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# The Changing Geopolitics of the Nuclear Energy Market

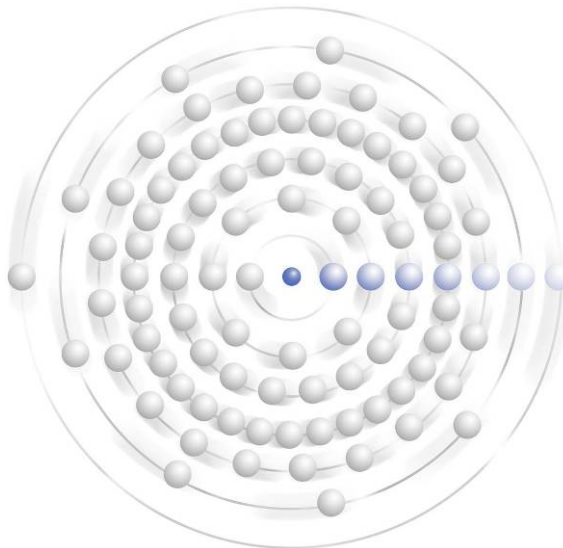
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## Russia

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## 1 – Introduction

The motivation for this study, *The Changing Geopolitics of the Nuclear Energy Market*, is to examine the dramatic shift that is taking place in the nuclear energy market from the standpoint of not only expected growth in nuclear capacity and demand for nuclear fuel, but also in terms of geography and international political considerations. Nuclear power is expected to grow rapidly in the East in order to meet the growing electricity needs in certain Eastern nations, and this creates associated demand for reactor components and nuclear fuel, impacting prices and supply availability.

It would be no exaggeration to say that Russia's nuclear industry has been going through "perestroika" – literally, restructuring. As a state-owned industry, nuclear followed (and continues to follow) Russia's ups and downs, and ups and downs again. The break-up of the Soviet Union was followed by a period of time that is often thought of as "the lost decade" in Russia. The new millennium gave a new start to Russia and its nuclear industry. The nuclear complex has always been considered a strategic industry in Russia and it has managed to survive more or less intact during the period of privatization, save for the nuclear equipment manufacturing sector.

Russia's newly found strength led to rethinking of the country's political and economic structure. As a reaction to this period of instability, order was sought. President Putin's solution was to build what he termed a "vertical vlasti" (power vertical), a top-down state structure that would be injected with some elements of private-sector-style corporate structure. Given this trend in state governance, it is no surprise that the nuclear industry followed a parallel path. The newly appointed head of Rosatom Sergei Kiriyenko's plan for "perestroika" amounted to, in effect, creating a modernized version of the former Soviet behemoth Minsredmash.

The structure of any branch of the civil nuclear industry in Russia consists (from the top down) of Rosatom, Atomenergoprom, and then the appropriate holding company for a branch under consideration. Grouping is important for such a structure, and the holding companies play a crucial role as they serve as an umbrella and a governing body for enterprises with similar missions. Examples include recently created Atomredmetzoloto (ARMZ), OJSC Separation-Sublimation Complex (RSK), and Khimpromengineering.

Consistent with the vertical structure, the goals to be achieved by the industry are set from the top and targets for the nuclear industry are formulated by the federal government in federal target programs. The federal targets have been translated into the industry program and a few sub-programs are in the process of development as well. The process of setting targets vaguely resembles the "five-year plans" that were characteristic of the economic planning in the Soviet Union. The effectiveness of the current target plans has yet to be proven. However, at least one positive result of creating such programs is that they lend clarity to the overarching goals of Russia's nu-

clear program. On the other hand, a federal mandate has several shortcomings. For example, the federal nuclear program has not been indexed to inflation or any cost increases, restricting payment to the amount put down on paper in 2006. This could potentially result in sub-contractors, some of which are private companies, under contract obliged to work at prices that are below cost, which is unsustainable.

## **The Complexities of Describing Russia's Nuclear Complex**

Russia's nuclear enterprises do indeed form a unified complex. The industry is not simply an umbrella term for an aggregation of independent state-owned assets and companies; instead, the industry can be best represented by a flow chart of the nuclear fuel cycle: complete, inter-related, and co-dependent. It is for this reason that this study of the Russian nuclear complex could be nothing if not comprehensive.

An understanding of this unity and inter-relatedness is often underappreciated, but is critical to understanding Russia's nuclear industry. It is difficult to examine only one part of the nuclear chain without giving at least some attention to other parts. The connectedness of the nuclear complex did not significantly diminish with the fall of the Soviet Union, as Russia retained most of it on its territory. Not surprisingly, during the planning of the nuclear industry, all facilities of any importance were purposefully located in Russia – only the placement of uranium deposits, determined by nature, could not be centrally planned. Thus, the only sector that was appreciably impacted by the dissolution of the Soviet empire was uranium mining, though a fuel fabrication facility in Kazakhstan was lost as well. These losses were felt; in 2006, Sergei Kiriyyenko lamented the break-up and urged for the nuclear industries of Russia, Kazakhstan and Ukraine to be united yet once again into a single complex, bringing back the legacy of Minsredmash.

As of now, the Russian nuclear industry continues to be in a state of flux, positioning itself as a formidable, unified and efficient player in all the global nuclear markets. One cannot afford to ignore these changes and a failure to understand the current and future trends within the Russian nuclear program would, in fact, signify a failure to understand the nuclear marketplace altogether. This report provides comprehensive “A to Z” coverage of the nuclear industry in Russia while providing a significant level of detail, insight and analysis for each part of the nuclear fuel cycle.

Given this deep inter-relatedness and the continuing adjustments and retooling within Russia's nuclear complex, this report attempts to provide both a comprehensive vision of the industry and its future as well as independent explanations of each separate sector comprising the overall industry. Thus, the reader can choose to review the entire report from start to finish, or just single chapters of specific interest. Each chapter covering a separate part of Russia's nuclear industry can be viewed as a stand-alone discussion; however, it is naturally very important to realize the multitudinous relationships that each sector has with other parts of the industry. Thus, no part of this report can be truly detached from the rest, since no sector in Russia's large nuclear industrial complex can be detached from the others.

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## Organization of Report

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This report starts with a review of the overall Russian nuclear power program, including both national and international trends as well as efforts to revamp the program, and then focuses in separate detailed sections on the specific aspects of Russia's nuclear power program. Following this Introduction, the report is organized as follows:

**Chapter 2 – Country Overview** provides an overview of Russia, including information on its geography, people, government, and economy. Additionally, this chapter discusses the position of the broader energy sector in Russia's economy and future.

In **Chapter 3 – Overview of Russia's Nuclear Industry**, the study reviews the history of nuclear power in Russia, and the latest facets of the restructuring of the industry, such as through the establishment of Rosatom and Atomenergoprom. This chapter also includes a detailed review of the domestic electric power sector and the impact of its restructuring on nuclear power prospects in Russia.

**Chapter 4 – Russia's Domestic Nuclear Reactor Program** examines the reactors that are now in operation, under construction, and planned in Russia. This chapter also covers UxC's latest forecast cases for Russian reactor development to 2030.

Russia is also a major player in the international reactor markets, and **Chapter 5 – Russia's Nuclear Power Plant Exports** analyzes Russia's current and future role in terms of nuclear power plant projects around the world. Along with Russian export reactor forecasts, the revenue potential for Russia is also examined.

**Chapter 6 – Reactor Design and Construction** looks at the history and future of Russian reactor designs, as well as Russia's large industrial complex that is dedicated to engineering, manufacturing, and construction for the nuclear reactor projects.

**Chapter 7 – Uranium Mining Sector** examines Russia's domestic uranium mining projects as well as its activities to procure  $U_3O_8$  from international partners. This chapter also looks at the latest UxC forecasts for uranium fuel requirements from Russian domestic reactors as well as Russian export units through 2030.

**Chapter 8 – Uranium Conversion Sector** covers the second step in the front-end fuel cycle, with analysis of Russia's modernization efforts for its conversion facilities and how the requirements for  $UF_6$  will fit into these plans.

**Chapter 9 – Uranium Enrichment Sector** analyzes Russia's supply of SWU and the latest in terms of Russia's enrichment technologies. A detailed discussion of the role of the HEU-LEU downblending program and how this fits into the enrichment supply picture in Russia is also included. Again, UxC's requirements forecasts for SWU from domestic and export units is included.

**Chapter 10 – Fuel Fabrication Sector** covers the various fuel fabrication facilities and companies involved in Russia. It also analyzes forecasts for VVER and RBMK fuel fabrication requirements domestically and abroad.

**Chapter 11 – Russia’s Role in World Nuclear Fuel Markets** ties together the preceding chapters and looks at Russia’s supply and demand balances in each fuel market and how this may allow for future Russian exports to additional countries.

**Chapter 12 – Back-End of the Nuclear Fuel Cycle** provides an overview of Russia’s reprocessing, MOX fuel, radioactive waste management, and decommissioning activities.

**Chapter 13 – International Nuclear Trade** looks at the role that various trade relations play in Russia’s nuclear sector, especially as it relates to Russia’s goals for expanded access to markets around the world.

**Chapter 14 – Nuclear Nonproliferation Issues** addresses the crucial role that Russia’s nuclear weapons program and disarmament efforts have played in shaping the civilian nuclear sectors. In addition, it examines the potential for some Russian initiatives to influence global nuclear nonproliferation goals.

**Chapter 15 – Strategic Analysis and Potential Future Scenarios** provides a look at key strengths that could help Russia’s nuclear program expand in the future along with potential hurdles that could hold back progress. It also offers broad predictions on the rate of Russia’s overall nuclear program expansion over the next two decades with three separate scenarios (realistic, optimistic, and pessimistic cases).

**Chapter 16 – Conclusions** offers the overall conclusions to this in-depth analysis of Russia’s nuclear power program and some final thoughts on its future.

In addition, there is a helpful **Glossary** as well as two appendices. **Appendix A** is a timeline of key events in Russia’s nuclear development, and **Appendix B** provides links to the websites of key Russian government organizations and companies (state-owned and private) that participate in the nation’s nuclear industry.

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## Work in Progress

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It should be understood that this study of Russia’s situation is very much a work in progress. Constant changes are taking place in Russia in terms of demand, supply capacity, government and business structure. Along with providing information on Russia’s current nuclear reactor program, fuel cycle sector, as well as international trade and nonproliferation policies, the intention is for this report to give the reader a framework to view these changes as well as an indication of where things are headed in the future. In conjunction with the other reports in this *Geopolitics Series*, the aim is for the reader to gain an appreciation of the important ways that the nuclear energy markets are evolving, especially with much greater emphasis on growth in Eurasia. In addition to our *Geopolitical Series*, UxC is also expanding and enhancing coverage of the latest policy and related developments in key countries, such as Russia, through our *Policy Watch* briefing service.