## VENDOR AND TECHNOLOGY SELECTION RECOMMENDATIONS FOR KAZAKHSTAN'S FIRST NUCLEAR POWER PLANT

Berik Matebay

## ABSTRACT

Kazakhstan is globally recognized for its vast natural resources, including substantial uranium reserves. The country employs in-situ leaching technology, making it the world's leading uranium producer for over a decade, supplying 36%–46% of global demand. This dominance is expected to grow due to geopolitical factors, such as instability in Niger and Western sanctions on Russia following its invasion of Ukraine. However, despite its resource wealth, Kazakhstan faces significant energy challenges. By 2035, domestic electricity demand is projected to reach 152 billion kWh, while production may decline to below 135 billion kWh due to aging coal-based infrastructure and global pressure to reduce carbon dioxide emissions.

On October 6, 2024, under the initiative of President Kassym-Jomart Tokayev, a national referendum was held, in which 71% of citizens supported the construction of Kazakhstan's first nuclear power plant. In response, the Ministry of Energy shortlisted four vendors: French EDF (EPR 1200), Russian Rosatom (VVER 1200), Chinese CNNC (HPR 1000), and South Korean KHNP (APR 1400). Additionally, this research evaluates the American Westinghouse and its AP1000 reactor technology. The Ministry of Energy now faces the critical task of selecting a partner for the plant's construction.

This research conducts an independent evaluation of these vendors across technical, economic, and geopolitical factors, considering Kazakhstan's extensive trade ties with China, Russia, and Western countries. The analysis assesses reactor construction expertise, project timelines, technical characteristics, nuclear fuel cycle infrastructure, estimated overnight construction costs, historical financing of nuclear projects, trade volumes with supplier countries, dependency on Kazakh uranium, opportunities for front-end fuel cycle development, and public survey results regarding the preferred vendor. Based on these factors, China emerges as the most suitable partner.

Findings indicate that China is uniquely positioned, with the capacity and strategic interest to support Kazakhstan in developing its domestic nuclear fuel infrastructure. If executed as a consortium, the study suggests that CNNC should lead construction, while French EDF should oversee the engineering, procurement, and construction (EPC) of HPR1000 reactors, focusing primarily on quality control and safety protocols. Rosatom is not a viable option due to the risk of sanctions and public opposition, while the United States lacks financial support and may oppose enrichment infrastructure development within Kazakhstan. South Korea, though cost-efficient, is unable to provide nuclear fuel independently and does not align with Kazakhstan's long-term goal of establishing a front-end nuclear fuel cycle.

Advisor (Dr. Fred Beach)

Sheldon Landsberger Co-Advisor (Dr. Sheldon Landsberger)