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INVESTIGATING THE FEASIBILITY OF NUCLEAR FISSION AS AN ENERGY SOURCE IN UZBEKISTAN

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Abstract: In recent years, people have become more aware of issues and devastating consequences of the energy sources utilized mostly: burning natural gas, wood, and charcoal. The former type of energy provider has proven to be at the top of the charts in Central Asian countries, particularly Uzbekistan. More than 80% of all energy comes from natural gas – based on statistics in 2019. It seems very concerning given that about 120 thousand tons of carbon dioxide in that year, had increased by 4.2% from 2018 [1]. This is necessarily due to burning natural gas and coal. It would appear that the growing energy demands coupled with environmental concerns from the public and eco-activists force people to reconsider the current sources and come up with a new, sustainable energy source. Environmental damage typically involves greenhouse gasses that facilitate not only temperature rise but also ozone layer depletion [2] [3].

There are several factors considered to evaluate how good an energy source is: the price of production, eco-friendliness, and abundance. Comparing existing energy sources, I've come to the conclusion that nuclear fission is on average highly beneficial [4]. In short, it is the reaction in which atoms fall apart, producing energy in a form of heat; it's then used to vapourize the water into steam so that it rotates a mechanism that generates energy. This proposed energy source is highly advantageous over the current – traditional – means of energy production: it is cleaner and more abundant in the regions of Uzbekistan [5]. Uzbekistan produces a thousand tons more uranium than China and India combined, 3300 and 2300 tons respectively. The calculations indicate that with these supplies, 6.2 million tons of coals can be substituted. In general, nuclear power plants will prove to be more beneficial and less environmentally hostile compared to conventional energy sources.

Literature review

In many parts of the developed world, nuclear fission is one of the key energy providers, and it is considered to be superior to ordinary energy sources. Perhaps there is no more prominent example than JET: it is an experiment on a thermonuclear reactor located in the UK, harvesting 4 MJ/s [6]. By far, it is one of the most successful experiments in harnessing energy by nuclear fission, for it has produced phenomenally large amounts of energy ever in one go, reaching 21 MJ [7]. The technology, or the proposal of nuclear fission for energy harvesting, is not a new idea at all; since the 1950s, nuclear reactors have been constructed and developed in design, so we have much experience in this field.

Another successful nuclear reactor has been designed by professionals working in Helion. The reactor, however, has a different, extraordinary appearance [8]. Thanks to this it could raise the temperature to a hundred million degrees Celsius. Uzbekistan has recently acquired the title of "developing country"; this is why nuclear reactors are usually the participants of mere jokes in there. As stated earlier, natural gas and coal are two major energy sources in the country, and it is

the major contributor of them in Central Asia [9]. One can suspect that fossil fuel mining plays an integral part in the economy of Uzbekistan, and they would certainly be correct. This is the reason why the economic importance should be taken into account before nuclear fission as an energy source can be proposed seriously. The considerations involve the workforce and export of liquefied natural gas: the jobs of tens of thousands of people in Uzbekistan heavily depend on fossil fuel mining, and the natural gas industry has two billion dollars in revenue annually. The abrupt halt would cause massive disruptions in not only the employment rate but the economy.

This is the reason why nuclear fission as an energy source has not been considered yet.

Existing issues

In this section, I have pointed out the challenges that Uzbek energy production and distribution schemes face. Initially, aging infrastructure can be a big problem because the existing power plants are inefficient and outdated, particularly thermal power plants [10]. The direct consequence is low energy output and higher carbon dioxide emissions. Instead of incessant renovations, I propose the construction of a more reliable power plant - nuclear reactors. They are more feasible and far more effective in energy production. Another concern is the heavy reliance on natural gas; even though it plays a pivotal part in the economy of Uzbekistan, this specific sector is highly vulnerable to fluctuations in gas prices as well as its supplies. However, the country faces a dilemma of choosing between exporting natural gas overseas or distributing it domestically, resulting in growing energy demands.

Next, the negative impact of current energy production on the environment is extremely high: air pollution is a usual phenomenon, because of which many people suffer from respiratory diseases

[11]; energy projects, especially those related to coal mining and natural gas, contribute to environmental degradation and desertification in some regions [12]. If this trend continues, much of Uzbekistan's territory can potentially be inhabitable. It can be assumed by someone that Uzbekistan is showcasing its interests in renewable energy sources such as harnessing wind and solar energy. However, the rate at which the shift is happening is very slow, even though it has great potential. Located in the middle of the desert, Uzbekistan has the necessary climate needed for successful solar power harnessing. Bureaucratic hurdles and lack of investment are two primary reasons.

Government’s interests

Speaking of government interest, it is important to pinpoint the initiatives currently in Uzbekistan. Hydropower plants, for instance, seem to be successful as they bring a substantial percentage of energy to both rural and urban sectors. It brings 12% of electricity generated by all power plants, which is six billion kWh. Plus, it has invested in multiple projects, including Nur Navoi Solar Power Plant (the first ever large-scale solar power plant in the country with 100 MWh electricity generated) and Samarkand / Navoi Wind farms (international collaboration; 500 MW generated). This shows that the government energy department is willing to implement renewable energy, so there is a prospect of it approving the building of nuclear power plants.

Methodology

Before the construction begins, four pre-steps must be taken to guarantee success - public awareness, the possibility of collaboration, the search for the perfect venue, and funding. Firstly, we should understand public opinion - whether it is negative or positive; how they would react.

If the former is true, public support cannot be awaited, and it would be more challenging to achieve the results in the short-term future. This can be done with the help of online polls and real-life surveys, for young and old people respectively. My general predictions are that the younger

generation will likely [13] warmly accept this proposal because they consider renewable energy a future of energy. To put pressure on the government - the energy department in particular - public support is of paramount importance. The second step is inviting international builders and scientists.

Collaborations with institutes and organizations are essential. Graduates from MIT and Berkey can significantly boost their progress. I would consider myself a big critic of Uzbek technology institutes due to a lack of resources and experts. Once these steps are completed, a perfect location should be found. I would argue that an excellent place has these factors: seismically stable, close to water sources, low population density, and being in proximity to existing infrastructure.

All of them must be considered to minimize the risks of impact in case of emergencies like radioactive waste leakage. However, the biggest setback is the funding required for the project completion - as much as 25-30 billion dollars can be needed to ensure the construction of a single nuclear power plant; the maintenance costs per year can reach 6-8 billion dollars, on average, per 1 GW . For the proper calculations of funding required, I took into account: Engineering, Procurement, and Construction (EPC)(60-70%); Licensing and Regulatory Compliance(5%); Financing Costs(5%); Commissioning(5-10%); Contingency(10-20%); Construction Time; and Decommissioning Costs: the construction of a fully functioning power plant would require building materials, builders, architectures, large amount of land(1.3 square miles), interests on loans and cost of capital, testing initial operation costs before the plant becomes fully operational, a buffer for unexpected costs [13]. Taking these costs into consideration, 6,000 dollars per kW of energy. Hinkley Point C (UK) – a recent power plant constructed took 33 billion dollars, on average, to be built, requiring approximately 6000 employees to operate.

The number of power plants does depend on the population in a particular region of the country, but it is primarily one power plant per region. This means that 13 nuclear power plants must be constructed. One power plant per region in Uzbekistan: Tashkent, Andijan, Bukhara, Fergana, Jizzakh, Namangan, Navoiy, Qashqadaryo, Samarqand, Sirdaryo, Surxondaryo, Tashkent Region, Xorazm, and the Republic of Karakalpakstan.The calculations are based on a comparison of existing data on the amount of energy supplied to households in each region and the predicted amount of energy that could be produced by a nuclear power plant.

According to recent data, Uzbekistan consumes around 30 million tonnes of oil equivalent (Mtoe) of energy annually. This equals roughly 28.3 billion cubic meters of natural gas (85%) and 41.87 petajoules (PJ) of energy produced by hydropower (10%), which together cost approximately $12 billion [9] [14].

Nuclear power plants can provide energy to the residential sector, which consumes around 40% of the total energy produced (equivalent to 12 Mtoe). A single nuclear power plant typically has the capacity to generate 1 GW of power. If it operates continuously throughout the year (365 days), it could produce approximately 8,760 GWh of energy annually (1 GW × 8,760 hours).

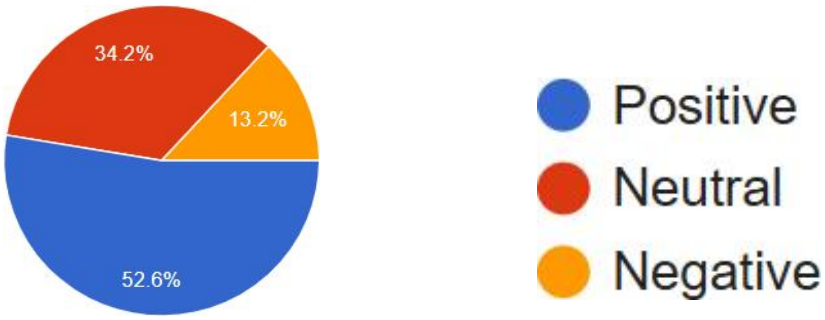
Given that the residential sector consumes 12 Mtoe, and 1 Mtoe equals 11.63 TWh, this means 12 Mtoe equals around 139.56 TWh (12 × 11.63 TWh). Therefore, 13 nuclear power plants, each generating 8.76 TWh annually, could produce 113.88 TWh, which would sustain a significant portion of the residential sector's energy demand. This would cover around a third of the total energy supply in Uzbekistan.

Poll results and evaluations

An essential factor in the success of any large-scale energy project is the level of public acceptance and understanding. To assess the sentiment toward nuclear energy in Uzbekistan, a poll

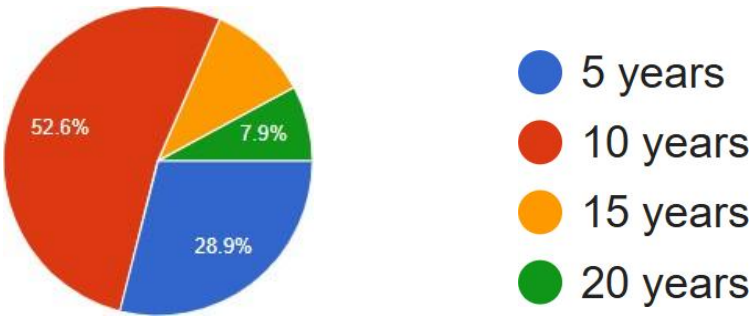
was conducted to gather insights from various segments of the population – age brackets, socio-economic status, region of residence. The results indicated that 56.6% of respondents were very positive about nuclear energy as a whole, and 35.2% were somewhat okay with it. In total, 86.5% of respondents expressed either positive or neutral opinions about implementing nuclear energy in Uzbekistan, while 13.5% held negative views.

The Use Of Nuclear Energy In Uzbekistan



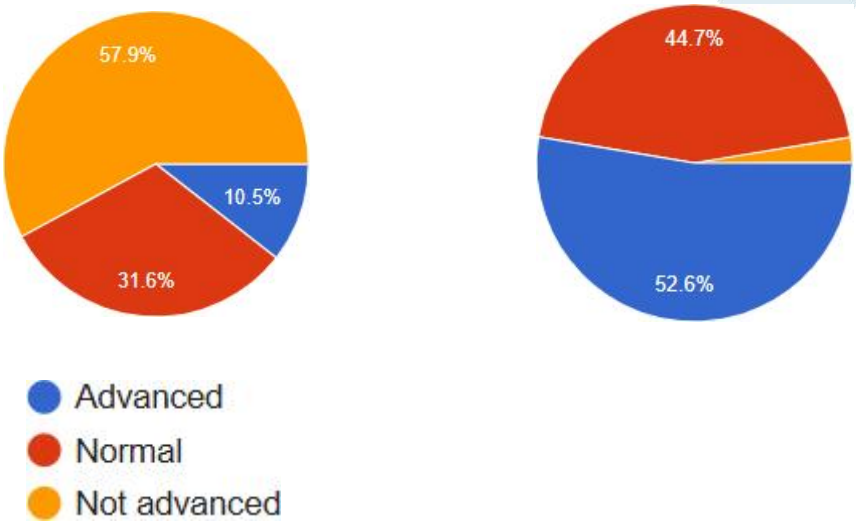
Public perception of Uzbekistan's nuclear future was mixed: while 30% believed that the country could build its first nuclear power plant within 5 years, a larger proportion, 50%, estimated it would take around 10 years. Additionally, there is a recognition that nuclear energy presents both significant benefits and drawbacks. Among the primary advantages mentioned were its low CO2 emissions, energy abundance, and increased energy security. On the other hand, the main concerns were related to its high costs and perceived dangers, reflecting the need for clear communication about nuclear safety and financing.

Projected Construction Time



Furthermore, when asked about the current state of nuclear technology worldwide, 97% of respondents felt that the world is somewhat advanced in utilizing nuclear fission for energy production. However, 56.8% of respondents felt that Uzbekistan is not yet advanced at all, suggesting a gap in public knowledge or infrastructure that needs to be addressed for nuclear energy to gain wider acceptance.

How Advanced Uzbekistan is VS Rest Of the World



Given these insights, it is crucial to take public opinion into account when planning nuclear projects, ensuring that information is transparently shared and that citizens' concerns are addressed in order to foster a more positive reception.

Conclusion

The investigation into the feasibility of nuclear fission as an energy source in Uzbekistan reveals a compelling case for the construction of nuclear reactors despite the challenges involved. While issues such as high initial costs, complex regulatory requirements, potential environmental risks, and public safety concerns cannot be ignored, the long-term benefits far outweigh these drawbacks. Nuclear reactors offer a clean, abundant, and sustainable energy alternative to fossil fuels, which currently dominate Uzbekistan's energy landscape but are environmentally damaging and economically unstable.

Public opinion, as gauged through surveys, indicates a predominantly positive association with nuclear energy. With 86.5% of respondents expressing either supportive or neutral views, there is a significant opportunity to leverage this sentiment to build public and governmental momentum. Additionally, the younger generation's openness to renewable energy and advanced technologies could play a pivotal role in driving the narrative for nuclear energy adoption.

In conclusion, I am fully committed to advocating for the construction of nuclear reactors in Uzbekistan. While economic and infrastructural challenges will require careful planning and substantial investment, the transition to nuclear energy aligns with both environmental goals and the growing energy demands of the nation. By fostering international collaboration, raising public awareness, and ensuring robust safety measures, Uzbekistan can pioneer a new era of energy production that is cleaner, more reliable, and sustainable for future generations.

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