HELLENIC FOUNDATION
FOR EUROPEAN & FOREIGN POLICY

ΕΛΙΑΜΕΠ
ELIAMEP

The Akkuyu NPP and Russian-Turkish Nuclear Cooperation: Asymmetries and risks

TURKEY PROGRAMME

Ioannis N. GRIGORIADIS & Eliza R. GHEORGHE

May 2022
Policy Paper #100/2022

ELIAMEP | Policy Paper #100/2022

The Akkuyu NPP and Russian-Turkish Nuclear Cooperation: Asymmetries and risks

HELLENIC FOUNDATION FOR EUROPEAN & FOREIGN POLICY (ELIAMEP)
49, Vasilissis Sofias Ave., 10676, Athens, Greece
Tel.: +30 210 7257 110 | Fax: +30 210 7257 114 | www.eliamep.gr | eliamep@eliamep.gr

Ioannis N. GRIGORIADIS
Senior Fellow & Head of the Programme on Turkey, ELIAMEP; Associate Professor & Jean Monnet Chair of European Studies, Department of Political Science & Public Administration, Bilkent University

Eliza R. GHEORGHE
Non-Resident Scholar, Programme on Turkey, ELIAMEP; Assistant Professor, Department of International Relations, Bilkent University

Summary

- By ratifying the 2016 Paris Agreement, Turkey has vowed to reduce the use of fossil fuels and promote clean and renewable energy production.
- The Turkish government has embraced nuclear energy as a solution to cutting carbon dioxide emissions.
- Turkey's first nuclear power plant, the Akkuyu Nuclear Power Plant (NPP), is being built by Russia's state-owned nuclear energy corporation, Rosatom, under a Build-Own-Operate contract, the first of its kind in the world.
- The Akkuyu NPP will reinforce Turkey's dependence on Russia for the next six decades.
- The Akkuyu NPP presents considerable environmental risks for the whole Eastern Mediterranean.

Introduction

Relations between Russia and Turkey have experienced spectacular vicissitudes in recent years. From Syria to Transcaucasia and from Libya to Ukraine, Russian-Turkish relations have become increasingly multi-level and complex. Confrontation, competition and cooperation have coalesced to produce a complex nexus of relations which has aptly been characterized as "conflictual camaraderie."[1] Russia's direct involvement in the Syrian civil war, and the 16 November 2015 downing of a Russian military aircraft by the Turkish air force, saw Russian-Turkish relations deteriorate to their lowest point in decades. While President Erdoğan seemed disappointed with the support its NATO allies offered Turkey against Russia, the relationship rebounded fast, albeit in an explicitly asymmetric form.[2] Thus, while both sides invested in revitalizing the economic and strategic aspects of that relationship, it was clear that Russia maintained the upper hand.

The Turkish government had to tolerate the survival of the Assad regime in Syria, which was made possible by decisive Russian intervention. The 15 July 2016 coup attempt played a catalytic role in a Russian-Turkish rapprochement; thus, while the view that the coup plotters had enjoyed Western support was widely circulated by pro-government circles in Turkey, Russia unequivocally supported the Turkish government. Even the 19 December 2016 assassination of the Russian ambassador to Ankara, Andrey Karlov, by an Islamist off-duty policeman could not derail the Russian-Turkish rapprochement: the agreement signed a few days later for the procurement by Turkey of two plus one batteries of Russian S-400 surface-to-air (SAM) missiles would emerge as a milestone in Turkey's relations with the West. Turkey became the first NATO member to be subject to Countering America's Adversaries Through Sanctions Act (CAATSA) sanctions. In addition, Turkey was removed from the joint production program of the F-35 aircraft, in which it had already invested some 9 billion USD. It also questioned the air superiority of the Turkish armed forces on a regional level. This brought the Turkish armed forces' air supremacy on a regional level into question. By maintaining a close but asymmetrical relationship with Turkey, Russia has managed to drive a wedge between it and its key Western partners, including the United States and NATO.

By maintaining a close but asymmetrical relationship with Turkey, Russia has managed to drive a wedge between it and its key Western partners, including the United States and NATO.

Energy and Russian-Turkish Relations

Energy has been a fundamental aspect of Russian-Turkish relations. Ever since the construction of the first natural gas pipeline delivering Soviet natural gas to Turkey through the Balkans, Turkey has been dependent on natural gas imports from the Soviet Union and, later, the Russian Federation. The implementation of mega projects such as Blue Stream and TurkStream made it possible to deliver sufficient quantities of natural gas, bypassing Ukraine and consolidating Russia's hegemonic position in the Turkish natural gas market. Thanks to natural gas, Russia is Turkey's second most important trading partner after Germany. However, this meant that Turkey's energy supply security remained compromised, as natural gas imports from Azerbaijan and Iran were insufficient to serve as substitutes for Russian gas. Moreover, Turkey's dependence on Russian gas has increased from around 33 percent in 2019 and 2020 to 40 percent in 2021 due to a spike in LNG prices and drought-induced decreases in output from

[1] Stanislav Secrieru, Sinikukka Saari and Dimitar Bechev, *Fire and Ice: The Russian-Turkish Partnership* (Paris: European Union Institute for Security Studies (EUISS), 2021)
[2] Aykan Erdemir, Sinan Ciddi and John Hardie, *Collusion or Collision? Turkey-Russia Relations under Erdogan and Putin* (Washington DC: Foundation for Defense of Democracies (FDD), 2021)

hydroelectric power plants.[3]

The announcement of the discovery of natural gas reserves within the Turkish EEZ in the Black Sea raised some hopes, but did not change the fundamentals, as the development and monetization of the natural gas fields could take many years in an energy market environment ever less attracted by hydrocarbon investment. While decarbonization and the transition to renewable energy sources have given Turkey an opportunity to reduce its energy dependency on Russia, Russian-Turkish cooperation in the sphere of nuclear energy has added a new dimension to their energy relationship.

The Akkuyu Nuclear Project

Cooperation on atomic energy is a crucial leg of the Russian-Turkish relationship, since, given the expected life cycle of the nuclear power plant (NPP) Russia is building in Akkuyu, it will bind the two countries together for the next six decades.

While Russian-Turkish dealings in various conflict hotspots in the Middle East, the Black Sea and Transcaucasia have attracted considerable international attention, international reactions to their collaboration in the field of nuclear energy have been rather muted. Nevertheless, cooperation on atomic energy is a crucial leg of the Russian-Turkish relationship, since, given the expected life cycle of the nuclear power plant (NPP) Russia is building in Akkuyu, it will bind the two countries together for the next six decades.[4] Turkey's Deputy Minister of Energy and Natural Resources, Alparslan Bayraktar, has described nuclear power as "essential to reach[ing] Turkey's 2053 target for achieving carbon neutrality."[5] Bayraktar's statement echoes the move taken by the European Commission on 2 February 2022 to establish a "green label" for nuclear power plants in the light of pandemic-related supply disruptions, energy price hikes, and the need to combat climate change. The inclusion of nuclear energy among the accepted transition fuels has sparked debates between EU member states, with France and Germany leading the two opposing groups. While Russia's invasion of Ukraine is likely to act as catalyst on this discussion in favor of nuclear energy, given the urgent need to eliminate the contribution of Russian energy imports to the EU energy mix, safety and environmental considerations will remain essential parameters for the evaluation of any nuclear power projects in the future.

Turkey's ambitions to develop a nuclear energy plant of its own were not new. They were not only linked to Turkey's growing electricity needs, but also to the perception that the project would improve Turkey's global status and prestige. In fact, the nation entered into negotiations with three different consortia concerning the possible construction of three nuclear power plants. The Akkuyu project near Mersin was negotiated with Rosatom, the Sinop project with France's Areva, and the Iğneada project in Eastern Thrace was discussed with China's State Nuclear Power Technology Corporation (SNPTC). Initially, this diverse set of potential contractors reassured Turkey's NATO allies that Ankara would not be completely dependent on a non-Western nuclear supplier. But as the Sinop and Iğneada projects dragged on and eventually stalled as the Akkuyu project forged ahead, the risks of Turkey's asymmetric dependence on Russia became more apparent.

Two of the most sensitive aspects of the Russian-Turkish nuclear partnership concern the business model Rosatom has put in place – Build Own Operate (BOO) – and the regulatory framework within which the Turkish authorities and Russian operator will operate. This arrangement is unprecedented in the nuclear market. The Russian state

[3] Sinan Tavsan, "Turkey Targets Nuclear and Local Gas to Reduce Energy Imports", *Nikkei Asia*, 12/4/2022
[4] Sinan Ülgen, *The Turkish Model for Transition to Nuclear Energy* (Istanbul: EDAM, 2012b) ibid.
[5] Tavsan, "Turkey Targets Nuclear and Local Gas to Reduce Energy Imports"

corporation has undertaken to finance the construction of the power reactors, to ensure the production of electricity, to guarantee the supply of nuclear fuel for the plant's entire lifespan, and to return the spent fuel to Russia. Turkey's Electricity Trading and Contracting Company (*Türkiye Elektrik Ticaret ve Taahhüt A.Ş*-TETAŞ) will buy the electricity produced by the plant at 12.35¢/kWh for a period of fifteen years. This price may seem advantageous in the current energy market, but the dramatic depreciation of the Turkish lira in recent years means TETAŞ will have to pay several times the amount initially envisaged in the power purchase agreement.

Two of the most sensitive aspects of the Russian-Turkish nuclear partnership concern the business model Rosatom has put in place - Build Own Operate (BOO) - and the regulatory framework within which the Turkish authorities and Russian operator will operate.

As for the regulatory framework, the relevant Turkish institutions have been in some degree of flux in recent years. Rosatom had the opportunity to set the Turkish regulatory framework, since there is no BOO contract in place anywhere in the world at present. While an independent nuclear authority –(*Nükleer Düzenleme Kurumu*-NDK)– was established in 2018 to regulate the operation of the nuclear power plant by the Russian-owned project company – *Akkuyu Nükleer Güç Santrali (NGS) Elektrik Üretim A.Ş.* –, its legal infrastructure was only settled in March 2022. This new legislative framework notwithstanding, the problem of procedural inertia may arise.

The NDK's predecessor was the Turkish Atomic Energy Authority (*Türkiye Atom Enerjisi Kurumu*-TAEK), whose responsibilities combined not only developing nuclear regulations and safety measures, but also operating Turkey's research reactors.[6] In essence, TAEK was tasked with regulating itself, which raised major concerns about a potential conflict of interest between its commercial and safety roles. According to Aaron Stein, this overlap of roles, combined with the involvement of Rosatom in drafting Turkey's nuclear security legislation, "risks regulatory capture."[7] Stein also noted that TAEK both reported to and was heavily influenced by the executive, due to the arrangements concerning its funding and leadership appointments.[8] TAEK was also one of those state institutions which experienced a major reshuffle in the wake of the failed coup of 15 July 2016, posing a challenge to its bureaucratic efficiency. The recent introduction of a novel regulatory framework was supposed to resolve the aforementioned issues. For instance, thanks to a presidential decree from 2018, the nuclear regulatory authority is no longer allowed to operate nuclear facilities in Turkey. Instead, research reactors would henceforth be operated by Türkiye Enerji, Nükleer ve Maden Araştırma Kurumu (TENMAK), while the Akkuyu nuclear power plant would be operated by the project company, Akkuyu NGS Elektrik Üretim A.Ş. Nevertheless, the new legislative framework caused some controversy, as the Court of Cassations (*Yargıtay*) declared the presidential decree unconstitutional in December 2020.[9] The Court justified its decision "on the ground that such a comprehensive regulation should be approved by lawmakers."[10] It took the Grand National Assembly until 8 March 2022 to adopt Law No. 7381 on Nuclear Regulation, just one day before the Court-set deadline was due to expire. Given that the creation of the NDK was first mentioned in the November 2007 Nuclear Power Plants Law No. 5710, critics have expressed concern about the apparent haste with which the law was passed in 2022, and about its close resemblance to the presidential decree that had been declared unconstitutional.[11]

[6] Salih Sarı, "Turkey 2021," in *IAEA Country Nuclear Power Profiles* (Vienna: IAEA, 2021)
[7] Aaron Stein, *Turkey's Nuclear Program: Challenges and Opportunities* (Washington DC: Atlantic Council, 2016)
[8] Ibid.
[9] Haberler, "Nükleer Düzenleme Kanunu Teklifi Ilgili Komisyondan Geçti", Bloomberg HT, 1/3/2022
[10] Economy News Desk, "Nuclear Energy Draft Bill to Be Submitted", *Hürriyet Daily News*, 10/2/2022
[11] Önder Algedik, "Nükleer KHK Tutmadı, Nükleer Kanun Verelim!", *Gazete Duvar*, 28/2/2022, Nedim Bülent Damar, "Sinop NGS Davasında NDK'nın Tutumu", *Birgün*, 1/4/2022, Hıdır Göktaş, "Nükleer Düzenleme Kanunu Yürürlüğe Girdi–Oğuz Türkyılmaz: "Maruz Kalınabilecek 'Makul' Radyasyon Dozu Nedir?"", *Medyascope*, 8/3/2022

The financing terms of the Akkuyu project are extraordinary, raising questions about the ulterior motives of the Russian side. The full amount of more than twenty billion USD was to be invested by Rosatom, which would then sell electricity to the Turkish state at a certain fixed price for 15 years, in order to recoup its money. Yet the plant would not be transferred to Turkish state authorities even after the investment was recouped; rather, the power plant is to remain under the management of Rosatom through. Rosatom would continue its operation until its eventual decommissioning, selling electricity to the Turkish state at a lower price.

The Akkuyu power plant sends out a powerful message: the decarbonization of the Turkish economy will not result in less Russian leverage over Turkey.

Moreover, the Akkuyu NPP has shed light on Turkish energy transition priorities. Turkey's October 2021 ratification of the 2016 Paris Agreement highlighted its commitment to reducing the use of hydrocarbons and promoting clean and renewable energy production. Similarly, the European Green Deal and the Fit for 55 Package have highlighted the significance of decarbonization and given rise to crucial policy instruments which extend beyond the EU borders and provide opportunities to countries like Turkey. While whether nuclear energy will be considered a legitimate instrument in the transition to a green economy is going to be debated across Europe and the globe, Turkey's decarbonization poses another important political question pertinent to Russian-Turkish energy relations. This is because a green transition of this sort would effectively end Turkey's dependence on Russian hydrocarbons, and hence deprive Russia of valuable revenues, but also crucial political leverage over Turkey. Russia's willingness to proceed with the Akkuyu project despite its extraordinary features may be better understood through this lens: Russia's commitment to the project is linked less to its economic merits and more to its propensity to consolidate the asymmetry in Russian-Turkish relations that could potentially be shattered by the decarbonization of the Turkish economy. The Akkuyu power plant sends out a powerful message: the decarbonization of the Turkish economy will not result in less Russian leverage over Turkey.

Turkey's Nuclear Program and its Inherent Risks

According to official communications, Turkey is expected to start producing power at its Akkuyu NPP in 2023.[12] Whether the first unit of the Akkuyu plant is completed on time or not, Turkey is slated to become the third country in the Middle East to include nuclear power in its energy mix, after Iran and the United Arab Emirates. The project has been at the center of a heated debate. Its supporters hail it as an important milestone in the modernization and advancement of the Turkish economy and Turkey's industry. Its critics point to three sets of concerns that caution against the adoption of nuclear power.

Risk of Natural Disasters

Environmental organizations have objected to the construction of the nuclear power plant in Akkuyu because of the project's environmental impact and safety risks. Cyprus and Greece have also raised concerns requesting Turkey's consultations with its neighbors about the possible regional environmental impact of the project.[13]

[12] Şebnem Udum, "A Uniquely Turkish Nuclear Energy Tale", *Bulletin of the Atomic Scientists*, 24/11/2021, News Desk, "Turkey to Complete First Unit of Akkuyu Power Plant in May 2023", *Ahval News*, 12/11/2021.
[13] News Desk, "Greece Calls on Turkey to Discuss Akkuyu Nuclear Plant with Neighbours", *Ahval News*, 26/4/2021

Water

Environmental organizations have objected to the construction of the nuclear power plant in Akkuyu because of the project's environmental impact and safety risks.

The Akkuyu NPP uses a considerable volume of water to cool its secondary circuit. The temperature of the seawater in the Eastern Mediterranean is higher than that of other bodies of water, such as the Baltic Sea, the Black Sea, or the Don River, which cools the nuclear power plant that serves as a point of reference for Akkuyu – the Novovoronezh NPP. The design of the heat exchangers had therefore to be adapted to increase the volume of water taken in from the Mediterranean. As a result, the Akkuyu NPP will discharge approximately one million cubic meters of water per hour into Akkuyu Bay by the time all four reactors are operating. This volume of water could change the structure of the seabed, but the temperature increase "may result in the a reduction in the species composition of fish fauna."[14] The project company mentions a seawater temperature increase of 0.5° C, while the Environmental Impact Assessment indicates that "the temperature of discharged seawater will not exceed 35° C".[15] This means that at the point of discharge, the temperature may exceed the average temperature of the Mediterranean Sea, but that within a wider perimeter, the warmer water combines with cool water so the increase will not be significant. Nevertheless, a constant inflow of warmer water can lead to thermal pollution, creating plumes that can reach a few kilometers in length. The water discharge from the two reactors operating at the Cernavoda NPP in Romania can serve as a precedent. The cooling water is discharged into the Danube, and the plume extends for about six kilometers downstream with a 1.5° C difference registered between the discharged water and its surroundings. In the Eastern Mediterranean, an increase in temperature of this magnitude could lead to algae blooms, whose proliferation can create inhospitable conditions for other forms of marine life. The Sea of Marmara has already seen the catastrophic effects of eutrophication when mucilage – phytoplankton blooms – spoiled its coastal waters during the summer of 2021. President Recep Tayyip Erdoğan blamed untreated waste and climate change for the situation in the Sea of Marmara.[16] Given how sensitive the ecosystem of the Eastern Mediterranean is to the extreme weather phenomena brought about by climate change, especially in terms of drought conditions, an increase in the temperature of the water, however -even if slight- could further disrupt the balance and lead to more frequent "mucilage-like" disasters, the proliferation of Lessepsian migrant species from the Red Sea[17] and the disappearance of endangered species like the Mediterranean monk seal from Turkey's Mediterranean coast.

Earthquakes

The nuclear disaster in Fukushima, caused by the 2011 Tohoku earthquake and tsunami in Japan, has been invoked as a cautionary tale for Turkey. Environmental activists warn against a core meltdown that could lead, as it did in the case of the Fukushima accident, to a release of radioactive steam into the atmosphere and contaminated water into the sea. A closer examination of the circumstances of the Fukushima disaster provides insights into the likelihood of a similar accident in Akkuyu.

Nuclear power reactors are built to withstand natural disasters like earthquakes, storm-force winds, floods, heavy snowfall, or wildfires. The core meltdowns at three of the

[14] Çevre Mühendisleri Odası İstanbul Şubesi, "Akkuyu Nükleer Güç Santrali Teknik Değerlendirme Raporu"
[15] Ibid., p. 25
[16] World Gallery, "'Sea Snot' Plagues the Turkish Coast", *Guardian*, 9/6/2021
[17] Argyro Zenetos and Marika Galanidi, "Mediterranean Non Indigenous Species at the Start of the 2020s: Recent Changes", *Marine Biodiversity Records*, Vol. 13, no. 1 (2020)

Fukushima reactors were caused by "a cascade of engineering and regulatory failures."[18] An independent investigatory commission created within the Japanese Diet found that the operator of the plant – the Tokyo Electric Power Company, TEPCO – had failed to meet basic safety requirements. Due to a conflict of interest involving the governmental agency in charge of Japan's energy production – the Ministry of Economy, Trade, and Industry (METI), which was both the promoter and regulator of the nuclear power industry, TEPCO's activity had escaped proper oversight.

The assumption that the Mersin province is earthquake-safe, and hence suitable for the construction of a NPP, was shattered on 30 July 2015, when an earthquake of 5.2 magnitude shook the province.

The Fukushima disaster involved a loss of coolant accident. When the earthquake started, the reactors automatically shut down. But the fuel rods continued to irradiate decay heat, and thus required continuous cooling. The pumps circulating the water needed to be powered, but the backup diesel generators were destroyed by the flooding caused by the tsunami. This breakdown was preventable: TEPCO had failed to place the generators at the proper elevation, and the generators were washed away by the flooding. As a result, the reactors experienced a loss of coolant, as the decay heat evaporated the remaining water. Molten fuel rods bored holes through the bottom of the reactor pressure vessel, contaminating the primary containment structure. The buildings housing Reactors 1 and 3 were further damaged by explosions resulting from the accumulation of hydrogen. To extinguish the fires caused by the explosions and to cool the fuel rods, TEPCO dumped sea water into the reactors. The molten fuel rods that had escaped the pressure vessel contaminated the water, which then seeped into the Pacific Ocean.

Turning to the Akkuyu NPP, the assumption that the Mersin province is earthquake-safe, and hence suitable for the construction of a NPP, was shattered on 30 July 2015, when an earthquake of 5.2 magnitude shook the province. [19] The Mediterranean basin is a seismically-active region owing to the subduction of the African plate beneath the Eurasian plate. The Mediterranean experiences approximately 10 percent of all the world's tsunamis. While most of them occur around Greece and Italy, they have also affected the Turkish coast. The Akkuyu NPP is designed to withstand earthquakes of up to 9.0 magnitude. The reactors are being built at more than ten meters above sea level as a precautionary measure against tsunamis. This elevation would protect the plant against the large tsunamis that are known to occur in the region at a frequency of once a century, which generate waves up to ten meters high, but it would not fare well against the "mega-tsunamis" that occur once every few millennia, which could be up to 50 meters high. One such tsunami occurred in 1600 BC after the eruption of the Thera (Santorini) volcano. The ensuing tsunami devastated coastal areas throughout the Eastern Mediterranean.

If a mega-tsunami hit the Akkuyu NPP, the reactors would not rely entirely on active safety systems, such as the emergency diesel generators; there are also passive safety systems that do not need electricity or staff involvement to operate. Among the most important innovations reactor designers have introduced to prevent and mitigate the effects of a nuclear disaster are "core melt traps" or "core catchers."[20] In the case of the VVER-1200 reactors of the Akkuyu NPP, these devices are secondary outside-cooled vessels located in the concrete pit below the reactor vessel. Should a loss of coolant occur, 169-tonne steel cones would hold any molten fuel that might perforate the

[18] Costas Synolakis and Utku Kânoğlu, "The Fukushima Accident Was Preventable", *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, Vol. 373, no. 2053 (2015)
[19] Nick Ashdown, "Turkish Nuclear Plant a Threat to Environment, Experts Say", *Ahval News*, 26/4/2018, Elias G. Hadjikoumis, "Turkey's Nuclear Plans Threaten East Med Ecosystems", *Kathimerini (English Edition)*, 10/12/2021
[20] Manfred Fischer et al., "Core Melt Stabilization Concepts for Existing and Future Lwrs and Associated Research and Development Needs", *Nuclear technology*, Vol. 196, no. 3 (2016)

pressure vessel and cool it down with the help of "sacrificial materials" – a combination of "non-metallic materials (special cements, oxides, etc.) which, as a result of mixing with the core melt, ensure even distribution of the melt in the device vessel filler."[21] Through their retention and cooling functions, core catchers reduce the risk of steam explosions, lower the temperature of molten fuel, prevent secondary criticality, and reduce the accumulation of hydrogen. The nuclear power plant in Akkuyu is therefore better equipped to deal with a core meltdown and prevent environmental degradation than the Fukushima NPP was in 2011. Nevertheless, this mitigation capacity should not be taken to equal "disaster immunity".

The Economic Costs and Benefits of Nuclear Power

Another criticism involves the economics of nuclear power. As mentioned above, the cost of the Akkuyu NPP is estimated to be around twenty billion USD. To defray these expenses, the financier – the Russian government – will have to charge a fairly high price for the resulting electricity. Those who oppose the construction of the Akkuyu NPP argue that the Turkish government could cover the share of its energy mix which it seeks to obtain from nuclear power from other, cheaper sources, such as renewables. A closer look at the costs of nuclear power compared to other energy sources sheds light on the merits of this argument.

Recent studies have indeed shown that nuclear power to be one of the most expensive energy sources.

Recent studies have indeed shown that nuclear power to be one of the most expensive energy sources. It not only costs more than power produced by solar, wind or thermal plants, it also takes longer to be added to the energy mix. Nuclear power plants take between three to nine times longer to build than renewable and conventional plants. The mean cost escalation in the sample of NPPs examined in the literature amounted to 117.3 percent of the initial budgets allocated. In all, 90 percent of all the nuclear power reactors that were considered experienced cost overruns.[22] If the most recently completed nuclear power plant in the region – the Barakah NPP in the UAE, whose initial budget was also $20 billion – serves as an example, Rosatom should expect cost overruns of at least $10 billion and a minimum delay of 1-2 years. Project delays and cost overruns are thus the norm rather than the exception.

Another factor that impacts on economic calculations in relation to nuclear power is the reliability of supply and the issue of carbon dioxide emissions. Nuclear power is sometimes labelled a "green" source of energy, because it releases lower quantities of CO_2 than fossil fuels. Moreover, nuclear power has an advantage over renewables like wind and solar, in so far as it is not intermittent. But there are renewable sources of energy – biomass, hydro, or geothermal – that can operate continuously and thus effectively replace fossil fuels. Even intermittent renewables can be an effective replacement for fossil fuels (and nuclear power) with the proper grid management practices and storage facilities in place. The availability of baseload renewables undermines the argument that nuclear power is the *sine qua non* for reducing emissions and ensuring a steady supply of electricity. Turkey could further leverage its renewable energy potential – especially in geothermal, solar and wind power – to address climate change and the growing demand for electricity.

[21] Vladimir Georgievich Asmolov et al., "New Generation First-of-the Kind Unit–Vver-1200 Design Features", *Nuclear Energy and Technology*, Vol. 3, no. 4 (2017), pp. 260-69

[22] Benjamin K. Sovacool, Alex Gilbert and Daniel Nugent, "An International Comparative Assessment of Construction Cost Overruns for Electricity Infrastructure", *Energy Research & Social Science*, Vol. 3 (2014)

Turkey and Nuclear Proliferation

The Akkuyu NPP's BOO scheme cannot facilitate any nuclear military ambitions Ankara may harbor.

Finally, another category of anxieties stemming from the introduction of nuclear power in Turkey relates to the military uses of the atom. As nuclear military technology proliferated in the Indian subcontinent and concerns grew about the Iranian nuclear development program and the possibility of proliferation in the Middle East, Turkey was among the countries that were rumored to have an interest in acquiring nuclear military capabilities, especially if the international community failed to prevent the acquisition of nuclear military capabilities by Iran and Saudi Arabia.[23] This raised concerns across the region.[24] What does the Akkuyu NPP mean for the issue of nuclear proliferation? To begin with, the Akkuyu NPP comprises four pressurized water reactors (PWRs) supplied by Russia. This choice of vendor has raised suspicions, due to Russia's negative image as a state which is lax about proliferation and a sponsor of illicit nuclear trade networks. Fears of "loose nukes" flowing out of the former Soviet arsenals into the hands of despots and terrorists during the 1990s were not without justification. Disaffected scientists did attempt to steal nuclear materials, even warheads, and sell them to interested buyers, especially violent non-state actors in the Middle East.[25] Unbeknownst to the leadership in Ankara, Turkey occasionally served as a route for nuclear smuggling operations. However, the most egregious case of nuclear trafficking through Turkey did not involve nuclear materials or weapons of Russian origin; rather, the network was run by the father of the Pakistani nuclear bomb, Abdul Qadeer Khan.[26] The involvement of Istanbul-based companies in Khan's operations gave rise to speculation that Turkey was the fifth country to purchase centrifuge technology from the Pakistani scientist.[27]

The BOO scheme thus deprives Turkey of a reason to build the enrichment and reprocessing facilities, without which it is impossible to build nuclear weapons.

However, to date, no evidence has come to light that Turkey possesses any form of uranium enrichment technology, including centrifuges. And while the International Atomic Energy Agency has raised concerns about other countries in the region, such as Iran, Israel, Iraq and Syria, it has not done so about Turkey's nuclear activities yet. In fact, the Akkuyu NPP's BOO scheme cannot facilitate any nuclear military ambitions Ankara may harbor. In normal circumstances, nuclear power plants can serve as a cover for a military nuclear program. Nuclear reactors require steady fuel supplies, and states may invoke unreliable foreign suppliers as a reason for acquiring their own enrichment or reprocessing plants. But in the case of the Akkuyu NPP, Russia signed a Build-Own-Operate contract with Turkey, which means that Rosatom is not simply in charge of building the nuclear power plant; it also provides the fuel for the plant, which it owns and operates. In addition, contract also foresees the return of the nuclear waste to the Russian Federation, a service most other suppliers are unwilling or unable to offer. The BOO scheme thus deprives Turkey of a reason to build the enrichment and reprocessing facilities, without which it is impossible to build nuclear weapons.

---

[23] Sinan Ülgen, *Turkey and the Bomb* (Washington DC: Carnegie Endowment for International Peace, 2012a), p. 3, Mustafa Kibaroğlu, *Between Allies and Rivals: Turkey, Nuclear Weapons, and BMD* (Paris: IFRI, 2014), p. 9

[24] Vassilis Nedos and Yiannis Souliotis, "Are Turkey's Nuclear Power Ambitions a Threat to Regional Safety?", *Kathimerini (English Edition)*, 12/3/2021

[25] Gary Ackerman and James Halverson, "Attacking Nuclear Facilities: Hype or Genuine Threat?" in Brecht Volders and Tom Sauer and Brecht Volders and Tom Sauer, eds., *Nuclear Terrorism: Countering the Threat* (London & New York: Routledge, 2016), p. Nuclear Facilities Attack Database entry 40

[26] Gordon Corera, *Shopping for Bombs: Nuclear Proliferation, Global Insecurity, and the Rise and Fall of the A.Q. Khan Network* (Oxford & New York: Oxford University Press, 2006), p. 115

[27] Mustafa Kibaroğlu, "Turkey's Quest for Peaceful Nuclear Power", *The Nonproliferation Review*, Vol. 4, no. 3 (1997), pp. 33-44, Hans Rühle, "Is Turkey Secretly Working on Nuclear Weapons?", *The National Interest*, 22/9/2015.

Conclusion

2023 could mark the advent of nuclear power in Turkey and a deepening of Ankara's asymmetric interdependence with Russia with significant risks for Turkey and the Eastern Mediterranean as a whole.

While Russian-Turkish relations have been in the spotlight for political, economic and strategic reasons, Russian-Turkish cooperation in the field of nuclear energy has not attracted the attention it deserves. The construction of the Akkuyu NPP has not only raised important environmental and institutional questions, along with concerns over nuclear proliferation in the Middle East, it has also served to showcase the asymmetrical relationship between Russia and Turkey – and the fact that this asymmetry is impervious even to the decarbonization of Turkish economy. In late 2021, President Erdoğan stated that Turkey might expand its nuclear cooperation with Russia to include the NPPs in Sinop and Iğneada.[28] This announcement did not go unnoticed among other nuclear suppliers. In the context of the ongoing Russian aggression in Ukraine, the United States appears poised to steer Turkey away from further contracts with Rosatom.[29] Finland, an important customer of Russian nuclear technology, has decided to renege on its agreement to import NPPs from Russia.[30] The Biden administration is possibly hoping to convince Turkey to follow in Finland's footsteps. Given that the first unit at Akkuyu is close to completion, it is highly unlikely that Ankara will cancel its cooperation with Rosatom. Instead, 2023 could mark the advent of nuclear power in Turkey and a deepening of Ankara's asymmetric interdependence with Russia with significant risks for Turkey and the Eastern Mediterranean as a whole.

[28] News Desk, "Turkey to Begin Work on 2 More Nuclear Power Plants: Erdoğan", *Daily Sabah*, 9/11/2021
[29] News Desk, "Turkey Looks to Curb Energy Imports through Nuclear Power, Local Gas", *Daily Sabah*, 12/4/2022
[30] Kati Pohjanpalo, "Finland Drops Nuclear Plant Deal with Russian Energy Company", *Bloomberg*, 2/5/2022

References

Gary Ackerman and James Halverson, "Attacking Nuclear Facilities: Hype or Genuine Threat?" in Brecht Volders and Tom Sauer and Brecht Volders and Tom Sauer, eds., *Nuclear Terrorism: Countering the Threat* (London & New York: Routledge, 2016)

Önder Algedik, "Nükleer KHK Tutmadı, Nükleer Kanun Verelim!", *Gazete Duvar*, 28/2/2022

Nick Ashdown, "Turkish Nuclear Plant a Threat to Environment, Experts Say", *Ahval News*, 26/4/2018

Vladimir Georgievich Asmolov, Igor Nikolaevich Gusev, Vladimir Ruslanovich Kazanskiy, Vladimir Petrovich Povarov and Dmitry Borisovich Statsura, "New Generation First-of-the Kind Unit–Vver-1200 Design Features", *Nuclear Energy and Technology,* Vol. 3, no. 4 (2017), pp. 260-69

Çevre Mühendisleri Odası İstanbul Şubesi, "Akkuyu Nükleer Güç Santrali Teknik Değerlendirme Raporu"

Gordon Corera, *Shopping for Bombs: Nuclear Proliferation, Global Insecurity, and the Rise and Fall of the A.Q. Khan Network* (Oxford & New York: Oxford University Press, 2006)

Nedim Bülent Damar, "Sinop NGS Davasında NDK'nın Tutumu", *Birgün*, 1/4/2022

Economy News Desk, "Nuclear Energy Draft Bill to Be Submitted", *Hürriyet Daily News*, 10/2/2022

Aykan Erdemir, Sinan Ciddi and John Hardie, *Collusion or Collision? Turkey-Russia Relations under Erdoğan and Putin* (Washington DC: Foundation for Defense of Democracies (FDD), 2021)

Manfred Fischer, Sevostian V Bechta, Vladimir V Bezlepkin, Ryoichi Hamazaki and Alexei Miassoedov, "Core Melt Stabilization Concepts for Existing and Future Lwrs and Associated Research and Development Needs", *Nuclear technology,* Vol. 196, no. 3 (2016), pp. 524-37

Hıdır Göktaş, "Nükleer Düzenleme Kanunu Yürürlüğe Girdi–Oğuz Türkyılmaz: "Maruz Kalınabilecek 'Makul' Radyasyon Dozu Nedir?"", *Medyascope*, 8/3/2022

Haberler, "Nükleer Düzenleme Kanunu Teklifi Ilgili Komisyondan Geçti", *Bloomberg HT*, 1/3/2022

Elias G. Hadjikoumis, "Turkey's Nuclear Plans Threaten East Med Ecosystems", *Kathimerini (English Edition)*, 10/12/2021

Mustafa Kibaroğlu, *Between Allies and Rivals: Turkey, Nuclear Weapons, and BMD* (Paris: IFRI, 2014)

———, "Turkey's Quest for Peaceful Nuclear Power", *The Nonproliferation Review,* Vol. 4, no. 3 (1997), pp. 33-44

Vassilis Nedos and Yiannis Souliotis, "Are Turkey's Nuclear Power Ambitions a Threat to Regional Safety?", *Kathimerini (English Edition)*, 12/3/2021

News Desk, "Greece Calls on Turkey to Discuss Akkuyu Nuclear Plant with Neighbours", *Ahval News*, 26/4/2021

———, "Turkey Looks to Curb Energy Imports through Nuclear Power, Local Gas", *Daily Sabah*, 12/4/2022

———, "Turkey to Begin Work on 2 More Nuclear Power Plants: Erdoğan", *Daily Sabah*, 9/11/2021

———, "Turkey to Complete First Unit of Akkuyu Power Plant in May 2023", *Ahval News*, 12/11/2021

Kati Pohjanpalo, "Finland Drops Nuclear Plant Deal with Russian Energy Company", *Bloomberg*, 2/5/2022

Hans Rühle, "Is Turkey Secretly Working on Nuclear Weapons?", *The National Interest*, 22/9/2015

Salih Sarı, "Turkey 2021" In *IAEA Country Nuclear Power Profiles*. Vienna: IAEA, 2021

Stanislav Secrieru, Sinikukka Saari and Dimitar Bechev, *Fire and Ice: The Russian-Turkish Partnership* (Paris: European Union Institute for Security Studies (EUISS), 2021)

Benjamin K. Sovacool, Alex Gilbert and Daniel Nugent, "An International Comparative Assessment of Construction Cost Overruns for Electricity Infrastructure", *Energy Research & Social Science,* Vol. 3 (2014), pp. 152-60

Aaron Stein, *Turkey's Nuclear Program: Challenges and Opportunities* (Washington DC: Atlantic Council, 2016)

Costas Synolakis and Utku Kânoğlu, "The Fukushima Accident Was Preventable", *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences,* Vol. 373, no. 2053 (2015), p. 20140379

Sinan Tavsan, "Turkey Targets Nuclear and Local Gas to Reduce Energy Imports", *Nikkei Asia*, 12/4/2022

Şebnem Udum, "A Uniquely Turkish Nuclear Energy Tale", *Bulletin of the Atomic Scientists*, 24/11/2021

Sinan Ülgen, *Turkey and the Bomb* (Washington DC: Carnegie Endowment for International Peace, 2012a)

———, *The Turkish Model for Transition to Nuclear Energy* (Istanbul: EDAM, 2012b)

World Gallery, "'Sea Snot' Plagues the Turkish Coast", *Guardian*, 9/6/2021

Argyro Zenetos and Marika Galanidi, "Mediterranean Non Indigenous Species at the Start of the 2020s: Recent Changes", *Marine Biodiversity Records,* Vol. 13, no. 1 (2020), p. 10