Wilton Park

Report: Accelerating sustainable development in Africa: Scaling up peaceful nuclear uses

Tuesday 30 April – Friday 3 May 2024

In partnership with
The Vienna Center for Disarmament and Non-Proliferation; Dahlberg; The African Commission on Nuclear Energy; The Sustained Dialogue on Peaceful Uses

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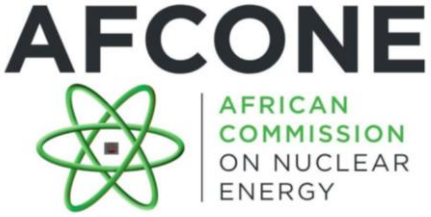

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Introduction

Considering the growing urgency to take action on energy security, climate change and sustainable development, Wilton Park[1], the Vienna Center for Disarmament and Non-Proliferation (VCDNP)[2], Dalberg[3], and the Sustained Dialogue on Peaceful Uses[4], in association with African Commission for Nuclear Energy (AFCONE)[5], organized a three-day multi-stakeholder workshop focusing on the nuclear-development-climate nexus. This workshop builds on a Wilton Park workshop in 2020 in South Africa "In support of Africa's Agenda 2063: pathways for expanding peaceful uses of nuclear energy and nuclear technology in Africa" and a suite of regional and subject specific consultations conducted by Wilton Park and the VCDNP over the last four years.

Among the many challenges that developing countries face, energy poverty is the most critical. Immediate action is required to ensure that these countries have access to clean, affordable and sustainable energy sources for development. Nuclear power is a low-carbon energy source and plays a crucial role in reducing greenhouse gas emissions and combating climate change. With the advent of small modular reactors, including advanced and micro reactors (hereafter "A/SMRs") there will be significant potential to widen affordable energy access. A/SMRs have the potential to bring nuclear power within the reach of developing countries and, as part of the energy mix, deliver a just energy transition.

However, nuclear power, and nuclear science and technology in general, face resistance and scepticism. The benefits of the peaceful application of nuclear science and technology (hereafter "peaceful uses") and the contribution it makes to achieving the UN Sustainable Development Goals (SDGs) and climate goals are not widely recognized. Peaceful uses are yet to be mainstreamed in national and international development frameworks. Advocacy and financing tools to accelerate an inclusive energy transition are currently focused on renewable energy options to the exclusion of nuclear power. New partnerships and focused efforts are urgently required to include nuclear power in the energy development frameworks of developing countries and to ensure that A/SMRs are successfully and sustainably deployed in these countries in the future.

Many developing countries lack the necessary infrastructure and skills to build and manage nuclear power programmes. Furthermore, many A/SMR developers have limited experience with nuclear power deployment and insufficient knowledge of developing country markets and conditions. Although A/SMRs have not yet been

[1] Wilton Park www.wiltonpark.org.uk/
[2] Vienna Center for Disarmament and Non-Proliferation (VCDNP) https://vcdnp.org/about/
[3] Dalberg https://dalberg.com/
[4] Sustained Dialogue on Peaceful Uses www.sustaineddialogue.com/
[5] African Commission for Nuclear Energy (AFCONE) www.afcone.org/

commercially deployed, it is crucial to start preparing the market and infrastructure, including the legal and regulatory framework, in developing countries.

An initial step for developing countries could be to expand non-power applications to improve health care, food safety and security, water and environmental management and for industrial development. A country that already has a robust infrastructure in place for non-power applications can expand and extend that infrastructure and thus may more easily implement a new nuclear power programme.

Advocacy and partnership building for nuclear power should thus encompass the full scope of peaceful nuclear technology for power (electrical and non-electrical) and non-power applications. There is an important window of opportunity to bring to the table finance for development, through Official Development Assistance (ODA) programmes, philanthropic foundations, industry, and government, for expanded engagement on peaceful uses.

The workshop successfully convened a diverse range of stakeholders, including non-traditional participants, to discuss these challenges and make recommendations for addressing them. Attendees included policymakers and regulators from 11 African countries, A/SMR developers, philanthropic foundations, potential investors, and international experts, including representatives from the International Atomic Energy Agency (IAEA) and the OECD Nuclear Energy Agency (NEA).

Think big and show success: promoting the benefits of the peaceful uses of nuclear energy, science and technology

Participants noted that as of 2022, 600 million people, or 43% of the African population, lack access to electricity, most of them in sub-Saharan Africa. Of the 55 African Union (AU) Member States, more than 20 currently do not have radiotherapy centres and over 70% of the African population does not have access to radiotherapy for cancer treatment. In Africa 280 million people face undernutrition. Currently Africa is a minor carbon contributor, responsible for less than 5% of global emissions from various sources. Yet, its fossil fuel dependency is growing rapidly, in parallel with its energy need. On its current fossil-fuel-dependent growth trajectory, Africa will become the region responsible for the most significant carbon emissions from fossil fuel use and will likely overtake the USA by 2050 and India's emissions by 2055.[6]

Nuclear science and technology contributes to nine of the 17 United Nations Sustainable Development Goals (SDGs), through power applications to increase access to reliable electricity and through non-power applications in the health, food

[6] For more information see: lize le Roux and Jakkie Cilliers (2024) Climate. Published online at futures.issafrica.org. Retrieved from https://futures.issafrica.org/thematic/14-climate-change/[Online Resource] Updated 26 May 2024.

and agriculture, the environment, water and industry sectors. The International Atomic Energy Agency (IAEA) provides support to its 178 Member States in these areas including through research, development, capacity building and knowledge transfer. However, more needs to be done to maximise the benefits of peaceful uses for people and the environment. The question is no longer one of what to do but rather how to upscale nuclear technology to bridge the development gap and meet climate change targets by 2050.

The implementation of non-power nuclear science and technology applications for health care, food safety, water management, and industrial development can pave the way for nuclear power. Countries with robust infrastructure for these applications can more easily transition to nuclear power programmes. Advocacy and partnerships for nuclear power should include the full range of peaceful nuclear technologies, covering both power and non-power applications.

The negative perception of nuclear and strategies to mitigate it

Nuclear science and technology continue to suffer from several image problems that hinder the expansion of peaceful uses. For example, nuclear technology is often conflated with nuclear weapons technology; peaceful uses are not mainstreamed into development frameworks; nuclear power for electricity generation is considered to be too costly and unsafe despite it being historically-proven one of the safest source of energy[7] taking into account, among other issues, the health issues and work related accidents caused by other sources of energy.

There was general agreement among the workshop participants that the nuclear narrative has to change, and that there is a need to significantly scale up advocacy and engagement activities to counter the anti-nuclear rhetoric and promote the benefits of peaceful uses. The workshop participants agreed that the benefits of peaceful uses should be mainstreamed through the education curriculum from primary school level to PhD level. A new nuclear narrative should recognise the extensive work of the IAEA, regulators and the nuclear industry to ensure that nuclear technologies are applied safely and securely and under safeguards.

Used fuel and radioactive waste (hereafter collectively referred to as “radioactive waste”) is frequently cited by the public and environmentalists as a decisive argument against nuclear power. However, an expert noted that radioactive waste management is a proven process with established methods for its handling and storage. The nuclear industry and other stakeholders should engage with civil society and the public to communicate how radioactive waste is managed, and the

[7] Hannah Ritchie (2020) - “What are the safest and cleanest sources of energy?” Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/safest-sources-of-energy' [Online Resource]. In 70 years of operation, the nuclear sector suffered two off-site damage, with one causing no direct casualties and damage to the environment that has been restored. For information on those accident, see the UN Scientific Committee on the Effect of Atomic Radiation (UNSCEAR) reports relating to the Chernobyl and the Fukushima accidents.

message of its safety should be integrated into the broader nuclear narrative. It would be important for a country wishing to develop a nuclear power programme to adopt a radioactive waste management strategy concurrently. In addition, it should be noted that some A/SMRs will be using radioactive waste as fuel, which would close the fuel cycle for those reactors.

The need to contribute comprehensively to the energy transition discussion was highlighted, emphasizing the importance of discipline and pragmatism in the environmental conversation. It is crucial to pragmatically assess the continent's energy needs and available resources. The point was made that reengineering and rethinking of the issue are required, with a focus on engaging beyond traditional decision-makers.

Participants agreed that more platforms are needed to engage policymakers, particularly those not traditionally involved in discussions on peaceful uses, such as those in health, food and agriculture, environment, finance, regulatory, legal, and other government sectors. Multistakeholder dialogues between policy makers, philanthropic foundations, multilateral international financial institutions (IFIs), commercial banks, industry, and climate and development communities would facilitate partnerships and increase financing in the nuclear power sector.

The promise of small modular reactors

There was broad agreement that addressing energy poverty in Africa cannot be accomplished using only renewable sources of energy like wind, solar and hydropower. Reliable and cost-effective baseload power that is firmly aligned with climate and sustainable development objectives is required, which nuclear energy provides.

However, most countries in Africa do not have electricity grids robust enough to accommodate a large (typically more than 1000 MWe) nuclear power plant, neither do they have the requisite human and financial resources to construct and run such a power plant. In comparison A/SMRs will have a smaller footprint[8], albeit with a much smaller power output and be quicker to build. Most A/SMRs are being developed with a modular approach. These reactors will be primarily fabricated in controlled factory settings and then transported to the installation site for final assembly. This approach aims to reduce construction time, improve quality control, and potentially lower costs compared to traditional on-site construction methods for large nuclear power plants. A/SMRs will also have enhanced safety and security features. Based on these characteristics, the potential of A/SMRs is that they can be located close to industrial activities, desalination projects, or cities, without the negative impacts on land-use (including loss of agricultural land) or the need to construct costly long-distance electricity transmission lines. The ability to cluster industrial activities around smaller nuclear power plant sites, for example in so-

[8] An expert provided the following information: A micro reactor could require a footprint as small as 400 m2 and a SMR up to 40 acres [~16 hectares], compared to 600 plus acres [~ 240 hectares] required for a traditional large nuclear power plant.

called "hydrogen hubs" makes A/SMRs very attractive to deploy on former coal-fired power plant sites, where parts of the existing infrastructure can be used.[9]

An expert argued that the true potential of nuclear energy lies not in its role in centralised electricity generation (i.e., nuclear forming part of a national energy mix as in the case of the Koeberg NPP in South Africa), but in providing decentralised low-carbon power and heat for energy-intensive industrial processes (such as for the production of hydrogen, ammonia and fertilisers, cement or steel) or for seawater desalination projects. Nuclear technologies should be firmly embedded within wider low-carbon energy transformation and industrial development strategies.

There are currently over 80 A/SMR designs under development in around 20 countries, most based on light-water reactor technology, which is long proven.[10] One participant noted an internal assessment that likely fewer than 10 A/SMRs will be running by 2030. This is due to several factors, such as the obtention of funds to develop the technology and the regulatory process to license the technology. Regardless of how many designs are in operation by 2030, they will have to demonstrate that this technology is licensable, operable, and effective for developing countries to pursue A/SMRs.

Ensuring the legislative and regulatory framework to facilitate expanded access to peaceful uses

In order for States to use nuclear science and technology in a safe, secure and responsible manner, they must establish a legislative and regulatory framework. This includes both a robust domestic framework as well as adherence to international conventions and to safeguards agreements with the IAEA.

Challenges to establishing a legislative and regulatory framework and the support offered by the IAEA

As setting up a comprehensive nuclear law for a country can take up several years to develop and enter into force, participants recommended that States ratify the relevant international conventions and adopt the related implementing laws as an early step in raising their capacity. Developing standards for licensing can be challenging even domestically; harmonising these standards internationally can pose additional challenges. As such, early and robust dialogue between the exporter and the domestic regulator of the importer was recommended. Establishing domestic licensing requirements similar to those of the exporting State may accelerate the development of projects.

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[9] 8 Things to Know About Converting Coal Plants to Nuclear Power, US Department of Energy, March 5, 2024: (available here).
[10] IAEA Advances in Small Modular Reactor Technology Developments, 2022 Edition: https://aris.iaea.org/Publications/SMR_booklet_2022.pdf

However, participants cautioned that complete harmonisation is neither realistic nor achievable in the near future. Caution was also advised against using “template regulations”; as regulations should be developed by each State for that State, bearing in mind its plans for developing its nuclear programme and other conditions specific to that State. This plan should span the entire nuclear fuel cycle, from the acquisition of material and facilities (whether imported or domestically produced) to decommissioning and radioactive waste management.

The IAEA’s Nuclear Harmonisation and Standardization Initiative (NHSI) was discussed as a resource that could be of benefit to States as they develop their regulations.[11] This includes both building domestic regulatory capacity and developing more standardised industrial approaches for A/SMR development. It was noted that design standardisation and harmonisation go hand in hand. The standardised approach to regulation of the airline industry was suggested as a way forward for A/SMRs. The NHSI resource is included in the IAEA’s SMR Platform, which facilitates cooperation and collaboration among Member States and other stakeholders to support commercial deployment of A/SMRs.

There are already a number of collaborations between nuclear safety authorities worldwide in order for "experienced” authorities to help newcomer countries to set up their own authority and regulatory framework. In addition, with regard to the licensing of A/SMRs there is an example of nuclear safety collaboration in the review of the design of a new reactor: the joint early review of the EDF Nuward SMR is being carried out by the safety authorities of six countries (Czech Republic, Finland, France, the Netherlands, Poland and Sweden).[12] This is an approach that could be considered in Africa. These initiatives have been addressed at the NHSI.

Participants noted that States with little regulatory experience are not starting from scratch. The IAEA’s Milestones Approach provides a detailed roadmap for nuclear newcomers, including a phased comprehensive method to assist countries that are considering or planning their first nuclear power plant. Existing conventions under the IAEA’s auspices can be instructive in developing regulations, including but not limited to the Convention on Nuclear Safety, the Convention on the Physical Protection of Nuclear Material and its 2005 Amendment.

The IAEA also publishes technical guidance documents with the support of Member States on a wide variety of topics in nuclear safety, security and safeguards. Further assistance is provided through IAEA review missions and advisory services, conducted at the request of Member States, inter alia:

- Integrated Nuclear Infrastructure Review (INIR) missions[13]

[11] www.iaea.org/services/key-programmes/smr-platforms-nhsi

[12] www.edf.fr/en/the-edf-group/dedicated-sections/journalists/all-press-releases/nuward-and-edf-are-proud-to-start-the-second-phase-of-the-joint-early-review-of-the-nuward-smr-design-with-an-extended-group-of-european-nuclear-safety-authorities

[13] IAEA, Guidelines for Preparing and Conducting an Integrated Nuclear Infrastructure Review (INIR), IAEA Services Series No. 34, IAEA, Vienna (2017)

- International Nuclear Security Advisory Service (INSServ)[14]
- Independent Safety Culture Assessment (ISCA)[15]
- State Systems of Accounting for and Control of Nuclear Material Advisory Service (ISSAS)[16]
- IAEA Comprehensive Capacity-Building Initiative for SSACs[17] and SRAs (COMPASS)[18]
- The IAEA legislative assistance programme.[19]

Understanding the benefits of 3S-by-design and safeguards-by-design

A practice that can help to address challenges posed by regulatory and legislative requirements is to integrate the approach to safety, security and safeguards (3S). Often in developing countries, safety, security, safeguards and other regulatory functions are housed under one body. 3S-by-design approaches to regulation by countries would facilitate nuclear newcomers growing their regulatory bodies at scale so the regulatory capacity increases commensurately with the size of the nuclear programme.

Potential end users of A/SMRs can also help create demand signal for reactor designers that their designs will be more quickly deployed and face fewer issues with costly retrofits if 3S considerations are integrated into every part of the design process. Safety, security and safeguards—while mutually reinforcing—are often treated in silos. Advanced reactor designers often and understandably treat nuclear safety with the highest priority, followed by nuclear security, and lastly—if at all—nuclear safeguards. In this respect, safeguards-by-design (SBD) could and should be considered by both designers and potential end users as beneficial practice from an economic standpoint.

Bilateral and multilateral capacity building and experience sharing were also referenced as best practices. This includes the United States' Foundational Infrastructure for Responsible Use of Small Modular Reactor Technology (FIRST) programme and capacity building activities conducted by non-governmental organisations. As one participant observed, there is an assumption that African countries do not have any capacity across the board, though some countries in Africa, notably Ghana, have been developing their own capacity for nuclear and training their regional partners for many years. Many of the lessons applicable to safeguards, for example, are also applicable to nuclear security and Member States

[14] IAEA, International Nuclear Security Advisory Service (INSServ) Guidelines, IAEA Services Series No. 39, IAEA, Vienna (2019)
[15] IAEA, Independent Safety Culture Assessment www.iaea.org/sites/default/files/isca_datasheet.pdf
[16] IAEA, IAEA Safeguards and SSAC Advisory Service (ISSAS) Guidelines, IAEA Services Series No. 13 (Rev.1), IAEA, Vienna (2021)
[17] SRA: State or regional authority responsible for safeguards
[18] IAEA, COMPASS - IAEA Comprehensive Capacity-Building Initiative for SSACs and SRAs www.iaea.org/topics/assistance-for-states/compass
[19] IAEA, Legislative Assistance www.iaea.org/services/legislative-assistance

have used similar approaches in addressing challenges related to one discipline as another.

The expectations of the nuclear industry of an exporting State with regard to the legal and regulatory framework of the receiving State

When exporting, a supplier of technology, equipment, or services (hereafter the "supplier") will require that the receiving State has adopted all the relevant international conventions and has implemented them in its national legislation and regulation in order to ensure that the client will be using its technology, equipment or services exclusively for civil purpose and in a safe manner. In addition, States have established export control regulations to regulate all nuclear export and usually sign a nuclear cooperation agreement with receiving State for the same purpose.[20]

In addition, the supplier will seek to have no liability for nuclear damage (i.e. damage caused by ionizing radiation) that may be caused by an incident occurring at the nuclear installation where its technology, equipment or services will be used, installed, or provided. This would require that the exporting State has adhered to the same international instrument(s) on civil liability for nuclear damage than the receiving State, establishing a "treaty relation" between the two. The purpose of this "treaty relation" is to ensure that the main nuclear liability principle, which provides that the operator of a nuclear installation will be exclusively and strictly liable[21] for all nuclear damage suffered, will be applied in case a nuclear incident occurs at that installation. There are five international instruments in this field:

- 1960 Paris Convention on Nuclear Third Party Liability (Paris Convention)
- 1963 Vienna Convention on Civil Liability for Nuclear Damage (Vienna Convention)
- 1997 Amending Protocol to the Vienna Convention (Revised Vienna Convention)
- 1997 Convention on Supplementary Compensation for Nuclear Damage (CSC)
- 1988 Joint Protocol relating to the application of the Vienna Convention and the Paris Convention.

In the absence of this "treaty relation", the supplier may be subject to claims to compensate potential victims of nuclear damage. The United Arab Emirates and Romania (two countries with nuclear programmes), and Ghana in Africa have, for example, joined the Revised Vienna Convention, the Joint Protocol and the CSC, which puts them in treaty relations with any country that is a party to the Vienna Convention, the Revised Vienna Convention and the CSC. The Joint Protocol puts them in treaty relations with the Paris Convention countries that have also adhered the Joint Protocol.

[20] The American suppliers cannot export nuclear technology, equipment or services to countries that have not signed a 123 Agreement for Peaceful Cooperation with the US government (see here for more information).
[21] No other than the nuclear operator will be liable to compensate victims of nuclear damage; and the victims will not need to prove fault or negligence, only the causal link between its nuclear damage and the nuclear incident.

Developing a Nuclear Workforce and Supply Chain

Two sessions during the workshop focused on challenges to the development of a nuclear workforce in potential end user countries, as well as establishing a reliable supply chain. In both cases, participants noted that it would be important for African countries to take ownership of the just energy transition, ensuring that approaches to workforce and supply chain development are localised, resulting in long-term employment for local citizens and profit for local industry.

Planting the seeds for a nuclear workforce

Participants noted the importance of developing homegrown expertise in nuclear subject matter starting as early as possible so that the workforce is in place when the decision is made to pursue nuclear power and non-power applications. Several participants emphasised that this should begin before countries sign memoranda of understanding (MOU) that would entail importing foreign human capital. The reason for this is that foreign labour is generally paid for in foreign currency which drives up prices. Public confidence in a major project is reduced when the local workforce is not involved, and there is a risk that the project can become entangled with the broader geopolitical relationship between the parties to the MOU. All these factors can cause resentment among the broader public towards the project, especially if foreign workers receive prestigious jobs while local workers receive low-paying jobs.

One participant observed that 42% of the global workforce will be from Africa by 2030, but that there is little encouragement for young people to study nuclear science and technology. There is also little opportunity to do so, as few African universities have nuclear engineering programmes. In this respect, participants noted that Africa is not a monolith in terms of capacity, that different countries have different levels of capacity. They recommended that universities should share experiences with one another to attract more students, establish more nuclear engineering programmes and devise harmonised curricula. Part of this effort will require awareness raising not just of the benefits of nuclear itself, but also of the national and international job opportunities in the nuclear field. Participants also observed that, in order for workforce development to be sustainable, policymakers need to send a clear signal that the country is pursuing an expansion of nuclear technology so that students know that jobs will be there for them once they complete their training.

Participants also discussed the role of communication in workforce development. The view was expressed that strategies for communicating the benefits of nuclear technology and developing a nuclear workforce should be devised with the country's individual needs in mind, rather than a template approach. These strategies would also include communicating with policymakers and the public more clearly about nuclear science and technology, making the information accessible to them.

Laying the groundwork for a sustainable nuclear supply chain

Many of the challenges associated with workforce development were also discussed in the context of nuclear supply chain development, including the need to start preparations for an expansion of nuclear technology early and a lack of awareness among key stakeholders as to the need to do so. One key takeaway from this discussion was that it is incumbent on all stakeholders—especially the designers themselves—to demonstrate the efficacy of A/SMRs in order to create the demand for supply chain development domestically. In this respect, one strategy would be to raise awareness among policymakers and the public of how large-scale A/ SMR deployment could take the burden off industries, including those that are energy intensive utilising fossil-fuel energy sources and consequently are associated with high levels of carbon emissions.

As many A/SMR designs will be built in factories and assembled in site, challenges around the shipping of nuclear materials were raised and it was suggested that the World Nuclear Transport Institute should take early action to attract more ships to transport the A/SMR components.

As with workforce development, participants discussed the benefits of localising the supply chain to ensure buy-in from civil society and to ensure that the supply chain is sustainable in the long-term. One participant reflected that Africa already has regional electrical grids (e.g. Southern African Power Pool[22], West African Power Pool[23]) and economic development communities (e.g. Southern African Development Community[24], Economic Community of West African States[25]). Participants said that these could provide a model for regional approaches to supply chain development, as this would be more feasible in the near term and sustainable in the long term. Participants also discussed that supply chain issues should be viewed as part and parcel of domestic and regional nuclear policies, including issues related to radioactive waste management and disposal.

Financing nuclear power: existing instruments, the role of philanthropy and the changing paradigm for nuclear

A/SMRs will change the financial landscape for nuclear power. The unique benefits and risks attached to these technologies, the partnerships required and innovative approaches to financing were discussed over two sessions. The first session focused on existing and potential new financial schemes to fund an expansion of nuclear power to new markets and the position of international financial institutions, which refuse until now to cover nuclear power projects considering that they are not environmentally friendly. The second focused on the role of civil society,

[22] Southern African Power Pool www.sapp.co.zw/
[23] West African Power Pool www.ecowapp.org/
[24] Southern African Development Community www.sadc.int/
[25] Economic Community of West African States www.ecowas.int

including philanthropies to increase investment in peaceful uses through partnership building and by promoting the benefits of peaceful uses.

Financial institutions: investing in the deployment of A/SMRs

A/SMRs offer the potential of less risk and lower costs than traditional nuclear power plants and also have diverse applications, which include non-electrical applications and off-grid use. A/SMR projects will likely be developed not only by states but also by the private sector, particularly for energy-intensive industries. This represents a shift towards a new business-to-business (B2B) approach in the nuclear industry. Such an approach has been rare in the nuclear sector, with Finland's Mankala model being a notable exception until now.[26]

These features would be attractive to commercial banks. However in OECD countries banks would prefer to invest in SMRs connected to the electricity grid for the time being as they would benefit from guarantees from the public sector. The possibility of off-grid investment being potentially more bankable in developing countries was countered by the assertion that if big industries in small countries leave the grid, the grid could collapse. The banks are looking at the possibility of developing B2B projects with A/SMRs, but they are waiting for the first projects to prove their feasibility. Participants agreed that strong government support, politically and through public private partnerships, would be essential to attracting investment from financial institutions.

The absence of multilateral international financial institutions, in particular the World Bank, is concerning as the deployment of A/SMRs in many developing countries would require the support of financial institutions. To this end the International Bank for Nuclear Infrastructure (IBNI) is being established. The IBNI is a conceptual new IFI that would provide financing and other support for qualified nuclear energy projects within its member countries.[27] Nonetheless it is essential that African policy makers lobby the World Bank, the African Development Bank and other IFIs to support their nuclear power ambitions.

Various approaches to financing were discussed. Substantial funding would be required to expand nuclear power globally. A suggestion was made to deconstruct the supply chain into concrete projects which can be presented to banks. Another was for African countries to negotiate a carbon tax that could fund the energy transition in Africa.

The strengths and weaknesses of a supplier-driven market approach versus a consumer-driven market approach were also considered. Once “first-of-a-kind” technologies have been proven and are commercially viable, a supplier-driven market—by which the reactor vendor would bear some of the financial risk—could

[26] “The Mankala model is a cornerstone of Finnish energy production”, TVO, February 2023, at www.tvo.fi/en/index/news/pressreleasesstockexchangereleases/2023/themankalamodelisacornerstoneoffinnishenergyproduction.html

[27] For more on the IBNI please see https://nuclearbank-io-sag.org/

help to make international financing more palatable. Early investment in non-power applications can also help provide assurance that the recipient country is experienced in handling nuclear projects and related financing arrangements.

The role of civil society

Civil society organisations have an important role to play in convening stakeholders from diverse communities on the nuclear-climate-development nexus. As highlighted throughout this workshop a key obstacle to scaling up peaceful uses is the lack of awareness about the benefits of peaceful uses and the ongoing efforts of the IAEA, regulators and the nuclear industry at large to ensure that nuclear material, related facilities and radioactive waste are safe, secure and safeguarded.

Another challenge to scaling up peaceful uses is limited funding. The IAEA operates on a zero-growth budget and is not able to meet the growing needs of its Member States. Philanthropic foundations and ODA funders invest billions of dollars annually to support the attainment of development and climate goals, but nuclear science and technology are not integrated into these efforts. These institutions could be a force multiplier for the IAEA's support to countries in capacity building, awareness raising, training and education. They could also contribute to nuclear technology development and deployment.

New partnerships and investment required to optimize the contribution of peaceful uses for climate change mitigation and development require a concerted effort to combat the negative perceptions around nuclear. The non-proliferation, safety and security community can be instrumental in this regard. These NGOs and think-tanks can change the narrative on nuclear threat and risk to a narrative that highlights the benefits of peaceful uses and the ongoing and successful efforts globally to ensure the safety of people and the environment.

The workshop benefited significantly from the participation of a prominent philanthropy, which in turn gained valuable insights through engagement with African policymakers, regulators, international experts, and industry representatives. Engaging more philanthropies is a priority, as they can play a crucial role in supporting NGOs and think tanks. These organizations can then convene nuclear, climate, and development communities and industries to promote and facilitate the mainstreaming of peaceful nuclear uses in development and energy policies. The role of philanthropies would be important not only for advancing A/SMR projects in Africa but also for bringing reliable energy to isolated communities. For instance, they could fund the installation of microreactors to power critical facilities like hospitals and schools, potentially replacing diesel generators – an approach similar to plans being developed in Canada.[28]

[28] Canada's SMR Action Plan Progress Update, SMR Action Plan Leadership Table, October 2022 available at: https://smractionplan.ca/sites/smractionplan/files/2023-01/full-appoved-progress-update-eng-access.pdf. "Stream 3 is focused on the provision of advanced reactors to off-grid or remote communities; a new class of micro-SMRs designed primarily to replace diesel use in remote communities and mines."

Recommendations

The following are key recommendations of thematic breakout groups and discussions throughout the workshop.

Regulatory and legal perspectives

1. Communication about the benefits of peaceful uses and the requisite legislative and regulatory requirements should be enhanced for different government offices and national parliaments.
2. Ratifying the international conventions and developing comprehensive nuclear laws and regulations early. This is an important first step in raising the country's capacity to regulate nuclear activities and should be done in such a way to allow for future expansion into nuclear power.
3. The technology vendor and the nuclear regulator of the exporting country should engage early with the government, the regulator and the radioactive waste management organisation in the importing African country. This will help to sensitise each other to their respective regulatory requirements and to develop harmonised licensing standards to the extent possible.
4. Safeguards-by-design should be promoted as a tool to ease the burden on the importing state and as a cost saving measure to reactor vendors, regulators and potential end-users.
5. Growing regulatory bodies commensurately with the size of the nuclear programme is important.

Financial perspectives

6. As one of the primary challenges to further expanding nuclear is financing, governments should support international as well as non-governmental organisations in publishing short briefs targeted to policymakers to raise awareness about the benefits of peaceful uses and potential financing options with an emphasis on reaching international financial institutions, philanthropic organisations, and ODA funders.
7. To mitigate risks and risk perceptions related to financing, risk analysis models should be developed to identify what international financial institutions view as threats to their investment, who the owner of a given risk would be, what the associated costs are and how the risk can be mitigated through insurance, legal measures, government action or action by other stakeholders.

8 While there has been no financing by international financial institutions for nuclear new build projects in the past, there are lessons to be learned from other large financing projects by these institutions. These lessons should be studied by the non-governmental expert community, expanded upon and shared broadly.

9 Because of the current lack of financing by international financial institutions for nuclear new build projects, national governments should fund more research into identifying specific data points based on different financing models to ameliorate the perception that nuclear technology is too expensive.

10 Efforts to engage philanthropic foundations and ODA funders on peaceful uses of nuclear technology should be urgently scaled up, with NGOs and think-tanks playing a crucial role in convening these stakeholders alongside industry and governments. Supporting these organizations can facilitate dialogue, identify new partnership opportunities, and advocate for integrating peaceful nuclear uses into development and climate change mitigation frameworks, thereby advancing the safe, secure, and sustainable deployment of A/SMRs in developing nations.

Stakeholder involvement and perception perspectives

11 National governments could create parliamentary committees to examine the potential role of nuclear technology for development in their countries, identify national challenges and begin early consultations with national stakeholders to mitigate these challenges.

12 When communicating on peaceful uses with policy makers, the public and other stakeholder groups, simple language without jargon should be used, backed up with easily accessible data and statistics.

13 A platform with easily accessible information with relevant data and statistics for journalists, policy makers and industry should be created on the benefits of peaceful uses, how nuclear science and technology contributes to development and climate change mitigation, and on nuclear safety, security and safeguards. This platform should complement and provide links to the IAEA's website.

14 When engaging with the public in Africa on nuclear power development, it is essential to start with the traditional leaders (chiefs) at local levels, as their buy-in will be necessary to mount local support for nuclear power.

15 The United Nations could establish a World Nuclear Day to provide international spotlight on the nuclear-climate-development nexus.

Infrastructure perspectives

16 [Political will is essential for the sustainable deployment of SMRs. African policymakers should promote the inclusion of nuclear technology in Africa's Agenda 2063, promote nuclear power for development to international financial institutions, such as the World Bank, and insist on increasing the share of nuclear power in the energy mix.

17 Human resource development should begin as early as possible, including education on nuclear technology starting from the elementary level through tertiary and vocational training. This will not only assist with human resource development as such, but also with public acceptance.

18 Universities should share experiences with one another to attract more students, establish more nuclear engineering programmes and devise harmonised curricula.

19 There should be more engagement between grid operators, reactor designers and international experts on the grid-related necessities of nuclear power.

20 More work in scientific forums should be dedicated to issues of siting nuclear facilities, including the conditions required for up-and-coming nuclear power plant designs and engagement with the general public in potential sites. Along the same vein, once a site is identified, priority should be placed on socio-economic development in that area to attract job seekers.

21 Utilize IAEA resources like the Nuclear Harmonization and Standardization Initiative (NHSI), the SMR Platform, the Milestones Approach, technical guidance documents, and request IAEA review missions and advisory services. These provide valuable frameworks and support.

Conclusion

There was broad agreement among participants that the momentum created by this workshop must be utilised to establish a long-term, multi-stakeholder process. Such a process should promote the nuclear-development-climate nexus, expand partnerships for financing of nuclear, and generate further engagement with ODA funders, philanthropic foundations, industry, and government for an expansion of peaceful uses globally.

A website will be launched to serve as a platform offering accessible information, including data and statistics, for journalists, policymakers, and industry professionals. The site will focus on the contributions of peaceful nuclear uses to development and climate change mitigation, as well as nuclear safety, security, and safeguards. This platform will complement and provide links to the IAEA, the NEA and the International Energy Agency (IEA) websites.

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