The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Uranium supplies are likely to be adequate until 2020

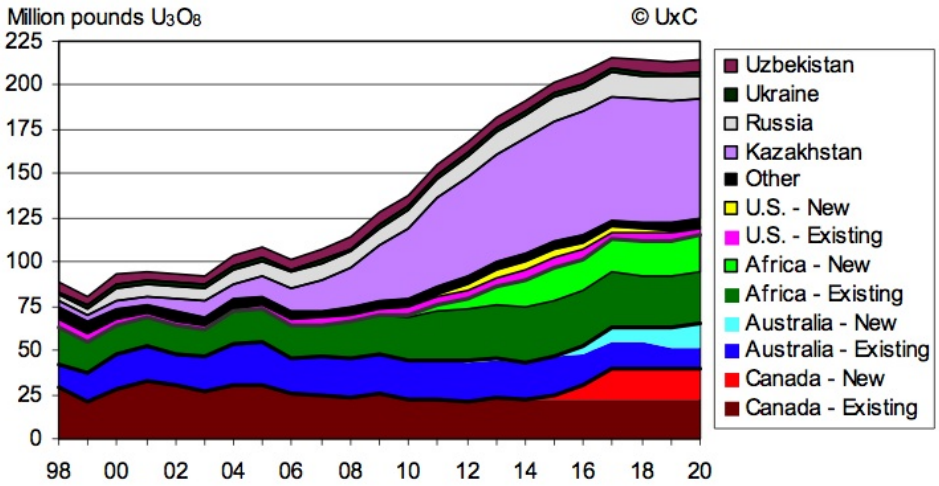
Posted by Engineer-Poet on December 1, 2009 - 10:25am
Topic: Alternative energy
Tags: brian wang, nuclear electricity, uranium [list all tags]

This is a guest post by Brian Wang, known as advancednano on The Oil Drum. He is an MBA and editor of nextbigfuture.com.

Michael Dittmar recently wrote a series of posts about nuclear energy that was published on The Oil Drum. In the first post of the series, he said that uranium "civilian uranium stocks are expected to be exhausted during the next few years" and "the current uranium supply situation is unsustainable".

It seems to me that this view is much too pessimistic, especially if prices rise from current levels. In this post, I will explain why. I will also talk about a bet with Dr. Dittmar regarding future production of nuclear electricity.

In support of my view of growing uranium production, below is a graph shown on the Ux Consulting website regarding future production. Ux Consulting describes itself as "The industry's leading source of consulting, data services, and publications on the uranium, conversion, and enrichments markets."



Forecast of future uranium production by Ux Consulting

Based on this graph, Ux Consulting expects uranium production to grow rapidly between now and 2020, with especially large gains in Kazakhstan, Africa and Canada.

The following is my summary of indications suggesting that uranium production is likely to rise

significantly in the near future. Please note that the Ux Consulting chart uses million pounds U3O8; most of the other numbers are in metric tons of uranium. Historical data is given is a chart at the end of this post, in metric tons. To convert from million pounds of U308 to metric tons of uranium, multiply by 384.6.

Kazakhstan - Already starting to ramp up

Ux Consulting is forecasting that Kazakhstan will increase its production to 40,000 tons a year by 2020--in other words to nearly as much as current world production of uranium.

There is evidence that a rapid ramp up in production in Kazakhstan is already taking place. In 2008, Kazakhstan produced 8521 tons. In the first 9 months of 2009, Kazakhstan produced 9535 tons, which is 61% more than the corresponding period for 2008. Kazakhstan is expected to continue its growth through 2017, before plateauing at 40,000 tons a year (eyeballed from Figure 1).

Canada and Australia - Leading producers historically; Canadian delays now

Canada's production does look to be back up from 2008. Cameco (which produces most of Canada's uranium) production at the end of the third quarter of 2009 was 9.3 million pounds U3O8 compared to 8.5 million pounds over the same period in 2008. We continue to expect our share of production to be 13.1 million pounds in 2009. The first 9 months are up 2700 tons of Uranium. Canada should be up 3000 tons from 2008.

Canada has had some delays because of water flooding problems at the Cigar Lake mine. Also, the Midwest mine in Saskatchewan has been shelved until uranium prices are higher. Currently uranium is at $45/pound.

Another attempt is being made to dewater the Cigar Lake mine:

> The inflow on the 420 metre level that forced suspension of dewatering on August 12, 2008 has been remediated by remotely placing an inflatable seal between the shaft and the source of the inflow and subsequently backfilling and sealing the entire development behind the seal with concrete and grout. The 420 level is not part of future mine plans.
>
> It is currently expected to take six to 12 months to dewater and secure the mine depending on what conditions are found in the shaft and the underground workings.

The Olympic dam mine in Australia is expected to be expanded. A decision will be made by the Australian government by July 2010.

There was an accident at the Olympic dam mine, but production is expected to be fully restored by the third quarter of 2010.

Africa - Major ramp up; exploration is inexpensive

In my analysis in September 2008 of expected future Uranium supplies, I showed two projects with over 1,000 tons or more of production planned for 2009. Both of these new large 2009 projects were in Africa.

One of these planned projects was Namibia's Valencia mine, expected to produce 1,000 tU/year. It is now expected to open in 2010, which is a delay from 2009. One of the issues in this and other delayed projects is the low price of uranium--now $45 ton.

The other large project listed in my September 2008 post for 2009 was the Malawi Kayelekera project. It began exporting uranium in Sept, 2009. It is expected to produce 1,269 tons per year initially. By calendar year 2012, production is expected to increase by 15%, with minimal capital investment, because it can utilize existing excess capacity.

In total (including Kayelekera previously mentioned), Paladin's production from all its African mines is expected to amount to 5.6 Mlb U3O8 (equivalent to 2,153 tons uranium) to 6.1 Mlb U3O8 (equivalent to 2,346 tons uranium) this year. It forecasts African production of 13.8 Mlb U308 (equivalent to 5,307 tons uranium) by mid 2014. This would amount to more than double current production in five years. Planned expenditures for this expansion are US$365 million.

Niger is an area of Africa that appears to be able to ramp up production. It appears to me that Niger is on a path to 10,000 tons per year of uranium production (around 2012-2014), if the price of uranium is high enough. They are finding quality uranium mines in Niger using $5 million per year in exploration spending.

In Niger, Areva is currently building a a big new mine, the Imouraren project, whose production was originally estimated as 5,000 tons. According to Bloomberg, its cost is estimated to be 1.2 billion euros ($1.8 billion), and it is scheduled to come on stream in 2012. The project is already delayed a year because of political turbulence in the country. "We will decide in 2011-2012 whether we should scale it for 2,000 tons or 5,000 tons or even 7,000 tons," Sébastien de Montessus, director of Areva's mining business unit said. The current uranium price (US$ 55 / lb U3O8) wouldn't be enough to make an investment of $500 million to $1.5 billion profitable, De Montessus said. "The market price has to go up to $70 to $80."

According to Extract Resources Limited, the new Rossing resource in Namibia appears to have great potential. An October 7 release reads:

> We believe a total resource of 500 Mlbs (192,300 tons) is achievable from targets already defined. The Company is now well advanced with the Rossing South Feasibility Study on Zones 1 and 2 and the project is shaping up to be one of the world's largest uranium mines, capable of producing 15 Mlbs of U3O8 per year. (5,769 tons uranium per year)

According to a recent article by Mineweb:

> Namibia is mining friendly. Paladin commissioned Langer Heinrich in 2007 on time and on budget, and continues with the process of ramping production to what could amount to 3000 tons of uranium a year, at a cash cost of USD 25/lb, by the second half of 2010. . .
>
> Namibia's more recent potential was startlingly highlighted by the August 2007 purchase by French transnational Areva for USD 2.5bn of Uramin. Trekkopje will be a big mine.

More information on Trekkopje can be found in this infomine article. This 2008 Mineweb article has the following to say about Trekkopje:

> But the uranium project could become the biggest in the country, and No. 10 in the world. Leathley said US$920-million would be pumped into the project to bring it into production. It will also be one of the top five low cost, open pit operations in the world.
>
> The company expects the property, which is located about 70 kilometres east of the coastal town of Swakopmund and quite close of Rössing and Langer Heinrich, to produce about 8.5-million pounds of uranium oxide (3,850 tonnes) a year.

Energy Resources (Rio Tinto Subsidiary) reported uranium production for the first three quarters of the year was 4,100 tons, up 11% from 2008.

Other Mines

Berkeley Resources is developing uranium production in Spain. According to this Mineweb article:

> Berkeley has 26m pounds of 450 parts per million uranium oxide at its Spanish projects; analysts familiar with the company reckon this resource will potentially triple in 2010 as Berkeley moves onto the Toronto Stock Exchange, and into production at around 1000 tons a year by 2012.
>
> Berkeley's Salamanca project would be the restart of an old mine, one shut down in 2000 by Spanish state company ENUSA following sustained low uranium prices. Relative to other projects with a similar deposit base, Salamanca rates as very low cost on capital expenditure, with operating expenditure likely to be around USD 30/lb.

Jordan is another place where uranium production is likely to expand. According to this article:

> High grade uranium was discovered at very shallow depths, at some points no more than five feet, making future mining both cheaper and easier.

Jordan already had a lot of uranium in phosphate deposits. China National Nuclear Corporation General Manager Kang Rixin expects that the first batch of uranium from Jordanian resources will be transported home in 2010; the total quantity probably will be 700 tons. (Caijing Magazine July 5, 2009). It has been expected that the uranium from Jordan phosphate would scale to 2000 tons per year.

In addition, the French giant Areva was expected to start uranium drilling in central Jordan in November to identify the locations of crude uranium, Toukan said in October. Following a feasibility study after exploring, work will begin to usher in a uranium mine with actual production expected to start in 2012 at an annual rate of 2,000 tons, he added.

On uranium in phosphates, he put the deposits at between 100,000 and 140,000 tons.

Wali Kurdi, Chairman and CEO of the Jordan Phosphate Mines Company said earlier in the year that the Jordanian phosphate used in manufacturing phosphoric acid contains about 50 to 100 parts per million (ppm) of uranium that can be extracted via modern technological methods. (Jordan Phosphate Mines Co.)

Russia is also developing new mines, including the Elkon mine and the Gornoe mine. The Elcon mine will have "up to 5,000 tons" per year capacity. Gornoe mine is expected to have 600 tons per year capacity. Construction of Gornoe is slated to begin in 2010.

Predictions, Bets, and Why Even with Mine Delays the Power Plants Will Run All Out

My view of future production, summarized

This is my view of future production and other sources of future uranium supply:

2009 can be expected to have roughly 50,000 tons of production, compared to 43,764 tons in 2008.

2010 should have 56,000+ tons of production. This includes another 3000 tons from Kazakhstan, Valencia in Namibia, and a full year of Malawi production.

World uranium production can be expected to exceed 100,000 tons of uranium per year in a

business as usual mode before 2020. A lot more uranium seems likely to produced than the IAEA/OECD projection for Kazakhstan. The IAEA/OECD forecast for Canada is probably too high until Cigar Lake gets sorted out. It also is likely to depend upon which projects proceed based on uranium prices.

Backstopping regular mining is the large supplies of Highly Enriched Uranium (HEU) and Low Enriched Uranium (LEU) in Russia and the US (75,000 ton surplus at the DOE). Another backstop is the depleted uranium.

Eventually prices will go up and some deferred projects like 2300/t per year Midwest mine in Saskatchwan, Canada and full scale up Imouraren in Niger will occur (smaller scale opening likely).

I also predict that Cigar Lake will be producing 4000 tons per year or more before 2020.

Africa and Kazakhstan will be where most of the new uranium production is added in the years leading to 2020. There will be increases in Canada, Australia, Russia, Jordan and other places as well.

Beyond the highly enriched uranium that Russia is supplying (downblended from decommissioned nuclear bombs or unmade bombs.) The US Department of Energy (DOE) also has 75,000 tons of uranium[1]. Shortfalls in uranium mining from delays can be made up for by nuclear utilities being willing to pay Russia enough or to make arrangements with the DOE. The million tons of depleted uranium can also be enriched to make several tens of thousand tons of fuel. (More about depleted uranium enrichment is detailed in an upcoming article that has been written with Engineer Poet.)

Bet with Dr. Michael Dittmar regarding future uranium production

Michael Dittmar has been getting some notice around the Internet and here at The Oil Drum about a claim that uranium supplies cannot/will not be increased from uranium mines around the world. In Part 1, Dittmar offers a bet:

> For those interested, I am offering a bet that the 2009 and 2010 numbers will not be higher than 45,000 tons and 47,000 tons, respectively.

I am willing to take those bets as stated. I would win and be correct if the 2009 world uranium mining production numbers come out to 45,001 tons or higher and the 2010 production numbers to 47,001 tons or higher. As indicated, I think 2009 and 2010 can be expected to show much higher production even with some delayed projects and the accident at Olympic Dam.

There is another series of bets with Dittmar already in play, based on a discussion between commenter advancednano and Dittmar in comments to Part 4 his series:

Under the terms of the bet, $20 is to be paid via Paypal to the other person, and a note is to be written and published recognizing that the other person was right in his prediction. (Note: Dittmar apparently is not willing to bet money.) Also I think if there is a near shutout (at least 8 out of 10 years), then there needs to be a public statement that the thesis of the losing side was wrong.

Each year: Loser must say: I lost to___ because _____ was more accurate in predicting nuclear power generation. The winner gets to add 200 words on why they were right that gets included with the loser statement.

The shutout or near shutout situation:

Loser must say: I lost X out of Y to ___ because _____ was more accurate in predicting nuclear power generation. The winner gets to add 1,000 words on why they were right and why they shutout or nearly shutout the loser.

	Dittmar	Wang	Midpoint
2009	2575 TWhe	2600 TWhe	2587.5
2010	2550 TWhe	2630	2590
2011	2550	2650	2600
2012	2550	2700	2625
2013	2525	2750	2637.5
2014	2250	2800	2525
2015	2250	2900	2575
2016	2250	3200	2725
2017	2250	3500	2875
2018	2250	3800	3025

The data to be used in determining this bet are the figures of the World Nuclear Association for the year, compared to the midpoint of the range. The amount of production for each year is expected to be published the following year. If the amount of the production is above the midpoint, Brian Wang is right, and advancednano is right and the winner; below the midpoint Dittmar is right and the winner for that year. The figure is the TWH level of generation of commercial nuclear fission or nuclear fusion.

The bet for 2009 will be close. France's production is down due to labor strikes and outages, plus electricity demand is down for the whole world because of the economy. UK's nuclear is up, and India's nuclear is up. Russia's could be down. Germany's could be down. Japan should be up. US should be up a little. China should be up slightly. For either one of us to win or lose 2009 has minimal larger implications relative to the overall trend. We are basically betting on the last quarter. By 2011-2013 we are starting to move out of the random noise. 2014 is the clear divergence where the actual fundamentals will matter a great deal. This is a link to a comment where advancednano summarizes his view of 2009 nuclear electricity production by country.

Endnotes

1) Details from http://www.ne.doe.gov/pdfFiles/inventory_plan_unclassified.pdf

The sales or transfers of the Department's excess uranium inventory identified in this Plan that are currently ongoing and/or planned (items 1 and 2, below) or are under consideration or may be considered by DOE in the future (items 3, 4 and 5, below) to accomplish the Plan objectives include:

1. Down-blend 12.1 metric tons of uranium (MTU) of unallocated highly enriched uranium (HEU) to about 220 MTU of LEU of which about 170 MTU could be used for a general or special-purpose DOE LEU inventory.
2. Make available for sale up to 4,461 MTU of uranium of various enrichment levels that are stored at the Portsmouth, Ohio, Gaseous Diffusion Plant. This uranium is not within commercial specification (off-spec) or in the form of uranium hexafluoride (UF_6).
3. Make available for sale up to 7,700 MTU of natural uranium (NU) (equivalent to 20 million pounds U_3O_8). This NU could be sold to licensed U.S. nuclear reactor operators for use in initial cores for new reactor build projects over a period of several years starting in 2010.
4. Make available as much as 4,647 MTU of NU to be enriched to approximately 500 MTU of LEU (at an enrichment of 4.95% $_{235}U$). This LEU could be included in a DOE LEU inventory.
5. DOE anticipates that it will engage in the sale of high-assay DUF_6 or enter into a contract to re-enrich the DUF_6 to natural uranium or LEU to realize the best value for the Government. DOE anticipates that it will also make available for sale any remaining NU. The sale of this material could reduce storage and security costs

Appendix: Historical Uranium Production

This is a summary of uranium production in metric tons. (Historical figures through 2008 based on data from the World Nuclear Association. Figures for 2009 and 2010 are the author's estimates based on reported production and capacities; most are explained above.)

Country	2010e	2009e	2009 Q1-Q3	2008	2007	2006	2005	2004
Australia	9200	8,527	6,996	8430	8611	7593	9516	8982
Brazil	330	330	248	330	299	190	110	300
Canada	11000	10,800	8,100	9000	9476	9862	11628	11597
China	769	769	577	769	712	750	750	750
Czech Rep	263	263	197	263	306	359	408	412
France	5	5	4	5	4	0	7	7
Germany		0	0	0	41	65	94	77
India	271	271	203	271	270	230	230	230
Jordan								
Kazakhstan	15800	12,713	9,535	8521	6637	5279	4357	3719
Malawi	1200	400	100					
Namibia	5600	4,400	3,275	4366	2879	3077	3147	3038
Niger	3300	3,032	2,274	3032	3135	3434	3093	3282
Pakistan	45	45	34	45	45	45	45	45
Romania	77	77	58	77	77	90	90	90
Russia	4000	3,521	2,641	3521	3413	3400	3431	3200
Ukraine	800	800	600	800	846	800	800	800
USA	1600	1,430	1,073	1430	1654	1692	1039	878

Uzbekistan	2600	2,338	1,754	2338	2320	2270	2300	2016
TOTAL	56,860	49,722	37,666	43198	40725	39136	41045	39423