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# The True Cost of Uranium Production

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**Abstract**

The global endowment of uranium is vast, with sufficient resources to fuel the growing nuclear industry and generate clean electricity for many years to come. What has become clear however is that, given the prolonged period of artificially low prices, the primary supply segment of our industry has missed an entire exploration cycle. While there is a high degree of confidence that more uranium will be found and developed, it will clearly take time. Licensing and construction periods alone typically extend beyond ten years, regardless of jurisdiction.

With the world's inventories of secondary supply being depleted, utilities are once again turning to the primary markets to secure the bulk of long-term fuel contracts. Given that uranium exploration has only experienced a revival in recent years, the current suite of deposits to choose from is relatively small and expensive to develop – expensive because the resource base and yearly production potential are small; expensive because the deposit is difficult to mine and/or mill; expensive because jurisdictional licensing and regulatory processes are prohibitive; or a combination of all of these factors and more.

The true cost of uranium production, one that considers the most thorough assessment of technical and commercial issues on a discounted basis, is the one that producers scrutinize prior to making an investment decision. The analysis is more than simply looking at historical production costs or using producing mines as analogs for cost. It is only the most thorough assessments, along with strategic considerations for the portfolio of production assets, that will deliver strong performance to shareholders.

The purpose of this Paper is to discuss the true cost of uranium production from a producer's perspective. It will briefly review some of the technical and commercial variables that are modeled prior to moving to an investment decision. More broadly, the paper will seek to shed some qualitative light on the expected near-term behaviour of producers and the notional strike price requirements among many of the known but optional deposits.

Again, while uranium resources are extensive, the vast majority are not delineated or developed. As the nuclear industry continues to experience its renaissance, one of the challenges will be to bring new production to market in a disciplined and timely manner, while continuing to ensure value creation for investors with a belief in clean electricity.

## Introduction

Like most investment decisions, the myriad of criteria relevant to the uranium deposit development decision are daunting and often qualitative at best. Decision makers must first agree that a particular deposit advances strategic goals and portfolio objectives such as geographic diversity. Economic indicators will then provide the ultimate check to ensure that the development will create the required shareholder value. Deriving answers for the bottom line economic criteria involves burdening economics with every cost and risk quantifiable, and then layering corporate finance standards unique to every company – things like tax, cost of capital or hurdle rates. Management expertise is then required to look at the non-quantifiable risks and assess their burden along with a commensurate return.

While the progression through scoping, pre-feasibility, feasibility and detailed design studies provide ever-increasing levels of confidence, it is important to have a first-pass assessment of all of the potential costs even at the scoping stage. In a world of finite capital, investors require an accurate depiction of potential even at the earliest stages. Without it, there is a high potential to destroy value for shareholders.

While grade and thickness estimates that lead to a resource approximation are useful in providing a first-pass assessment of deposit existence and potential, these stand-alone metrics clearly do not provide a measure for the economic feasibility of a mine. All too often, optimistic geology is tempered by realistic development costs. The explanation of the true cost of uranium production seeks to identify some of the daunting issues and costs that face uranium producers during a development decision.

## Beyond Strategic and Portfolio Issues – Economic Considerations

### *Mining*

Mining costs for various known yet undeveloped deposits around the world are often quoted based on historical mining cost for what are believed to be analogous geological models. Scoping type estimations are also used, yet these analyses are rarely undertaken with a true appreciation for what is going on under the ground.

The true cost of uranium mining can only be known once the ore body has been well delineated, grade distributions have been logged and the deposit geology is well understood. Whether open pit or underground mining, a raft of cost implications flow from the determination of the geometry of the ore body, the ground conditions and the presence of groundwater.

Cost correlations to grade are self explanatory – the lower the grade, the greater the volume of barren material which must be removed and processed so that the contained uranium can be extracted. Material handling and processing capital and operating costs are substantial, and may be the key factor in determining development economics.

In addition, geological and geotechnical factors generally dictate the mining method. The mining method then impacts extraction costs by determining equipment and labour requirements to achieve a certain mining rate.

Underground mining costs are not only sensitive to the mining method but also to numerous others factors such as depth, the amount of waste rock development required, ground conditions and the presence or lack of groundwater. Ore bodies located generally below a 400 metre depth, such as McArthur River, require capital-intensive shafts for access. Direct sinking costs are generally correlated with depth. Site indirect costs may, however, be considerably greater during the sinking phase since an often remote site must be accessed and maintained. Near surface ore bodies, such as Eagle Point, may be accessed by a decline (or ramp), if open pit mining is not feasible. Decline access has large economic implications in comparison to a shaft access mine, since capital costs can be greatly reduced.

In the Athabasca Basin, the two key technical challenges that must be successfully overcome are the often incompetent nature of the ore and the potential presence of groundwater under high static pressures. This is particularly relevant for deposits located in sandstone. The severe hydrogeological conditions at McArthur River and Cigar Lake have dictated the need for ground freezing as part of the mining method. This not only isolates the ore from the groundwater but also improves ore competency. Only the size and the grade of the resource at both sites justify this extraordinary civil engineering measure. Eagle Point, on the other hand, is located in more competent basement rock with less likelihood of encountering groundwater. Hence, more conventional mining methods are possible to extract this lower grade ore competitively.

Open pit mining costs are greatly impacted by the amount of waste rock that must be removed to access the ore, the ore grade, the mine location, the scale of the operation and the presence or lack of groundwater. Grades as low as 0.03% U are successfully mined today by open pit methods, whereas a deposit such as Midwest Lake remains unmined at grades over 3% U. The key reasons for this are economies of scale, stripping ratio (generally, the amount of overburden which must be removed to access the ore) and the presence or lack of groundwater on operating costs.

In general, it is more difficult to predict the operating issues that will be encountered in an underground mine in comparison to an open pit. Poorer than anticipated ground conditions often leads to higher ground support, manpower, ventilation and equipment requirements for a given production rate. This is often accompanied by lower than expected ore grades due to excessive ore body dilution. Dilution can then impact the revenue stream if the mill cannot process higher tonnage rates to compensate. Proposed underground mines therefore deserve significant project scrutiny.

Beyond access to the ore, uranium mining has some challenges unique to the element. Clearly, special ventilation systems are required to keep the amount of airborne radon at safe levels and, depending on ore grade, additional shielding may be required to protect personnel from gamma radiation. Keeping the mine very clean also contributes to reducing radiation exposure, but places higher demands on water and water treatment.

While it is true that many of the conventional mining costs are foregone with *in situ* leach (ISL) operations, ISL well field drilling and installation costs are also substantial and recoveries are typically not as high as conventional operations. Well field pattern design and flow rates also have implications for cost. In any event, ISL costs need to be assessed on a case-by-case basis, just as conventional mines do. ISL cost centre headings downstream of the mine are also similar to those assessed in conventional mining.

Ultimately, it is the quantification of all combined cost considerations along with an estimate of mining recovery that leads to a mining cost and contribution to the revenue line. Furthermore, the slate of potential deposits which could be considered for development today are unique in their own right, and require dedicated individual assessments to arrive at the true cost of mining.

*Milling*

In most cases the product leaving the production centre is, of course, not ore, but is in fact a refined uranium concentrate product, often referred to as yellowcake. The milling method varies for different ores, such that the process in the majority of cases is complex and unique. The individual physical and chemical rock properties of the deposit influence cost substantially, such that blanket cost generalizations are often inaccurate and misleading. Beyond physical and chemical properties, the grade of the deposit and desired yearly production will also largely determine mill throughput and establish mass balances. Equipment sizing and energy consumption are also largely dependent on these factors.

Most ores from conventional mines require size reduction prior to the chemical process of extracting the uranium from the ore. Again, crushing and grinding circuit designs are influenced by a number of factors, including rock hardness and abrasiveness. Pre-crushing/grinding material size distributions are also largely influenced by the mining method, which in turn has significant cost implications for design of the comminution and material handling circuits.

The chemical process then follows the reduction of particle size. Typical uranium milling processes for the extraction of concentrates can be generally narrowed to two processes: namely, acid leach and carbonate leach. Both chemically complex, the required processes are determined by the chemical composition of the ore. Clearly, costs vary for both, such that milling cost assessments need to be completed for all potential developments.

In all cases the design and efficiency of the milling circuit determine the mill recovery rate, which in turn has very significant implications for the revenue line. Assuming that a generic combination of milling costs and recovery rates can produce erroneous results, a more detailed assessment specific to the ore body is required in all cases.

While economies of scale may be achieved by developing mill capital capable of processing several deposits simultaneously, this concept introduces a raft of other cost considerations for material handling and circuit design. Distance from mine to mill and lower consolidated recoveries associated with processing varying mineralogy all have revenue and cost implications.

In other words, milling costs cannot be generalized across what may be viewed metallurgically as similar deposits. The true cost of uranium milling needs to be assessed on a case-by-case basis. Blanket generic modeling can be misleading and dangerous given that milling burdens make up a large part of overall capital and operating costs.

*Tailings*

Tailings issues are often considered in the context of overall milling costs. While tailings management facility design may be dependent upon the milling process employed, specific uranium tailings issues are so substantial and so onerous that they deserve consideration as a stand-alone cost centre. Perhaps most environmentally scrutinized of all, purpose-built tailings management facilities require heavy science and heavy engineering. In most cases, baseline studies combined with utterly complex hydrogeological modeling and detailed engineering are required as development prerequisites. Again, such considerations have significant implications for cost.

Clearly, the tailings discussion is very relevant for licensing and regulatory matters, and also represents a very large component of decommissioning and reclamation costs. But beyond these considerations (discussed later) are the material cost line items associated with building and operating the facility. Excavation, linings, dewatering, water treatment, deposition systems and ongoing management influence cost in all cases. Tailings management facilities should be sized commensurate with life-of-mine output, and require redundancies and safeguards which can reduce the probability of an environmental excursion to near zero.

Not surprisingly, good development decisions will have a specific tailings management assessment backing them. Again, generically quoted costs embedded within a milling capital or operating number do not give justice to the gravity of tailings considerations and do not accurately represent the true cost of tailings management.

*Utilities Consumption and Infrastructure Costs*

Infrastructure costs such as power, water and transportation often correlate heavily with the remoteness of the deposit. There are many examples of deposits which are inspiring from a mining and milling point of view, but are so remote that the economics are crushed by the cost of developing the necessary infrastructure to run the mine.

Most uranium mines are power and water intensive, so that delivering the required wattage and volumes to site become a major cost centre. This is especially significant when development of a mine means the introduction of power and water to a region. While site-specific power can be installed, the energy source still needs to arrive at site (e.g. diesel fuel for on-site power generation). Similarly, while water treatment, recycle and discharge (also specific cost centres) are designed around water usage optimization, an initial water source must be introduced to site such that water transport systems can service base load water requirements for the life-of-mine. Of course, in the case where site services need to be developed at a grassroots level, cooperation with local governments and regulatory agencies is likely to be a high priority on the project agenda.

Beyond the discussion of site utilities is the matter of transportation infrastructure – for employees, for consumables and for finished product. For very remote sites, these costs are again onerous and may involve the introduction of routine flight rosters, the development of road networks or routings for transport across bodies of water. Development of on-site housing for employees may also be necessary. Accommodations, amenities and services for on-site employee lodgings can be very expensive, and needs to be included in the cost calculation.

Given that deposits lie in different geographic regions with unique access to infrastructure, development decisions again require assessments of utilities consumption and infrastructure development cost specific to the deposit. Development promotion that is not backed by an assessment of infrastructure requirements is erroneous. The true cost of uranium production in all cases, is the cost that includes a specific assessment of utilities consumption and infrastructure cost.

*Jurisdictional Risk*

Several of the known but undeveloped deposits lie in jurisdictions with embryonic mineral or company laws. The region may also rank poorly on corruption indices, or even be subject to civil unrest. These risks would be burdens over and above the potential infrastructure development costs mentioned earlier, and certainly need to be accounted for in the true cost of uranium production. While often difficult to quantify, blanket burdens represented as a percentage of overall cost may provide a proxy, and in some cases can be based on previous experiences in the region (whether it be your own or those of another company's).

It is true that the jurisdictional risks associated with entering a new and undeveloped region are risks that are often more patent for investors than are the technical and less understood risks. For firms deciding to invest in these high-risk regions, their cost of borrowing reflects the potential blatant consequences. In such cases, however, investors expect a return that rewards them for their risk taking, so that while value creation should return the higher cost of borrowing and above, the cost can only be truly represented by burdening the economics with some kind of risk quantification.

*General and Administrative Expenses*

Although mine and mill operating costs may be accurately estimated, mine general and administrative costs (G&A) are often poorly defined. G&A charges typically include costs associated with transport to site for personnel and materials (mentioned above), camp operating costs if any, administrative costs, licences and fixed fees. Cost may range from 15% to over 50% of mine-plus-mill operating costs.

One of the larger cost components that may also fall under the general and administrative cost heading can be compensation. In a rising price environment with anticipated industry growth, the supply of skills is also becoming limited, such that the cost of acquiring skills may rise. True G&A costs require an assessment of workforce requirements and associated total compensation amounts. Project earnings cannot be accurately stated without looking at the people requirements.

Finally, while remoteness and jurisdictional risks have been mentioned as potential encumbrances to development for direct cost reasons, these issues may have another hidden G&A type cost associated with consuming management time. Management time expended on smaller or somewhat pesky projects has an opportunity cost associated with it – the cost related to neglecting other executive matters while focusing on trying projects. While this cost is indeed difficult to quantify, it is worth noting as an issue during the investment decision process.

*Licensing and Permitting Requirements*

While the licensing and regulatory approvals processing has its own price tag, it has a far more dramatic effect on project economics than the specific line item type costs – it has the effect of continuing the negative project cash flows while pushing positive cash flows further into the future, in what may seem like perpetuity. In a discounted, time-value-of-money type economic assessment, the impact on economics may be huge. This is especially true given that development times for uranium mines can be ten years or beyond, regardless of jurisdiction. In other words, the investing company can expect to be cash negative on the project for the first ten years and can only expect positive cash flows after an operating licence has been granted. Again, pushing these positive flows out substantially impacts value when returns are translated to current terms via discounting. In any event, it is absolutely clear that the true cost of uranium mining cannot be assessed without having an entirely realistic assessment of the licensing and regulatory costs and time frame.

*Sustainable Development*

Working in cooperation with local stakeholders and gaining the support of local communities is most often a core value among producers, and is absolutely essential for corporate sustainability and smooth operations. Investing resources into the community and working to ensure that local stakeholders benefit from the development are vital to the success of the operation. Investment examples may include local workforce training, social development investment, and other forms of community sponsorship. While these types of investments may be consistent with corporate values, sustainable development and corporate social responsibility programs have real costs associated with them. These costs should be estimated and included in the overall assessment of the true cost of uranium production.

*Decommissioning and Reclamation*

Due to constantly changing regulatory requirements, a uranium mining company must be prepared for substantial reclamation costs extending five to ten years beyond the end of the life-of-mine. The need to fund perpetual care of the property should also not be ruled out.

Unlike the licensing and regulatory price with real near term effects on cash flow, decommissioning and reclamation costs are incurred at the end of the life-of-mine. In most cases, these costs are far out in the schedule of cash flows, and so their impact is not substantial on a discounted basis. Yet the costs are relevant in current dollar terms, and should be allowed for when assessing the true cost of uranium production.

*Corporate Finance and Accounting Considerations*

After all of the engineering estimates for mining and milling have been completed, after the tailings and infrastructure costs have been assessed, after utilities consumption, infrastructure development costs and general and administrative expenses have been estimated, after projects have been burdened for jurisdictional risk, after the licensing and regulatory requirements and decommissioning and reclamation costs and timelines have been established, after all of this, corporate economists test sensitivities to variables which can have absolutely enormous effects on the attractiveness of the project.

A few of the finance and accounting type considerations include:

- discount rates, returns, project financing and corporate cost of capital;
- anticipated escalation, especially over the licensing and development period;
- anticipated foreign exchange rate behaviours;
- taxes and royalties;
- consolidated depreciation and overall contribution to consolidated earnings; and
- contribution to consolidated cash flows.

Each of these variables deserves a short discussion in its own right.

Discount rates employed in discounted cash flow type valuations are often related to the company's cost of capital (in that the firm seeks to at least return the cost of capital to shareholders), and premiums are often applied in an attempt to ensure that quality returns are generated. While the appropriate discount rate employed may be the subject of an academic discussion, there is no question that the choice of discount rates can dramatically affect the attractiveness of a project. At the very least, the discount rate should be set to return the cost of capital. For different companies consolidated risk profiles will be different, and so lenders (both debt and equity) will charge accordingly. In all cases, companies facing the investment decision must ensure that they will, at a minimum, return their true cost of capital to shareholders. As such, discount rates must be set accordingly.

Escalation (the increase in price of specific materials or services) is also germane to the investment decision. Escalation has a particular relevance given that economics are typically being assessed for a deposit that may be ready for development in five to ten years from the time of the economic analysis. In short, many things can happen in that period, not the least of which may be more than anticipated escalation of costs. Costs can indeed escalate for a number of reasons – even today many rue the day that steel prices began the ascension associated with dramatic Chinese consumption. Overall national inflation also has implications for almost all cost centres – whether it be steel, labour, the cost of power, etc. Economic analyses should have an assessment of, and allowances for, escalation and inflation.

The impact of foreign exchange fluctuations is self-explanatory. Uranium concentrate prices are denominated in U.S. dollars, and real revenues are massively affected by the relevant variations between the currency of the producing country and the national currency of the purchaser. Foreign exchange estimation also shares the same forecasting issues as escalation. That is, foreign exchange rates are difficult to predict for five to ten years out. Indeed, project economics are quite often very sensitive to foreign exchange fluctuations.

Often project economics are expressed on a pre-tax basis, as if tax is going to have a negligible impact on feasibility. Yet there are many, many jurisdictions in the world where tax can consume one third (or more) of the penultimate bottom line. Depending on jurisdiction, taxes can also be levied on more than just income. These may include property taxes, goods and services taxes, value-added tax and so on. Some of these levies may not even be a function of mine earnings, and could be payable despite not being profitable. The impact of tax is enormous and clearly project attractiveness is heavily influenced by tax considerations. Add to this the burdens associated with paying royalties, and margins may shrink even more. While royalties are typically based on production, they are clearly another negative cash flow, and need to be assessed when considering project economics. All true uranium production cost assessments require the inclusion of tax burdens and royalties – results must be stated on an after tax basis and net of royalties.

While discounted cash flow analyses obviously consider only the cash items, contributions to corporate earnings are also important to shareholders. As such, depreciation of mine capital added to the balance sheet after the investment decision contributes to reducing earnings. While the overall earnings contribution of the development prospect may be net positive and accretive, the depreciation expense should be considered in the context of corporate earnings. Clearly shareholders seek to experience earnings accretion very early in the project, and for capital-intensive mine developments depreciation may be substantial.

Finally, given that the contemporary market sentiment may form the impression that cash is king, the assessment of overall consolidated cash flows is important. Again, for onerous licensing and approval times, dilutive cash flow effects in the early stages of the development may not be palatable for investors, and so the project may be by-passed.

In any event, corporate finance and accounting considerations play an absolutely central role in determining the economic feasibility of a project. An assessment of the true cost of uranium production will incorporate realistic finance metrics into the analysis, and results will be represented to shareholders accordingly.

*Mineral Resources and Potential Yearly Production*

The economic impacts of resource size and potential yearly production are obvious – they comprise half of the revenue calculation (the other half is of course attributable to the topic discussed in the section below). Yet again, substantial mineral resources for what some companies are calling economic deposits are often materially in the inferred category. That is, the resource calculation is not backed by any of the economic assessment discussed above. To call an inferred resource economic is a contradiction in terms and is speculative at best. Even for proven reserves, they have to be substantial enough for the combination of reserves and production (or life-of-mine in other words) along with uranium price to make the revenue line larger than the total cost line, and for the sum of discounted balances to be greater than zero.

Similarly, potential yearly production figures are often quoted before assessing the true cost of production. Limitations through the mining, milling, tailings deposition and infrastructure cost centres dictate production rates. Ultimately, with good recoveries, the entire resource will be extracted. But if production rates are not based in reality, cash flows will once again be spread out over a longer period of time and pushed further and further out. Again, using time-value-of-money concepts, pushing positive cash flows further out has detrimental effects on project economics.

*The Deciding Factor - Market Conditions*

Ultimately, if the project makes sense from a strategic and portfolio perspective, and all costs have been accounted for and revenue-influencing parameters have been assessed, it is the anticipated price of uranium that will sway the investment decision. Considering the revenue and cost pieces on a discounted basis using criteria specific and unique to the deposit and investing firm, means that uranium prices required to stimulate mine development cannot be compared to simple operating costs for potential developments. Projects are only “in-the-money” if the uranium price is high enough to make the net present value of the project greater than zero – again this is a life-of-mine assessment that considers all of the revenue and cost implications discussed above. While part of the price risk can be mitigated with base contracting, it is also risky to let the exuberance of base loading contracts obscure the need to fully understand the overall price required to provide a return to investors. There have been examples of production that was base loaded at prices that were later found to be “out-of-the-money”.

Another difficulty is that it is not so much the price of uranium today that is the relevant price – it is the price for concentrates at the time production actually starts that is the pertinent one. As mentioned previously, development times can be in the order of ten years and beyond, so price forecasts that far out are used for investment decisions today. This is not to say that all capital costs must be committed to at the very early stages of the project. On the contrary, projects can be viewed and reassessed in stages and played as real options. Yet in bull uranium markets, financing activities and securities valuation can be largely based on scoping level excitement, as opposed to focusing on the true cost of uranium production. Often the cost, revenue and schedule realities are lost in a less relevant discussion of inferred resources. Without a reference to the true cost of uranium production, companies get over-valued, and in due course the probability of destroying shareholder value increases.

**A Word About Other Resources**

While less quantifiable and perhaps less tangible, a real and utterly dire necessity facing any company looking to develop a uranium deposit is the need for skills. Uranium production is very specialized, from mining through milling through tailings deposition through reclamation, not to mention the skills and resources required to see the licensing and regulatory process through and to actually operate the mine. A survey of existing companies with a successful track record in developing and operating uranium mines is a quick exercise – there is only a handful. This is not particularly surprising, given that such a significant amount of fortitude and tenacity are required to see the project through. That is, any company deciding to invest does so with the knowledge that development times from the start of feasibility and the regulatory process to actual production can be ten years and beyond.

Clearly management expertise is also a prerequisite to development. As mentioned previously, there are a myriad of development risks that are unique to uranium production. While it is important to quantify as many of these risks as possible, some can only be generally qualified. Experienced management is required to ensure that these risks have been properly addressed and that adequate mitigation measures are in place. Ultimately it is management proficiency at assessing the fully-risked, true cost of uranium production, and the ability to accurately translate the information into an expected return for investors, that is required to sustain a stable and profitable uranium production company.

The point is that investment decisions must be scrutinized to determine whether the company and individuals even have the skills to assess the true cost of uranium production, whether they have the management and resources to move through the development steps, whether they have the skills to move into operation, and whether they have the management team to accurately represent the investment to stakeholders. For investors, competent management and skilled technical people should be paramount.

**Conclusions**

Clearly, the discussion of the true cost of uranium production in no way seeks to predict what future uranium prices will be – indeed market clearing mechanisms will take care of this. Yet many industry pundits continue to forecast bull uranium markets for years to come, and market signals seem to indicate that the uranium price recovery could be sustained – sustained at least for the near-to-medium term with less interference from secondary supplies than there has been in the past. This would give rise to the need for more primary production.

Yet without a slate of successful exploration delineations, many of the more imminently developable mineralizations sit on the margin, especially when considered in the context of the true cost of uranium production. It could be that there are companies exercising caution to ensure that the recent market recovery is sustainable, with investment decisions deferred for just a bit longer. However, the more likely scenario is that the prophecy of the true cost of uranium production is self-fulfilling. That is, even with the substantial rise in uranium prices, the number of development announcements has been limited to just a few, and some expansion capital or mine-life-extension capital decisions continue to be on hold. The proof lies in the behaviour of producers, such that the absence of development announcements may signal that prices may not have reached the "in-the-money" tranche for many of the known yet undeveloped deposits. The contrarian argument could point to the fact that there is no shortage of companies who are claiming an inferred resource on their books with a reasonable associated operating cost. But again, many of those references have very little to do with the true cost of uranium production. In fact, the even harsher reality is that some of the development decisions that have been announced are not based on the true cost of production. In such cases shareholder value will clearly be destroyed. The comfort the market can take in a bad investment decision is that the production will likely be there – it will simply be that a group of unfortunate investors will have financed a development decision that was not predicated on the true cost of uranium production.

A final word of caution is that this discussion only speaks to the primary supply side of the market. Other market forces and secondary sources of supply could also become economic as uranium prices rise, so from a macro market perspective the existing price tranche may be the market clearing one. Again though, if demand looks more to primary supply than elsewhere, it may be true that the current price tranche is not the one that will stimulate significant new primary production in the near to medium term. Again, today it would seem that the primary supply side is simply not coming forward with an overwhelming response to the recent rise in price.

The closing caveat for the long-term is, of course, that there is a high degree of confidence that global uranium exploration programs will be successful in finding new and economic deposits. Indeed, there is ample evidence that the exploration sector is responding. Again however, the term "economic" implies that rising demand for uranium from primary production will establish market prices in the long term that are sufficiently robust to cover the true cost of uranium production for new discoveries. Given that the true cost of producing uranium from new deposits will not be known until they are discovered, the real questions about primary supply, demand and price reaction are particularly relevant for the ten to twenty years in the period prior to bringing new found resources on stream.