

# International Symposium on Uranium Raw Material for the Nuclear Fuel Cycle: Exploration, Mining, Production, Supply and Demand, Economics and Environmental Issues (URAM-2018)



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## Sustainable Development of uranium production: Status, prospects, challenges

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Recent WNA [1] and UxC [2] reports demonstrate similar approaches for uranium supply demand forecasts until 2035 in the reference case scenario. Both reports show uranium oversupply at least until 2023. About 10% of global requirements will be provided during this period from secondary sources. The share of the secondary sources will gradually decrease in time. Primary uranium has no alternatives in a long term perspective. According to the WNA report, uranium production is expected to increase in about 40% by 2035. Primary uranium production from existing mines will decrease by 30% in 2035 due to resources depletion and mines closure, while new planned mines will only compensate exhausted mines capacities. Both reports show, that during 2023-2026 uranium demand may exceed supply and new prospective mines from so-called supply pipeline, which development is not yet confirmed by companies plans, must start production during the next 10 years to fill the gap and ramp up to 30 ktU/y by 2035. Are uranium resources and mining capacities sufficient to meet future long-term NPP requirements?

Despite depressed market, uranium production continued to grow steadily during the last decade and reached 62 ktU in 2016, which was a historical maximum since 1983. However, in 2017 it dropped back to 59 ktU. Kazakhstan provided the major historical input, increased uranium production six times during the last decade and keeps the world leadership since 2009. Its share comprised 40% of the world total in 2017, followed by Canada with 22% share. Kazatomprom keeps leadership in companies ranking with 21% share, followed by Orano, Cameco (both 16%) and Rosatom (Uranium One + ARMZ) with 14% share.

In Situ Leach is the main uranium mining method. Its share in the world total production has increased from 20% in 2005 to 50% in 2016 and 2017. Kazakhstan contributed 40%, while five other ISL producing countries (Uzbekistan, Russia, USA, Australia, China) - 10% of the world total. ISL mining capacities will start to decline after 2028 and production from low cost ISL mines will sharply decline starting from 2022 due to resources depletion, while higher cost ISL production may partly replace it and only until 2028 [3]. Thus, uranium companies may face economic and technical challenges in new ISR projects development due to higher costs and resources availability.

Statistics in ranking operating mines by costs and mining capacities show that 95% of mines with full cost below current spot price are located in Kazakhstan [3]. While keeping only 27% of total existing production capacities, they produce 40% of world total. All six Uranium One mines in Kazakhstan are in top 20 of low cost mines and five of them are in top 5. Today is the era of Kazakhstan, however in the new mines supply pipeline there are only seven small new ISL mines, and only one of them in Kazakhstan.

Only 40% of 43 currently operating mines produce U at a cost below spot market price. That means than only companies with low cost production or favorable long term contracts may survive in current challenging uranium market. Low uranium prices do not boost production and force companies to stop, revise or defer their exploration and development projects. In addition to low U prices, companies face technical constraints, political, social and environmental factors. These risks hamper development of several world class uranium projects in Canada, Australia, Africa, Russia and other countries. Kazakhstan has recently announces about 20% below contracts 2018 production, Cameco announced on McArthur stop in 2018. It may result in uranium production further drop in 2018 by at least 10%. However, the companies do not refuse from new mining projects, but focus more on their optimization and effective technologies development.

Reliable and low cost uranium resources is a key factor for sustainable long-term production development. Global uranium resources are more than sufficient to ensure the long-term needs of nuclear industry. At the same time, the great share of resources belong to high cost categories and after 2020 uranium producers may face the shortage of low cost resources [4]. During the last decade the total global known uranium resources increased by 21%, however resources in low cost category <80\$/kgU decreased by 48%.

Kazakhstan nowadays is a world leader, but it may also face all above-mentioned challenges in future. Kazakhstan U resources amounted to about 1 MtU in 2015 [4], 70% of which are in low cost sandstone type, amenable for ISL. Remaining resources belong to lignite, vein and phosphate types. However, 95% of ISL amenable resources belong to operating and under construction mines. Kazakhstan plans to maintain current uranium mining capacities at a level of 65Mlbs until 2020, however actual uranium production during this period may be below capacities from 10 to 20% due to unfavorable uranium market. After 2020, Kazakhstan may face uranium production gradual decrease by 40% in 2030 and by 70% in 2035 due to resources mining depletion and old mines closure. In order to extend existing mining capacities for a long-term period, new uranium mines must start operation during the next five years, but potential for stand by uranium deposits development is limited.

The history of uranium discoveries in Kazakhstan shows that almost all deposits in Kazakhstan for ISL mining with initial huge resource base (1,238 MtU) were identified between 1970 and 1990. Uranium exploration during the last decade was focused more on prognosticated resources conversion into measured and indicated categories. The exploration potential to discover new large uranium deposits amenable for ISR mining within the largest uranium provinces in Kazakhstan is far from being exhausted. Favorable transparent legislation must facilitate investments in uranium exploration, when the investor has a State guarantee to mine discovered resources and possess produced uranium under strict compliance with established national standards and regulations.

#### REFERENCES

- [1] The Nuclear Fuel Report. World Nuclear Association, September 2017.
- [2] Uranium Market Outlook. Ux Consulting, Q1 2018 Report.
- [3] Uranium Production Cost Study. Ux Consulting, August 2017 Report.
- [4] OECD NUCLEAR ATOMIC ENERGY AGENCY, INTERNATIONAL ATOMIC ENERGY AGENCY, Uranium 2016: Resources, Production and Demand, A Joint Report by the OECD Nuclear Energy Agency and the IAEA (2016)

## Country or International Organization

Russian Federation

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