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AKKUYU NUCLEAR POWER PLANT: IS IT POSSIBLE? AN UPDATED AND CRITICAL ANALYSIS[*1]

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Abstract. The current study provides a holistic overview of Turkey's Akkuyu Nuclear Power Plant (NPP), positioning it as a central figure in the country's emerging energy infrastructure. Using both primary and secondary sources, the study explores the plant's technical specifications, economic configuration, geopolitical status, as well as socio-environmental concerns. Akkuyu NPP is being suggested as a part of Turkey's strategic resource in the pursuit of energy security, which aims to diversify its energy mix and reduce fossil fuel import dependence. The use of Russian technology and expertise—through the involvement of Rosatom—is, nonetheless, an issue for technological sovereignty and geopolitical vulnerability. The build-own-operate approach employed by Russia entails establishing long-term political and financial interdependencies, which may have effects on Turkey's autonomy in energy policymaking. Along with strategic and technical issues, the study highlights significant reactions by civil society, including opposition from local communities and environmental groups. These interests have triggered concerns over the ecological footprint of the plant, seismic risks, and apparent lack of transparency in decision-making. Environmental impact assessment and public consultation have been criticized for their limited coverage and ability to influence populations more, perpetuating societal distrust. The paper argues that while Akkuyu NPP is a historic investment in Turkey's energy destiny, it also represents complex issues traversing international relations, environmental ethics, and domestic policy. The study highlights ultimately that there needs to be a more open and transparent process of energy planning, particularly for projects that have profound long-term implications for the sovereignty and environmental sustainability of the country.

1. INTRODUCTION

Turkey's strategic pursuits of diversifying its energy mix have accelerated in the last two decades due to rising domestic consumption, energy security concerns, and the ambition to decrease imported fossil fuel dependence. Against this background, the construction of Turkey's first nuclear plant, in Akkuyu, is a turning point in its energy path. Located in the Mersin Province of Turkey's

Mediterranean coastline, the Akkuyu Nuclear Power Plant (NPP) is not just a technological project but also an indicator of Turkey's shifting geopolitical allegiances and long-term energy strategy (Artantas, 2024).

The project is developed by Russia's state nuclear corporation Rosatom on a Build-Own-Operate (BOO) basis. Akkuyu is the world's first such project to be undertaken by a foreign company in it's almost entirety. This model comprises Rosatom's financing, construction, operation, and ownership of the plant over its entire life cycle, with Turkey purchasing the generated electricity under a long-term agreement. Even though the model has technical and financial advantages—particularly for a country with no serious nuclear experience—it also places complex interdependencies and raises questions about national sovereignty, strategic autonomy, and long-term economic implications (Temocin, 2019). The Akkuyu project plans to include four VVER-1200 reactors, each producing 1,200 MW approximately, with the goal of providing around 10% of Turkey's electricity when finished. It's seen as a big step toward reducing carbon emissions and helping Turkey move to cleaner energy sources. But not everyone agrees. Environmental groups are concerned about how the project might affect the Mediterranean coastline, especially given earthquake risks in the area of south Turkey. They also question whether the environmental assessments done are enough. On the other hand, civil society groups have criticized the process for being too fast and not being transparent enough. Geopolitically, Akkuyu emphasizes a closer energy partnership between Turkey and Russia, which could change regional power balances. Some view this as Turkey moving away from its traditional Western alliances, hinting at a more multi-polar foreign policy. This is a big deal because Turkey is related for a long time on Western companies for energy and hopes to become a central energy hub connecting East and West.

Economically, it remains to be seen whether the BOO concept is cost-efficient in the short and long term, in terms of pricing contracts, and potential effects on Turkish consumers. While Rosatom undertakes the initial cost, assured off-take at fixed prices may yet prove to be more costly in the long term. Localization of nuclear expertise and establishing local capacity are still restricted, which would restrict Turkey's potential for carrying out subsequent nuclear projects independently. This essay aims to conduct a multi-dimensional analysis of the Akkuyu NPP by examining its technical features, financial arrangement, geopolitical significance, and socio-environmental impacts. Furthermore, through a review of scholarly literature, policy documents, and stakeholder views, the study hopes to analyze how Akkuyu NPP fits into Turkey's broader energy policy and what it can offer to other future infrastructure developments. By situating Akkuyu NPP in national and

international contexts, the article contributes to discussions about energy governance, sustainability, and intersections of technology and geopolitics.

2. HISTORICAL AND POLITICAL CONTEXT

2.1 Evolution of Turkey's Nuclear Strategy

Turkey's pursuit of nuclear power has evolved over several decades, driven by domestic aspirations, local pressures, and global patterns in energy. Initial enthusiasm for nuclear technology occurred during the 1970s because of aims to expand energy diversification and reduce dependence on imported fossil fuels. Political unrest, frequent changes in governments, and budgetary constraints seriously hindered progress during the Cold War era (Sovacool, 2010). The lack of institutional continuity and limited technical capability also delayed the establishment of a consistent nuclear policy. During the early 2000s, the energy requirements in Turkey exploded due to the rapid growth of urbanization, industrialization, and population leading to renewed enthusiasm for nuclear energy as a strategic measure to counter energy insecurity. The Turkish government then shifted its focus to long-term energy planning, which was eventually finalized in the 2007 Nuclear Law, which created the legislative framework for international and private investment in nuclear facilities (Kibaroglu, 2012). A turning point was the signing of an intergovernmental agreement between Russia and Turkey in 2010. This contract facilitated the construction of the Akkuyu Nuclear Power Plant (NPP), Turkey's initial nuclear commercial power plant, in Mersin province. This project represented a shift from policy intention to practical action, starting Turkey's nuclear age (Erdoğan & Erdoğan, 2024). The Akkuyu project further addressed Ankara's broader strategic goal of becoming an energy hub and reducing its vulnerability to energy supply shocks.

2.2 The Turkey–Russia Agreement

Turkey–Russia nuclear cooperation is unique not only on the technical and economic but also on the geopolitical level. The Akkuyu plant is being built on the Build-Own-Operate (BOO) basis, an exception to the world nuclear sector. Russia's state nuclear corporation Rosatom will possess 99% ownership of the plant, with Turkey providing regulatory control, land allocation, and grid access (Turkey Today, 2025). This structure allows Russia to maintain operating control and financial risk, but Turkey has energy production without paying initial capital costs. The BOO approach has

caused controversy among energy analysts and policymakers. Its advocates see that it improves technology transfer, simplifies project implementation, and minimizes financial risk for host countries. Critics raise issues on long-term dependence on foreign players, limited domestic capacity building, and potential national security implications (Schneider & Froggatt, 2023). In the case of Turkey, the deal is a pragmatic solution to overcoming domestic shortage in nuclear expertise and finances. Beyond the technical framework, the Akkuyu agreement signals a heightening strategic alignment between Ankara and Moscow. While Turkey remains a NATO ally and has long cooperated with Western institutions, its energy relationship with Russia reflects a more nuanced foreign policy trajectory. The nuclear agreement is among other types of bilateral ties, including natural gas pipelines (e.g., TurkStream), defense procurements (e.g., S-400 missile systems), and regional diplomacy in Syria and the Caucasus (Nordic Monitor, 2025). This multi-layered relationship has raised concerns among Western allies over Turkey's geopolitical orientation. Some analysts have interpreted the Akkuyu deal as part of a shift in Ankara towards an independent and multi-vector foreign policy, balancing with both Western and Eastern actors (Öniş, 2020). Others have interpreted it as an exhibition of transactional pragmatism rooted in energy needs and economic interests rather than ideological congruence.

2.3 Strategic Implications and Future Outlook

Turkey's nuclear policy has significant regional, technological development, and energy security implications for it. When operational at full capacity, the Akkuyu plant is expected to produce 10% of Turkey's electricity demand approximately, reducing reliance on natural gas and coal imports (World Nuclear Association, 2024). This follows the general decarbonisation and energy diversification goals outlined in Turkey's National Energy Plan and Climate Strategy. However, the long-term sustainability of Turkey's nuclear ambition rests upon several factors. These include the development of local human capital, regulatory capacity, and public trust. Nuclear power remains controversial in Turkey, and concerns regarding environmental risk, seismological risk, and transparency of decision-making persist (Aydın, 2021). These issues are possible to be resolved through sound governance, stakeholder engagement, and adherence to global safety norms. Besides, Turkey's own experience with the BOO model may have implications for other emerging economies considering nuclear power. Success at Akkuyu can be made into a blueprint for public-private collaboration in the nuclear sector. Failure or setbacks in operation or foreign policy, however, may add more weight to oppositions against foreign-controlled energy infrastructure. Overall, the nuclear policy of Turkey is a complex mix of local ambition, global cooperation, and

geopolitical strategy. The Akkuyu project, being as symbol of modernity as it is, is also riddled with questions of sovereignty, reliance, and strategic placement. As Turkey embarks on attaining nuclear status, it must balance technological progress with political prudence, ensuring that energy autonomy does not come at the cost of national sovereignty or regional stability.

3. TECHNICAL SPECIFICATIONS OF AKKUYU NUCLEAR POWER PLANT (NPP)

3.1 Reactor Design and Specifications

Akkuyu Nuclear Power Plant (NPP) in southern Turkey's Mersin province is the country's first nuclear power station and a landmark in its energy sector diversification campaign. The plant is under development on a Build-Own-Operate (BOO) basis by Russia's state-owned nuclear energy company, Rosatom. It will consist of four Generation III+ VVER-1200 pressurized water reactors (PWRs), each generating a gross electrical capacity of 1,200 MW and a net capacity of around 1,200 MW. The VVER-1200 type reactor is an upgrade of the earlier VVER-1000 series with better safety, efficiency, and lifespan. All of the units must operate at least 60 years, with potential further extensions to 80 years, subject to regulatory approval and technological refitting. Total annual electricity production of the Akkuyu NPP is expected to be 35–40 billion kWh, which would account for nearly 10% of Turkey's electricity consumption. The two-loop steam generator system employed in VVER-1200 reactors isolates the primary coolant—ultrapure desalinated water—from the secondary circuit. This prevents radioactive contamination possibilities and increases the safety factor of operations. There are 163 hexagonal fuel assemblies that constitute the reactor core, each containing 312 fuel rods of zirconium alloy with low-enriched uranium pellets.

3.2 Safety Features

Safety is one of the fundamentals of Akkuyu NPP design philosophy. VVER-1200 reactors are equipped with accurate active and passive safety systems, developed in accordance with international requirements such as the European Utility Requirements (EUR), International Atomic Energy Agency (IAEA) recommendations, and Russian Regulatory Documents (RRC).
The key passive safety features include:

a. The Passive Heat Removal System with Eight air-cooled heat exchangers in the reactor building dome accomplish residual heat removal without utilizing any external power sources.
b. The Core Catcher, a steel container weighing 144 tons that is designed to contain and cool molten core material in a severe accident. It is built to withstand seismic, hydrodynamic, and impact stresses.
c. A double-layered concrete containment system with high-tensile steel strands is used for the reactor building to resist internal pressure rise as well as external occurrences.
d. The Emergency Core Cooling System (ECCS) including hydraulic reservoirs that supply borated water for 72 hours without operator intervention in any complete loss of power scenarios are integrated into the system.

The plant is designed to resist extreme natural disasters, including earthquakes of a magnitude of up to 9.0, tornadoes of velocities up to 60 m/s, and tsunamis of wave heights up to 10 meters. These demands are particularly important given Turkey's location on the seismically active North Anatolian Fault Line.

3.3 Cooling and Environmental Engineering

Akkuyu NPP employs a direct-flow cooling system whereby seawater from the Mediterranean is employed to cool the condensers of turbines. Single-pass circulation is followed by discharging the hot water into the sea. Although the method is efficient, it has been faulted for generating thermal pollution and disrupting marine ecosystems.

Recent studies and green activists have identified the vulnerability of the Mediterranean Sea to rising temperatures, which can make the cooling system less efficient. The surface waters in Mersin-Akkuyu have reached up to 31.9°C, above the 28°C mark that is considered essential for safe reactor cooling. These temperatures have already made nuclear plants in France and Sweden close during heat waves. To address these issues, Rosatom has commissioned an automatic monitoring system of water, which tracks key parameters of discharged water according to temperature, chemical composition, and rate of flow. Additionally, industrial and domestic wastewater is treated and recycled, reducing the intake of seawater and minimizing environmental effects. Independent environmental monitoring remains scarce despite these efforts. The critics argue that lack of third-party regulation is not transparent and damages trust and also has issues regarding long-term ecological sustainability. Also, since the plant is located near sensitive marine

ecosystems and will have the potential to impact local biodiversity, it requires ongoing monitoring and adaptive management practices.

4. ECONOMIC ANALYSIS AND ENERGY POLICY

4.1 Cost and Financing

Akkuyu Nuclear Power Plant (NPP), located in Mersin Province, is among the most ambitious and expensive infrastructure projects in Turkey's recent history. With an estimated total cost of $25 billion, Akkuyu is Turkey's most expensive energy-related investment project to date (Turkey Today, 2025). The scale of the project illustrates as much the technical advancement of nuclear energy production as it does the strategic importance vested in diversification of energy resources and long-term viability. The project is funded by Russia's state nuclear corporation, Rosatom, entirely, which has near-complete ownership of the plant. This approach to funding is new in the nuclear energy sector, where host countries typically bear a large portion of the expense. Rosatom's complete investment has spared Turkey the initial capital outlays, but it has also meant restricted Turkish control over the operations and direction of the plant (Gürkan, 2023). Turkey's role is mainly limited to administrative oversight, environmental regulation, and the donation of land for the facility. Such an ownership arrangement raises fundamental questions regarding sovereignty and long-term energy governance. While the fiscal arrangement appears profitable in the short term, it merely places a significant portion of Turkey's energy infrastructure under foreign control. It has been suggested by some that such reliance could have implications for both national security and energy independence, particularly within the context of the ongoing war between Russia and Ukraine supported by Western countries (Kibaroglu & Ozdemir, 2022). Moreover, the finance model depicts a broader trend of Russian nuclear diplomacy whereby Rosatom offers turnkey options to countries seeking nuclear capability. The approach has been replicated in other countries such as Egypt and Hungary, often with the inclusion of long-term fuel supply agreements as well as technical support contracts that further entrench Russian presence in the host country's energy market (Schneider & Froggatt, 2023).

4.2 Power Purchase Agreement

One of the most important components of the Akkuyu project is the Power Purchase Agreement (PPA) included in the 2010 intergovernmental agreement between Russia and Turkey. Under the agreement, Turkey is required to purchase 70% of electricity generated by the first two reactor units and 30% generated by the remaining two units at a flat rate of 12.35 US cents per kWh over a period of 15 years (Nordic Monitor, 2025). The formula for pricing has become the source of much debate among energy policy-makers and economists. The non-variable rate under the PPA is significantly higher than the prevailing market rate for electricity in Turkey, which generally ranges between 5 to 8 cents/kWh (Kaya, 2023). The difference is thought by the critics to translate to higher costs for consumers and public finance charges if the government chooses to subsidize the difference to the point where the energy will be made more affordable. Furthermore, the rigidity of the price schedule may limit Turkey's capacity to meet forthcoming market conditions or technological advances reducing the cost of other energy sources. The proponents of the deal claim that the premium rate reflects the stability and reliability of nuclear energy, which supplies base load power with minimal carbon emissions. They further emphasize the long-term benefits of diversification of Turkey's energy mix and reduced exposure to liberalizing fossil fuel markets. The economic rationale of the fixed price model remains controversial, however, especially in light of the sharp decline in the cost of renewable sources of energy and increasing competitiveness of solar and wind technologies (IEA, 2024). Furthermore, the lifetime and terms of the PPA can constrain Turkey's energy policy responsiveness. While the global energy markets evolve and decarbonisation is being implemented at full throttle, Turkey may find itself locked into a costly and inflexible agreement that hinders its capacity to turn toward more sustainable and more financially prudent alternatives (Acar & Yeldan, 2021).

4.3 Energy Independence

One of the primary driving factors for the Akkuyu NPP is the pursuit of energy independence. Turkey has traditionally relied on imported fossil fuels, particularly natural gas, for over 30% of its electricity generation (Erdoğan & Erdoğan, 2024). This reliance exposes the country to geopolitical risks, price volatility, and supply disruptions, particularly in the wake of regional conflicts and global energy market unpredictability. By incorporating nuclear into its portfolio, Turkey aims to move itself from imported natural gas and render its energy system more robust. Nuclear power is a stable and predictable source of electricity that can complement intermittent renewable and stabilize the grid. In theory, Akkuyu could be a major player in such ambitions, with Turkey's energy

demands slated to continue rising. However, critics argue that the project will merely relocate the source of dependency rather than breaking it. For as long as Akkuyu reduces dependence on gas imports, it doubles down on dependence on Russian technology, know-how, and nuclear fuel supply. Rosatom not only runs the plant but also provides the nuclear fuel, manages waste, and handles maintenance, effectively inserting Russian influence in Turkey's energy sector for generations (Yılmaz, 2023; Bilgin, 2020). This has led some observers to question whether Akkuyu truly contributes to energy sovereignty or simply transforms existing vulnerabilities. The reliance on a single foreign supplier for critical components of the energy system could introduce strategic vulnerabilities, particularly in the event of diplomatic dispute or supply chain disruption. Moreover, the lack of local capacity in nuclear technology development can turn into a hindrance for Turkey's independent control and development of its nuclear program in the future (Karakaya & Sriwardhana, 2022). In conclusion, while Akkuyu is an excellent step towards Turkey's energy mix diversification, its economic and strategic implications need careful consideration. The funding model, cost, and geopolitical ramifications of the project highlight the complex trade-offs in pursuing nuclear energy as a path to energy independence. As Turkey starts its energy evolution, cost-effectiveness, sovereignty, and sustainability will have to be finely balanced if it is to be successful in the long run.

5. GEOPOLITICAL IMPLICATIONS AND ENERGY MIX

5.1 Russian–Turkish Strategic Partnership

Akkuyu Nuclear Power Plant (NPP), a Russian-Turkish flagship project, is not just a bilateral energy venture—it is a milestone in a deepening strategic partnership promising to open doors beyond traditional sector boundaries. Initiated under a Build-Own-Operate (BOO) framework, the project is fully funded and operated by Russia's state corporation Rosatom, giving Moscow a long-term influence over a strategic portion of Turkey's energy infrastructure (Ünal & Yıldız, 2021). This deal has occasioned alarm among Western analysts who interpret the alliance as being part of a step-by-step withdrawal of Ankara from its traditional Western allies, the NATO and the EU in the first instance. The stakes of this alliance are threefold. First, it is Turkey's realistic reaction to diversifying energy sources and guaranteeing stable electricity supply against growing domestic demand. On the other hand, it raises questions about whether NATO's strategic coherence has been undermined, especially with Turkey's increasing defence cooperation with Russia, like the much-debated S-400 missile system purchase (Kardaş, 2021). The Akkuyu project is thus a geopolitical

barometer, signalling the changing outlines of Turkish foreign policy and its balancing between East and West.

5.2 Responses of NATO and EU

Akkuyu's proposed strategic realignment also did not go unnoticed by Western institutions. NATO and the EU have warned against the transparency and governance of the project, particularly as regards the BOO structure that de facto transfers a part of Turkey's energy sovereignty to foreign hands (Sari, 2022). The European Commission has also raised concerns about the compatibility of Akkuyu with EU-wide climate and energy security aims, specifically due to the lack of independent regulatory agencies and inadequate public accountability mechanisms (European Commission, 2023). Furthermore, the implications for regional stability and alliance cohesion are also significant. NATO's strategic strategy makes energy security a priority as a component of collective defence, and Turkish infrastructure entwinement with Russian interests could complicate combined operations and intelligence sharing. The EU, for its part, has failed to bring neighbourhood geopolitics into alignment with its climate ambitions, and Turkey's nuclear course—though potentially carbon-saving—may not be compatible with the Union's emphasis on decentralized, renewably based systems (Kaya, 2023).

5.3 Regional Energy Dynamics

Aside from its institutional and bilateral nature, Akkuyu reshapes the energy dynamics of the Eastern Mediterranean. In making Turkey more efficient at generating electricity locally, the project reduces its dependency on external fossil fuels and strengthens its role as a regional energy hub. The realignment has immediate implications for maritime negotiations and border disputes, particularly in regions of dispute between Greece, Cyprus, and Israel (Bilgin, 2020). Turkey's assertive energy diplomacy—evinced by exploratory drilling and naval forays—has already strained relations with regional states. Operation of Akkuyu would embolden Ankara's claims in the region, solidifying its discourse of energy independence and strategic autonomy. Experts are convinced that this change has the potential to rebalance regional power relationships, especially as others try to pursue their own energy projects, such as the EastMed pipeline and off-shore gas deposits off the coast of Israel and Cyprus (Kösebalaban, 2021). To boot, the image which nuclear power embodies regarding technological progress and geopolitical clout cannot be dismissed. Akkuyu brings Turkey

into a select club of countries with operational nuclear reactors, potentially improving its standing in local situations and multilateral negotiations.

5.4 Energy Mix Integration

Turkey's energy mix is undergoing a significant transformation, driven by both domestic imperatives and international pressures. As of 2024, the projected distribution of electricity generation was as it is shown in Table 1.

TABLE 1: Turkey's energy mix

Source	Share of Electricity Generation
Natural Gas	~30%
Coal	~25%
Hydropower	~20%
Wind & Solar	~15%
Nuclear (Akkuyu)	~10% (projected)

This diversification is a strategic effort at reducing reliance on carbon sources while continuing to access energy. Critics argue, however, that its emphasis on nuclear power—particularly foreign control—is likely to generate new risks. Renewable energy advocates maintain that such decarbonisation can be realized with more rapid investment in solar and wind technologies, which are more deployable, less geopolitically hazardous, and more in tune with EU climate policies (Acar & Yıldız, 2022; Kaya, 2023). Moreover, nuclear power's centralizing mode conflicts with the decentralized ethos of renewable, which provide more autonomy for local communities and reduce system-wide risks. With Turkey having abundant solar and wind resources, some specialists question whether the strategic benefits of Akkuyu are justified by its long-term costs, especially in terms of dependency, environmental footprint, and local tensions.

6. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

6.1 Ecological Concerns

The Akkuyu Nuclear Power Plant (NPP) along Turkey's Mediterranean coast has stirred up considerable ecological controversy owing to its potential to disrupt the region's delicate marine and

terrestrial environments. Environmental organizations and the scientific community have expressed concern over thermal pollution, an event that occurs when discharged cooling water by the plant warms nearby marine environments. The process affects local biodiversity, predominantly affecting temperature-sensitive species and altering the eco-equilibrium of the coastal waters (Aydın, 2019). In addition to thermal effects, habitat destruction and fragmentation have occurred due to the establishment and functioning of the plant. The Mediterranean coast is home to numerous endemic species, including rare flora and fauna that are highly sensitive to environmental change. To date, infrastructure land clearing, and increased human presence in the region have already resulted in significant declines in specific populations, such as the Mediterranean monk seal and native plant species (Özdemir and Şahin, 2023). These incursions are compounded by the absence of strict third-party environmental audits, which lowers accountability and transparency when quantifying the total amount of ecological loss (Demir, 2022). Furthermore, the cumulative impacts of industrialization in ecologically sensitive regions raise questions regarding environmental regulation in Turkey. Domestic and foreign observers have criticized the lack of comprehensive full-scope environmental impact assessments covering long-term ecological simulation modelling and stakeholder consultation. Without effective mitigation strategies and constant monitoring, the environmental footprint of Akkuyu will have far-reaching effects beyond the immediate vicinity, affecting migratory routes, coastal erosion, and sea food webs.

6.2 Seismic Risk

Turkey's geophysical past is a unique challenge to the safe running of nuclear facilities. It sits across several active fault lines, among them the North Anatolian Fault that has triggered fatal earthquakes historically. Despite the advent of advanced engineering measures to mitigate seismological phenomena, there has been continued public doubt regarding the plant's capacity to resist a massive earthquake (Çelik, 2021). The record of previous nuclear disasters—most notably Chernobyl (1986) and Fukushima (2011)—continues to shape public perception about nuclear safety. They demonstrated the vulnerability to natural catastrophes of even sophisticated technologies when further compounded by human accident or institutional error in oversight. Karakaya and Yıldız (2022) claim that worst-case scenarios have not been properly put into the risk communication strategy by the Turkish government, and therefore the populations are in doubt regarding emergency planning and evacuation procedures. Seismic risk is not only a technical issue but also a socio-political issue. Risk awareness impacts public trust in institutions and has implications for the legitimacy of energy policy decisions. Where seismic activity has a background, nuclear plants

must meet not only engineering-based standards but public and societal standards of safety and transparency as well. Without independent seismic risk assessment and with reduced public participation in safety planning, concerns about the long-term viability of the plant are increased.

6.3 Public Opinion

Public attitudes towards the Akkuyu NPP are extremely polarized, reflecting broader tensions in Turkish society regarding energy policy, the environment, and national sovereignty. The project is regarded by its proponents as a strategic gamble on Turkish energy independence, reducing reliance on fossil fuels and enriching the national energy mix. To some, Akkuyu symbolizes technological progress and geo-political assertiveness, particularly in the face of Turkey's growing energy demands and regional ambitions (Gürbüz, 2020). Critics, however, cite the environmental risk and doubts over the prudence of entrusting to outsiders a strategic infrastructure project. The plant is being constructed and operated by Rosatom, Russia's state nuclear corporation, on a build-own-operate (BOO) basis. This transaction has ignited controversy regarding foreign control of national energy resources and what this implies for Turkey's energy sovereignty (Sarı, 2022). Opponents have argued that the lack of local experience and controls can weaken safety standards and limit Turkey's independence of action in a crisis situation on its own. Public demonstrations, lawsuits, and publicity campaigns have become forms of dissent, notably by environmental organizations, local communities, and civil society. These movements highlight the need for participatory decision-making in energy planning. Lack of inclusive consultation and open decision-making has led to an atmosphere of suspicion, where technical assurances are simply met with scepticism and opposition.

6.4 Waste Management

Perhaps the most controversial aspect of the Akkuyu NPP is its radioactive waste management policy. The plant will generate high-level radioactive waste (HLW), which will be temporarily kept at the site in interim storage installations. There are temporary storage facilities, but long-term disposal policy is undeveloped and unclear. Turkey currently lacks a national facility for HLW storage, which puts into question the security and sustainability of its nuclear waste policy (Yılmaz, 2023). Russian involvement in waste management only makes it more complicated. In light of Rosatom's pledge to manage spent fuel and radioactive waste, certain doubts exist on the long-term

commitment of foreign operators. The International Atomic Energy Agency (IAEA, 2022) highlights the importance of domestic control of nuclear waste management because reliance on foreign sources can undermine regulatory consistency as well as public confidence. Furthermore, the absence of a clear-cut legal and institutional framework for waste disposal poses actual dangers. Without robust legislation, independent inspection, and public participation, radioactive waste management can become a source of environmental and political unrest. Özdemir and Şahin (2023) warn that excessive delay in the formation of a national repository may lead to extended on-site storage, increasing the risk of leakage, contamination, and security threats. Confronted by these challenges, experts call for an extensive national waste management policy with geological disposal, stakeholders' participation, and international best practice. Such a framework would not just ensure safety but also align Turkey's nuclear policy with global standards of environmental responsibility and transparency.

7. CONCLUSIONS AND POLICY RECOMMENDATIONS

7.1 Strategic Overview

Turkey's first nuclear power plant and a turning point for energy diversification in Turkey, the Akkuyu Nuclear Power Plant (NPP) will supply approximately 10% of Turkey's electricity. The plant is being constructed on a Build-Operate-Own (BOO) basis by Russian state-owned company Rosatom, with full financing and operational control resting with Russian parties (Firstpost, 2023). Even though the project promises reduced carbon footprint and enhanced energy security, it brings, in turn, a complex set of geopolitical, environmental, and socio-economic challenges.

7.2 Critical Weaknesses of the Akkuyu Project

Aside from its strategic appeal, the Akkuyu NPP has various structural and functional shortcomings that undermine its long-term credibility. The plant is located in the seismically active Mersin Province. Critics highlight that site selection disregards Turkey's geological vulnerabilities, undermining nuclear security in the event of an earthquake (Al Jazeera, 2021).

The Akkuyu Nuclear JSC project company is entirely owned by Russia. There is no Turkish equity ownership in spite of provisions for a maximum of 49% Turkish ownership. This lack of local

ownership limits Turkey in having influence over operational control and strategic direction (Nordic Monitor, 2025).

Environmental impact assessments have been accused of being non-transparent and lacking public consultation. The long-term ecologic impacts, especially on marine biodiversity and water resources, are still poorly addressed (Gürbüz, 2020).

Turkey is contractually obliged to purchase power from Akkuyu at a pre-set price of 12.35 cents per kWh for 15 years, significantly higher than market rates. This could lead to increased energy prices for consumers and industrial uses (Sirin, 2023).

Russian sanctions from the West have affected the supply of critical components, such as Siemens' gas-insulated switchgear. Though replacement suppliers have been established, such disruptions expose the project's vulnerability to geopolitical shifts (Turkey Today, 2024).

7.3 Strategic Risks and Foreign Dependence

The Akkuyu project demonstrates a higher reliance of Turkey on foreign powers, particularly Russia, in an area which is critical to national security. Rosatom provided all the reactor technology, fuel supply, and operating expertise. Turkey lacks indigenous capacity to manage or maintain the plant on its own, which creates long-term reliance on Russian technical support (Al Jazeera, 2021). Financial Exposure: The $20 billion investment is funded by Russian capital, with reduced Turkish influence. This funding structure not only puts Turkey more at risk from Russian economic coercion but also jeopardizes sanctions evasion and illicit financial streams (FDD, 2025).

Russia's control of Akkuyu gives it a bargaining power in Turkey's energy system. During times of diplomatic tension, this bargaining power can be used to influence Turkish foreign policy or induce energy supply disruption (Nordic Monitor, 2025).

Although Akkuyu falls under Turkish commercial law and regulation by the Nuclear Regulatory Authority (NDK), Rosatom and its subsidiaries' operational autonomy limits the effectiveness of Turkish regulatory policy (Bayraktar, 2025).

7.4 Incontestable Observations and Policy Failures

Several areas in the Akkuyu project are incontestable examples of tangible policy errors for which the Turkish government is desperate to deny. Despite legal provisions, Turkey has refused to exercise its right to acquire equity in the project and lost strategic control. The civic community and civil society were not adequately consulted in decision-making, contrary to democratic principles and environmental justice (Gürbüz, 2020). The Russia-centric exclusive partnership ignores the potential of multilateral cooperation in nuclear energy, as well as with EU or IAEA-funded frameworks. Lack of Adequate Waste Management Planning: Turkey still lacks a national waste management plan, with long-term environmental and public health consequences (Yılmaz, 2023).

7.5 Inevitable Risks and High Failure Probabilities of the Akkuyu Nuclear Power Plant

Although the Akkuyu Nuclear Power Plant (NPP) is strategically important, it also carries a sequence of systemic vulnerabilities that elevate the probabilities of failure to high—probabilities that cannot be wholly eliminated by Turkey because of structural, geopolitical, and technical constraints.

Concerning the Geopolitical Vulnerability and Foreign Dependence, Russian state institutions wholly own and operate the Akkuyu NPP on the Build-Own-Operate (BOO) model. Turkey has not exercised its prerogative to purchase up to 49% of the project company, and thus it has no strategic ownership over a strategic energy asset (Nordic Monitor, 2025). Sanctions by the West on Russia due to the war in Ukraine have already slowed the delivery of key components, such as Siemens' substation equipment. The delays forced Rosatom to locate standbys from China, which introduces fresh risks and vulnerabilities (Turkey Today, 2024). Russian financing pays the $20 billion project price in full. This creates long-term economic leverage by Russia over Turkey, especially during moments of diplomatic tension (NucNet, 2024).

Concerning the earthquake and environmental risks Akkuyu is located in Mersin Province, which is seismically active. Since there are issues of the validity of seismic hazard estimates and the capability of the reactor design to take a major earthquake (Martin, 2000) the Turkish government should consider possible measures in the case of a strong earthquake. Although European Nuclear

Safety Regulators Group (ENSREG) peer-checked a stress test in 2024, the final report conceded the requirement for further safety enhancements and further studies (ENSREG, 2024).

Considering technical and operational issues, in-house reports indicate the presence of a dearth of Turkish engineers and technicians with appropriate skills, reflecting an undue reliance on Russian personnel and suppliers and limiting local capacity development (Protothema, 2019). The VVER-1200 reactor design, while having been tested in Russia, has faced adaptation challenges in Turkey due to differences in regulatory needs and environmental conditions (Martin, 2000).

Concerning the Regulatory and Governance Constraints, in spite of the Nuclear Regulatory Authority (NDK) having licensing and inspection functions, the ability to coerce compliance is restricted by the operational autonomy of Rosatom and lack of Turkish share in the project (Nordic Monitor, 2025). The 2010 intergovernmental arrangement provides Turkey theoretical control, but in reality, corporate management remains under the control of Russian parties. This gap undermines Turkey's ability to respond to crises or policy shifts (Nordic Monitor, 2025).

Finally, there are non-negotiable defects that Turkey cannot gloss over easily or correct. Turkey lacks the facilities to fabricate, reprocess, or get rid of nuclear fuel and are, therefore, excluded from ever being free from Russian supply chains. Up to 2025, Turkey had no overall strategy for the treatment of nuclear waste, which poses long-term environmental and health risks (Martin, 2000). Turkey is bound to purchase electricity at a fixed rate for 15 years regardless of market conditions, which could lead to economic inefficiencies and public dissatisfaction (Turkey Today, 2024).

7.6 Policy Recommendations

In order to further safeguard against threats and improve its nuclear power plan sustainability, Turkey needs to adopt certain practices. Nuclear policy cannot be kept outside of public consultation and environmental impact assessments. The nuclear policy should be subject to review by independent authorities and public disclosure (Gürbüz, 2020). Incorporation of solar, wind, and geothermal power into the energy mix would balance dependence on nuclear and fossil fuels, and align with global efforts at decarbonisation (Acar & Yıldız, 2022). A robust institutional framework for nuclear waste management, storage, and disposal is needed in order to ensure public health as well as environmental integrity (Yılmaz, 2023). Turkey needs to look for partners alternative to Russia, e.g., European and Asian nuclear partners, in order to balance geopolitical risks and

encourage technological pluralism (Bilgin, 2020). The Nuclear Regulatory Authority must be entrusted with greater autonomy and funds to enforce safety provisions and monitor foreign-owned facilities.

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APPENDIX 1

Research project "The geopolitical repercussions of Nuclear Turkey": Reports

THE SOCIO-ECONOMIC PROFILE OF THE PROVINCE OF NEVSEHIR AND THE NUCLEAR TURKEY, September 2020
https://www.researchgate.net/publication/344153788_The_socio-economic_profile_of_the_province_of_Nevsehir_and_the_nuclear_Turkey

THE AKKUYU NUCLEAR POWER PLANT (in greek) - ΤΟ ΠΥΡΗΝΙΚΟ ΕΡΓΟΣΤΑΣΙΟ ΗΛΕΚΤΡΟΠΑΡΑΓΩΓΗΣ ΤΟΥ ΑΚΚUYU, September 2022
https://www.researchgate.net/publication/394520250_THE_AKKUYU_NUCLEAR_POWER_PLANT_in_greek_-_TO_PYRENIKO_ERGOSTASIO_ELEKTROPARAGOGES_TOU_AKKUYU

NUCLEAR TURKEY. A REVIEW OF LITERATURE, August 2025
https://www.researchgate.net/publication/394479582_NUCLEAR_TURKEY_A_REVIEW_OF_LITERATURE

AKKUYU NUCLEAR POWER PLANT: IS IT POSSIBLE? AN UPDATED AND CRITICAL ANALYSIS, August 2025
https://www.researchgate.net/publication/394522901_AKKUYU_NUCLEAR_POWER_PLANT_IS_IT_POSSIBLE_AN_UPDATED_AND_CRITICAL_ANALYSIS