

Re: Uranium availability

Source: <http://sci.tech-archive.net/Archive/sci.energy/2007-05/msg00147.html>

- *From:* bill <ford_prefect42@xxxxxxxxxxx>
 - *Date:* 30 May 2007 12:19:15 -0700
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On May 30, 2:39 pm, T. Keating <tkuse...@xxxxxxxxxxx> wrote:

On 30 May 2007 08:22:12 -0700, bill <ford_prefec...@xxxxxxxxxxx> wrote:

On May 29, 8:18 pm, Maximust <maxi_m...@xxxxxxxxxxx> wrote:

dave.walt...@xxxxxxxxxxx wrote:

From the always good and
informative "Nuclear is Our
Future" blog at:

<http://blog.niof.org/>

More Russian Uranium Deposits

Worldwide, we "use" about 67,000 tons of uranium per year, 670 tons of which is actually used (the rest is stored). Nuclear power provides 20% of world electricity, and could provide 100%, requiring 3,350 tons per year. The US, being 5% of the world's population, uses 25% of world energy; giving everyone American per-capita access to energy using nuclear power would require another five-fold increase in uranium consumption, assuming that the

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proportion of electricity out of total energy is the same worldwide—totaling 16,750 tons of uranium per year.

These eight Russian deposits contain 320,000 tons of uranium.

The math is not difficult: if their contents were used sensibly, these eight new mines could provide all the uranium needed to fuel all the nuclear power plants needed to provide American-style quantities of electricity to everyone in the world for almost twenty years.

Be reminded that this is 6% of worldwide uranium reserves. That's enough to last almost 320 years. However, there are two other major sources of uranium: coal ash and seawater. Uranium is present in coal ash at an average level of 4.5 parts per million. In the US—and this is just in the US—118 million tons of new coal ash are available every year. That comes out to 531 tons—about 80% of the world's current uranium requirement. Seawater is the big one, though. Uranium is present in seawater at an average level of 3.3 parts per billion. The oceans have about 1,500,000,000,000,000 tons of water and thus about 4,950,000,000 tons of uranium, with 35,000 tons added per year by runoff from rivers. Quite simply, as long as we use less than 35,000 tons of uranium per year, uranium from seawater is being made available faster than it is being consumed. Technically, it is a renewable resource.

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Technically, yes. Practically, no. It takes way too much energy to extract uranium from coal dust and/or seawater for them to be a valid source. Beware of wishful thinking at a time when global crude production has peaked, as it did in May, 2005.

In a different thread, it is estimated that uranium extraction should be possible from sea water and coal ash at roughly \$200/kg. assuming that number is off by a full order of magnitude, and it will really cost \$2000/kg, that still only represents $3\,500\,000 \text{ kWh/kg} / \$2000/\text{kg} = \$0.0005/\text{kWh}$ in fuel costs assuming reprocessing.

You're off by a factor of 118x.

Maximum current yield is ~35,000 kWh per kg..

Assumptions.

1GWe/3GWt reactor.

220,000 kg of U consumed per annual refueling cycle. (includes enrichment consumption.)

90% duty factor.

95% actual production factor.

\$2000 per Kg of U.

Math

$1\text{GWe} * \text{prod} - f(.95) * \text{duty cycle} (.90) / 1000 \text{ /hr} = 855,000\text{kWh/hr}$

Est annual production $855,000\text{kWh} * 365 * 24 = 7.49 \text{ GWh/yr.}$

$7.49\text{GWh/yr} / \sim 220,000 \text{ kg of raw U consumed} == 34,045 \text{ kWh/kg.}$

This number does not include any personal, capital, interest, shifted liability, construction, maintenance, enrichment, regulatory, manufacturing, reprocessing, transportation, storage, or waste disposal costs nor their respective energy inputs ! The above number also fails to subtract out the mining and refining energy inputs which increases rapidly as U ore concentration drops.

(Raw U fuel costs per kWh)

$\$2000 \text{ kgU} / 34045 \text{ kWh} == \0.059 per kWh.

Notes:

Estimated price of metallic U is around \$324 per Kg, Yellow cake U3O8 spot price is ~\$275 per Kg and climbing rapidly.

There is no rational basis to think that climbing U prices will peak out at \$2000 per kg. The market will charge whatever the reactor

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operators can pay.

Again, in my above calculation, I stated the *assuming reprocessing*. at anything above \$720/kg, reprocessing is economically feasible, and therefore MAY be factored in to these calculations when determining the energy produced by the extraction of 1 kg of natural uranium.

sources:

<http://www.nea.fr/html/ndd/reports/efc/efca09.pdf> \$720 (in 1990 dollars) cost of reprocessing)

sources vary on this.

<http://www.aec.go.jp/jicst/NC/tyoki/chokei2004/chokei15/siryo1.pdf> has the cost/kg for reprocessed fuel at somewhere between \$500 and \$2000.

Now, that DOES mean that my number wasn't right. I neglected the reprocessing cost. However, it could be stated that at \$2000, the first runthrough is at .05/kwh, the second runthrough is at \$720/kg + .10% at \$2000, so call it \$750/kg for the second runthrough. which will give you an averaged lifecycle fuel cost of approximately .02/kwh.

Now, there is reason to believe that there will be a peak uranium price, there are dozens to hundreds of potential suppliers, so competition will keep the prices down to approximately production costs by the most economic measure attainable. unless you think that the russian producers will collude with the canadians, americans, japanese, and chinese to keep prices high? we've already seen estimates of extraction costs that range as low as \$200/kg from ubiquitous sources like coal and sea water, I don't believe them, but they only have to be within an order of magnitude to prevent an opec type situation.

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