

Special Report

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Nuclear Power and Governance Frameworks: Egypt, Ghana and South Africa

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African perspectives
Global insights

Executive summary

This report examines three African countries that are at different stages in using nuclear energy to achieve developmental outcomes. The year 2020 marked the 50th anniversary of the Treaty on the Non-Proliferation of Nuclear Weapons' entering into force. This treaty asserted the right of all states to the peaceful use of nuclear technology. This is important for African states, which are trying to make progress in terms of the UN's 2030 Sustainable Development Goals and priority areas of the AU's Agenda 2063. Many of these states also have the resources needed for nuclear energy, such as uranium, plutonium, thorium and zirconium.

Egypt, Ghana and South Africa have been selected as case studies for this report, as they represent three African countries at different points in their journey towards the peaceful use of nuclear energy.

Egypt has been expected to develop a nuclear weapons programme because of its historical role as a leader in the pan-Arab movement, and the fact that it is the most populous country in the Arab world. However, the country instead opted for non-proliferation and the peaceful use of nuclear energy. Now it is finally realising a long-held dream by building a nuclear power plant in cooperation with ROSATOM, the Russian state atomic energy corporation. The professed objective of the project is to achieve self-sufficiency in terms of energy amid increasing demand and a growing population. However, the project has also been framed with overtones of national prestige, and critics have noted that non-nuclear options should have been given greater consideration.

Ghana aspires to do the same, although its nuclear ambitions are still at a nascent stage. Electricity supply in the country has been outstripped by demand, leading to numerous energy crises. The government of Ghana has renewed its commitment to implement a nuclear power programme and to use nuclear power to drive economic development. The country is approaching this in a responsible manner, by following the International Atomic Energy Agency's Milestones Approach. This is a comprehensive guide for the establishment of nuclear power programmes that sets out three phases imperative to 'developing the infrastructure necessary to support a nuclear programme'. While significant steps have been taken in establishing a nuclear programme in Ghana, much work lies ahead.

South Africa has the most advanced nuclear programme in Africa, and the continent's only nuclear power plant. Post-apartheid South Africa was regarded as the poster child for nuclear disarmament, nuclear non-proliferation and the peaceful use of nuclear energy after voluntarily dismantling its nuclear weapons programme. It joined a number of multilateral nuclear regimes and organisations and signed various international agreements. One of the most significant nuclear legacies of apartheid South Africa is the nuclear facilities created during that era. However, Africa's first and only nuclear power plant, Koeberg, and the SAFARI-1 research reactor have recently reached their end-of-life cycle. Urgent investment is needed to secure the extension of their lifespan, as is additional investment to meet the broader energy demands of the country.

Abbreviations & acronyms

AEB	Atomic Energy Board
AEC	Atomic Energy Corporation
AG	Australia Group
ANC	African National Congress
DMRE	Department of Mineral Resources and Energy
EAEA	Egypt Atomic Energy Agency
EE	energy efficiency
ELA	Earthlife Africa
ENRRA	Egyptian Nuclear and Radiological Regulatory Authority
GAEC	Ghana Atomic Energy Commission
GNPP	Ghana Nuclear Power Programme
GNPPO	Ghana Nuclear Power Programme Organisation
IAEA	International Atomic Energy Agency
INIR	Integrated Nuclear Infrastructure Review
IRP	Integrated Resource Plan
MoEE	Ministry of Electricity and Renewable Energy
MTCR	Missile Technology Control Regime
NAM	Non-Aligned Movement
NECSA	South African Nuclear Energy Corporation
NEPIO	Nuclear Energy Programme Implementation Organisation
NPPA	Nuclear Power Plants Authority
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NRA	Nuclear Regulatory Authority
NRWDI	National Radioactive Waste Disposal Institute
NSG	Nuclear Suppliers Group
SAFCEI	Southern African Faith Communities' Environment Institute
SONA	State of the Nation Address
CSO	civil society organisation
PAIA	Promotion of Access to Information Act
PBMR	Pebble Bed Modular Reactor
RFI	request for information

RPI	Radiation Protection Institute
iThemba LABS	iThemba Laboratory for Accelerator Based Sciences
WA	Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies
ZC	Zangger Committee

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Cover image

Inside detail of a nuclear reactor (Getty Images)

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Introduction

The year 2020 marked the 50th anniversary of the Treaty on the Non-Proliferation of Nuclear Weapons' (NPT) entering into force. Although the treaty is an important pillar of global security in terms of the weaponisation of nuclear energy, it also asserts the right of all states to the peaceful use of nuclear technology. This is particularly important for the African continent. African countries are looking at ways to achieve the 2030 Sustainable Development Goals and make headway on priority areas of Agenda 2063. One of the ways to achieve developmental progress is through nuclear energy. Apart from possessing the natural resources (uranium, plutonium, thorium and zirconium) necessary for nuclear energy, a number of African states are either building or expanding their facilities for civilian use. Others are working jointly with international institutions and other countries (in both the North and the South) to leverage the developmental benefits that can be derived from this technology.

Egypt, Ghana and South Africa have been selected as case studies for this report because they represent countries at different points in their journey towards the peaceful use of nuclear energy

Egypt, Ghana and South Africa have been selected as case studies for this report because they represent countries at different points in their journey towards the peaceful use of nuclear energy. Egypt is finally realising its long-held dream of building a nuclear power plant. Ghana aspires to do the same, although its nuclear ambitions are still at a nascent stage. South Africa has the most advanced nuclear programme on the continent, and Africa's only nuclear power plant. Yet it too faces challenges, owing to ageing equipment and maladministration.

First, this report gives the background of each nuclear project. This not only provides a historical overview of a country's nuclear ambitions and the progress achieved but also shows how political considerations and changing political administrations (whether through democratic means or coups) can have significant ramifications for national nuclear goals.

Second, it lists existing nuclear installations, facilities and research centres in each of the country case studies, along with a brief description of their work on nuclear energy. Third, it discusses relevant domestic governance frameworks and structures that are crucial for the safe and secure use of nuclear energy. The past decade saw several low-profile nuclear

incidents on the continent, some of which were only revealed after the fact. This does not help to inspire public trust in nuclear power.

Fourth, the report gives an overview of international commitments made by each country over the years. Africa (with the exception of South Sudan) has committed to and ratified all the major disarmament treaties, including the NPT. The continent has also a home-grown initiative, the African Nuclear-Weapon-Free Zone Treaty (Pelindaba Treaty), which entered into force on 15 July 2009. Compliance with international and continental standards is crucial for states interested in pursuing a nuclear path.

Fifth, it discusses the role of civil society and public input into nuclear matters. It is necessary to encourage the active engagement of civil society organisations (CSOs), women and youth groups in discussions on governance and regulatory institutions in Africa, as well as on nuclear non-proliferation and the peaceful use of nuclear technology. This is crucial, as many of these discussions are happening behind closed doors and among officials, with very little information or transparency on the broader implications for society. Informed engagement by civil society (including the media) helps to galvanise governments and intergovernmental organisations.

Lastly, the report charts the way forward for each country in pursuing or expanding its nuclear capabilities. Based on this section, this report makes practical policy recommendations.

Origins of nuclear programmes

Egypt

Because of Egypt's historical role as a leader in the pan-Arab movement and the fact that it is the most populous country in the Arab world, it has been expected – and has often faced pressure – to develop a nuclear weapons programme.¹ Indeed, since the 1950s political analysts have consistently argued in favour of Egypt's need for a bomb. However, the country opted instead for non-proliferation, and scholars have frequently used its path as a case study on nuclear restraint.²

The logic behind a nuclear programme in the years immediately after its independence was based on a combination of technological modernism, its leadership role in the Arab world and the Non-Aligned Movement (NAM), and a desire for a balance of power with Israel (a point that is elaborated on in greater detail later). The idea of a nuclear programme – even a peaceful one – has therefore been associated with national pride, and each of the country's presidents has discussed nuclear aspirations. Plans to establish a civilian nuclear power programme have almost consistently been under consideration but never implemented, until now.

The idea of a nuclear programme – even a peaceful one – has been associated with national pride, and each of the country's presidents has discussed nuclear aspirations

The country launched a civilian nuclear programme in 1954 and has since trained cadres of nuclear scientists. In 1958 President Jamal Abd al-Nasser procured a pilot plant from the Soviet Union. The ETTR-1, located at Inshas, is a 2MW light-water research reactor, was launched in 1961 with Soviet technical assistance. It became operational three years later and continues to operate to this day. The primary focus of the Inshas facility is industrial and

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- 1 Adel Safety, "Proliferation, Balance of Power, and Nuclear Deterrence: Should Egypt Pursue a Nuclear Option?", *International Studies* 33, no. 1 (1996): 21–33.
 - 2 Gawdat Bahgat, "The Proliferation of Weapons of Mass Destruction: Egypt", *Arab Studies Quarterly* 29, no. 2 (2007): 1–15; Maria Rost Rublee, *Non-Proliferation Norms: Why States Choose Nuclear Restraint* (Athens: University of Georgia Press, 2009), 99–148; Robert J Einhorn, "Egypt: Frustrated but Still on a Non-Nuclear Course", in *The Nuclear Tipping Point: Why States Reconsider Their Nuclear Choices*, eds. Kurt M Campbell, Robert J Einhorn and Mitchell N Reiss (Washington DC: Brookings Institution Press, 2004), 43–82; Etel Solingen, *Nuclear Logics: Constraining Paths in East Asia and the Middle East* (Princeton: Princeton University Press, 2007), 229–245.

agricultural research. In 1964 Egypt proposed Sidi Krir (west of Alexandria, 135km east of Al Dabaa) as a site for a nuclear reactor, but the project was halted owing to the Six-Day War with Israel in June 1967, which almost completely destroyed Egypt's air force.

The Nasser administration's attempts to acquire nuclear weapons throughout the 1960s proved to be futile. The Egyptian president reportedly approached the Soviet Union and China in his quest for nuclear weapons, but both countries were reluctant to help. Eventually, Egypt opted to establish itself as working in favour of non-proliferation, and it currently views the development of nuclear weapons as contrary to its strategic interests.

After Nasser's death, the administration of president Anwar al-Sadat re-started the nuclear power plant project. US president Richard Nixon and Sadat released a joint statement in June 1974 announcing US plans to help Egypt construct two reactors. However, the Nixon administration later backtracked.³ Members of the US Congress argued that Nixon's agreement with Sadat was premature. In particular, they highlighted the volatile political situation in the Middle East at the time, with another Arab-Israeli war in 1973 and no political settlement.⁴ Fearing that the safeguards overseen by the International Atomic Energy Agency (IAEA) might be insufficient to deter Egypt from attempting to build a bomb, they imposed three additional conditions. These were Egypt's signing of the NPT, guarantees that the nuclear reactors would be safe from sabotage by armed groups, and that plutonium produced in the power plant would not be re-processed or stored on Egyptian territory without express US approval. In the face of these conditions, the project ultimately faltered.

In 1981, Al Dabaa was suggested as the site of an electricity-generating power plant in a presidential decree by Hosni Mubarak, who became president after Sadat's assassination. The site was deemed the most feasible for the project based on studies contracted by the Egyptian government, owing to its proximity to water, its distance from the seismic belt, groundwater movement, and demographics (it is relatively sparsely populated).⁵ However, the pursuit of the reactors was halted in 1986 after concerns over the Chernobyl nuclear disaster.⁶

During most of Mubarak's nearly 30-year rule, the project was shelved. Plans for a nuclear power plant at Al Dabaa were only revived in September 2006 as a result of increasing energy needs, coupled with rising oil and gas prices.⁷ The project was proposed by

3 J Samuel Walker, "Nuclear Power and Nonproliferation: The Controversy over Nuclear Exports, 1974-1980", *Diplomatic History* 25, no. 2 (2001): 215-249.

4 US Congress, "US Foreign Policy and the Export of Nuclear Technology to the Middle East, Hearing before the Subcommittees on International Organizations and Movements and on the Near East and South Asia of the Committee on Foreign Affairs, House of Representatives, Ninety Third Congress, Second Session, June 25; July 9, 18; and September 16, 1974" (US Government Printing Office, Washington DC, 1974), 168-170.

5 Mohamed M Megahed, "Feasibility of Nuclear Power and Desalination", *Desalination* 246, no. 1-3 (2009): 238-256.

6 "Egypt Unveils Nuclear Power Plan", *BBC News*, September 25, 2006, http://news.bbc.co.uk/2/hi/middle_east/5376860.stm.

7 Charles K Ebinger and Sharon Squassoni, "Industry and Emerging Nuclear Energy Markets", in *Business and Nonproliferation: Industry's Role in Safeguarding a Nuclear Renaissance*, eds. John P Banks and Charles K Ebinger (Washington DC: Brookings Institution Press, 2011), 66-120.

Mubarak's son Gamal, who had played a role in Egypt's economic liberalisation and was widely perceived as being groomed for succession.⁸ A popular uprising – part of the Arab Spring – in January 2011 ousted Mubarak. The military placed itself in charge of the democratic transition and in June 2012 Muhammad Mursi of the Muslim Brotherhood's Freedom and Justice Party was elected.

Between 2011 and 2013, after Mubarak had been ousted, the project was neither cancelled nor officially frozen, but little progress was made. Al Dabaa was still deemed the most suitable site for a nuclear reactor, and the government still compensated residents who were being moved from Al Dabaa to make way for the power plant. However, there were no consultations with residents over this decision. Meanwhile, the disaster at the Fukushima Daiichi plant in March 2011 led to renewed public questioning of the role of nuclear energy in Egypt.⁹

On the one-year anniversary of Mursi's rule, defence minister Gen. Abd al-Fattah al-Sisi launched a coup d'état. He became president in 2014.¹⁰ Depicting himself as the saviour of the nation, Sisi's agenda has centred on two key pillars: restoring security and stabilising the economy. His administration has also restarted the nuclear project. It is seen as one of two 'giant national projects' that the president has prioritised, alongside the expansion of the Suez Canal.¹¹ These large-scale, top-down and modernist projects are portrayed as patriotic duties that Egyptians need to embrace and perhaps even fund, as the government has consistently solicited funds to assist with the building of these projects, such as the Long Live Egypt fund.¹² In November 2015 a nuclear power plant was established at the Al Dabaa site on the country's northern coast (140km from Alexandria), in the governorate of Matrouh. It is expected to contain four 1 200MW pressurised water reactors (known as VVER-1200).

Approximately 85% of the current nuclear project is funded by a \$25 billion loan from ROSATOM, the Russian atomic energy corporation, repayable over 22 years. Egypt will begin repaying the loan in October 2029 on a biannual basis, at 3% interest. The remaining 15% of the cost will be raised by the Egyptian government, but it is not clear whether this will come from the public or private sector. The Russian proposal for Al Dabaa was reportedly the most favourable, with other proposals by Japan, France, South Korea and China, although the details have not been shared with the public.¹³

8 Dominic Moran, "Egypt's Nuclear Imbroglio", Centre for Security Studies, ETH Zurich, <https://css.ethz.ch/en/services/digital-library/articles/article.html/106118>; "Egypt and Nuclear Power: Nuclear Succession", *The Economist*, September 28, 2006, <https://www.economist.com/middle-east-and-africa/2006/09/28/nuclear-succession>.

9 Ebinger and Squassoni, "Industry and Emerging Nuclear", 96.

10 Ruth Michaelson, "Threat of Jail Looms Over Even Mildest Critics Under Egyptian Crackdown", *The Guardian*, January 24, 2020, <https://www.theguardian.com/world/2020/jan/24/threat-of-jail-shapes-egyptian-lives-nine-years-after-uprising>.

11 Sami Abdelrahman, "New Chairman of the Nuclear Power Plants Authority in First Dialogue with 'Rosa El Youssef'", Non-Proliferation Policy Education Center, November 15, 2017, <http://www.npolicy.org/article.php?aid=1357&rtid=14>.

12 Yezid Sayegh, "Owners of the Republic: An Anatomy of Egypt's Military Economy" (Carnegie Middle East Center, Beirut, 2019), 208.

13 Walaa Hussein, "Russia to Build Egyptian Nuclear Reactor", *Al Monitor*, September 4, 2015, <https://www.al-monitor.com/pulse/fr/originals/2015/09/egypt-russia-offer-build-nuclear-reactor.html>.

The professed objective of the project is to achieve self-sufficiency in energy amid increasing demand and a growing population of around 100 million people

The professed objective of the project is to achieve self-sufficiency in energy amid increasing demand and a growing population of around 100 million people. However, the project has also been framed in undertones of national prestige. In political speeches, the plant has been likened to other moments celebrated and commemorated in the official national discourse.¹⁴ In addition to the absence of public input, many of these projects have been marked by a lack of transparency over tenders. The text and terms of the Egyptian-Russian agreement on the construction of Al Dabaa, for example, have not been made public. Aside from the Nuclear Power Plants Authority (NPPA), whose budget is subject to parliamentary oversight, Egypt's budget for nuclear affairs and institutions is also opaque. Indeed, immediately after the agreement, Egypt imposed a gag order on any news related to the power plant.¹⁵

Ghana

Ghana's emerging nuclear power programme is the culmination of nearly 60 years of socio-economic and political developments under successive governments since independence in 1957. Ghana's first president, Kwame Nkrumah (1957–1966), was an advocate of pan-Africanism and a founding member of the Organization of African Unity (now the AU).¹⁶ His quest to gain global recognition for Ghana and ensure the well-being of the country centred on securing access to energy for its people. He argued that Ghana's development and rapid industrialisation required access to sufficient, reliable and sustainable electrical power, ultimately initiating the Ghana Nuclear Power Programme (GNPP).

In 1961 Nkrumah's government instituted a major atomic policy initiative – the Kwabenya Nuclear Reactor Project – and set up the Ghana Atomic Energy Committee to oversee its implementation. The Kwabenya Nuclear Reactor Project was established to 'introduce nuclear science and technology into the country, and to exploit nuclear energy in its

14 Abdelrahman, "New Chairman of the Nuclear"; see also State Information Service, "Nuclear Project Abdelnasser's Dream", <https://www.sis.gov.eg/section/4683/4685?lang=en-us&lang=en-us>.

15 "NGOs Slam El-Dabaa Nuclear Power Plant Media Gag", *Daily News Egypt*, December 29, 2015, <https://www.dailynewssegypt.com/2015/12/29/ngos-slam-el-dabaa-nuclear-power-plant-media-gag/>.

16 African American Registry, "Kwame Nkrumah Fathered Pan-Africanism", <https://aaregistry.org/story/kwame-nkrumah-fathered-pan-africanism/>.

The Kwabenya Nuclear Reactor Project was established to ‘introduce nuclear science and technology into the country, and to exploit nuclear energy in its peaceful applications’

peaceful applications for the solution of problems of national development’.¹⁷ It aimed to develop infrastructure for the GNPP, and acquire nuclear technology to provide sufficient electricity for industrialisation.¹⁸ In 1963 the first nuclear legislation, the Atomic Energy Commission Act No. 204 of 1963, was enacted. This created the Ghana Atomic Energy Commission (GAEC) and the first operational institute under the commission: the National Nuclear Research Institute.¹⁹ The establishment of the GAEC in 1963 replaced the provisional 1961 Ghana Atomic Energy Committee. The mandate of the GAEC was, among others, to build a 2MW Soviet-type nuclear research reactor and advise the government on all matters relating to nuclear energy.

On 25 November 1964 Nkrumah delivered a seminal pro-nuclear speech at the laying of the foundation stone for the construction of the commission’s offices at Kwabenya.²⁰ By introducing nuclear policies, enacting the Atomic Energy Commission Act and constructing GAEC infrastructure, he set in motion a trajectory for the development of nuclear energy in Ghana. However, there was a midcourse halt when a military coup overthrew Nkrumah, and the pursuit of nuclear energy was abandoned in 1966.²¹ For almost 30 years afterwards (1966–1992) the GNPP lay dormant amid economic ruin and political uncertainty.²²

Ghana’s nuclear ambitions were revived during Jerry J Rawling’s second rule (1981–2001), against the background of increasing political stability and improved economic management. To expand the GAEC’s operational activities, the Atomic Energy Commission Act was amended in 1993 by the Provisional National Defence Council Law No. 308. This created two additional institutes under the commission: the Radiation Protection Institute (RPI) and the Biotechnology and Nuclear Agriculture Research Institute.²³ In 1994 Ghana purchased a 30kW tank-in-pool miniature neutron source reactor, known as the Ghana Research Reactor 1, from China with the help of the IAEA.²⁴ In a significant legislative move in 2000,

17 International Atomic Energy Agency, “Country Nuclear Profile: Ghana”, 2008, <https://www-pub.iaea.org/MTCD/Publications/PDF/cnpp2018/countryprofiles/Ghana/Ghana.htm>; Linda Asante Agyei, “Nkrumah Lays Foundation for Atomic Reactor ... in 1964”, MyJoy Online, 2020, <https://www.myjoyonline.com/opinion/nkrumah-lays-foundation-for-atomic-reactor-in-1964/>.

18 IAEA, “Country Nuclear Profile: Ghana”, 2008.

19 National Nuclear Research Institute, “About Us”, <https://nnri.gaecgh.org/about-us/>.

20 Agyei, “Nkrumah Lays Foundation”.

21 BJB Nyarko and Akaho I Ennison, “Nuclear Power for Future Electricity Generation in Ghana: Issues and Challenges” (IAEA, Vienna, 2009), https://www-pub.iaea.org/MTCD/Publications/PDF/P1500_CD_Web/htm/pdf/topic2/2S03_B.J.B.%20Nyarko.pdf.

22 IAEA, “Country Nuclear Profile: Ghana”, 2008.

23 Ghana Atomic Energy Commission, “About Us”, https://gaecgh.org/?page_id=30.

24 IAEA, *Research Reactors in Africa* (Vienna: IAEA, 2011), <https://www.iaea.org/sites/default/files/18/09/research-reactors-in-africa.pdf>.

Parliament enacted the new Ghana Atomic Energy Commission Act No. 588,²⁵ which superseded the Atomic Energy Commission Act.

The administrations of John Kufuor (2001–2009), John Atta Mills (2009–2012), John Dramani Mahama (2012–2017) and President Nana Akufo-Addo (2017–present) have built on the progress made under Rawlings, further contributing to policy development, legislation and regulation of the nuclear field. A noteworthy example of Ghana's nuclear progress was the establishment of the School of Nuclear and Allied Sciences in 2006, to train postgraduate students in nuclear science applications in agriculture and medicine.²⁶

Steady progress has continued since 2012, when Ghana's Nuclear Energy Programme Implementation Organisation (NEPIO) was established under the Mahama administration.²⁷ NEPIO has clear terms of reference that call for a comprehensive review of all the issues relevant to a decision on proceeding with a nuclear power programme. The Ghana Nuclear Power Programme Organisation (GNPPO) has been tasked with 'coordinat[ing] the activities of all stakeholder institutions involved in the planning of the nuclear power programme'.²⁸

Another important milestone was achieved in 2015, when the Nuclear Regulatory Authority Act No. 895 of 2015 was enacted.²⁹ The act established the Nuclear Regulatory Authority (NRA) of Ghana,³⁰ which replaced the RPI of the GAEC. The main functions of the NRA and its regulatory control programmes include, but are not limited to,³¹

review and evaluation of the notification by applicants of their intention to undertake activities involving radiation, authorisation of practices involving ionising and non-ionising radiation sources and devices, and inspection of nuclear installations against their records keeping, safety, safeguards and security measures.

The creation of the NRA, as an independent nuclear regulatory regime in Ghana, was an important step in ensuring a conducive environment for investment in nuclear power.

There is also progress on the technical front. In the last three years, under the Akufo-Addo administration, the IAEA's Integrated Nuclear Infrastructure Review (INIR) team has visited Ghana twice to review the ongoing development of the country's nuclear infrastructure. 'INIR missions enable IAEA Member State representatives to have in-depth discussions

25 Ghana Atomic Energy Commission, "History of Ghana Atomic Energy Commission", https://gaecgh.org/?page_id=4242.

26 Elizabeth Ama Agyeman and Albert Bilson, "Research Focus and Trends in Nuclear Science and Technology in Ghana: A Bibliometric Study Based on the INIS Database", *Library Philosophy and Practice* (February 27, 2015), <https://digitalcommons.unl.edu/libphilprac/1212/>.

27 IAEA, "Country Nuclear Profiles (2018 Edition): Ghana", (IAEA, Vienna, 2018), <https://www-pub.iaea.org/MTCD/Publications/PDF/cnpp2018/countryprofiles/Ghana/Ghana.htm>.

28 IAEA, "Country Nuclear Profile: Ghana", 2008.

29 "IAEA Offers Support to Ghana", *World Nuclear News*, March 21, 2016, <https://www.world-nuclear-news.org/Articles/IAEA-offers-support-to-Ghana>.

30 "IAEA Offers Support to Ghana".

31 Government of Ghana, "Nuclear Regulatory Authority Bill", 2015, 5, https://inis.iaea.org/collection/NCLCollectionStore/_Public/47/076/47076480.pdf?r=1.

with international experts about experiences and best practices in nuclear power infrastructure development.³² The missions were beneficial in evaluating readiness for the construction of the first nuclear power plant in Ghana.

The Phase 1 INIR mission was conducted from 16–23 January 2017.³³ In mid-2019 Akufo-Addo's cabinet 'approved the setting up of an organisation that will oversee the construction and operation of Ghana's first nuclear power plant'.³⁴ The INIR team conducted a follow-up Phase 1 mission from 21–24 October 2019. The follow-up mission assessed the progress made since the 2017 visit and helped the Ghanaian host team to prioritise further activities under Phase 1.³⁵

By December 2019 the GNPPO had compiled most of the Phase 1 studies but had yet to submit the comprehensive progress report to the cabinet for review. The report is required for the government to make an informed decision on the development of a nuclear power programme. A favourable policy decision will usher in Phase 2 activities, which include 'preparatory work for the contracting and construction of a nuclear power plant'.³⁶

South Africa

The origins of South Africa's atomic interests can be traced to 13 August 1944. During the Second World War Britain requested the country's assistance in securing uranium for the Manhattan Project. Shortly after the war South Africa established two domestic bodies: the Uranium Research Committee (1946) and the Atomic Energy Board (1948). At the global level, it became involved in the establishment of the IAEA in 1957. In 1961 South Africa began to construct the National Nuclear Research Centre and research reactor.³⁷ In 1965 prime minister Hendrik Verwoerd inaugurated the country's first nuclear research reactor, SAFARI-1. However, when the NPT opened for signature in 1968, South Africa, which had participated in the negotiations thereof, did not ratify it. In fact, as discussed later in this report, South Africa only ratified it decades later, in 1991.

South Africa's nuclear programme was officially aimed at peaceful uses until 1977, when the emphasis officially changed to developing a strategic deterrent capability. However, South Africa had actually been preparing a nuclear test facility in the Kalahari Desert since 1975. These developments were detected by a Soviet satellite in August 1977, causing an international outcry. By April 1978, when prime minister John Vorster approved a three-

32 IAEA, "Integrated Nuclear Infrastructure Review (INIR)", <https://www.iaea.org/services/review-missions/integrated-nuclear-infrastructure-review-inir>.

33 IAEA, "INIR 1 Mission to Ghana", 2017, <https://www.iaea.org/node/37949>.

34 "Ghana Vice President Confirms Nuclear Commitment", *World Nuclear News*, August 2, 2019, <https://www.world-nuclear-news.org/Articles/Vice-President-confirms-Ghana-nuclear-commitment>.

35 Elisabeth Dyck, "IAEA Reviews Progress of Ghana's Nuclear Infrastructure Development", IAEA, October 24, 2019, <https://www.iaea.org/newscenter/news/iaea-reviews-progress-of-ghanas-nuclear-infrastructure-development>.

36 IAEA, "Milestones Approach", <https://www.iaea.org/topics/infrastructure-development/milestones-approach>.

37 Nuclear Energy Corporation of South Africa, 2018 *Integrated Annual Report* (Peliindaba: NECSA, 2018), 4, <http://www.NECSA.co.za/wp-content/uploads/2019/02/NECSA-Annual-Report-2018.pdf>.

phased deterrent strategy amid growing international isolation, the country still denied the existence of a nuclear weapons programme. Despite these denials, the international community was alerted to South Africa's nuclear ambitions when, on 22 September 1979, the so-called Vela or Double Flash Incident occurred in the South Atlantic, implicating South Africa in conducting a nuclear test. The Vela Incident was confirmed as a joint South African-Israeli nuclear test decades later.³⁸

South Africa's nuclear programme was officially aimed at peaceful uses until 1977, when the emphasis officially changed to developing a strategic deterrent capability

South Africa's nuclear ambitions escalated as it faced increasing opposition during the so-called Border War (1966–1991), with its deterrent strategy underpinned by the completion of the country's first nuclear device in 1978. Eventually, South Africa produced six nuclear devices during the duration of the programme, which was launched during the tenure of Vorster in 1978 and terminated by FW de Klerk in 1989.

The nuclear programme was cancelled owing to several factors. Towards the late 1980s South Africa's international isolation and the rising human and financial cost of the Border War became untenable. In the mid-1980s the South African government had begun to engage with the incarcerated Nelson Mandela. However, the Botha government was reluctant to introduce further reforms and continued its hard-line position in the face of international and domestic opposition. De Klerk succeeded PW Botha, who had suffered a stroke in January 1989, assuming office in August 1989. Barely a month into his tenure, De Klerk appointed a committee to oversee the dismantling of the nuclear weapons programme. In addition, he accelerated talks with the African National Congress (ANC), which in February 1990 culminated in Mandela's release and the unbanning of the country's liberation movements. Talks about South Africa's future constitutional

Only in March 1993, one year before South Africa's first democratic elections and once the IAEA verification process was completed, did De Klerk admit the extent of the country's nuclear capabilities

38 "Declassified Documents Indicate Israel and South Africa Conducted Nuclear Test in 1979", *Ynetnews*, August 12, 2016, <https://www.ynetnews.com/articles/0,7340,L-4890545,00.html>.

dispensation began, while South Africa engaged the IAEA on accession to the NPT (1991) and the signing of a Safeguards Agreement. Only in March 1993, one year before South Africa's first democratic elections and once the IAEA verification process was completed, did De Klerk admit the extent of the country's nuclear capabilities.

In 1993 South Africa embarked on the Pebble Bed Modular Reactor (PBMR) to meet its future energy demands. It soon became apparent that the project was not suitable for this purpose, owing to the expense and political considerations. When the ANC assumed power in 1994 it inherited a country free of nuclear weapons, although one that operated a nuclear power station, the Koeberg Nuclear Power Station. At the time South Africa was one of a few African states with a nuclear research reactor, and the continent's most advanced in terms of nuclear energy and technology. A quarter of a century later, this has not changed. During President Mandela's tenure, however, the country's nuclear landscape began to change as new normative frameworks were operationalised through legislation and institutions. Mandela's successors continued this trajectory, which signalled a major departure from the apartheid nuclear weapons state towards nuclear governance aligned with international norms and practices.

By 2000 the PBMR project was once again underway. However, by 2006 it was clear that the PBMR project was unlikely to meet the country's energy needs in the near future. Thus, in 2006 president Thabo Mbeki's administration decided to complement the PBMR programme with post-apartheid South Africa's first major nuclear expansion plan – the construction of a conventional nuclear power plant similar to Koeberg (ie, a pressurised water reactor).

In 2007 Eskom approved proposals to double the country's nuclear power generation to 80GWe by 2025. This approach would increase the contribution of nuclear energy to the country's power pool from 5% to 25%.³⁹ Nuclear-1, as this expansion plan was known, envisaged a much larger programme than the 2006 plans, proposing a total of five nuclear sites and an intention to begin their construction in 2016. However, by the end of 2007 two significant events had occurred. First, the early stages of the country's largest-ever energy crisis and power cuts unfolded. The scale of the energy crisis underlined the need for urgency and clarity on the country's nuclear future and culminated in the release of its nuclear policy. This in turn spurred the promulgation of the Nuclear Energy Act that, among others, established key nuclear governance institutions (discussed later in this report). Second, Mbeki lost the presidential race of the ANC to Jacob Zuma in December 2007. The ANC subsequently 'recalled' Mbeki as the country's president in September 2008 and he was briefly succeeded by interim president Kgalema Motlanthe.

Motlanthe's tenure ended with the 2009 South African elections that brought Mbeki's nemesis, Zuma, to power. His first term in office saw several significant nuclear-related

39 "Eskom's Nuclear Plan Hit by Crises", *World Nuclear News*, September 25, 2008, <https://www.world-nuclear-news.org/Articles/Eskom-s-nuclear-plan-hit-by-crises>.

decisions. In 2011 Zuma's cabinet approved the Integrated Resource Plan (IRP), which adapted the country's energy mix to include a share of 13.4% (compared to the current 5% and the previously envisaged 25%) nuclear energy by 2030, effectively adding 9MWe additional nuclear energy generation capacity.⁴⁰

During his state of the nation addresses (SONAs) of 2014, 2015 and 2016, Zuma explicitly referred to his government's nuclear expansion agenda. The South African government's intention to proceed with its nuclear expansion plans attracted significant international interest in the lucrative contracts that would emerge from this. Soon after SONA 2014, South Africa's nuclear suitors lined up and signed several bilateral agreements with the country. An agreement with ROSATOM, which was expected to contribute \$10 billion to South Africa's expansion plans, was followed by an agreement with France in October 2014. The country also signed four agreements with China in November and December 2014, and another one in February 2015. During 2015 agreements with the US, South Korea and Japan followed.

Reports of widespread government corruption and Zuma's involvement were confirmed in a damning report by public protector Thuli Madonsela in October 2016.⁴¹ Zuma continued with impunity. In November 2016 the Department of Energy issued its updated IRP, which now increased the nuclear contribution to the country's energy mix to 30% by 2050.⁴² However, in December 2016 Treasury, realising the enormous cost of the expansion plans, withdrew its authorisation for the RFI and significantly toned down its non-binding request for information from vendors.⁴³

Zuma's nuclear ambitions suffered their biggest setback in April 2017, when the Western Cape High Court ruled that the government had not complied with constitutional provisions when it signed the nuclear agreements with Russia, the US and South Korea. This followed a case brought by Earthlife Africa (ELA) and the Southern African Faith Communities' Environment Institute (SAFCEI) against the nuclear build programme.⁴⁴ The ruling also set aside the approvals by the National Energy Regulator of South Africa of two ministerial determinations of November 2013 and December 2016 on the procurement of 9.6GWe nuclear energy, as well as Eskom's RFI issued in December 2016.⁴⁵

In the meantime, the country's energy crisis continued. This resulted in the government's signing agreements with several independent power producers, but not shelving its nuclear expansion plans. Following the Final Environmental Impact Report for the siting

40 Anthonie Cilliers, "Update: History of Nuclear in South Africa", *ESI Africa*, February 18, 2019, <https://www.esi-africa.com/features-analysis/update-history-of-nuclear-in-south-africa/>.

41 Public Protector of South Africa, "State of Capture: Report No. 6 of 2016/17", *Mail & Guardian*, November 2, 2016, <https://mg.co.za/article/2016-11-02-breaking-read-the-full-state-capture-report/>.

42 Cilliers, "Update: History of Nuclear".

43 Cilliers, "Update: History of Nuclear".

44 *Earthlife Africa (ELA) and the Southern African Faith Communities' Environment Institute (SAFCEI) v Minister of Energy and Others*, High Court of South Africa (Western Cape Division), Judgement, Case No. 19529/2016, 26 April 2017, <https://www.groundup.org.za/media/uploads/documents/EarthlifeAfricaJhbnMinisterOfEnergy.pdf>.

45 *ELA and SAFCEI vs Minister of Energy and Others*.

of the nuclear power stations, the Minister of Environment, on 18 October 2017, granted environmental authorisation for the construction and operation of a new nuclear power plant at Duynefontein, close to Koeberg. Opposition to Zuma's corruption in the ANC resulted in his resignation on 14 February 2018. Besides the devastating financial legacy of the state capture during his tenure, another outcome was the termination of South Africa's nuclear expansion plans owing to financial considerations. Zuma's successor, Cyril Ramaphosa, inherited a bankrupt Eskom and financially stressed fiscus.

Existing installations

Egypt

Egypt's nuclear power plant is under construction. In terms of the country's broader nuclear programme, the Egypt Atomic Energy Agency has four research centres. These are the Nuclear Research Centre (NRC); the Hot Laboratories and Waste Management Centre (HLWMC); the National Centre for Radiation Research and Technology; and the National Centre for Nuclear Safety and Radiation Control. The NRC and HLWMC are housed at Inshas in the Western Delta, while the other two research centres are located in Nasr City, a district in Cairo.⁴⁶

Ghana

Like Egypt, Ghana does not have a nuclear power plant yet, and no construction has even started. However, the country does have nuclear energy equipment, facilities and laboratories not related to power generation. The major ones are the Ghana Research Reactor-1 Facility, Multi-Purpose Gamma Irradiation Facility, external beam radiotherapy centres, brachytherapy equipment, detection instruments for nuclear security application, and radiological imaging centres. These facilities focus on a wide range of activities, including research, training, teaching, treatment of cancer patients, sterilisation of medical products, preservation of food products by means of irradiation, control of harmful insects,⁴⁷ CT scans, and detection of terrorist threat materials in transportation.

South Africa

South Africa is the most advanced African country in terms of nuclear energy and technology, with the continent's first and only nuclear power plant, Koeberg, and the SAFARI-1 research reactor. However, both are legacies of the previous apartheid regime and are now reaching their end-of-life cycle. This means that they need urgent investment to extend their lifespan, as well as additional investment to meet the broader energy demands of the country.

Koeberg was built following an agreement between South Africa and France in 1976. It consists of two reactors with a total capacity of 1 860MW. The reactors have been

⁴⁶ Mark Fitzpatrick, "Nuclear Capabilities in the Middle East", in *WMD Arms Control in the Middle East: Prospects, Obstacles and Options*, ed. Harald Muller (London: Routledge, 2015), 114.

⁴⁷ Hans Blix, "Inauguration of Ghana Research Reactor 1", IAEA, March 8, 1995, <https://www.iaea.org/newscenter/statements/inauguration-ghana-research-reactor-1>.

operational since April 1984 (Koeberg 1) and July 1985 (Koeberg 2) – later than originally scheduled owing to the ANC’s bombing of Koeberg on 18 December 1982.⁴⁸ Koeberg supplies approximately 6% of South Africa’s electricity demand.⁴⁹ Its reactors will reach their 40-year end-of-life design in 2024. According to the Integrated Resource Plan (IRP 2019), moves are afoot to extend Koeberg’s design life and nuclear safety licence for another 20 years, to 2044.⁵⁰ This means that the two nuclear reactors’ lifespan will effectively total 60 years each. According to the South African government, this extension ‘is critical for continued energy security’.⁵¹

South Africa is the most advanced African country in terms of nuclear energy and technology, with the continent’s first and only nuclear power plant, Koeberg, and the SAFARI-1 research reactor

SAFARI-1, a 20MW research reactor, is another key installation. It was inaugurated in 1965 and, like the ageing Koeberg 1 and Koeberg 2 reactors, is also being pushed beyond its original life cycle. The South African government has established a ministerial task team to investigate the acquisition of a new multi-purpose reactor to replace SAFARI-1 by 2030.⁵² The fact that it is owned and operated by the South African Nuclear Energy Corporation (NECSA) adds to concerns. NECSA was established as a public company under the 1999 Nuclear Energy Act and is completely state-owned. Its main functions are to conduct and promote research and development in the field of nuclear energy and radiation sciences and technology, and to process source material, special nuclear material and restricted material.⁵³ However, since 2016 NECSA has been experiencing operational, financial and governance challenges, and is ‘technically bankrupt’.⁵⁴ Lapses in safety procedures resulted in the National Nuclear Regulator’s shutdown of NECSA’s NTP Radioisotope plant, one of the world’s largest commercial producers of the medical isotope Molybdenum-99, in November 2017. South Africa’s auditor-general has also raised concerns about the inadequate financial provisions for the decommissioning and dismantling of SAFARI-1.

48 Jo-Ansie van Wyk, “Nuclear Terrorism in Africa: The ANC’s Operation Mac and the Attack on the Koeberg Nuclear Power Station in South Africa”, *Historia* 60, no. 2 (2015): 51–67.

49 Department of Minerals and Energy, *Nuclear Energy Policy for the Republic of South Africa* (Pretoria: DME, June 2008), 13, http://www.energy.gov.za/files/policies/policy_nuclear_energy_2008.pdf.

50 DME, “Integrated Resource Plan (IRP 2019)”, *Government Gazette* 652, no. 42784 (October 18, 2019), 17, 21, 40, 52, 57, <http://pmg-assets.s3-website-eu-west-1.amazonaws.com/191018IRP2019.pdf>.

51 Department of Mineral Resources and Energy, *Annual Performance Plan 2020/21* (Pretoria: DMRE, 2020), 20, http://pmg-assets.s3-website-eu-west-1.amazonaws.com/DMRE_APP_2020-21_V_9_2.pdf.

52 DMRE, *Annual Performance Plan 2020/21*, 5.

53 DME, *Nuclear Energy Policy*, 13.

54 “Pulane Kingston (Chair of NECSA Board) Letter to Sahlulele Luzipo, Chair of Portfolio Committee on Mineral Resources and Energy”, *Moneyweb*, October 17, 2019, <https://www.moneyweb.co.za/wp-content/uploads/2019/11/NECSA-Board-Update-17-October-20191.pdf>.

It is also worth mentioning two smaller installations – iThemba Laboratory for Accelerator Based Sciences (iThemba LABS) and the Vaalputs Radioactive Waste Disposal Facility. The former operates the only cyclotron facilities in Africa and is the largest accelerator facility in the southern hemisphere. iThemba’s accelerators are used to accelerate charged particles for basic nuclear physics research, radioisotope production, radiobiology research related to particle therapy, and applications such as radiation hardness testing of electronic components used in satellites and detector calibrations.⁵⁵ As a research facility, iThemba LABS has established a wide network of international scientific collaborations with international research laboratories. Vaalputs is a national repository for low- and intermediate-level nuclear waste. It was commissioned in 1986 for waste from Koeberg and is financed through fees paid by Eskom. In 2008 Vaalputs became the National Radioactive Waste Disposal facility and continued to be managed by NECSA until 2014, when the National Radioactive Waste Disposal Institute (NRWDI) was established in terms of the National Radioactive Waste Disposal Act No. 53 of 2008.

55 iThemba LABS, “About iThemba”, <https://tlabs.ac.za/about/>.

Governance frameworks

Egypt

The decision to review Egypt's nuclear legal framework was made in 2007, when the Mubarak administration was taking the first steps to acquire nuclear energy. The objective was to bring the Egyptian regulatory framework for nuclear facilities in line with international safety standards and protect individuals, society and the environment. Apart from that, the legislation needed to fulfil Egypt's obligations to those treaties and conventions it had signed.

Egypt subsequently promulgated the Law on Activities in the Nuclear and Radiation Field in 2010. It was drafted with input from the IAEA and stipulates that the activities of all nuclear and radiation facilities in the country are strictly for peaceful purposes. The law seeks to govern comprehensively all elements of nuclear activity and security, and contains provisions that deal with plant licensing, radiation protection, safety and security, radioactive waste management, spent fuel management, civil liability in case of nuclear damages, transport of radioactive material, emergency responses to disasters, and import and export controls.⁵⁶ In addition, it created a new regulatory body, the Egyptian Nuclear and Radiological Regulatory Authority (ENRRA), tasked with monitoring all nuclear and radiation facilities, activities and practices. This body is technically independent from the government, as it does not fall under one specific ministry, and reports directly to the prime minister.⁵⁷ The ENRRA was involved with the site evaluation of Al Dabaa. Within the ENRRA, the law also establishes a nuclear security system that defines anticipated threats, reviews and evaluates the performance of nuclear security systems, and monitors trafficking of nuclear or radioactive material, etc.⁵⁸ The ENRRA has also established a training and technical support centre for employees working on nuclear and radiation security.

The rest of Egypt's regulatory and governing bodies pertaining to atomic energy all fall under the authority of the Ministry of Electricity and Renewable Energy (MoEE), which itself falls under the oversight of the prime minister. There are three key nuclear-related authorities under the MoEE: the Egyptian Nuclear Materials Authority (ENMA), Egypt Atomic Energy Agency (EAEA) and NPPA. Within these three main bodies, there are smaller cooperating agencies as well, such as the research clusters operating under the EAEA.

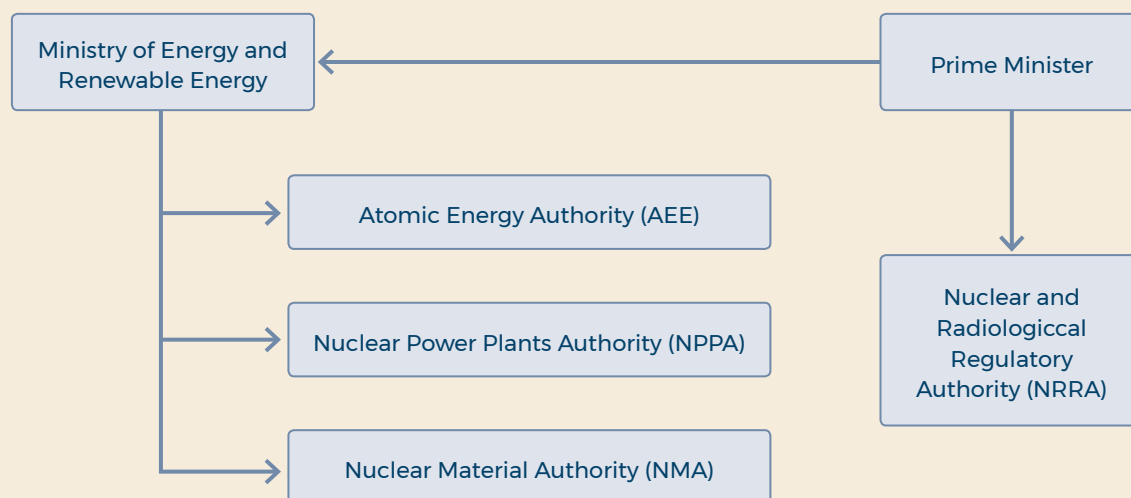
56 Nuclear Energy Agency, *Nuclear Law Bulletin*, no. 85 (2010/1): 103, <https://www.oecd-neo.org/law/nlb/nlb85.pdf#page=101>.

57 IAEA, "Country Profiles: Egypt", 2015, <https://cnpp.iaea.org/countryprofiles/Egypt/Egypt.htm>.

58 Nuclear Security Summit, "National Progress Report: Egypt", March 31, 2016, <http://www.nss2016.org/document-center-docs/2016/3/31/national-progress-report-egypt>.

Established in 1955 as the Atomic Energy Commission, the EAEA is the oldest of these bodies. The EAEA has widespread outreach activities, such as producing a monthly magazine, *Al-Taqa Al-Zariya* (Atomic Energy), and convening a training programme for interested scientists.⁵⁹ The ENMA was initially a department within the EAEA – the Geological and Nuclear Raw Materials Department. However, in 1977 it was transformed into a separate body that oversees the prospection, exploration and evaluation of raw nuclear materials. Its activities, according to an IAEA paper written by the head of the department, have included ‘training of exploration teams, conduct[ion] of airborne, ground follow up and preliminary geological mapping as well as execution of limited exploration drilling’.⁶⁰ Finally, the NPPA was established in 1976 as the sole entity responsible for managing the construction and operation of Egypt’s nuclear power plants. It is the main body currently overseeing the establishment of the Al Dabaa power plant. For the fiscal year 2019–2020, the NPPA’s budget was EGP⁶¹ 6.2 billion (\$395 million). It is headed by Amgad al-Wakil, who was previously affiliated with the Military Technical College in Cairo.⁶² The ENRRA, as a separate body with technical competence and legal authority, has been designed to support and review the work of these three entities, and is able to issue new regulations in line with its mandate (see Figure 1).

Figure 1 Organisational chart



Source: International Atomic Energy Agency, “Country Profiles: Egypt”, 2015, <https://www-pub.iaea.org/MTCD/Publications/PDF/cnpp2018/countryprofiles/Egypt/Egypt.htm>

59 Egyptian Atomic Energy Authority, “Training”, <https://eaea.org.eg/training/>; EAEA, “Al-Taqa Al-Zariya” (Atomic Energy), December 2019, <https://eaea.org.eg/wp-content/uploads/2019/12/inside.pdf>.

60 Nagdy Farag, “Uranium Exploration in Egypt: Past, Current, and Future Activities” (IAEA-CN-216, Abstract 091, IAEA, Vienna, 2014), https://inis.iaea.org/collection/NCLCollectionStore/_Public/48/039/48039488.pdf.

61 Currency code for the Egyptian pound.

62 “Parliament Committee Sets Draft Budget for NPPA at LE 6.2bnm”, *Egypt Independent*, May 14, 2019, <https://egyptindependent.com/parliament-committee-sets-draft-budget-of-nppa-at-le6-2-bnm/>.

The Egyptian Parliament continued revising and expanding the legal framework after the nuclear deal with Russia. In addition, in 2017 it approved the creation of regulatory bodies on nuclear power in support of the deal.⁶³ The first, the Executive Authority for the Supervision of Nuclear Stations for Electricity Generation, affiliated with the Ministry of Electricity, provides technical supervision of electricity-producing nuclear stations. It assesses the performance of contractors hired to build nuclear stations and issues progress and annual reports, alongside other monitoring roles. A second body was established to conduct research on the establishment of such electricity-generating nuclear stations.⁶⁴ The IAEA has continued to help Egypt with the development of a legal and regulatory framework for the introduction of nuclear power.⁶⁵

The IAEA has continued to help Egypt with the development of a legal and regulatory framework for the introduction of nuclear power

Ghana

Effective nuclear governance is crucial to public confidence in a nuclear build programme,⁶⁶ and Ghana is no exception to this rule. To comply with its obligations under international instruments, successive governments have formulated national nuclear policies, enacted legislation and established committees and entities to ensure the safe, secure and peaceful use of nuclear power in the country since 1961. These policies and legislation cover the core issues of ensuring nuclear safety and security, preventing nuclear proliferation and dealing responsibly with the environmental legacy of nuclear power.

Ghana's nuclear legislation is also not static. For instance, the 2015 Nuclear Regulatory Act made provision for consequential amendments to some of the existing laws. Ghana has already assessed and identified the national legislation requiring amendment to ensure consistency with the Nuclear Regulatory Act when developing a national nuclear infrastructure. The Nuclear Regulatory Authority (NRA) of Ghana is expected to develop draft regulation on all aspects of the use of nuclear materials and the operation of nuclear power plants in the country. By the end of 2019 the NRA was developing regulations

63 Gamal Essam El-Din, "Egypt Parliament to Vote in Plenary Session on Three Laws Related to Nuclear Activities", *Al Ahram*, November 26, 2017, <http://english.ahram.org.eg/NewsContent/1/64/282258/Egypt/Politics-/Egypt-parliament-to-vote-in-plenary-session-on-thr.aspx>.

64 Gamal Essam El-Din, "Egypt's Parliament Approves Laws Creating Nuclear Power Regulatory Bodies", *Al Ahram*, November 27, 2017, <http://english.ahram.org.eg/NewsContent/1/64/282327/Egypt/Politics-/Egypts-parliament-approves-laws-creating-nuclear-p.aspx>.

65 Elisabeth Dyck, "IAEA's INIR Service Looks Ahead to 2020 After Year's Final Mission to Egypt", IAEA News Center, November 7, 2019, <https://www.iaea.org/newscenter/news/iaeas-inir-service-looks-ahead-to-2020-after-years-final-mission-to-egypt>.

66 Partnership for Nuclear Security, "Strengthening Nuclear Governance", <https://partnershipforglobalsecurity.org/strengthening-nuclear-governance/>.

and guidelines to ensure the implementation of the provisions of the NRA Act. As of December 2019, draft regulations on radioactive waste management, basic radiation control, safeguards, siting, requirements for technical services and regulation of the security of radioactive sources were undergoing review. At the same time, Ghana was also developing national safety requirements, regulations and associated guidelines on, among others, nuclear safeguards, licensing of nuclear installations, nuclear security regulation, emergency preparedness of nuclear installations, and a decommissioning plan for nuclear installations.⁶⁷

Going forward, the country hopes to draft the following regulations and guidelines between 2020 and 2023:⁶⁸

- Nuclear Liability and Civil Damage Fees and Charges Integrated Management System for Facilities (2020);
- Commissioning of Nuclear Installations Operation of Nuclear Installations (2021);
- Decommissioning of Nuclear Installations and Mining of Radioactive Materials (2022); and
- Nuclear Power Generation in Ghana (2023).

Various structures are responsible for nuclear governance in Ghana. Involving a wide range of interested parties in decision-making in Ghana's nuclear power programme has helped to enhance public awareness, understanding and confidence. Table 1 lists the main stakeholders and their functions.

TABLE 1 MAIN NUCLEAR POWER PROGRAMME STAKEHOLDERS AND THEIR FUNCTIONS IN GHANA	
Entity	Function
Nuclear Power Ghana	<ul style="list-style-type: none"> • Acting as owner-operator of planned NPP
Ministry of Energy	<ul style="list-style-type: none"> • Formulating, implementing and monitoring energy policies • Liaising with other agencies on matters relating to power • Supervising state-owned power utilities to ensure adequate, reliable and cost-effective service provision
Ministry of Environment Science and Technology	<ul style="list-style-type: none"> • Providing leadership and guidance on the environment, science and technology within the broad sector of the economy through policy formulation and implementation • Ensuring the establishment of the regulatory framework and setting standards to govern the activities of science and technology and the management of the environment for sustainable development • Ensuring the coordination, supervision, monitoring and evaluation of activities related to the environment, science and technology, while fulfilling national benefit-sharing commitments

67 Ghana Nuclear Regulatory Authority, *National Report Presented by the Republic of Ghana on Compliance with the Convention on Nuclear Safety Obligations* (Accra: GNRA, 2020), https://gnra.org.gh/images/Download/report/Final_CNS_Report_Prof.pdf.

68 RG Abrefah, "Regulatory Infrastructure for Nuclear Power Programme In Ghana", GNRA, 2020, https://agighana.org/uploaded_files/document/c9971219bfc94016763c2e1899faa70d.pdf.

Ministry of Finance and Economic Planning	<ul style="list-style-type: none"> • Formulating and implementing sound fiscal and financial policies • Ensuring effective mobilisation and efficient allocation of resources • Improving public financial management
Ghana Atomic Energy Commission	<ul style="list-style-type: none"> • Advising government on matters relating to nuclear energy, science and technology • Drafting governmental proposals for legislation in the field of nuclear radiation and radioactive waste management • Collaborating with universities and research institutes on conducting research into matters connected with peaceful uses of nuclear energy and technology
Energy Commission	<ul style="list-style-type: none"> • Advising Minister of Energy on national energy policies • Ensuring indicative energy planning at the national level • Providing licensing and technical regulation of the activities of all electricity sector operators
Public Utilities and Regulatory Commission	<ul style="list-style-type: none"> • Providing guidelines for rates to be charged by public utilities • Monitoring standards of performance for the provision of utility services • Protecting the interests of both consumers and providers of utility services • Promoting fair competition
National Development Planning Commission	<ul style="list-style-type: none"> • Undertaking studies and making recommendations on development and socio-economic issues • Formulating comprehensive national development planning strategies and ensuring that the strategies, including consequential policies and programmes, are effectively carried out • Preparing broad national development plans
Ghana Grid Company	<ul style="list-style-type: none"> • Undertaking economic dispatch and transmission of electricity from wholesale suppliers (generating companies) to bulk customers • Providing fair and non-discriminatory transmission services to all power market participants • Carrying out planning and implementation as necessary for transmission system investments to reliably transmit electric energy and manage the wholesale power market
Environmental Protection Agency	<ul style="list-style-type: none"> • Creating awareness in the mainstream environment of the development process at the national, regional, district and community levels • Ensuring that the implementation of environmental policy and planning is integrated and consistent with the country's desire for effective, long-term maintenance of environmental quality • Ensuring environmentally sound and efficient use of both renewable and non-renewable resources for national development
Universities and Polytechnics	<ul style="list-style-type: none"> • Conducting research and training to support human resource development
Ghana Nuclear Regulatory Authority	<ul style="list-style-type: none"> • Licensing nuclear power plants and nuclear facilities • Performing regulatory activities • Providing training and organising personnel, according to the Nuclear Regulatory Act
National Disaster Management Organisation	<ul style="list-style-type: none"> • Preparing for and responding to nuclear and radiological emergencies
Ghana Nuclear Power Programme Organisation (GNPPO)	<ul style="list-style-type: none"> • Coordinating the activities of all stakeholder institutions involved in the planning and implementation of Ghana's nuclear power programme

Geological Survey Department	• Providing technical support for the implementation of the nuclear power programme, especially in determining appropriate sites
Hydrological Services Department	• Providing technical support for the implementation of the nuclear power programme, especially in determining appropriate sites
Water Resources Commission	• Providing technical support for the implementation of the nuclear power programme, especially in determining appropriate sites

Source: Compiled by author

South Africa

While the origins of South Africa's nuclear programme can be traced to 1944, its nuclear governance architecture and institutions came into being in 1948, when the Atomic Energy Board (AEB) was established in terms of the Atomic Energy Act. Somewhat later, in 1963, the Nuclear Installations Act came into force, providing for the licensing of nuclear installations by the AEB. The Uranium Enrichment Act followed in 1970 and the Uranium Enrichment Corporation was established. The Uranium Enrichment Act provided for the enrichment of uranium by a state-owned corporation separate from the AEB and subject to licensing by the latter. In 1982 the Nuclear Energy Act was legislated. The Atomic Energy Corporation (AEC), which succeeded the AEB, was established in terms of the Nuclear Energy Act. The AEC became responsible for all nuclear matters in South Africa, including uranium enrichment. In 1988 there was a significant amendment to the Nuclear Energy Act – the Nuclear Energy Amendment Act – that created the autonomous Council for Nuclear Safety, responsible for nuclear licensing and separate from the AEC.⁶⁹ In 1993, as the country was negotiating its democratic constitution, the Nuclear Energy Act was replaced by the Nuclear Energy Act No. 131 of 1993. This secured the autonomy of the Council for Nuclear Safety and provided for the implementation of a safeguards agreement with the IAEA pursuant to the requirements of the NPT, which South Africa had acceded to in June 1991.

It is important to note the secretive nature of South Africa's nuclear weapons programme and securitisation of the apartheid state. As a result, the country's nuclear policy framework was predominantly directed at a military and nuclear weapons programme outside international oversight. Post-1994 South Africa signed, ratified and committed to numerous treaties and agreements. It also focused on domesticating these obligations through the adoption of relevant national legislation and policy.

Presently, the South African government's policies on nuclear non-proliferation, arms control and disarmament practices are informed by various acts of Parliament. These acts represent a complete overhaul of South Africa's nuclear energy governance architecture. By 2020 some of this legislation had been amended several times, reflecting new global developments and South Africa's commitment to them. This included the Nuclear Energy Act No. 46 of 1999; National Nuclear Regulator Act No. 47 of 1999; National Conventional

69 IAEA, "Country Nuclear Power Profiles: South Africa", 2018, <https://cnpp.iaea.org/countryprofiles/SouthAfrica/SouthAfrica.htm>.

Presently, the South African government's policies on nuclear non-proliferation, arms control and disarmament practices are informed by various acts of Parliament

Arms Control Act No. 41 of 2002; Non-Proliferation of Weapons of Mass Destruction Act No. 87 of 1993 (amended in 1995, 1996 and 2005); and National Radioactive Waste Disposal Institute Act No. 53 of 2008. The nuclear sector in South Africa is also governed by at least 27 other related acts, including apartheid-era legislation that, ironically, remains relevant today. These include the Customs and Excise Act No. 91 of 1964; Hazardous Substances Act No. 15 of 1973; Dumping at Sea Control Act No. 73 of 1980 (amended in 1995); National Environmental Management Act No. 107 of 1998; Defence Act No. 42 of 2002; Explosives Act No. 15 of 2003; and Prohibition of Certain Conventional Weapons Act 18 of 2008.⁷⁰

The country's impressive legislation, which covers every aspect of nuclear energy regulation, is a strong indicator that the nuclear sector is subject to comprehensive oversight by the state. It also makes the state the final guarantor of the country's nuclear safety and security in compliance with international law.

As in the above sections on Egypt and Ghana, it is useful to discuss the entities responsible for nuclear governance in South Africa. In May 2009, following the national elections that had brought Zuma to power, the Department of Minerals and Energy was divided into two new departments, namely the Department of Energy and the Department of Mineral Resources. A reversal occurred following the national elections of 2019, when Ramaphosa came to power, with the departments of Energy and Mineral Resources once again amalgamated into one single department, the Department of Mineral Resources and Energy (DMRE). The DMRE plays the most important role in nuclear governance in South Africa. In fact, its stated purpose is to 'manage the South African nuclear energy industry and control nuclear material in terms of [its] international obligations, nuclear legislation and policies to ensure the peaceful use of nuclear energy'.⁷¹ Its other key functions include overseeing the management and implementation of all matters relating to nuclear safety and technology, as required by legislation and international agreements, in South Africa; and implementing South Africa's Nuclear Energy Policy in terms of the country's IRP.⁷² The DMRE also administers the country's nuclear safety, liability and emergency management,

70 South African Council for the Non-Proliferation of Weapons of Mass Destruction, *The Twenty-Fourth Annual Report of the South African Council for the Non-Proliferation of Weapons of Mass Destruction. Report Period: 1 April 2017 – 31 March 2018* (Cape Town: NPC, 2019), 24, http://pmg-assets.s3-website-eu-west-1.amazonaws.com/2017-2018_Annual_Report_of_the_Non-Proliferation_Council_2.pdf; Department of Energy, "Nuclear Energy: Core Function", http://www.energy.gov.za/Nuclear/nuclear_core.html.

71 Parliamentary Monitoring Group, "Department of Mineral Resources and Energy Strategic Plan and the 2020-2021 Annual Performance Plan" (Presentation to the Portfolio Committee on Mineral Resources and Energy, Cape Town, May 7, 2020), <https://pmg.org.za/committee-meeting/30156/>.

72 PMG, "Department of Mineral Resources".

and manages and implements its nuclear non-proliferation and radiation security commitments in terms of national legislation and international agreements.⁷³ Finally, the DMRE, in fulfilling South Africa's nuclear governance obligations, oversees relevant nuclear energy-related state-owned entities. Table 2 lists these entities, as well as their functions and legislation under which they became operational.

TABLE 2 DEPARTMENT OF MINERAL RESOURCES AND ENERGY ENTITIES		
Entity	Legislation	Function
National Nuclear Regulator	National Nuclear Regulator Act No. 47 of 1999	<ul style="list-style-type: none"> • Protect persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices
National Radioactive Waste Disposal Institute (NRWDI)	National Radioactive Waste Disposal Institute Act No. 53 of 2008	<ul style="list-style-type: none"> • Long-term management and disposal of radioactive waste in a technically sound, socially acceptable, environmentally responsible and economically feasible manner
South African National Energy Development Institute	National Energy Act No. 34 of 2008	<ul style="list-style-type: none"> • Direct, monitor and conduct applied energy research and development, demonstration and deployment, as well as undertake specific measures to promote energy efficiency (EE) throughout the economy • Establish a nationally focused energy research, development and innovation sector and undertake EE measures with a strong relevance for South Africa
South African Nuclear Energy Corporation (NECSA)	National Energy Act No. 34 of 2008	<ul style="list-style-type: none"> • Undertake and promote research on nuclear energy, radiation sciences and technology • Process source, special nuclear and restricted material, including uranium enrichment • Collaborate with other entities
The Central Energy Fund Group of Companies	Central Energy Fund Act No. 38 of 1977	<ul style="list-style-type: none"> • Meet the future energy needs of South Africa, SADC and sub-Saharan Africa, including oil, gas, electrical power, solar energy, low-smoke fuels, biomass, wind and renewable energy sources • Manage the operation and development of the oil and gas assets of the South African government
National Energy Regulator of South Africa	National Energy Regulator Act No. 40 of 2004	<ul style="list-style-type: none"> • Regulate electricity, piped gas and petroleum pipeline industries within South Africa

Source: PMG, *Budgetary Review and Recommendation Report of the Portfolio Committee on Mineral Resources and Energy (Vote 26)*, October 22, 2019, <https://pmg.org.za/taled-committee-report/3951/>

⁷³ PMG, "Department of Mineral Resources".

International commitments

Egypt

Egypt signed the NPT in 1968 but only ratified it in 1981. Initially, Cairo was hesitant to ratify the treaty, but did so to obtain nuclear energy production facilities from the US, although the agreement ultimately faltered. In addition, it has signed and ratified the IAEA Safeguards Agreement, the Vienna Convention on Civil Liability, the Joint Protocol relating to the Application of the Vienna and Paris Conventions, the Convention on Early Notifications of Nuclear Accidents, and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.⁷⁴ It signed the Convention on Nuclear Safety in 1994 but has not ratified it.⁷⁵

The UN Office for Disarmament Affairs cites six principal multilateral export control regimes, namely the Zangger Committee (ZC), the Nuclear Suppliers Group (NSG), the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (WA), the Missile Technology Control Regime (MTCR) and the Australia Group (AG). Out of these, Egypt has worked with the NSG, but is not a member of other groupings. It has nonetheless signed bilateral agreements on the peaceful use of nuclear energy with many countries, including Argentina, Australia, Belgium, Canada, China, France, Germany, India, Italy, South Korea, South Africa, Russia, the UK and the US. It has also signed an MoU with Sweden and agreements to cooperate with countries in the region, such as Jordan and Morocco.

Egypt's policy on nuclear weapons continues to be dictated by its vision of a nuclear weapon-free zone in the Middle East, as well as concerns over Israel's nuclear arsenal and the power asymmetry this creates.⁷⁶ The nuclear issue remains a source of tension

Egypt's policy on nuclear weapons continues to be dictated by its vision of a nuclear weapon-free zone in the Middle East, as well as concerns over Israel's nuclear arsenal

74 The Nuclear Power Plants Authority published on its website a table summarising Egypt's international and multilateral treaties and agreements. See NPPA, "International Agreements", <https://nppa.gov.eg/en/international-cooperation/#International-Agreements>.

75 See IAEA, "Country Profiles: Egypt", 2004, <https://www-pub.iaea.org/MTCD/publications/PDF/cnpp2007/countryprofiles/Egypt/Egypt2005.htm>.

76 On Israeli nuclear weapons, see Avner Cohen, *Israel and the Bomb* (New York: Columbia University Press, 1998).

between the two countries, even as their security and foreign policy priorities have become increasingly aligned.⁷⁷ After fighting wars in 1948, 1956, 1967 and 1973, Egypt and Israel signed the Camp David Peace Accords in 1979. Two years later Israel returned the Sinai Peninsula, which it had occupied since the 1967 War, to Egyptian control.⁷⁸ Egypt also has a nuclear waste disposal agreement with Israel.⁷⁹

While Egypt remains an active actor in nuclear diplomacy, its officials have embraced a combative approach at the NPT Review Conferences, as Cairo continues to argue in favour of the establishment of a WMD-free zone in the Middle East as the only solution to the proliferation issues that dominate in the region. The objective of this policy is to signal its protest at the failure of the international nuclear non-proliferation regime to take measures to combat Israel's undeclared, yet well-known, possession of nuclear weapons, and what Egyptian officials perceive to be Western powers' double standards. Therefore, since 1992 Egypt has refused to sign new agreements on arms control until all regional actors 'sign all treaties in the field of disarmament', in the words of Amr Moussa, the Egyptian foreign minister who crafted this policy.⁸⁰ For instance, Egypt has refused to sign the Convention on Chemical Weapons, the Comprehensive Nuclear Test Ban Treaty and the Biological and Toxin Weapons Convention.⁸¹

Furthermore, Egypt has yet to ratify the Pelindaba Treaty,⁸² even though Cairo played a vital role in various stages of its negotiation. Similarly, although Egypt was part of the New Agenda Coalition, alongside Brazil, Ireland, Mexico, South Africa and New Zealand, which supported the Treaty on the Prohibition of Nuclear Weapons, it has not signed or ratified this document. Egypt's policy of active participation in nuclear diplomacy is not at odds with its freeze on ratifying new nuclear agreements; rather, both are part of its efforts to draw attention and object to the prevailing nuclear asymmetry in the Middle East. However, its policy has influenced the country's peaceful uses of nuclear energy as well. Although it is a member of the IAEA, Egypt has thus far refused to sign the IAEA Additional Protocol, which would grant the agency expanded right of access to and inspection of nuclear sites and activities.⁸³

77 David D Kirkpatrick, "Secret Alliance: Israel Carries Out Airstrikes in Egypt, with Cairo's OK", *The New York Times*, February 3, 2018, <https://www.nytimes.com/2018/02/03/world/middleeast/israel-airstrikes-sinai-egypt.html>.

78 The full text of the Camp David Peace Accords is available online at Peacemaker, "Israel and Egypt: Framework for Peace in the Middle East Agreed at Camp David", June 15, 1979, https://peacemaker.un.org/sites/peacemaker.un.org/files/EG%20IL_780917_Framework%20for%20peace%20in%20the%20MiddleEast%20Agreed%20at%20Camp%20David.pdf.

79 James F Keeley, "A List of Bilateral Civilian Nuclear Co-Operation Agreements, Volumes 1-5", University of Calgary, 2009, https://dspace.ucalgary.ca/bitstream/handle/1880/47373/Treaty_List_Volume_02.pdf;jsessionid=B626010EF3F93D3B8C606E408A3C18B7?sequence=8. See also the Nuclear Power Plants Authority's website, which contains a table summarizing Egypt's bilateral agreements, at NPPA, "Bilateral Agreements", <https://nppa.gov.eg/en/international-cooperation/#Bilateral-Agreements>.

80 Israel Ministry of Foreign Affairs, "Joint Press Conference Israeli Foreign Minister Shimon Peres and Egyptian Foreign Minister Amr Moussa", August 31, 1994, <https://mfa.gov.il/MFA/PressRoom/1994/Pages/JOINT%20PRESS%20CONFERENCE%20FMS%20PERES%20AND%20MOUSSA%20-%2031-A.aspx>.

81 Dany Shoham, "Chemical and Biological Weapons in Egypt", *The Nonproliferation Review* 5, no. 3 (1998): 48-58.

82 David Santoro, "Status of Non-Proliferation Treaties, Agreements, and Other Related Instruments in the Middle East", in *WMD Arms Control in the Middle East: Prospects, Obstacles and Options*, ed. Harald Muller (London: Routledge, 2015), 72.

83 Mark Hibbs, "The Unspectacular Failure of the IAEA Additional Protocol", Carnegie Endowment for International Peace, April 26, 2012, <https://carnegieendowment.org/2012/04/26/unspectacular-future-of-iaea-additional-protocol-pub-47964>.

On this note, it is worth mentioning that Egypt's international commitments have not been without controversy. In 2004–5, Egypt faced scrutiny in international nuclear non-proliferation circles. The IAEA revealed that it was investigating several 'undisclosed experiments' related to atomic research in the country. The watchdog said it found traces of highly enriched uranium, leading to multiple media reports about clandestine efforts by Egypt to develop nuclear weapons and its lack of compliance with the NPT.⁸⁴ The situation was diffused when IAEA inspectors visited the radioisotope production facility at Inshas.⁸⁵ The investigation eventually concluded that Egypt was not seeking to develop nuclear weapons and had not enriched uranium. Apart from this, Egypt had failed to comply with the requirement to report its inventory of nuclear materials (which includes various forms of uranium, both imported and domestically produced, as well as fuel rods containing enriched uranium). It also carried out 16 experiments between 1990 and 2003 that it did not report, involving 'the irradiation of small amounts of natural uranium and the subsequent dissolution of the material'.⁸⁶ Egypt also failed to include further information on its radioisotope production facility at Inshas.⁸⁷

Ghana

Although its nuclear project has not fully started yet, Ghana has already demonstrated its commitment to responsible nuclear behaviour and standards through the ratification of relevant international nuclear instruments, bilateral agreements with responsible nuclear partners, and membership of major multilateral nuclear organisations. Notably, the country has not expressed any reservations about or placed any conditions on its joining any international agreement, especially in the nuclear field. At the IAEA General Conference in 2010, Ghana also reiterated its commitment to the International Legal Framework for Nuclear Security.

Although its nuclear project has not fully started yet, Ghana has already demonstrated its commitment to responsible nuclear behaviour and standards

Ghana has ratified or acceded to at least 10 international treaties, conventions and protocols related to nuclear non-proliferation. These include the 1968 NPT, 1996 Comprehensive

84 "IAEA: Weapons-Grade Uranium Found in Egypt", *The Jerusalem Post*, May 6, 2009, <https://www.jpost.com/Middle-East/IAEA-Weapons-grade-uranium-found-in-Egypt>.

85 IAEA, *Implementation of the NPT Safeguards Agreement in the Arab Republic of Egypt*, GOV/2005/9, Report by the Director General (Vienna: IAEA, 2005).

86 Nuclear Threat Initiative, "Egypt Failed to Report 'a Number' of Nuclear Materials, Activities, Facilities, IAEA Says", February 14, 2005, <https://www.nti.org/gsn/article/egypt-failed-to-report-a-number-of-nuclear-materials-activities-facilities-iaea-says-4666/>.

87 NTI, "Egypt Failed to Report".

Nuclear Test Ban Treaty, the 2005 Convention on the Prevention of Nuclear Terrorism, and the 2017 Treaty on the Prohibition of Nuclear Weapons (Nuclear Weapons Ban Treaty). Apart from signing the 1957 IAEA Statute, it also signed eight other agreements and supplementary protocols with the agency. These include the 1973 Additional Protocol (which, as discussed earlier, Egypt has not signed). It is also a signatory to the Pelindaba Treaty. Unlike Egypt, Ghana is a member of five of the six principal multilateral export control regimes (except the AG).

South Africa

Since 1994 South Africa has reiterated that a 'primary goal' of its foreign policy is to 'reinforce and promote it as a responsible producer, possessor and trader of defence-related products and advanced technologies in the nuclear, biological, chemical and missile fields'.⁸⁸ The country argues that in this way, it 'promotes the benefits which non-proliferation, disarmament and arms control hold for international peace and security, particularly to countries in Africa and the ... NAM'.⁸⁹

One of the first major nuclear-related events for post-apartheid South Africa was its participation in the 1995 Review and Extension Conference of the NPT, the first time since it acceded in 1991. The 1995 conference was burdened by the question of the future of the NPT. South Africa, now a celebrated poster child for the three pillars (non-proliferation, disarmament and peaceful use of nuclear energy) of the NPT, was able to convince signatories to extend the treaty indefinitely. This added to the country's nuclear credentials and recognition of its commitment to international normative frameworks. More than 25 years after this milestone conference, South Africa's commitment to international nuclear norms is evident in its ratification of all the major multilateral treaties, including the NPT, IAEA Statute and the Additional Protocol, Pelindaba Treaty and at least 20 other agreements, frameworks and treaties. In addition, after the end of South Africa's international isolation post-1990, it signed numerous bilateral agreements with key actors, including the EU, China, France, Russia, South Korea and the US. The country has also signed bilateral agreements with international bodies such as the AU and IAEA.

Besides these bi- and multilateral treaties, South Africa, like Ghana, is a member of various multilateral organisations and export control regimes,⁹⁰ including the ZC, the NSG, the WA and the MTCR. Neither country participates in the AG. It is also a member of The Hague Code of Conduct against Ballistic Missile Proliferation. Apart from that, South Africa, along with Ireland, Sweden, New Zealand, Egypt, Brazil, Mexico and Slovenia, is a member of the New Agenda Coalition and the Conference on Disarmament.

88 Department of International Relations and Cooperation, "United Nations Disarmament Commission", February 13, 2004, <http://www.dirco.gov.za/foreign/Multilateral/inter/undc.htm>.

89 DIRCO, "United Nations Disarmament Commission".

90 UN Office for Disarmament Affairs, "Export Controls", <https://www.un.org/disarmament/wmd/export-controls/>.

South Africa's membership of these multilateral organisations and export control regimes has several implications. First, it reiterates the country's normative commitment to nuclear disarmament, nuclear non-proliferation and the peaceful use of nuclear energy. Second, it is bound by international oversight mechanisms that prevent nuclear recidivism (ie, restarting a nuclear weapons programme). Third, South Africa realises the economic benefits from so-called dual-use goods that its small but advanced nuclear technology sector can accumulate for the country. Finally, but not limited to these aspects, South Africa's future development of nuclear energy for peaceful purposes has to meet the safety and security standards set by the global institutions it joined.

Civil society and public input

Egypt

Thus far, the nuclear project's design and implementation have been highly centralised. There was virtually no input from civil society into the relevant policy planning and proposals. In many ways, the public has largely been excluded from the development of the nuclear legislation framework. Furthermore, the government's decision-making process has been shrouded in secrecy, with little transparency regarding the agreement or how it was reached. There is no known anti-nuclear lobby in Egypt, and opposition from civil society has been limited owing to severe constraints on freedom of speech and of the press in the post-2013 period. These constraints have been enforced via a state of emergency and other laws that limit freedom of expression and of assembly, and political activism generally.

There were public concerns after the August 2019 nuclear explosion at the Russian naval testing range in Severodvinsk. The explosion took place at a ROSATOM-controlled test base and killed five nuclear scientists. In its wake, Egyptians began to question the company's expertise and whether the same mistakes could be repeated during the construction of Al Dabaa. They questioned whether there were potential technical defects in modern Russian reactors. The Egyptian government sought to allay these fears, clarifying that there was no relationship between the test that had been conducted and the construction of nuclear power plants in general. According to it, the concerns raised were 'misplaced and exaggerated'.⁹¹

Ghana

Unlike Egypt, Ghana has involved a wide range of national stakeholders in the GNPPO. Stakeholder engagement and communication strategies have also been developed. A series of activities aimed at awareness raising, public outreach and education have been conducted, such as workshops, seminars and publications. Ghana's 2010 National Energy Policy also seeks to ensure a balance between the aspirations of the government and the interests of industry players, academia, local communities, civil society and other key stakeholders.⁹² To that end, it has established a platform to monitor all upstream petroleum activities and ensure accountability.

91 "Qalaq misri min infijar rusiya al-nawawi wa-makhawif min mufa'il al-dabaa" (Egyptian Concerns about the Russian Explosion and Fears Over the Nuclear Reactor], *Al Jazeera*, August 16, 2019, <https://ajm.me/fkpb2>; "Ru'b wa-sukhriya fi misr bi-sabab al-hadith al-nawawi al-rusi" (Horror and Derision in Egypt Because of the Russian Nuclear Accident), *Deutsche Welle*, August 13, 2019, <https://p.dw.com/p/3NqNR?maca=ar>.

92 Government of Ghana, Ministry of Energy, *Medium Term Expenditure Framework for 2019–2022* (Accra: Ministry of Energy, 2019), 16, <https://www.mofep.gov.gh/sites/default/files/pbb-estimates/2019/2019-PBB-MoEn.pdf>.

While there are thousands of CSOs in Ghana, many of which are active in issues concerning the environment and energy, no officially registered or publicly known CSO advocates for or against the use of nuclear power. Nonetheless, it is expected that once the president makes an official declaration and commits to an NPP, this will trigger intense national discourse that might result in the rising of pro- or anti-nuclear CSOs. Social risk investment has been identified as the most significant risk associated with the introduction of nuclear power in Ghana.⁹³ Therefore, social acceptance of nuclear energy is critical for its successful implementation.

South Africa

Historically, South Africa conducted its nuclear affairs in secret. In contrast to the apartheid-era nuclear programme, however, democratic South Africa's nuclear programme is not military driven. Instead, public oversight of all government decisions is enshrined in Chapter 9 of the country's Constitution.⁹⁴ In addition, civil society engagement on nuclear matters is robust. Most significant of all, in 2017 the ELA and SAFCEI lodged a successful court challenge to the legality of the Zuma government's nuclear procurement deal. The court declared the agreement with Russia and other vendor countries unconstitutional.⁹⁵

Historically, South Africa conducted its nuclear affairs in secret. In contrast to the apartheid-era nuclear programme, however, democratic South Africa's nuclear programme is not military driven

There are also a number of other, less high-profile engagements that demonstrate the public and civil society's commitment to providing oversight and holding the government accountable in terms of its decisions on nuclear power. In 2007, for instance, 31 organisations and individuals made presentations to Parliament's public hearings on nuclear energy.⁹⁶ In 2018 the Portfolio Committee on Energy received 41 written submissions and 38 requests to make oral submissions on the Draft Integrated Resources

93 Stephen T Odonkor and Samuel Adams, "An Assessment of Public Knowledge, Perception and Acceptance of Nuclear Energy in Ghana", *Journal of Cleaner Production* 269 (2020): 1.

94 South Africa, *The Constitution of the Republic of South Africa, Act 108 of 1996* (Pretoria: Government Printer, 1996).

95 "Court Sets Aside Nuclear Deals With Russia, Other Countries", *Fin24*, April 26, 2017, https://www.news24.com/fin24/Economy/breaking-court-sets-aside-nuclear-deals-with-russia-other-countries-20170426?_sp=8c39daf0-b5ea-42cd-8711-d6c204d88a04.1591637025930.

96 Portfolio Committee on Environmental Affairs and Tourism, "Nuclear Energy Impact in South Africa: Public Hearings", PMG, June 20, 2007, <https://pmg.org.za/committee-meeting/9013/>.

Plan 2018.⁹⁷ A total of 14 organisations made presentations on the Draft Integrated Resources Plan 2018 to the committee in October 2018.⁹⁸

Besides submissions to public hearings and public opinion surveys, contestation over South Africa's nuclear future and decisions has taken place at community level and in South African courts. For instance, CSOs such as Save Bantamsklip and the Thuyspunt Alliance advocated on behalf of communities affected by Bantamsklip and Thuyspunt's being designated as sites for new nuclear power stations.

The media has also become involved on several occasions. Most notably, *Business Day*, *The Sunday Times* and the Council for the Advancement of the South African Constitution made an application in October 2014, under the Promotion of Access to Information Act (PAIA), to request a record of the Zuma government's decision to continue with its nuclear power plans. In parallel, *The Sunday Times* submitted a PAIA application to the Presidency, Parliament and the Department of Energy to access the framework agreement South Africa had signed with Russia. The request was refused by the Department of Energy because it would 'compromise the delicate negotiations' between South Africa and other vendor countries. The main opposition party in Parliament, the Democratic Alliance, asked the minister of energy to appear before Parliament to explain the South Africa-Russia and South Africa-France framework agreements. Minister Tina Joemat-Pettersson failed to do so. Also in November 2014, the SAFCEI made a PAIA application to National Treasury for information on the nuclear agreements.⁹⁹

These challenges show that South Africa has an active civil society that continuously try to hold the government accountable, using all available means to do so, such as court cases and parliamentary submissions. Although not all these challenges were successful, ultimately they contributed to the termination of the Zuma presidency's nuclear plans and international agreements.

97 Portfolio Committee on Energy, *Report of the Portfolio Committee on Energy on the Draft Integrated Resource Plan 2018 (IRP2018) Public Hearings*, PMG, November 27, 2018, <https://pmg.org.za/taled-committee-report/3488/>.

98 Portfolio Committee on Energy, "Draft Integrated Resources Plan 2018: Public Hearings", PMG, October 17, 2018, <https://pmg.org.za/committee-meeting/27278/>.

99 Brenda Martin and David Fig, *Final Report: Findings of the African Nuclear Study* (Johannesburg: Heinrich Böll Stiftung Southern Africa, 2015), 20, https://www.sortirdunucleaire.org/IMG/pdf/heinrichbo_IIstiftung-2015-findings_of_the_african_nuclear_study-final_report.pdf.

The way forward

Egypt

The project to construct a power plant at Al Dabaa is still at an early stage of development. As of March 2020 infrastructure to support the building of the plant was under construction. There were also delays in the finalisation of the agreement and the start of the plant's construction, including reports of ROSTATOM's having concerns over the site and financing issues.¹⁰⁰ Construction of the first power plant was expected to proceed in the second half of 2020, after all licensing for the project had been completed. The NPPA claimed that the schedule had not been affected by the outbreak of COVID-19 and that measures had been taken to ensure work on the project was proceeding.¹⁰¹ According to the most recent timeline, the first reactor of the four is scheduled to become operational by 2026, with the rest following afterwards. The entire project – to build four reactors – is scheduled for completion by 2040.

Egypt's nuclear power plant is pitched as enabling a diversification of the country's energy supply

Egypt's nuclear power plant is pitched as enabling a diversification of the country's energy supply. The country currently relies heavily on fossil fuels for energy, particularly oil and gas. The new nuclear power plant also has the potential to establish Egypt as a regional energy hub. A spokesperson for the Ministry of Electricity and Renewable Energy has argued that the Russian loan is economically beneficial to Egypt, as it can sell the energy generated from the reactors, ultimately allowing the country to break even.¹⁰² This may be a direct response to the Ethiopian bid to position itself as a regional electricity supplier,

100 Joy Nasr and Ali Ahmad, "Middle East Nuclear Energy Monitor: Country Perspectives 2018" (American University of Beirut, Issam Faris Institute for Public Policy and International Affairs, Beirut, 2018), 5. See also International Institute for Strategic Studies, *The Geopolitics of Nuclear Energy: New Dynamics of Supply and Demand*, Workshop Report (London: IISS, November 2018), 2, <https://www.iiss.org/-/media/images/comment/analysis/2018/december/iiss-cenness-moscow-workshop-report-2018.pdf?la=en&hash=81DABE0B5BBF56D1F6FDDB569ADCCF76C41B8A7F>.

101 Mohamed Farah, "COVID-19 Not Affecting Dabaa Implementation Timetable: NPPA", *Daily News Egypt*, April 2, 2020, <https://www.dailynewssegyp.com/2020/04/02/covid-19-not-affecting-dabaa-station-implementation-timetable-nppa-head/>. See also "ROSATOM Takes Measures in Egypt's Dabaa Nuclear Plant over Coronavirus," *Egypt Today*, April 2, 2020, <https://www.egypttoday.com/Article/1/83267/Rosatom-takes-measures-in-Egypt%E2%80%99s-Dabaa-nuclear-plant-over-coronavirus>.

102 "Russia Lends Egypt \$25 Billion for Dabaa Nuclear Power Plant", *Al Monitor*, February 26, 2020, <https://www.al-monitor.com/pulse/originals/2020/02/power-plant-nuclear-egypt-russia-loan.html>.

given tensions between the two over the Nile. There are also reports of plans to share power with nearby states such as Libya, Sudan, Jordan and Saudi Arabia, although Jordan and Saudi Arabia, along with the United Arab Emirates, have also declared their intentions to build nuclear power plants.¹⁰³ Furthermore, in a speech in December 2019 Sisi announced Egypt's willingness to export 20% of its surplus electricity to African countries at low prices, calling for the construction of electricity transmission lines across the continent.¹⁰⁴

Therefore, after five decades of on-and-off discussions about constructing a nuclear power plant under successive governments, the project is now officially in progress, and Egypt is fulfilling its long-held ambition to enter the nuclear age. Despite its multiple detractors, the highly ambitious project is proceeding, albeit most likely with numerous delays and potentially escalating costs. Some analysts also insist that the power plant is a solution to a non-existent problem, as Egypt is no longer in need of additional sources of energy, thus effectively rendering the power plant merely another mega-project driven by pride or hubris.¹⁰⁵

With such widespread criticism and concern over the project, Egypt will have much to prove, both domestically and internationally. It will have to demonstrate that the project is not simply a luxury item the government seeks for purposes of prestige or signalling. Furthermore, it must convince critics of its responsibility in handling nuclear affairs, which will most likely require greater transparency. A potential solution could be for Egypt to consider introducing more public consultation on the development of an appropriate nuclear governance framework that ensures a higher level of confidence around issues of nuclear safety and compliance. The government's reluctance to discuss any risks associated with the reactor is worrying in this regard, demonstrating an ideological commitment to the project and a technological fetishism.

The country may be able to assuage international critics by signing up to additional global treaties on nuclear power and continuing to work closely with the international community to ensure compliance with global nuclear governance frameworks. In that sense, the nuclear project could become a confidence-building measure, and as such could act as an example in the Middle East and North Africa. However, this policy may have little sway with domestic critics of Egypt's bid for nuclear energy. Given the fundamental lack of transparency surrounding the entire project, as well as insufficient public consultations, they may not be convinced by accession to international treaties. The challenges associated with the way in which the Egyptian government has pursued nuclear energy – ie, without public consultation – are deeply rooted and have been echoed in the other mega-projects

103 Rachel Bronson, "Power Shift in the Middle East", *Bulletin of the Atomic Scientists* 72, no. 1 (2016): 10-15.

104 Rami Galal, "Egypt Moves into Position as Regional Energy Hub", *Al Monitor*, December 26, 2019, <https://www.al-monitor.com/pulse/originals/2019/12/egypt-electricity-export-africa-gerd-low-price-ethiopia.html>.

105 Eric Trager, "Egypt's Costly Nuclear Project" (PolicyWatch 2632, The Washington Institute for Near East Policy, Washington DC, June 16, 2016), <https://www.washingtoninstitute.org/policy-analysis/egypts-costly-nuclear-project>; Maged Mandour, "Sisi's Vanity Projects", Carnegie Endowment for International Peace, August 6, 2019, <https://carnegieendowment.org/sada/796252>.

that seek to re-organise the lives of Egyptians.¹⁰⁶ Finally, the Egyptian government will need to convince people that there is an economic benefit to the project, even if only in the long term, and that it has not squandered the resources of already cash-strapped taxpayers.

Ghana

Ghana began considering building a nuclear power plant in 1964, marked by Nkrumah's speech in which he laid the foundations of the Ghana Nuclear Reactor Project.¹⁰⁷ In 2020, 56 years later, Ghana still did not have a nuclear power plant, but it was seeking to build one before 2030.¹⁰⁸

Ghana's nuclear power programme is currently being developed in line with the IAEA-recommended and internationally accepted comprehensive framework for developing infrastructure for nuclear power: the IAEA Milestones Approach.¹⁰⁹ At each phase, 19 infrastructure issues need to be considered, which require specific actions during each of the three phases. Completion of these actions in each phase represents the achievement of the associated milestone. The associated milestones are:¹¹⁰

- the country is 'ready to make a knowledgeable and informed commitment to a nuclear power programme' (or to decide not to proceed);
- the country is 'ready to invite bids or negotiate a contract for [its] first nuclear power plant'; and
- the country is 'ready to commission and operate the first nuclear power plant'.

Ghana is currently in Phase 1. If the Akufo-Addo cabinet decides to move forward with the nuclear power programme, the GNPPO and the other national nuclear bodies will embark on Phase 2 activities.

The IAEA's 2017 Integrated Nuclear Infrastructure Review mission noted that five of the 19 infrastructure issues outlined in the milestones document presented key challenges to Ghana's nuclear power infrastructure development: national position, legal framework, government funding and financing, and stakeholder involvement.

106 Timothy E Kaldas, "Egypt's Disdain for Transparency Will Backfire in this Coronavirus Crisis", *The Guardian*, March 31, 2010, <https://www.theguardian.com/commentisfree/2020/mar/31/egypt-coronavirus-transparency-sisi-crackdown>.

107 Agyei, "Nkrumah Lays Foundation".

108 Magdalene Larnyoh, "Ghana To Generate Nuclear Power By 2030", *Pulse Ghana*, January 23, 2020, <https://www.pulse.com.gh/bi/strategy/ghana-to-generate-nuclear-power-by-2030/sk23lk5>.

109 IAEA, "Milestones in the Development of a National Infrastructure for Nuclear Power" (IAEA Nuclear Security Series No. NG-G-3.1 [Rev. 1], IAEA, Vienna, 2015), https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1704_web.pdf.

110 IAEA, "Milestones in the Development".

South Africa

The South African government adopted the Nuclear Energy Policy for the Republic of South Africa in 2008.¹¹¹ More than 12 years later, it is still the official policy document on the country's nuclear energy expansion plans. Its nuclear energy development 'is premised on Article IV of the NPT, which affirms South Africa's inalienable right to research, develop, produce and use nuclear energy for peaceful purposes'.¹¹² It is, however, important to bear in mind the political context, significant power shifts and escalating energy crises (resulting in regular power cuts) in the country between 2008 and the present day.

Initially, Ramaphosa decided to shelf Zuma's nuclear expansion plans, both because of their high cost and to gain the trust of international investors, given the allegations of corruption around the project. Yet Zuma's nuclear decisions and agreements continue to cast a shadow over the country's energy future. In May 2018, for example, energy minister Jeff Radebe confirmed that nuclear energy remained part of South Africa's future energy mix, with Loyiso Tyabashe, the senior manager of Nuclear New Build at Eskom, sharing the view.¹¹³ In addition, Russia's President Vladimir Putin repeatedly brings up the nuclear issue in discussions with Ramaphosa.¹¹⁴

The Ramaphosa administration released its own energy blueprint, the Integrated Resource Plan (IRP), in October 2019. According to the document, South Africa will consider nuclear energy expansion in the long term, but using smaller nuclear units rather than a fleet.¹¹⁵ The IPR also proposes that the nuclear power plan proceed 'at a scale and pace that flexibly responds to the economy and associated electricity demand, in a manner that avoids tariff shocks in particular'.¹¹⁶ More importantly, the plan includes the decision to '[c]ommence 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'.¹¹⁷

In presenting his portfolio's Strategic Plan and the 2020-2021 Annual Performance Plan to Parliament in May 2020, Minister of Mineral Resources and Energy Gwede Mantashe informed Parliament of the Ramaphosa administration's New Nuclear Build Programme, which until that point had been shrouded in denials, contradictions and uncertainties. Mantashe made several important announcements about the implementation of the

111 DME, *Nuclear Energy Policy*.

112 DME, *Nuclear Energy Policy*, 6.

113 Khulekani Magubane, "Nuclear Still in SA's Energy Mix, Says Jeff Radebe", *Fin24*, May 16, 2018, [https://www.news24.com/fin24/Economy/nuclear-still-in-sas-energy-mix-says-jeff-radebe-20180516?_sp=8c39daf0-b5ea-42cd-8711-d6c204d88a04.1591635957686;Carin Smith, "Eskom Continues with Front-End Nuclear Preparation", *Fin24*, May 17, 2018, https://www.news24.com/fin24/Economy/Eskom/eskom-continues-with-front-end-nuclear-preparation-20180517?_sp=8c39daf0-b5ea-42cd-8711-d6c204d88a04.1591635907362](https://www.news24.com/fin24/Economy/nuclear-still-in-sas-energy-mix-says-jeff-radebe-20180516?_sp=8c39daf0-b5ea-42cd-8711-d6c204d88a04.1591635957686;Carin%20Smith,%20%22Eskom%20Continues%20with%20Front-End%20Nuclear%20Preparation%22,%20%22Fin24,%20May%2017,%202018,%20https://www.news24.com/fin24/Economy/Eskom/eskom-continues-with-front-end-nuclear-preparation-20180517?_sp=8c39daf0-b5ea-42cd-8711-d6c204d88a04.1591635907362).

114 Sibongile Khumalo, "Ramaphosa Tells Putin the Time's Not Right for Nuclear", *News24*, July 27, 2018, [https://www.news24.com/fin24/Economy/ramaphosa-tells-putin-the-times-not-right-for-nuclear-20180727-2;Peter Fabricius, "Ramaphosa Pleads Poverty as Putin - Again - Pitches That Big Nuke Deal", *Daily Maverick*, 25 October 2019, https://www.dailymaverick.co.za/article/2019-10-25-ramaphosa-pleads-poverty-as-putin-again-pitches-that-big-nuke-deal/#gsc.tab=0](https://www.news24.com/fin24/Economy/ramaphosa-tells-putin-the-times-not-right-for-nuclear-20180727-2;Peter%20Fabricius,%20%22Ramaphosa%20Pleads%20Poverty%20as%20Putin%20-%20Again%20-%20Pitches%20That%20Big%20Nuke%20Deal%22,%20%22Daily%20Maverick,%2025%20October%202019,%20https://www.dailymaverick.co.za/article/2019-10-25-ramaphosa-pleads-poverty-as-putin-again-pitches-that-big-nuke-deal/#gsc.tab=0).

115 DMRE, "Integrated Resource Plan (IRP 2019)", 2019, 13, <http://www.energy.gov.za/IRP/2019/IRP-2019.pdf>, accessed 28 May 2020.

116 DMRE, "Integrated Resource Plan", 48.

117 DMRE, "Integrated Resource Plan", 48.

programme envisaged for the 2020/21 financial year, specifically starting ‘procurement processes to ensure the security of energy supply’. He also said that South Africa was considering small modular reactors.¹¹⁸ Moreover, Mantashe confirmed the schedule for the programme, stating that South Africa aimed to procure 2 500MW nuclear energy by 2024.¹¹⁹

Significantly, on 14 June 2020 Mantashe issued a formal RFI: ‘The South African Nuclear New Build Programme’. While the RFI was an invitation to submit ‘Information for the Works/Goods/Services of the South African Nuclear New Build Programme’, it cautioned that it was ‘a stand-alone information-gathering and market-testing exercise only, and NOT a competitive tender’.¹²⁰ Given the high cost of nuclear build programmes, the RFI indicates that the financing options and related ownership models for such a high capital cost programme are of great importance. Consideration will be given to the complete range of such options.¹²¹ In November 2020 the National Energy Regulator of South Africa published a consultation paper for public comments on the government’s plans to procure 2 500MW capacity from nuclear. Public submissions were due on 5 February 2021.¹²²

While policy matters and strategies are being considered, it is also important to focus on the here and now, especially given the ageing infrastructure discussed earlier. A comprehensive IAEA Safety Aspects of Long Term Operation peer review of Koeberg is expected to be conducted in September 2021.¹²³ This review will determine South Africa’s compliance with IAEA Safety Standards and recommend improvements to achieve compliance. It will also strengthen public and international confidence in Koeberg’s operations and support licensing for the long-term operation of the plant. Apart from that, the Radioactive Waste Management Fund Bill is expected to be tabled during the 2020/21 financial year. The purpose of the bill is secure the financial sustainability of the NRWDI, which is currently funded by the DMRE.¹²⁴

¹¹⁸ PMG, “Department of Mineral Resources”.

¹¹⁹ PMG, “Department of Mineral Resources”.

¹²⁰ DMRE, “Request for Information (RFI): The South African Nuclear New Build Programme”, June 14, 2020, <http://www.energy.gov.za/files/tenders/2020/nuclear-rfi/Nuclear-RFI-Advert.pdf>.

¹²¹ DMRE, “Request for Information”.

¹²² National Energy Regulator of South Africa, “Annexure D: Consultation Paper for Nuclear Procurement” (NERSA, Pelindaba, November 2020), <http://nersa.org.za/wp-content/uploads/2020/11/Annexure-D-Consultation-Paper-for-Nuclear-Procurement.pdf>.

¹²³ DMRE, “Request for Information”.

¹²⁴ DMRE, “Request for Information”.

Conclusion

Sixteen African states – Algeria, the Democratic Republic of Congo, Egypt, Ghana, Libya, Kenya, Morocco, Namibia, Nigeria, Tanzania, Tunisia, Rwanda, Senegal, Sudan, Uganda and Zambia – have expressed interest in pursuing nuclear builds. They are currently at different stages of their nuclear quests. While active nuclear research and development programmes are already underway in some, others are only starting to explore the possibility of building nuclear reactors. More countries are likely to join this list in the near future, as they look at ways to provide electricity to larger segments of their populations. Currently, South Africa has the continent's only operational nuclear power plant, but this will change in the near future, with Egypt joining its ranks. This report attempted to outline the existing nuclear programmes in both these countries, as they are the most advanced in Africa. It also focused on Ghana as a country that aspires to use nuclear energy for peaceful purposes and follows all the necessary steps before embarking on a nuclear build. Based on this report's findings, there are numerous challenges. These should, however, not prevent these three countries, or others, from using nuclear energy for developmental purposes. Rather, there is a need for African governments to share lessons learned and best practices with each other. This would include cooperating closely with established nuclear actors in the North and South, as well as continental and regional organisations such as the IAEA and the African Commission on Nuclear Energy. Such cooperation would help aspiring nuclear powers to establish credible, robust nuclear non-proliferation regimes, which are essential for the safe and peaceful use of nuclear energy.¹²⁵

¹²⁵ Yarik Turianskyi and Jo-Ansie van Wyk, "Atoms 4 Development' In Africa – Experts Weigh In", December 11, 2020, <https://saiia.org.za/research/atoms-4-development-in-africa-experts-weigh-in/>.

Policy recommendations

These recommendations are primarily aimed at, but not limited to, the governments of the three case study countries. They were formulated in the spirit of constructive criticism, with the aim of making governance of nuclear energy more effective, including a variety of stakeholders and promoting peaceful uses of nuclear energy for developmental outcomes.

Egypt

- Decision-making processes surrounding the nuclear power plant should be more transparent and inclusive. Discussions and debates on the project need to incorporate greater public consultation and include more stakeholders from Egyptian society, including detractors.
- Egypt should focus on developing an appropriate nuclear governance framework that ensures greater confidence on issues of nuclear safety and compliance.
- Technological processes – and their potential failures – should be discussed more openly and critically. The current approach of technological fetishism may result in blindness to accidents and risks, thereby maintaining vulnerability.
- The questions raised about the feasibility and necessity of the project – particularly owing to its expense – may also be of relevance to other states pursuing nuclear energy as a mega-project.

Ghana

- Ghana should plan effectively for every stage of the life of its nuclear plant. This includes having concrete steps in place for the treatment of nuclear waste, which should be outlined during the planning phase.
- Human capital investment is essential and the country would benefit from having local nuclear experts. The country's well-established nuclear research programme is a major advantage in this area and should continue to be supported.
- Ghana should think beyond its borders and consider the benefits from nuclear energy technology for itself and neighbouring countries.
- It is important that the country focuses on those areas identified by the IAEA as still in need of work. Adhering to the recommendations and advice of the IAEA will make for smooth sailing in this case.

- Transparency should be prioritised in the development of the nuclear power plant. A clear understanding of public opinion must be present.
- The country's legal framework must reflect its commitment to nuclear safety and security.
- Ghana should ensure that the nuclear power programme is developed in a stable political environment.
- The full potential cost of setting up and running a nuclear power plant should be known and understood from the outset. Ghana should develop and implement a communication plan on the sustainable use of energy resources to improve public awareness and understanding, and manage public perceptions on rationalising price subsidies.

South Africa

- South Africa should only pursue a future nuclear installation if this holds a financial advantage versus other energy options.
- Public education on nuclear energy should be conducted continuously. Education campaigns in the past have been short lived with no real assessment of impact.
- Wasteful expenditure must be stopped, and parliamentary oversight needs to be stronger. Besides this, criminal proceedings should be instituted against those involved in corruption in the sector and those who failed to achieve their fiduciary duties.
- State-owned entities such as the NECSA group of companies should not be reliant on government funding. This will improve their performance and financial viability.
- A skills audit should be conducted to determine the state of nuclear energy training and education in the country. The audit should include an assessment of existing national and inter-governmental training programmes.
- A dedicated nuclear university or campus should be established within one of the existing universities. A second option would be to prevent the duplication of educational and other training programmes.
- A follow-up IAEA INIR mission needs to take place to assess the implementation of its recommendations, as well as make new recommendations to improve nuclear governance.
- The long-overdue restructuring of Eskom needs to be finalised.
- The 2008 Nuclear Energy Policy issued in 2008 must be revised and updated, as many domestic and international changes have occurred since its adoption by cabinet. Besides this, the Nuclear Energy Policy of 2008 should be reconsidered and/or reviewed. Formulated during the last part of Mbeki's administration and coinciding with a global

nuclear renaissance, the policy, albeit ambitious, requires reconsideration to take account of new realities such as COVID-19's financial impact and the cost of nuclear energy.

- Apart from this, it is crucial to revise and update existing nuclear legislation to account for the said changes and the shortcomings identified by the IAEA in 2013.



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