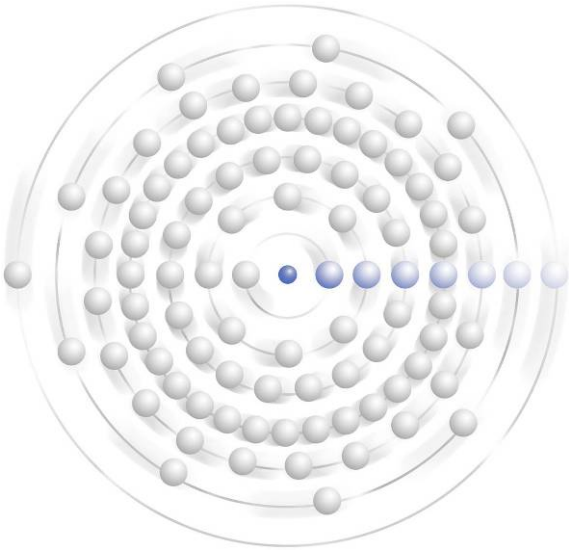
The Changing Geopolitics of the Nuclear Energy Market

India



Ux Consulting
1401 Macy Drive
Roswell, GA 30076
(770) 642-7745
www.uxc.com

Table of Contents

List of Figures

List of Tables

1 – Introduction

The motivation for our 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.

India is a nation with a huge and incredibly diverse population. The majority of its people live in relative poverty, but the nation's economy is growing rapidly. Economic development and increasing competition with China – its large neighbor to the northeast – are at the forefront of India's national goals. However, its economic growth is threatened by infrastructure woes, one of the most serious of which is an inadequate supply of electricity.

As a result of international isolation stemming from the detonation of a nuclear device in 1974, India has developed its nuclear power industry almost entirely on its own up until now. However, the situation has changed dramatically with the finalization of necessary international agreements in late 2008 that opened up India to nuclear trade. This is often simply referred to as the "India nuclear deal." Chapter 7 of this report, which begins on page 80, provides a background on the circumstances that led to India's nuclear isolation along with the recent international approvals for nuclear trade with India, and bilateral nuclear cooperation agreements it has recently signed with the key export countries, such as U.S., France, and Russia.

Due to rising prices for fossil fuels and recent opening of access to international nuclear trade, nuclear power is taking on an increasing importance as part of the solution to India's energy needs. However, even though it now has access to uranium and nuclear technology from other nations, India will likely need to reform its electricity industry to ensure that its supply of electricity expands fast enough to feed its rapidly growing economy. It is only because India has now received the approvals necessary to obtain nuclear fuel and technology from other nations that it will be able to rapidly grow its nuclear energy program potentially to its stated goal of 20,000 megawatts-electric (MWe) by 2020, and possibly even as high as 30,000 MWe by 2020.

One key difference between India and most other nations with respect to nuclear energy is that nearly all of its currently operating reactors are pressurized heavy water reactors (PHWR) that run on natural uranium as opposed to enriched uranium. Thus India at present has only a limited need for enriched uranium, and its enrichment requirements to date have been met by Russia, which has supplied India's two small boiling water reactors (BWR) and agreed to provide a lifetime nuclear fuel supply for two VVER-1000 reactors that are now nearing completion. However, this situation

will undoubtedly change as India is expected to order light water reactors (LWR) from other countries, such as France and the U.S.

India's domestic supply of uranium is limited, but the country is endowed with one of the world's largest reserves of thorium, another potential source of nuclear fuel. For this reason, the nation laid out a three-stage program to first develop PHWRs, then develop fast breeder reactor (FBR) technology on a commercial scale, and finally to develop and deploy advanced reactors that run primarily on thorium. The nation's top nuclear officials, including Anil Kakodkar, who heads the Department of Atomic Energy (DAE), have stressed that they will continue this three stage program to reduce uranium dependence even though the country now has access to international uranium supplies.

The first stage of India's nuclear development plan is well underway with India having in recent years brought its first 540 MWe-gross indigenous reactors online, with construction on larger 700 MWe-gross indigenous reactors expected to begin soon. The second stage is now in development, with India's first commercial scale fast breeder reactor with a 500 MWe capacity expected to begin operation in 2010. The third stage is currently in the experimental and design phase, but India is planning to start construction on a 300 MWe advanced heavy water reactor (AHWR) that will make use of thorium sometime around 2010. Due to India's large thorium reserves, it is likely to become the first nation in the world to build thorium-powered reactors on a large scale, perhaps 20 to 30 years from now. However, at the present time, India has just begun importing uranium, and as the nation's nuclear program continues to grow, the impact on the world's uranium supply will become more and more significant. As of May 2009, India's gross nuclear capacity is slightly in excess of 4,000 MWe, but it is feasible to imagine the nation's nuclear capacity growing to around 20,000 MWe by 2020 or soon thereafter. Thus, it is necessary to examine all aspects of the nation's nuclear program and provide the appropriate context in which to imagine how such a future could unfold.

Organization of Report

This report starts with a review of the broader national and energy issues impacting India's future, and then focuses in later sections on the specific aspects of India's nuclear power program. The report is organized as follows:

Chapter 2 – Country Overview provides an overview of India, including information on its geography, people, government, economy, and international relations.

In **Chapter 3 – Energy in India**, a description of India's overall energy situation and electricity market is provided.

An in-depth review of the nation's nuclear power program begins in **Chapter 4 – Overview of India's Civilian Nuclear Program**, including the history of nuclear power in India, and the role played by both government-owned and private entities in the nation's nuclear industry. The section in Chapter 4 entitled **Major and Emerg-**

ing Players in the Industry has descriptions of companies that are either currently playing a major role in India's nuclear program or that have the potential for a greater role in nuclear energy in the future and also discusses various joint ventures that could help Indian companies to expand their nuclear manufacturing capabilities.

Chapter 5 – Nuclear Reactor Program examines the reactors that are now in operation, under construction, and planned in India.

Chapter 6 – Nuclear Fuel Cycle Program describes India's nuclear fuel cycle capabilities, including uranium mining, conversion, enrichment, fuel fabrication, and reprocessing, and also briefly touches on India's nuclear research centers.

Chapter 7 – Nonproliferation Issues and International Cooperation looks at how India's previous nuclear weapons tests impacted the nation in the past and examines the events that led to the "nuclear deal" and bilateral cooperation agreements India has recently signed with the U.S., Russia, and France along with pending agreements with other nations. This chapter also addresses some obstacles that still need to be overcome before India can begin nuclear trade with the U.S. and a few other nations.

Chapter 8 – Strategic Analysis of India's Nuclear Program provides a look at key strengths that could help India's nuclear program expand in the future along with potential hurdles and also makes predictions on the rate of India's nuclear program expansion by 2020 and 2030, with high, base, and low case scenarios. This chapter also includes results from UxC's proprietary fuel requirements forecasts as well as a reactor market size analysis for India through 2030.

Chapter 9 – Conclusions offers our overall conclusions to this in-depth analysis of India's nuclear power program.

In addition, there is a helpful **Glossary** as well as three appendices. **Appendix A** provides a more expanded look at India's history and its religions than that found in Chapter 2. **Appendix B** is a timeline of key events in India's nuclear development, and **Appendix C** provides links to the websites of key Indian government organizations and companies that participate in the nation's nuclear industry.

- **Work in Progress**

It should be understood that our study of India's situation is very much a work in progress. Constant changes are taking place in India in terms of demand, supply capacity, government and business structure. Along with providing information on India's current nuclear power situation, our 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 the much greater emphasis on growth in Asia. 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 India, through our *Policy Watch* briefing service.

