


Chapter 2

Advancing Nuclear Energy: Why Peaceful Uses Need the Non-Proliferation and Disarmament Regimes

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2.1 Introduction

A significant number of African states are looking to nuclear power to address some of their biggest developmental challenges, including extending electricity access to their populations and addressing the difficulties brought about by climate change (Stott & Bosman 2021). This growing interest in nuclear energy is part of a developing trend, what the International Atomic Energy Agency (IAEA) calls “an evolution in clean energy generation” on the continent (IAEA 2022). Since 2009, more than 26% of the requests for assistance from the IAEA in determining the viability of nuclear power came from African states (IAEA 2022).

But nuclear science and technology remains a controversial subject. The detonation of atomic bombs has caused some of the biggest environmental destruction, health risks, and loss of human life in history (WHO 1995). Since the first of these weapons was tested in 1945 (the same year in which the only military application of nuclear weapons to date took place), more than 2,000 nuclear test explosions have followed (Duggal

& Haddad 2022). And no comfort is to be found in knowing that there are more than 12,000 of these weapons in nuclear arsenals today (Kristensen, Korda, Johns & Kohn 2023). This tally is split between nine states: China, France, India, Israel, North Korea, Pakistan, the Russian Federation, the United Kingdom (UK), and the United States of America (USA), with Russia and the USA possessing the largest arsenals in the world.

However, long before this knowledge was used to create weapons, nuclear energy was harnessed for peaceful purposes. The genesis of this science can be traced to 1895, when Wilhelm Röntgen discovered what he termed “x-rays”, after passing electron beams through empty glass (cathode) tubes and creating the world’s first x-ray image—that of the bones in his wife’s left hand (Brown 2018; World Nuclear Association 2020). A mere 8 weeks after this revelation, the practice was incorporated in medical care and continued to evolve, resulting in many of the procedures we are familiar with today, such as brachytherapy, radiotherapy, and radionuclide diagnostics, to name a few (Brown 2018). With the discovery in the late 1930s of fission (the splitting of atoms, resulting in a sustained chain reaction that produces mass amounts of energy), a significant diversification of nuclear science and technology took place, and between 1939 and 1945 nuclear weapons began to take shape. According to the World Nuclear Association, only in 1945 did the focus really begin to shift again in the direction of peaceful purposes through work on “harnessing this energy in a controlled fashion for naval propulsion and for making electricity” (World Nuclear Association 2023). One of the most important focus areas of this renewed attention to the peaceful uses of nuclear science and technology involved nuclear power plants (World Nuclear Association 2023). Although there are several risks and concerns associated with the peaceful application of nuclear energy (accidents, radioactive waste disposal, and proliferation are some of the biggest), the potential of nuclear science and technology for enhancing living conditions by directly contributing to the improvement of healthcare, food security, and electricity access, *inter alia*, cannot be overstated.

This chapter aims to show that the application of nuclear science and technology for peaceful purposes, specifically for nuclear energy, is deeply dependent on the non-proliferation and disarmament regimes, a self-evident truth clearly contained in these legal frameworks. To illustrate these points, I draw briefly on the history of the legal case for peaceful uses, looking chiefly at the 1953 “Atoms for Peace” initiative, before exploring the ways in which this is made clear in the NPT. The chapter then considers the Treaty of Pelindaba, showing how it complements and enhances, perhaps even surpasses, the objectives of the NPT, before concluding with reflections on the current and future peaceful applications of nuclear energy in Africa and how these legal instruments will be vital for preserving its many benefits.

2.2 Promoting nuclear energy: what is required?

Because of the destruction that nuclear weapons can cause, many fear the peaceful application of this technology for civil electricity production. Disasters and nuclear accidents the like of Three Mile Island (1979), Chernobyl¹ (1986), and Fukushima Daiichi (2011) have also caused many to dismiss nuclear power altogether as dangerous, unreliable, and therefore not worth pursuing. Associating nuclear energy purely with the destructive force of which the atom is capable is a significant oversight. While it is true that the fission and fusion of the atoms of certain elements (most commonly uranium, plutonium, and hydrogen) have exhibited significant destructive force, nuclear energy can also be used to further human socio-economic development (Barbarino 2023).

The Three Mile Island, Chernobyl, and Fukushima Daiichi incidents all made a dent in the public opinion of nuclear energy. The threats of armed attack levelled against Zaporizhzhia Nuclear Power Plant (ZNPP) in the ongoing Russia-Ukraine war added to this. Fears of such disasters being repeated are understandable. But these incidents revealed where more focus is required to improve the safety of operating nuclear power plants going forward, whether in design, operator capabilities,

1 This is the accepted Ukrainian transliteration.

or disaster preparedness (Aytbaev *et al.* 2020). To address these concerns, science is constantly improving the technology, with safety always at the heart of new design developments. China, for example, is working on the world's first thorium molten salt reactor and plans to begin construction of this plant in 2025. It is widely recognised that such reactors would be safer to operate than traditional nuclear power plants, but it comes with its own challenges related to salt corrosion and waste disposal (Jackson 2024). In addition, the developing situation at the ZNPP shows that stronger physical protection of nuclear facilities is a necessity for preserving the peaceful use of nuclear energy (Bosman 2023). The question that many are grappling with is whether the benefits of this form of energy outweigh the costs of its implementation, real or hypothetical. The evidence indicates that the world has not yet discarded nuclear energy as an option.

The world's first nuclear power reactor came online in 1954, marking the beginning of the full-fledged development of a global nuclear power industry throughout the 1960s and an upscale of the implementation of nuclear power during the oil crisis of the early 1970s (Ge 2022). The World Nuclear Association reports that there are currently 436 nuclear power reactors in operation across the globe with an additional 59 under construction (World Nuclear Association 2023). Added to these numbers are 220 research reactors in use across 50 countries for "the production of medical and industrial isotopes, as well as for training" (World Nuclear Association 2023). As early as 1968, the IAEA stated that because of "over-population, lack of food and limited traditional resources, nuclear energy is emerging as a most powerful force for the benefit of man" (IAEA 1968). Today, rather than being resolved, these issues have only been compounded, and humanity is faced with addressing food insecurity, increased pandemic and disease risk, and a shift away from fossil fuels as the race to combat climate change is intensifying.

In its recent *Climate Change and Nuclear Power 2022: Securing Clean Energy for Climate Resilience*, the IAEA maintains that to address the growing impact of climate change, "energy sector

investment must be scaled up and directed towards cleaner and more sustainable technologies that support climate change mitigation and adaptation” (IAEA 2022:84). It also maintains that there is a “need to reinvigorate and rebalance energy sector investment to address energy security vulnerabilities and broader sustainability challenges”, all factors to which nuclear power can directly contribute (IAEA 2022:5). Thus, nuclear energy could be utilised to address some of the biggest socio-economic and environmental challenges facing humanity in the twenty-first century. But for these benefits to be harnessed, a robust legal framework is required not only to ensure that nuclear power plants are operated safely and securely but to create a security environment in which nuclear installations are protected in times of conflict and, more importantly, the authority of these legal instruments is respected (Ge 2022).

Such a framework has been developed over the last five decades (a process in which African states were, and continue to be, important players) to guide the peaceful application of nuclear science and technology and to mitigate associated risks. Africa has relied on the law to establish the continent as a nuclear-weapons-free zone through the Treaty of Pelindaba (1996). Apart from prohibiting the development, acquisition, possession, stationing, and testing of nuclear weapons on the continent, the treaty also provides the legal basis for the peaceful uses of nuclear energy in Africa and contains articles relating to the physical protection of and prevention of armed attacks on nuclear installations (Articles 10 and 11) (AU 1996). The Treaty of Pelindaba draws inspiration from the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) of 1968. The NPT was born from the need to prevent an increasing number of states from acquiring nuclear weapons (non-proliferation) and to achieve widespread nuclear disarmament. In addition, the peaceful uses of nuclear energy are one of its three core principles. The NPT (and the Treaty of Pelindaba) therefore make explicit the undeniable links between non-proliferation, disarmament, and peaceful uses. For this reason, as Black-Branch and Fleck (2016:1) rightly observe, non-proliferation, disarmament, and peaceful uses cannot be “examined in isolation”. In other words, without including non-proliferation

and disarmament in considerations, we miss a crucial aspect of what it means to benefit from the peaceful uses of nuclear energy.

2.3 Enshrined in international law: How the peaceful uses pillar ended up in the NPT and beyond

It is significant that the very first resolution adopted by the UN General Assembly addressed the concerns around the diversion of nuclear science and technology away from peaceful application (Chossudovsky 1990). On 24 January 1946, the 51 Member States gathered in the General Assembly adopted A/RES/1(I), “Establishment of a Commission to Deal with the Problems Raised by the Discovery of Atomic Energy”. Apart from condemning nuclear weapons and calling for disarmament, A/RES/1(I) also calls on the committee established pursuant to the resolution to propose steps for “extending between all nations the exchange of basic scientific information for peaceful ends”, the “control of atomic energy to the extent necessary to ensure its use only for peaceful purposes”, and finally to implement “effective safeguards by way of inspection and other means to protect complying States against the hazards of violations and evasions” (UN General Assembly 1946).

Concerns about proliferation risks and growing nuclear arsenals continued into the 1950s and, soon enough, the matter of moving away from military applications of nuclear science and technology towards peaceful applications instead was brought to the table again (Chossudovsky 1990). At the 470th Plenary Meeting of the UN General Assembly on 8 December 1953, Dwight D. Eisenhower, then president of the USA, delivered what the media of the time famously called the “Atoms for Peace” speech (Drogan 2016:948–74). In this speech, Eisenhower made the case for the peaceful application of nuclear science and technology in healthcare, agriculture, and civil electricity production, *inter alia*. The speech also called for the creation of an atomic energy agency to oversee the international transfer of peaceful nuclear technologies and storage and dissemination of fissionable nuclear fuel. At the same time, Eisenhower also promised support from the

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US (technology and knowledge transfers) for implementing the peaceful uses of nuclear energy so that “the miraculous inventiveness of man shall not be dedicated to his death but consecrated to his life” (Eisenhower 1953).

A symbolic type of fission, Eisenhower sought to separate the peaceful, progressive, developmental aspects of nuclear science from the violence and ruin for which the atom became known in 1945. A nuclear arms race swiftly followed. Eisenhower was convinced that “if the fearful trend of atomic military build-up can be reversed, this greatest of destructive forces can be developed into a great boon, for the benefit of all mankind” (Eisenhower 1953). Drogan maintains that Atoms for Peace “grew out of a proposal to be more open with the U.S. public about the nation’s nuclear project” (Drogan 2016:950). Until Eisenhower’s speech, US policy on the matter of nuclear technology was “one of total secrecy and denial” (Krass *et al.* 1983:195). By publicly voicing the Atoms for Peace proposals, it switched to what Krass *et al.* (1983:195) term “selective secrecy and control by co-operation”. But while more transparency as a factor was considered, the speech at its start also marked “the kick-off to a massive propaganda campaign by the U.S. Information Agency (USIA)” (Drogan 2016:948). Nuclear power, Gattie and Massey (2020:124) maintain, “had become a political issue ‘in the context of the great contest between Western freedom and Soviet totalitarianism’ and would require candour, trust, and confidence with the American public and with US allies in an emerging world order”.

The Eisenhower administration was searching for a way to “offer a sense of optimism and portray the United States as an advocate for peace instead of war”, an opportunity the speech provided (Drogan 2016:950). Referring to a 1955 National Security Document, “Peaceful Uses of Atomic Energy”, that grew out of Eisenhower’s 1953 proposals, Drogan describes it as “concerned almost entirely with the ‘psychological benefits’ to be gained from the globalisation of nuclear power under American leadership” (Drogan 2016:972). But it was also a clear indication that nuclear power had become an issue of national security to the US and, in this spirit, the US’s leadership in the

development of the peaceful uses of nuclear energy was viewed by the country's National Security Council as a way to "promote cohesion within the free world and to forestall successful Soviet exploitation of the peaceful uses of atomic energy to attract the allegiance of the uncommitted people of the world" (National Security Council Report cited in Gattie & Massey 2020:124). When Eisenhower delivered the speech in 1953, no concrete plans for a project to promote the peaceful uses of nuclear energy were actually in place. In fact, apart from his inner circle, a significant number of officials in the US government were not aware of Eisenhower's proposals until he delivered the speech (Drogan 2016).

Furthermore, while he strongly emphasized civil electricity production in the speech, the US had no nuclear power reactors of the size and scale necessary for this task, with government reports from the time stating that "nuclear power was neither economical nor ready for export, and that it represented a serious proliferation risk" (Drogan 2016:949). Eisenhower's speech and the US's framing of nuclear energy coincide with both the establishment of a liberal post-war world order and the "rising Communist power", ultimately steering the National Security Council "to establish an international system to safeguard the US and the world from future great power conflicts by controlling atomic energy in all its various pathways that could offer peaceful applications and prevent military extensions" (Gattie & Massey 2020:125). Atoms for Peace had a lasting impact on the world and became the platform for the realisation of several bilateral cooperation agreements, and nuclear technology and fissionable fuel were shared; it would also ultimately result in the establishment of the IAEA in 1957 (Drogan 2016). By creating these formal platforms for sharing knowledge and technology related to nuclear science, Atoms for Peace contributed to an acceleration of their dispersal but at the same time delivered its crowning achievement: "the establishment of a normative framework that in its absence likely would not have emerged" (Scheinman 2003). Moreover, as Lawrence Scheinman, former Distinguished Professor in the Center for Non-proliferation Studies at Monterrey University argues, it is very likely that without

the Atoms for Peace proposals, the IAEA would not have been created; and, in such an environment, it is anyone's guess as to whether nuclear technology sharing would have proceeded unabated or with clear-cut conditions (Scheinman 2003).

The two sides of nuclear science and technology that Eisenhower (and the UN General Assembly before him and advocates for peaceful uses to this day) sought to split, however, oscillate in "fundamental tension" (Krass *et al.* 1983:197). As David Bergmann, founder of the Israel Atomic Energy Commission remarked, "by developing atomic energy for peaceful uses you reach the nuclear option; there are not two atomic energies" (Bergmann quoted in Scheinman 2003:7). Thus, the same fears that plagued the international community in 1946, about nuclear technology and knowledge-sharing resulting in proliferation of nuclear weapons, still exist to some extent today. To dismiss such concerns offhand would be counterintuitive. As the so-called "father of the hydrogen bomb", Edward Teller, opined, "eventually nuclear proliferation is unavoidable unless we find better solutions to international problems than are now on the horizon" (Teller quoted in Scheinman 2003:7).

The consequences of unsafeguarded sharing of nuclear technology and scientific know-how have been well demonstrated. One example is Canada's transfer of a nuclear research reactor without safeguards to India in 1954, a reactor that was ultimately used to produce the plutonium for India's first nuclear weapons test in 1974 (International Panel of Fissile Material 2010). Another is the purchase of a nuclear reactor from France by Israel in 1956 (Scheinman 2003). The well-documented A. Q. Khan nuclear network incident also shows how it is possible to share the technical know-how needed to design nuclear weapons in the absence of strict trade regulations and control mechanisms. In his analysis, "Shadow and Substance: Securing the Future of Atoms for Peace", Scheinman argues that Teller's assessment of the inevitability of nuclear proliferation points to an unsettling but important probability: "that capability alone is an insufficient explanation of the risk of proliferation. Motivation also matters" (Scheinman 2003).

Many legitimate proliferation concerns have been raised, from reaching weaponisation from civilian application to proliferation by non-state actors and safeguarding of existing nuclear weapons and weapons technology from malicious actors. And while it could be possible, strictly speaking, to move from civil electricity production to weapons production, the very process itself is not easy, and a majority of states have no desire, or more precisely, lack the motivation, for the production, stockpiling, and maintenance of nuclear weapons. That is not to say that proliferation should not be a concern. In a 2007 debate between renowned political scientists Scott Sagan and Kenneth Waltz, Sagan (in Sagan, Waltz & Betts 2007:140) best summarised the issue in his criticism of Waltz's statement:

Professor Waltz argues that we do not need to wonder whether new nuclear states will take good care of the nuclear weapons—they have every incentive to do so. 'They', an abstract entity called the state, may have the incentive to do so. But other actors inside these states may not have similar incentives.

The safe operating, safeguarding, and physical protection of nuclear installations is therefore of the utmost importance not only for preventing accidents but also for ensuring that the technology does not fall into the hands of actors whose interests do not align with this goal. Thus, as Sagan (in Sagan, Waltz & Betts 2007:145) posits, "[t]he key is to permit the development of civilian nuclear reactors but stop the spread of uranium enrichment and reprocessing technologies". The normative and legal framework that evolved from the Atoms for Peace initiative and that gave rise to the IAEA and the NPT can be regarded as some of the "better solutions" referred to by Teller. Their goal should be to remove the motivation states might have for diverting peaceful uses to weapons applications. To do this, various regional and international instruments have entrenched disarmament and non-proliferation as ideals and requirements, and made the peaceful uses of nuclear energy conditional on certain safeguards and circumstances and at the same time subject to a legal framework capable of penalising those who

depart from the accepted standards. And this is precisely where the NPT comes in (Sagan 2009).

2.4 The Treaty on the Non-Proliferation of Nuclear Weapons: Peaceful uses subject to...

The NPT carries tremendous symbolic and practical weight. To date, the treaty has a total of 191 States Parties (Nuclear Threat Initiative 2024). States party to the NPT include China, France, the Russian Federation, the UK, and the US (the Permanent 5 or P5), all recognised nuclear weapon states (NWS) under the NPT. There are five non-state parties to the NPT: India, Israel², North Korea (who withdrew from the treaty in 2003), Pakistan, and South Sudan, the first four of which are considered nuclear-armed states. In the more than 50 years since its entry into force, the NPT achieved many milestones, especially as envisioned at the time of its negotiation, most notably near universal accession and the creation of several more regional nuclear-weapon-free zones that reinforce its legitimacy (Abe 2020).

But the drafting and eventual entry into force of this treaty was a long and winding path. Eisenhower's Atoms for Peace proposal set in motion a drive at the highest international levels to, firstly, place prohibitions on the development, dissemination, and possession of nuclear weapons and, secondly, to legitimise the peaceful application of nuclear science and technology under carefully laid out safeguards requirements to prevent diversion from this route. The 1950s arguably became the most important decade for promoting these ideals, especially at the level of the UN General Assembly. The General Assembly in the 1950s was dominated largely by US interests, and while these certainly played an important role in shaping the NPT and general disarmament and non-proliferation frameworks (as did

² Israel has neither officially confirmed nor denied its possession of nuclear weapons. However, it is commonly believed that it does possess some and it is generally included in the list of nine NWS. According to the Center for Arms Control Non-Proliferation, estimates indicate that Israel is in possession of 90 plutonium-based nuclear warheads (Center for Arms Control and Non-Proliferation n.d).

the interests of the Soviet Union), several other (smaller) states or aligned state groupings became prominent actors in the field during this time (Macqueen 1984). They effectively used the General Assembly and its First Committee (Disarmament and International Security) as vehicles for tabling their interests on the most important issues of the day and pushing for action on these matters, which would ultimately result in the opening for signature of the NPT in 1968 and its entry into force two years later.

Key in this process was Ireland's minister for external affairs, Frank Aiken (Chossudovsky 1990). Aiken served as minister for external affairs from 1951–1954 and 1957–1969. A member of the UN since 1955, Ireland recognised the threat that the unrestricted spread of nuclear weapons (horizontally and vertically) could pose for international security going forward and used its UN membership between 1958 and 1961 to persistently push for legal mechanisms to rein in this rapidly evolving sphere of science (Chossudovsky 1990). During this time, Ireland submitted four resolutions (one in each year), addressing growing concerns about the spread of nuclear weapons, and successfully turning this item into a General Assembly (and First Committee) agenda action point (Chossudovsky 1990).

A precise history of this process spanning 1958–1961 is well beyond the scope of this chapter. To briefly summarise, however, Ireland's efforts led to the adoption of several General Assembly resolutions (including Resolution 1380 of 1959 and Resolution 1576 of 1960) on the matter, peaking with what Chossudovsky calls the “notable, if not historic” unanimous approval of its 1961 draft resolution by the First Committee (30 November 1961) and General Assembly (4 December 1961), and the introduction of UN General Assembly Resolution 1665(XVI) (Chossudovsky 1990). Resolution 1665(XVI), “Prevention of the wider dissemination of nuclear weapons”, “calls upon all states, and in particular upon the states at present possessing nuclear weapons, to use their best endeavours to secure the conclusion of an international agreement containing provisions under which the nuclear states would undertake to refrain from

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relinquishing control of nuclear weapons and from transmitting the information necessary for their manufacture to states not possessing such weapons, and provisions under which states not possessing nuclear weapons would undertake not to manufacture or otherwise acquire control of such weapons” (UN General Assembly 1961:6; Chossudovsky 1990).

It is worth noting that Ethiopia, Liberia, Sudan, and Tunisia were some of the African countries also involved in these and other early efforts to create a single treaty document on non-proliferation and disarmament.³ It would also be remiss to leave out consideration of the various proposals for nuclear arms control put forward by the US and the former Soviet Union in the creation of the NPT (Goldschmidt 1986). With nuclear weapons testing on the rise in the late 1950s and the ensuing Cuban Missile Crisis of 1962, the need for nuclear arms control was clear and the US, UK, and Soviet Union entered into the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space, and Under Water in August 1963 (Athanasopoulos 1997). The importance of controlling the spread of nuclear weapons would be made even more apparent in 1964 when China conducted its first nuclear test. In 1959, the Soviet Union assisted China with the construction of a gaseous diffusion plant used to enrich the uranium to build its bombs. Krass *et al.* (1983:196) report that as a result of this “traumatic experience”, no “further exports of enrichment technology by the Soviet Union” were recorded.

Subsequently, negotiations of the NPT kicked-off in 1965, and by 1 July 1968 a treaty document had been approved and opened for signature (Goldschmidt 1980). The NPT is built upon the distinction of peaceful uses from non-proliferation and disarmament. The Treaty consists of 11 articles that address non-proliferation and disarmament commitments as well as the continuation of the use of nuclear science and technology for peaceful purposes. The first four of these articles will be considered here. Acknowledging the existence of five nuclear weapons states, Article 1 of the NPT places restrictions on the

3 For a detailed history of Ireland’s, and more specifically Aiken’s role, see Chossudovsky (1990).

transfer of nuclear weapons or related explosive devices and their control to any of its non-nuclear weapons state parties and to not incentivise these states to want to produce or acquire nuclear weapons (UNODA 1968). Article 2 flips the table on the non-nuclear weapons states parties, requiring that they will not accept the transfer of nuclear weapons or related explosive devices, nor transfer of the control over such weapons systems, and not produce, or ask for assistance to produce, such weapons (UNODA 1968).

Article 3 of the NPT pertains to safeguards and is broken into four parts. According to Article 3(1), every state party to the NPT not in possession of nuclear weapons “undertakes to accept safeguards as set forth in an agreement to be negotiated and concluded” with the IAEA. These safeguards are to draw directly from the Statute and safeguards system of the IAEA (UNODA 1968). Safeguards under the NPT are put in place for “the verification of the fulfilment of its obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices” (UNODA 1968). Article 3(2) provides that every party to the treaty (NWS included) shall not provide “(a) source or special fissionable material, or (b) equipment or material especially designed or prepared for the processing, use or production of special fissionable material, to any non-nuclear-weapon State for peaceful purposes, unless the source or special fissionable material shall be subject to the safeguards required by this Article” (UNODA 1968).

The safeguards provision in the NPT links directly to Article 4 (Peaceful Uses), and Article 3(3) states that the safeguards requirement “shall be implemented in a manner designed to comply with Article IV . . . and to avoid hampering the economic or technological development of the Parties or international co-operation in the field of peaceful nuclear activities” before finally concluding in Article 3(4) with an obligation on non-nuclear weapon states to “conclude agreements with the [IAEA] to meet the requirements of this Article either individually or together with other States in accordance with the Statute of the [IAEA]” (UNODA 1968).

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This requirement is time-sensitive: within 180 days of the entry into force of the NPT, states were expected to begin these negotiations, and those that ratified it after this period will be subject to agreement that “enter into force not later than eighteen months after the date of initiation of negotiations” (UNODA 1968). Article 4(1) of the NPT provides for the “inalienable right of all the Parties to the Treaty to develop research, production, and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty” (UNODA 1968). It is important to note, however, as Sagan emphasises, this inalienable right comes with the condition that states be in *good standing* with the NPT, the initial clause of Article 4 (Sagan, Waltz & Betts 2007:148). In other words, states should not be found to be acquiring nuclear technology under the pretence of civilian application only to be caught diverting it for weapons purposes.

Furthermore, according to Article 4(2), all state parties “undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy” (UNODA 1968). Proponents of nuclear energy frequently cite Article 4 of the NPT as the guarantor of its use, drawing on the phrase “inalienable right”. And while this article does cement the right to peaceful uses of nuclear science and technology, it has also fallen victim to what Scheinman terms “an imperfect and uncritical reading” that veils the reality that the threat of proliferation still remains even where nuclear science and technology is applied for peaceful purposes (Scheinman 2003). Scheinman maintains that it is taken for granted that Article 4(1) goes on to say that peaceful uses will only be permitted “in conformity with Article I and II”—in-line with Sagan’s “good standing” reminder—which specifically mandate non-proliferation and nuclear sharing within established safeguards mechanisms (Scheinman 2003).

Sagan notices the same frequent oversight and argues that “this ‘inalienable right’ is in reality a conditional right, dependent upon the state in question” adhering to Articles 1 and 2 (Sagan 2009:160). In other words, to separate peaceful uses

from non-proliferation and disarmament—or put differently, to forget the dangers and destructive capabilities to which nuclear science and technology can be applied—is a mistake, since the application of this science for purposes of a peaceful nature does not remove the inherent risk that a state might succumb to the temptation, whatever the motivation may be, to divert and go down the explosive path. Referring to the case of suspected proliferation in Iran’s nuclear programme, Sagan argues that “it is too often forgotten . . . that a state that is not behaving ‘in conformity’ with its Article II commitment . . . has at least temporarily sacrificed its rights to acquire civilian nuclear technology under Article IV” (Sagan 2009:160; cf. also Sagan, Waltz & Betts 2007).

Ultimately, it is compliance with Articles 1 and 2 that upholds the right supplied in Article 4. As the president of the tenth NPT Review Conference remarked at Wilton Park in 2021, “In this way, non-proliferation commitments enable peaceful uses, but it is the promise of the benefits under this third pillar that prop up the other two” (Zlauvinen 2021:2). In other words, states should be motivated to conform with Articles 1 and 2 to gain from the benefits of peaceful uses. At the same time, Kirsten and Zarka (2022:7) argue that there is also a generally noticeable “lack of awareness of peaceful uses, particularly of non-power applications”, meaning that a significant majority of people are inclined to associate peaceful uses simply with nuclear power, ignorant of “the lifesaving applications in treating cancer, improving food security, and detecting and fighting disease”. This necessitates placing more emphasis on the peaceful uses of nuclear energy, especially now when it is poised to alleviate so many of the developmental challenges the world faces. However, it should not be forgotten that it then rests ultimately on states to adhere to their safeguards and non-proliferation commitments. Applying nuclear science and technology peacefully therefore comes with the price of strict regulation.

In 1995, the NPT was extended indefinitely, a process in which South Africa, a new party to the treaty and widely acclaimed champion of disarmament after dismantling its

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nuclear weapons programme, was instrumental (Arms Control Association 2022). Discontent with the little progress made by NWS on disarmament since the treaty entered into force was high in 1995, and non-nuclear weapon states sought to increase the pressure on NWS to disarm. This included “the establishment of a set of principles and objectives on nuclear non-proliferation and disarmament to hold . . . particularly the nuclear-weapon states, accountable to their commitments” (Arms Control Association 2022). Furthermore, also on the table was the possible creation of a weapons of mass-destruction-free zone in the Middle East (Arms Control Association 2022). This ideal has not yet been realised.

African states, however, have further cemented their widespread support of the NPT by following this line of thought and creating a nuclear-weapon-free zone on the continent. This aligns with Article 7 of the NPT, which states that “Nothing in this Treaty affects the right of any group of States to conclude regional treaties in order to assure the total absence of nuclear weapons in their respective territories” (UNODA 1968). As the next section will show, although this aligned with the objectives of the NPT, Africa’s commitment to nuclear disarmament and the peaceful uses far precedes the NPT. In addition to its domestic regulations, African states display high levels of support for the NPT, as outlined in Figure 1.

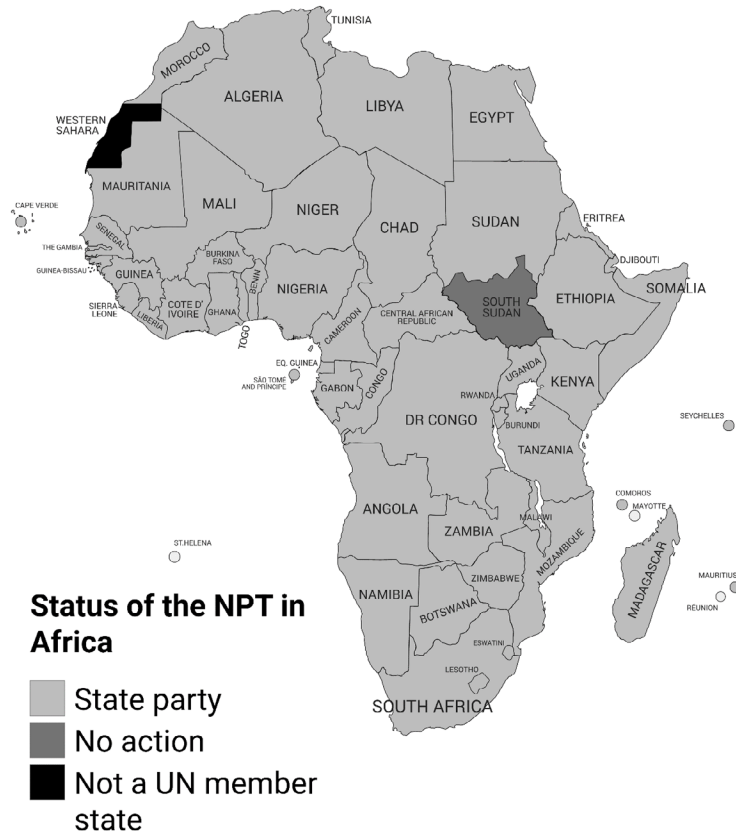


Figure 1: Map detailing the status of the NPT on the African continent. Source: Author

2.5 Africa’s commitment to disarmament, non-proliferation, and the peaceful uses of nuclear energy: The African Nuclear-Weapon-Free Zone Treaty (Treaty of Pelindaba)

The African Nuclear-Weapon-Free Zone (NWFZ) Treaty, also called the Treaty of Pelindaba, is Africa’s flagship nuclear non-proliferation and disarmament instrument. The Treaty opened for signature on 12 April 1996, and has been in force since 15 July 2009, following ratification of the Treaty by Burundi, the

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required 28th state depositary for entry into force (Nuclear Threat Initiative 2023). Its origins, however, go back to two documents introduced more than three decades prior to the opening for signature: the UN General Assembly resolution 1652 of 1961, and the Declaration on the Denuclearisation of Africa of 1964 by the Organization of African Unity (OAU), the predecessor of the African Union (AU).

Resolution 1652(XVI), “Consideration of Africa as a denuclearised zone”, was born from the growing global concerns about the spread of nuclear weapons but, more specifically, considering the superpower politics of the Cold War, from “the need to prevent Africa from becoming involved in any competition associated with the ideological struggles between the Powers engaged in the arms race and, particularly, with nuclear weapons” (UN General Assembly 1961). The obligations of the resolution are threefold: nuclear tests of any kind in Africa are to come to an end; Africa’s territory, including water and airspace, may not be used for nuclear weapons tests or to store and transport nuclear weapons; and, finally, Africa is to be considered a denuclearised zone and treated as such (UN General Assembly 1961).

In 1964, at the first ordinary meeting of heads of African states and government of the OAU, the continental body issued the declaration AHG/Res.11(I), “Denuclearisation of Africa”, which was later also endorsed by the UN General Assembly (Nuclear Threat Initiative 2023). The declaration reaffirms both the statements made in General Assembly Resolution 1652 as well as the Resolution on General Disarmament adopted by African Heads of State and Government in 1963 (OAU 1964). In the declaration, African states “declare their readiness to undertake in an International Treaty to be concluded under the auspices of the United Nations not to manufacture or acquire control of nuclear weapons” (OAU 1964). Additionally, African states call upon “all peace-loving nations” to do the same, call on NWS to “respect and abide by this Declaration”, and call for the approval of the declaration by the UN General Assembly (OAU 1964).

From these frameworks, cooperation between the OAU and the UN would progress to the creation of a Joint Group of Experts (GOE) for the drafting of an African NWFZ treaty. This GOE met for the first time in Addis Ababa in 1991 and in the ensuing years would meet again in Lomé (1992), Harare (1993), and twice in 1994 in Windhoek and Addis Ababa. It is during these latter two meetings that the GOE adopted the first draft of the envisioned African NWFZ Treaty (Nuclear Threat Initiative 2023). Meeting in Johannesburg and Pelindaba in South Africa in May and June of 1995 respectively, experts worked towards approval of the text, a goal it achieved on 23 June 1995. The UN General Assembly approved the treaty that November and by 11 April 1996, when it officially opened for signature, 47 African states added their signatures to the African NWFZ Treaty (Nuclear Threat Initiative 2023).

Athanasopoulos (1997) regards the Treaty of Pelindaba as “an important legal development” worthy of being an example for the establishment of other nuclear-weapon-free zones around the world. In its preamble, African states recognise the Treaty of Pelindaba as “an important step towards strengthening the non-proliferation regime, promoting cooperation in the peaceful uses of nuclear energy, promoting general and complete disarmament and enhancing regional and international peace and security” (AU 1996:1). Furthermore, it also confirms the importance of the NPT and “the need for the implementation of all its provisions” (AU 1996:2). In particular, a deep-seated interest for “taking advantage” of Article 4 of the NPT is also expressed in the preamble (AU 1996:2). The Treaty of Pelindaba prohibits states parties from producing, acquiring, stockpiling, or controlling (briefly put) nuclear weapons or nuclear explosive devices (AU 1996:1). Article 8 of the Treaty provides the conditions for the peaceful uses of nuclear science and technology on the continent. As in the NPT, safeguards are awarded high importance in the Treaty of Pelindaba and states parties are “encouraged to make use of the programme of assistance available in IAEA and, in this connection, to strengthen cooperation under the African Regional Cooperation Agreement for Research, Training and Development Related to

Nuclear Science and Technology” (AFRA) in Article 8(3) (AU 1996:6).

The Treaty then takes a stricter tone, obligating states parties in Article 9(a) to “conduct all activities for the peaceful use of nuclear energy under strict non-proliferation measures to provide assurance of exclusively peaceful uses” (AU 1996:6). Whereas IAEA assistance is encouraged in Article 8, Article 9(b) mandates the conclusion of “a comprehensive safeguards agreement with IAEA for the purpose of verifying compliance with the undertakings in subparagraph (a) of this article” (AU 1996:6). The Treaty also establishes the African Commission on Nuclear Energy (AFCON) as a further compliance mechanism (AU 1996). To complement its safeguards and verification provisions, the Treaty of Pelindaba also includes requirements for the “physical protection of nuclear materials, facilities and equipment to prevent theft and unauthorised handling” (Article 10) and calls on states parties to commit “not to take, or assist, or encourage any action aimed at an armed attack by conventional or other means against nuclear installations in the African Nuclear-Weapon-Free Zone” (Article 11) (AU 1996:7).

The Treaty of Pelindaba is an important legal basis for a continent that has over the years proven to be not only committed to nuclear disarmament and the peaceful uses of nuclear science and technology but deeply interested in applying it to enhance its socio-economic development. Beyond the NPT and Treaty of Pelindaba, African states have also been active members of the international grouping of states and civil society organisations that promoted the so-called “humanitarian consequences” initiative from which the Treaty on the Prohibition of Nuclear Weapons (TPNW)—the treaty banning nuclear weapons—evolved (Swart 2016:753–773). This initiative turned the nuclear disarmament debate on its head by suggesting that nuclear weapons should be banned because, in the event of a nuclear bomb detonation, the humanitarian consequences would be grave and responding to such a disaster almost impossible, since critical infrastructure is likely to be destroyed, emergency relief personnel also injured, and the risk of radiation exposure very high. Beginning with the first

international conference on the Humanitarian Impact of Nuclear Weapons in 2013, several African states have stepped into active leadership roles, delivering remarks and suggestions, allowing for input on a subject that has for decades been the domain of the nuclear expert and not civil society and states sure to be affected by the use of nuclear weapons (Swart 2016:753–773).

Remaining active players in this discussion will also benefit the wishes of African states to upscale the role of nuclear energy on the continent. Apart from the continent's one existing nuclear plant in South Africa, ten research reactors are also present on the continent and used in a variety of applications, including the production of medical isotopes, research, training, food nutrition analysis, soil fertility analysis in the agricultural sector as well as processes such as neutron activation analysis in geology (Stott & Bosman 2021). As African countries seek to expand their economies and become more industrialised, nuclear energy could add value in meeting rising electricity demand (Gil 2018; Foy & Bosman 2021). Construction is currently underway on Egypt's El Dabaa nuclear power plant, the result of a bilateral agreement between the Nuclear Power Plants Authority of Egypt and the Russian state nuclear corporation, Rosatom (World Nuclear News 2023). This means that in the near future, the continent will have a second, operational nuclear power plant. Other states have also indicated their desire to turn to nuclear power and the IAEA has reportedly been contacted by Algeria, Ghana (who has made significant progress in assessing its viability), Kenya, Morocco, Niger, Nigeria, Sudan, Tunisia, Uganda, and Zimbabwe for assistance in determining readiness and other requirements (Foy & Bosman 2021; Bosman 2021).

Nuclear science and technology provide a unique opportunity for addressing the Sustainable Development Goals and the AU's Agenda 2063 beyond just diversification of electricity supply and widening access to electricity; they can also assist in improving healthcare, agriculture, food security, and education, which are all included in these development agendas in one form or another (Stott & Bosman 2022). Nearly 50% of the population of sub-Saharan Africa does not have access to electricity and it is believed that the addition of

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nuclear energy could alleviate this shortage (Stott & Bosman 2021). African states will also become more reliant on nuclear science and technology in the future to address key health and food security challenges. There is a continent-wide shortage of radiotherapy machines, vital in treating cancer, and the number of cancer cases diagnosed on the continent is also on the rise (Stott & Bosman 2021). Furthermore, nuclear technology will prove a vital component of science in a world where future zoonotic disease outbreaks are predicted to increase. Future programmes to mitigate this challenge can build on the existing Zoonotic Disease Integrated Action (ZODIAC) and Veterinary Diagnostic Laboratory Network (VETLAB) initiatives established in conjunction with the IAEA to monitor and mitigate zoonotic disease outbreaks and treating animal disease outbreaks to protect livestock and human populations simultaneously (Stott & Bosman 2021). All of these uses of nuclear science and technology will require strong domestic regulatory frameworks and adherence to regional/continental and international legal guidelines. Africa's strong support for the NPT combined with widespread ratification of the Treaty of Pelindaba will help ensure that nuclear science and technology is continuously applied within the safeguards and verification measures implemented to prevent diversion and, ultimately, ensure the longevity of the use of nuclear energy for peaceful aims. To date, the Treaty of Pelindaba has 44 states parties and 52 signatory states, as illustrated in Figure 2. One state, South Sudan, has neither signed nor ratified the Treaty.



Figure 2: Map detailing the status of the NPT on the African continent. Source: Author

2.6 Conclusion

It is ironic that the science behind one of the most destructive human-made forces on earth could also be precisely what is required to extend to humanity some of its most crucial rights and provisions like access to clean and reliable energy sources, healthcare, and a secure food supply. Of course, nuclear energy is not a cure-all and, in some contexts, might not even be the best solution. But aside from its ability to produce electricity, nuclear science and technology also hold many other advantages, without some of which twenty-first century life would be drastically altered. This is a form of science that is continuously evolving and developing with an eye on improvement, higher precision, and, importantly, increased safety and security.

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New technology such as Small Modular Reactors (SMRs) have garnered a lot of attention due to the significantly cheaper costs and flexibility attached to them. SMRs typically have a production capacity of around 300MW and their small physical size allows for these reactors to be placed on sites not suited to traditional power plants (Liou 2023). Their application can also be tailored to geographical location, and an SMR could, for example, be used to power just one city. Microreactors, a sub-category of SMRS, are even smaller (10 MW) and according to Liou (2023) are good candidates for “backup power supply in emergency situations” or for the replacement of diesel-powered generators in remote areas. SMRs could be especially useful in Africa where electricity access is low, especially in rural areas.

Peaceful uses of nuclear science and technology have been guaranteed in a vast collection of legal instruments, the most important of which is the NPT. It is the most important because it holds some of the biggest NWS in the world to a requirement to disarm and holds its other states parties to the obligation of non-proliferation— to respect the right to peaceful uses by not violating this principle. Africa is not alone in its quest to draw more on these peaceful uses, and it has without doubt displayed exemplary levels of commitment to the NPT’s three pillars. Although it boasts near universal accession to the NPT, the continent added an additional layer in the form of the Treaty of Pelindaba. By enshrining those same conditions—application of peaceful uses conditional on safeguards and verification—the Treaty of Pelindaba reinforces the commitment of African states to the NPT and its own commitments to nuclear disarmament that precede it. It also has an important role to play in the global disarmament and non-proliferation regimes and these continental mechanisms add to its reputation as leader in the field. For this reason, more should be done to increase the number of states parties to the Treaty of Pelindaba. Moreover, more focus should be placed on educating people about the peaceful uses of nuclear science and technology and, equally, about the legal mechanisms that exist to protect and, ultimately, guarantee it. This framework developed alongside it and therefore should not be neglected. The Humanitarian Consequences Initiative proves that that

narrative matters. Perhaps it's time to remember that nuclear science and technology started out peacefully and to return it to that purpose alone.

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