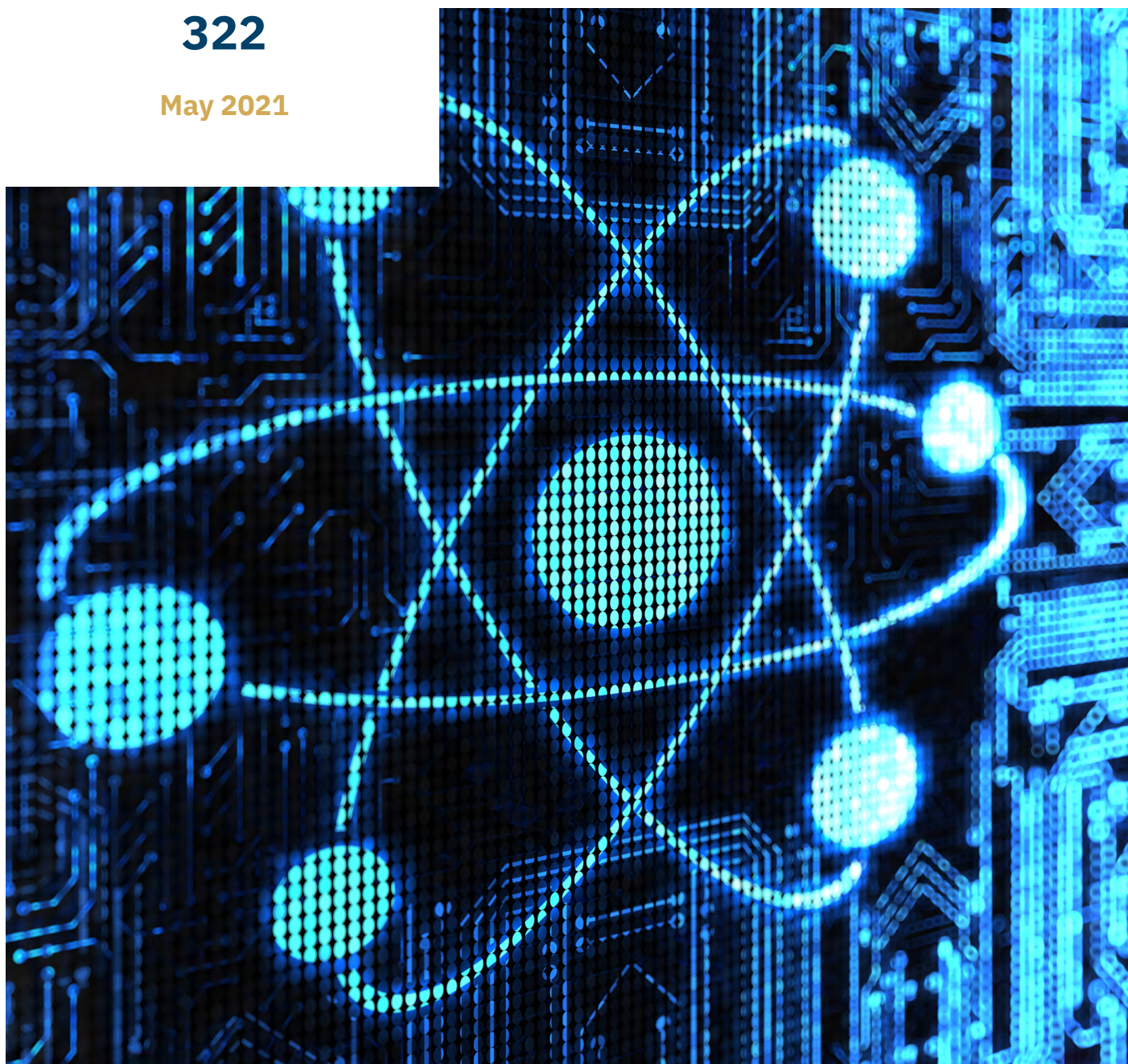


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Nuclear Revival in North Africa? Developments in Algeria, Libya, and Egypt

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African perspectives
Global insights

Abstract

This paper explores nuclear science and technology through the prism of three North African case studies: Algeria, Egypt and Libya. All three countries have constructed research reactors, albeit in different periods. Egypt's first research reactor – acquired from the Soviet Union – became operational in 1961, and it built another one in 1992. Algeria also has two research reactors, supplied by Argentina and China in the late 1980s. Libya, meanwhile, has a Soviet-designed research reactor, constructed in 1981. Accordingly, all three countries have bureaucratic and legislative infrastructure to manage nuclear science and technology, as well as institutions and centres focusing on nuclear safety, support, training and expertise. This paper analyses and contrasts their capabilities and technologies, while paying attention to instances of collaboration between the three North African countries on nuclear science and technology.

In addition to existing nuclear infrastructure, the paper also looks at historical and future plans for nuclear power plants in the three countries. Egypt's plans to build the Al Dabaa nuclear power plant are currently underway, after having signed an agreement with Russia to build four reactors. This comes after a long history of failed plans to build nuclear power plants. Libya has a similar – albeit more controversial – history with nuclear technology, which includes discussions with Soviet, French and Belgian firms to build a reactor, and a clandestine nuclear weapons programme that was ultimately rolled back in 2003. Even while Libya was embroiled in a civil war, the Libyan Atomic Energy Establishment was still discussing national plans for a first nuclear power plant, although tentatively. Algerian officials, similarly, have sought to lay the groundwork for nuclear energy in the coming decades. This paper outlines these plans, how they are presented to the public, and how citizens have reacted.

Introduction

This paper aims to contribute to an understanding of nuclear politics, science and technology in three North African countries. It discusses the history and politics of Libya, Algeria and Egypt in terms of nuclear research, including previous and future plans to pursue nuclear energy. These techno-nationalist endeavours – requiring active official backing and resource dedication – are large, complex and bureaucratic. All three countries have had research reactors for several decades. However, both academic and policy circles have largely overlooked this form of nuclear technology in favour of a focus on nuclear weapons and proliferation.¹ This is especially relevant in the context of the Middle East,

¹ The discussion on 'horizontal proliferation' became a main concern in security studies after the Cold War. See, for example, Barry Buzan and Lene Hansen, *The Evolution of International Security Studies* (Cambridge: Cambridge University Press, 2009), 100.

where studies on public policy have tended to ignore nuclear technology beyond the focus on proliferation.²

Seeking to fill this gap, this paper pays closer attention to the politics behind the peaceful application of nuclear science and technology in North Africa. The three case studies are comparable not only because of their geographic proximity and similar trajectories on nuclear energy but also because they have adopted similar discourses on nuclear science, technology and energy. In addition to building research reactors, they have all expressed a long-standing interest in building nuclear power plants. Egypt, for example, has taken concrete steps to build four such power plants. Algeria has proposed ambitious timelines for developing nuclear energy capabilities and, after the 2018 uprising, has re-affirmed these plans. Libya, meanwhile, is seeking to re-establish stability after its civil war, but proposals for nuclear energy continue to circulate.

Many of the nuclear energy projects discussed here may remain on paper, talked about and contemplated by officials but not necessarily acted upon. Indeed, many remain unrealised owing to a variety of reasons, ranging from cost to political instability. However, it is still worth understanding and contextualising these ideas, as well as the lingering attraction to nuclear technology. What are the meaning and objectives of these widespread nuclear aspirations? Why do these states still emphasise nuclear energy after decades of failing to act, and despite recent political upheavals? What is the particular discursive appeal of nuclear energy? What is the institutional framework within which nuclear research has been conducted in these three case studies? Finally, are there any instances of collaboration between these countries in the field of nuclear research and technology?

This paper first introduces each of the case studies, with an emphasis on the history of nuclear technology and infrastructure, peaceful uses of nuclear science, international agreements and politics, plans for nuclear energy, and potential obstacles in realising these plans. The subsequent section discusses the dynamics of collaboration in the realms of nuclear science and technology in North Africa. A brief concluding section reflects on the implications of this study and places the three case studies within the context of the contemporary regional dynamics of the Middle East and Africa.

Libya

History of nuclear technology

Under pro-Western monarch King Idris I, Libya became a member of the International Atomic Energy Agency (IAEA) in 1963, and signed the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) six years later. However, with the coup that brought Col. Muammar

² For example, see Bruno Tétrais, "The Middle East's Next Nuclear State" (Strategic Insights, Center for Contemporary Conflict, Monterey), <https://www.hsdl.org/?view&did=791235>.

al-Qaddafi to power in 1969, Libya sought to acquire nuclear technology with an eye to establish a nuclear weapons programme. Starting in 1970, Libyan officials tried to buy a nuclear weapon from China, the Soviet Union, India, Pakistan, France and Argentina.³ In 1973 Libya also sought to annex the Aouzou Strip in northern Chad, thought to be rich in uranium deposits.

At the same time, Libya launched a civilian nuclear programme in 1971 and created the Atomic Energy Establishment (AEE) in 1973, which remains operational. It then obtained a Soviet-designed 10 MW research reactor, which became functional in 1981 and is located in Tajura in the Greater Tripoli area in north-west Libya. In the same year it founded the Secretariat of Atomic Energy, which was tasked with overseeing the AEE. Prior to supplying Libya with the research reactor, the Soviet Union had insisted on Libya's ratification of the NPT, which happened in 1975. In 1984 there were around 750 Libyan experts at the Tajura reactor, although a declassified US intelligence report from 1985 believed that they were still largely dependent on around 200 Soviet specialists.⁴ The Tajura Centre and Al Fatah University in Tripoli both trained Libyan scientists and engineers. The country developed a highly complex bureaucracy, and the AEE's own organisational structure has dozens of entities.⁵

Peaceful uses of nuclear science and technology

The AEE currently operates the Nuclear Research Centre in Tajura and the Centre for Radiological Measurements and Training. The former produces radioactive isotopes for use in agriculture, medicine, geology, biology and industry. Its facilities comprise laboratories for nuclear, solid state and neutron physics, as well as for material science and engineering, radiation biophysics and others. It carries out research and development on desalination, while also working with hospitals and clinics on isotope use, training and radiological surveys.⁶ A 2015 article notes that Libya has more than 125 facilities in the medical sector that use radioactive sources.⁷

Libya has more than 125 facilities in the medical sector that use radioactive sources

3 Etel Solingen, *Nuclear Logics: Contrasting Paths in East Asia and the Middle East* (Princeton: Princeton University Press, 2007), 213.

4 Solingen, *Nuclear Logistics*, 213; 'The Libyan Nuclear Program: A Technical Perspective' Directorate of Intelligence, SW 85-10017CV, SC 00387/85, February 1985, p. iii, <https://nsarchive2.gwu.edu/nukevault/ebb423/docs/10.%20libya%201985.pdf>.

5 The Atomic Energy Establishment's official website has a chart outlining its internal structure. See AEE, "About Us" (in Arabic), <http://aee.gov.ly/about-us/>.

6 AEE, "Nuclear Research Centre" (in Arabic), <http://aee.gov.ly/tc/>.

7 Usama Elghawi and Husam Shames, "Management of Radioactive Waste in Libya: Case Study", *Journal of Hazardous, Toxic, and Radioactive Waste* 20, no. 3 (2015).

The Centre for Radiological Measurements and Training manages fuel and radioactive waste, which includes supervising radioactive waste management operations.⁸ Owing to oil and gas exploration and operation in Libya there is naturally occurring radioactive material, creating a need for a radioactive waste management system to protect the environment and human health.⁹ The AEE oversees the Benghazi Office for Radiometry, which was established to provide services such as radiological analysis and measurement of foodstuffs and food processing. It is unclear from the AEE's website whether some of these activities have been placed on hold as a result of the civil war, which was in its 10th year at the time of writing. A new unity government has since been formed in Tripoli after UN-sponsored peace talks, but the future is uncertain.

International isolation and re-integration

Several plans to build nuclear power plants in Libya have faltered. In the late 1970s and mid-1980s Libya had an agreement with the Soviet Union to build two power plants, with each reactor intended to deliver 440 MW.¹⁰ A site on the country's northern coast was selected.¹¹ The power plants were intended to both produce electric power and desalinate

Several plans to build nuclear power plants in Libya have faltered

seawater. However, there were various disputes between the two parties and the plans ultimately fell apart. Libya subsequently sought to negotiate with a Belgian firm to take over the contract; however, fearing the proliferation of nuclear weapons, the US pressured the Belgian government to reject the deal, and the project was suspended indefinitely in 1986. Washington cut bilateral relations with Libya in 1981 and imposed sanctions on the country. This international isolation increased with a Libyan's involvement in the Lockerbie bombing in December 1988. From the 1980s to 2003, Libya used the Tajura Centre in attempt to develop nuclear weapon capabilities, as well as numerous other sites for centrifuge research, uranium conversion, and storage of strategic materials.¹² Its nuclear weapons programme intensified in the 1980s and, despite US sanctions, Libya managed to procure a uranium conversion facility from Japan, for example.

8 AEE, "Centre for Radiological Measurements and Training" (in Arabic), <http://aee.gov.ly/crmt/>.

9 Elghawi and Shames, "Management of Radioactive Waste".

10 Thomas O'Toole, "Libya Said to Buy Soviet A-Power Plant", *The Washington Post*, December 12, 1977, <https://www.washingtonpost.com/archive/politics/1977/12/12/libya-said-to-buy-soviet-a-power-plant/5746253e-fcb3-4de8-8d12-ce7e13c2ad14/>.

11 Usama Elghawi and Wedad El-Osta, "The Alternative Energy Sources and Technologies Suitable for Libyan Future Energy Demand Mix", *International Journal of Energy Technology and Policy* 11, no. 1 (2015): 48-49.

12 Nuclear Threat Initiative, "Libya", <https://www.nti.org/learn/countries/libya/facilities/>.

In December 2003 Libya signed an agreement with the US and the UK to end its nuclear weapons programme

In December 2003 Libya signed an agreement with the US and the UK to end its nuclear weapons programme. It began cooperating with the IAEA and signed the additional protocol in 2004.¹³ Admission of guilt (ie, having a nuclear weapons programme) was a key part of the agreement: Qaddafi publicly declared that the country had pursued a covert nuclear weapons programme and that it was subsequently dismantled, with international inspectors ensuring the dismantlement. Libya worked with the US, the UK and the IAEA to dismantle all nuclear materials and equipment. The Tajura Centre was merged with others, focusing on water and solar power, and transformed into the Renewable Energies and Water Desalination Research Centre. In 2006 fuel at the Tajura plant was converted from highly enriched uranium (HEU) to low enriched uranium.¹⁴ Libya's renunciation of its nuclear programme has since been praised as a 'model' for nuclear disarmament, although many analysts remain sceptical.¹⁵

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Nuclear energy plans

After the agreement and the dismantlement of its nuclear programme, Libya sought to pursue peaceful uses of nuclear energy, signing agreements with France, Canada, Ukraine and Russia. The country also established a regulatory body in 2009 to manage radiological and nuclear control.¹⁶ As recently as 2010 Libya was renewing plans to develop nuclear energy capabilities. It is worth noting that it is an oil-producing country, and also has natural

13 Elghawi and El-Osta, "The Alternative Energy Sources".

14 International Atomic Energy Agency, *Research Reactors in Africa: A Directory* (Vienna: IAEA, 2020), <https://www.iaea.org/sites/default/files/20/07/research-reactors-in-africa-2020.pdf>.

15 Richard Nephew, "When Talking about North Korea, Don't Mention Libya", Brookings, May 29, 2018, <https://www.brookings.edu/blog/order-from-chaos/2018/05/29/when-talking-about-north-korea-dont-mention-libya/>.

16 Fatma Changir, "Nuclear Energy in Libya" (Paper, Joint ANNuR-FNRBA Workshop on Milestones and Infrastructure for New Research Reactor Projects, Cairo, May 10-14, 2015), https://gnssn.iaea.org/main/ANNuR/Activity%20Documents%20%20Public/Joint%20ANNuR%E2%80%93FNRBA%20Workshop%20on%20Milestones%20and%20Infrastructure%20for%20New%20Research%20Reactor%20Projects/Libya_presentation.pdf.

gas reserves. The oil sector represents nearly 70% of its export earnings, and it has been a member of the Organization of the Petroleum Exporting Countries (OPEC) since 1962.¹⁷

Following widespread protests against Qaddafi during the Arab Spring in 2011, a multi-state coalition led by NATO launched an intervention. However, the situation has not stabilised since. The civil war has made conditions volatile, and there have been concerns that Libyan rebels could use the nuclear centre in Tajura to combine conventional explosives with the remaining radioactive materials.¹⁸

Despite the civil war, the AEE still pursues the possibility of nuclear energy, if only discursively. For instance, a 2015 presentation by the agency outlined the national plan for the country's first nuclear power plant. It was described as still being in Phase 1: Pre-project, where considerations are discussed prior to launching the programme. But, as others have noted, it is unlikely that international actors will sign an agreement with Libya at this stage.¹⁹ Another presentation, in December 2017, argued that Libya should introduce a small modular reactor for petroleum preservation, electric production, desalination and environmental purposes.²⁰ However, this presentation acknowledged the political instability and insecurity, as well as a history of misuse of nuclear technology under Qaddafi.

Looking ahead

The AEE has highlighted the political situation as a key obstacle to its ability to function. An example of this is the difficulties associated in bringing international experts to visit Libya owing to the shutdown of embassies. Falling under the jurisdiction of the UN-recognised Government of National Accord (GNA), the AEE recently asked the Council of Ministers to review the conditions hindering its ability to proceed with its work. On the AEE's official website, the chairperson of the Board of Directors reminds visitors that despite the challenging political circumstances, the institution has a vision, mission and goals that it is striving to achieve.²¹ The statement calls on the state and relevant authorities to carry out key reforms that will enable the institution to carry out its work without interruptions and transfer practical knowledge across generations, noting that otherwise the institution may be paralysed.

Libya still cooperates with the IAEA, and signed a Country Programme Framework in 2019, highlighting its priorities in using nuclear technology to support national development.²²

17 Organization of the Petroleum Exporting Countries, "Libya: Facts and Figures", https://www.opec.org/opec_web/en/about_us/166.htm.

18 "Ex-IAEA Official Warns of Libya 'Dirty Bomb' Material", *Reuters*, August 24, 2011, <https://www.reuters.com/article/libya-nuclear-heinonen/ex-iaea-official-warns-of-libya-dirty-bomb-material-idINLDE77N04X20110824>.

19 Changir, "Nuclear Energy in Libya".

20 Amal Algahwaji and Sana Edoukali, "Introducing Nuclear Technology for Cogeneration in Libya" (Paper, Workshop on Small Modular Reactor Safety and Licensing, Hamamat, December 12-15, 2015), <https://gnssn.iaea.org/NSNI/SMRP/Shared%20Documents/Workshop%2012-15%20December%202017/Introducing%20Nuclear%20Technology%20for%20Cogeneration%20in%20Libya.pdf>

21 AEE, "Centre for Radiological Measurements".

22 IAEA News Center, "Libya Signs Its Third Country Programme Framework (CPF) for 2019-2023", October 22, 2019, <https://www.iaea.org/newscenter/news/libya-signs-its-third-country-programme-framework-cpf-for-2019-2023>.

Furthermore, the AEE continues to seek to build national and scientific capability for peaceful nuclear technology. In January 2019 it revealed that it was proceeding with talks, inside and outside Libya, to create a scientific forum for experts to discuss peaceful applications for nuclear technology, including renewable energy and medicine.

There is little information in Libya on public views on nuclear technology, but the country's nuclear history – and the ways in which Qaddafi squandered public funds in pursuit of a nuclear weapons programme – remains controversial

There is little information in Libya on public views on nuclear technology, but the country's nuclear history – and the ways in which Qaddafi squandered public funds in pursuit of a nuclear weapons programme – remains controversial. There have been some publications debating the potential of nuclear energy in Libya's future. For example, a text published by the Arab Scientific Community Organisation compares nuclear and solar power. It notes that, while the trend appears to be in favour of nuclear, solar energy is more financially viable and has fewer political and security risks.²³

Algeria

History of nuclear technology

After a long and violent struggle with French colonialism, Algeria became independent in 1962. Like many other newly independent states, its efforts were focused on developing indigenous capabilities for science and technology. This extended to the nuclear realm, and in the early 1970s Algeria began setting up institutions for training nuclear scientists and engineers, in order to eventually establish nuclear infrastructure.²⁴ Discussions to construct a nuclear power plant began in 1975, and Algeria conducted feasibility studies in the decade that followed. However, these plans have not yet materialised and continue to be postponed.

In the 1980s and 1990s Algeria began to invest more actively in nuclear technology. It established nuclear research centres and infrastructure. This culminated in two research

23 Al-Za'ilik, "For Those Who Prefer Nuclear Energy to Solar Energy in Libya" (in Arabic), Arabic Scientific Community Organization, March 5, 2015, <https://arsco.org/article-detail-612-8-0>.

24 Brahim Meftah, "Outlook of Nuclear Energy in Algeria" (Proceedings, International Conference on Opportunities and Challenges for Water Cooled Reactors in the 21st Century, IAEA, Vienna, 2011).

reactors. The 1MW Nur reactor is a light-water moderated pool reactor, which became operational in 1989 and is used for training and research. It was supplied by the state-owned Argentine firm INVAP, with an emphasis on Algerian professional and technical efforts as well as the participation of Algerian firms in its construction and maintenance, to ensure 'the genuine transfer of technology'.²⁵ It is located in Draria, a suburb of Algiers on the east coast. The second reactor, Es-Salem, is a heavy water moderated tank-type reactor that became operational in 1992 and has an output of 15MW.²⁶ Supplied by China's National Nuclear Corporation, it is used for scientific research, medical isotope production, hot-cell laboratories, waste storage and other civil purposes. It was upgraded and modernised in 2019²⁷ and is located in Birine, 250km south of Algiers, in the province of Djelfa.

Peaceful uses of nuclear science and technology

In addition to the research reactors, Algeria established infrastructure to support nuclear research. The Commission of Atomic Energy (COMENA) was established in 1986 and became part of the Ministry of Energy and Mines. COMENA is in charge of Algeria's nuclear research centres: Al-Darariya, Algiers, Pirin and Tamanrasset.²⁸ The agency handles all nuclear research and training and their use in agriculture, industry, medicine, water and environment. The Al Darariya site also houses a pilot fuel fabrication plant.

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In terms of peaceful applications of nuclear science and technology, COMENA is involved in the research and development of radioisotopes, radiobiology and radio-pharmaceuticals for diagnosis. It has a laboratory for isotope hydrology and has contributed to studies on water resources, such as detecting dam leakage. In addition, COMENA has acquired a gamma irradiator, which is used for agricultural applications. It also carries out research on animal reproduction, and works on the exploration of nuclear raw materials in Algeria and the

25 INVAP, "Reactor Nur (Algeria): Introduction", <https://web.archive.org/web/20070928035035/http://www.invap.net/nuclear/nur/intro-e.html>.

26 Sidi Ali Kamel and Brahim Meftah, "Introduction of Nuclear Power Plants in Algeria: Presentation of the development of NP Program, 24-27 January 2012" (Presentation, US Department of Energy, Office of Scientific and Technical Information, Oak Ridge), <https://www.osti.gov/etdeweb/servlets/purl/21544904>.

27 China National Nuclear Corporation, "CNNC Completes Algerian Upgrade", March 9, 2019, http://en.cnncc.com.cn/2019-03/09/c_345830.htm.

28 More information on each of the nuclear research centres is available at Commissariat à l'Énergie Atomique (in Arabic and French), <https://www.comena.dz/>.

improvement of nuclear installations and development of computing systems. COMENA works with various Algerian universities and scientific centres. To further develop national scientific capacity, it makes the use of its accelerator, neutron generator and other facilities available to the Algerian scientific community as needed.²⁹

International agreements and collaboration

Algeria has collaborated actively with international institutions such as the IAEA, and sought international agreements with various actors on nuclear science and technology, including Russia, the US, China and Argentina.³⁰ There was, however, some controversy over Algeria's acquisition of the Es Salam nuclear reactor in 1991. The US, suspecting that Algeria was seeking to develop nuclear weapons with Chinese assistance, pressured China for assurances about the sale of the reactor.³¹ Under pressure from the US, Algeria allowed the IAEA to inspect its reactors in 1992.

While it was never entirely clear whether these concerns were justified, they eventually resulted in Algeria's signing the NPT in 1995, after its initial refusal owing to the NPT's inability or unwillingness to confront Israel's nuclear programme. It subsequently also signed the Treaty of Pelindaba in 1996, establishing a Nuclear-Weapon-Free Zone in Africa. Concerns were not immediately dispelled, and some continued to argue that the nuclear programme was designed for military purposes, given Algeria's large oil and gas reserves and its refusal to sign the Additional Protocol (which gives the IAEA extended powers to verify the peaceful use of nuclear materials).³²

Furthermore, Algeria has invested in efforts to explore uranium, with some sources estimating that it has the largest uranium reserves of any state in the Middle East – an estimated 26 000 tons.³³ While it currently has no uranium enrichment capacity, it has signed uranium mining agreements with Russia, France and Jordan.³⁴

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29 Commissariat à l'Énergie Atomique, "Programmes Recherches-Développement", <https://www.comena.dz/programmes-recherche-developpement/>.

30 For example, see "Russia, Algeria Agree to Cooperate in Nuclear Energy, NPP Project Possible", *Ria Novosti*, September 5, 2014, <http://www.atominfo.ru/en/news4/d0083.htm>.

31 US National Security Archive, The Nuclear Vault, "The Algerian Nuclear Problem, 1991: Controversy Over the Es Salam Nuclear Reactor", September 10, 2007, <https://nsarchive2.gwu.edu/nukevault/ebb228/index.htm>.

32 David Albright and Corey Hinderstein, "Algeria: Big Deal in the Desert?", *Bulletin of the Atomic Scientists* 57, no. 3 (May/June 2001): 45–52.

33 US Congress, Office of Technology Assessment, *Technology Transfer to the Middle East* (OTA-ISC-173, OYA, Washington DC, September 1984), 369.

34 See WISE Uranium Project, "New Uranium Mining Projects: Africa", <https://www.wise-uranium.org/upafr.html>.

Algeria is an oil-producing country and has large reserves of natural gas. Its energy needs are largely met by fossil fuels, and it is an active participant in OPEC, like Libya. However, it has sought alternative energy sources, including nuclear and solar energy, owing to rising demand.

Plans for nuclear energy

Discussions of a nuclear power plant were never officially shelved, even while Algeria experienced a civil war in the 1990s and an economic recession. The nuclear accident at Chernobyl in 1986 also dampened enthusiasm for nuclear energy projects. However, these plans were more assertively renewed in the 2000s, when Algerian officials revealed a highly optimistic plan to have a first reactor by 2020. While the schedule was repeatedly pushed back, government statements continued to affirm the plan, with similar timeframes of 15 or 20 years. For instance, a 2014 statement declared that Algeria sought to have a nuclear power plant by 2029.³⁵

In 2007 Algeria established the Directorate of Nuclear Energy (DEN), which also falls under the Ministry of Energy and Mines. While COMENA is still in charge of nuclear facilities and their applications, the DEN was created to coordinate national policy on nuclear energy. Despite these efforts Algeria has not chosen a suitable location yet – in particular, one that is not prone to earthquakes and not populated.³⁶ Building a nuclear power plant will also likely require the country to invest in training personnel. Like many other states in Africa, Algeria has considered cooperating with ROSATOM to construct the nuclear power plant, building on extensive Algerian-Russian cooperation in other realms, including weapons and energy.³⁷ Russian officials have offered Algeria ‘close and preferential cooperation in the nuclear energy field’, signing a bilateral agreement in 2015.³⁸

Looking ahead

After ruling the country since 1999, Algeria’s president Abdelaziz Bouteflika resigned in 2019 following widespread protests. The new political leadership has adopted a similar approach to science and technology. Algeria’s energy minister, Muhammad Arkab, was quoted as saying that the country was planning to build a power plant. In June 2019 he outlined a plan for Algeria to shift its energy consumption to include 6% from nuclear energy and

35 Economist Intelligence Unit, “Algeria aims to become a nuclear power producer by 2029”, October 23, 2014, <http://country.eiu.com/article.aspx?articleid=1742415758&Country=Algeria&topic=>.

36 “Algeria Plans Nuclear Power Stations from 2020”, *Reuters*, February 24, 2009, <https://www.reuters.com/article/ozabs-algeria-nuclear-20090224-idAFJJOE51N09V20090224>.

37 Russian Federation to the United Kingdom of Great Britain and Northern Ireland, “Foreign Minister Sergey Lavrov’s Interview with Algerian Newspaper L’expression, Published February 28, 2016”, Press Release, February 29, 2016, <https://www.rusemb.org.uk/fna/pr/5456>.

38 Tobias Schumacher and Cristian Nitoui, “Russia’s Foreign Policy towards North Africa in the Wake of the Arab Spring”, *Mediterranean Politics* 20, no. 1 (2015): 97–104, 103.

20% from solar.³⁹ He said that these plans had been fully studied, including the effects of radiation on the environment and health, and argued that COMENA was 'capable' of disposing of nuclear waste and radiation. In response to questions raised about potential damages resulting from the construction of a nuclear reactor near residential areas, Arkab maintained that the reactor would be built according to international standards of safety and security, citing the participation of the IAEA in a monitoring safety.⁴⁰ However, he did not provide additional details on how this would take place. This resembles the Egyptian context, where information is not effectively and transparently communicated to citizens. In both cases, questions about safety have been met with a response that emphasises technical solutions.

Arkab proposed a timeline of 15–20 years, although he noted that this might be reduced owing to Algeria's existing competencies in nuclear science

Arkab proposed a timeline of 15–20 years, although he noted that this might be reduced owing to Algeria's existing competencies in nuclear science.⁴¹ Like Libya, however, Algeria is unlikely to complete the project in the near future. No tenders have been issued yet, and there have been continued protests and political turmoil, which could pose further hurdles to its implementation.

Furthermore, the topic of nuclear energy is likely to retain a degree of controversy in Algeria, where France carried out 17 nuclear tests between 1960 and 1967. The French tests in Algeria ignited pan-African political mobilisation in opposition to such nuclear imperialism.⁴² Official French estimates of those affected by nuclear testing in Algeria are around 27 000 people, but Algerian sources suggest the figure is closer to 60 000.⁴³ More

The topic of nuclear energy is likely to retain a degree of controversy in Algeria, where France carried out 17 nuclear tests between 1960 and 1967

39 "Arkab: Algeria Seeks to Produce 6 Percent of Its Electricity from Nuclear Energy", *Radio Algeria*, June 18, 2019, <https://www.radio-algerie.dz/news/ar/article/20190618/172523.html> (in Arabic).

40 "Algeria Is Seeking to Produce Electricity through Nuclear Energy", *El Massa*, July 15, 2019, <https://www.el-massa.com/dz/news/ةي وونللا-ةق اطلال-قي رط-نع-ءاب رلكللا-ح ات نال-ي ع ست-رئ ا ز ل ل ا> (in Arabic).

41 "Algeria is seeking to produce".

42 Jean Allman, "Nuclear Imperialism and the Pan-African Struggle for Peace and Freedom: Ghana, 1959-1962", *Souls* 2 (2008): 83-102.

43 Johnny Magdaleno, "Algerians Suffering From French Atomic Testing, 55 Years After Nuke Tests", *Al Jazeera*, March 1, 2015, <http://america.aljazeera.com/articles/2015/3/1/algerians-suffering-from-french-atomic-legacy-55-years-after-nuclear-tests.html>.

than 60 years later, thousands of Algerian victims continue to seek compensation from France over the fallout, with little success.⁴⁴

Egypt

History of nuclear technology

Of the three countries surveyed in this paper, Egypt is the closest to building a nuclear power plant. Its plans – agreed upon with ROSATOM in 2014 – are to build four nuclear reactors in Al Dabaa, on the country's northern coast, and are currently underway. The project is funded by a \$25 billion loan from ROSATOM, repayable over 22 years. Construction of the power plants has begun, after numerous delays. Owing to COVID-19, work on the site has not yet entered the main phase. The construction so far has been of administrative buildings. Egypt and Russia announced that they had agreed on a new schedule, but did not make it public.⁴⁵

Of the three countries surveyed in this paper, Egypt is the closest to building a nuclear power plant

Egypt's nuclear programme was inaugurated in 1954. Like Algeria and Libya, it began its nuclear journey by importing research reactors: one from the Soviet Union and another from Argentina. These deal with industrial and agricultural research, and are located at Inshas in the western Delta (40km north of Cairo).⁴⁶ The first reactor is a 2MW light-water research reactor that became operational in 1961. Its capacity was increased to 5MW in an agreement with India in the early 1990s. Egypt acquired the second reactor from Argentina in 1992, and it went operational in 1998. At Inshas, Egypt is thought to employ 1 400 nuclear science and engineering scientists.⁴⁷

44 Elizabeth Bryant, "Algeria: 60 Years On, French Nuclear Tests Leave Bitter Fallout", *Deutsche Welle*, February 13, 2020, <https://p.dw.com/p/3Xfl1>.

45 "Russia, Egypt Adjusted Plans for Construction of El-Dabaa NPP Due to Pandemic", *TASS*, February 2, 2021, <https://tass.com/economy/1251959>.

46 Mark Fitzpatrick, "Nuclear Capabilities in the Middle East", in *WMD Arms Control in the Middle East: Prospects, Obstacles and Options*, ed. Harald Muller (London: Routledge, 2016), 114.

47 Sarah Burkhard et al., *Nuclear Infrastructure and Proliferation Risks of the United Arab Emirates, Turkey, and Egypt*, Report (Washington DC: Institute for Science and International Security, August 25, 2017), https://isis-online.org/uploads/isis-reports/documents/Middle_East_Proliferation_Assessments_25Aug2017_Final.pdf.

Peaceful applications of nuclear science and technology

The Egyptian nuclear research centres focus mainly on medical, industrial, environmental and agricultural applications. Irradiation technology is used for sterilisation and food preservation, for example. The Hot Laboratory and Waste Management Centre at Inshas deals with radioactive waste disposal and radioisotope production for medical and industrial purposes, and includes processes of national decontamination, to protect the environment and people from any radioactive waste. In addition, there is a cyclotron used for nuclear physics training, isotope production, geological analysis and radiation research. In 2017 the IAEA provided support to upgrade and improve the cyclotron's performance, which, according sources in its Technical Cooperation Programme, 'included delivering and installing a radiofrequency system to provide radioisotopes for medical treatment'.⁴⁸

The Egyptian nuclear research centres focus mainly on medical, industrial, environmental and agricultural applications

Cairo has also collaborated with the IAEA to strengthen the industrial applications of nuclear science and technology, improve human health and radiation safety, and support water resource management.⁴⁹ Like the other case studies, Egyptian nuclear research is situated within a larger national matrix, working to fortify local industry, train personnel and cooperate with universities.

International agreements

Egypt signed and ratified the NPT as part of its pursuit of nuclear energy in the 1980s, but it has since become one of the most outspoken critics of the nuclear non-proliferation regime enshrined by the NPT. Egyptian officials, particularly in the foreign ministry, resent Israel's undeclared but well-known possession of nuclear weapons. Both Libya and Algeria have

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48 IAEA, Technical Cooperation Programme, "Egypt", <https://www.iaea.org/sites/default/files/20/07/tc-egypt.pdf>.

49 IAEA, "Egypt".

also criticised Israeli possession of nuclear weapons and typically vote with Egypt on the subject in international forums, such as the NPT. Egypt led the opposition to the indefinite extension of the NPT in 1995, which it only agreed to after the NPT adopted a resolution in favour of establishing a Weapons of Mass Destruction-Free Zone (WMDFZ) in the Middle East. However, plans for the WMDFZ in the Middle East remain stalled.

Egypt has also faced international scrutiny of its reactors. In 2004–5 the IAEA reported ‘undisclosed experiments’ and traces of HEU. It was revealed that Egypt had conducted 16 experiments between 1990 and 2003 without officially disclosing these.⁵⁰ Concerns over non-compliance led to premature reports of Egypt’s developing nuclear weapons.⁵¹ However, the situation was eased after IAEA inspectors visited the facility.

Nuclear energy project

Like its neighbours, Egypt’s plans for nuclear energy follow many years of planning for – but failing to realise – the construction of a power plant. Since the 1960s each of the country’s presidents has sought and pursued, to an extent, plans to build a power plant. Proposals by the first president, Gamal Abd al-Nasser, were halted due to the war with Israel in June 1967. His predecessor, Anwar al-Sadat, re-started the project and sought US assistance in constructing the reactors in the 1970s. However, following the US’ imposition of preconditions, Egypt officials became reluctant to continue.

After Sadat’s assassination in 1981 Hosni Mubarak restarted the project, and Al Dabaa was chosen as a site. Yet no concrete action was taken, and the Egyptian government had second thoughts after the Chernobyl disaster. Mubarak’s son Gamal restarted the project in 2006, while his father was still president, and the project gained parliamentary approval. However, Mubarak was ousted in 2011, and between 2011 and 2013 only small steps were taken to proceed with the project. A coup d’état by Abd al-Fattah al-Sisi in 2013 resulted in an enthusiastic resumption of this project, along with other mega-projects.

Like its neighbours in the postcolonial period, Egypt prioritised the development of indigenous nuclear science capacities. It has used plans to build a reactor at Al Dabaa to develop new institutions for training nuclear scientists and engineers. The localisation of

Like its neighbours in the postcolonial period, Egypt prioritised the development of indigenous nuclear science capacities

50 Nuclear Threat Initiative, “Egypt Failed to Report ‘a Number’ of Nuclear Materials, Activities, Facilities, IAEA Says”, February 15, 2005, <https://www.nti.org/gsn/article/egypt-failed-to-report-a-number-of-nuclear-materials-activities-facilities-iaea-says-4666/>.

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

the project has been emphasised by Egyptian and Russian officials as a key objective.⁵² An estimated 15 000 people will reportedly be employed at the power plant, and the division of labour is expected to be 85% Egyptian and 15% Russian. To support the nuclear energy project, Egypt has implemented a wide array of laws and created new institutions. It adopted national legislation in March 2010 that governs all elements of nuclear activity and safety. It also created a regulatory body, the Egyptian Nuclear and Radiological Regulatory Authority, which reports directly to the prime minister. All other bodies for nuclear energy fall under the Ministry of Electricity and Renewable Energy, which has led the drive to nuclear power as part of its Sustainable Development Strategy and as an attempt to transform the country into a regional energy hub.

Looking ahead

Egypt's rationale for the construction of nuclear power plants is that it needs to satisfy a growing demand, and the nuclear reactor is expected to cover 5–10% of the country's electricity requirements when operational. Egypt's population – nearly 100 million people – is significantly larger than that of Algeria and Libya (with 43 million people and just under 7 million, respectively). Egypt is an oil producer but significantly less so than Algeria and Libya, and it is not a member of OPEC. It relies heavily on oil and gas for its current energy needs. In 2015 a 'super-field' of natural gas, *Zohr*, was discovered off the coast of Egypt, the largest-ever discovery in the Mediterranean, and in 2020 Egypt announced record-high crude oil production for the first time since 1957.⁵³ Many have argued that its pursuit of nuclear energy is therefore largely redundant.⁵⁴ The prioritisation of nuclear energy over other key reforms shows the strong political interest in the strategic industry, which pre-dates the current administration.⁵⁵

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52 Walaa Hussein, "Russia to Build Egyptian Nuclear Reactor", *Al-Monitor*, September 4, 2015, <https://www.al-monitor.com/pulse/fr/originals/2015/09/egypt-russia-offer-build-nuclear-reactor.html>; "Egypt: Staff for Nuclear Industry", *ROSATOM Newsletter* 227, March 2020, http://rosatomnewsletter.com/?post_middleeast=egypt-staff-for-nuclear-industry.

53 Rasha Mahmoud, "Egypt Announces Record-High Crude Oil Production for the First Time in Decades", *Al-Monitor*, September 24, 2020, <https://www.al-monitor.com/pulse/originals/2020/09/egypt-record-crude-oil-production-gas-regional-hub.html>.

54 Kareem Gerges and Ali Ahmad, "Egypt's Nuclear Power Program: Security and Economic Risks" (Policy Brief #6/2018, American University of Beirut, Issam Faris Institute, Beirut, October 2018), https://www.aub.edu.lb/ifi/Documents/publications/policy_briefs/2018-2019/20181018_egypt_nuclear_power_program.pdf.

55 Paul H Suding, "Struggling Between Resources-Based and Sustainable Development Schemes: An Analysis of Egypt's Recent Energy Policy", *Energy Policy* 39, no. 8 (2011): 4442.

While Egypt does not have an active anti-nuclear lobby, citizens frequently voice concerns over plans to develop nuclear energy, which is perceived as costly, potentially dangerous, and not environmentally sustainable, owing to the relative scarcity of water in the country. As in Libya, it is often discussed in comparison to solar energy, which is perceived as much more favourable.⁵⁶ Non-governmental organisations have also expressed concerns about potential nuclear accidents and their effects on the environment.⁵⁷ Egyptian officials have dismissed these concerns, relying mainly on technological solutions to insist that the power plant will be safe. The National Power Plants Authority cites the power plant's adherence to international standards of safety and the adoption of advanced technology to protect against accidents.⁵⁸ Although Egyptian and Russian officials frequently emphasise acceptance of nuclear energy, the project has not always been communicated effectively or clearly to the Egyptian public, who are treated as recipients rather than stakeholders. Questions have been raised about mechanisms of disposal, for example, because of the lack of information available.

Nuclear collaboration

As mentioned earlier, in the context of the NPT, officials in the Arab Group in the UN tend to work together and sometimes vote as a bloc.⁵⁹ However, outside multilateral diplomacy, successful collaboration in and coordination of nuclear research have been minimal. These countries do not appear to have direct bilateral cooperation with one another, despite both Egypt and Algeria having signed extensive bilateral agreements with countries in Europe, North and South America, and Asia.⁶⁰

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- 56 Khaled Diab, "Egypt's Nuclear Energy Folly", *Al Jazeera*, June 4, 2016, <https://www.aljazeera.com/indepth/opinion/2016/06/egypt-nuclear-energy-folly-160602110506962.html>; Egyptian Initiative for Personal Rights, "Nuclear Loses the Energy Race Against Better Alternatives" (Position Paper, EIPR, Cairo, April 23, 2019), <https://eipr.org/en/publications/position-paper-nuclear-more-expensive-and-more-dangerous>; Sherife Abdelmessih, "7 Reasons Why the Russian Nuclear Agreement is Bad for Egypt", Future Energy Corporation, <http://www.futurenergcorp.com/insights>.
- 57 EIPR, "Nuclear Loses the Energy".
- 58 The Nuclear Power Plants Authority's website has a section on safety that focuses exclusively on technological responses. See NPPA, "El-Dabaa NPP Project: Safety", <https://nppa.gov.eg/en/el-dabaa-npp-project-2/#Safety>.
- 59 For example, see UN Meetings, "Arab Group Statement, Second Preparatory Committee for the 2020 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons: Special Regional Issues including the implementation of the 1995 ME Resolution", <http://statements.unmeetings.org/media2/18559724/arab-group-e-cluster-2-specific-issues-english-translation.pdf>.
- 60 See NPPA, "Bilateral Agreements", <https://nppa.gov.eg/en/international-cooperation/#Bilateral-Agreements>; Commissariat à l'Énergie Atomique, "Bilateral Cooperation" (in Arabic and French), <https://www.comena.dz/cooperation-bilaterale/>.

The mechanisms for collaboration include the Arab Atomic Energy Agency (AAEA) and the Arab Network of Nuclear Regulators (ANNuR). Hosted in Tunisia, the AAEA is a scientific entity and a subsidiary of the League of Arab States (LAS), founded in August 1988. The AAEA is tasked with supporting Arab countries' pursuit of peaceful uses of atomic energy and encouraging scientific development of nuclear technology. In 2007, during its Riyadh Summit, it reaffirmed its member states' desire to develop peaceful nuclear activities, although the institution has largely been dormant.⁶¹ The ANNuR was established in January 2010 to help LAS member states develop and strengthen their regulatory bodies. It is supported by the IAEA, which also acts as its scientific secretariat.⁶² It is under the auspices of these two agencies that cooperation in the field of nuclear technology between the three countries takes place.

Academic conferences appear to be the main vehicles of nuclear knowledge sharing in Africa and the Middle East. Participants tend to be from national atomic energy agencies and usually give presentations on their latest developments and plants.⁶³ For example, a conference hosted by the AAEA in Tunis in March 2014, dealing with the management and disposal of radioactive waste, brought together representatives of Libya, Egypt, five other Arab states in West Asia, and 15 other African states.⁶⁴ Another conference hosted by the IAEA and AAEA in Tunisia in December 2017 dealt with safety at and licensing for small modular reactors.⁶⁵ Representatives of ANNuR, the Forum for Nuclear Regulatory Bodies in Africa (FNRBA) and the US Nuclear Regulatory Commission attended. A joint conference between ANNuR and FNRBA in Cairo in May 2015 dealt with milestones and infrastructure for new research reactor projects.⁶⁶ Both Arab and African states participated.

There are other high-level meetings focusing specifically on energy, such as the Middle East and North Africa Renewable Energy Conference – a Euro-Mediterranean summit that has convened six times, most recently in 2016. In the Maghreb specifically (the region of North Africa, excluding Egypt), a 2008 meeting led to a renewed commitment to cooperate in the development of peaceful uses of nuclear energy.⁶⁷ While strategic summits still take place, they rarely seem to result in new collaborative projects.

61 Mohamed I Shaker, "Nuclear Power in the Arab World and the Regionalization of the nuclear Fuel Cycle: An Egyptian Perspective", *Daedalus* 139, no. 1 (Winter 2010): 96–97.

62 IAEA, "Arab Network for Nuclear Regulators", <https://www.iaea.org/sites/default/files/20/10/annur.pdf>.

63 See Ghangir, "Nuclear Energy in Libya"; Algahwaji and Edoukali, "Introducing Nuclear Technology"; Sami M Alwaer, "Radioactive Waste Management in Takoura Nuclear Research Center" (Paper, Regional Workshop on Waste Management and Safe Disposal of Radioactive Waste, Tunis, March 17–21, 2014), <https://gnssn.iaea.org/main/ANNuR/Activity%20Documents%20%20Public/Regional%20Workshop%20on%20Management%20a%20Safe%20Disposal%20of%20Radioactive%20Waste/Libya%20-predisposal.pdf>.

64 The workshop was organised by the IAEA, in coordination with the Arab Atomic Energy Agency and Arab Network of Nuclear Regulators and the Forum of Nuclear Regulatory Bodies in Africa. See IAEA, *Summary Report: Regional Workshop on Management and Safe Disposal of Radioactive Waste*, Tunisia, March 17–21, 2013, <https://gnssn.iaea.org/main/ANNuR/Activity%20Documents%20%20Public/Regional%20Workshop%20on%20Management%20a%20Safe%20Disposal%20of%20Radioactive%20Waste/Tunis%20Summary%20Report.pdf>.

65 Arab Network of Nuclear Regulators, Workshop on Small Modular Reactors: Safety and Licensing, Hammamet, December 12–15, 2017, http://www.aaea.org.tn/wp-content/uploads/2017/10/Prospectus_SMR-workshop-Dec-2017.pdf.

66 IAEA, "Joint ANNuR-FNRBA Workshop: Milestone and Infrastructure for New Research Reactor Projects", Cairo, May 10–14, 2015, https://gnssn.iaea.org/main/ANNuR/Activity%20Documents%20%20Public/Joint%20ANNuR%E2%80%93FNRBA%20Workshop%20on%20Milestones%20and%20Infrastructure%20for%20New%20Research%20Reactor%20Projects/Draft_Agenda.pdf.

67 Michael Mason and Dennis Kumetat, "At the Crossroads: Energy Futures for North Africa", *Energy Policy* 39, no. 8 (2011): 4407–4410.

Limits in collaboration can partly be explained by the continued nationalisation of nuclear science in each of these countries, as shown above, which has been the dominant approach in the postcolonial era. Nuclear science and technology are viewed as strategic areas and accordingly heavily securitised, which ultimately undermines the development of transnational collaborative projects. However, despite the ostensible nationalisation of nuclear science, it also remains heavily contingent upon external actors with technical knowledge, which limits intra-regional collaboration. North African states thus seek to collaborate with international actors, rather than one another.

Limits in collaboration can partly be explained by the continued nationalisation of nuclear science in each of these countries which has been the dominant approach in the postcolonial era

Furthermore, regional collaboration is limited by internal rivalries and political tensions. In the post-2013 era, Egypt has played a direct role in Libya's civil war, providing support for General Khalifa Haftar's camp in eastern Libya, which is fighting against the UN-recognised GNA in the west. Historically, there have been tensions between Libya and Egypt, which resulted in a war in 1977 as well as subsequent skirmishes in the 1980s. Internal suspicions may also play a role: reports indicate that Tunisia and Morocco have been concerned about Algeria's developing nuclear weapons.⁶⁸ There have also been long-standing tensions between Algeria and Morocco over the status of Western Sahara, recognised by the AU and several UN members as the Sahrawi Arab Democratic Republic.

Conclusion

Although enthusiasm for nuclear technology has gone through different stages in North Africa, plans for nuclear energy have never been completely abandoned, and continue to be re-invoked sporadically. In all three country case studies there was a clear interest in nuclear science in the immediate postcolonial period, a reflection of a context in which states were seeking to develop indigenous capabilities of science more broadly and expanding their educational systems and national bureaucracies. Since the 2000s there has been a renewed push for nuclear energy in all three states.

These three cases are not unique. Rather, they are part of a wider trend that has emerged in the Middle East and Africa. For example, Tunisia began discussing plans to build a

68 Albright and Hinderstein, "Algeria: Big Deal", 45.

nuclear power plant in 2007, signing a nuclear cooperation agreement with France two years later.⁶⁹ Little concrete progress was subsequently made, but these plans re-emerged in 2015, and Tunisia signed a Memorandum of Understanding with ROSATOM to develop nuclear energy.⁷⁰ Similarly, Morocco has expressed interest in nuclear power and sought to take concrete steps towards fulfilling this goal, also increasing its collaboration with Russia.⁷¹

While the only functional nuclear power plant in Africa is in South Africa, nuclear aspirations abound across the continent

While the only functional nuclear power plant in Africa is in South Africa, nuclear aspirations abound across the continent. In addition to Morocco, Ghana, Kenya, Nigeria, Niger and Sudan have also engaged the IAEA to launch studies on the feasibility of their nuclear plans.⁷² Meanwhile, in the Middle East, the first nuclear reactor by the United Arab Emirates, Barakah, began operating in August 2020.⁷³ The level of official enthusiasm for nuclear energy in the current period may be at an all-time high, as it continues to feature extensively in future plans regarding energy policy. Russia, in particular, has grown increasingly influential in promoting cooperation in North Africa, with many analysts seeing it as part of a larger, continent-wide bid for influence.⁷⁴

Indeed, nuclear energy is increasingly being depicted as a crucial part of a shift to sustainable development. Many states are seeking to diversify their energy sources away from fossil fuels and are looking to nuclear energy, sometimes in conjunction with other forms of energy such as solar.

However, the uncritical depiction of nuclear energy as inherently environmentally friendly may be problematic, especially in countries that have suffered severe water shortages. The Middle East and North Africa, as a region, is the most water-scarce in the world. This suggests that nuclear energy may be less about establishing an eco-friendly alternative to

69 "Tunisia Plans Nuclear Power Plant by 2020", *Reuters*, January 31, 2007, <https://www.reuters.com/article/idUKAM233712620061123>; "France Seals Nuclear, Aid Deals with Tunisia", *Reuters*, April 23, 2009, <https://www.reuters.com/article/idUKLN941296>.

70 "Tunisia: MoU Signed in Moscow Between Tunisia and Russia on Peaceful Use of Nuclear Energy", *All Africa*, June 3, 2015, <https://allafrica.com/stories/201506040714.html>.

71 "Morocco Takes Step Towards 1st Nuclear Reactor", *Reuters*, January 13, 2011, <https://www.reuters.com/article/morocco-nuclear-idAFLDE70C28720110113>.

72 Laura Gil, "Is Africa Ready for Nuclear Energy?", IAEA News Center, September 3, 2018, <https://www.iaea.org/newscenter/news/is-africa-ready-for-nuclear-energy>.

73 "Barakah: UAE Starts Up Arab World's First Nuclear Power Plant", *BBC News*, August 2, 2020, <https://www.bbc.com/news/world-middle-east-53619916>.

74 "North African Countries: Gateway to Africa?", *Deutsche Welle*, October 23, 2019, <https://p.dw.com/p/3Rnsg> (in Arabic); "Moscow Penetrates the Arab House in North Africa Through Nuclear, Military, and Economic Cooperation and the Stimulation of Tourism", *Al Quds*, September 22, 2017, <https://www.alquds.co.uk/?p=795390> (in Arabic); Mohamed Kerini, "Moscow Reaches into North Africa", *Arab Policy Forum*, January 20, 2020, <https://www.alsiasat.com/?p=3002> (in Arabic).

fossil fuels and more about political positioning and prestige. While many analysts have attributed interest in nuclear energy in the Middle East to fears of a nuclearised Iran, this is arguably only applicable to the Gulf Cooperation Council, or even more specifically, Saudi Arabia. Political interest in nuclear energy can nonetheless be related to other broader foreign policy objectives, such as regional and scientific hegemony. Yet, as others have noted, reliance on nuclear power comes with various forms of vulnerability and dependence and may not necessarily align with national objectives.⁷⁵ This is especially the case when compared to the power generation potential of renewable energies, which are more affordable and more promising.⁷⁶

Furthermore, nuclear energy has been treated as a top-down endeavour in these three contexts. There are few independent sources dealing with this subject, and most of the information is based entirely on official statements. In the case of Egypt, even as the project is being implemented there is still vital information that is not clearly or effectively communicated. Statements in Algeria seem to adopt a similar orientation, suggesting that the government knows best and can handle, internally, the various technical and political dynamics involved in building a nuclear power plant. While there may be attempts to train nuclear scientists and engineers, there are no attempts to engage civil society groups.

Finally, the timelines and frameworks discussed for dealing with nuclear energy have been highly optimistic at best, or perhaps even unrealistic.⁷⁷ This suggests that the articulation of these dates is based mainly on political expediency, in line with the view that the projects are mainly symbolic political manifestations of techno-nationalism.

75 Nikolaus Supersberger and Laura Führer, "Integration of Renewable Energies and Nuclear Power into North African Energy Systems: An Analysis of Energy Import and Export Effects", *Energy Policy* 39, no. 8 (2011), 4458-4465.

76 Marcus Marktanner and Lana Salman, "Economic and Geopolitical Dimensions of Renewable vs. Nuclear Energy in North Africa", *Energy Policy* 39, no. 8 (2011): 4484.

77 Some estimates have declared that nuclear energy could supply 9-15% of all electricity consumption in North Africa by 2030. See J Jewell, "A Nuclear-Powered North Africa: Just a Desert Mirage or Is There Something on the Horizon?", *Energy Policy* 39, no. 8 (2011): 4445-4457.

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