World Market Situation of Uranium

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Topics

- Production countries / - volumes / terms
- The market situation / prize development (IAEA)
- Assessment by other players in U market
- World nuclear industry status report
- Conclusions
### U Producers/Production Volumes estimated in 2007 (!!)

<table>
<thead>
<tr>
<th>Country</th>
<th>Prod.Cap.(tU) by</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>10 000</td>
<td>2015 more by 2018?</td>
</tr>
<tr>
<td>Canada</td>
<td>10 000</td>
<td>stable ?</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>15 000</td>
<td>2010 18000 by 2012 ?</td>
</tr>
<tr>
<td>Niger</td>
<td>10 000</td>
<td>2012</td>
</tr>
<tr>
<td>Russia</td>
<td>13 000</td>
<td>2015 reduced recently</td>
</tr>
<tr>
<td>USA</td>
<td>12 000</td>
<td>2015 ?</td>
</tr>
<tr>
<td>Namibia</td>
<td>4 000</td>
<td>2009 6000 by 2012 ?</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>2 500</td>
<td>5000 by 2012 ?</td>
</tr>
<tr>
<td>Others</td>
<td>3 500</td>
<td>?</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>&gt; 80 000</strong></td>
<td>2015</td>
</tr>
</tbody>
</table>

Source: IAEA  
Proj. global demand > 85 000 (tU)
Uranium (U3O8) and Enrichment – a relationship (TL Neff, MIT, 2006)
A resource and a process.....substitute factors in the production of nuclear fuel

- Enrichment measured in SWU = separative work unit SWU (= not energy, but expression of efficiency of separation process)
- Nuclear fuel is function of U supply, enriched output and depleted tailings
- In most production processes, change in price of one factor leads to change in price of its substitute: If both U and SWU scarce: price of both will rise.. .(Neff, 2006)
U Market today and challenges for the future
J. Slezak U resource specialist IAEA 10/09

- U market often been described as „unstable, not transparent, volatile, unpredictable“
- U production initially for purely military purposes
- Since mid 60‘s also influenced by Nuclear industry
- Since 90‘s world production of U behind global demand = Direct reason for interest of many countries to start U mining
Changes in Projection of U Production ...
U Participation Corporation (UPC): recommendations (2008) ...

- Enough resources available, but this does not necessarily mean enough production
- Production climbing slowly but still lagging behind demand. Increase needed to meet (proj.) demand
- Unknown volume of secondary sources
- Strong and stable market conditions necessary to encourage necessary investment

**Conclusion:** due to low public acceptance and volatile market still unpredictable situation, but „hope“ for future higher U market stability, otherwise ... ??
World Nuclear Association - Update on U market prize levels 2013

Production from world U mines now supplies about 85% of the requirements of power utilities.

Primary production from mines supplemented by secondary supplies, principally from used military material (nukes) & other inventories.

World mine production is now expanding significantly!
Recent opinions...

- **Uranium stocks tumble after RBC takes axe to price forecasts** (Peter Koven June 5, 2014)
- Message of U miners to investors over past couple of years: Short-term outlook bad, but no worry, a lot more uranium is going to be needed down the road.
- RBC Capital Markets Analysts agree. Only they think it will be a much longer road than most: Analyst Fraser Phillips et al. sent shudders through the industry as they cut their uranium price forecasts: they cut 2014 spot price forecast to US $31.50/lb down from US$45. And then the 2015 target was cut to US$40 (from US$60), and targets for the 2016 to 2018 period fell to just US$40-US$45 from US$75-US$80.
World Nuclear Association - Update on U market 2013: Production costs

Uranium Mine Production Cost Curve 2010

Nominal US$/lb of U₃O₈

Cumulative Production (1000 tonnes U₃O₈)
Production & Demand: Scenarios?

Reference Case Supply, tU
World Nuclear Assctn: explanations...

- Mineral commodity markets = cyclical. Quoted “spot prices“ usually represent less than 20% of supply. Most trade is via long term contracts with producers selling directly to utilities.
- Reasons for fluctuation in mineral prices relate to demand and perceptions of scarcity. U price cannot indefinitely be below the cost of production, nor will it remain at very high levels for longer than it takes for new producers to enter market and anxiety about supply to subside.
- Conclusion: logically new producers (e.g. Tanzania, Mali) will need to compete with established ones and very likely will meet low price levels...
THE management of Rio Tinto's Roessing mine was considering placing the uranium mine on care and maintenance like Areva's Trekkopje as a way of arresting the perilous financial situation the company is facing.

“The situation is bad,” a source said and that „Rio Tinto, the Australia-based majority owner of the mine, has also been considering selling the mine“.

http://allafrica.com/stories/201305300555.html by C KAIRA, 30.5.13
What are U customers doing?

Nuclear weapons producers: dismantle old nukes (although not as quickly as we like...) and use HEU from weapons to produce low enriched reactor fuel, supply approx 15% of demand only

Nuclear power plant operators: inspite of NE growth in China, Russia, S-Korea, global park of NPP shrinking ...

What does the nuclear industry status report 2013 say ??
Key results:

- 10% of global electric energy demand are met NP (down from 17% 1993). Share of global commercial energy prod 4.5%
- 66 reactors under construction in 14 countries (average construction time is 8 years) but
- 9 reactors listed „under construction for > 20 yrs
- 45 projects without official start-up date on IAEA database
- 23 reactors have multiyear construction delays. The other 43 reactors have not yet reached projected start-up dates. 44 of the units in China, India and Russia
World Nuclear Industry Status Report in 2013... (II)

3 reactors started up in 2012, 6 were shut down. In 2013 1 unit started, but 4 shutdown decisions all in US. 2 US units receive 8 billion federal loan guarantees and subsidies for construction costs. Special laws transfer financial risks to public and customers.

Japan: 2/54 reactors back to grid since 6/2012. July: Final number to be higher but unlikely original 54 units.

Certification delays: EPR will receive certification in 2015.

Construction costs rapidly rising. Adjusted for inflation, new EPR cost estimates increased by factor of 4 over the past ten years.
World Nuclear Industry Status Report 2013...(III) Financial issues

- 2/3 of nuclear companies and utilities downgraded by Standard and Poor’s in past 5 years. Nuclear investments considered „risky“ ....

- Shares of world’s largest nuclear operator, French state utility EDF, lost 85% of their value. Shares of world’s largest nuclear corp, AREVA, fell by 88%

- Capital costs: Cost estimates have increased in the past decade from $1,000 to $7,000 per kW installed.

- Operating costs have escalated so rapidly that average reactor’s operating costs is barely below the normal band of wholesale power prices.

- Fukushima: addtl. costs due to upgrading and backfitting: substantial impact in future!
Nuclear sending shock waves through Wall Street

By Barbara Vergetis Lundin, Fierce Energy, August 7, 2013

Duke Energy has announced that it will retire its Levy nuclear reactor project in Florida. This is the second such announcement in just a few weeks....
OAK HARBOR, Ohio — Davis-Besse is identified in a new economic report as one of a dozen U.S. nuclear reactors most likely to be closed by their utilities before their licenses expire because of changing energy markets, including falling natural gas prices, rising costs of nuclear operations, repairs, and post-Fukushima retrofits (7/22/2013).

"The Duke decision to pull the plug on Levy follows by just one day the announcement that the French-subsidized nuclear giant EDF is pulling out of the U.S. nuclear power market due to the inability of nuclear power to compete with alternatives and the dramatic reduction in demand growth caused by increasing efficiency of electricity consuming devices,"
World Nuclear Industry Status Report 2013...(IV) The alternatives

- In contrast, renewable energy shows rapid growth figures. China, Germany, Japan generate more power from renewables than from nuclear.

- Global investment in renewable energy totaled US$268 billion in 2012, 5 x 2004 amount. In same period, total cumulative investment in renewables is over US$1 trillion. Compares to nuclear power investment of about $120 billion.

- Global nuclear capacity decreased again in 2011, while the annual installed wind power capacity produced 500TWh and Solar 100 TWh more than in 2000 alone. While nuclear produced 100 TWh less in same time period. In China Solar electricity generation grew by 400%.
World Nuclear Industry Status Report in 2011...(V)

Quotes by 2 co-authors:

✱ „Portrait of an industry suffering from the cumulative impacts of the world economic crisis, effects of Fukushima, ferocious competition and its own planning and management difficulties“ (M. Schneider)

✱ „The market for nuclear is shrinking year by year, while renewable energy deployment continues at pace and in an ever increasing number of countries. With nuclear power becoming more expensive than a widening range of renewable energy technologies, this trend will only continue” (A. Froggatt)
Nuclear Renaissance anywhere ... ??

Invest in Nuclear Power plants ...??

Invest in new Uranium Mines ....??
World Nuclear Association: explanations...(1)

- Mineral commodity markets = cyclical, ie. prices rise and fall substantially over the year.
- These fluctuations superimposed on long-term trend decline in real prices, due to technological progress.
- In the U market high prices in the late 1970s gave way to depressed prices in the whole of the period of the 1980s and 1990s, with spot prices below the cost of production except for lowest cost mines. In 1996 spot prices briefly recovered but they then declined again and only started to recovery in late in 2003.
Uranium and Enrichment: relationship also reflected in prize levels...

- In most production processes, change in price of one factor leads to change in price of its substitute.

- This was not true for U or enrichment – oversupply allowed prices to be set independently. Oversupply has ended and prices for U and enrichment will be strongly coupled, and predicted to be significantly higher, because...
Literature on low level radiation:

   http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2009418/

   http://bjr.birjournals.org/cgi/reprint/70/830/130.pdf


5.b. Kaatsch P, Spix C, Schulze-Rath R, Schmiedel S, Blettner M; Leukaemia in young children living in the vicinity of German nuclear power plants
   Int J Cancer. 2008 Feb 15; 122(4): 721-6


   www.strahlentelex.de/Stx_11_590_S14-16.pdf
Literature on low level radiation:


13. Edwards G: continued blog on nuclear power <ccnr@web.ca>, (GE mathematician and nuclear expert in Montreal Canada, recipient Nuclear free future award  2011)

World Nuclear Industry Status Report in 2011 (7/2012) ...(I)

Key results:
- 3% of global electric energy demand are met NP
- Only 7 new reactors started, while 19 were shut down
- Japan: 2/54 reactors back to grid in July: future NE in Japan?
- 4 countries will phase out nuclear power
- 5 countries will not engage / re-engage in nuclear programs
- Of 59 units under construction, >18 are experiencing multiyear delays. 41 projects started within past 5 years/ have not yet reached projected start-up dates.
- Construction costs rapidly rising. Adjusted for inflation new EPR cost estimates have increased by factor of 4 over the past ten years.
- 2/3 of nuclear companies and utilities downgraded by Standard and Poor’s in past 5 years
Topics to be discussed

- The nuclear chain
- The U mine: from prospecting to production
- The market situation / prize development (IAEA)
- Production countries / volumes
- World nuclear industry status report
Looking at demand for U:
- Nuclear weapons and
- Nuclear Power plants ...

uclear weapons ... Inspite of resistance by nuclear powers, relentless strong global efforts towards nuclear abolition (ICAN)!

Nuclear power: so called nuclear renaissance (?)

Facts: recent World nuclear Industry Status Report (July/12) by M.Schneider):

Portrait of an industry suffering from the cumulative impacts of the world economic crisis, Fukushima, ferocious competitors and its own planning and management difficulties
Looking at status of Nuclear Power industry...

Key results:

- 3% of global electric energy demand are met by nuclear power.
- Only seven new reactors started up, while 19 were shut down in 2011.
- Japan: In July 2012 two reactors from 54 were brought back to grid. However, it remains highly uncertain how many others will receive permission to restart operations in Japan.
- Four countries announced that they will phase out nuclear power within a given timeframe.
- At least five countries have decided not to engage or re-engage in nuclear programs.
World Nuclear Industry Status Report in 2011... (II)

Key results:

- Shares of world’s largest nuclear operator, French state utility EDF, lost 82% of their value. Shares of world’s largest nuclear builder, French AREVA, fell by 88%.
- In contrast, renewable energy shows rapid growth figures.
- Global investment in renewable energy totaled US$260 billion in 2011, 5x 2004 amount. In same period, total cumulative investment in renewables is over US$1 trillion. Compares to nuclear power invstmnt of about $120 billion.
- Global nuclear capacity decreased again in 2011, while the annual installed wind power capacity increased by 41 GW in 2011 alone. Installed wind power and solar capacity in China grew by a factor of around 50 in the past five years, while nuclear capacity increased by a factor of 1.5.
Looking at status of Nuclear Power industry...

Key results:

🌱 Of the 59 units under construction in the world, at least 18 are experiencing multi-year delays, while the remaining 41 projects were started within the past five years or have not yet reached projected start-up dates.

🌱 Construction costs are rapidly rising. European EPR cost estimate has increased by a factor of four (adjusted for inflation) over the past ten years.

🌱 2/3 of nuclear companies and utilities were downgraded Standard and Poor’s in past 5 years.
Looking at status of Nuclear Power industry...

Key results:

- The shares of the world’s largest nuclear operator, French state utility EDF, lost 82 percent of their value, that of the world’s largest nuclear builder, French state company AREVA, fell by 88 percent.

- In contrast, renewable energy rapid growth figures.

- Global investment in renewable energy totaled US$260 billion in 2011, 5x 2004 amount. Over the same period, the total cumulative investment in renewables has risen to over US$1 trillion, which compares to nuclear power investment decisions of about $120 billion.
Looking at status of Nuclear Power industry...

Key results:

Installed worldwide nuclear capacity decreased again in 2011, while the annual installed wind power capacity increased by 41 GW in 2011 alone. Installed wind power and solar capacity in China grew by a factor of around 50 in the past five years, while nuclear capacity increased by a factor of 1.5
Looking at status of Nuclear Power/ U industry...

Key results:

- The market for nuclear is shrinking year by year, while renewable energy deployment continues at pace and in an ever increasing number of countries. With nuclear power becoming more expensive than a widening range of renewable energy technologies, this trend will only continue” (A. Froggatt)

- Mid- and longterm influence on U Prodctn?
U as Resource

**RESOURCE: U** = non-renewable! mined in many countries (India, China, Australia, Canada, Mongolia, Niger etc.)

U used yearly by the 440 NPPs. Stocks for approx. 80 years, IF same number of power plants!

High prize of U makes mining profitable, but

Decreasing demand = lower world marked prize (Japan?)

Alternative resources:

**Thorium**: industry „fuel of the future“! Thorium-produced uranium-233 can be used without reprocessing. Thorium reactors = rel. inefficient "breeders": pose serious financial disincentives to developers. Russia, China, India interstd.

**Nuclear weapons derived U**: by blending highly enriched uranium (HEU) from warheads to produce low enriched reactor fuel and reprocessing of spent fuel, will also grow in importance as a fuel source.
Uranium and Enrichment: complex relationship ...

- Low U prices and high tails assay have led to lack of enrichment capacity to substitute for U
- Given a U price, enrichers can raise price to point that utilities seek to substitute more U for SWU (by raising tails assay) and
- Given a SWU price, U suppliers can raise price to point that utilities seek to substitute more SWU for U
UPC assessment of development limitations.

- Market still not transparent and very volatile
- Public acceptance ?
- Regulatory requirements ?
- Government initiatives ?
- Market turmoil still present

- All in all: unpredictable situation, but „hope“ for future higher U market stability, otherwise ... ??