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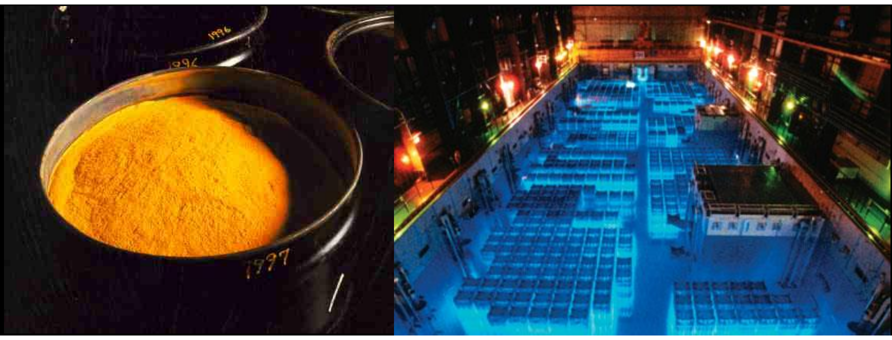
The Alchemist



This issue

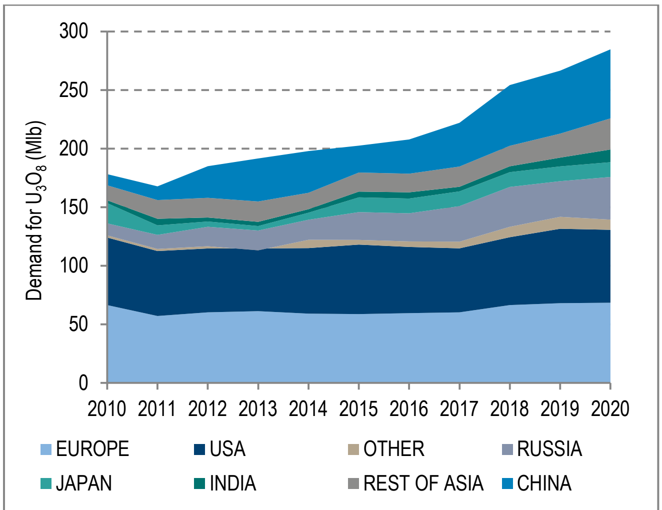
Uranium

Uranium: From North Korea with Love

Last month's nuclear weapon test by North Korea may not at first seem the most obvious point from which to begin a discussion of the outlook for uranium, but it actually encapsulates several of the key themes and issues faced by the uranium sector. Asian insatiable demand for uranium, inaction by America, fears over enrichment capability, and public concern over proliferation are as much issues faced by the uranium sector as they are topics related to Pyongyang's latest provocation.

By its recent actions, North Korea has broadcast itself as yet another Asian sovereign consumer of uranium in the face of American cautious indecision. As with nuclear weapons, America leads the world in terms of the number of its nuclear reactor fleet, but in terms of growth there are only a handful of American reactors in construction and these are the first to be built in 30 years. In stark contrast, China's latest nuclear reactor expansion plans forecast that its current fleet of 17 reactors will have grown in number to rival the US hegemony of nuclear energy generation by 2020. When added to the growth plans of South Korea, India and the likely restart of Japanese reactors – future growth in nuclear power and uranium demand can clearly be seen to have an Asian flavour.

Figure 1: Global demand for uranium (2010-2020)



Source: The Alchemist, IAEA, WNA

It now seems likely that North Korea has secret uranium enrichment capability supplementing output from the known gas centrifuge facility at Yongbyong. As with weaponry, nuclear power requires raw uranium to undergo enrichment, although to a far lesser extent (3.5% vs 90%). While North Korea appears to have sufficient enrichment capacity to meet the needs of its weapons programme, concerns have been raised that the global nuclear reactor fleet may face a fuel bottleneck due to limited enrichment capacity. As shown by the hidden North Korean plants, enrichment technology is a closely-guarded secret with few countries capable of it and fewer still applying it commercially.

Whilst North Korea has been enriching uranium to weapons-grade levels, and potentially exporting some to Iran and Libya, Russia has been doing the polar opposite for the past two decades. The Megatons to Megawatts (M2M) programme established in 1993 has successfully recycled the equivalent of 18,899 nuclear warheads to provide fuel for US reactors. However, this programme which provided around 23.4Mlb of secondary uranium supply annually is due to cease mid-way through this year. Although a transitional supply contract has been agreed which will commence in 2013, even when it has ramped up to full production in 2015 it will only provide US reactors with around half of what they previously sourced. The new transition supply will utilise Russia's spare enrichment capacity rather than down blending excess weapons grade stock. Given the M2M programme provided around ~11% of current world uranium supply, its loss is likely to have a major impact on the uranium sector and could precipitate the long awaited inflection point in market sentiment towards uranium.

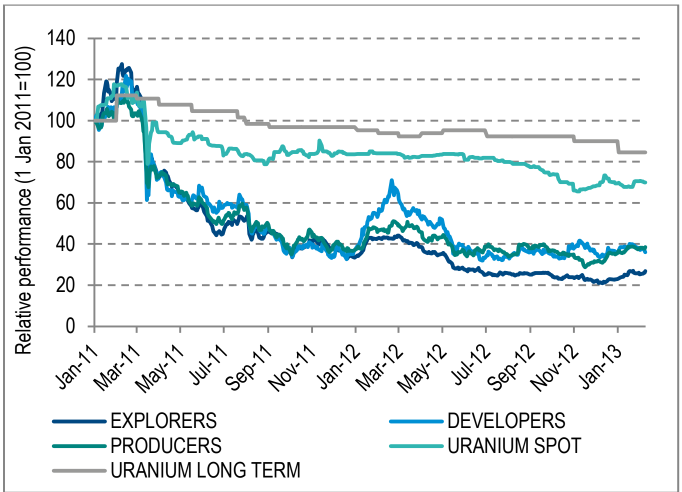
Although this recent weapon test by North Korea might reignite public concerns towards nuclear power generation by association, it seems unlikely that it will have the sort of impact on valuation that the 2011 Fukushima incident exerted. That wave of anti-nuclear sentiment appears to have waned, as seen by the recent election of a pro-nuclear government in Japan, and the removal of moratoria on expansion plans by China and other Asian countries meeting little opposition.

While Germany, and potentially Switzerland, may permanently shutdown their reactors, those instances of political reaction to public concerns are unlikely to have a major impact on the outlook for global nuclear power generation in the near-to-medium term. Germany will slowly phase out its remaining 8 reactors over the next five years, by which time 24 of the 28 reactors currently under construction in China are forecast to come online. Elsewhere in Europe, nuclear reception is more favourable with two reactors in construction in Slovakia and one in Finland and France.

The important takeaway from this is that those countries which are critical to the growth of the global nuclear reactor fleet - including China, India, South Korea, Russia and Japan - have all recently had elections of pro-nuclear governments and face looming energy crises. While the growth of nuclear power does hinge as much on political as economic decisions, the calls for cleaner air and an end to power blackouts drown out those from anti-nuclear lobbies in these growth economies.

The continued malaise of uranium equities appears to be in marked defiance of broadly supportive demand and supply fundamentals. Much of this depressed performance is due to the low and languishing uranium spot and contract price, which reflects the current flat demand in the market with slightly fewer reactors operational now than before Fukushima. However, uranium equities valuations appear unresponsive to positive developments over the last six months. Despite the resurrection of China's grand expansion plans for its nuclear reactor fleet and the election of a pro-nuclear government in Japan, uranium equities currently stand at 25-40% of their pre-Fukushima valuations.

Figure 2: Performance of uranium equities and prices (2011-present)



Source: Bloomberg

Not all investors hold this disheartened view on uranium's prospects, as demonstrated by the buoyant implied valuations from recent M&A deals in the sector. Given the nature of the buyers in these latest deals – key industry and strategic investors – this issue of *The Alchemist* revisits uranium's market fundamentals and attempts to provide a balanced perspective on the likelihood that uranium stocks' green shoots will grow strongly once again in spite of the permafrost of market sentiment.

A key driver to any such thawing will be the recovery of the uranium price. It seems unlikely that the recent storms in Kazakhstan or the operational difficulties at some of the leading uranium mines will cause a price spike similar to the one witnessed in 2007. Nevertheless, *The Alchemist* believes that the uranium price will improve. Our view is that the marginal cost of production argument provides the most compelling case for a near term rise in spot price and our analysis of industry cost curves suggests prices could reach $70/lb by 2015.

This extended issue of *The Alchemist* seeks to provide an update on the current state of play for uranium. We will address concerns that investors may have over demand growth and importantly we will delve into the impact of reactor shutdowns. This issue will also examine the current discrepancy between current market valuations and recent transactions in the sector to reveal the key characteristics of projects which can stand out against the pack as the uranium renaissance regathers momentum.

Long-term demand – a double-edged sword

Demand for uranium is long-term in nature and easily discernible. Aside from the machinations of North Korea and Iran, nearly all raw uranium will end up being enriched to be used in nuclear power generation. In 2012, total global demand for raw U3O8 stood at ~185Mlb. Central to an understanding of uranium market dynamics is the fact that a new nuclear reactor represents around 30 years of guaranteed demand for enriched uranium feedstock. One 1,300MW nuclear power plant typically requires 25 tonnes of enriched uranium each year, which is formed by treating ~210 tonnes of raw U_3O_8. In light of nuclear power generation's role as a base load provider, this level of consumption is fairly constant with reactors usually only taken offline for maintenance or upgrades. Hence the shock from the sudden shutdown of 50 reactors in Japan following Fukushima – never before had so many of the global nuclear fleet been turned off at once.

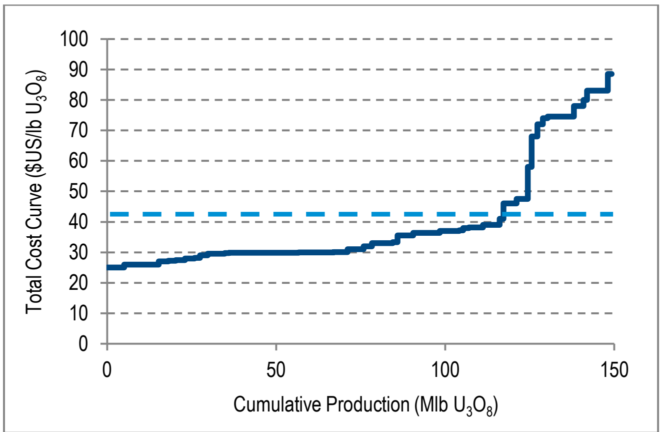
Nuclear reactor build programmes are highly visible due to their significant capital cost, the requirement to gain public approvals, and the large construction effort. Once the first cement has been poured, there is little room for turning back on the investment decision. It is for this reason that the potential expansion of Asian nuclear reactor fleets, in particular China's 28 reactors currently under construction, is of key importance to the outlook for uranium. China's growth by 2020 will put its reactor fleet on a par with France and also shoulder-to-shoulder with the USA in terms of generation capacity. By 2020 new reactors will increase China's uranium demand by around 30Mlb per annum (20% of current global mine production). Further significant additions to reactor fleets are also expected in South Korea, India and Russia by 2020.

The growth of nuclear reactor fleets in these countries reflects plans to meet forecast energy shortages while recognising the need to diversify away from reliance on fossil fuels for power generation. Recent noises out of China are promising for uranium demand; President-elect Xi Jinping and the State Council have both called for a reduction in the country's reliance on coal-fired power generation. The proposed cap on coal consumption in the current Five Year Plan aims to provide the Chinese with cleaner air and to prevent the smog conditions recently experienced in many cities. Although this supposed cap actually allows for an increase in current levels of coal usage, the motivation behind its announcement is clear. Rather than just being empty rhetoric, China has the balance sheet and conviction to make such energy diversification plans a reality. Indeed, the fact that those countries in the vanguard of fleet expansion are willing, and on the whole able, to dedicate state funds to such projects helps to de-risk the positive outlook. Even oil rich nations such as Saudi Arabia and the UAE have decided to invest heavily in nuclear in order to free up more crude for export rather than domestic power generation.

There is a high level of concentration in the demand and supply of uranium. This typically results in long-term supply contracts. Such contracts continue to be the norm - Areva recently agreed to supply 66Mlb of U_3O_8 to EDF from 2014 to 2075. Similarly contracts may be negotiated many years in advance; EDF, for example, paid $200m upfront for its supply deal for 13.7Mlb over five years with Paladin even though deliveries will only commence in 2019. With so much raw uranium earmarked to satisfy these long term agreements, only ~10-15% of raw uranium is traded on the spot market. This tight market results in a potentially volatile spot price, and helps to explain the 2007 price spike when uranium spot prices reached $137/lb.

While long term contracts provide security for uranium producers they can also become a millstone around producers' necks when high-cost uneconomic mines are forced to continue operations in order to meet contract quotas. At current uranium prices, many analysts view up to ~20% of current supply as being uneconomic.

Figure 3: Uranium 2012 total cost curve vs. current spot price



Source: The Alchemist

The low spot and contract price also acts as a disincentive for developers to progress as seen recently by Cameco's $168m writedown and delay of its Kintyre project. Cameco's CEO, Tom Gitzel, noted that it would take a uranium price of $67/lb (vs. current ~$42/lb) to make Kintyre attractive again. This is a recurrent theme across the development space – with a price in the range of $70-90/lb often cited as necessary for projects to progress. A 2012 JPMorgan report concluded that of twenty mines due to come into production over the next ten years, representing a doubling of current mine production of ~150Mlb, the average price required to justify continuing development was $83/lb. Since that report was issued, the situation has deteriorated further with uranium prices ~$10/lb lower. This continued price malaise means that developments will continue to be pushed back year on year waiting for the necessary improvement. *The Alchemist* forecasts that uranium prices are likely to rise to between $65-70/lb by 2015, so once financing and construction time is factored in, at best only a quarter of the twenty mines surveyed will be coming into production by 2020. These represent additional production of around 25-30Mlb/year. Cameco's Cigar Lake project is critical to this forecast as it alone contributes ~18Mlb a year. This should be considered in relation to the likely production declines at some existing operations. Previously investors were concerned with the potential for the Olympic Dam expansion to 'burst' and flood the market, these fears seem now to have abated with the earliest likely date of an expansion being at least 20 years away.

The importance of Cigar Lake and Olympic Dam to the global supply picture highlights the fact that uranium supply is heavily concentrated in the hands of a few producers and operations. This concentration potentially poses a further risk to supply as operational issues at a single mine can have a major impact on global mine production. As can be seen from the table below, the top 10 operations account for 51% of global mine production and the top 20 make up 80%.

Figure 4: World's leading uranium operations in 2012

Name	Ownership	Mlb U_3O_8
McArthur River	Cameco/Areva	19.4
Olympic Dam	BHP Billiton	8.9
Ranger	Rio Tinto	8.2
Katco Operations	Areva JV (KazAtomProm)	8.1
Somair	Areva JV (Somair)	6.8
Rossing	Rio Tinto	5.9
Priargunsky Operations	ARMZ	5.7
Langer Heinrich	Paladin	5.1
Inkai	Cameco JV (KazAtomProm)	4.4
Karatau	Uranium One (ARMZ)/KazAtomProm	4.0
	Top 10 (% of Global Mine Production)	**51%**
	Top 20 (% of Global Mine Production)	**80%**

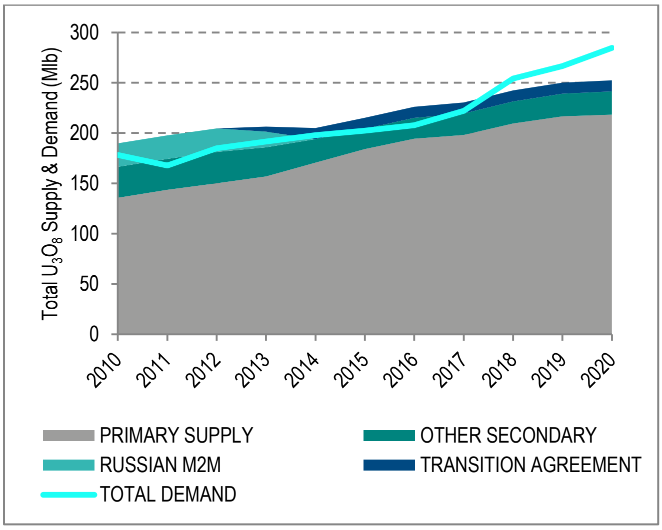
Source: Intierra, company announcements

Market imbalance: secondary supply decline – finally upon us?

Although there is sufficient supply to meet market requirements in the near-term through a combination of mine supply and secondary sources, our estimates suggest that uranium demand may start to outpace supply from 2017 onwards.

A key factor in this outlook is the reduction in secondary uranium supply from mid-2013 onwards. Mine supply presently accounts for ~75% of U_3O_8 supply with the remainder coming from secondary sources such as the reprocessing of weapons grade material as part of the US-Russian M2M agreement or recycling of used fuel rods. However, the M2M programme, which alone met ~13% of total raw uranium demand in 2012, is due to end in the second half of 2013. While the replacement US and Russian transition agreement has commenced, at its peak it will only make up for half of the shortfall from the M2M loss.

Figure 5: Global uranium demand and supply (2010-2020)



Source: The Alchemist

The Alchemist's outlook that a market imbalance could occur from 2017 assumes that Russia's remaining weapons grade feedstock will not reach the market in the near term. The replacement transition agreement utilises Russian spare enrichment capacity and thus reduces capacity to also downblend weapons grade material at the same level as M2M. Russia has its own burgeoning nuclear growth plans to build 54 reactors by 2030 and may use its weapons grade stock to support that pursuit. Alternatively, in order to assist with the spread of its nuclear reactor designs (two reactors were recently sold to Turkey) it may support sales of these external units with guaranteed supply from the former M2M feedstock in the medium term.

The implications of the loss of M2M secondary supply are less severe than they would have been pre-GFC. A flattening or slight decline in energy consumption forecasts for the US and Europe, combined with construction delays and reactor shutdowns following Fukushima has pushed a likely market imbalance out by a couple of years.

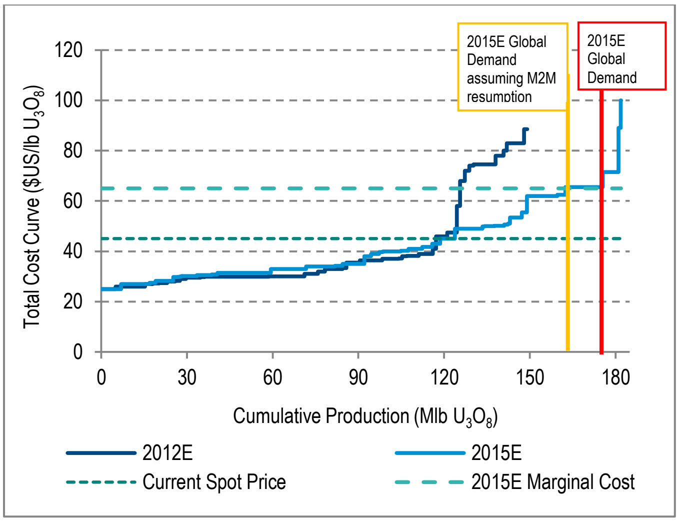
The prospect of the M2M supply falling offline has been flagged by commentators, including *The Alchemist* for some time with little visible response by the market. However, with cessation imminent, the market will be forced to accept that the buffer which secondary supply has provided for the past 3 years will be noticeably tighter. As already outlined, demand is fairly discernible and long-term so surprises to the market balance are more likely to come from the supply side. Furthermore, taking account of the long lead times to bring a development project to production, these surprises are likely to be on the downside. Declining grades and rising costs at existing operations means that their forecast production is relatively flat out to 2020, placing greater importance on the progression of new development projects to production. As seen already, the current uranium price is having an adverse effect on any likely progression by such development projects.

Our outlook is deliberately capped to 2020, as we feel that up to that year we have greater certainty over likely demand from reactor growth numbers. With reactors taking on average between 5-7 years to construct depending on design type, we are able to extrapolate demand levels on the basis of those that are currently in production. Based on the level of approvals and effort to bring a nuclear reactor project into construction, we feel it is fair to assume that once the cement has first been poured it is unlikely that the build will not come to fruition. Supporting our conviction is the successful delivery last month of the Hongyanhe 1 reactor in Liaoning Province, China, which began construction in August 2007.

Whilst *The Alchemist* sees no impediment to China proceeding with its grand reactor fleet construction out to 2050, we note that there are likely to be three changes of government over that period (assuming the ten year change-over precedent is observed), which opens the door to the possibility of a shift in policy. Given that in the period up to 2020 our forecasts suggest that demand will have started to outpace supply, we feel this is a stronger case for uranium than relying solely on 'blue skies' visions out to 2050.

Uranium price rise – with and without M2M

Figure 6: 2015E vs. 2012 total cash cost curve



Source: The Alchemist

The Alchemist's conviction that uranium prices have underlying support at the $65/lb level, whether M2M material reaches the market via another route or not, is supported by the chart above.

Assuming that the transition agreement enrichment capacity would have to be redirected to M2M processing, this would ultimately lead to a net increase in secondary supply of ~10Mlb. As M2M material is likely to take precedence over mined raw U_3O_8 in the market then 2015 uranium demand would simply shift from red to yellow. If the uranium price reflects the marginal cost of bringing a further unit of production to market then in either scenario a $65/lb level is supported. There is an argument that high cost existing operations might have to continue to supply to the market due to long-term contracts irrespective of the cost, however given that overall uranium supply is forecast to increase between now and 2015, unless the incentive price of $65/lb mentioned above is provided for new entrants then there is likely to be a supply shortage.

Enrichment – a potential bottleneck?

As uranium enrichment is a phrase often linked with concerns over the weapons programme of countries such as Iran, it is unsurprising that the technology itself is a closely-guarded secret amongst around nine countries. When enrichment facilities are built in foreign countries a strict black-box policy is adopted and facilities are often monitored or "safeguarded" by the IAEA. In terms of the commercial enrichment market there are four main players, supported heavily by their respective governments – Tenex (Russia), USEC (USA), Eurodif/Areva (France) and Urenco (UK, Germany, Netherlands). The recent sale process for Germany's stake in Urenco highlights the level of political involvement in this sector – with the transaction being as much about price as ensuring the suitability of potential bidders. Urenco is particularly sensitive to this given that A.Q. Khan, the father of Pakistan's Nuclear Bomb, as well as Iran's and North Korea's nuclear programmes, was accused of espionage at one of its facilities in Almelo, Netherlands.

In essence, enrichment capacity – measured in separative work units (SWU) – and raw uranium exhibit a substitution relationship. Back in 2004, Thomas Neff of MIT gave a paper detailing the market inefficiencies created by the fact that much of Western centrifuge capacity was built on the basis of long term contracts at attractive SWU prices. Those utilities with locked-in low SWU prices would seek to enrich their lower tail assays, forcing the rest of the market to compensate for scarcer SWUs by enriching higher tails assays with the overall result that the market used more raw uranium.

Looking to the fundamentals, announcements of reduced enrichment capacity due to shutdowns (e.g. Urenco's Paducah) or postponing expansion (e.g. Areva's Eagle Rock) are more than balanced out by reports of the continued growth of Russian and Central Asian facilities. Given the paradigm shift in energy demand post-GFC, it seems unlikely that SWU capacity will cause an escalation in uranium prices in the manner that some theorists feared. Based on the combination of continued decline of SWU prices, and recently reported existing SWU capacity, *The Alchemist* believes that there is sufficient SWU capacity to meet enrichment demand out till 2016 if not 2020 and thus any escalation in raw uranium price will be due to factors other than a SWU scarcity bottleneck.

Demand – China, Japan and ageing reactors

Much investment commentary focusses on the growth profile of nuclear reactor fleets, notably China's planned expansion from its current 17 reactors (12.8GWe) to ~58GWe by 2020 with 26 reactors already in construction (~29GWe). Beyond 2030, China has its sights on 200GWe rising to 400GWe by 2050. Such a surge in reactor construction when combined with plans in other Asian powerhouses such as India and South Korea would surely be grounds for celebration amongst uranium investors. However, several looming questions hang over the extent to which this proposed growth will materialise. These include questions over actual Chinese appetite for nuclear power, the speed at which Japanese reactors will be brought back online, and the 64,000MW question over the expiry of ageing nuclear reactors currently in operation.

Chinese appetite for nuclear – at home and abroad

To put China's nuclear expansion into perspective, it should be remembered that even if the full fleet expansion programme is enacted and nuclear power generates 200GWe by 2030, this will constitute less than a tenth of China's forecast energy generation capacity. The sheer scale of the forecast energy requirement of the world's second biggest economy lends support to what might otherwise appear too much of a great leap forward. Furthermore, the envisioned build out relies predominantly on two particular reactor designs – CPR-1000 and AP1000 – offering a cookie-cutter like approach. China has experience building the CPR-1000 design with five already in operation, one of which is the recently completed Hongyanhe 1 reactor.

One element that potentially places a limit on the build out programme is the intellectual property rights associated with the reactor designs. The CPR-1000 design is actually a Chinese adaptation of a French 900MWe Generation II+ pressurized water reactor, with some of the IP still retained by Areva. A subsequent ACPR1000+ design has been created by the Chinese to remove the Areva IP restrictions on certain components. The AP1000 is a Westinghouse design capable of net power output of 1,117Mwe; the intention is for the Chinese State Nuclear Power Technology Corp (SNPTC) and Westinghouse to undertake a collaborative effort to create a larger variation on this generation III+ reactor with 1,400-1,700MWe capacity. These reactor designs will not only be used for the domestic build programme but if these Chinese collaborative generation III and III+ designs are successful then the Chinese will attempt to export their designs around the world. The creation of an international Chinese reactor building player would further cement China's dedication to a nuclear future.

China's commitment to pursuing its role as a nuclear leader is also demonstrated by the possibility that it will partner on foreign projects which are currently struggling due to financing. Indeed, there is a clear dichotomy between those countries which are committed to supporting their nuclear reactor build programmes with state funding and those relying on the private sector. As shown by the recent case of EDF's Hinkley Point C project, the latter are struggling to progress primarily due to a lack of private sector funding. It is likely that the government will have to intervene to make Hinkley more attractive to outside investors. This may take the form of guaranteeing preferential pricing per MWh from Hinkley or helping to cover construction risk for the £14bn project via the new UK Government's Guarantee Scheme. The difficulty of attracting outside investors was demonstrated by the withdrawal of Centrica from the project earlier this year. Analysts believe that if EDF were to take the cost of the project itself that it would jeopardise its current credit rating given its current €39.2bn of debt. The naming of China Guangdong Nuclear Power Corp (CGNPC) as a potential new partner in the project is further demonstration that the growth of nuclear power generation internationally will be reliant on support from China.

Japanese U-turns – possible delays

The election of a pro-nuclear government in late 2012 appeared to give hope and an important reprieve to Japan's nuclear industry. The landslide victory of Shinzo Abe's party and his public statements that the previous government's zero-nuclear policy was both "unrealistic and irresponsible" led to a rally by Japanese nuclear-related equities, with the share price of TEPCO, owner of the Fukushima Daiichi plant, soaring 33% on the back of the election.

However, it should be noted that the 48 reactors which are currently offline in Japan are unlikely to be switched back on for some time. Although Abe has pledged to restart reactors, the caveat is that they must first pass tougher guidelines which are being drafted by the new and independent Nuclear Regulation Authority (NRA). Although elements within the Japanese government are calling for greater control of the independent body, it appears unlikely that the Abe government will risk trying to influence or ignore the NRA's stipulations.

Whereas prior to Fukushima such guidelines on reactor safety were voluntary, adherence to the costly proposed refits and additional safety measures will now be compulsory. No restarts will be allowed prior to the new standards formally taking effect in July. Indeed, when TEPCO announced that it hoped to restart reactors at the Kashiwazaki-Kariwa plant in April this year as part of its corporate recovery plan, it was publicly reprimanded by the NRA chief.

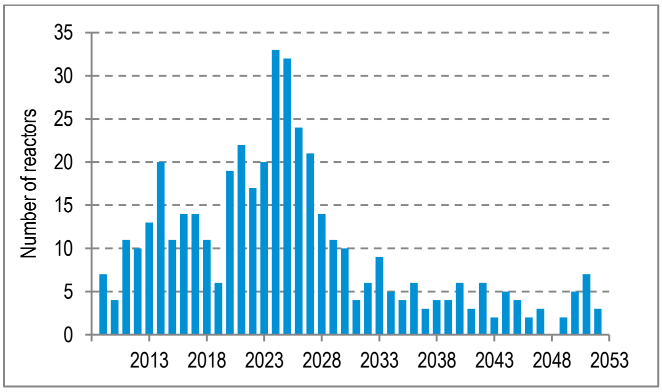
The likely cost of the necessary refits and additional safety measures will be in the billions - Kansai Electric Power has estimated $3.1bn for its 11 reactors. The NRA has insisted, in the face of nuclear power company opposition, that going forward boiling water reactors should have two separate mechanisms to vent pressure. At present, none of the 26 boiling water reactors in Japan have one, let alone two, filtered venting mechanisms. Alternative Pressurized Water Reactors present less of a threat due to their larger containment vessel design and thus may be permitted to restart with a grace period to implement other design improvements. A further concern exists over those reactors which appear to have been constructed on fault lines.

For all of the above reasons *The Alchemist* has assumed that only a fraction of the Japanese fleet is likely to be restarted in 2013 and that resumption of operations close to pre-Fukushima activity is unlikely until at least 2015. Nevertheless, however bleak these NRA-related concerns may appear to make the outlook for Japanese nuclear powered utilities, it should be remembered that cheap electricity is a central pillar of Abe's pro-business agenda. A recent report by the Tokyo-based Institute of Energy Economics claimed that Japan could save more than $20bn a year by restarting just half of their reactors, due to the savings from not having to import as much LNG. Furthermore, delays to restarting reactors although costly are a marked improvement on the previous government's plans to phase out nuclear power altogether.

Ageing reactors – the 64,000MWe question

Given the recent press coverage of the difficulties and costs of shutting down of the UK's nuclear reactors, it seems surprising that relatively little attention is paid to the wave of generation II reactors which are reaching the end of their initial licence periods.

Figure 7: When is the current reactor fleet going to turn 40?

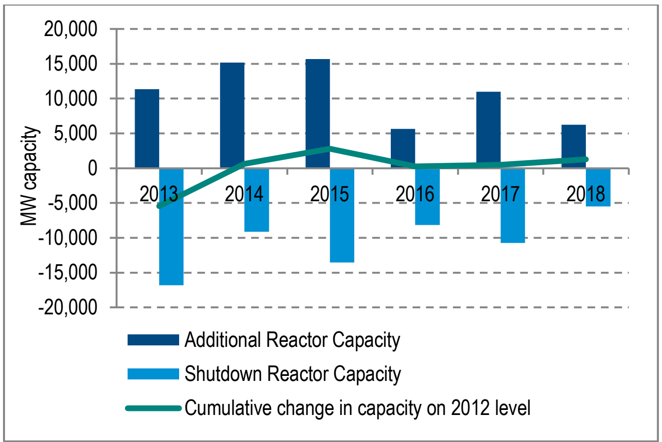


Source: IAEA-PRIS

The average lifespan of reactors that have been shutdown permanently is ~24 years, but that includes first generation reactor models. Perhaps a more useful measure is the lifespan which reactors have been licenced to operate – which stands at 40 years. Whilst several US reactors have been granted a 20 year operating extension, anecdotal evidence suggests that some of these have subsequently withdrawn from the grid. The recent decision by Duke Energy to retire rather than repair its damaged Crystal River reactor may herald further shutdowns, especially given the competitive energy landscape created by the weak natural gas price in the USA.

In such circumstances, it seems prudent to consider the worst case scenario – i.e. what would the effect be if all reactors over 40 years old were forced to shutdown. *The Alchemist* has undertaken this analysis and reveals that those reactors which will reach their 40 year anniversaries over the next six years represent ~64,000MW capacity. This compares with around 65,000MW capacity coming online from the reactors currently in construction. This analysis confirms a statement by a leading energy consultant to the UK government that if the full wave of potential reactor shutdowns were to occur then the reactor construction industry would have to work flat out in order to maintain the current global fleet number.

Figure 8: Worst case scenario – all 40yr+ reactors are taken offline



Source: The Alchemist, IAEA-PRIS

The likelihood of such a widespread reactor fleet shutdown is low due to a number of factors; chief among them being the likely cost of decommissioning and the impact on the US energy infrastructure of such a move. The majority of the reactors that would be shutdown under this scenario are located in the USA. Although weak gas prices make other sources of generation appear costly at the moment, the need to maintain a range of energy generation options as well as supporting their domestic nuclear related industries means that the US is unlikely to turn its back on nuclear. This contention is supported by the recent 20 year extensions that have been granted over the last few years to those reactors reaching the end of their licence periods.

In terms of the impact on uranium, this worst case scenario for reactor capacity does not necessarily translate into flat underlying demand for raw uranium. Newer and more efficient reactors may move towards higher burnup rates, requiring greater fuel enrichment and thus more raw uranium. Furthermore, some reactors may attempt to secure feedstock supply by stockpiling in the initial years. Even in the worst case, therefore, raw uranium demand is unlikely to decline from current levels.

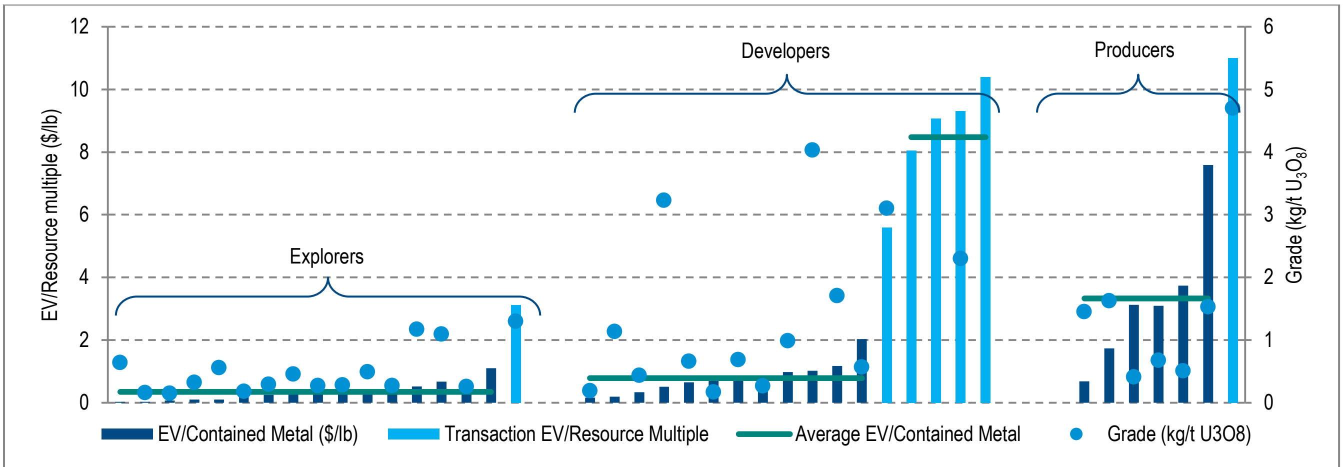
M&A activity: standing on the shoulders of giants

The clear disparity between trading and transaction multiple valuations of development projects (see Figure 9) provides compelling evidence that investment opportunities still exist in the uranium sector. *The Alchemist* is of the view that given the barrier to entry presented by the current low uranium price, those development projects which are viable and able to progress in the short term will likely benefit from valuation uplift as they continue to develop or as macro conditions improve. Such projects are, as seen by recent transactions, becoming acquisition targets for key industry/strategic players looking to secure supply post 2017.

Rather than dampen their enthusiasm, the depressed valuations of projects post-Fukushima has presented leading uranium players with an opportunity to secure good projects. Whether acquiring for cash or for scrip, leading corporates and strategic players, including state owned enterprises such as CGNPC, have been willing to pay significantly higher multiples for the right projects.

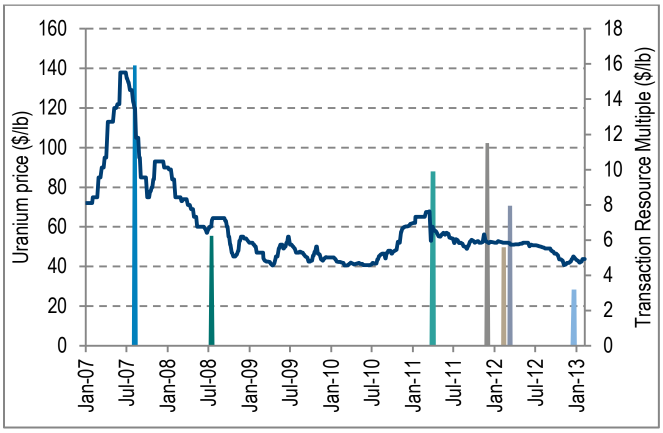
One of the distinguishing features of recently acquired projects has been grade. Those transactions which lack a marker for grade in Figure 9 would require the axis to be rescaled – their grades are literally off the chart, with some being in the 100+ kg/t U_3O_8 range. Several of these projects are located in the Athabasca region in Canada close to other existing operations, for example Fission's Waterbury asset is immediately adjacent to Rio Tinto's recently acquired Roughrider deposit. A further takeaway from Figure 10 is that the average grade of some developers' assets is higher than those in production. *The Alchemist* has compared the grade and

Figure 9: Discrepancy between recent uranium transaction and current trading resource multiples of uranium equities



Source: Intierra, company announcements, Bloomberg

Figure 10: Uranium price performance vs. recent deal multiples

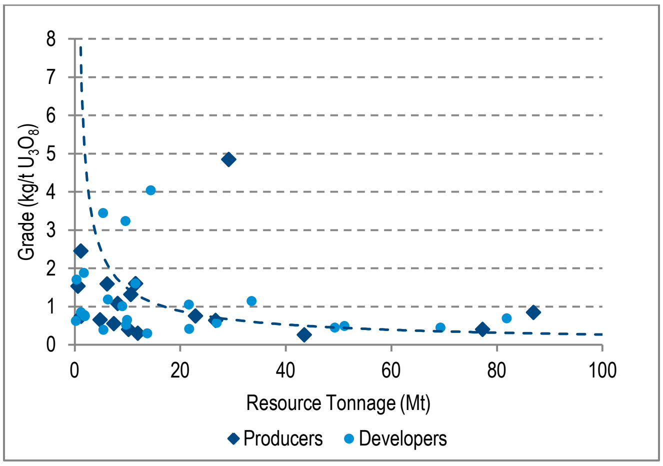


Source: Bloomberg, Intierra, company announcements

resource size of assets currently in production against development projects (see Figure 11 which focuses on assets with grades sub 8 kg/t U_3O_8). Our analysis indicates that there are several development projects that stand out from the pack. These assets do not have the bonanza grades of the Athabasca region but nevertheless are likely to be on the radar of some of the majors, still hungry for acquisitions.

Given the stated goal of Cameco to double its production by 2018 – the 'Double U' programme – it appears that the conviction of leading producers and strategic investors to acquire development projects in the near term is still strong. In terms of gauging the outlook for uranium, investors might gain comfort in the actions of these leading players. As such, some investors may hope to see further ahead than the rest of the market by standing on the shoulders of these uranium giants.

Figure 11: Standing out from the pack: project grades vs. mineral resource

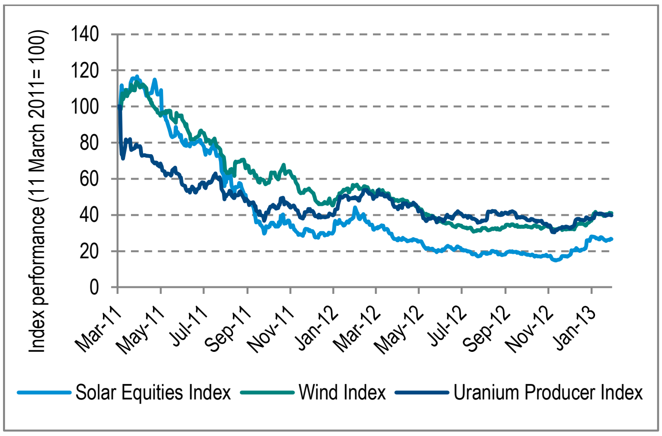


Source: Intierra

Nuclear vs. renewable alternatives

Back in March 2011, when financial markets were forced to make knee-jerk reactions to the events unfolding at the Fukushima Daiichi Plant, some investors turned their backs on nuclear and piled into alternative solar and wind power equities. Despite the continued depressed performance of nuclear-related stocks, it should be noted that if you had chosen to sell out of nuclear and invest in a bundle of solar or wind power producer equities on 11 March 2011 you would now be no better off in wind and worse-off in solar than if you had held faith with uranium.

Figure 12: Post-Fukushima performance of nuclear vs. solar/wind



Source: Bloomberg

While the prospects look good for nuclear reactor build plans in China and the rest of the non-OECD vanguard, concerns remain on European and other countries' capabilities to adopt nuclear due to the immense front-ended capital expense. Whereas the world fears the ability of North Korea to miniaturise a nuclear device, miniaturised nuclear generators are potentially the solution for nuclear to be adopted by a greater number of countries. They also offer the opportunity for nuclear power to be part of what could turn out to be a restructuring of the energy demand and provision industry – with many small generators taking in aggregate some of the strain off national grid systems, leading to a flattening of base load requirements. As with all things in nuclear technology, small nuclear generators have already been proven to work due their use in military and naval contexts. Russia aims to construct its first commercial floating nuclear power plant by 2017. Named the Akademik Lomonsov, this 70MW mobile power plant will be capable of generating enough power for a city of 200,000 people. Far from being merely an academic exercise, this could represent yet further demand for uranium by significantly bringing down the cost of reactor builds.

Will 2013 be the year when market sentiment towards uranium finally reaches an inflection point? Any such improvement would be dependent upon a uranium price improvement. There is a strong case for such as a movement to occur over the next 2 years and given the current depressed uranium price, this presents an opportunity for a contrarian play. In a previous issue, the question was posed "has the party ended for uranium?" All indications suggest that nuclear energy is here to stay and that the outlook to 2020, and indeed 2050, is strong. We remain bullish on uranium in the medium term and *The Alchemist* recommends investors hungry for a good opportunity should save a little space for a slice of yellowcake.

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