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Nuclear Science and Technology: Driving Africa's Development

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Executive summary

In 2013 the AU adopted Agenda 2063 as the continent's strategic framework for sustainable development and economic growth. The goals and aspirations enshrined in Agenda 2063 complement those of the UN's Sustainable Development Goals (SDGs). Nuclear science and technology have the potential to contribute directly to the achievement of the objectives of both these initiatives. This policy insight outlines the current state of the use of nuclear technology in Africa, including its application outside of civil electricity production. In particular, it focuses on the healthcare and agriculture sectors to show how the peaceful use of nuclear energy can be enhanced as a driver for Africa's development and the realising of the aspirations of Agenda 2063 and the SDGs. It also emphasises the importance of key African legal commitments to the peaceful use of nuclear energy. While there has been significant progress in the use of nuclear technology in Africa, a more sustainable and coordinated approach to develop the continent's nuclear sector is required.

Introduction

Nuclear science and technology hold great development potential and can contribute directly to meet the objectives of both the AU's Agenda 2063 (adopted in 2013) and the UN's SDGs on the continent. The development potential of nuclear energy is one aspect that features prominently in this context, since the success of modern economies is closely linked to reliable sources of electricity. However, when the scope of development is widened to also include human capital – as done in Agenda 2063 and the SDGs – the development potential of nuclear science and technology becomes even more apparent in fields such as healthcare and agriculture.

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Agenda 2063, described by the AU as 'a concrete manifestation of the pan-African drive for unity, self-determination, freedom, progress and collective prosperity', is firmly grounded in the principles of pan-Africanism and the African Renaissance. It is the framework through which the continent aims to achieve 'inclusive and sustainable development'.[1] Agenda

1 AU, "Agenda 2063: The Africa We Want".

2063 looks to the future not only by outlining the development goals for the continent but also by identifying 'flagship programmes' that would make the achievement of these goals possible and facilitate 'both quantitative and qualitative transformational outcomes for Africa's people'.[2] The goals outlined in Agenda 2063 include 'Well-educated citizens and skills revolution underpinned by science, technology and innovation'; 'Healthy and well-nourished citizens'; 'Environmentally sustainable and climate resilient economies and communities'; 'Modern agriculture for increased productivity and production'; and ensuring that 'Peace, security and stability is preserved'.[3]

A development agenda set for 2030 and adopted in 2015, the SDGs are regarded as a way of bringing together 'the three dimensions of sustainable development: the economic, social and environmental'.[4] Alongside Agenda 2063, the SDGs are a means to 'address a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection'. They further recognise that it is possible to address these concerns in a manner that is complementary to post-COVID-19 recovery.[5] At the heart of the SDGs are 17 goals that include clean, affordable energy; good health; and the eradication of hunger.[6] Taken together, Agenda 2063 and the SDGs have the potential to be key drivers of Africa's development. It is therefore important to highlight those tools – like the peaceful application of nuclear science and technology – that can be used in the advancement of both these development agendas.

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This policy insight outlines the current state of the use of nuclear science and technology in Africa, including its application outside of civil electricity production. Its particular focus is on the healthcare and agriculture sectors and how the peaceful use of nuclear energy can drive sustainable development. It provides an outline of the regime on the peaceful uses of nuclear science and technology, considering the relevant international and continental nuclear non-proliferation treaties, and the role of the International Atomic Energy Agency (IAEA), nuclear science and technology in relation to Agenda 2063 and the SDGs, and their application in the health and agriculture sectors. It also looks at some of the challenges

2 AU, "Agenda 2063".
3 AU, "Goals & Priority Areas of Agenda 2063".
4 International Atomic Energy Agency, "Sustainable Development Goals: Overview".
5 UN Sustainable Development Goals, "17 Goals to Transform Our World".
6 UN, Department of Economic and Social Affairs: Sustainable Development, "The 17 Goals".

faced by African countries in pursuing advanced nuclear technologies, and concludes with recommendations that may advance a more sustainable and co-ordinated approach.

Nuclear science and technology in use in Africa

At present, research reactors are the primary mode of interaction with nuclear science and technology in Africa; the continent is currently home to 10 such reactors.[7] Research reactors are often regarded as the first step a country takes in progressing towards a fully functioning nuclear power programme.[8] They are also employed for various types of 'environmental, agricultural, and medical research'[9] and have a vital role to play in development. Table 1 provides an overview of the research reactors currently in operation on the continent.

TABLE 1 AFRICAN NUCLEAR RESEARCH REACTORS

Country	Nuclear facility name	Type	Built by	Capacity (kW)
Algeria	Es-Salam (temporary shut down)	Heavy Water	China	15,000
Algeria	Nur	Pool	Argentina	1,000
Democratic Republic of Congo	TRICO-II (extended shutdown)	Pool, TRIGA Mark II	US	1,000
Egypt	ETRR-1 (extended shut down)	Tank	USSR	2,000
Egypt	ETRR-2	Pool	Argentina	22,000
Ghana	GHARR-1	MNSR, Tank in pool	China	30
Libya	IRT-1 (temporary shut down)	Pool, IRT	USSR	10,000
Morocco	MA-R1	TRIGA Mark II	US/France	2,000
Nigeria	NIRR-1	MNSR, Pool	China	30
South Africa	SAFARI-1	Tank in pool	US	20,000

Source: Abigail Sah et al., "Atoms for Africa: Is There a Future for Civil Nuclear Energy in Sub-Saharan Africa?" (CGD Policy Paper 124, Center for Global Development, Washington DC, April 2018), 5

All of Africa's research reactors are used to train nuclear scientists and engineers.[10] For countries looking to implement nuclear energy, training and education are an important part in the development of their nuclear power programmes. The nuclear research reactor is one of the most important public education tools available to governments. Research reactors are easily accessible to the public and can therefore contribute towards the

7 Abigail Sah et al., "Atoms for Africa: Is There a Future for Civil Nuclear Energy in Sub-Saharan Africa?" (CGD Policy Paper 124, Center for Global Development, Washington DC, April 2018).
8 Sah et al., "Atoms for Africa".
9 Sah et al., "Atoms for Africa", 5.
10 See IAEA, *Research Reactors in Africa* (Vienna: IAEA, 2011).

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'generating [of] vocational interest in nuclear sciences and in allaying fears about nuclear energy and radiation'.[11] Apart from these educational and training functions, Africa's research reactors also contribute significantly to the enhancement of development and nuclear science and technology, especially in the medical and environmental fields.

South Africa's SAFARI-1 reactor is one of the biggest global producers of molybdenum-99, a radioactive isotope that breaks down to technetium-99m (Tc-99m). Tc-99m, most commonly used for the 'detection and staging of heart and cancer disease diagnoses', is highly valued in nuclear medicine and has been used in 'four of every five diagnostic procedures worldwide'.[12] Nigeria's NIRR-1 research reactor has been particularly useful in an analytical role and has been used for the 'elemental analysis of flesh, bones and gills of popularly consumed fish in Nigeria to improve nutrition and health', as well as in soil fertility and geochemical composition studies.[13] A number of Africa's research reactors (Es-Salam, MA-R1, IRT-1, and GHARR-1) have been frontrunners in the use of neutron activation analysis, a popular technique for the 'multi-element non-destructive analysis in earth sciences ..., environmental monitoring and pollution assessments ..., food and agriculture, health, medicine and pharmaceuticals'.[14]

Africa's research reactors also contribute significantly to the enhancement of development and nuclear science and technology, especially in the medical and environmental fields

The operation of nuclear research reactors also minimises the risk of losing future scientists. They remove the need to travel outside of Africa to undergo training in nuclear science, thereby ensuring that the continent maintains the necessary human resources it requires for the future operation of nuclear power plants.[15] While it is true that many aspiring African

11 Marguerite Leonardi and Vincent Lukanda Mwamba, "Why Research Reactors Are So Important for Africa", *World Nuclear News*, October 12, 2020.
12 IAEA, *Research Reactors in Africa*, 23.
13 IAEA, *Research Reactors in Africa*, 21.
14 IAEA, *Research Reactors in Africa*, 15.
15 Leonardi and Mwamba, "Why Research Reactors Are So Important".

nuclear scientists do still travel abroad for their studies, this is often done in collaboration with other countries that recognise the importance of having local experts involved in these programmes. For example, Rosatom, a Russian nuclear company that has long been involved in the development of nuclear science and technology in Africa, offers scholarships to aspiring nuclear scientists who complete degrees in Russia and then return to Africa.[16]

Apart from education programmes, Africa also works in close cooperation with nuclear oversight bodies from other countries in the maintenance of its research reactors. Most recently, the China National Nuclear Corporation (CNNC) has been closely involved in the upgrading of Algeria's Es-Salam research reactor, a process formally completed on 7 March 2019. Es-Salam was designed by the CNNC and its recent upgrade to modernise key parts has therefore been a continuation of the close cooperation between these two countries in the peaceful use of nuclear energy.[17] South African universities are popular locations for aspiring nuclear scientists on the continent, and in recent years the number of courses in nuclear science and engineering on offer in other countries on the continent have also increased.[18] The following section examines the use of nuclear science and technology in Africa outside of civil electricity production, by considering its use in healthcare and agriculture.

Nuclear science and technology in Africa's health sector

Dr Kelvin Kemm, a nuclear physicist, describes nuclear medicine as 'spectacularly accurate', praising its usefulness in the early detection of and effective treatment of various cancers.[19] One of the most widely known and used nuclear techniques for the combatting of disease is radiotherapy (radiation applied in the treatment of cancer). Cancer is a global health challenge, but it disproportionately affects low- and middle-income countries, a large portion of which is in Africa. Global cancer cases and deaths are projected to increase to 27.5 million and 13 million respectively by 2040, and it is estimated that 70% of these will be recorded in low- and middle-income countries.[20] According to World Health Organization data sourced from Globocan, the Global Cancer Observatory, a total of 1 109 209 new cancer cases and 711 429 cancer deaths were recorded in Africa in 2020.[21]

At present, a severe shortage of radiotherapy machines across the continent is inhibiting the ability of African countries to successfully respond to the increase in cancer cases. To put this into perspective, there are only 385 radiotherapy machines available in all of Africa,

16 Sah et al., "Atoms for Africa".
17 China National Nuclear Corporation, "CNNC Completes Algerian Upgrade", March 9, 2019.
18 Sah et al., "Atoms for Africa".
19 Kelvin Kemm, "SA Nuclear Medicine Could Save State Time and Money", *IOL*, April 13, 2021.
20 International Cancer Expert Corps, "Innovative Technologies towards Building Affordable and Equitable Global Radiotherapy Capacity (ITAR)", June 11, 2020.
21 World Health Organization and International Agency for Research on Cancer, "Factsheet: Africa".

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with 60% of these located in Egypt, Morocco and South Africa.[22] The Lancet Oncology Commission – Global Task Force on Radiotherapy for Cancer Control of the Union for International Cancer Control recently determined that an additional 5 000 radiotherapy machines would be needed as soon as 2035 in order to mitigate the rise in cancer cases and offer treatment to cancer patients in Africa.[23] South Africa is uniquely positioned to share its knowledge and skills not only in the area of nuclear energy but increasingly also in nuclear medicine. It is the world's second largest supplier of nuclear medicine, exporting it to some 60 countries across the globe.[24]

Radiotherapy is a nuclear technology that can contribute directly to the achievement of SDG 3, 'Good health and well-being',[25] and to the third goal of the AU's Agenda 2063, 'Healthy and well-nourished citizens'.[26] In addition to its application in the treatment and diagnosis of cancer, nuclear science and technology can also be applied to other diseases, thus further helping to realise the SDGs and Agenda 2063. Nuclear technology has proven very successful in the 'early warning, risk reduction and management of major health hazards, including infectious diseases, such as Ebola, dengue, and Zika'.[27] Nuclear science and technology can also be used to diagnose malnutrition, so contributing to the second part of goal number three of Agenda 2063 and SDG 2, 'Zero hunger'.[28]

In its quest to achieve these twin goals, Africa has received vital assistance from the IAEA. The IAEA is firmly integrated into the wider network of UN oversight bodies and promotes cooperation and integration 'with its Member States and multiple partners worldwide to promote safe, secure and peaceful use of nuclear technologies'.[29] It provides assistance in the form of education and training, which includes not only the training of specialist healthcare professionals but also covers 'training and education on safety and radiation protection of patients and health professionals'; 'comprehensive cancer control programmes'; and the promotion of 'nuclear medicine, radiation therapy and oncology and

22 ICEC, "Innovative Technologies".
23 ICEC, "Innovative Technologies".
24 Kemm, "SA Nuclear Medicine".
25 UN, "The 17 Goals".
26 AU, "Goals & Priority Areas".
27 IAEA, "Sustainable Development Goals".
28 IAEA, "Sustainable Development Goals".
29 IAEA, "About Us".

radiology facilities'.[30] Outside of the medical sector, the IAEA has a wealth of knowledge that it can share with African countries in terms of the management of radioactive waste.[31]

In terms of nuclear power programmes, more than 10 African member states have engaged in technical cooperation projects with the IAEA. The promotion of these aspects of nuclear science and technology makes the IAEA a vital component in creating global peace and security as part of the SDGs.[32] Through its Technical Cooperation (TC) Programme, the IAEA assists all of its member states, including those in Africa, with the 'peaceful, safe and secure application of nuclear science and technology'.[33] In the African context, IAEA technical cooperation has been carefully aligned with the development needs and priorities of the continent. For more than 60 years, African states have been cooperating with the IAEA TC Programme in order to 'strengthen Africa's human and institutional capacity of the peaceful and safe utilization of nuclear techniques in the areas of human health, food and agriculture, water and environment, energy, and industry'.[34] The IAEA TC Programme also promotes 'self-reliance and sustainable development in Africa'. At present 45 African IAEA member states, 26 of which have been classified as least-developed countries, participate in the programme.[35]

Nuclear science and technology in Africa's agriculture sector

According to the Food and Agriculture Organization (FAO) of the UN, an increase of 70% in global food production is necessary to meet the demands of a world population that by 2050 could reach 9.1 billion.[36] This is a feat that would have to be accomplished in spite of challenges such as 'climate change, increased droughts, flooding and rising sea levels which hamper crop productivity and make farming a high-risk venture'.[37] Nuclear science and technology have become integral to global efforts to 'develop and implement sustainable, climate-smart agricultural practices'.[38] This positions nuclear science and technology at an important intersection, whereby the technology can be applied not only to achieve food security but also to combat climate change.

Nuclear science and technology are increasingly important in developing countries, where they have been used to enhance food production in a sustainable manner by

30 IAEA, "Sustainable Development Goal 3: Good Health and Well-Being".
31 Messaoud Baaliouamer, "Opening Address: Wilton Park Conference – In Support of Africa's Agenda 2063: Pathways Forward for Expanding Peaceful Uses of Nuclear Energy and Nuclear Technology in Africa", February 25, 2020, 3.
32 IAEA, "Overview".
33 IAEA Department of Technical Cooperation, "IAEA Technical Cooperation in Africa", 2018.
34 IAEA, "IAEA Technical Cooperation", 1.
35 IAEA, "IAEA Technical Cooperation", 1.
36 Ingrid Kirsten, *The Contribution of Innovative Nuclear Technology to Sustainable Agriculture Development*, Case Study (Vienna: Vienna Center for Disarmament and Non-Proliferation, November 2020).
37 Kirsten, *The Contribution of Nuclear*, 1.
38 Kirsten, *The Contribution of Nuclear*, 1.

'breeding improved crops, enhancing livestock reproduction and nutrition, as well as controlling animal and plant pests and diseases'.[39] Nuclear technology can also be used to evaluate soil in order to 'improve soil productivity and water management'.[40] Ultimately, nuclear technology contributes to an overall enhancement of 'the livelihood of farmers' by contributing towards the augmentation of 'agriculture productivity, food security and nutritional quality'.[41]

In recent years Africa has been a key site for the use of nuclear science and technology in the agriculture sector. The COVID-19 pandemic has made apparent some of the risks attached to the increased movement of people between countries, and serves as a sobering reminder of the influence animals can have on human health. Society can be disrupted by 'transboundary animal diseases', as well as some zoonotic diseases that pass from animals to humans, affecting 'public health, community livelihoods, and trade'.[42] In recognition of this risk, the Veterinary Diagnostic Laboratory Network (VETLAB Network) was established by the FAO and the IAEA Division of Nuclear Techniques in Food and Agriculture.[43] The VETLAB Network was initially established to 'support the global rinderpest eradication campaign through the development, evaluation, validation and transfer of selected diagnostic technologies'.[44]

The VETLAB Network has had an overwhelmingly positive effect on the continent. VETLAB was crucial in the eradication of rinderpest in Africa and remains a vital component in the 'prevention, control and eradication of transboundary animal and zoonotic diseases'.[45] A total of 32 sub-Saharan African countries form part of VETLAB, with institutes in Côte d'Ivoire, Cameroon, Ethiopia and Botswana emerging as regional leaders in the field of veterinary diagnostics using nuclear science and technology.[46] Building on the motivation behind the VETLAB Network and as a direct response to COVID-19, in 2020 the IAEA established the Zoonotic Disease Integrated Action (ZODIAC) Project. ZODIAC is intended to become a global integrated network for the 'monitoring, surveillance, early detection and control of animal and zoonotic diseases such as COVID-19, Ebola, avian influenza and Zika'.[47] Globally, some 2.7 million people die annually as a result of zoonotic diseases. Initiatives like VETLAB and ZODIAC will therefore benefit not only Africa but the entire globe.

39 IAEA, *Nuclear Technology for a Sustainable Future* (Vienna: IAEA, June 2012), 6.
40 IAEA, *Nuclear Technology for a Sustainable Future*, 6.
41 Kirsten, *The Contribution of Nuclear Technology*, 1.
42 Food and Agriculture Organization, "Building Veterinary Laboratory Diagnostic Capacity in Africa: The VETLAB Network", FCC-EMPRES Information Sheets, 2015.
43 FAO, "Building Veterinary Laboratory".
44 FAO, "Building Veterinary Laboratory".
45 FAO, "Building Veterinary Laboratory".
46 FAO, "Building Veterinary Laboratory".
47 IAEA, "IAEA Launches Initiative to Help Prevent Future Pandemics", Press Release, June 15, 2020.

Outline of the regime on the peaceful uses of nuclear science and technology

These peaceful research- and practical applications of nuclear science and technology all point to the undeniable fact that nuclear science and technology has the potential to change society for the better. But positive change is only possible in the context of legal commitments to their peaceful use. Africa is a global frontrunner in this regard, and the peaceful application of nuclear science and technology is deeply engrained in its wider development ambitions. As the world's largest nuclear-weapons-free zone, Africa is deeply committed to the peaceful use of nuclear science and technology, especially when used to promote and enhance development.[48] Following a series of dangerous and damaging nuclear tests conducted by France in the Sahara Desert in the 1960s, the need to establish Africa as 'a de-nuclearised zone' became apparent and the UN called on all its member states in 1961 to adopt a resolution on the matter.[49]

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The Organisation of African Unity, predecessor of the AU, followed suit and adopted the 'Declaration on the Denuclearisation of Africa' shortly afterwards, in 1964.[50] The continent has been committed to the ideal of denuclearisation and the peaceful use of nuclear science and technology ever since. It has adopted ever more treaties on the matter and established a range of oversight bodies in order to ensure the establishment of a nuclear-weapons-free environment, while promoting the developmental potential of nuclear science and technology.

Treaty on the Non-Proliferation of Nuclear Weapons

The destructive potential of nuclear science and technology is well known. However, in promoting its peaceful application and by taking a firm stance against nuclear weapons of any kind, African states have, through the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), recognised the developmental potential of nuclear science and

48 Messaoud Baaliouamer, "Statement to the 25th Anniversary of the Opening for Signature of the Pelindaba Treaty" ("Nuclear Weapon Free Zone", Microsoft Teams, April 12, 2021).
49 Baaliouamer, "Statement to the 25th Anniversary".
50 Baaliouamer, "Statement to the 25th Anniversary".

technology. They are now actively seeking and promoting those avenues through which nuclear science and technology can enhance the lives of their people. The NPT promotes the peaceful use of nuclear technology globally and aims to 'prevent the spread of nuclear weapons and technology' as a means of achieving comprehensive nuclear disarmament.[51]

The NPT encourages the peaceful use of nuclear energy and knowledge exchange between states, and recognises the 'inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes'.[52] Under the NPT, nuclear-weapon states – China, France, Russia, the UK and the US – undertake not to transfer nuclear weapons or any related devices or expertise in creating such devices to non-nuclear weapon states, while non-nuclear weapon states undertake not to manufacture nuclear weapons or to receive any such weapons or expertise relating to their manufacture.[53] The NPT entered into force in 1970 and is subject to review every five years.[54] Participation in the NPT is high on Africa's agenda; only two states have neither ratified nor acceded to the NPT, and more than half of its states parties have also ratified additional protocols that allow for inspection and monitoring by the IAEA.[55]

African Nuclear-Weapons-Free Zone Treaty

In April 2021, Africa celebrated the 25th Anniversary of the Opening for Signature of the African Nuclear-Weapons-Free Zone Treaty (Pelindaba Treaty) – a significant milestone in the establishment of Africa as a nuclear-weapons-free zone. The Pelindaba Treaty promotes the ideals of nuclear disarmament, nuclear non-proliferation and the peaceful use of nuclear energy. Signatories to the Pelindaba Treaty agree 'not to conduct research on, develop, manufacture, stockpile or otherwise acquire, possess or have control over any nuclear explosive device by any means'.[56] The Pelindaba Treaty was agreed to in 1995 during the 31st Ordinary Session of the OAU, signed in April the following year, and entered into force on 15 July 2009. It has been signed by 52 African member states and ratified by 42. The Pelindaba Treaty fits into a 'wider strategy to implement the Common African Defence and Security Policy' and is a vital part of the AU's general peace and security framework.[57]

The African Commission on Nuclear Energy (AFCONE) was established through the Pelindaba Treaty and is tasked with 'ensuring States parties' compliance with their obligations under the Treaty and the Protocols thereto'.[58] AFCONE also actively promotes 'cooperation in the peaceful, safe and secure uses of nuclear science and technology in

51 UN Office for Disarmament Affairs, "Fact Sheet: Treaty on the Non-Proliferation of Nuclear Weapons", July 2014.
52 IAEA, "Treaty on the Non-Proliferation of Nuclear Weapons", Information Circular 140, April 22, 1970.
53 UNODA, "Fact Sheet: Treaty".
54 UNODA, "Fact Sheet: Treaty".
55 Sah et al., "Atoms for Africa".
56 Baaliouamer, "Statement to the 25th Anniversary", 3.
57 Noël Stott, "The Treaty of Pelindaba: Towards Full Implementation of the African Nuclear-Weapon-Free Zone Treaty" (Institute for Security Studies, Pretoria, March 2011).
58 Baaliouamer, "Opening Address: Wilton Park", 3.

the continent, as well as advancing global disarmament and non-proliferation efforts'.[59] Its bureau is located in Pretoria, South Africa. From its states parties, 12 experienced professionals in the fields of nuclear and technology, security and diplomacy are elected to serve as the body's commissioners. As the treaty oversight body, AFCONE is committed to 'support nuclear research and training activities with an emphasis on continually improving, in the field, nuclear safety, security and safeguards' and to ensure the safe and efficient integration of nuclear power in regional energy systems.[60]

Role of nuclear science and technology in meeting Agenda 2063 and the SDGs

Development itself is inherently linked to 'access to clean, sufficient and affordable energy'.[61] As countries continue to experience socio-economic growth, electricity will also be in higher demand.[62] Yet many African countries suffer from critical electricity shortages and fail to meet this rise in demand. According to 2020 estimates, 592 million people on the continent (nearly half of the total population) had no access to electricity.[63] Low electricity access rates and recurring power outages are detrimental to economic development and without electricity it is unlikely that development projects can achieve their intended goals.

Nuclear science and technology are increasingly regarded as an attractive potential solution to these shortcomings. Excluding South Africa, which already operates a nuclear power plant, Egypt is fast approaching the completion of its own nuclear power project. Algeria, Ghana, Kenya, Morocco, Nigeria, Sudan and Tunisia could be ready to operate nuclear power plants by 2030.[64] At present, another 17 African countries have expressed interest in nuclear power and could be ready for its implementation by 2050.[65] According to Messaoud Baaliouamer, AFCONE's executive secretary, AFCONE has aligned its 'strategic goals and enablers with those adopted by the African Union Commission', including both Agenda 2063 and the UN SDGs.[66]

Science, technology and innovation (STI) forms part of the pillars that support both Agenda 2063 and the aspirations of the SDGs. In the context of increased emphasis on STI and the aspiration of meeting the goals of Agenda 2063 and the SDGs, Baaliouamer notes that an increase in the demand for 'nuclear techniques' can be expected across the continent, as governments seek to mitigate Africa's 'development challenges, including those

59 Baaliouamer, "Opening Address: Wilton Park", 3.
60 Baaliouamer, "Opening Address: Wilton Park", 6.
61 IAEA, "*Nuclear Technology for a Sustainable Future*", 9.
62 Laura Gil, "Is Africa Ready for Nuclear Energy?", IAEA, 3 September 2018.
63 IAEA, "Population Without Access to Electricity in Africa, 2000–2020", October 12, 2020.
64 Jacob Kincer and Jessica Lovering, "Who in Africa is Ready for Nuclear Power?", Energy for Growth Hub, January 12, 2021.
65 Kincer and Lovering, "Who is Ready for Nuclear".
66 Baaliouamer, "Opening Address: Wilton Park", 3.

pertaining to poverty and hunger, human health, energy, water and climate change'.[67] These challenges are also at the heart of what Agenda 2063 and the SDGs seek to mitigate. As interest in nuclear science and technology across the continent escalates, African states will continue to seek ways of 'strengthening nuclear infrastructure and enhancing nuclear expertise and know-how to enable the African end-users to respond more effectively to their development priorities'.[68]

> The ripple effects of progressive nuclear science and technology applications in the fields of human and animal healthcare, agriculture, environment and research can be felt

Already, the ripple effects of progressive nuclear science and technology applications in the fields of human and animal healthcare, agriculture, environment and research can be felt. The benefits of nuclear energy will be a bonus, enhancing economic development while enabling the human development already enhanced through the application of nuclear science and technology outside of electricity generation.

Africa's challenges in accessing, maintaining and applying nuclear science and technologies

The contribution of nuclear science and technology to meet Africa's developmental aspirations notwithstanding, the fact that nuclear material poses potential risks cannot be ignored. Some of the biggest risks include:

- the possibility that nuclear and radioactive materials might fall into the hands of criminal or terrorist actors, a concern raised by the AU;

> The contribution of nuclear science and technology to meet Africa's developmental aspirations notwithstanding, the fact that nuclear material poses potential risks cannot be ignored

67 Baaliouamer, "Opening Address: Wilton Park", 4.
68 Baaliouamer, "Opening Address: Wilton Park", 4.

- the creation of waste that remains radioactive and dangerous to human and animal health for thousands of years, thus adding to environmental concerns more broadly; and
- the possibility that nuclear material may be enriched in order to create nuclear weapons.

There is certainly a need for advanced technologies to address the particular energy, health and agricultural needs of the African continent, many of which nuclear science and technology are in a position to address. But the path to achieving this is not easy and African countries will have to overcome a number of challenges in order to gain fully from nuclear science and technology. A SWOT analysis conducted by African states prior to the 2020 Wilton Park Conference (at which African states discussed the role of nuclear science and technology in support of Agenda 2063) revealed a number of these challenges.

African countries will have to overcome a number of challenges in order to gain fully from nuclear science and technology

Some of the most significant challenges included scepticism about nuclear technology as a result of insufficient 'public relations and communication strategies' on the part of African governments, and the non-alignment of nuclear science and technology with national development goals.[69] Another challenge relates to the time frame of establishing a nuclear power programme, which requires invested commitment from the planning phase all the way through to the decommissioning phase of a nuclear power plant. In addition, there are issues of financial stability and ability to fully fund nuclear power programmes and even nuclear research.[70] Scepticism about nuclear technology also lowers public support, making it more difficult to implement.

Conclusion and recommendations

Africa is no stranger to nuclear science and technology and has for decades recognised the tremendous developmental potential vested in this technology. This is evident from its deep commitment to denuclearisation and active promotion of the peaceful uses of nuclear energy. Nuclear science and technology has the potential to accelerate the achievement of the goals of Agenda 2063 and the SDGs. In the long run, it can be a vital component of the successful economic and human development of the continent. The drive for increased applications of nuclear science and technology apart from civil

69 Baaliouamer, "Opening Address: Wilton Park", 9.
70 Gil, "Is Africa Ready for Nuclear".

electricity production reflects countries' commitment to the value attached to STI in both Agenda 2063 and the SDGs. It is also reflective of a continent that seeks to improve the lives of its people and that has recognised the role that nuclear science and technology can play in this. Thus, its application in the healthcare and agriculture sectors in particular reflects the aspirations of Agenda 2063 and the SDGs, namely of improving the health and nourishment of Africa's people, and ensuring development that is environment and climate conscious. Above all, Africa's deep commitment to the peaceful use of nuclear science and technology aligns perfectly with its aspiration for peace and security, also enshrined in Agenda 2063. Importantly, African states have also identified some of the key challenges that currently prevent the full development of a flourishing continental nuclear science and technology network, a key step in progressing towards its development. Through increased regional and international cooperation, the continent will be able to overcome these and any future emerging challenges.

> Africa is no stranger to nuclear science and technology and has for decades recognised the tremendous developmental potential vested in this technology

Recommendations

- National and continental public education programmes on nuclear science and technology should be implemented as part of the planning phase for nuclear power programmes and other areas where nuclear technology may be applied.
- Training and education in nuclear science and engineering that takes place on the continent will be beneficial but should be expanded.
- Existing close cooperation with the IAEA in all forms of nuclear science and technology should continue as more African states are prone to zoonotic diseases and food insecurity.
- As a beacon of denuclearisation and an important partner in global nuclear medicine and research programmes like VETLAB and ZODIAC, Africa should continue to invest in these initiatives.
- Having aligned its priorities closely with Agenda 2063 and the SDGs, African states seeking to include nuclear science and technology in their development agendas can benefit from working closely with AFCONE.
- In light of increasing diagnoses of non-communicable diseases, African states can benefit from investing more in nuclear medicine and related research.

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SAIIA is an independent, non-government think tank whose key strategic objectives are to make effective input into public policy, and to encourage wider and more informed debate on international affairs, with particular emphasis on African issues and concerns.

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Cover image

Nuclear power plant and flowering meadow (Getty Images/narvikknarvikk)

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