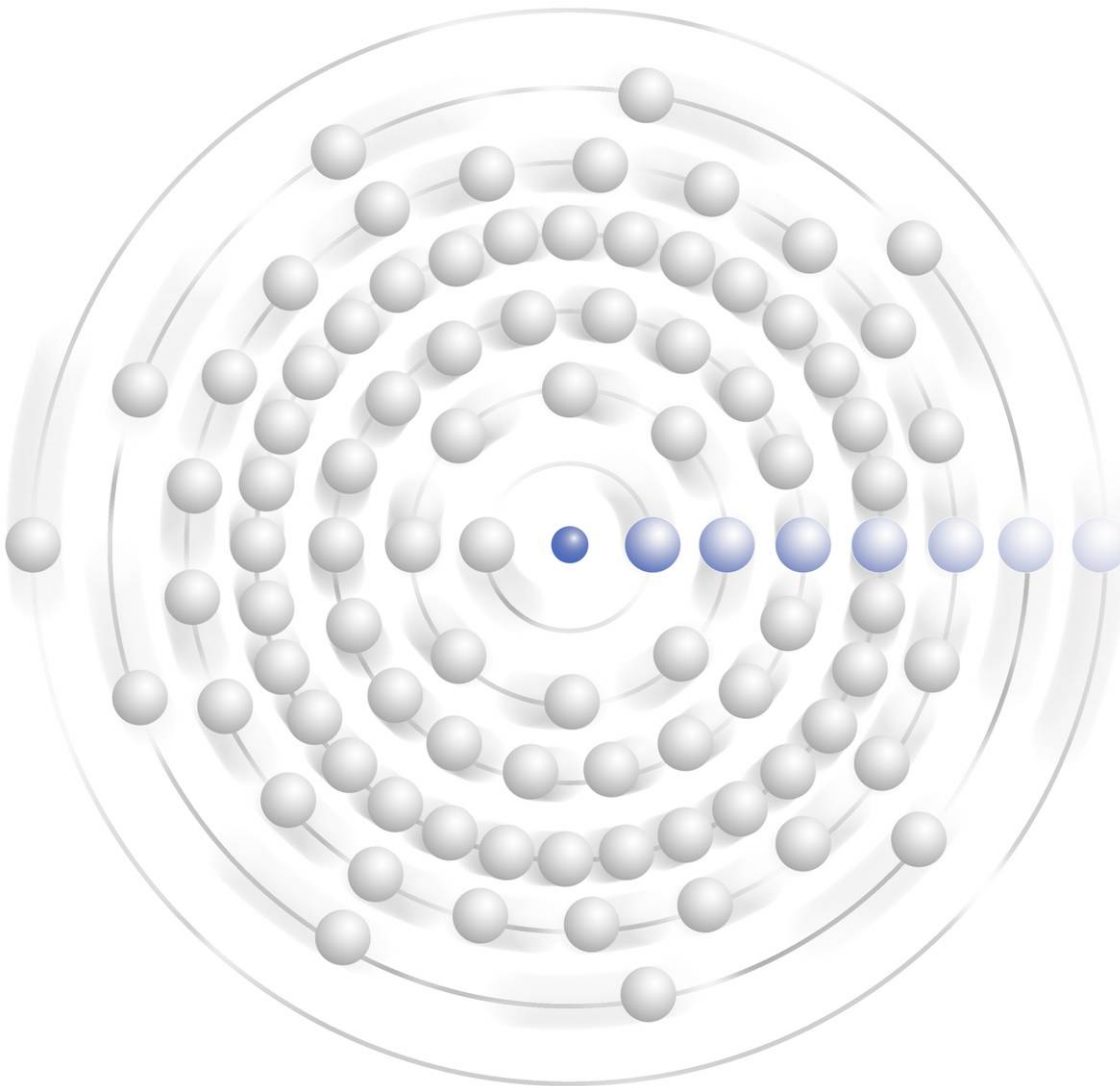




Uranium Production Cost Study



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Introduction and Overview

Introduction

Given the move toward cleaner energy, reduced carbon emissions, and more secure long-term energy sources, uranium supply is becoming more important to utilities worldwide. Currently, in our post-Fukushima demand case, uranium demand is still projected to double by 2030, mainly due to increased demand from Southeast Asia – China in particular.

With the U.S.-Russia HEU Agreement coming to an end in 2013, resulting in the elimination of 24 million pounds U_3O_8 per year from the market, and other secondary supplies and mine reserves being depleted, there is much greater emphasis on primary production today than ever before. It has only been until recently that uranium exploration has experienced a revival, but even this is being threatened in the post-Fukushima environment as many suppliers are now expected to find it more difficult to obtain project financing. As a result, the current menu of worldwide projects is not all that exhaustive due to the fact that most of the recent exploration has been on brownfield sites that were discovered 20, 30, or even 40 years ago. Although uranium resources within the widely known IAEA “Red Book” are extensive, the vast majority of these are neither delineated nor developed. As the nuclear industry transforms itself into a safer and robust industry, one of the challenges will be for the supply side of the industry to expand and bring new production to a market still in an aftershock.

This study complements UxC’s *Uranium Supplier’s Annual* in identifying where expanded and new uranium supply will come from among 116 worldwide projects to meet future demand through 2030. Cost curves for operational, planned, and potential projects are developed to identify those projects most likely to produce in the future, as well as present a long run cost structure for the industry. Additionally, the study identifies key factors that impact how production costs are calculated as well as their weight in a supplier’s decision of whether to advance a project to the production stage.

Structure of Report

The *Uranium Production Cost Study* is organized as follows:

Chapter 1 – Key Factors Affecting Production Costs reviews the many factors that impact production costs, including ore grade, reserve tonnage, deposit depth, spatial density, ore thickness, deposit composition and chemical agents, various technical factors, water flows and drainage, energy costs, labor costs, transportation/hauling costs, etc.

In **Chapter 2 – Uranium Mining Costs**, we discuss uranium mining costs for conventional (open pit and underground) and in-situ recovery deposits, specifically fo-

ocusing on the breakdown of capital costs for each mining method. Specific variables impacting capital mining costs for each mining method are discussed in detail.

Chapter 3 – Uranium Processing and Milling Costs identifies the capital and operating costs associated with uranium processing plants/mills. This chapter specifically looks at the direct and indirect costs related to total milling operating expenses. Typical operating costs for both acid leach and alkaline leach processing circuits are also presented.

Chapter 4 – Financial & Market Considerations on Costs discusses the time value of money and how this works in calculating the present value of a project. This chapter also discusses the difference between escalation and inflation and how each can impact the economics of a deposit. Lastly, this chapter focuses on how important market conditions are accounted for in deciding whether to make an investment and development decision.

In the following four chapters, we detail estimated production costs in constant (2011) dollars for prospective world uranium deposits. **Chapter 5 – World Production Costs** presents a production cost curve for all worldwide uranium projects, breaking the cost curve down by four tiers. Additionally, the production cost curve is broken down by operating, planned, and potential projects. **Chapter 6 – World Production Cost Case vs. Demand (2009-2030)** compares UxC's URM High and Base Demand Cases to potential world production stacked by cost range for the 2009-2030 period. **Chapter 7 – Production Costs by Region** shows production costs for Africa, Australia, North America, and the Former Soviet Union and Asia. **Chapter 8 – Production Costs by Mine Method** illustrates potential production from all three mining methods in the 2009-2030 period, providing costs curves and production by cost for each method.

Chapter 9 – A Return to Normal Queuing briefly details how the market has shifted from an inventory driven one to one that now must cover the cost of the highest-cost producer given how quickly demand is growing. Low cost production is no longer on the top of the supply curve as it was just ten years ago.

Chapter 10 – Financial Implications on Prices analyzes how financial implications not only affect uranium production costs directly, but indirectly on the sales price of uranium through variations in country exchange rates. Furthermore, inflation impacts uranium price formation, as increasing cost pressures on uranium prices then result in similar upward price pressure on the factor inputs for uranium production.

Chapter 11 – Matching Production Costs to Prices analyzes why prices are slightly higher than our marginal-cost pricing picture, with a broad discussion of floor prices, term contract prices, and spot prices.

Lastly, **Chapter 12 – Issues Affecting Next Generation of Projects** identifies key issues mostly likely to affect the development of new uranium projects over the next 20-30 years.