2016 The IAEA makes a follow-up Integrated Nuclear Infrastructure Review and finds that Bangladesh has made considerable progress. BAERA issues a site license.

2017 Construction begins.

2025 to 2026 Unit 1 & 2 expected to be operational.[70]

70 World Nuclear Association, "Nuclear Power in Bangladesh,"; Ahmed Humayun Kabir Topu, "Rooppur Nuclear Power Plant: First Unit to Start Production in December," *The Daily Star*, April 27, 2024, https://www.thedailystar.net/news/bangladesh/news/rooppur-nuclear-power-plant-first-unit-start-production-december-3596116; Dyck, E. "IAEA Reviews Progress of Bangladesh's Nuclear Infrastructure Development," *International Atomic Energy Agency*, June 1, 2016, https://www.iaea.org/newscenter/news/iaea-reviews-progress-of-bangladeshs-nuclear-infrastructure-development.

4.2 Could Small Modular Reactors be a Good Bet?

While the IAEA defines SMRs as those with a generation capacity ranging from 30 to 300 MWe, designs go up to 500 MWe.[71] Advocates argue that their modular design will result in reactors that are cheaper, faster and easier to build. These claims may or may not be proven in the future. As mentioned in the section on vendors, Rosatom operates two SMRs: the 35 MWe Lomonosov 1 and 2 reactors. These reactors constitute a floating nuclear power station that provides electricity to a remote part of Siberia. China is currently building an SMR and has one demonstration plant operational.[72]

South Korea's Nuclear Safety and Security Commission granted standard design approval in 2024 for the 365 MWt (110 MWe) SMART100 reactor. The Korea Atomic Energy Research Institute, the King Abdullah City for Atomic and Renewable Energy and Korea Hydro & Nuclear Power are jointly developing the SMART100 reactor. Whether the SMART100 will ever come to fruition remains an open question.[73]

Numerous initiatives to advance SMRs in the West have failed, including a recent deal in the US for an electricity utility in Utah to purchase six of NuScale's 77 MWe VOYGR reactors, totalling 462 MWe. First announced in 2015, the project was terminated in 2023 due to soaring costs, reaching an estimated US$9.3 billion (nearly US$15,000 per kW).[74]

Western companies that have invested in SMR designs include Rolls-Royce, NuScale, Hitachi, Holtec and Framatome. Apart from NuScale, none have secured regulatory approvals for their designs or have constructed a demonstration plant.

Allison Macfarlane, the former chairperson of the U.S. Nuclear Regulatory Commission, noted in 2023 that within the SMR sector, there is a great deal of money to be made in the short-term through agreements and deals that boost share prices and investor returns, regardless of whether reactors are ever built. Profits stem from the promotion rather than the product itself.[75]

71 Thomas, S., & Sequens, E. (2023). *Prospects of Small Modular Reactors in the Czech Republic* (Prague: Heinrich Böll Stiftung Prague, Calla – Association for Preservation of the Environment, and Hnutí DUHA – Friends of the Earth Czech Republic, 2023), https://cz.boell.org/en/2023/10/16/perspektivy-malych-modularnich-reaktoru-v-ceske-republice.

72 Ibid

73 Korea Atomic Energy Research Institute, "Korea's SMART100 Achieves Standard Design Approval, Paving the Way for Global SMR Deployment," September 27, 2024, https://www.kaeri.re.kr/board/view?pageNum=1&rowCnt=10&no1=247&linkId=12113&menuId=MENU00718&schType=0&schText=&boardStyle=Image&categoryId=&continent=&country=&schYear=.

74 Thomas et al, 2023; M.V. Ramana, "The collapse of NuScale's project should spell the end for small modular nuclear reactors," 31 January 2024, https://www.utilitydive.com/news/nuscale-uamps-project-small-modular-reactor-ramanasmr-/705717/ .

75 Allison Macfarlane, "The End of Oppenheimer's Energy Dream," July 21, 2023, https://reneweconomy.com.au/the-end-of-oppenheimers-nuclear-energy-dream-modular-reactors-supported-by-ideology-alone/.

Despite the lack of evidence of the commercial viability of SMRs, they are attracting interest from African governments. Beyond the promised lower costs and easier fabrication, there is the notion that SMRs could be better suited to countries with smaller electricity grids.

Ghana and Rwanda are notable examples that show how the continent is becoming a focus for SMR developers. Rwanda has signed an agreement with Canadian company Dual Fluid Energy to build a SMR demonstration plant based on a highly speculative design.

Ghana and NuScale's parent company (Regnum Technology Group) have signed memorandums of understanding to deploy a NuScale SMR in Ghana. No firm decision has been made on the reactor yet and no contract has been signed.

For vendors, the ability to connect reactors to smaller grids represents a potentially larger market. The global SMR market is projected to be worth US$72.4 billion by 2033.[76] This and similar projections on the SMR market should be viewed with caution as there is no real-world data to back them up.

Russia, China and South Korea are backing the technology. So is the US. On 5 February 2025, the new Secretary of Energy, Chris Wright, ordered that:

> The long-awaited American nuclear renaissance must launch during President Trump's administration. As global energy demand continues to grow, America must lead the commercialization of affordable and abundant nuclear energy. As such, the Department will work diligently and creatively to enable the rapid deployment and export of next-generation nuclear technology.[77]

SMRs may not be as unlikely as they once were thought to be and Africa might be a significant market for the technology.

76 Hyeon-woo Oh et al, "Doosan Enerbility to Supply SMR Parts"

77 U.S. Department of Energy, "Secretary Wright Acts to 'Unleash Golden Era of American Energy Dominance,'" February 5, 2025, https://www.energy.gov/articles/secretary-wright-acts-unleash-golden-era-american-energy-dominance.

4.3 Should African Countries with Uranium Reserves Enter the Nuclear Fuel Cycle Business?

A persistent talking point in the nuclear industry is that African countries with uranium reserves should build nuclear power plants so that they can fuel them with their own enriched uranium. However, an analysis of the nuclear fuel cycle questions about whether this is a viable proposition.

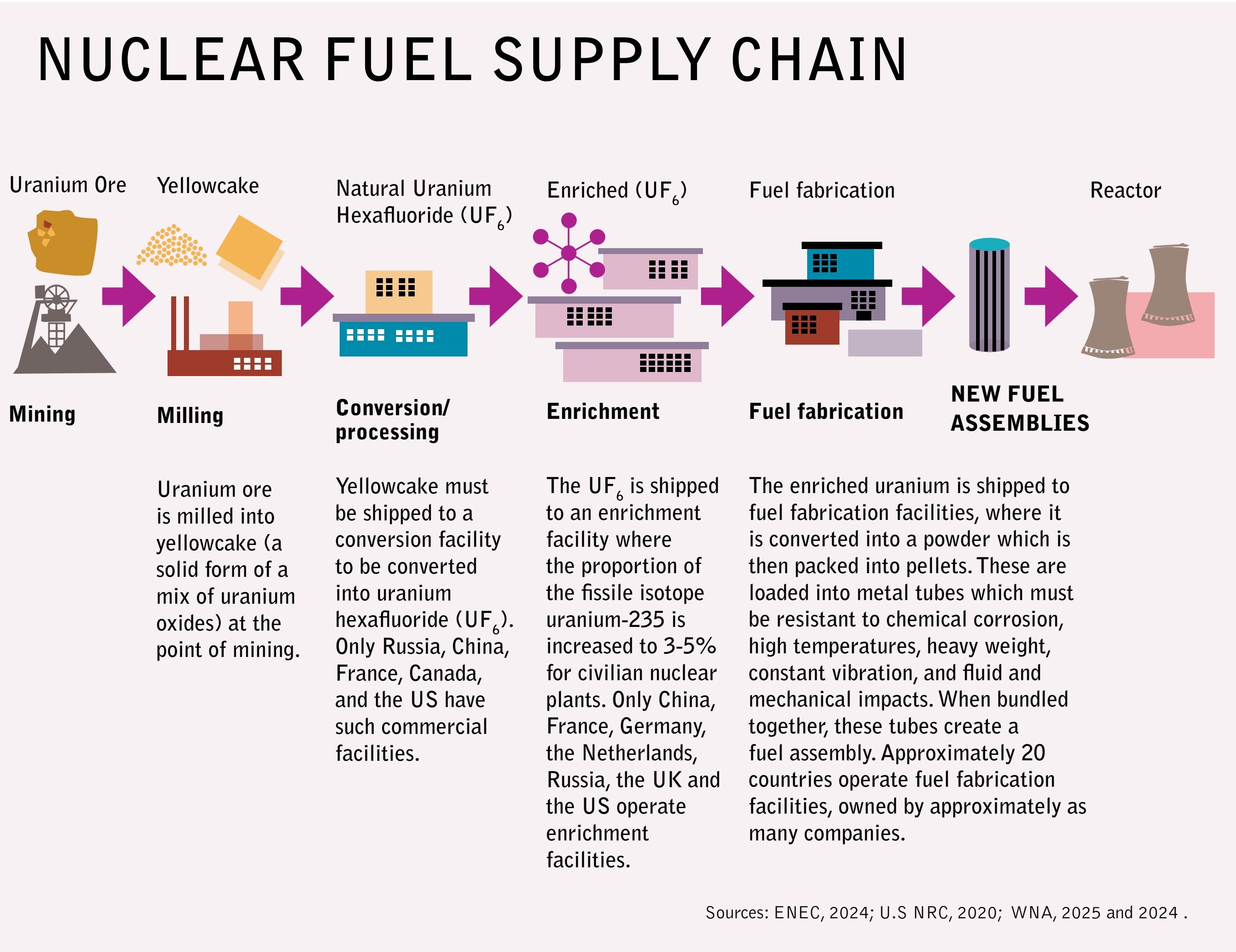


Figure 7: The Nuclear fuel supply chain

Sources: https://www.enec.gov.ae/discover/fueling-the-barakah-plant/the-nuclear-fuel-cycle/, https://www. nrc.gov/materials/fuel-cycle-fac/ur-enrichment.html., https:// world-nuclear.org/information-library/nuclear-fuel-cycle/introduction/nuclear-fuel-cycle-overview, https://world-nuclear.org/information-library/nuclear-fuel-cycle/conversion-enrichment-and-fabrication/uranium-enrichment.

Transforming mined uranium into nuclear fuel is a complex, capital-intensive process requiring advanced expertise and specialised infrastructure. As a result, only a few countries and companies participate in the nuclear fuel cycle. Even fewer dominate key stages.

The beneficiation process begins with milling the ore. The milled ore is then turned into yellowcake, a solid form of uranium oxides. Milling is typically conducted in or near mining sites.[78] Yellowcake is then converted into uranium hexafluoride (UF6) at specialised facilities: only Russia, China, France, Canada and the US have such facilities.[79]

The UF6 is then sent to an enrichment facility where the proportion of the isotope uranium-235, which is fissile, is increased by 3% to 5% for civilian nuclear plants. For small modular reactors the enrichment is 5% and for research reactors the enrichment is 20%. Some research reactors run on highly enriched uranium (above 20%) but this is, quite wisely, being phased out.[80 81 82]

Uranium enrichment is particularly sensitive. From a non-proliferation standpoint, uranium enrichment is subject to tight international controls as the process of enriching uranium (or plutonium) is a key part of nuclear weapons development. Another route to achieving weapons grade material is through the reprocessing of spent fuel.

The companies Orano, Rosatom and Urenco enrich uranium collectively account for 85% of global enrichment capacity (2022 figures). The China National Nuclear Corporation (CNNC) holds approximately 14% of the remaining capacity, primarily for domestic use, but plans to double its capacity by 2030 with a view to export.[83]

The only countries that have enrichment capacity are France, Germany, the Netherlands, the UK, the US, China, Russia, Brazil, Argentina, Japan, Iran, India, North Korea, Pakistan and probably Israel. Of the latter five, the enrichment programmes are for nuclear weapons. Pakistan, Israel and India are non-signatories to the Nuclear Non-Proliferation Treaty. North Korea withdrew from the Treaty in 2003 and Iran is ignoring the treaty's provisions. Brazil's enrichment capabilities came out of its weapons programme in the 1970s and 80s. Argentina also began uranium enrichment as part of a weapons programme. As Japan has no domestic uranium sources and despite the economic burden of the process, the country enriches uranium as a geopolitical energy choice to minimise

78 World Nuclear Association, "Nuclear Fuel Cycle Overview," March 21, 2025, accessed June 26, 2025, https://world-nuclear.org/information-library/nuclear-fuel-cycle/introduction/nuclear-fuel-cycle-overview.

79 Emirates Nuclear Energy Company, "The Nuclear Fuel Cycle".

80 United States Nuclear Regulatory Commission, "Uranium Enrichment," accessed October 28, 2024, https://www.nrc.gov/materials/fuel-cycle-fac/ur-enrichment.html.

81 Ibid.

82 World Nuclear Association, "Conversion and Deconversion," November 20, 2024, https://world-nuclear.org/information-library/nuclear-fuel-cycle/conversion-enrichment-and-fabrication/conversion-and-deconversion.

83 World Nuclear Association, "Uranium Enrichment,"

dependence. Japan is the only country without nuclear weapons to engage in the entire nuclear fuel cycle.[84] [85] [86]

To illustrate the difficulties of engaging in the nuclear fuel cycle, the UAE's nuclear policy is useful. The policy specifically states that:

> Unlike many countries having civilian nuclear energy programs, the UAE will not be involved in nuclear fuel-cycle activities beyond those that would be required for the management and disposal of radioactive waste in the event that the UAE deployed nuclear power plants within its territory. A number of factors underlie this view, including the economic infeasibility of operating enrichment and reprocessing facilities for comparatively small nuclear fleets, concerns from the international community regarding spent fuel reprocessing and enrichment plants in developing countries, and the dual use nature of components employed in fuel fabrication and processing. In consideration of these factors, the UAE will not seek to develop domestic capabilities in those areas, either as part of its evaluation of nuclear energy or as a component of future UAE nuclear program.[87]

The final step of the nuclear fuel cycle is fuel fabrication. Enriched UF6 is transformed into uranium dioxide powder, which is then used to construct reactor specific fuel assemblies.[88] Fuel fabricators are often owned by the vendors themselves. Generally, this has meant that if a country has a VVER reactor, the fuel would have to come from Russia. However, the market is changing slightly. Russia can supply fuel specific to Western reactors and Westinghouse started supplying Ukrainian reactors well before the current war.[89]

The World Nuclear Association reports that current fuel fabrication and enrichment capacities exceed global demand considerably. Oversupply of enriched uranium has led to falling prices.[90] Moreover, one of the prime interests of a vendor is to lock buyers into

84 Central Intelligence Agency, "*Implications of Argentina's Uranium Enrichment Capability*," December 5, 1983, https://www.cia.gov/readingroom/docs/CIA-RDP85T00287R000601320001-1.pdf.

85 Daphne Morrison, "Brazil's Nuclear Ambitions, Past and Present," NTI, August 31, 2006, https://www.nti.org/analysis/articles/brazils-nuclear-ambitions/.

86 World Nuclear Association, "Japan's Nuclear Fuel Cycle," last modified January 14, 2021, https://world-nuclear.org/information-library/country-profiles/countries-g-n/japan-nuclear-fuel-cycle.

87 United Arab Emirates, *Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy* (April 2008), 9, https://www.enec.gov.ae/doc/uae-peaceful-nuclear-energy-policy-5722278a2952f.pdf.

88 United States Nuclear Regulatory Commission, "Uranium Enrichment," accessed October 28, 2024, https://www.nrc.gov/materials/fuel-cycle-fac/ur-enrichment.html.

89 World Nuclear Association, "Nuclear Fuel and its Fabrication," 13 October 2021, https://world-nuclear.org/information-library/nuclear-fuel-cycle/conversion-enrichment-and-fabrication/fuel-fabrication.

90 World Nuclear Association. "Uranium Enrichment." *World Nuclear Association Information Library*, June 06, 2025. https://world-nuclear.org/information-library/nuclear-fuel-cycle/conversion-enrichment-and-fabrication/uranium-enrichment.

long-term fuel contracts. Vendors not only want to sell a nuclear plant, they also want to sell nuclear fuel for the plant over the next 60 to 80 years.

For Niger, Tanzania, South Africa or any other African country to become a player in the nuclear fuel cycle, it would cost billions of dollars and require decades long investment in technological infrastructure and human resource capacity. Even with the blessing of the IAEA, the very mention of uranium enrichment would spark intense scrutiny from the UN Security Council's permanent members.

Furthermore, fuel represents only a small part of a nuclear plant's costs (on a US$/kWh basis) and the costs of building a fuel fabrication industry would far outweigh the benefits.

The nuclear fuel cycle demands major capital investments and the development of highly technical infrastructure and expertise. Kazakhstan, for example, holds the world's second-largest uranium reserves, produces 43% of the world's uranium sourced from mines and is a major player in nuclear fuel production.[91] The country's uranium beneficiation facilities are the direct product of the USSR's investments into nuclear fuel infrastructure that began in 1949. This investment would be required at a time when global supply, as mentioned above, already exceeds demand.

91 Yanliang Pan, "To Secure Kazakhstan's Uranium, Chinese Players Were Compelled to Accommodate Local Partners," *Carnegie Endowment for International Peace*, March 26, 2024, https://carnegieendowment.org/posts/2024/03/to-secure-kazakhstans-uranium-chinese-players-were-compelled-to-accommodate-local-partners?lang=en.

5. AFRICAN COUNTRY NUCLEAR PROFILES

5.1 Nuclear Power Players

5.1.1 Egypt: The Only Current Nuclear Build on the Continent

Egypt is the only African country constructing a nuclear power plant at the moment. Construction of the El Dabaa nuclear power station began in 2022. Completion of the first unit is scheduled for 2026 and the remaining three units are to be completed by 2030.[92]

As the timeline below shows, Egypt has had 60 years of nuclear cooperation in total with the Soviet Union and Russia. The involvement of Korea Hydro & Nuclear Power and Doosan Enerbility in the El Dabaa plant as a contractor and subcontractor respectively underscores the global nature of modern nuclear supply chains and the level of international cooperation in nuclear power plant construction. The motive for including other countries could also be political: commercial links are likely to moderate how geopolitical differences are managed.

Rosatom is constructing the plant on a turnkey basis. There is, however, the possibility that cost overruns may be the subject of contractual clauses and legal disputes and hence Egypt and not Rosatom may have to pay. This is impossible to assess at this juncture.

Rosatom's involvement with the plant will continue for decades. Over the plant's lifetime, Rosatom will supply fuel, parts, operational support, maintenance and training.[93] In September 2021, the first group of Egyptian specialists began training at Rosatom's Technical Academy in St Petersburg. The goal is to train about 1700 Egyptian specialists by 2028.[94]

92 Power Technology, "El Dabaa Nuclear Power Plant," last modified July 14, 2023, https://www.power-technology.com/projects/el-dabaa-nuclear-power-plant/

93 International Atomic Energy Agency, Contracting and Ownership Approaches, 51.

94 Rosatom, "Training of ElDabaa NPP Personnel Started at Rosatom Technical Academy," last modified September 13, 2021, Rosatom Technical Academy, https://rosatom-service.ru/en/news/v-tekhnicheskoy-akademii-rosatoma-startovalo-obuch/.

BASIC INFORMATION[95] [96] [97] [98] [99] [100]

VENDOR: Rosatom.

TECHNOLOGY: Four VVER-1200 reactors. Total gross electrical capacity: 4800 MW.

SITE: El Dabaa, Mediterranean coast, 320 km from Cairo.

COST AND FINANCING:

- Total: US$28.75 billion.
- Russia: 85% loan at 3% interest, repayable over 22 years.
- Egypt: 15% paid in instalments.

CONTRACTUAL ARRANGEMENTS:

- Turnkey construction.
- Egypt's Nuclear Power Plants Authority is the sole owner and operator. Rosatom will train Egyptian nuclear specialists.
- Rosatom will provide lifetime fuel and services support, including initial operational support and maintenance. The contract can be extended.

INTERNATIONAL PARTNERSHIPS:

- Korea Hydro & Nuclear Power: US$2.2 billion contract for ancillary buildings.
- Doosan Enerbility: US$1.2 billion subcontract for turbine and other structures.

95 International Atomic Energy Agency, "Egypt", Pris database, updated July 19, 2025, https://pris.iaea.org/PRIS/CountryStatistics/ReactorDetails.aspx?current=137

96 Day, E. "Russian International Nuclear Energy Expansion," Partnership for Global Security, June 28, 2024, https://partnershipforglobalsecurity.org/russian-international-nuclear-energy-expansion/.

97 World Nuclear Association, "Nuclear Power in Egypt," last modified April 25, 2024, https://world-nuclear.org/information-library/country-profiles/countries-a-f/egypt.

98 International Atomic Energy Agency, Contracting and Ownership Approaches.

99 Patrycja Rapacka, "South Korea's KHNP Wins $2.25 Billion El Dabaa Contract From Russia," NucNet, August 30, 2022, https://www.nucnet.org/news/south-korea-s-khnp-wins-usd2-25-billion-el-dabaa-contract-from-russia-8-2-2022.

100 Ik-Hwan Kim, "Doosan Enerbility Signs $1.2 Billion Deal to Build Nuclear Plant in Egypt," *The Korea Economic Daily*, November 10, 2022, https://www.kedglobal.com/construction/newsView/ked202211100013#:~:text=Doosan%20Enerbility%20said%20it%20will,required%20by%20the%20 Egyptian%20 government.

Timeline

1955 Egyptian Atomic Energy Authority (EAEA) is formed.

1961 Experimental Training Research Reactor Number One (Soviet supplied) reaches criticality.

1964 A 150 MWe reactor with 20,000 m3/day desalination capacity proposed.

1974 A 600 MWe reactor proposed.

1976 Nuclear Power Plants Authority (NPPA) is established as a national operator.

1982 Nuclear Regulatory and Safety Commission is established.

1983 El Dabaa site is selected: Westinghouse, Framatome and KWU (Germany) submit tenders.

1986 Nuclear programme suspended following Chernobyl.

1992 A second research reactor acquired from INVAP (Argentina).

1999 to 2003 Nuclear feasibility study conducted.

2004 Cooperation agreement signed with Rosatom.

2006 Ministerial announcement of a 1000 MWe plant at El Dabaa.

2008 Second cooperation agreement signed with Rosatom.

2015 Intergovernmental agreement signed: Russia to build and support four reactors with training, spent fuel management and regulatory infrastructure.

2015 Russian and Egyptian nuclear regulators sign a cooperation agreement.

2017 Negotiations on contracts pertaining to engineering, construction, operation support, fuel supply and maintenance are concluded.

2019 El Dabaa site approved. IAEA completes an Integrated Nuclear Infrastructure Review.

2022 Construction begins.[101]

101 Timeline sources: Wikipedia, "Nuclear Program of Egypt," last modified September 22, 2024, https://en.wikipedia.org/wiki/Nuclear_program_of_Egypt; World Nuclear Association, "Nuclear Power in Egypt,"; International Atomic Energy Agency, Contracting and Ownership Approaches*, 51*.

5.1.2 Ghana: Almost There?

Outside of South Africa and Egypt, Ghana is the country closest to building a nuclear reactor in Africa. The country has steadily progressed along the IAEA's milestones roadmap and has identified two potential reactor sites.[102 103] Ghana issued a tender in 2024 for a 1000 MWe plant to be developed on a build, own, operate and transfer basis. The tender attracted bids from South Korea, Russia, France and China.[104] A decision is anticipated in 2025.

As its timeline shows, Ghana has followed the IAEA's Milestones Approach, ratifying international agreements and investing in infrastructure and institutions. Although a successful deal is not guaranteed, the experiences of Bangladesh and Egypt suggest that obtaining favourable vendor financing is possible. Of course, there is the possibility that despite a successful tendering process Ghana will not, in the end, sign a binding contract.

In addition to pursuing a conventional large-scale reactor and as mentioned briefly before, Ghana is also exploring SMR technology. At the US–Africa Nuclear Summit in 2024, Nuclear Power Ghana signed an agreement with Regnum Technology Group (NuScale's parent company) for a NuScale VOYGR-12 SMR. The US is actively supporting NuScale's efforts in Ghana, both politically and technically. As of mid-2024, Ghana and the US are negotiating an agreement for the exchange of nuclear technology and materials. In addition, Ghana signed an MoU with NuScale to establish an SMR development centre, which opened in January 2025 at the Graduate School of Nuclear and Allied Sciences in Accra. The US government provided support for the school.[105 106 107]

If Ghana successfully deploys an SMR, it would be a game-changer. A successful NuScale and Ghana partnership would pave the way for other African countries interested in SMRs such as Rwanda and South Africa to follow suit.

102 L. Milne, G. Ragosa, J. Tomei and J. Watson (2024). Realising Ghana's nuclear power plans: opportunities and challenges. Climate Compatible Growth Programme Policy Brief Series. climatecompatiblegrowth.com/wp-content/uploads/Ghana-Nuclear-Policy-Brief_20240917.pdf

103 Milne et al.

104 Boafo, G. A. (2024, July 9). Ghana is planning its first nuclear energy plant: What's behind the decision. *The Conversation Africa*. https://theconversation.com/ghana-is-planning-its-first-nuclear-energy-plant-whats-behind-the-decision-232022

105 VOA, "East and West firms compete to build nuclear power plant in Ghana," 24 May 2024, https://www.voaafrica.com/a/east-and-west-firms-compete-to-build-nuclear-power-plant-in-ghana-/7621335.html

106 Ibid

107 Nuclear Engineering International, "Ghana launches NuScale SMR simulator training centre," 27 January 2025, https://www.neimagazine.com/news/ghana-launches-first-nuscale-smr-simulator-training-centre/

Timeline

1952 Ghana Atomic Energy Commission is established.

1958 University College of the Gold Coast begins radioactive fallout monitoring.

1961 Ghana and the USSR sign an agreement on peaceful nuclear cooperation.

1961 to 1965 Steps taken toward installing a research reactor with USSR support.

1966 Military coup halts reactor programme.

1973 A reactor project with West Germany is terminated due to a coup.

1994 Ghana Research Reactor-1 achieves criticality. China provided the reactor.

2006 The School of Nuclear and Allied Sciences established at the University of Ghana.

2007 Government announces plans for nuclear energy.

2012 and 2015 Nuclear cooperation agreements signed with Rosatom.

2015 Ghana Nuclear Regulatory Authority is established.

2015 Various IAEA conventions signed and ratified.

2017 Ghana Research Reactor-1 is converted from highly enriched uranium to low-enriched uranium with Chinese assistance.

2017 IAEA conducts an Integrated Nuclear Infrastructure Review

2018 Nuclear Power Ghana created to manage the planned nuclear power programme.

2019 IAEA follow-up review finds Ghana has made significant progress.

2021 Tendering process underway.

2023 Nsuban (Western Region) is identified as the preferred site for a nuclear power plant. Obotan (Central Region) is identified as the backup site.

2024 IAEA conducts an Integrated Regulatory Review Service and recommends strengthening the regulator.

2024 At IAEA meeting Ghana announces that Phase 2 activities are underway and it is committed to work with the IAEA to achieve Milestones 2 & 3 in the near future"

2024 Announcement of winning bid was expected in December. Announcement date shifts to an undisclosed point in 2025.

2025 NuScale Power Energy Exploration Centre opens at the University of Ghana.[108]

108 Timeline sources: Modern Ghana, "School of Nuclear and Allied Sciences Celebrates 10th Anniversary," March 22, 2016, https://www.modernghana.com/news/681895/school-of-nuclear-and-allied-sciences-celebrates-10th-annive.

5.1.3 South Africa: Fourth Time Lucky?

South Africa is the only African country with an operational commercial nuclear power plant. With decades of experience in nuclear science and technology, it has met all three IAEA milestones and is technically prepared to acquire new nuclear power plants. Yet, over the past three decades, repeated attempts to do so have failed.

The country's existing nuclear capacity comes from the 1840 MWe Koeberg nuclear power station, which provides between 4 to 5% of the country's electricity. Koeberg was designed by Westinghouse and built by the French company Framatome. Construction began in 1976, the first unit was commissioned in 1984 and the second unit in 1985.[109]

The state utility, Eskom, is going through the process of extending Koeberg's lifespan. In July 2024, the National Nuclear Regulator granted Unit 1 a 20-year licence extension. While a decision on Unit 2 will be made in November 2025, there is no guarantee that the licence will be extended for the full 20 years due to problems with the containment vessel.[110] An extension of licence does not mean the plant will run for the full licence term: serious and unexpected problems may arise and force premature plant closure.

South Africa's nuclear ambitions and institutions have evolved over decades. Unlike other African nations, the country's civilian nuclear programme developed alongside a covert atomic weapons programme during the apartheid era. This programme produced six nuclear bombs, built by scientists trained under the Atoms for Peace initiative. The weapons programme was dismantled in the early 1990s during South Africa's transition to democracy and South Africa is now a firm opponent of nuclear weapons and proliferation.

Since 1994, the country has attempted to expand its nuclear fleet three times. The Pebble Bed Modular Reactor (PBMR) programme was cancelled due to design flaws and public opposition (see Box 4, page 53). From 2006 to 2017, the South African government made two other attempts to procure new nuclear reactors. The first failed in 2008 due to a lack of finance. The second failed due to civil society opposition that led to a successful court challenge. In 2017, a South African court ruled that the procurement

html; World Nuclear Association, "Emerging Nuclear Energy Countries," last modified April 26, 2024, https://world-nuclear.org/information-library/country-profiles/others/emerging-nuclear-energy-countries#africa; World Nuclear News, "IAEA Commends Ghana on Nuclear Power Programme Progress," December 23, 2024, https://world-nuclear-news.org/articles/iaea-commends-ghana-on-nuclear-power-programme-progress; International Atomic Energy Agency, "Statement By Ghana During The Ministerial Conference On Nuclear Science, Technology And Applications And The Technical Cooperation Programme," November 26–28, 2024, https://www.iaea.org/sites/default/files/24/12/cn-328_ghana.pdf; Nuclear Engineering International, "Ghana Launches NuScale SMR Simulator Training Centre,"; International Atomic Energy Agency, "IAEA Mission Finds Ghana Committed to Nuclear and Radiation Safety, Encourages Continued Improvements," December 5, 2024. accessed June 27, 2025, https://www.iaea.org/newscenter/pressreleases/iaea-mission-finds-ghana-committed-to-nuclear-and-radiation-safety-encourages-continued-improvements.

109 Eskom, "Koeberg Nuclear Power Station", accessed July 19, 2025, https://www.eskom.co.za/eskom-divisions/gx/koeberg-nuclear-power-station/

110 National Nuclear Regulator, "NNR Decision and Documentation on the Koeberg LTO Application," July 19, 2024, https://nnr.co.za/nnr-decision-on-the-koeberg-lto-application/

process and inter-governmental agreements with South Korea, Russia and the US were unlawful and unconstitutional.[111]

In 2024, the government started a process to procure 2500 MW of nuclear power. While a civil society legal challenge forced the government to pause the formal process to ensure administrative law was followed, the government continues to express a strong willingness to procure new reactors. Because the government seems to be paying additional attention to meeting legal requirements, the likelihood of a successful tendering process has increased.[112]

On 29 November 2024, the energy department's Deputy Director General for Nuclear, Zizamele Mbambo, said:

> [To] restore our position as a leader in nuclear energy research by bringing to market a working prototype small modular reactor, with supporting fuel production, that can be successfully commercialised, the Department will soon recommend that Cabinet approve the lifting [of] the state of Care and Maintenance on the PBMR to revive this programme in South Africa to create jobs and contribute to the economy.[113]

Therefore, it is likely that SMRs will be part of the national energy plan, due to be approved South Africa's national cabinet in 2025. Nuclear companies are interested: Koya Capital, promoting the High-Temperature Modular Reactor (HTMR-100), and US-based X-energy, offering its Xe-100 pebble bed reactor design, are currently seeking investment for SMR development in South Africa. Two of X-energy's engineers previously worked on the PBMR project.[114]

Given the government's continued push for nuclear power, there is a strong possibility that South Africa will invite bids for additional nuclear capacity in 2025 or 2026. The government is likely to follow legislative administrative processes correctly. The target commissioning date is around 2033.[115] The preferred vendors appear to be China and Russia.

111 Anthonie Cilliers, "Update: History of nuclear in South Africa," ESI Africa, February 18, 2019, https://www.esi-africa.com/industry-sectors/generation/update-history-of-nuclear-in-south-africa/

112 Creamer, T. "Ramokgopa Withdraws 25 GW Nuclear Procurement Determination, Citing Lack of Public Consultation," *Engineering News*, August 16, 2024, https://www.engineeringnews.co.za/article/ramokgopa-withdraws-25-gw-nuclear-procurement-determination-citing-lack-of-public-consultation-2024-08-16 ; World Nuclear Association, " Nuclear Power in South Africa" April 29, 2025, https://world-nuclear.org/information-library/country-profiles/countries-o-s/south-africa. National Nuclear Regulator, "NNR Decision and Documentation".

113 World Nuclear News, "South Africa 'Committed to New Nuclear and PBMR'," December 3, 2024, https://www.world-nuclear-news.org/articles/south-africa-government-reiterates-commitment-to-new-nuclear-and-pbmr.

114 Myles Illidge, "South Africa Going Nuclear," *My Broadband*, September 13, 2024, https://mybroadband.co.za/news/energy/560250-south-africa-going-nuclear.html.

115 World Nuclear News, "South Africa 'Committed'"

Timeline

1948 South African Atomic Energy Board is established.

1952 The country's first uranium plant is opened near Johannesburg.

1957 As part of the Atoms for Peace programme, South Africa and the US sign a 50-year nuclear cooperation agreement. South Africa is a founding member of the IAEA.

1965 The US supplied SAFARI-1 research reactor begins operation at Pelindaba near Pretoria.

1970s South Africa begins its nuclear weapons programme.

1976 The US concludes South Africa is developing nuclear weapons.

1976 The South African Energy Supply Commission and Framatome-Framateg, a French consortium, sign a contract to build the Koeberg nuclear power station outside of Cape Town.

1977 The antagonistic relationship between South Africa and the IAEA starts with the end of safeguard negotiations at SA's semi-commercial uranium enrichment plant. Poor relations would continue up to at least 1988.

1977 The first of six nuclear gun-type weapons is built.

1982 The African National Congress bombs the under-construction Koeberg nuclear power station.

1984 Koeberg Unit 1 is connected to the grid.

1985 Koeberg Unit 2 is connected to the grid.

1991 South Africa dismantles its nuclear weapons and ratifies the Non-Proliferation Treaty.

1993 Dismantlement of nuclear weapons programme made public. The apartheid government destroys documentation regarding the nuclear weapons programme.

1994 First democratic elections held. African National Congress comes to power.

1999 The National Nuclear Regulator is established. The South African Atomic Energy Corporation is renamed the South African Nuclear Energy Corporation. PBMR Ltd. is formed.

2004 The South African government starts directly funding the PBMR programme.

2006 Nuclear Energy Policy published, which includes long-term plans for nuclear expansion.

2007 Eskom announces intention to build new nuclear reactors.

2008 The PBMR project halted due to funding and commercialisation challenges.

2008 Areva submits a bid to Eskom for two 1600 MWe EPRs units. Westinghouse submits a bid for three 1134 MWe AP1000 units.

2008 Eskom announces that it would not proceed with the bids, citing a lack of finance.

2010 South Africa announces its intention to procure 9.6 GW of nuclear power.

2013 IAEA conducts an Integrated Nuclear Infrastructure Review.

2013 Nuclear cooperation agreements signed with Westinghouse and Russia's NIAEP-Atomstroyexport.

2014 Nuclear cooperation agreements regarding new nuclear power stations signed with Russia, France and China.

2017 South African court rules nuclear procurement process and key agreements with Russia, South Korea and the US unlawful and unconstitutional.

2019 The 2019 Integrated Resource Plan states that South Africa should, "Commence preparations for a nuclear build programme to the extent of 2 500 MW at a pace and scale that the country can afford because it is a no-regret option in the long term."

2022 National Energy Regulator of South Africa approves procurement of 2500 MW of new nuclear capacity.

2023 to 2025 Koeberg undergoes final stages of lifetime extension. Unit 1 given a 20-year licence extension in 2024. The national regulator will make a decision on Unit 2's extension in November 2025.

2024 Government suspends procurement process for 2500 MW to ensure compliance with administrative law.

2025 The South African government will make a final decision on the scale of nuclear procurement. Tendering process expected to begin.[116]

116 Timeline sources: Khulekani Magubane, "South Africa to Spend R60bn on Nuclear Build Programme," *Sunday Times*, May 4, 2025, https://www.timeslive.co.za/sunday-times/business/business/2025-05-04-south-africa-to-spend-r60bn-on-nuclear-build-programme/; World Nuclear Association, "Nuclear Power in South Africa,"; Zondi Masiza, "A Chronology of South Africa's Nuclear Program," *The Nonproliferation Review*, Fall 1993, https://www.nonproliferation.org/wp-content/uploads/npr/masiza11.pdf; Steve Thomas, "The Pebble Bed Modular Reactor: An Obituary," Energy Policy 39, no. 5 (May 2011), https://www.sciencedirect.com/science/article/abs/pii/S0301421511000826; Department of Mineral Resources and Energy, *Integrated Resource Plan 2019*, October 17, 2019, 48, https://www.dmre.gov.za/Portals/0/Energy_Website/IRP/2019/IRP-2019.pdf.

Box 4: A Financial Meltdown – The Pebble Bed Modular Reactor

South Africa began its pursuit of a small modular reactor in 1988, building on a German design. A pebble bed modular reactor is a helium-cooled, high-temperature reactor that uses graphite-encased fuel spheres roughly the size of tennis balls. However, the German experimental reactor on which the design was based had a troubled history. The THTR-300 (300 MW) operated for only 423 days before being shut down in 1987, following 125 safety incidents. The most serious occurred in 1986, when radioactive gas and material were released during fuel loading. According to atommüllreport.de, the operator initially failed to report the incident, hoping the fallout from the Chernobyl disaster would obscure the release.[117] [118]

The problems with pebble bed designs started before the THTR-300. An earlier pebble bed design, the German AVR Jülich (13 MW), experienced a list of problems including contamination and release of the radioactive isotope strontium-90.[119]

Despite this poor track record, South Africa proceeded with the project. Between 1999 and 2009, nearly US$980 million of mostly taxpayer and consumer money was spent attempting to develop a demonstration pebble bed modular reactor. The project was eventually mothballed in 2010.[120]

117 Stephen Thomas, "The demise of the pebble bed modular reactor", *Bulletin of the Atomic Scientists*, 22 June 2009, https://thebulletin.org/2009/06/the-demise-of-the-pebble-bed-modular-reactor/

118 atommüllreport, "THTR Hamm-Uentrop", 17 August 2024, https://www.atommuellreport.de/daten/detail/thtr-hamm-uentrop.html

119 Rainer Moormann, "AVR prototype pebble bed reactor: a safety re-evaluation of its operation and consequences for future reactors," Kerntechnik 74, 2009, https://www.researchgate.net/publication/269459361_AVR_prototype_pebble_bed_reactor_A_safety_re-evaluation_of_its_operation_and_consequences_for_future_reactors

120 Thomas, "The demise of the pebble bed modular reactor."

5.2 Medium Prospects

5.2.1 Kenya: A Research Reactor First?

Kenya first announced its intentions to build a nuclear power plant in 2007, the same year as Ghana. Nearly two decades later, despite renewed political attention in 2024 and the signing of multiple international agreements, the country remains far from launching a nuclear power plant. Kenya may have taken a step backward with the 2025 dissolution of the Nuclear Power and Energy Agency (NuPEA), which was part of broader government cost-cutting measures.

Over the past two decades, Kenya has made significant efforts to progress along the IAEA's milestones roadmap. Kenya has developed legal and institutional frameworks and undertaken a Strategic Environmental and Social Assessment (SESA). Following a second Integrated Nuclear Infrastructure Review in 2021, Kenya positioned itself in Phase 2 of the IAEA's roadmap.

However, the SESA remains unapproved and faces a legal challenge brought by civil society.[121] In 2024, Kenya's National Environmental Management Authority requested an independent review, which found it fell short of IAEA standards and could not support informed decision-making.[122] A civil society review also undertaken in 2024 found that the SESA failed to adequately evaluate the economic implications of nuclear power for the country.[123]

NuPEA has been blighted by institutional and operational challenges. A 2022/23 parliamentary review cited slow progress and the agency's own 2023–2027 strategic plan identified risks including shifting political priorities, limited funding, low public engagement and chronic understaffing. Despite NuPEA's estimated funding need of US$280 million, the 2024/25 national budget allocated only US$7.1 million to the entity, just 1.3% of the country's energy budget. In January 2025, the Kenyan cabinet decided to dissolve NuPEA and its fate is unclear.[124] [125] [126]

121 Caroline Kimeu, "Kenya's First Nuclear Plant: Why Plans Face Fierce Opposition in Country's Coastal Paradise," *The Guardian*, June 17, 2024, https://www.theguardian.com/global-development/article/2024/jun/17/kenya-plans-first-nuclear-power-plant-kilifi-opposition-activists.

122 Netherlands Commission for Environmental Assessment, "Advisory report SESA Nuclear Power Programme," November 7, 2024, https://www.eia.nl/en/news/advisory-report-sesa-nuclear-power-programme/

123 Öko-Institut, Review of NuPEA's "*Strategic Environmental and Social Assessment Report (SESA) for Kenya's Nuclear Power Programme*," July 2024, https://www.centerforjgea.com/assets/reports/Review-of-the-SESA-report.pdf.

124 Fred Obura, "How NuPEA Plans to Spend KSh 36.233 Billion on Kenya's Nuclear Power Project," *The Kenyan Wall Street*, March 20, 2024, https://kenyanwallstreet.com/nupea-to-spend-36b-on-kenyas-nuclear-power/.

125 The National Treasury & Economic Planning, *Mwananchi Guide for Financial Year 2024/25 Budget*, June 2024, https://www.treasury.go.ke/wp-content/uploads/2024/06/Budget-Highlights-The-Mwananchi-Guide-for-the-FY-2024-25-Budget.pdf.

126 Charles Mghenyi, "Coast lobby welcomes government dissolution of nuclear power agency", *The Star*, January 24, 2025, https://www.the-star.co.ke/counties/coast/2025-01-24-coast-lobby-welcomes-government-dissolution-of-nuclear-power-agency

Therefore, there are significant doubts on Kenya's stated goal to begin construction of its first nuclear power station by 2034. Without strong political will, adequate funding and regulatory clarity that timeline appears out of reach.

The acquisition of a research reactor, however, appears to be a more achievable and likely first step. Such a project could help build technical capacity and lay the groundwork for a nuclear power station. South Korea is probably the preferred vendor, given its past cooperation with Kenya. South Korea's investments include scholarships for Kenyan nuclear engineers. South Korea has also been involved in the Konza Technopolis, an envisioned tech hub that has yet to meet expectations.[127] A research reactor could serve as an anchor project for the Konza Technopolis.

The cost of a research reactor would depend on the model. The reactor is likely to be similar to Jordan's Research and Training Reactor (US$173 million) and not like Korea's Kijang Research Reactor (US$574 million). The Jordan reactor was partially funded through a soft loan from South Korea: US$70 million at 0.2% interest over 30 years.[128] A similar financing model could be viable for Kenya.

127 Nuclear Power and Energy Agency (NuPEA), *2021 Annual Report and Financial Statements*, June 30, 2021, https://www.nuclear.co.ke/wp-content/uploads/2024/07/NuPEA-Annual-Financial-Report-20202021.pdf.

128 World Nuclear Association, "Nuclear Power in Jordan."

Timeline

1994 Institute of Nuclear Science & Technology is established at the University of Nairobi.

2007 Kenyan government announces its intention to pursue nuclear power.

2010 Kenya's National Economic & Social Council recommends nuclear power by 2020. Former energy minister Ochilo Ayacko appointed to lead the Nuclear Electricity Project Committee.

2012 The committee evolves into the Kenya Nuclear Electricity Board (KNEB).

2015 KNEB signs an agreement with China General Nuclear Power to explore the construction of a Hualong One reactor.

2015 IAEA conducts an Integrated Nuclear Infrastructure Review.

2016 Government sets nuclear power targets: 1000 MWe by 2025, 4000 MWe by 2033.

2016 Nuclear cooperation agreements signed with Rosatom and Korea Electric Power Corporation.

2016 KNEB announces plans to start building a 1000 MWe plant by 2021 with commissioning in 2027. Estimated cost: US$5 billion.

2017 Follow-up cooperation agreement signed with China General Nuclear Power.

2019 KNEB becomes the Nuclear Power and Energy Agency, established under the Nuclear Regulatory Act.

2020 NuPEA revises plant construction timeline: construction to begin in 2027 at one of two sites: Kilifi, 66 km north-east of Mombasa, or Kwale, 25 km south-west of Mombasa.

2021 NuPEA site selection team visits the Jordan Research and Training Reactor.

2021 Second IAEA Integrated Nuclear Infrastructure Review is conducted. Kenya advised to do more preparatory work prior to achieving Milestone 1.

2022 to 2023 NuPEA holds discussions with KEPCO and INVAP, the Argentin company behind the Open Pool Australian Lightwater research reactor.

2023 Draft Strategic Environmental and Social Assessment is published.

2023 IAEA conducts an Integrated Nuclear Infrastructure Review mission focused on research reactors.

2024 IAEA reports Kenya aims to commission a research reactor between 2030 and 2034.

2024 **Kenya Nuclear Regulatory Authority signs a MOU with the United States Nuclear Regulatory Commission.**

2025 **Cabinet passes a resolution to dissolve NuPEA in January 2025. While the fate of NuPEA is unclear, its functions may be transferred to the Ministry of Energy.**[129]

129 Timeline sources: World Nuclear Association, "Emerging Nuclear Energy Countries,"; Nuclear Power and Energy Agency (NuPEA), "News & Events," accessed October 26, 2024, https://www.nuclear.co.ke/media-center/news-events/page/4/; *The Star*, "Boost for Kenya's nuclear bid as landmark MoU with US signed," September 17, 2024, https://www.the-star.co.ke/opinion/leader/2024-09-17-boost-for-kenyas-nuclear-bid-as-landmark-mou-with-us-signed?fbclid=IwZXh0bgNhZW0CMTEAAR0R_Cpmh_4_tSJEx-0AXfPe017dSqWLkj-u75T-KZtrVwbw05LbBClo_occ_aem_eqyWk5VFzaBej8EFCzPdXA; University of Nairobi, *INST Brochure*, 2019, https://engineering.uonbi.ac.ke/sites/default/files/2021-02/2019%20INST%20Brochure%20-%20Final%20%281%29%20%281%29.pdf; Kipkemoi, "NuPEA CEO".

5.2.1 Nigeria: Significant Ambitions and Significant Challenges

Although Nigeria has clear nuclear ambitions and is progressing toward the IAEA's second milestone, significant challenges remain before a nuclear power plant becomes a realistic prospect. These include legal and institutional arrangements, security and grid capacity.

The country has announced a goal of 4000 MW of nuclear capacity and is working with the IAEA to establish a comprehensive legal and regulatory framework.[130] While installed capacity is around 12.6 GW[131], frequent blackouts and infrastructure limitations restrict daily dispatch to about 5000 MW.[132] Given that nuclear plants typically should not exceed 10% of grid capacity, significant upgrades would be required and expanding the grid is a no-regrets investment regardless of whether nuclear is chosen or not. However, and as noted in Section 1, grid expansion is possible within relatively short time frames.

General security concerns are likely Nigeria's most significant obstacle. Persistent insurgencies and internal conflicts mean that it is highly unlikely that any vendor proceeds without a positive IAEA security assessment. The extent to which these concerns will delay or prevent a nuclear project remains uncertain.

Although corruption is frequently cited as a challenge to Nigeria's nuclear programme, it is not unique to the country. Bangladesh, Pakistan, Russia, South Africa and China all have problems with corruption yet have nuclear power plants, as illustrated in the table below. Corruption could possibly even accelerate nuclear power projects.

130 Ochuko Felix Orikpete et al., "Nuclear Fission Technology in Africa: Assessing Challenges and Opportunities for Future Development," *Nuclear Engineering and Design* 413 (2023), https://doi.org/10.1016/j.nucengdes.2023.112568.

131 Nigerian Electricity Regulatory Commission, *Electricity on Demand: 3rd Quarter 2023 Report*, 2003, https://nerc.gov.ng/wp-content/uploads/2024/02/NERCThirdQuarter2023Report.pdf.

132 Charlotte Remteng et al., "Nigeria Electricity Sector," *Energypedia*, accessed October 30, 2024, https://energypedia.info/wiki/Nigeria_Electricity_Sector#:~:text=Nigeria%20has%20a%20 total%20 installed,11%2C972MW%20(Figure%209).

TABLE: Corruption in Select Countries[133]

Country	Transparency International's Corruption Perception Index score (100 means no perceived corruption) (2023)
Bangladesh	24/100
Nigeria	25/100
Russia	26/100
Uganda	26/100
Pakistan	29/100
Kenya	31/100
Egypt	35/100
Algeria	36/100
Tanzania	40/100
South Africa	41/100
China	42/100
Ghana	43/100
Rwanda	53/100
South Korea	63/100
Japan	73/100
Singapore	83/100

133 Transparency International, Corruption Perception Index, 2023, accessed October 30, 2024, https://www.transparency.org/en/cpi/2023?gadsource=1&gclid=Cj0KCQjwsoe5BhDiARIsAOXVoUs4RhRXQvtGO61kI-GNzmWX-pyRjj4BO0KSkFhHYhfzUJCwawFgd_7QaAqpiEALw_wcB.

Timeline

1976 Nigeria Atomic Energy Commission is created. Becomes operational in 2006.

1995 Nuclear Safety and Radiation Protection Act establishes the Nigerian Nuclear Regulatory Authority.

2001 The Nigerian Nuclear Regulatory Authority begins operations.

2004 First research reactor (31.1 kW Chinese neutron source) commissioned at Ahmadu Bello University.

2009 Nigeria signs two nuclear agreements with Russia.

2010 Four candidate sites for a nuclear power plant are selected for evaluation.

2012 Rosatom and the Nigeria Atomic Energy Commission sign a memorandum of understanding for the development of nuclear power plants, related infrastructure and a regulatory system for nuclear safety and regulation. Rosatom would provide financing options and the plants, at a stated cost of US$20 billion, would be on a build, own and operate basis.

2015 Two sites selected as preferred: Itu in Akwa Ibom State and Geregu in Kogi State.

2015 IAEA conducts an Integrated Nuclear Infrastructure Review.

2018 IAEA conducts an Integrated Nuclear Infrastructure Review for research reactors.

2022 IAEA assists Nigeria with the draft Atomic Energy Bill.

2024 China and Nigeria hold talks on a nuclear power plant. In addition, the talks addressed training and basic nuclear research.

2024 Nigeria remains in Phase 2 of the IAEA's Milestones Approach.[134]

134 Timeline sources: World Nuclear Association, "Emerging Nuclear Energy Countries"; Nigeria Atomic Energy Commission, "Nigeria Holds Talks Nuclear Energy with China," accessed September 2024, https://nigatom.gov.ng/nigeria-signs-mou-on-nuclear-energy-with-china/#:~:text=Nigeria%20 holds%20 talks%20 Nuclear%20 Energy,peaceful%20use%20of%20 nuclear%20energy.&text=3.,Training%20of%20human%20resources; International Atomic Energy Agency, "IAEA Reviews Nigeria's Nuclear Power Infrastructure Development," June 29, 2015, https://www.iaea.org/newscenter/pressreleases/iaea-reviews-nigerias-nuclear-power-infrastructure-development; International Atomic Energy Agency, "*Technical Cooperation Report for 2023*," August 2024, https://www.iaea.org/sites/default/files/gc/gc68-inf-7.pdf.

5.2.3 Rwanda: A Bet on Small Modular Reactors

Rwanda's interest in nuclear power is recent and is focused on small modular reactors. However, limited civil society and media freedom mean that publicly available information is often sparse and of questionable reliability.

Rwanda is among the world's fastest electrifying countries: between 2009 and 2024 household access to electricity grew from 6% to 75%.[135] [136] In 2010, the electricity generation capacity in Rwanda was 97 MW and is currently 409 MW.[137] [138] With a very small grid, a small modular reactor (approximately 30 MW) might make more sense on paper than a traditional large reactor.

As the timeline shows, Rwanda has taken several formal steps toward nuclear development, including international partnerships and domestic institutional reforms. The most significant is a 2023 agreement with Canadian company Dual Fluid Energy to build a demonstration SMR. The reactor, still in the design phase, is described by the World Nuclear Association as a "first-of-a-kind unit: a liquid fuel, lead-cooled, high-temperature fast reactor."[139] Construction is tentatively planned for 2026, with licensing by 2028 and commercial production by 2034.[140] These projections are highly optimistic and far from certain. The entire enterprise, building a reactor based on a design no other country is seriously considering, could be a recipe for disaster.

Rwanda risks repeating South Africa's failed Pebble Bed Modular Reactor project, years of investment without a single reactor being built (see Box 4, page 53). Consultants, on the other hand, would reap significant financial benefits.

135 World Bank Group, "Energy Access in Eastern and Southern Africa," accessed October 27, 2024, https://www.worldbank.org/en/region/afr/brief/afe-energy.

136 World Bank Group, "Ingredients for Accelerating Universal Electricity Access: Lessons from Rwanda's Inspirational Approach," April 10, 2024, https://www.worldbank.org/en/news/feature/2024/04/10/ingredients-for-accelerating-universal-electricity-access-lessons-from-afe-rwanda-inspirational-approach.

137 Rwanda Development Board, "Investment Opportunities: Energy," accessed October 27, 2024, https://rdb.rw/investment-opportunities/energy/.

138 Ministry of Infrastructure, Rwanda, "Rwanda targets more than 300 MW of energy by 2024, Minister Gatete," 23 January 2020, https://www.mininfra.gov.rw/updates/news-details/rwanda-targets-more-than-300mw-of-energy-by-2024-minister-gatete

139 World Nuclear Association, "Emerging Nuclear Energy Countries."

140 Dual Fluid, "Technology," accessed October 27, 2024, https://dual-fluid.com/technology/.

Timeline

2012 Rwanda joins the IAEA.

2017 Signs first Country Programme Framework with the IAEA.

2018 Signs an Intergovernmental agreement with Russia to establish a Centre for Nuclear Science and Technology.

2018 Law governing radiation is passed. Rwanda Utilities Regulatory Authority is given regulatory oversight.

2020 Rwanda Atomic Energy Board is established.

2021 Signs second Country Programme Framework with the IAEA.

2023 Agreement signed with Canadian company Dual Fluid Energy to build a demonstration SMR. Construction is targeted to begin in 2026, completion in 2028.

2024 Signs a MOU with US company NANO Nuclear Energy Inc. on SMR development.[141]

141 World Nuclear Association, "Emerging Nuclear Energy Countries,"; International Atomic Energy Agency, "Rwanda Signs its Second Country Programme Framework (CPF) for 2022–2027," April 12, 2022, https://www.iaea.org/newscenter/news/rwanda-signs-its-second-country-programme-framework-cpf-for-2022-2027; Rwanda Atomic Energy Board, accessed October 27, 2024, https://www.raeb.gov.rw/; World Nuclear News, "Rwanda Signs Agreement with NANO Nuclear," August 16, 2024, https://www.world-nuclear-news.org/Articles/Rwanda-signs-agreement-with-NANO-Nuclear.

5.3 Low Prospects

5.3.1 Algeria: A Long Way to Clean Water

Algeria's interest in expanding its electricity capacity is closely tied to its urgent need to meet rising water demands in a water-scarce region. To secure current and future freshwater supply, the country is increasingly turning to desalination, which is an energy-intensive process. Between 2005 and 2021, Algeria built 14 desalination plants producing a combined total of 2.09 million cubic metres per day, meeting only 17% of national needs at the time. New desalination plants are under construction and, by 2030, the government aims to meet 60% of drinking water needs through desalination.[142]

Algeria's current installed electricity capacity is 26 GW, growing at about 5% annually. Natural gas currently accounts for 99% of this capacity, although efforts are being made to diversify. The government is currently suggesting an energy mix comprising 27% renewable energy by 2030.[143] [144] [145] [146]

However, Algeria's interest in nuclear technology is long standing and was reaffirmed even after the political unrest of 2019, which led to a change in political leadership. That same year, the new administration announced that 6% of the future energy mix would come from nuclear. While the national grid is large enough to support a conventional nuclear power plant, Algeria has also expressed interest in small modular reactors.[147]

As with other countries covered in this report, Algeria cites its uranium reserves – considered among the largest in the Middle East – as justification for pursuing nuclear power. The country has signed uranium mining agreements with Russia, France and Jordan.[148] However, as explored in Section 2, the assumption that local uranium automatically supports nuclear power development is flawed.

142 Lakehal El Amine, "Seawater Desalination in Algeria: A Comprehensive Assessment of Its Viability as a Water Security Strategy," *Revue Le Manager* 10, no. 2 (2023), https://asjp.cerist.dz/en/downArticle/451/10/2/238879.

143 The Regional Center for Renewable Energy and Energy Efficiency, "Algeria," accessed December 3, 2024, https://rcreee.org/algeria/.

144 Reda Amrani, "Algeria's Evolving Energy Strategy," *Energy Intelligence*, October 28, 2024, https://www.energyintel.com/00000192-d1e7-de51-a19a-fbf7e35e0000.

145 Energy Capital & Power, "Algeria Powers Ahead with Sustainable Energy Initiatives," October 2, 2023, https://energycapitalpower.com/algeria-renewable-energy-capacity-2035/.

146 Sonelgaz, "Key Figures 2023," accessed December 3, 2024, https://www.sonelgaz.dz/fr.

147 Hocine Benkharfia, *Nuclear Power as an Option for the Diversification of Energy Sources in Algeria,* presentation at the IAEA INPRO Dialogue Forum, March 2023, https://nucleus.iaea.org/sites/INPRO/d20/Slides/Algeria.pdf.

148 Heba Taha, Nuclear Revival in North Africa? Developments in Algeria, Libya, and Egypt, Occasional Paper 322, *South African Institute of International Affairs* (SAIIA), May 2021, https://saiia.org.za/wp-content/uploads/2021/05/Occasional-Paper-322-taha.pdf.

In a presentation to the IAEA in 2023, Hocine Benkharfia of the Algerian Commission of Atomic Energy explained how far Algeria still had to go before nuclear is an option, as illustrated below:[149]

TABLE: Algeria's Challenges according to the Algerian Commission of Atomic Energy

Challenges	Actions required
Human resources development	Legal and regulatory framework to be issued
Complexity of the program (IAEA milestones)	Upgrading of basic nuclear infrastructure
Many nuclear regulations to be promulgated (safety, security, etc.)	Performance improvement of NUR and Es-Salam research reactors
Long term programming (project management, strategies, etc.)	Engineering competency development
Financing	Site selection and evaluation for a nuclear power plant
Licensing and regulatory issues	Evaluate existing reactor technologies and future trends
	The development of a small modular reactor is an attractive option for Algeria

In a 2012 presentation to the IAEA, Benkharfia outlined similar challenges but concluded with the statement that Algeria's first nuclear power plant would be built between 2020 and 2025.[150] The pace of preparation shows that it is unlikely that Algeria will acquire a nuclear plant soon.

Compounding these technical and institutional challenges is Algeria's controversial nuclear history. Between 1960 and 1967, France conducted nuclear tests in the Algerian Sahara, allegedly affecting 60,000 people. Thousands of Algerians continue to seek compensation.[151]

149 Benkharfia, *Nuclear Power as an Option for the Diversification of Energy Sources in Algeria"*

150 Hocine Benkharfia, *National Vision and Strategy for the Introduction of Nuclear Power Plant in Algeria*, presentation at the IAEA INPRO Dialogue Forum, August 2012, https://nucleus.iaea.org/sites/INPRO/df5/Session%202-B/Countries%20without%20NP/2._Hocine_Benkharfia_Algeria_0828.pdf

151 Mohamed Taha, Nuclear Revival in North Africa? Developments in Algeria, Libya, and Egypt, Occasional Paper 322, *South African Institute of International Affairs* (SAIIA), May 2021, https://saiia.org.za/wp-content/uploads/2021/05/Occasional-Paper-322-taha.pdf.

Timeline

1970s Training begins at the Centre for Nuclear Science and Technology for nuclear technicians and postgraduate students.

1976 to 1982 Feasibility studies explore the acquisition of a nuclear plant, projecting possible commissioning by 1996.

1986 The Commission of Atomic Energy is established.

1989 The NUR research reactor (1 MWt), built by Argentina's INVAP, achieves criticality.

1995 The Es-Salam research reactor (5 MWt), built by a Chinese vendor, becomes operational.

1995 Algeria signs the Nuclear Non Proliferation Treaty.

1996 Algeria signs the Treaty of Pelindaba and establishes the Atomic Energy Commission.

2007 Directorate of Nuclear Energy is established.

2007 to 2008 Nuclear agreements signed with Argentina, China, France, US and Russia.

2013 Nuclear Engineering Institute is established.

2014 Intergovernmental agreement with Rosatom.

2016 Two additional agreements signed with Rosatom. A preliminary agreement signed with CNNC for a Hualong One and an ACP100 SMR.

2016 to 2019 CNNC refurbishes the Es-Salam reactor.

2024 Talks held with China on nuclear power cooperation.[152]

152 World Nuclear Association, "Emerging Nuclear Energy Countries,"; Le Commissariat à l'Énergie Atomique, "Historique," accessed December 2, 2024, https://www.comena.dz/historique/; Latifa Ferial Naili, "Algeria and China Discuss Expanding Cooperation in Nuclear Technologies," AL24 News, October 28, 2024, https://al24news.com/en/algeria-and-china-discuss-expanding-cooperation-in-nuclear-technologies/.

5.3.2 Morocco: Technical Capabilities, Political Uncertainty

Morocco's 2009–2030 energy policy prioritises renewable energy. However, the country's interest in nuclear energy and related infrastructure dates back several decades. Morocco is currently considering incorporating nuclear into its post-2030 energy mix.[153]

Since joining the IAEA in 1957, Morocco has developed considerable nuclear infrastructure and expertise. This includes applications in medicine, industry and agriculture. Morocco also operates a 2 MW research reactor.[154] [155]

Yet, concrete steps toward building a nuclear power plant remain limited. As in other countries, the decision to pursue nuclear power is political. In Morocco, executive authority is concentrated in the monarchy. Although the 2011 Constitution is intended to embed democratic principles, analysts note that major energy decisions have fallen outside of democratic control.[156] At present, there are no indications that the crown will make a decision on nuclear power soon.[157]

153 Hafsa Housni et al., "Strategic Analysis for Advancing Morocco's Nuclear Infrastructure Using PESTEL Framework," *Nuclear Analysis*, Volume 3, Issue 2, 2024, June 2024, https://doi.org/10.1016/j.nucana.2024.100110.

154 Khammar Mrabit, "Building the Nuclear and Radiological Safety and Security Authority in the Kingdom of Morocco: Sharing Experience and Lessons Learned," in *Nuclear Law: The Global Debate*, ed. International Atomic Energy Agency (The Hague: T.M.C. Asser Press, January 2022), 319–33, https://doi.org/10.1007/978-94-6265-495-2_15.

155 Imane Lechheb, "Morocco's Nuclear Plans Still on Hold, but New Tech Could Change That," *World Nuclear Industry Status Report* blog, April 7, 2025, citing the *World Nuclear Industry Status Report* 2024, https://www.worldnuclearreport.org/Report-Morocco-s-nuclear-plans-still-on-hold-but-new-tech-could-change-that

156 Jawad Moustakbal, "The Moroccan Energy Sector: A Permanent Dependence," *Transnational Institute*, December 2, 2021, https://www.tni.org/en/article/the-moroccan-energy-sector.

157 Abdellatif El Hamamouchi, "Morocco, Hanging on the Edge of an Abyss," *PassBlue*, July 30, 2024, https://www.passblue.com/2024/07/30/morocco-on-the-edge-of-an-abyss/.

Timeline

1957 Morocco joins the IAEA.

1960s Nuclear physics programme is established at the University of Rabat.

1970s Initial discussions on nuclear-powered desalination.

1980s Pre-feasibility site studies are conducted with the IAEA and Sofratome. Sidi Boulbra is identified as a suitable site for a nuclear power plant.

1986 National Centre for Nuclear Energy and Technology is established.

1994 IAEA expert mission confirms suitability of Sidi Boulbra.

2007 Partnership with France to build a nuclear power plant is announced.

2009 TRIGA Mark II research reactor (2 MW) is commissioned. General Atomics (US) is the vendor.

2009 A Committee on Nuclear Power and Desalination is established to evaluate nuclear infrastructure required for a nuclear power plant.

2014 Legislation passed to create a regulatory authority.

2015 IAEA conducts an Integrated Nuclear Infrastructure Review.

2016 The Moroccan Agency for Nuclear and Radiological Safety and Security is established.

2016 With the IAEA's assistance, the country develops a 2016–2019 action plan to implement recommendations from the Integrated Nuclear Infrastructure Review.

2017 Feasibility study agreement for a nuclear power plant signed with Rosatom.

2022 IAEA Emergency Preparedness Review is conducted.

2023 IAEA conducts an Integrated Regulatory Review Service mission. An agreement with Rosatom to explore desalination technologies is signed.[158]

158 Housni et al., "Strategic Analysis"; World Nuclear Association, "Emerging Nuclear Energy Countries,"; General Atomics, "TRIGA," accessed December 2, 2024, https://www.ga.com/triga/; Jihane Rahhou, "Morocco's Water & Energy Solutions, Rosatom Partner on Desalination Project," *Morocco World News*, July 30, 2024, https://www.moroccoworldnews.com/2023/07/31061/moroccos-water-amp-energy-solutions-rosatom-partner-on-desalination-project/; International Atomic Energy Agency, "Country Nuclear Power Profiles 2018 Edition: Morocco" https://www-pub.iaea.org/MTCD/Publications/PDF/cnpp2018/countryprofiles/Morocco/Morocco.htm.

5.4 No Prospects

5.4.1 Tanzania: The Uranium to Nuclear Fuel Myth

Tanzania is a clear example of how uranium reserves are often falsely cited as justification for acquiring commercial nuclear reactors. In 2015, the country's National Energy Policy claimed that the "availability of uranium in Ruvuma and Dodoma regions provides an opportunity for nuclear power generation, considering the fact that electricity demand is increasing."[159]

In reality, Tanzania is far from ready to develop a nuclear power plant. Significant work remains in building institutions, regulatory capacity and infrastructure. Current government statements and agreements reflect long-term ambitions rather than realistic short-term plans.

Moreover, while Tanzania holds an estimated 58,200 tonnes of uranium (about 1% of global reserves), it has no operational mine.[160] The largest known reserve is the Mkuju River deposit (25,900 tonnes). Rosatom's subsidiary Uranium One received a mining licence for the deposit in 2013. Development was suspended in 2017 due to low uranium prices, though it may resume in the medium-term.[161] [162]

During President John Magufuli's term (2015–2021), a series of changes were made to mining taxation and ownership regulations. These were regarded as unfriendly towards investors and mining companies and it is only now, under a new government, that the mining sector is beginning to pick up: in particular, rare earth minerals, lithium, graphite and gold. Tanzania has considerable work to do in order to have a functioning uranium mine, let alone a nuclear plant.

Timeline

2003 Atomic Energy Act is passed.

2003 The Tanzania Atomic Energy Commission is established.

2015 An IAEA mission identifies major challenges in creating an independent nuclear regulator.

2016 An agreement signed with Rosatom to explore a research reactor.

2023 Tanzania expresses interest in nuclear power at Russia-Africa Summit.

2023 Country Programme Framework for 2023–2027 signed with IAEA.

2024 Tanzania reiterates its nuclear ambitions at US-Africa Nuclear Summit in Nairobi.[163]

159 United Republic of Tanzania, *National Energy Policy 2015*, accessed December 3, 2024, https://www.nishati.go.tz/uploads/documents/en-1622283004-National%20Energy%20Policy%20(NEP),%202015.pdf, 12.

160 For reasons of data consistency, all uranium reserves and production figures are from 2022.

5.4.2 Mali, Niger, Burkina Faso and Ethiopia: Civil Wars and Geopolitics

Three of the four countries have attracted significant media attention in recent years as their security problems spiralled into coups. Burkina Faso had two coups in 2022, Niger in 2023 and Mali in 2020 and 2021. There are fundamentalist Islamic insurgencies in all three countries. Major insurgent groups are Jama'at Nasr al-Islam wal-Muslimin and Islamic State – Sahel Province.

Relations with the colonial power, France, have been severed and Russia has stepped in. Niger revoked French uranium mining licences in 2023 and may take over the formerly French mines. Niger accounts for 5% of global uranium reserves and is seventh in terms of production.[164]

Russia signed nuclear cooperation agreements with Mali in 2024 and with Burkina Faso in 2023 and 2024.[165] [166] The agreements are geopolitical theatre, Russia expanding its interests in Africa, and not expressions of any possible nuclear development. The political and security situations preclude it.

Ethiopia is in a state of civil war, and is therefore not a likely candidate for nuclear power, despite the country signing a series of nuclear cooperation agreements with Russia between 2017 and 2023.[167] [168]

161 World Nuclear Association, "World Uranium Mining Production," May 16, 2024, https://world-nuclear.org/information-library/nuclear-fuel-cycle/mining-of-uranium/world-uranium-mining-production.

162 Interfax, "Rosatom Plans to Start Commercial Mining of Uranium in Tanzania in Several Years," November 22, 2022, https://interfax.com/newsroom/top-stories/85232/.

163 The Tanzania Atomic Energy Commission, accessed October 27, 2024, https://www.taec.go.tz/; International Atomic Energy Agency, "IAEA Mission Says Tanzania Faces Challenges in Radiation Safety Regulation," October 14, 2015, https://www.iaea.org/newscenter/pressreleases/iaea-mission-says-tanzania-faces-challenges-radiation-safety-regulation; United Republic of Tanzania, *National Energy Policy 2015*, December 2015, https://www.nishati.go.tz/uploads/documents/en-1622283004-National%20Energy%20Policy%20(NEP),%202015.pdf; Ippmedia.com, "Government Reveals Nuclear Power Wish at US-Led Meet," August 30, 2024, https://ippmedia.com/the-guardian/news/local-news/read/government-reveals-nuclear-power-wish-at-us-led-meet-2024-08-29-225459#google_vignette; The East African, "Russian Firm Plans to Build Research Nuclear Reactor in Tanzania," July 28, 2020, https://www.theeastafrican.co.ke/tea/news/east-africa/russian-firm-plans-to-build-research-nuclear-reactor-in-tanzania-1357462; Henry Lyimo, "Tanzania Gives Stance On Nuclear Technologies At Russia-Africa Summit," *Tanzania Daily News*, August 2, 2023, https://allafrica.com/stories/202308020063.html.

164 World Nuclear Association, "World Uranium Mining Production."

165 Rosatom, "Rosatom and Burkina Faso Begin Cooperation on Preparation to Nuclear Technology Development," June 5, 2024, https://atommedia.online/en/2024/06/05/rosatom-i-burkina-faso-nachinajut-sotru/.

166 Rosatom, "Russia and Mali Plan to Develop Cooperation in Peaceful Applications of Atomic Energy," March 25, 2024, https://rosatomafrica.com/en/press-centre/news/russia-and-mali-plan-to-develop-cooperation-in-peaceful-applications-of-atomic-energy/.

167 World Nuclear Association, "Emerging Nuclear Energy Countries."

168 World Nuclear News, "Zimbabwe and Ethiopia Sign Nuclear Energy Cooperation Agreements with Russia," July 28, 2023, https://www.world-nuclear-news.org/Articles/Zimbabwe-and-Ethiopia-sign-nuclear-energy-cooperat.

5.4.3 Uganda: Grandiose Visions

Uganda's nuclear ambitions must be viewed in light of two dynamics. Firstly, the myth that uranium reserves justify a nuclear plant build. Secondly, the tendency of authoritarian regimes to pursue grandiose projects that are often misaligned with actual capacity and resources.

For over a decade, Uganda appeared to be gradually following the conventional path toward nuclear power development. However, in 2023, President Yoweri Museveni claimed Uganda had agreements with Russia and South Korea to build two nuclear power plants with a combined capacity of 15.6 GW.[169] By May 2024, the Minister of State for Mineral Development, Phiona Nyamutoro, stated the total would in fact be 24 GW.[170]

These announcements strain credibility. No corresponding agreements appear on the websites of Rosatom, KEPCO, the IAEA or Uganda's Atomic Energy Council. The world's largest operational nuclear plant, South Korea's Kori facility, has a capacity of 7489 MW, while Uganda's current total installed electricity capacity is just 2048 MW.[171] [172] [173]

Furthermore and despite years of institutional groundwork, Uganda does not appear close to building even a modest nuclear power plant. Uganda's 2023 national energy policy identifies major barriers, including a weak legal and institutional framework, limited technical expertise and inadequate investment. Even the foundational premise that Uganda has usable uranium remains unproven.[174]

169 NEWSUPDATES - STAMZNOW, "Inside Museveni's Deal With Russia & Korea To Build Uganda's 15,000MW Nuclear Power Stations," *YouTube video*, 14:25, posted August 14, 2024, https://www.youtube.com/watch?v=km-LKwuvCWQY.

170 World Nuclear News, "Uganda Looks to Potential Uranium Production," 16 May 2024, https://world-nuclear-news.org/Articles/Uganda-looks-to-potential-uranium-production

171 Wikipedia, "List of Largest Power Stations," accessed October 29, 2024, https://en.wikipedia.org/wiki/List_of_largest_power_stations#Nuclear

172 Statista, "Uganda: Gross Domestic Product (GDP) in Current Prices from 1989 to 2029," 24 October 2024, https://www.statista.com/statistics/447778/gross-domestic-product-gdp-in-uganda/.

173 Electricity Regulatory Authority, "Installed Capacity," 25 September 2024, https://www.era.go.ug/installed-capacity/

174 Ministry of Energy and Mineral Development, *Energy Policy for Uganda 2023* (April 2023), https://nrep.ug/wp-content/uploads/2023/09/Energy-Policy-for-Uganda-2023_Final.pdf.

Timeline

2008 Atomic Energy Bill Act is enacted.

2009 Atomic Energy Council is established.

2013 Uganda Vision 2040 includes nuclear in the future energy mix.

2015 Cabinet approves Nuclear Power Roadmap Development Strategy.

2016 Framework agreement signed with Rosatom.

2017 Agreement signed with Rosatom on nuclear infrastructure and research centres.

2018 Cooperation agreement signed with China Central Plains Foreign Engineering Company and China Nuclear Manufacturing Group.

2019 Nuclear agreements signed with China National Nuclear Corporation and Rosatom.

2021 An IAEA Integrated Nuclear Infrastructure Review concludes Uganda must complete more work to pass Milestone 1.

2023 Uganda publishes a new energy policy. The Buyende region is identified as the preferred site for a nuclear power plant.

2023 Reuters reports in March that Ruth Ssentamu, the Minister of Energy and Mineral Development, states that "preparation to evaluate the Buyende Nuclear Power Plant site is ongoing to pave the way for the first nuclear power project expected to generate 2,000 MW [sic], with the first 1000 MW to be connected to the national grid by 2031."

July 2023 Interfax reports an agreement for a nuclear power plant signed with Russia.

August 2023 Anadolu Agency quotes President Yoweri Museveni as saying in August during a coffee summit in Kampala that "Russia and South Korea are going to build two nuclear power plants of 15,000 megawatts."

September 2023 State Minister for Energy Okaasai Opolot claims that Uganda is progressing toward IAEA Milestone 2.

2024 Abubaker Jeje Odongo, the Minister of Foreign Affairs, announces that Uganda is looking to negotiate a nuclear deal with Russia.[175]

175 World Nuclear Association, "Emerging Nuclear Energy Countries,"; International Atomic Energy Agency (IAEA), *Statement by Uganda at the 68th IAEA General Conference 16-20th September 2024*, https://www.iaea.org/sites/default/files/24/09/uganda-gc68.pdf, accessed 29 October 2024; Godfrey Olukya, "Russia, South Korea to Build Nuclear Power Plants in Uganda," *Anadolu Agency*, 9 August 2024, https://www.aa.com.tr/en/energy/nuclear/russia-south-korea-to-build-nuclear-power-plants-in-uganda/38677; Reuters, "Uganda Plans to Start Nuclear Power Generation by 2031 – Minister," 9 March 2023, https://www.reuters.com/world/africa/uganda-plans-start-nuclear-power-generation-by-2031-minister-2023-03-09/; Atomic Energy Council, https://www.atomiccouncil.go.ug/, ac-

cessed 28 October 2024; IAEA, *Report of the INIR Phase 1 Mission to Uganda, 29 November – 6 December 2021*, accessed 29 October 2024, https://www.iaea.org/sites/default/files/documents/review-missions/inir-uganda-061221.pdf; Rosatom, "Russia and Uganda Sign Intergovernmental Agreement on Cooperation in the Peaceful Use of Nuclear Energy," 17 September 2019, https://rosatomafrica.com/en/press-centre/news/russia-and-uganda-sign-intergovernmental-agreement-on-cooperation-in-the-peaceful-use-of-nuclear-ene/; Chinedu Okafor, "Uganda Joins the List of African Countries Exploring a Nuclear Deal with Russia," *Business Insider Africa*, 14 November 2024, https://africa.businessinsider.com/local/markets/uganda-joins-the-list-of-african-countries-exploring-a-nuclear-deal-with-russia/w8hdkn7.