DEVELOPMENT AND COOPERATION ON NUCLEAR RESEARCH AND ENERGY IN THE MIDDLE EAST

WORKSHOP REPORT

By Sarah Ruth Opatowski

MIDDLE EAST WEAPONS OF MASS DESTRUCTION FREE ZONE SERIES

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UNIDIR
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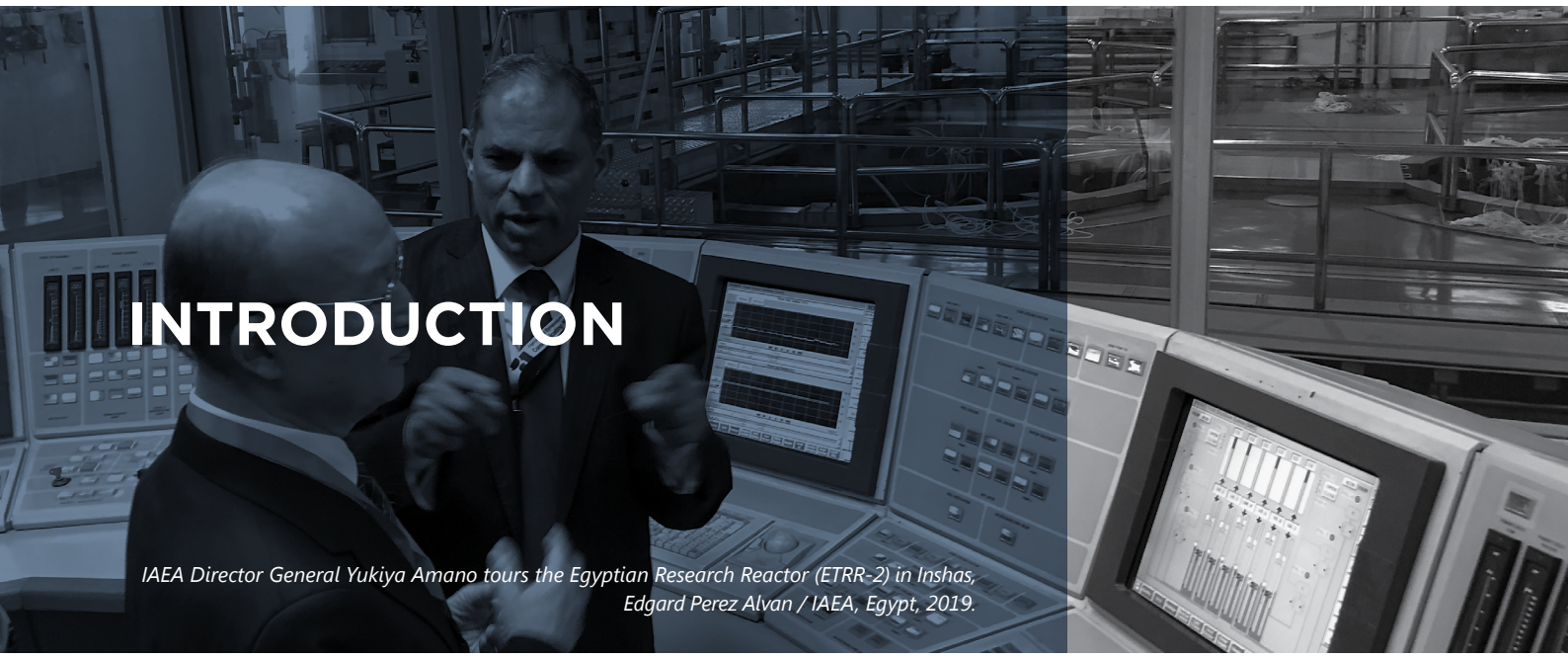
LIST OF ACRONYMS AND ABBREVIATIONS

AAEA	Arab Atomic Energy Agency
ACRS	Arms Control and Regional Security
AFCONE	African Commission on Nuclear Energy
ANNuR	Arab Network of Nuclear Regulators
ASEAN	Association of Southeast Asian Nations
BIS	Bid invitation specifications
BOO	Build-Own-Operate
CBRN	Chemical, Biological, Radiological and Nuclear
GCC	Gulf Cooperation Council
GNEII	Gulf Nuclear Energy Infrastructure Institute
IAEA	International Atomic Energy Agency
INIR	Integrated Nuclear Infrastructure Review
K.A.CARE	King Abdullah City for Atomic and Renewable Energy
ME WMDFZ	Middle East Weapons of Mass Destruction-Free Zone
MW	Megawatt
NPP	Nuclear power plant
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NWFZ	Nuclear weapon-free zone
RANET	Response and Assistance Network
SEANWFZ	Southeast Asia Nuclear Weapon Free Zone
SESAME	Synchrotron-light for Experimental Science and Applications in the Middle East
SMART	System-Integrated Modular Advanced Reactor
SMR	Small modular reactor
STEM	Science, technology, engineering and mathematics
UAE	United Arab Emirates



INTRODUCTION

IAEA Director General Yukiya Amano tours the Egyptian Research Reactor (ETRR-2) in Inshas, Edgard Perez Alvan / IAEA, Egypt, 2019.

On 1–2 February 2022, UNIDIR held a two-day workshop exploring the development of and opportunities for nuclear research and energy cooperation in the Middle East. Fifteen officials and experts from the region participated under the Chatham House Rule to discuss four topics:

1. The status of nuclear energy programmes in the region
2. Existing mechanisms for regional cooperation on nuclear research and energy
3. Potential areas for cooperation in nuclear safety and security
4. Nuclear research and energy in the context of the Middle East Weapons of Mass Destruction-Free Zone (ME WMDFZ)

Interest in exploring the benefits of nuclear peaceful applications in the Middle East dates back to the 1950s with the Atoms for Peace programme. There are 14 research reactors operating in nine states, spanning various applications such as medical research and isotope production. In the mid-2000s, there was renewed interest in nuclear energy in the region, with more than 18 states declaring their intention to pursue nuclear energy programmes. Several countries in the Middle East currently have nuclear energy programmes at different stages of development. The Islamic Republic of Iran operates one reactor, while the United Arab Emirates (UAE) operates three, with a fourth nearing completion. Egypt is in the initial stages of constructing three reactors, with an additional one under consideration, and Saudi Arabia is yet to decide on a supplier for two units.

Supporting the development of nuclear technologies and their peaceful applications, including nuclear research and energy, is at the core of most existing nuclear weapon-free zones (NWFZs). Provisions supporting the peaceful applications of nuclear energy would likely be included in a ME WMDFZ treaty, although this has yet to be further explored. In an effort to understand and provide ideas on how nuclear research and energy could be treated within the ME WMDFZ, this report provides a summary of the discussion, key findings and insights of the workshop.[1]

1 Some additional updates were added to reflect recent developments as well as insights gathered in a workshop organized by UNIDIR's ME WMDFZ Project in January 2023 in Bahrain.

KEY TAKEAWAYS

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Discussions around nuclear research and energy in the Middle Eastern context offered important takeaways of both national and regional relevance. At the national level, experts noted and underlined throughout the workshop that:

- Diversification of energy resources is the main motivation behind the pursuit of nuclear energy in the region. Nuclear energy is considered to be part of a future energy mix that decreases dependency on fossil fuels and meets projected increases in electricity demand. Environmental considerations were mentioned as another factor in some states' decisions to pursue nuclear energy.

- Across all states of the region that pursue nuclear energy programmes it was noted that there is a need to develop human capacity and local expertise to ensure the sustainability of the programmes and to secure national public acceptance. This can be done by establishing a strong educational basis to train and develop local expertise and create public awareness programmes to mitigate public concerns and potential opposition.

- The International Atomic Energy Agency (IAEA) plays a key role in the development, regulation and safety of national programmes. Cooperation with the IAEA ensures that each nuclear project complies with all these requirements.

Experts discussed various aspects related to regional cooperation in peaceful nuclear research and energy, with the following highlights:

- The responsibility of supervising and regulating nuclear programmes is first and foremost that of the state. Nonetheless, as risks pertaining to nuclear energy are transnational, regional cooperation is of great importance, especially for emergency preparedness, response and mitigation.

- The importance of regional cooperation is heightened when considering the unique circumstances that characterize the region. This includes the high dependency on limited water resources and the concentration of large populations in small areas. However, the lack of universalization of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) in the region and deep mistrust among regional states have impeded cooperation.

- Opportunities for regional cooperation are multifaceted. States could share human resources and research facilities; pool resources for emergency response and disaster relief; develop educational programmes for the public; and establish regional regulatory coordination. Participants emphasized the need for harmonization of regulations and for expansion of human resource capacities. There are safety, security and financial benefits to cooperating on these issues for all national nuclear energy and research programmes.

- Beyond the need to galvanize domestic acceptance of a national nuclear energy programme, due consideration should be given to the regional and international dimensions. Past experiences of developing nuclear weapons programmes in the region mean that states in the Middle East will have to build confidence in their programmes in order to address possible suspicions about their objectives.

- States of the region could also identify and facilitate opportunities for data-sharing. This could serve a double motive of building confidence between parties and breaking taboos about sharing information that may be considered sensitive.

- Ongoing bilateral cooperation such as between Saudi Arabia and Jordan as well as between Saudi Arabia and the UAE could serve as a first step towards cooperation between more Middle Eastern states.

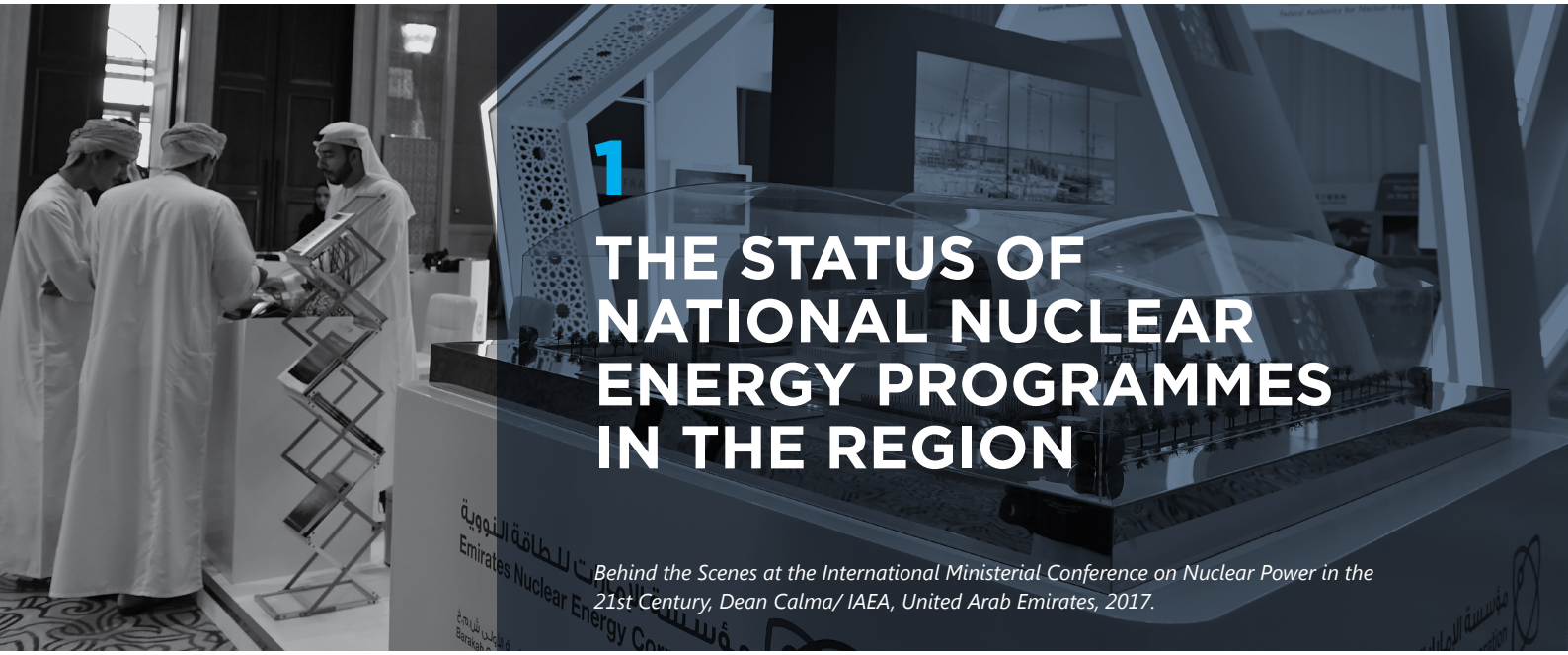
- The IAEA could play a key role, as it has done thus far, in facilitating and promoting regional cooperation mechanisms.

- Pursuing small modular reactor (SMR) technology, rather than large reactors, is an attractive option for many states in the region for grid capacity, desalination and financial reasons. Cooperation could be explored when considering questions on developing and deploying SMR technology and its governance.

- It was noted that the Middle East has yet to establish a regional mechanism that could in turn foster regional cooperation in nuclear energy. Participants discussed whether such a mechanism should predate a ME WMDFZ or whether it could only become possible under such a zone.

- Participants mentioned that further Track 1 to Track 2 discussions could help in building relationships and networks, as well as fostering ideas for cooperation. This could include by creating opportunities and incentives such as through building strong scientific and technical capabilities that address difficult technical challenges (e.g., cancer treatment). Working on scientific and technical issues could be one way of circumnavigating some of the political difficulties surrounding cooperation on such issues.

- While only states with nuclear energy programmes were invited to attend the workshop, participants noted that an Israeli perspective was missing.



1 THE STATUS OF NATIONAL NUCLEAR ENERGY PROGRAMMES IN THE REGION

Behind the Scenes at the International Ministerial Conference on Nuclear Power in the 21st Century, Dean Calma/ IAEA, United Arab Emirates, 2017.

Participants in the workshop noted that peaceful nuclear energy could be of interest for many states of the Middle East. Nuclear energy could address the increase in water scarcity across the region, which also has the highest water subsidies in the world.[2] Due to population growth, the demand for electricity is projected to double by 2030.[3] Currently, oil and gas are the main sources of electricity generation in the region while non-fossil resources play a minor role in the energy supply. Nuclear energy can address the anticipated demands and challenges by supporting water-desalination efforts and by diversifying electricity-generation resources.[4]

Currently, six countries in the region are operating, constructing or considering acquiring nuclear power plants (NPPs) (see also map 1). There are 23 research reactors in the Middle East, consisting of 14 operational reactors, one research reactor under construction, six in extended shutdown and two decommissioned (see also map 2). Additionally, several states have expressed an interest in embarking on a nuclear power programme, with Iran and the UAE already operating nuclear power plants.

Participants discussed their national nuclear energy programmes and detailed their components, including the motivation for pursuing these programmes, the type of programme and the infrastructure under consideration, as well as organizational issues. In addition, they identified areas for collaboration and where regional cooperation can be encouraged in the future.

2 Kalpana Kochhar, Catherine Pattillo and Yan Sun, "Is the Glass Half Empty or Half Full? Getting Incentives Right can go a Long Way Toward Managing Water Challenges While Protecting the Poor", Finance & Development 52, no. 2 (June 2015): 19, https://www.elibrary.imf.org/view/journals/022/0052/002/article-A006-en.xml.

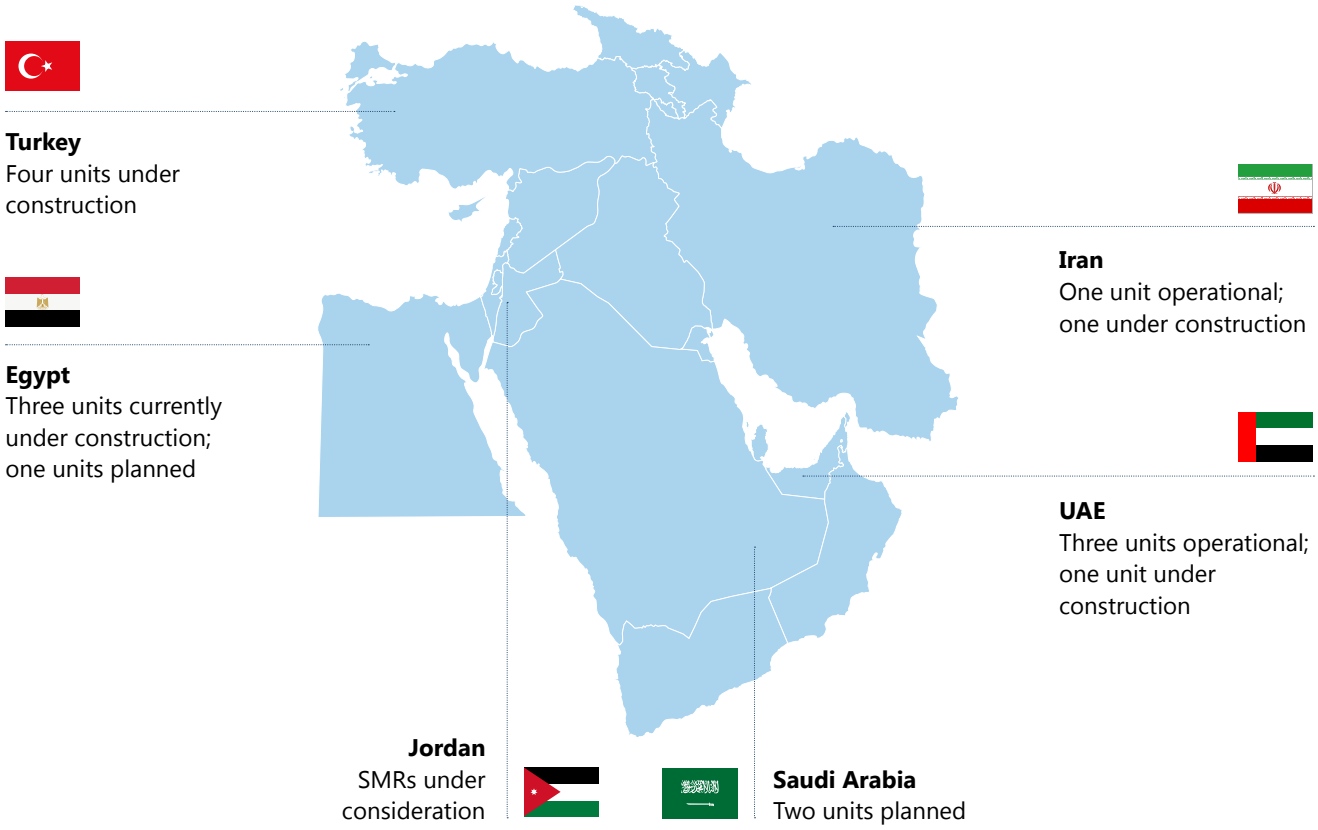
3 Mohammad Ghazal, "Electricity Demand Expected to Triple by 2030 – Minister", The Jordan Times, 11 June 2014, http://www.jordantimes.com/news/local/electricity-demand-expected-triple-2030-%E2%80%94-minister.

4 International Atomic Energy Agency, New Technologies for Seawater Desalination Using Nuclear Energy, (Vienna: IAEA, 2015), https://www.iaea.org/publications/10732/new-technologies-for-seawater-desalination-using-nuclear-energy.

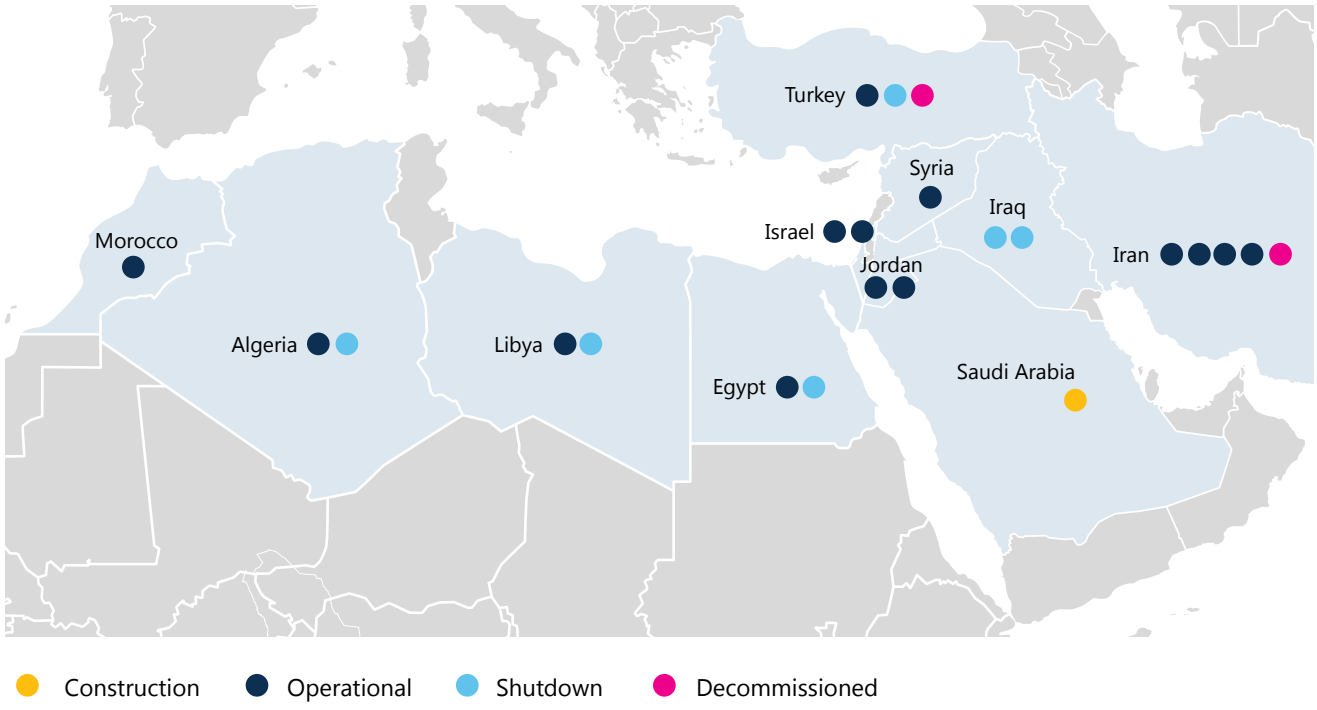
5 World Nuclear Association, "Nuclear Power in Egypt", updated July 2022, https://world-nuclear.org/information-library/country-profiles/countries-a-f/egypt.aspx; International Atomic Energy Agency, "Egypt, Country Nuclear Power Profiles", updated 2022, https://cnpp.iaea.org/countryprofiles/Egypt/Egypt.htm; Darrell Proctor, "Russia Says Construction of Egypt's First Nuclear Plant Ahead of Schedule", Powermag, 20 November 2022, https://www.powermag.com/russia-says-construction-of-egypts-first-nuclear-plant-ahead-of-schedule/; International Atomic Energy Agency, Nuclear Power Reactors in the World, 2022 Edition, Reference Data Series No. 2, IAEA-RDS-2/42 (Vienna: IAEA, 2022), https://www-pub.iaea.org/MTCD/Publications/PDF/RDS-2-42_web.pdf; International Atomic Energy Agency, "Power Reactor Information System: The Database on Nuclear Power Reactors", https://pris.iaea.org/pris/home.aspx.

6 International Atomic Energy Agency, "Research Reactor Database", https://nucleus.iaea.org/rrdb/#/home.

Map 1: Status of nuclear power reactors in the Middle East[5]



Map 2: Status of research reactors in the Middle East and North Africa[6]



The Jordanian programme

The Jordanian nuclear programme is based on three pillars: (1) investment in human resource development with an emphasis on research; (2) uranium mining; and (3) nuclear power development. The Jordan Atomic Energy Commission is mandated with the development and promotion of the peaceful uses of nuclear energy.[7]

Jordan has recognized the need to develop nuclear energy as a means of reducing its high dependency on fossil fuels, which make up 93 per cent of its import.[8] This dependency has had a negative impact on Jordan's economic development,[9] making energy diversification and securing a reliable energy supply the primary motivations for pursuing nuclear energy. A second motivation derives from the potential to stabilize electricity prices and reduce the cost of fuel imports, particularly given the volatility of fossil fuel prices.[10]

The reduction of CO_2 emissions is also an objective that Jordan may increasingly prioritize in the future given the focus on reducing emissions at the 2021 United Nations Climate Change Conference in Glasgow and the increase in international positive signals on developing nuclear energy.[11] Another motivation for Jordan is to increase its limited water resources through water desalination. As one of the most water-deprived countries in the world,[12] the only opportunity for new indigenous and Jordan-controlled water resources is desalination of water from the Red Sea.[13] Water desalination requires a significant amount of energy – around 330 megawatts (MW)[14] – which could be produced through nuclear energy.

Jordan started its nuclear programme in 2009 and initially aimed to pursue a large NPP.[15] However, there proved to be a misalignment between the dynamics of market demand, including the prices of electricity generated by the proposed nuclear station, and the limitations of constructing a large NPP given Jordan's population size and grid capacity. In 2015, Jordan shifted its focus to SMRs, and the first unit is expected to become operational by 2030–31, providing 200–400 MW.[16] SMRs are an attractive alternative to larger reactors for Jordan, as they enable integration of nuclear energy at a local scale, as well as provision of power to isolated communities. They can also potentially contribute to the decarbonization of various sectors and can be useful for dry cooling through water- and air-cooled condensers. While Jordan has not completely abandoned the idea of constructing a large reactor, it will only consider constructing one after 2030.[17]

To satisfy Jordanian energy requirements, the installed SMRs will have to process heat and hydrogen.[18] Jordan is currently considering vendors from China, the Republic of Korea, the Russian Federation and the United States as well as new vendors including British, Canadian and French designs. Jordan has narrowed down the competition to 11

7 World Nuclear Association, "Jordan", Country Profiles, updated May 2022, https://world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx.

8 United Nations Development Programme, "UNDP Jordan Moving Towards Environmental Sustainability", 12 January 2023, https://www.undp.org/jordan/blog/undp-jordan-moving-towards-environmental-sustainability.

9 John P. Banks, "Why Jordan Is Building Two New Nuclear Power Plants", Brookings, 8 March 2013, https://www.brookings.edu/on-the-record/why-jordan-is-building-two-new-nuclear-power-plants/.

10 International Monetary Fund, Jordan: 2022 Article IV Consultation and Fourth Review Under the Extended Arrangement Under the Extended Fund Facility, Request for Augmentation and Rephasing of Access, and Modification of Performance Criteria-Press Release; Staff Report; Staff Statement; and Statement by the Executive Director for Jordan, IMF Country Report No. 2022/221 (Washington DC: IMF, 2022), 61, https://www.imf.org/-/media/Files/Publications/CR/2022/English/1JOREA2022003.ashx.

11 Artemis Sianni-Wedderburn, "Nuclear Energy Carries Potential to Build Kingdom's Future Power Needs – JAEC", Jordan Times, 27 June 2022, http://jordantimes.com/news/local/nuclear-energy-carries-potential-build-kingdoms-future-power-needs-%E2%80%94-jaec.

12 World Bank, "The World Bank in Jordan, Overview", updated 9 January 2023, https://www.worldbank.org/en/country/jordan/overview; UNICEF, "Water, sanitation and hygiene", UNICEF Jordan, https://www.unicef.org/jordan/water-sanitation-and-hygiene.

13 European Investment Bank (EIB), "New Life for the Dead Sea", EIB Stories, 19 September 2017, https://www.eib.org/en/stories/red-sea.

14 International Atomic Energy Agency, "Countries Move Ahead to Study Nuclear Desalination Systems", IAEA News Center, updated 27 July 2017, https://www.iaea.org/newscenter/news/countries-move-ahead-study-nuclear-desalination-systems; International Atomic Energy Agency, Introduction of Nuclear Desalination: A Guidebook (Vienna: IAEA, 2000), 35, https://www-pub.iaea.org/MTCD/Publications/PDF/TRS400_scr.pdf; World Nuclear Association, "Desalination", updated March 2020, https://world-nuclear.org/information-library/non-power-nuclear-applications/industry/nuclear-desalination.aspx.

15 World Nuclear Association, "Nuclear Power in Jordan", updated May 2022, https://world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx.

16 Ali Ahmed, "Nuclear Energy Prospects in the Mediterranean Countries", in IEMed. Mediterranean Yearbook 2020, ed. IEMed (Barcelona: European Institute of the Mediterranean, IEMed, 2020), 288, https://www.iemed.org/publication/nuclear-energy-prospects-in-the-mediterranean-countries/.

17 World Nuclear Association, "Small Nuclear Power Reactors", updated January 2023, https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.aspx; Sinamees Hajarat, "Overview of Jordan's Nuclear Energy Program", Presentation at the International Atomic Energy Agency's Innovative Nuclear Power Reactors and Fuel Cycles (INPRO) Dialogue Forum, Ulsan, South

SMR designs after evaluating them primarily based on technological and economic criteria, without issuing firm bid invitation specifications (BIS). Jordan is preparing a BIS for the NPP based on 200–400 MW SMRs for electricity generation and water desalination.[19] Once a BIS is issued, Jordan estimates that it will take six years for the SMR to be constructed.

Jordan has been collaborating with other countries in the region that are also embarking on nuclear energy projects, such as Saudi Arabia, which has invested 40 per cent in the System-integrated Modular Advanced Reactor (SMART) of the Republic of Korea.[20] Saudi Arabia's cooperation with Jordan is part of its interest in marketing its SMART reactor in the region. The SMART design could be used in Jordan for both electricity generation and desalination purposes with a preference for equity sharing with the vendor.

One of the key takeaways from Jordan's experience is the importance of securing public support. A country needs to develop strong educational and public-awareness programmes to address and mitigate public concerns over the risks associated with a nuclear energy programme and share with the public the opportunities of such a programme. Rushing into a programme without education and awareness-raising may lead to public opposition to the deployment and use of nuclear energy.

The United Arab Emirates programme

The UAE was heavily reliant on importing natural gas for electricity generation in 2007, with 65 per cent of its supply coming from Qatar via the Dolphin Gas Project pipeline.[21] The following year, energy studies projected that the UAE would experience a threefold increase in demand for electricity by 2020.[22] As the UAE did not have sufficient local hydrocarbons to support the projected increase in demand, the only immediate option available to it at the time was to increase the import of natural gas. At this crossroads, the UAE considered various new energy options and found nuclear energy to be a commercially and environmentally strong one. However, the key to the success of this choice as a viable new source of electricity was the timely construction and operation of the nuclear programme. The UAE would otherwise have had to look at less competitive and less attractive resources, including coal, to meet the projected demand.

The UAE published a high-level policy document in 2008 that outlined the rationale and principles behind pursuing nuclear energy, including major milestones, a transparency approach, cooperation with the IAEA and a focus on long-term sustainability.[23] Following this policy announcement, the UAE developed

Korea, September 2019, https://nucleus.iaea.org/sites/INPRO/df17/VI.9-Jordan_Sinamees Hajarat.pdf; International Atomic Energy Agency, "17th INPRO Dialogue Forum on Opportunities and Challenges in Small Modular Reactors", INPRO Collaboration Platform, 2–5 July 2019, https://nucleus.iaea.org/sites/INPRO/Pages/df-17.aspx; Alghad, "زواتي: استراتيجية قطاع الطاقة ال جديدة لا تشمل توليد "الكهرباء النووية" [Zawati: The new energy sector strategy does not include the generation of "nuclear electricity], December 2018, https://www.alghad.com/story/594959.

18 International Atomic Energy Agency, Small Modular Reactors: A New Nuclear Energy Paradigm (Vienna: IAEA, 2022), 15, 21, 37, https://nucleus.iaea.org/sites/smr/Shared Documents/SMR Booklet_22-9-22.pdf; World Nuclear Association, "The Need for Large and Small Nuclear, Today and Tomorrow", September 2020, https://www.world-nuclear.org/getmedia/b2c3bc85-deb0-4856-a5fb-3d9a5149294a/the-need-for-large-and-small-nuclear.pdf.aspx.

19 Nuclear Business Platform, "Jordan's Latest Timeline for SMRs Introduction", 22 September 2022, www.nuclearbusiness-platform.com/industry-insights/jordan-smr.

20 World Nuclear News, "Jordan and Saudi Arabia Team Up on Uranium, SMRs", 29 March 2017, https://www.world-nuclear-news.org/NP-Jordan-and-Saudi-Arabia-team-up-on-uranium-SMRs-2903174.html.

21 US Energy Information Administration, "Country Analysis Executive Summary: United Arab Emirates", 6 May 2020, 4, https://www.eia.gov/international/analysis/country/ARE.

22 Justin Dargin, "Addressing the UAE Natural Gas Crisis: Strategies for a Rational Energy Policy", Belfer Center for Science and International Affairs, Policy Brief, Harvard Kennedy School, 2010, 2, https://www.belfercenter.org/publication/addressing-uae-natural-gas-crisis.

23 Emirates Nuclear Energy Corporation, "Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy", 2008, https://www.enec.gov.ae/about-us/overview/the-uae-nuclear-energy-policy.

Jordan's experience highlights the importance of education and awareness efforts to gain public support for a nuclear energy programme and to address public concerns

a "roadmap to success" that mapped a timeline and outlined the development plan for the infrastructure.[24] This was submitted to the government for approval before implementation began. Other notable early development milestones included adoption of a Federal Nuclear Law[25] and establishment of the Emirates Nuclear Energy Corporation in 2009.[26]

As the drive for nuclear energy was to address the increasing demand for electricity, and the priority was timely construction and operation, the UAE was keen to avoid the delays that are typically associated with deploying a new reactor design. These are exemplified by the delays in deploying a French first-of-a-kind technology design in Finland,[27] an instance that the UAE studied during its early considerations. Hence, the UAE considered only reactor designs that had already been deployed and that had their own reference plans. The UAE considered its nuclear power project as a business model and focused on reducing commercial, political and safety risks. As such, deploying a design that has been successfully implemented in another country provided a chance to incorporate lessons learned without repeating the same mistakes.

When examining proven designs, the UAE was only interested in deploying third-generation light-water reactors and considered only reactor supplier companies that could provide the whole package of technology, construction and operation. Having such requirements narrowed the pool of competing companies, but the criteria were specific enough for several companies to collaborate and submit a joint bid. This meant that a procurement contract to build four reactors could be signed with a Korean consortium within only one year – the shortest time in history.[28] Korean regulators and the IAEA heavily supported the establishment of the regulatory body and associated regulations of the UAE's nuclear energy programme. Furthermore, the IAEA's cooperation was instrumental in providing the UAE with assistance and technical support. The IAEA conducted more than 12 peer review missions to the UAE covering all aspects of the programme, from infrastructure to nuclear safety.[29]

While the UAE reactor design is not first-of-a-kind, adjustments had to be made when the reactor was deployed in the UAE. The water temperature is higher in the Gulf compared to the Korean Peninsula, so bigger exchangers were required to retain a higher cooling efficiency. Air conditioners were also installed in the whole plant to maintain a reasonable working temperature to address the higher air temperature in the UAE – an element that was not included in the original Korean design. In addition, since the UAE has more dust, additional equipment has been incorporated to filter it out. Another example of adaption due to the difference in conditions between the UAE and the Republic of Korea was the construction of an ice factory in Al Barakah, where

24 Hamad AlKaabi, "Nuclear Newcome Countries – The Path of the United Arab Emirates", in Nuclear Law: The Global Debate, ed. International Atomic Energy Agency (The Hague: T.M.C. Asser Press, 2022), 305, https://link.springer.com/book/10.1007/978-94-6265-495-2; Emirates Nuclear Energy Corporation, "Strategic Roadmap", https://www.enec.gov.ae/about-us/overview/strategic-roadmap/.

25 Ibid., 306.

26 Ibid.

27 Richard Milne, "French-backed Finnish Nuclear Plant Delayed Again", Financial Times, 6 October 2017, https://www.ft.com/content/99922334-acc8-11e7-aab9-abaa44b1e130.

28 Strategic Roadmap; David Adam Stott, "South Korea's Global Nuclear Ambitions", The Asia Pacific Journal 8, no. 12 (22 March 2010): 1, https://apjjf.org/-David-Adam-Stott/3322/article.pdf.

29 International Atomic Energy Agency, "Peer Review and Advisory Services Calendar: United Arab Emirates", 2022, https://www.iaea.org/services/review-missions/calendar?type=All&year[value][year]=&location=3500&status=4275.

concrete was mixed with ice – instead of water – to achieve the right temperature for pouring.[30]

The UAE offered to share its experience in adopting safeguards, safety and security measures and to act as a hub for regional nuclear energy development

The UAE nuclear programme was discussed as a potential model of how to develop a programme that adopted important safeguards, safety and security measures to reassure its citizens, neighbours and the international community about its objective. It was noted throughout the workshop that the UAE model could provide an example an example of a good approach to nuclear safety that emphasizes building a strong, independent and transparent regulator. For example, the UAE delayed its nuclear programme by two years to make sure that its operator was well-trained and well-equipped. It was acknowledged that the UAE has considerably more financial resources for this compared to other countries in the region; nonetheless, it remains an important positive example. As of May 2023, the UAE has an operating nuclear energy programme, with three reactors connected to the grid and commercially operational and the the fourth nearing completion.[31]

The UAE focuses on developing human resources to support its nuclear energy plans. Thousands of local engineers work on the programme and almost 70 per cent of the regulatory body is Emirati.[32]

The UAE has extensively engaged with other states in the region and sees the benefits of fostering regional cooperation on nuclear energy. The UAE's regional engagement has included the establishment of working groups with Saudi Arabia that have discussed regulations, shared experiences and exchanged updates.[33] Studies undertaken by the Gulf Cooperation Council (GCC) in the late 2000s concluded that, while safety and security of a nuclear energy programme is first and foremost a national responsibility, there are aspects on which states could cooperate.[34] The UAE expressed readiness to share its experience and serve as a hub for developing and learning about nuclear energy. Moreover, the UAE can bring qualities such as a young workforce and experts – including science, technology, engineering and mathematics (STEM) graduates – that the West does not have available to work in the Middle East.[35]

The Saudi Arabian programme

Saudi Arabia is pursuing nuclear energy as part of its strategy to diversify its energy mix while keeping in mind environmental considerations. Diversifying away from oil would allow Saudi Arabia to invest in its valuable natural resources and highly competitive refinement capability, while using its oil for exports to international markets to generate larger revenues. The Saudi government considers nuclear energy as a reliable, clean and safe energy source with the highest capacity among the alternatives. In April 2010, a royal decree announced that the development of atomic energy is essential to

30 Adam Lane, "Nuclear Leader", Utilities, 15 October 2016, https://www.utilities-me.com/people/article-2148-nuclear-leader.

31 "Homepage," Emirates Nuclear Energy Corporation, https://www.enec.gov.ae/.

32 International Atomic Energy Agency, "United Arab Emirates, Country Nuclear Power Profiles", updated 2022, https://cnpp.iaea.org/countryprofiles/UnitedArabEmirates/UnitedArabEmirates.htm.

33 Arab News, "Saudi–Emirati Cooperation in Peaceful Atomic-energy Programs can be a Model, Says Head of UAE's Nuclear Regulator", updated 7 November 2022, https://www.arabnews.com/node/2194691/middle-east; Federal Authority for Nuclear Regulation, "UAE and Saudi Nuclear Regulators Share Nuclear Expertise", 31 May 2021, https://www.fanr.gov.ae/en/media-centre/news?g=80DA9D14-04D1-4CA8-9709-245CC2870375.

34 Laura El-Katiri, "The GCC and the Nuclear Question", Oxford Energy Comment, Oxford Institute for Energy Studies, 2012, 1, https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2012/12/The-GCC-and-the-Nuclear-Question.pdf.

35 The previous three sentences are based on insights gathered in a workshop organized by UNIDIR's ME WMDFZ Project in Bahrain in January 2023.

meet the country's growing requirements for energy to generate electricity and desalinate water while reducing reliance on depleting hydrocarbon resources.[36]

To support its interest in peaceful nuclear energy, Saudi Arabia has established various institutions and mechanisms. It established the King Abdullah City for Atomic and Renewable Energy (K.A.CARE) to serve as the competent agency for the treaties on nuclear energy that is has signed.[37] It also launched the National Atomic Energy Programme in 2017 and has issued the programme's national policy and established a nuclear law and a law on civil liability for nuclear damage. Saudi Arabia has established an independent regulatory agency to monitor the implementation of the programme, ensure compliance and secure the highest operational safety standards.[38] In 2018, Saudi Arabia received an IAEA Integrated Nuclear Infrastructure Review (INIR) mission to ensure efficiency and integration in the execution of its National Atomic Energy Programme.[39]

As part of its nuclear programme, Saudi Arabia plans to mine uranium, which it perceives as another step towards self-sufficiency in producing nuclear fuel. Preliminary studies show that Saudi Arabia boasts an estimated 60,000 to 90,000 tons of uranium.[40] Exploratory uranium-mining studies are being carried out to fully utilize and monetize the country's natural mineral resources.

Saudi Arabia plans to build one or two large NPPs and expects to solicit bids to carry out the engineering, procurement and construction. In 2015, K.A.CARE and the Korea Atomic Energy Research Institute (KAERI) signed a memorandum of understanding to construct two 100-MW SMRs of the SMART design.[41] The partnership between Saudi Arabia and the Republic of Korea is based on the desire for full intellectual property ownership of the nuclear steam supply system. The two also plan to export SMRs to other states in the Middle East and North Africa, starting with Jordan, for energy supply to remote cities, industry and coastal and inland locations.

Some insights were shared from the Saudi experience so far. One was related to the importance of – and challenges to – building a nuclear sector with solid institutional infrastructure, a powerful legal and regulatory system, a strong industrial base, and advanced human capital. Attaining public acceptance for the programme was mentioned as another challenge due to the prevailing concerns among the public arising from major accidents in the past with large NPPs (despite the fact that the nuclear energy industry has the lowest risk ratio per MW-hour generated).[42] To facilitate public acceptance, nuclear energy needs to be accepted politically and by large segments of the population by presenting it as an effective greenhouse gas mitigation technology that is safe to develop and use. Another insight was the necessary considerations when choosing the reactor vendor, including maintaining

36 والمرتجددة [Saudi Royal Decree establishing King Abdullah City for Atomic and Renewable Energy], 17 April 2010, https://www.kacare.gov.sa/ar/about/Documents/trl.pdf; Olli Heinonen and Simon Henderson, "Nuclear Kingdom: Saudi Arabia's Atomic Ambitions", The Washington Institute for Near East Policy, 17 March 2014, https://www.washingtoninstitute.org/policy-analysis/nuclear-kingdom-saudi-arabias-atomic-ambitions.

37 World Nuclear Association, "Nuclear Power in Saudi Arabia", updated April 2022, https://www.world-nuclear.org/information-library/country-profiles/countries-o-s/saudi-arabia.aspx.

38 Noura Mansouri, "The Saudi Nuclear Energy Project", King Abdullah Petroleum Studies and Research Center, January 2020, 3, https://www.kapsarc.org/research/publications/the-saudi-nuclear-energy-project/.

39 International Atomic Energy Agency, "IAEA Reviews Saudi Arabia's Nuclear Power Infrastructure Development", 31 July 2018, https://www.iaea.org/newscenter/pressreleases/iaea-reviews-saudi-arabias-nuclear-power-infrastructure-development.

40 Sylvia Westall, "Saudi Arabia to Extract Uranium for 'Self-sufficient' Nuclear Program", Reuters, 30 October 2017, https://www.reuters.com/article/us-saudi-nuclear-idUSKBN1CZ1ON.

41 World Nuclear News, "Korea, Saudi Arabia to Cooperate on SMART Deployment", 20 September 2019, https://world-nuclear-news.org/Articles/Korea,-Saudi-Arabia-to-cooperate-on-SMART-deployme.

42 Salma Al Zahrani, Anas AlWafi and Salman AlSherhri, "A Framework of Examining the Factors Affecting Public Acceptance of Nuclear Power Plants: Case Study in Saudi Arabia", Nuclear Energy and Technology 55, no. 3 (November 2022): 908, https://www.sciencedirect.com/science/article/pii/S1738573322005356.

strong diplomatic bilateral relations for the duration of the project.
Saudi Arabia has concluded a number of important bilateral agreements with other states for cooperation on peaceful uses of nuclear energy. It collaborates with the UAE on the large reactors and knowledge transfer, and has identified additional opportunities for collaboration. While the region lacks regional cooperation, there seems to be plenty of opportunities for it. The collaboration between the UAE and Saudi Arabia could perhaps be a seed for a broader cooperation in the Middle East.

The Egyptian programme

The Egyptian nuclear programme dates back to the establishment of two research reactors in the 1960s.[43] Since the early 2000s, Egypt has been reconsidering developing an NPP.[44] It wants to include nuclear energy in its electricity mix as part of its climate change mitigation strategy. To achieve this, Egypt embarked on developing its regulatory body and infrastructure before deciding to embark on its first NPP. In 2015, Egypt signed an intergovernmental agreement with the Russian State Atomic Energy Corporation, Rosatom.[45] This was followed by four commercial contracts between the national operators addressing procurement and construction, nuclear fuel supply, operation and maintenance, and spent nuclear fuel treatment. Egypt has signed a contract to build a third-generation Russian VVER-1200 pressurized water reactor.[46] The project consists of four 1200-MW reactors, capable of producing up to 4800 MW. Egypt's contract with the Russian Federation also includes the supply of nuclear fuel, and building a special storage facility and supply containers for the spent fuel.[47]

In 2019, Egypt invited the IAEA to carry out an INIR mission to ensure that the project is moving in the right direction and is complying with regulatory, safety and security standards. The IAEA concluded that Egypt's project had a clear commitment to safety, security and cooperation, and that it was receiving strong support from the government.[48] Several recommendations were made, including that Egypt should join the 1994 Convention on Nuclear Safety[49] to further adhere to regulatory and legal standards. Accordingly, Egypt has begun the constitutional procedures to ratify the convention. In addition, Egypt has been engaging with the IAEA in developing an "integrated work plan" that brings together multiple minor projects to enhance the regulation of the Egyptian nuclear project and its management of security, safety and safeguards.[50]

43 Maria Rost Rublee, "Egypt's Nuclear Weapons Program Lessons Learned", The Nonproliferation Review 13, no. 3 (July, 2010): 556, https://doi.org/10.1080/10736700601071637.

44 Heba Taha, "Origins of Nuclear Programmes Egypt" in Nuclear Power and Governance Frameworks: Egypt, Ghana and South Africa, eds. Yarik Turianskyi and Jo-Ansie Van Wyk (Johannesburg: South African Institute of International Affairs (SAIIA), 2021), 12–13, https://www.africaportal.org/publications/nuclear-power-and-governance-frameworks-egypt-ghana-and-south-africa/.

45 Reuters, "Egypt, Russia sign deal to build a nuclear power plant", 19 November 2015, https://www.reuters.com/article/us-nuclear-russia-egypt-idUSKCN0T81YY20151119.

46 Raphael Ofek, "Egypt's Nuclear Deal with Russia", Begin-Sadat Center for Strategic Studies no. 710 (January 2017): 1-2, https://www.jstor.org/stable/resrep16859?seq=1.

47 World Nuclear News, "Construction of Egypt's First Nuclear Power Plant Under Way", 20 July 2022, https://www.world-nuclear-news.org/Articles/Construction-of-Egypts-first-nuclear-power-plant-u.

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

49 Christine Weiss, "Gaining a Better Understanding of the International Legal Frameworks: IAEA Holds National Workshop in Egypt", IAEA News Centre, 24 July 2019, https://www.iaea.org/newscenter/news/gaining-a-better-understanding-of-the-international-legal-frameworks-iaea-holds-national-workshop-in-egypt.

50 International Atomic Energy Agency, "Egypt Signs its Fourth Country Programme Framework (CPF) for 2022–2027", 21 September 2021, https://www.iaea.org/newscenter/news/egypt-signs-its-fourth-country-programme-framework-cpf-for-2022-2027.

Staff Track and Check the Safety Measures at One of SESAME's Storage Rings, Dean Calma/ IAEA, Jordan, 2017.

2 EXISTING MECHANISMS FOR REGIONAL COOPERATION ON NUCLEAR RESEARCH AND ENERGY

Throughout the workshop, participants discussed several existing regional initiatives aimed at fostering cooperation on nuclear research and energy. Regional cooperation presents various benefits, including the opportunity to share experiences and to complement each other's strengths in areas such as human resources, financing, uranium resources and regulatory bodies. Regional cooperation can increase the efficiency, safety and security of implementation of national nuclear energy programmes.

The Arab Atomic Energy Agency

The Arab Atomic Energy Agency (AAEA) is an Arab scientific organization and an independent subsidiary of the League of Arab States that includes 14 member states.[51] The AAEA's mission is to coordinate the development of safe, effective and sustainable use of nuclear technologies in Arab countries. The agency strives to enhance economic and social development by promoting the peaceful applications of nuclear energy in various fields such as in agriculture. The AAEA has four key missions: (1) to coordinate the peaceful application of nuclear energy among its member states; (2) to assist in the development of human resources through knowledge transfer; (3) to establish a nuclear safety and security culture by setting unified Arab regulations; and (4) to raise public awareness of the benefits of nuclear energy and address concerns regarding its hazards. To achieve these objectives, the AAEA developed a strategy for 2021–2030.[52] The strategy identifies

51 Mohamed I. Shaker, "Nuclear Power in the Arab World & the Regionalization of the Nuclear Fuel Cycle: An Egyptian Perspective", Daedalus 139, no.1 (Winter 2010): 96.

52 "The Arab Strategy for the Peaceful Uses of Atomic Energy until 2030", Arab Atomic Energy Authority, www.aaea.org.tn/?page_id=4180.

priority areas, such as water resources, food security, human health, environment and energy. This strategy also includes the establishment of a training centre and a virtual laboratory.

Regional cooperation can help national nuclear energy initiatives operate more effectively, safely and securely

The AAEA has organized several projects supporting Arab countries' nuclear energy plans. This has included the establishment of the Arab Network of Nuclear Regulators (ANNuR), training thousands of Arab personnel on aspects of the application of nuclear techniques, and the creation of an Arab programme for training radiation-protection officers. The AAEA's emphasis on developing the human capacity of nuclear programmes is also evident in its sponsorship of various training activities. Although the number of face-to-face training programmes reduced during the COVID-19 pandemic, the number of trainees increased, for example, from 700 to 1750 virtual trainees in 2021. The AAEA is thus exploring additional virtual training activities through the establishment of virtual laboratories and simulations. Virtual laboratories offer the dual benefit of being both less expensive and safer for beginners.

The Arab Network of Nuclear Regulators

ANNuR was created in January 2010 as part of the AAEA's long-term regulatory project to implement the Arab Strategy for Peaceful Use of Atomic Energy.[53] ANNuR's mandate is to strengthen and harmonize the regulatory and legislative frameworks for nuclear and radiation activities in Arab countries. With the increased interest among Arab countries in atomic energy research reactors and nuclear power programmes and many already establishing legal and regulatory infrastructure, there has been an evident need to support their national regulatory bodies. ANNuR is composed of eight working groups, including a group that focuses on strengthening infrastructure and building capacity, another looking at legislation and regulation frameworks, and one that considers the safety management of research reactors.[54] As Arab countries share the same language, ANNuR's activities and training are conducted in Arabic. The IAEA played a significant role in ANNuR's establishment and frequently sends experts to participate in its various activities.

ANNuR aims to provide a platform for all Arab regulatory bodies to regularly meet to discuss and exchange experiences and lessons learned.[55] Providing such a platform will help establish sustainable regional cooperation, coordination and collaboration to continuously improve nuclear safety. While the day-to-day responsibility of nuclear safety is primarily that of the operators and licensers, the role of the regulators is to ensure that this

53 Arab Atomic Energy Agency, The Arab Strategy for the Peaceful uses of Atomic Energy until 2020 (Tunis: AAEA, 2008), https://inis.iaea.org/search/search.aspx?orig_q=RN:45083411.

54 International Atomic Energy Agency, "ANNuR Arab Network for Nuclear Regulators", IAEA Global Nuclear Safety and Security Network (GNSSN), https://gnssn.iaea.org/main/ANNuR/Pages/default.aspx.

55 Ibid.

responsibility is implemented in compliance with regulatory standards.

As part of implementing the Arab Strategy for Peaceful Use of Atomic Energy,[56] ANNuR has several long-term projects to support the implementation of nuclear safety measures in Arab countries. The projects consist of measures to strengthen the regulatory and legislative frameworks for nuclear and radiation activities; strengthen the Arab and national capability to respond to a nuclear or radiation emergency; establish an Arab network for radiation monitoring, early warning and to combat illicit trafficking; as well as build capacity for radioactive waste management. These projects are delivered through training programmes, on-the-job training, coordinated research projects, expert meetings and more.

The Synchrotron-light for Experimental Science and Applications in the Middle East project

The Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME) project is a 2.5-gigaelectronvolt light source based in Jordan. It was officially opened in 2017,[57] and produced its first beamline in 2018.[58] SESAME aims to foster the advancement of basic science and technology among Middle Eastern states and their experts, including physicists, chemists, pharmacists and doctors.[59]

SESAME is used as a regional training centre for research on nuclear reactors and as a scientific platform to bridge between a diverse set of countries, modelled on the European Organization for Nuclear Research (CERN). Eight member countries participate in SESAME: Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Palestine and Turkey.[60] Cooperation also extends to other regions, including Asia, Europe, Latin America and North America. SESAME has been a positive example of regional cooperation where users from a variety of countries come and develop their own projects. Proposals are submitted and considered solely on their scientific merit. Thus far, there have been 114 research projects, and 37 peer-reviewed international articles have been published. SESAME is an example of a collaborative project that cannot be accomplished by a single state alone. The project necessitates the incorporation of various expertise located in different states in the region. Two areas for potential future collaboration were mentioned at the workshop: a joint research project by Arab and Israeli scientists, as well as further research into SMR technologies.

The Gulf Nuclear Energy Infrastructure Institute

The Gulf Nuclear Energy Infrastructure Institute (GNEII) is hosted at the Khalifa University of Science and Technology in Abu Dhabi, UAE.[61] GNEII was established with the support of Sandia National Laboratories and Texas A&M University of the United States.[62]

56 The Arab Strategy for the Peaceful uses of Atomic Energy until 2020.

57 SESAME, "What is SESAME?", 2020, https://www.sesame.org.jo/about-us/what-is-sesame.

58 SESAME, "Beamlines", 2020, https://www.sesame.org.jo/beamlines.

59 European Commission, "Questions and Answers on 'SESAME'", 28 May 2013, https://ec.europa.eu/commission/presscorner/detail/en/MEMO_13_460; Rebecca Collard, "How Jordan's Particle Accelerator is Bringing Together Middle East Enemies", The World, 14 March 2018, https://theworld.org/stories/2018-03-14/how-jordans-particle-accelerator-bringing-together-middle-east-enemies.

60 SESAME, "Members and Observers of SESAME", 2020, https://www.sesame.org.jo/about-us/members-sesame.

61 Adam David Williams et al, The Gulf Nuclear Energy Infrastructure Institute (GNEII): Origins, Objectives, and Operations – A Joint Report, (Albuquerque: Sandia National Laboratories, 2019), 7, https://doi.org/10.2172/1592894.

62 Ibid., 24.

GNEII aims to act as a regional capacity-building mechanism that allows indigenous training of experts, a benefit lacking in educational opportunities outside the Middle East.

GNEII has been running for around a decade and it has been successful in adapting many international best practices for safety, security and safeguards into the regional context including in its training programmes on operationalization of nuclear facilities. As GNEII expanded and established itself as a direct beneficiary to the Emirati civilian nuclear power program, the reputation of the institute has also grown.

GNEII slowly became more attractive for wider regional participation. However, although GNEII expanded its regional outreach, this has not been nearly as extensive as predicted. It is currently undergoing internal restructuring and hopes to expand its reach and serve as a regional capacity-building institution.

Two areas for potential future collaboration are a joint research project by scientists from the region as well as further research into SMR technologies

3 POTENTIAL AREAS FOR COOPERATION IN NUCLEAR SAFETY AND SECURITY

Hamdan bin Zayed attends opening of ConvEx-3 'Barakah UAE', which is aimed to test the global emergency response system for a severe accident simulated at the Barakah nuclear power plant, WAM/Hassan Bashir/Hatem Mohamed, UAE, 2021.

Throughout the workshop safety and security of nuclear and radioactive material have been identified as fruitful and important areas for regional and sub-regional cooperation. It was noted that these areas are first and foremost a responsibility of the state. States are obligated to ensure that appropriate guidelines and tools are developed and implemented. During the workshop, prior to discussing nuclear safety and security as an area for potential regional cooperation, a general conversation was held about the inherent tension between the nuclear safety and security cultures, as safety culture is based on transparency and information sharing, whereas security culture is based on secrecy, confidentiality and classification.[63] Yet, the cultures coexist, both are necessary and, ultimately, they serve complementary purposes. Moreover, although safety and security in nuclear plants may be handled by two different departments, the need for compatibility was nonetheless emphasized, along with constant interaction between the departments on the human, technological and organizational levels. This is a must as "good security is 20 percent equipment and 80 percent culture".[64] It was noted that some mature industries, such as the aviation sector, present good examples of where safety culture and security culture have been increasingly intersecting.

Emergency response

Workshop participants noted emergency response as an important area for collaboration. It was indicated that emergency response required both domestic and regional coordination. Domestically, the various national authorities and entities involved in nuclear energy programmes

63 International Atomic Energy Agency, "Safety and Security Culture", 2016, https://www.iaea.org/topics/safety-and-security-culture.

64 Matthew Bunn and Scott D. Sagan, A Worst Practices Guide to Insider Threats: Lessons from Past Mistakes (Cambridge: American Academy of Arts and Sciences, 2014), 10, https://www.amacad.org/sites/default/files/publication/downloads/insiderThreats.pdf.

must be involved and roles clearly understood in order to eliminate ambiguity in their responsibilities. Testing contingency plans is essential for assessing their reliability and efficiency and for identifying any gaps. When establishing and improving these domestic capacities, states can utilize support offered by various international frameworks. For example, existing international standards can provide best practices on how to set up robust systems and regulations to prevent nuclear or radiological emergencies from happening in the first place. In addition, international standards can provide states with best practices on how to respond to such incidents should they occur. Relevant frameworks include the Convention on Nuclear Safety,[65] the Convention on Early Notification of a Nuclear Accident,[66] and the Convention on the Physical Protection of Nuclear Material.[67]

Although nuclear plant safety and security may be managed by separate departments, they must work together closely and regularly on human, technological and organizational aspects to ensure compatibility

The global Covid-19 pandemic has highlighted the necessity of timely and coordinated preparedness and response to any potential risk, including those involving a civilian nuclear programme. The most obvious risks related to the operation of nuclear programs are safety and security ones due to the nature of the materials involved. As such, these technologies highlight not only the safety dimension associated with nuclear programmes, but the inherent duty of care to the population and the environment.

Due to the transnational nature of some of these risks, addressing them will require regional cooperation. Cooperation could include exchanging best practices, sharing relevant data and information as well as a collective pooling of resources for emergency response and disaster relief. Data sharing serves a double purpose of both building confidence and breaking taboos about sharing information that may be thought of as confidential. Additionally, it is critical – although perhaps not easy – to establish expert-level contacts between the states of the region in advance, as it is "too late to exchange business cards during an emergency".

Several regional and international emergency-response initiatives were mentioned. On the regional level, the Radiation Detection Training Center in Jordan offers the technical and practical skills necessary for regional stakeholders to counter threats posed by radiological nuclear materials in an effective and coordinated manner.[68] Another example is the Arms Control and the Regional Security (ACRS) process of the early 1990s.[69] In some of their discussions in ACRS, Middle Eastern states had agreed to establish a communications network, which they referred to as a "warm line", to act as the preliminary step in creating a hotline for crisis management and to serve as a potential confidence-building, risk-

65 International Atomic Energy Agency, "Convention on Nuclear Safety", adopted on 17 June 1994, INFCIRC/449, https://www.iaea.org/topics/nuclear-safety-conventions/convention-nuclear-safety.

66 International Atomic Energy Agency, "Convention on Early Notification of a Nuclear Accident", adopted on 26 September 1986, INFCIRC/335, https://www.iaea.org/topics/nuclear-safety-conventions/convention-early-notification-nuclear-accident.

67 International Atomic Energy Agency, "Convention on the Physical Protection of Nuclear Material (CPPNM) and its Amendment", adopted on 26 October 1979, INFCIRC/274/Rev. 1, https://www.iaea.org/publications/documents/conventions/convention-physical-protection-nuclear-material-and-its-amendment.

68 Radiation Detection Training Center, "Countering the Threat of Radiological and Nuclear Materials in the Middle East Together", June 2022, http://mesis.jo/uploads/2022/06/RDTC-Brochure.pdf.

69 "Parties of the Madrid Peace Conference create the Arms Control and Regional Security (ACRS) Working Group", 1 December 1991, UNIDIR Timeline, https://unidir.org/timeline/1990s/1992-1995-arms-control-and-regional-security-working-group-acrs.

reduction and de-escalation measure.[70] Despite the collapse of ACRS, the "warm line" idea demonstrates that, even in an environment of high mistrust, states of the region were willing to establish the preliminary infrastructure and capacities to address fundamental safety and security issues, should the need arise.[71]

On the international level, the IAEA's Response and Assistance Network (RANET) seeks to mitigate the consequences of both nuclear and radiological emergencies and allows member states to either request assistance or facilitate the provision of assistance.[72] A few Middle Eastern states participate in RANET, including Egypt, Israel and Saudi Arabia. Additionally, the European Union's Chemical, Biological, Radiological and Nuclear (CBRN) Centres of Excellence Initiative allows states to work in subregional clusters to develop grassroots solutions to CBRN security needs.[73] Four of the eight centres are based in the Middle East and North Africa.

Cooperation on emergency responses could prove useful within the parameters of a ME WMDFZ. One of the underlying objectives of existing NWFZ treaties is regional cooperation on peaceful nuclear applications, whether it is to prevent incidents from happening in the first place or addressing them effectively through emergency response. Emergency prevention and response were mentioned as potential confidence-building measures to be applied during both the negotiation phase of a ME WMDFZ and its subsequent implementation phase. It was also seen as a unifying area that could help address issues of trust among the parties involved. Support mechanisms could be put in place for preparedness, information sharing, communication and response to emergencies. These have the potential to go a long way in furthering the spirit and provisions of an eventual treaty on a ME WMDFZ. In essence, emergency response is an area that can bring states of the region together, especially given the growing interest in nuclear energy and research in the region.

Nuclear safety

Throughout the discussion, three challenges were mentioned as featuring in the global debate around nuclear safety. First, nuclear safety is largely seen as a national responsibility, although the implications of any accident or potential problem goes beyond the borders of the country where the accident has taken place. While national responsibility should not be diluted, collaborative action is required to affectively address nuclear safety challenges. The second challenge lies in the fact that nuclear safety assessments often focus on safety by design, for example, through a comparison of old and new reactors. Discussing these technological advances often misses two other important components of nuclear safety: safety by regulation and safety by operation. Finally, in the global debate about nuclear safety, significant emphasis is given to the number of deaths from incidents. This has proved to be an unsatisfactory way to approach

70 Michael D. Yaffe, "Promoting Arms Control and Regional Security in the Middle East", in Disarmament Forum, vol. 2, ed. Kerstin Vignard (Geneva: UNIDIR, 2001), 11, https://unidir.org/sites/default/files/publication/pdfs//the-middle-east-en-357.pdf.

71 A participant noted that, although there was mistrust between the states of the region, there was some hope that trust could be derived in the future. ACRS did not exist in a vacuum and there were other elements, chiefly the parallel bilateral tracks, that shaped any possible progress made in the multilateral tracks.

72 International Atomic Energy Agency, "IAEA's Network for Response and Assistance for Nuclear Emergencies Grows Beyond 40 Countries", 9 February 2023, https://www.iaea.org/newscenter/pressreleases/iaeas-network-for-response-and-assistance-for-nuclear-emergencies-grows-beyond-40-countries.

73 European Union External Action Service, "European Union (EU) Chemical Biological Radiological and Nuclear (CBRN) Centres of Excellence Initiative", 28 February 2017, https://www.eeas.europa.eu/node/21539_en.

the issue, as the impact of any nuclear accident goes beyond the number of casualties. Any nuclear accident would disrupt economies and ecosystems, especially in areas like the Middle East – and especially the Gulf – due to high interdependences between water, food and other resources. These factors should be part and parcel of any nuclear safety assessments.

Although nuclear safety is primarily a national responsibility, the effects of an accident could extend beyond national borders; collaboration is necessary for effective solutions while still maintaining national responsibility

A number of risks pertaining specifically to nuclear safety in the Middle East were mentioned in the discussion. The population in the Gulf, for instance, is concentrated in very small areas and there is little margin for relocation in case of emergency evacuation. The region is acutely water strained. In no other region in the world does the subsistence of its people, trade, export and source of food depend on the safety and security of one source of water.[74] Substantial contamination would carry significant and multifaceted impacts. Due to these circumstances, the Middle East requires a higher level of cooperation on nuclear safety than other regions. Yet, these challenges are even harder to address cooperatively given some of the strong political tensions that characterize the region. The fact that some countries do not communicate with each other is a particularly problematic aspect when information sharing is the first step to achieving higher levels of cooperation. Another safety concern unique to the Middle East that was mentioned during the discussion was the intention of some countries in the region to use the Build-Own-Operate (BOO) model for their nuclear energy programmes. Such a model is potentially problematic from a nuclear safety perspective as the vendor is not necessarily responsible or liable for the general regulatory oversight of the program.

Nuclear safety could constitute an opportunity for cooperation as part of a ME WMDFZ – it could informally be incorporated within the zone's provisions. This would respond to the unique circumstances of the Middle East as well as offering an opportunity to address development-related issues through clean energy within the zone context. Participants noted that, on the national level, states in the region could utilize their militaries to assist in the development of security protocols around nuclear plants.[75]

74 "Gulf Arab States Eye Arabian Sea for Safer Water Supplies", Reuters, 18 July 2013, https://www.reuters.com/article/us-water-gcc-link-idUSBRE96H0BZ20130718; Mohammad Al-Saidi and Sally Saliba, "Water, Energy and Food Supply Security in the Gulf Cooperation Council (GCC) Countries – A Risk Perspective", Water 11, no. 3 (March 2019): 455, 6, https://doi.org/10.3390/w11030455.

75 Some of these insights are based on discussion that took placein a workshop organized by UNIDIR's ME WMDFZ Project in January 2023 in Bahrain.

4

NUCLEAR RESEARCH AND ENERGY IN THE CONTEXT OF THE MIDDLE EAST WEAPONS OF MASS DESTRUCTION-FREE ZONE

IAEA Forum on Experience of Possible Relevance to the Creation of a Nuclear-Weapon-Free Zone in the Middle East, Dean Calma/ IAEA, Austria, 2011.

During the final session of the workshop, experts discussed cooperation on nuclear peaceful applications in the context of a ME WMDFZ. They first explored the treatment of peaceful nuclear energy within existing NWFZ treaties before considering the unique challenges and opportunities for regional cooperation in the Middle East.

Addressing peaceful nuclear technologies in existing nuclear weapon-free zones

There are currently five NWFZs in the world.[76] All but one of the treaties includes provisions relating to the use of peaceful nuclear applications (see table 1 for an overview). The way in which these treaties handle peaceful nuclear applications could provide insights into how this issue could be addressed within a ME WMDFZ.

An analysis of the provisions on peaceful nuclear applications in existing NWFZ treaties shows that there is no correlation between, on the one hand, the existence of power and research reactors in a zone and, on the other, the number of provisions that address the topic in the treaty. There is also no correlation between the existence of power and research reactors in the region and the level of cooperation in the NWFZ. Notably, cooperation on peaceful applications of nuclear energy is more advanced in NWFZs than cooperation on nuclear safety, security or safeguards, perhaps because the latter issues received less attention globally and regionally when these NWFZ treaties were negotiated than they do today.

76 Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Treaty of Tlatelolco), opened for signature 14 February 1967, https://www.iaea.org/publications/documents/treaties/treaty-prohibition-nuclear-weapons-latin-america-tlatelolco-treaty; South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga), INFCIRC/331, opened for signature on 6 August 1985, https://www.iaea.org/sites/default/files/infcirc331.pdf; Treaty on the Southeast Asia Nuclear Weapon-Free Zone (SEANWFZ Treaty or Bangkok Treaty), INFCIRC/548, opened for signature on 15 December 1995, https://www.iaea.org/sites/default/files/infcirc548.pdf; The African Nuclear-Weapon-Free Zone Treaty (Treaty of Pelindaba), signed on 11 April 1996, https://www.iaea.org/publications/documents/treaties/african-nuclear-weapon-free-zone-treaty-pelindaba-treaty; Treaty on a Nuclear-Weapon-Free Zone in Central Asia (Treaty of Semipalatinsk), opened for signature on 8 September 2006, https://treaties.unoda.org/t/canwfz.

Table 1: Comparison of references to peaceful nuclear energy in NWFZ treaties[78]

	Latin America and the Caribbean: Treaty of Tlatelolco (1967)	South Pacific: Treaty of Rarotonga (1985)[79]	South East Asia: Treaty of Bangkok (1995)	Africa: Treaty of Pelindaba (1996)	Central Asia: Treaty of Semipalatinsk (2009)
Preamble	+	–	–	+	+
Declarations	Article 1	–	–	Article 6	–
Control system	Article 12	Article 8	–	Article 12	–
Use of nuclear energy for peaceful purposes	Article 17	Article 4	Article 4	Article 8	Article 7
Explosions for peaceful purposes	Article 18	–	–	–	–

It was mentioned that – since 10 of the 24 prospective members of the ME WMDFZ are currently members of the African NWFZ – any future ME WMDFZ will have to take into account the terms of the African NWFZ, or at least not contradict them. Negotiators could also consider close collaboration between the zones. It was noted that the Treaty of Pelindaba incorporates various aspects of regional cooperation, including institutionalizing it through the African Commission on Nuclear Energy (AFCONE), which was mandated with building human building human capacity and knowledge dissemination on peaceful nuclear energy.[77]

77 Treaty of Pelindaba, Articles 8, 12, Annex III.

78 An "+" in the table indicates where the NWFZ treaty mentions nuclear energy, material or facilities for peaceful purposes in the preamble.

79 Notably, the Treaty of Rarotonga is a "nuclear-free" rather than "nuclear weapon-free" zone and does not include provisions related to the promotion of nuclear energy, reflecting the preference of some of the island states to limit peaceful nuclear activities.

Challenges: The unique circumstances of the Middle East

Although nuclear energy could be an attractive opportunity for national programmes and regional cooperation endeavours to pursue, there are several challenges and unintended risks to consider moving forward.

- **Lack of regional cooperation** – As discussed above, the high concentration of population in a small area and the high dependency on limited natural resources necessitates strong regional cooperation. The Middle East does not currently have an existing mechanism or even a statutory group that could accommodate region-wide cooperation on nuclear

Cooperation on nuclear energy is addressed in existing NWFZs more than safety or security since limited attention was paid to these issues when the zones were negotiated

80 Treaty of Pelindaba, Articles 8 and 12.

81 The Plan of Action to Strengthen the Implementation of the Treaty (2018–2022) notes, in Article 1(i), that it will "strengthen the relevant existing and prospective mechanisms within ASEAN such as the Nuclear Energy Cooperation Sub-Sector Network and the ASEAN Network of Regulatory Bodies on Atomic Energy to contribute to the eventual development of a regional nuclear safety regime to regulate and oversee the safety assessment requirements for those states which have embarked on peaceful nuclear energy programmes".

82 Treaty of Pelindaba, Annex III. Additionally, AFCONE has two notable regional cooperation initiatives: the Forum of Nuclear Regulatory Bodies in Africa (FNRBA) and the African Network for Education in Nuclear Science and Technology (AFRA-NEST). FNRBA was established in 2009 as a platform for exchanging experiences, sharing knowledge and advancing excellence in nuclear regulatory systems in the region. AFRA-NEST was established to facilitate the implementation of its strategy on human resources development and nuclear knowledge management.

83 Treaty of Pelindaba, Article 12.

energy and research (see table 2). Participants held diverging views on whether such a mechanism should be established under a ME WMDFZ or should predate it. The argument against establishing such an organization prior to the zone is the lack of political readiness to cooperate on nuclearrelated issues. The technical element of nuclear energy is linked to nonproliferation – as long as not all states of the region are party to the NPT and political recognition is still in question, several participants cautioned against a region-wide cooperation that is not under the IAEA umbrella and without having the zone in place first. In the example of the African NWFZ, AFCONE was established as a mechanism to support regional cooperation in the application of nuclear energy, only after South Africa dismantled its nuclear weapons.[80] Therefore, given that there is not even a Middle East regional forum similar to the Africa Union to encompass the peaceful uses of nuclear energy, the only prospective mechanism is the ME WMDFZ. Therefore, the establishment of a ME WMDFZ could facilitate regional nuclear energy and cooperation.

Table 2: Comparison of provisions related to the establishment of peaceful nuclear cooperation organization under existing NWFZs

Latin America and the Caribbean: **Treaty of Tlatelolco**	**Dedicated organization** The Agency for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (OPANAL) has been functioning as the main focal point of its member states in coordinating regional efforts and articulating common positions on nuclear disarmament and non-proliferation.
Central Asia: **Treaty of Semipalatinsk**	**Dedicated organization** The treaty does not establish any institution as part of the NWFZ, nor is there any pre-existing regional cooperation institution or mechanism that could serve as a secretariat for the Central Asian NWFZ.
South East Asia: **Treaty of Bangkok**	**Dedicated organization** The Association of Southeast Asian Nations (ASEAN) is loosely affiliated with the Southeast Asia NWFZ (SEANWFZ). ASEAN represents the SEANWFZ at the NPT Review Conferences and topics related to the NWFZ are discussed at ASEAN summits. SEANWFZ does have a Commission that is tasked primarily with verification- and compliance-related matters.[81]
South Pacific: **Treaty of Rarotonga**	**Dedicated organization** This nuclear-free zone is not institutionalized; its Consultative Committee is convened by the Secretary General of the Pacific Islands Forum Secretariat. The Forum mainly deals with sustainable development, cybersecurity and transnational organized crime, and is not actively engaged in disarmament and non-proliferation issues.
Africa: **Treaty of Pelindaba**	**Dedicated organization** The treaty established AFCONE, whose purpose is set out in Annex III.2 of the treaty.[82] AFCONE is subdivided into four thematic working groups and its responsibilities include "encouraging regional and sub-regional programmes for cooperation in the peaceful uses of nuclear science and technology."[83]

The Middle East lacks a mechanism for regional cooperation on nuclear energy and research; views on creating such a mechanism differed among participants regarding whether it should precede or follow a ME WMDFZ

In contrast, other participants held that regional nuclear cooperation could predate establishment of the zone. They pointed out that, to effectively address nuclear safety and security, the order must be reversed, whereby first there should be a mechanism and then a zone. It would be wasteful to invest solely in building a community of nuclear experts in the region that will not have anything to do until political agreement is reached. It was suggested that it could be beneficial to encourage technical experts to inform the zone discussions. As it currently stands, even if a ME WMDFZ were to be immediately realized, the region would not have the required capacity for its implementation and verification. Thus, having a zone and creating a supporting mechanism are not mutually exclusive, and there is an interest and, arguably, a need to invest in these capacities before forming a zone. Moreover, it would be beneficial to use existing skills to build talent and capacity to verify the future zone. This could include mode-sensing technologies, which are regularly used across the region for land-mapping and natural resource monitoring. In a different context, these same technologies and skill sets can be used for verification purposes.

Participants noted that cooperating on these issues does not mean that the issue of the zone would be bypassed or that its establishment would become a secondary issue. In fact, building technical capacities is important for informing the negotiations and advising diplomats. During diplomatic negotiations on this issue, pertinent technical teams will be needed to advise on their respective national security needs and to frame expectations of the sort of information that will be availed or withheld under a verification process.

- **Realistic assessment of the risks and opportunities** – One inadvertent risk is the danger of overestimating the applications and benefits of nuclear energy. Peaceful nuclear energy projects are not necessarily aligned with the development needs of every country. This is especially true based on experience when some states in the Middle East began with grandiose statements about the projected number of reactors, employment and localization opportunities but were forced to scale down their projects or projections once they reached the planning stage.

- **Investment in education and creating employment opportunities** – Participants noted that, in order to ensure the sustainable development of nuclear energy in the region and leverage the interest to use it as a basis for nuclear cooperation, more investment is needed in STEM education and scientific research. Moreover, beyond the need to invest in and utilize the local workforce, especially the youth,

Nuclear energy programmes in the Middle East face obstacles to acceptance on the local, regional and international levels

it is important to prevent brain drain by providing employment opportunities to ensure that they have somewhere to work within the region after pursuing their education.[84] Developing local expertise is also relevant to building indigenous capacity to judge advice given to states, especially by foreign consulting experts who tend to be either a vendor or linked with them. The primary interest of these foreign companies is to sell their designs, and they do not necessarily care whether there is a strong regulator or a safety culture in a given country. Furthermore, investment in local capacities and human resources would help a nuclear programme to become more sustainable and economically attractive, which in turn can help development goals. The region is arguably characterized by "reverse orientalism" whereby supplier states find it difficult to localize and culturally contextualize the technology and expertise they export. Localization is essential as it also constitutes the predominant factor in shaping performance on the local level, as well as fostering ideas and identifying priorities on the regional level. Discussion with potential suppliers should include discussion on a country's development needs and readiness for a nuclear energy programme that should include insights from local expertise.

- **The role of experts** – Experts in the region will have to walk a very delicate line between candour and discretion. On the one hand, experts need to be the voice of reason and provide a candid account of the opportunities offered and the challenges posed by a nuclear energy programme. It is imperative for experts to be seen as trusted partners whose advice can be relied on. On the other hand, experts will have to be careful not to be discredited if perceived to be lecturing governments on what they should or should not do in issues related to sovereignty. It is important for experts to be able to follow this line while being transparent with policymakers with their recommendations, whether publicly or behind closed doors. Chiefly, experts should enhance awareness while the country will be the one to decide whether or not to follow through with a nuclear energy programme and its specifications.

- **Acceptance** – The pursuit of nuclear energy programmes in the Middle East faces issues of acceptance on the local, regional and international levels. On the local level, for example, when Jordan announced its interest in exploring nuclear energy, billions of dollars were invested in Jordan's renewable energy sector from communities that wanted to discourage the authorities from initiating a nuclear programme.[85] As for the regional dimension, states in the Middle East may deem one state's initiation of nuclear energy as a threat, disingenuous or as a prelude to hedging. While Saudi Arabia, for instance, is a state party to the NPT and supports the establishment of a ME WMDFZ, it has stated that

84 The two previous sentences are based on insights gathered in a workshop organized by UNIDIR's ME WMDFZ Project in Bahrain in January 2023.

85 Amélie Pinel, "Solar or Nuclear Power? Reducing Jordan's Energy Dependence", in Atlas of Jordan: History, Territories and Society, ed. Myriam Ababsa (Beyrouth: Presses de l'Ifpo, 2013), 437–441, http://books.openedition.org/ifpo/5063.

it would reconsider its position if Iran were to acquire military nuclear capabilities.[86] On the international level, any country in the Middle East that announces an interest in nuclear energy will have to justify it to the international community given the many cases of violations of the NPT under the pretext of a peaceful nuclear programme. Making viable and justifiable arguments for nuclear energy, and having the international community accept them, may well prove difficult.

Participants also discussed several factors unique to the Middle East which require special attention by the negotiators of a ME WMDFZ.

- **Non-state actors** – One such issue is the question of how to address the threat by non-state actors. Discussions on this issue cannot only cover the circumstances that may emerge and prevail whereby non-state actors target strategic facilities, as was recently evidenced by events in Saudi Arabia and the UAE.[87] They must also consider the ways that threats by non-state actors could be addressed within the parameters of a WMDFZ when they are not party to it.

- **Engaging extraregional states** – Another question is how to engage nearby states and regions in a ME WMDFZ. Turkey, for instance, is an neighbouring state that is in the process of constructing NPP and already operates a research reactor,[88] with implications that could transcend the borders of the delineated WMDFZ. Therefore, a serious discussion needs to take place to consider ways to engage Turkey in WMDFZ discussions while it is not a member of the zone.

Opportunities: Ideas for promoting regional cooperation

There is a noticeable absence across the region of credible organizations that advocate and champion for regional cooperation. rganizations tend to have national mandates or be inward looking, and states have, universally, a natural tendency not to want to work together. Under such circumstances, it was suggested to look for ways to motivate further progress towards cooperation in the region (see table 3), rather than seeking perfection. Some participants commented that hoping for change to materialize overnight through the realization of a ME WMDFZ is unrealistic given the status quo. Instead, implementing intermediate steps could pave the way towards goals such as the zone. Furthermore, these steps can assist in generating interest and even demand for greater regional cooperation. Sometimes the best approach is to generate demand that does not yet exist (e.g., there was no demand for iPhone prior to its creation).

- **Collaboration on scientific issues** – One way to promote regional cooperation is working around scientific issues that improve quality of life across the region, for example with paediatric patient safety. The Jordanian Research and Training Reactor and SESAME was

86 Al Jazeera, "Saudi Minister Says 'All Bets Off' If Iran Gets Nuclear Weapon", 11 December 2022, https://www.aljazeera.com/news/2022/12/11/saudi-minister-says-all-bets-off-if-iran-gets-nuclear-weapon.

87 Aziz El Yaakoubi and Maha El Dahan, "Saudi Aramco Petroleum Storage Site Hit by Houthi Attack, Fire Erupts", Reuters, 26 March 2022, https://www.reuters.com/world/middle-east/saudi-air-defences-destroy-houthi-drones-state-tv-2022-03-25/; Patrick Wintour, "Saudi Oil Tankers Show 'Significant Damage' After Attack – Riyadh", 13 May 2019, https://www.theguardian.com/world/2019/may/12/uae-four-merchant-ships-reported-sabotaged.

88 International Atomic Energy Agency, "Türkiye, Country Nuclear Power Profiles", updated 2022, https://cnpp.iaea.org/countryprofiles/Turkey/Turkey.htm.

Overwhelmingly, participants saw an opportunity to cooperate on SMRs, which are increasingly becoming an attractive option to many countries in the region that cannot deploy large reactors

mentioned as a venue that could bring together countries that use isotopes for hospital treatment and thus begin an initiative around patient safety in radiotherapy. Assembling a group of diverse doctors on the topic of radiation therapy – and not necessarily nuclear safety officials or diplomats – could be a starting point for collaboration without any political strings attached. Paediatric radiation safety is an attractive and novel area; it would be an apolitical issue where a lot of undisputable common ground could be found. In other words, radiation therapy safety could serve as a proxy for cooperation in other areas.

- **Nuclear energy** – Discussing issues related to the technical aspects of peaceful nuclear energy was mentioned as safe and objective option that could aid cooperation in the future. Framing challenging discussions using academic and technical perspectives is one way of circumnavigating some of the political difficulties related to cooperating on nuclear issues. Indeed, past experiences such as ANNuR, GNEII, the Middle East Scientific Institute for Security (MESIS) and the Radiation Measurements Cross Calibration (RMCC) project demonstrated that focusing on technical solutions for objective technical problems has allowed discussions on cooperation to proceed despite the political impasse.

In addition, continuing to garner support not only from within the region but through other regional and international bodies, including the IAEA, plays a key element. Several opportunities directly linked to nuclear energy cooperation were also suggested, such as electricity production and water desalination,[89] which could play a role similar to that of coal and steel in post-war Europe's attempts to build a more and interdependent community.[90] It was noted that nuclear energy offers plenty of room for regional cooperation in terms of development and expansion of human resources, research, training facilities, and in harmonization of regulations. Developing a regulatory body could be used as a regional cooperative mechanism, which would allow the expensive costs of creating and maintaining such a body to be shared.

Overwhelmingly, participants saw an opportunity to leverage cooperation through SMRs, which are increasingly becoming an attractive option for many countries in the region that cannot deploy large reactors. The small size of SMRs and their passive safety measures enable countries with less nuclear experience and smaller electricity grids to deploy nuclear power. SMRs have lower requirements for cooling water, which makes them highly suitable for remote regions. Economically, SMRs are less expensive, require smaller investment and can be built in a shorter time than

89 Dive into Water-Energy-Food Nexus", 21 September 2020, https://petra.gov.jo/Include/InnerPage.jsp?ID=28485&lang=ar&name=en_news.

90 HRH Prince El Hassan bin Talal, "How do we Move from Humiliation to Human Dignity?", Alain Elkann Interviews, 1 November 2020, https://www.alainelkanninterviews.com/hassan-bin-talal/.

an NPP project. Many countries in the Middle East are considering SMRs and have questions about how they operate. Identifying the right technologies and the right size of technologies poses a set of questions that could be cooperatively explored. Moreover, governance related to SMRs is also a rich area for cooperation.

- **No attack on civilian nuclear power facilities** – Participants discussed the option of the states of the region agreeing not to target each other's civilian nuclear power facilities. The GCC has conducted a study on the Gulf and the ways its nuclear facilities could be protected.[91] It explored the 1988 India–Pakistan Non-Attack Agreement in which India and Pakistan mutually devised ways to avoid targeting each other's peaceful nuclear power facilities and other peaceful facilities like water-desalination centres.[92] Participants noted the challenge, yet importance, of including not only states, considering how to address threats by proxies in such an agreement. This red line could act as an entry point for later nuclear energy and research cooperation.

- **Regional participation** – While only states with nuclear energy programmes were invited to attend the workshop, participants noted that they would have valued an Israeli perspective on the issues discussed, and that perhaps further Track 1 to Track 2 discussions could indirectly build relationships.

91 Sara Z. Kutchesfahani, "Prospects for a Middle East Regional Safeguards Organization", Federation of American Scientists, 25 February 2014, https://fas.org/pir-pubs/prospects-middle-east-regional-safeguards-organization/; International Atomic Energy Agency, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), IAEA Nuclear Security Series No. 13 (Vienna: IAEA, 2011), https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1481_web.pdf.

92 India–Pakistan Non-Attack Agreement, signed on 31 December 1988, https://www.nti.org/education-center/treaties-and-regimes/india-pakistan-non-attack-agreement/.

Table 3: Suggested areas for regional cooperation in nuclear peaceful uses

DEVELOPMENT AND COOPERATION ON NUCLEAR RESEARCH AND ENERGY IN THE MIDDLE EAST

WORKSHOP REPORT

Most existing nuclear weapon-free zones include provisions related to the promotion of nuclear technologies and their peaceful applications. This report provides a summary of the discussion, key findings and insights from a workshop organized by UNIDIR to inform discussion on this issue in the Middle East Weapons of Mass Destruction-Free Zone context. The report provides an overview of the status of nuclear energy programmes in the Middle East; reviews existing mechanisms for regional cooperation on nuclear research and energy, identifies potential areas for cooperation in nuclear safety and security, and offers insights on these in the context of the Middle East Weapons of Mass Destruction-Free Zone.

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