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Russian and Kazakhstani Nuclear Energy: Trends in Economic Cooperation

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Abbreviations

ARMZ – Atomredmetzoloto

CIS – Commonwealth of Independent States

EC «RGC» – «Engineering Center «Russian gas centrifuge»

FSUE «CDBMB» – «Central Design Bureau of Machine Building»

IAEA – International Atomic Energy Agency

JSC «Afrikantov OKBM»– Joint Stock Company «Afrikantov Experimental Design Bureau for Mechanical Engineering»

JSC «SPAEP» – Joint Stock Company «Saint Petersburg Research and Design Institute» ATOMENERGOPROEKT

NN AEP – Nizhniy Novgorod Engineering Company Atomenergoproekt

NPP – nuclear power plant

«OK RSK» JSC – «United Company» JSC separation sublimated complex

PRIS – Power Reactor Information System

RM/REM – rare metals/rare earth metals

SNF – spent nuclear fuel

SWU – separative work unit

Key conclusions

- **The growing electricity consumption** and volatile fossil fuel prices have prompted many countries to search for new energy sources. Nuclear energy promises to become one of the most sustainable and economic solution. The International Atomic Energy Agency (IAEA) forecasts the global demand for energy to rise by 66% from the 2008 level by 2030.
- **The integration of the nuclear energy sectors of Kazakhstan and Russia is warranted by economic and political reasons,** particularly, the complementarity of production assets and technology at different steps of the nuclear fuel cycle that were inherited from the Soviet period. Integration began in 1998. However, not all integration initiatives were conclusive.
- **Common nuclear agency: in 2010 new steps towards the economic integration of nuclear energy of Russia and Kazakhstan were taken.** Rosatom and Kazatomprom signed two documents, a memorandum on integration and cooperation in peaceful use of nuclear energy and a joint statement on the uranium enrichment centre project. Thus the companies declared prospects for deeper integration by recreating the former Soviet nuclear agency in a new format. This structure may well become the largest player on the global uranium market.
- The world's leading users of nuclear energy – France, Canada, the US, Japan and Russia show **great interest in Kazakhstani uranium.** In recent years, new players (including China, India, South Korea and Belgium) have also started to compete for Kazakh uranium supplies. In 2009 Kazakhstan produced 13,900 tonnes of uranium, outperforming the traditional leaders, Canada and Australia, and providing over one quarter of the world's uranium output. In 2009 alone, total uranium production in Kazakhstan increased by 63%. Notably, Kazatomprom produced one third of this volume; the rest was mined by joint ventures.
- **Kazakhstan's State Programme for Industrial Development in 2010–2014** provided for the creation of a vertically integrated complex capable of running a full nuclear fuel cycle. Work is under way to recreate the missing nuclear fuel cycle steps – uranium conversion and enrichment and the production of fuel assemblies. To date, Kazatomprom engages only in uranium mining and fabrication of uranium dioxide powder and pellets.
- **Rosatom is becoming increasingly active on the Kazakh uranium market.** In 2009 Atomredmetzoloto (ARMZ) of Russia and Uranium One of Canada declared a strategic alliance. This agreement elevated Atomredmetzoloto to a position next to the largest foreign player in Kazakhstan, Cameco. At the same time Rosatom is becoming a leader in terms of the number of joint projects with Kazatomprom and total uranium production.
- **Russia is building nuclear power plants (NPPs) throughout the world.** Rosatom has plans to build new NPPs in Belarus, Armenia and Ukraine. To date, Russia has large full-service nuclear energy contracts with India, Bangladesh, China, Vietnam, Iran, Turkey and some Eastern European countries.
- **The population of CIS countries is cautious about peaceful uses of nuclear energy.** Nuclear energy proponents account for a quarter to a third of the population; opponents – for a half to two thirds.

Introduction

Nuclear energy presently enjoys a renaissance and plays an increasingly prominent role in the world economy. Notably, developing countries that do not possess the necessary technology are the main driving force behind this revival of interest. States that possess immense fossil fuel resources, such as the United Arab Emirates and Saudi Arabia, are also showing significant interest in nuclear energy.

Nuclear energy is three times cheaper than wind energy and five times cheaper than solar energy. The operation of an NPP is more environmentally friendly than other power stations as there are almost no greenhouse gas emissions. In this respect, the full nuclear energy cycle, including uranium mining, nuclear fuel transportation, construction of reactors and disposal of wastes, is comparable to electricity generation from the renewable sources. If all the world's 440 reactors were replaced by thermal power plants, generation of the same quantity of electricity would lead to an annual increase in carbon emission of 3.2 billion tonnes (Deripaska, 2009).

Swift fluctuations in fossil fuel prices and the rapid depletion of oil, gas and coal deposits prompt the main producers of these resources (including Russia and Kazakhstan) to search for new sources of income. Under such conditions, the uranium industry has the opportunity to become the mainstay of these economies. Moreover, the strong political and economic ties between Russia and Kazakhstan could help them in their quest for leading positions in the global nuclear market. In the near future, cooperation with Russia could enable Kazakhstan to emerge not only as an international supplier of raw materials but also as a nation that has mastered the full nuclear fuel cycle. Russia, in turn, will benefit equally greatly from access to cheap Kazakh uranium.

The purpose of this review is to follow up on the EDB's 2008 study of integration processes in the nuclear energy sector of Russia and Kazakhstan (Vinokurov, 2008). Particularly, we will focus on the two countries' initiatives in peaceful uses of nuclear energy, and evaluate the progress of the integration projects mentioned in the previous paper.

We also provide an overview of the world nuclear market and Kazakhstan's uranium industry, elaborating on the roles of the Kazakh national nuclear company Kazatomprom and Russian State atomic energy corporation Rosatom, as main representatives of the countries on the international nuclear market. Finally, we give an overview of the current status and prospects of the nuclear energy sector in Russia and analyse some Russian–Kazakh bilateral and multilateral cooperation initiatives in nuclear sector.

1. World trends in nuclear energy and uranium production

1.1. Trends in nuclear energy development

Both the growing energy dependence of most global economies and volatile fossil fuel prices give rise to the search for new sources of energy. Nuclear energy promises to be one of the most reliable, economic and environmentally friendly solutions. According to the International Atomic Energy Agency (IAEA), the use of nuclear energy plants results in reducing CO_2 emissions by 2.9 billion tonnes per annum compared to coal–fired generation, or 24% of the total annual energy market emissions (Technology Roadmap, 2010).

The IAEA forecasts a nearly two–fold increase in global demand for energy in the next 25 years, which cannot be met by conventional sources such as oil, gas or coal. In parallel with that, by 2030 global demand for nuclear energy will rise by 66% from the 2008 level (Vestnik Atomproma, 2009b).

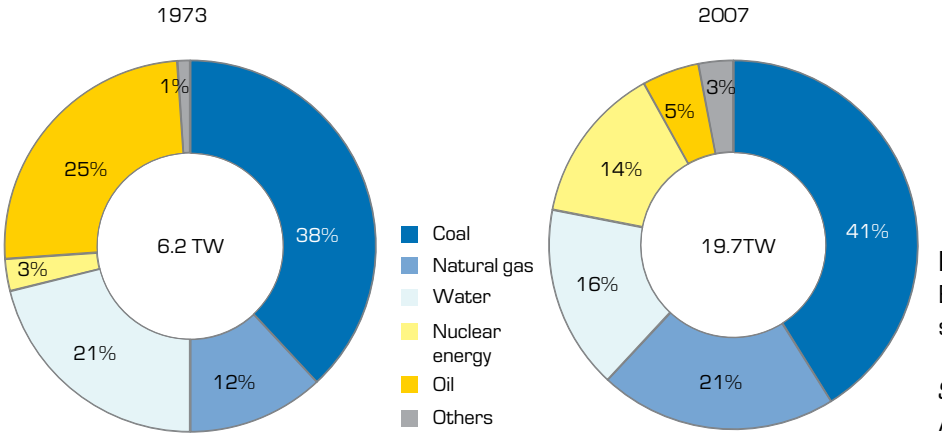


Figure 1.1.
Electricity generation by source (1973 and 2007)

Source: International Energy Agency, 2009

According to the World Nuclear Association, in March 2009 there were 436 functional nuclear reactors in 30 countries; 55 reactors were under construction; 108 reactors were at the project preparation stage; and 266 projects were under consideration (see Table 1.1). Nuclear energy currently provides 16% of the world's electricity. However, nuclear energy policy differs between countries: in France, NPPs generate 78% of all electricity consumed, whereas in China they account for as little as 2%. Yukio Amano, General Director of the IAEA, says that over 50 nations have declared their interest in developing nuclear energy. This interest is driven by the highly volatile prices of fossil fuel and unstable energy supplies. Uranium is much easier to transport, and decreases the cost of electricity 4–6 times, compared to that generated using coal or natural gas (Vestnik Atomproma, 2009a).

Another advantage of nuclear energy is that the fuel component in the tariff for electricity is small, preventing strong fluctuations in electricity rates. For example, a triple increase in the price for natural gas automatically leads to a triple increase in the price of electricity. By contrast, the same triple increase in the price of uranium would result in a 5–6% increase in the price of electricity generated by a NPP (Simakova, 2009), because fuel cost accounts for merely 24% of all nuclear power plant costs (including uranium mining, conversion, enrichment and the actual production of nuclear fuel). Most NPPs purchase nuclear fuel under long–term contracts at prices which are typically lower than the market price (this difference can be up to 60%) (Bank of Moscow, 2008). Operation, maintenance and decommissioning account for 58%, and construction for about 18% of all NPP costs (see Figures 1.2 and 1.3).

Country	Number	Capacity (MW)
Argentine	1	692
Bulgaria	2	1,906
China	20	19,920
Finland	1	1,600
France	1	1,600
India	5	2,708
Iran	1	915
Japan	1	1,325
South Korea	6	6,520
Pakistan	1	300
Russia	9	6,996
Slovakia	2	782
Taiwan	2	2,600
Ukraine	2	1,900
USA	1	1,165
Total	55	50,929

Table 1.1.
NPPs under construction (2009)

Source: IAEA PRIS

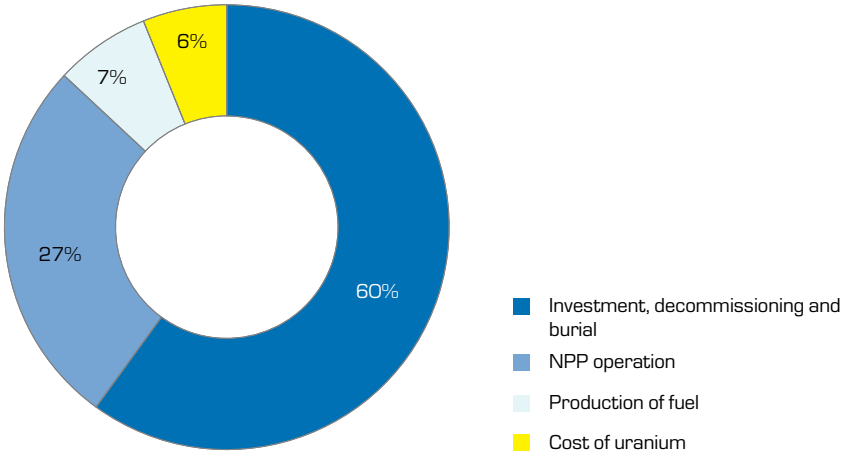


Figure 1.2.
Construction and operation costs of NPP

Source: AREVA, 2007

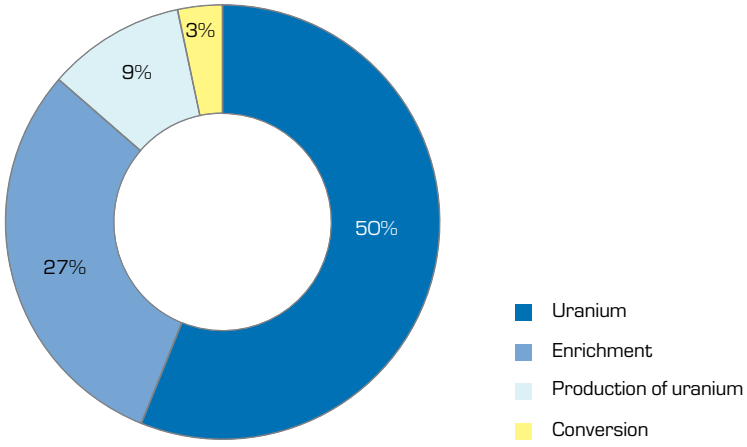


Figure 1.3.
Structure of NPP fuel costs

Source: Eurasian Development Bank
Note: based on Bank of Moscow data, 2008

An important factor in favour of nuclear power plant (especially after the Chernobyl disaster in 1986) is that reactors are subject to strict safety regulations. All new generation reactors are «passively safe» – that is, in case of an emergency the operator does not need to take any special action, as the reactor design features include automatic shutdown (Simakova, 2009).

1.2. The uranium cycle

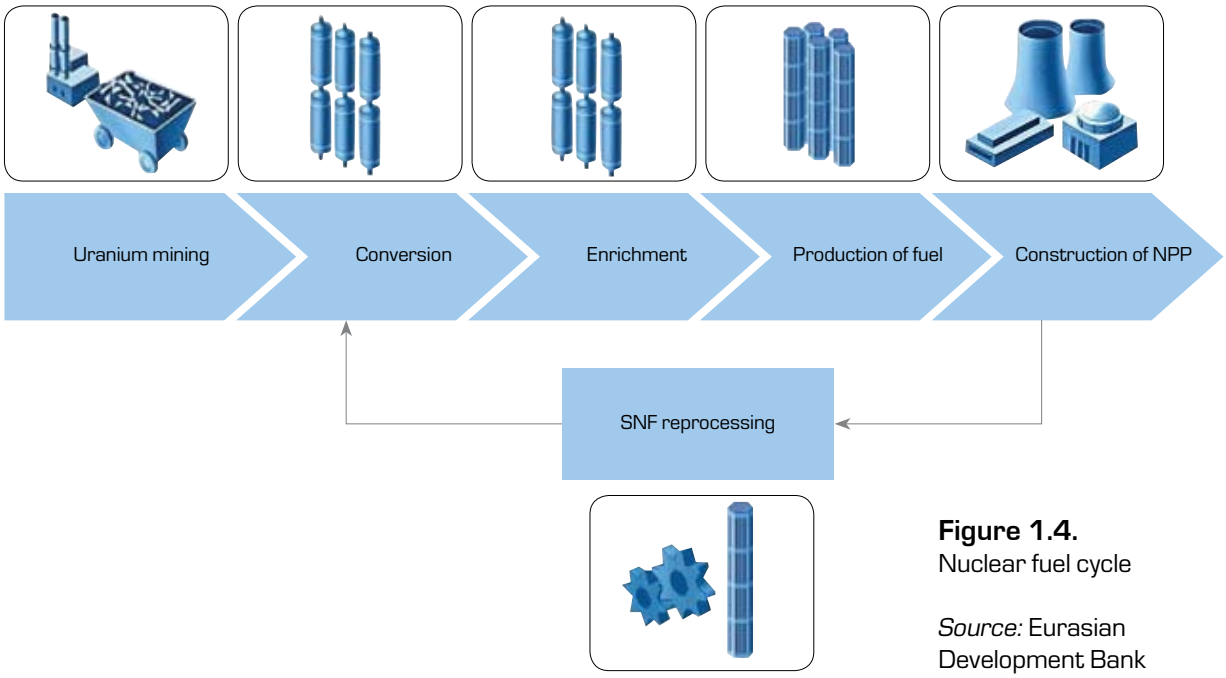


Figure 1.4.
Nuclear fuel cycle

Source: Eurasian Development Bank

Uranium cycle (or nuclear fuel cycle) includes all processes and operations that cover the processing chain of nuclear fuel. It is assumed that nuclear fuel cycle consists of six main stages: uranium mining, production of uranium concentrate (U_3O_8), conversion (fluoridation), enrichment, production of nuclear fuel and generation of electricity. Ore extraction and production of uranium concentrate is carried out directly by mining companies, and then the concentrate is delivered to enrichment plants. Depending on the use of spent nuclear fuel (SNF) the nuclear fuel cycle can be open and closed. If SNF is not reprocessed, the fuel cycle is referred to as an open fuel cycle; if SNF is reprocessed and used repeatedly for electricity generation, it is referred to as a closed fuel cycle.

1.3. Analysis of the world nuclear energy market

It should be noted that the nuclear energy market is a combination of several different markets (see Figure 1.5).

The first market is natural uranium production and processing. This fully developed market is dominated by 14 countries; ten of them account for 90% of the world's uranium production (see Figure 1.6).

The second is uranium enrichment services market. This market has four key players: Russia, the USA, France and the British–German venture URNCO. Russia controls one quarter of the market (export of low enriched uranium).

The third market is the production of fuel assemblies. There are many national players on this market. The largest players are TVEL (Russia), AREVA (France), Toshiba/Westinghouse and

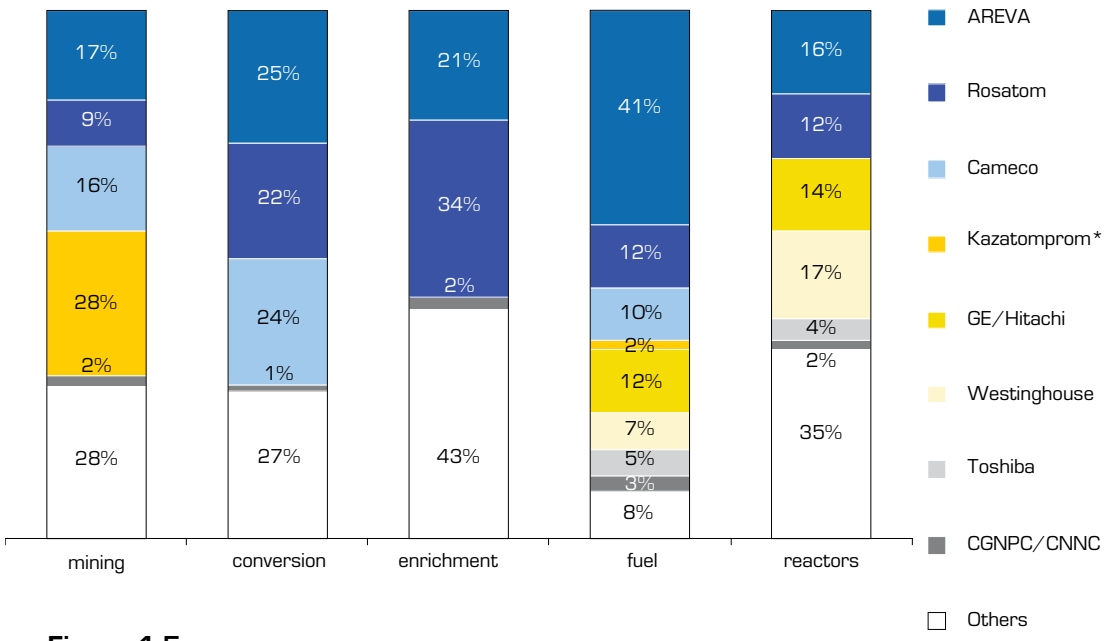


Figure 1.5.
Key uranium market players

Source: Eurasian Development Bank
Note: * (Kazatomprom, 2010a)

GE/Hitachi (Japan/USA). This stage of nuclear fuel production accounts for about 6% of the total nuclear fuel cycle cost.

The fourth market is design of reactors. To date, there are several types of nuclear reactors available globally, including Russian, American (General Electric, Westinghouse) and German–French (Siemens–Framatom) designs (Beckman, 2009).

Experts from ARMZ estimated the 2009th global uranium output at 48,512 tonnes (see Figure 1.7). Kazakhstan was principally responsible for the increase in global production by contributing

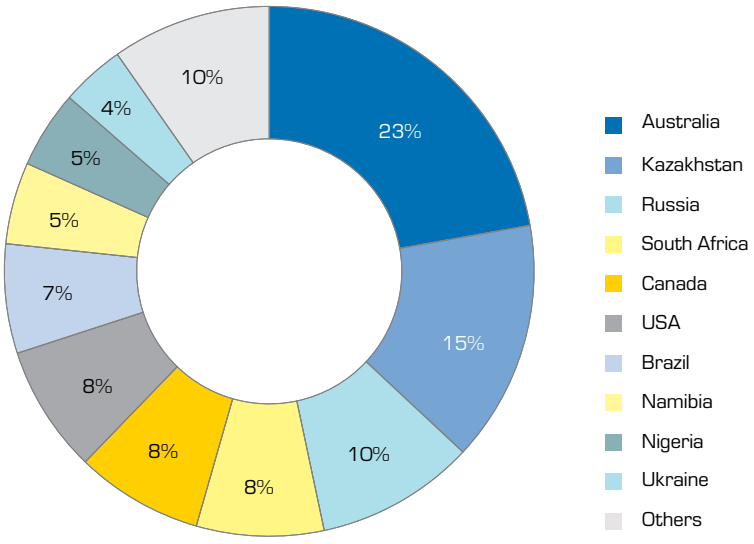


Figure 1.6.
Recoverable uranium reserves by country in 2009

Source: Eurasian Development Bank
Note: based on Vestnik Atompromа data, 2010

13,900 tonnes (one forth of the world's production), thus outperforming Australia and Canada and becoming the absolute leader. Russia ranks fifth, standing just behind Namibia. Uzbekistan and the US produced more than 1,000 tonnes each and accounted for 14% of global production. Ukraine, China, South Africa, India, Brazil, Malawi and other countries producing less than 1,000 tonnes a year each contributed 7% in total (Vestnik Atomproma, 2010).

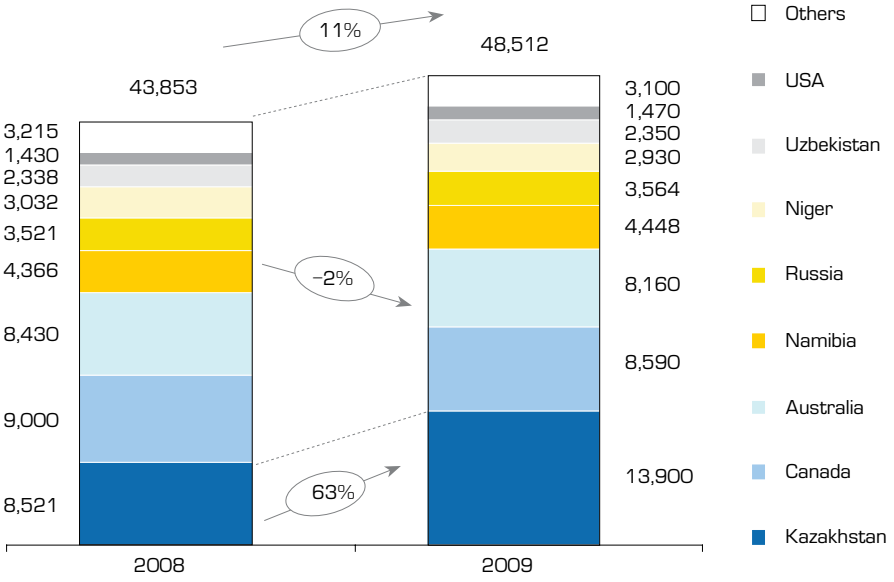


Figure 1.7.
Uranium production by country (tonnes)

Source: Eurasian Development Bank
Note: based on ARMZ data

According to ARMZ, total production by the so-called *Big Uranium Seven* (with a production of more than 1,000 tonnes) – Rio Tinto, Cameco, AREVA, Kazatomprom, ARMZ, BHP Billiton and the Navoi Mining and Metallurgical Combinat amounted to 43,340 tonnes or 90% of global uranium production. In 2008 this group was joined by Uranium One, and in 2009 expanded to *Nine* with the appearance of Paladin Energy (see Table 1.2).

Company	Country	Main assets	2008 (tonnes)	2009 (tonnes)	Change (%)
Rio Tinto	UK	Ranger (ERA), Rossing (ERA)	7,989	8,055	7
Cameco	Canada	McArthur River, Rabbit Lake	6,655	7,770	17
Kazatomprom	Kazakhstan	Karatau, Inkai, Katko	5,225	7,963	52
AREVA NC	France	Arlit, Akouta, McLean Lake	6,307	7,500	19
Atomredmetzoloto	Russia	Priargunskoye	3,687	4,624	25
BHP Billiton	Australia/UK	Olympic Dam	3,344	3,000	−10
Navoyi Ore Mining and Dressing Works	Uzbekistan	Uchkuduk, Nurabad	2,338	2,340	0
Uranium One	Canada	Akdala, Zarechnoye, Akbastau	1,115	1,346	21
Paladin Energy	Australia	Langer Heinrich	948	1,150	21
Others			6,079	4,770	−25
Total			43,648	50,527	13

Table 1.2.
World uranium producers

Source: Eurasian Development Bank
Note: based on ARMZ and World Nuclear Association data, 2009

Atomredmetzoloto forecasts the global uranium production to reach 51,000–52,000 tonnes in 2010 (Vestnik Atompromа, 2010v).

The main producers and consumers of nuclear energy typically do not possess uranium deposits (see Table 1.3). For example, there are no any significant uranium reserves in France – one of the main nuclear energy producer (78% of total energy is produced by NPP) ,therefore the country is in permanent search of new sources. The AREVA group of companies (controlled by the French government) mines uranium in Nigeria, Kazakhstan and Australia.

Table 1.3.
Main nuclear energy producers

Source: World Nuclear Association, 2009

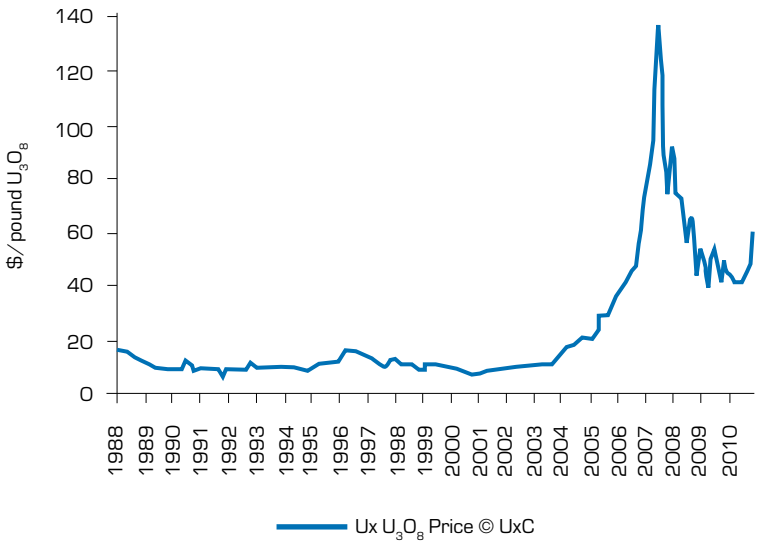
Country	TW/h	(%)	Capacity (GW)	Share of nuclear power in total energy (%)
The USA	837	30.8	106	19.4
France	440	16.2	63	77.9
Japan	264	9.7	49	23.5
Russia	160	5.9	22	15.8
South Korea	143	5.3	18	33.6
Germany	141	5.2	20	22.3
Canada	93	3.4	13	14.6
Ukraine	93	3.4	13	47.2
Sweden	67	2.5	9	45
The UK	63	2.3	11	16.1
Others	418	15.3	48	6.6
Total	2719	100	372	13.8

1.4. Uranium prices

2009 was favourable for the uranium industry despite the financial and economic crisis. This year a record 10% increase in annual production was achieved – this is the best performance in the past decade. Despite the steady decline of the uranium prices in the spot market ($45–50 per pound of mixed oxide (U_3O_8) at the end of 2009), the industry continued to expand. Compared to the 2007 peak, uranium prices dropped almost four times (see Figure 1.8).

Figure 1.8.
World prices of U_3O_8 (1988–2010)

Source: The Ux Consulting Company, LLC



An increase in uranium prices was triggered by the announcement of some sizable projects to build new NPPs . The uranium market was characterised by emergence of new players that

were buying for a rise. In the summer of 2007 the prices reached a peak of nearly $140 per pound of U_3O_8, which was followed by the downward trend. The earthquake in Japan, which damaged one of the nuclear power plants, contributed to the fall in price. Moreover, some reactors in the UK and Germany were suspended that year, which had a negative impact the uranium prices (Beckman, 2009). The global financial crisis also affected the uranium industry. Many non–core investors who had entered the spot market during the peak of uranium prices started to withdraw, and the cost of uranium continued to fall to the current level of $59.5 per pound of U_3O_8 (as at 23.11.2010).

Although as little as 10% of all uranium is traded on the spot market (the rest is sold privately under long–term contracts), market quotations on influence on long–term contractual supplies (Beckman, 2009). In other words, the current low prices may lead to nuclear fuel shortages, as uranium companies have no incentives to expand production or operate deposits at higher mining costs.

The cost of uranium enrichment services (measured in separative work units, SWU) doubled over the past decade and currently averages at $153 per SWU (as at 23.11.2010) (see Figure 1.9).

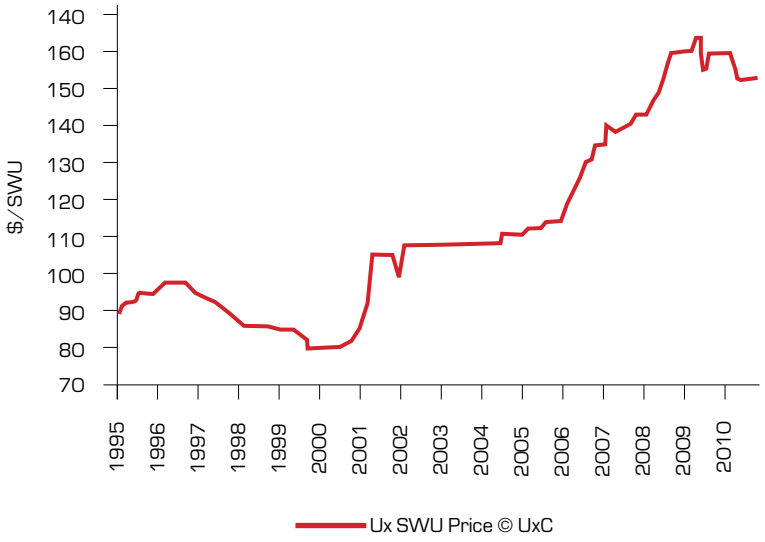


Figure 1.9.
Cost of uranium enrichment services in 1995–2010 (SWU)

Source: Ux Consulting Company, LLC

Thus, the situation on the uranium market in recent years can be described as unstable. Uranium prices have been on a sustained downward trend, whilst uranium production has been on the rise – principally due to the expansion in Kazakhstan. However, the level of «cheap» uranium (i.e. which mining costs are less than $40 per pound) is shrinking. This in the long term may necessitate the development of more expensive[1] deposits, leading to a rise in uranium prices.

Uranium conversion technology has been sufficiently time–tested and is not overly sophisticated. Conversion is an important (although not very costly) component of the nuclear fuel cycle. We estimate that for the nearest future the conversion prices will remain constant at the current level of $13–15 per kg of uranium.

Enrichment is the most expensive stage of nuclear fuel cycle: according to different sources, up to 40% of the nuclear fuel cost accounts for this stage. Considering the specific structure of the industry (only a few nations possess the enrichment technology), we do not expect any radical changes in the market players composition. To date, Russia has excess capacity for enrichment

[1] Deposit with the cost of uranium production higher than $40 per pound

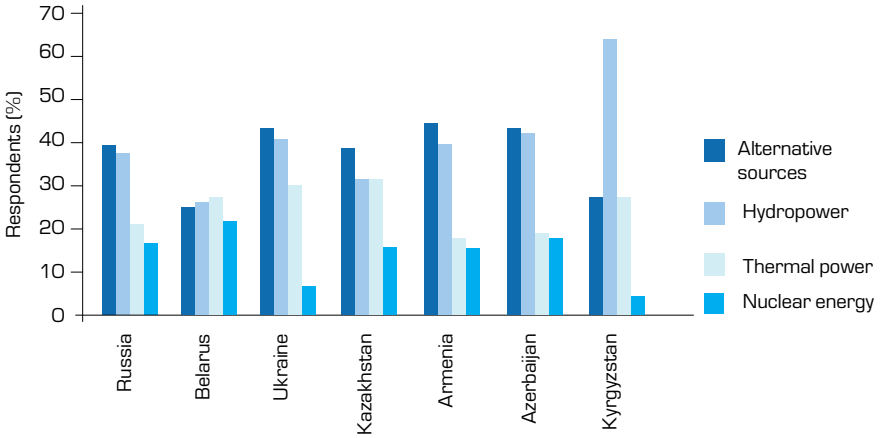
services, whereas other countries are likely to have unmet demand for them. As a result, the prices of these services were growing rapidly in recent years, and are expected to grow even further.

1.5. Public attitude towards nuclear energy

According to a poll conducted under the *Eurasia Monitor* project (www.earasiamonitor.org), the majority of respondents in the CIS are supportive of building power plants using alternative sources of energy and traditional hydropower (see Figure 1.10). Nuclear energy proponents account for a quarter to a third of the population; opponents – for a half to two thirds. The only exception is Armenia where the number of respondents, supporting the usage of nuclear energy, outnumbers opponents – probably due to the fact that the Armenian economy is heavily dependent on the single NPP that the country possesses (Eurasia Monitor, 2007).

Figure 1.10.
Public opinion on the need to build power plants of different types

Source: Eurasia Monitor, 2007

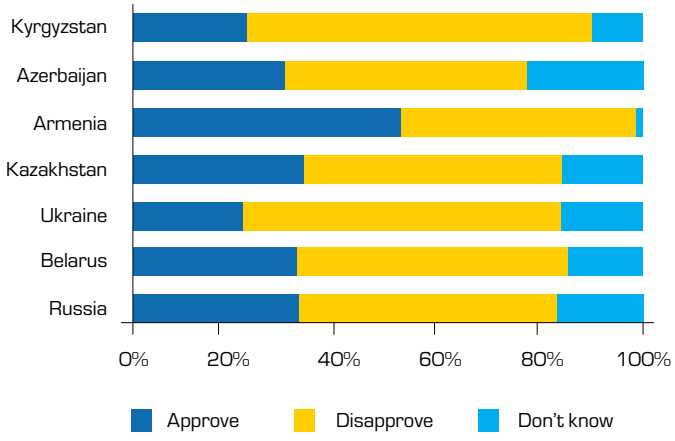


These results were confirmed by a national study on nuclear energy held in Kazakhstan by the Centre of Social and Political Studies «Strategy» in July 2008. According to this survey, the Kazakh society has a negative attitude towards nuclear energy. Only one third of the respondents supported nuclear energy, whereas every other respondents voted against the peaceful atom. The share of loyal individuals remains unchanged – 34%. Country index of support for the use of nuclear energy is –0.155, which indicates a negative attitude (Simakova, 2009).

In Russia, the number of supporters of nuclear energy is increasing. According to the *Eurasia Monitor*, in 2007 only 33% of respondents approved use of NPPs. A similar poll held by the Levada Analytical Centre in 2009 shows that 35% of Russians support the

Figure 1.11.
Public attitude towards nuclear energy

Source: Eurasia Monitor, 2007



preservation of nuclear energy at current level, the same percentage – for its active development. Data from this survey indicate a stable, positive attitude of Russian's towards nuclear energy (Vestnik Atomproma, 2009a).

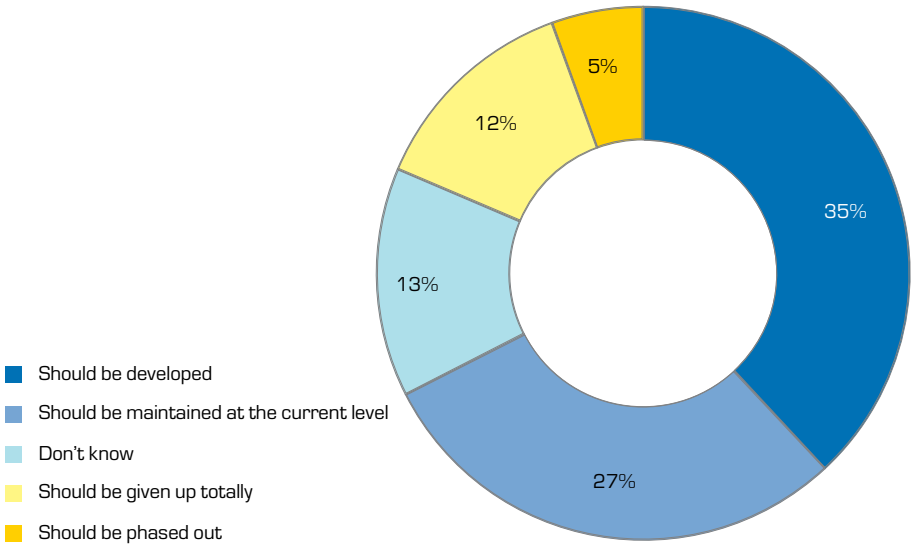


Figure 1.12.
Public poll on the future of nuclear energy in Russia

Source: Eurasian Development Bank
Note: based on *Vestnik Atomproma* data, 2009a

2. Nuclear energy in Kazakhstan

2.1. The current status of the Kazakh uranium industry

At present the uranium industry in Kazakhstan shows the most rapid growth rate. The country's current energy resources structure is as follows: coal – 34%, oil – 8.8%, natural gas – 6.6%, minerals – 4.2%, and uranium – 46%. Thus according to Kairat Kadyrzhanov, General Director of the National Nuclear Centre, Kazakhstan is a *uranium nation,* and it is nuclear energy that can make the country truly competitive internationally (Shaternikova, 2009). This is facilitated by the fact that Kazakhstan has immense uranium deposits, ranking second globally in recoverable reserves (21% of the world's total).

In 2009, uranium production in Kazakhstan rose by 63% to about 14,000 tonnes. Thus, the country became the leading producer of uranium (28% of the world's production), outperforming Canada (24%) and Australia (19%). To mention, Kazatomprom itself produced only one third of this volume and the rest was mined by joint ventures.

The main uranium regions are Shu–Sarysusky (60.5% of the national reserves), North Kazakhstan (16.5%), Syrdaryinsky (12.4%), Iliysky (6%), uranium mineralisation in the Mangyshlak region (1.8%), and Pribalkhashsky region (0.4%).

2.2. Kazatomprom today

By 2008 Kazatomprom had secured agreements with the key players in the international nuclear market for building conversion, enrichment and fuel assembly facilities, thus finalising its transformation into a vertically integrated company.

Kazatomprom is a holding company comprising 26 subsidiaries engaged in geological exploration; production, processing and enrichment of uranium; production, storing, transportation and processing of molybdenum and copper ores; design of small and medium capacity nuclear reactors; construction of NPPs; generation of electricity and heat; and joint production of nuclear fuel for VVER–1000 type water–cooled power reactors. Kazatomprom owns a uranium plant, a tantalum plant and a beryllium plant which supply materials to the nuclear, aerospace, electric and instrument–making industries, and has commenced construction of sulphuric acid and enrichment facilities at the Ulba Metallurgical Plant. Kazatomprom also has a research centre, a special training centre and an educational centre. On the whole, Kazatomprom and its affiliate Stepnogorsk Mining–Chemical Complex LLP employ about 22,000 people. Kazatomprom and its subsidiaries operate 16 deposits in Kazakhstan (see Table 2.1).

Kazakhstan's uranium production in the first half of 2010 totalled at 8,452 tonnes – a 42% surplus compared with the same period of the previous year. According to reviewed production plans, 9,770 more tonnes will be mined in the second half of 2010. The growth was achieved by increased production in almost all subsidiaries of the holding; particular mention should be made on the commencement of commercial production by Baiken–U LLP and Kyzylkum LLP and pilot production by the Akbastau joint venture (Invest–market, 2010). Kazatomprom's gross income in the first half of 2010 amounted to 105.687 billion tenge – a 58% rise compared to the first half of 2009. Net income was 19.414 billion tenge (a 64% rise) (Kazatomprom, 2010).

One of the major events of 2010 is the placement of Kazatomprom's debut 5–year Eurobonds for $500 million with a 6.25%–coupon. The order book totalled $4.3 billion. The proceeds will be used to expand production and repay loans ($50 million will go towards the subsidiaries' most expensive borrowings). Kazatomprom is also considering acquiring companies that possess uranium conversion and enrichment technology (Kazatomprom, 2010).

2.3. Kazatomprom's nuclear fuel cycle

Prior to independence, Kazakhstan's uranium industry was under the control of the Soviet military nuclear agency code–named the «Ministry of Medium Engineering». After the disintegration of

No.	Deposit	Company	Commencement year	Annual design capacity (tonnes of uranium)	Owners	Kazatomprom's share (%)
1	Inkai, blocks 1, 2 and 3	Joint venture Inkai	2004	4,000	Cameco (Canada)	40
2	South Moiynkum	Joint venture Katko	2006	1,000	COGEMA (France)	49
3	East Mynkuduk	Gornorudnaya Kompaniya LLP	2006	1,000		100
4	Zarechnoye	Joint venture Zarechnoye	2006	1,000	Tekhsnabeksport, Atomredmetzoloto (Russia), KGRK (main shareholder of RENOVA group, Russia)	49.3
5	Inkai, block 4	Joint venture Betpak Dala	2007	2,000	Astana Kazakhstan Investment Group	30
6	Central Mynkuduk	Ken Dala.kz LLP	2007	2,000		100
7	Budyonovskoye, block 2	Karatau LLP	2007	1,000	Uranium One (Canada)	50
8	Tortkuduk	Joint venture Katko	2007	2,000	COGEMA (France)	49
9	Kanzhugan, Kainarsky block	Gornorudnaya Kompaniya LLP	2008	300		100
10	West Mynkuduk	APPAK LLP	2008	1,000	Sumitomo Corporation (25%) and Kansai Electric Power Co., Inc. (10%) (Japan)	65
11	Khorasan–1	Kyzylkum LLP	2008	3,000	Toshiba Corporation, TEPCO, Chubu Electric, Tohoku Electric, Kyushu Electric, Marubeni Corporation (Japan), Uranium One (Canada)	30
12	Irkol	Semizbai–U LLP	2008	750		100
13	Semizbai	Semizbai–U LLP	2009	500		100
14	Budyonovskoye, block 1	Akbastau	2009	1,000	ARMZ (to be handed over to Uranium One as a payment)	50
15	Budyonovskoye, blocks 3 and 4	Akbastau	2010	2,000	ARMZ (to be handed over to Uranium One as a payment)	50
16	Khorasan–2	Baiken–U LLP	2009	2,000	Japanese energy consortium Energy Asia Limited	5
17	South Zarechnoye	Joint venture Zarechnoye	2010	1,000	ARMZ (to be handed over to Uranium One as a payment)	49.3

Table 2.1.
Uranium deposits under development in Kazakhstan

Source: Eurasian Development Bank
Note: based on company data

the Soviet Union the country mastered two steps of nuclear fuel cycle – uranium mining and production of uranium dioxide pellets. The company plans to set a vertically integrated complex capable of running a full nuclear fuel cycle. The State Programme for Industrial Development in 2010–2014 in particular provides for the development of missing nuclear fuel cycle stages (conversion, enrichment and production of fuel assemblies) (see Figure 2.1).

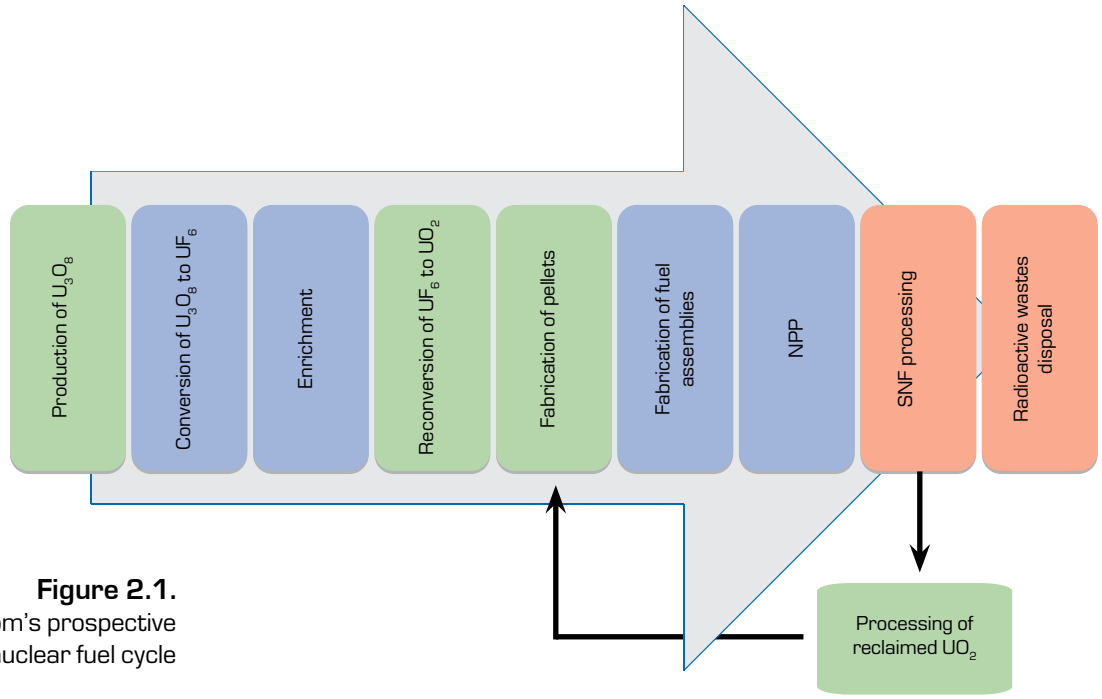


Figure 2.1.
Kazatomprom's prospective nuclear fuel cycle

Source: Kazatomprom, 2010b

Nuclear fuel cycle stages already mastered by Kazatomprom are marked green; stages to be obtained under the company's development strategy are marked blue; and stages which will not be developed are marked red.

Kazatomprom is currently engaged only in uranium mining and fabrication of UO_2 powder and pellets. Notably, 6,537 tonnes out of 6,609 tonnes of the company's uranium sales in 2009 were sold in the form of raw material – triuranium octoxide (U_3O_8). U_3O_8 accounts for just 35% of the cost of fuel assembly (Business Resource, 2010).

Table 2.2.
Fuel assembly cost structure ($1 million)

Raw material (U_3O_8)	Conversion to hexafluoride (UF_6)	Enrichment	Fabrication of UO_2 powder and pellets	Alloys	Fabrication of fuel rods and assemblies
35%	4%	37%	6%	9%	10%

Note: highlighted columns indicate nuclear fuel cycle stages mastered by Kazatomprom
Source: Business Resource, 2010

2.4. NPP Construction in Kazakhstan

Kazakhstan has plans to build the first national NPP, intending not only to act as supplier of raw materials but also to avail itself of the final product, electricity. The National Atomic Company is developing a feasibility study of the first national nuclear power plant. The new NPP is expected

to be commissioned in 2020. The NPP will be built on the basis of the Mangistau nuclear energy complex which has operated nuclear fast-breeder reactor BN-350 for more than 25 years (at present the reactor is being decommissioned). The new plant will have two power units. The Kazakh government is also negotiating with the Japan Nuclear Power Company (JNPC) on the construction of another NPP in East Kazakhstan.

Taking into consideration the technical requirements of Kazakhstan's energy system the construction of a nuclear plant with a capacity of 1,000 MW would be uneconomic, as power transmission over a vast territory results in considerable losses. Having three 300 MW plants instead of one 1,000 MW plant is more suitable for Kazakhstan: this would enhance the stability of the power system and ensure coverage of the whole country.

An analysis of the world reactor market shows that to date there is no commercial variant of 300 MW reactors. The main producers, Westinghouse, AREVA, General Electric, etc. specialise in reactors with a minimum capacity of 1,000 MW. Therefore, Kazakhstan and Russia decided to jointly design the VBER-300 reactor based on the marine reactor plant of block type, thus occupying the niche of small and medium capacity reactors (Kazatomprom, 2010b). To this end, a Kazakh-Russian joint venture was founded and entrusted with both reactor design and the construction of an NPP (Gazeta.kz, 2010).

2.5. Kazatomprom's foreign partners

In the 21st century Kazakhstan's uranium became the subject of keen interest from the world's leading users of nuclear energy – France, Canada, the US, Japan and Russia. In recent years, new players (including China, India, South Korea and Belgium) have also started to compete for Kazakh uranium supplies.

One of the main Kazakhstan's partners on the uranium market is Japan. This country has no uranium deposits but operates 53 reactors which generate about 30% of the country's electricity, and this figure is forecasted to exceed 40% in 2017[2].

In October 2009 a number of documents on the establishment of joint ventures with major Japanese corporations were signed:

- A Protocol of Intent for cooperation in rare metals production with Toshiba Corporation. The parties signed an agreement on establishment of joint venture to conduct studies, produce and sell rare and rare earth metals (RM/REM) and related products. This joint venture may complete a feasibility study for extraction and high-level processing of RM/REM within the next two years and establish whether it is economically beneficial to launch high-tech and science-intensive RM/REM facilities in Kazakhstan. Moreover, Toshiba sold a 10% stake in holding companies, controlling Westinghouse, to Kazatomprom for $540 million.
- A Memorandum of Understanding and Mutually Beneficial Cooperation under the Project of Rare-Earth Metals Development in the Republic of Kazakhstan with Sumitomo Corporation. An agreement on the establishment of the Summit Atom Rare Earth Company (SARECO) joint venture was signed on March 24, 2010. Kazatomprom and Sumitomo will hold 51% and 49% respectively. SARECO wll be headquartered in Ust-Kamenogorsk, Kazakhstan. At an early stage SARECO will conduct a feasibility study on the production of RM/REM. The project envisages construction and commissioning of mining and processing complex, a hydrometallurgical facility to produce collective ore concentrates, a chemical facility to separate rare earth metals into individual metal oxides The joint venture is also to deal with exports and sales of its products (Kazatomprom, 2010).

[2] http://leit.ru/modules.php?name=Pages&pa=showpage&pid=1411

Moreover a memorandum of understanding was signed with Kansai Electric Power Co., Inc. and Nuclear Fuel Industries, Ltd.

The Ulba Metallurgical Plant will produce nuclear fuel assembly components for *Nuclear Fuel Industries;* these fuel assemblies will be supplied to NPPs operated by Kansai Electric Power Co. in Japan. The Japanese companies undertook to obtain certificates for UO_2 powder and pellets produced by the Ulba Metallurgical Plant with a view to selling them on the Japanese market (BRCA, 2010).

A pilot and demonstration NPP with a 50 MW high–temperature gas–cooled reactor will be built in Kurchatov with support from the Japan Atomic Energy Agency. Construction work will be completed in 2018. It is envisaged that this demonstration project will turn into commercial production by 2022 (Panorama, 2010).

Another key Kazakhstani partner in nuclear energy is France. In 2008 and 2009 Kazatomprom and AREVA signed a number of agreements on the establishing of joint ventures Katko (Kazatomprom – 49% and AREVA – 51%) and IFASTAR (Integrated Fuel Asia Star). Katko's core business is uranium production. It was agreed that until 2039 Katko will annually produce 4,000 tonnes of uranium which will be marketed by AREVA. IFASTAR will conduct a feasibility study to:

- assess the target Asian market with respect to selling integrated fuel packages (including all stages of nuclear fuel cycle, except for NPP construction, using the uranium resources of Kazatomprom and AREVA's technology) to existing power companies; and
- design and construct of a nuclear fuel production line with an annual capacity of 400 tonnes at the Ulba Metallurgical Plant.

Depending on the results of this assessment, and a decision made by the partners, IFASTAR will start marketing these products, while a separate joint venture between Kazatomprom (a 51% stake) and AREVA (49%) will be responsible for production (Kazatomprom, 2010b).

During the visit of Kazakh President to France another agreement on construction of a plant capable of manufacturing nuclear fuel assemblies was signed with AREVA. The project will cost $170 million. The plant will be constructed in 2009–2012, and production will be launched in 2013.

Within the framework of the Minex Central Asia 2010 forum, Kazatomprom secured an strategic agreement with SOLVAY (Belgium). The parties agreed to conduct a feasibility study on the construction of a hydrogen dioxide plant which will cater for the needs of the uranium industry. This plant will use hydrogen extracted from natural or associated gas (Kazatomprom, 2010b).

3. Nuclear energy in Russia

3.1. The current status of the Russian uranium industry

The Russian government attaches great importance to nuclear energy development. About 1 trillion roubles will be invested in this industry by 2015, and another 68 billion roubles will be allocated from the federal budget for the construction of new NPPs (Beroyeva, 2010). Special positions will be created in selected Russian embassies whose responsibility will be to lobby and promote Russian nuclear technology (Kommersant FM, 2010).

Even now Rosatom has an advantage on the international nuclear energy market, as it has mastered the full nuclear fuel chain from uranium mining to the construction of NPPs (only French AREVA can compete with Rosatom in this regard). Rosatom controls 34% of the enrichment market, 22% of the conversion market, 12% of the nuclear fuel market and 12% of the NPP construction market. However, the corporation is not satisfied with its current status. During the visit to Volgodonsk NPP Russian Premier Minister Vladimir Putin said: «We need to strengthen our positions in the field of peaceful nuclear energy. These are unique technologies. It is within our power to capture at least 25% of the NPP construction and operation services market. We should actively offer not only NPP construction services, but also operation and maintenance and fuel disposal services» (Beroyeva, 2010).

3.2. The State atomic energy corporation Rosatom

Rosatom is a corporation comprising over 240 companies and organisations. These include all civil nuclear companies, military nuclear companies, research institutions, organisations in charge of nuclear and radiation safety, and the nuclear icebreaker fleet. Russian nuclear industry employs over 190,000 people. Uranium is mined by three companies: Priargunsky Mining and Chemical Works JSC, Dalur CJSC and Khiagda JSC.

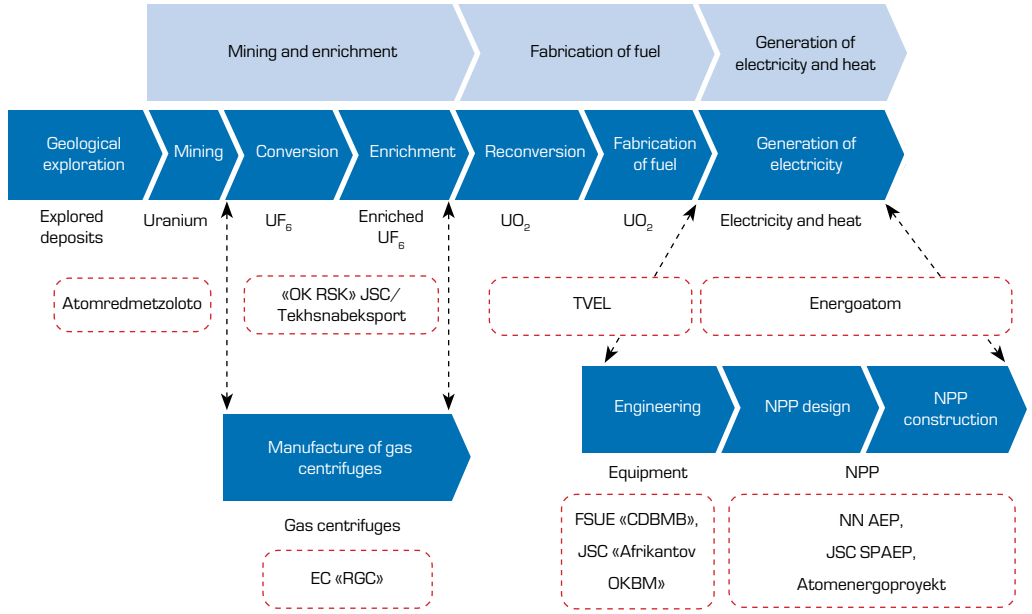


Figure 3.1.
The current status of the Russian uranium industry

Source: Rosatom, 2010

In 2006 it was decided to establish a specialized vertically integrated company for producing NPP equipment. Nuclear industry was divided into the military and civil segments. All companies in the civil segment were reorganised into joint stock companies, with the corresponding transformations in terms of accounting. According to Rosatom's General Director Sergey Kiriyenko, the reform was successful: the value of the corporation's net assets rose by 360% and productivity by 170%. In 2009 Rosatom's income totalled 518 billion roubles, a 37% surplus compared with 2008 (Kommersant FM, 2010).

Geological exploration was carried out in fields operated by existing and prospective Russian ventures. Some 170,000 running metres were drilled, and total investments in uranium exploration amounted to 1.05 billion roubles. It is expected that a reserve increment of uranium will amount to 8,000 tonnes. In addition, geological exploration was started in Armenia and Namibia (Vestnik Atompromа, 2010v).

3.3. Rosatom on the international market

Russia's main uranium producer, Priargunsky Mining and Chemical Works JSC, accounts for 93% of the national output and meets only one third of the domestic uranium demand. To satisfy the growing demand, Rosatom is actively searching for new sources. Following Rosatom's directive, the Russian uranium holding company Atomredmetzoloto started to pursue an aggressive merger and acquisition policy. Particularly, the company is ready to invest some $1 billion in the development of deposits in Namibia. In 2008 ARMZ founded a joint venture with VTB Capital Namibia Ltd. and Arlan Invest Holdings SWA Uranium Mines to develop Namibian deposits with estimated reserves of about 8,000 tonnes. However, this project was suspended due to a moratorium on uranium production by foreign companies. A final agreement between Rosatom and the Namibian Ministry of Mines which permits Rosatom to commence operations was signed only in May 2010 (Chelpanova, 2010).

Taking advantage of its vast experience in development and operation of nuclear reactors inherited from the Soviet Union and upgraded in the recent decade, Russia constructs NPPs all over the world. Russia currently has large full–service nuclear energy contracts with India, Bangladesh, China, Vietnam, Iran, Turkey and some Eastern European countries. Additional full–service contracts for NPP construction and supply of nuclear fuel with Argentina, Belarus, Nigeria, Kazakhstan and Ukraine are in the pipeline. As of 2010 Atomstroyexport is building five NPP units abroad: two units for the Kudankulam NPP in India, one unit for the Bushehr NPP in Iran and two units for the Belene NPP in Bulgaria (Atomstroyexport, 2010). Atomstroyexport is an engineering company on construction of nuclear power facilities abroad owned by Rosatom.

Stiff competition forced Rosatom to revise its policy on the supply of technology, equipment and services, and now the company is in a position to act not only as building contractor but also as co–investor. Recent examples include an Armenian project in which Rosatom intends to secure a 40% stake; a Turkish project with an initial commitment of 100% and the right to sell electricity for the next 15–20 years; and Rosatom's prospective shareholding in Belene NPP in Bulgaria. A joint venture has been founded in Iran to operate an NPP at an early stage. Finally, Rosatom has negotiated a number of joint ventures with Ukraine, India and other countries to operate in all stages of nuclear fuel cycle (ATOMEXPO, 2010b).

Rosatom maintains close contacts with the key uranium market players. A strategic cooperation agreement was signed with Toshiba. In the beginning of 2009, a joint venture for NPP construction was negotiated with Siemens (Gilyova, 2010).

Moreover, Russia cooperates closely with other nuclear nations. In June 2010 the Federation Council ratified an intergovernmental agreement with Australia on cooperation in peaceful uses of nuclear energy which provides for the processing and use of Australian uranium in Russia. This agreement permits Russian and Australian companies to enter into direct contracts.

Companies from other countries will be able to order high-level processing of Australian uranium in Russia, including conversion, enrichment and fabrication of nuclear fuel (Atomic energy, 2010).

In 2009 Rosatom took advantage of an amendment to the Agreement on Suspension of the Antidumping Investigation on Deliveries of Uranium Products from Russia. Due to this amendment Techsnabexport JSC, state-owned company which trades uranium fuel and fuel processing services abroad, was able to enter into six long-term contracts for supply of low enriched uranium to US energy companies for a total of about $3 billion. In 2010 at least three more such contracts for a total of $1 billion was expected to be signed. In addition, in 2009 Techsnabexport signed new long-term contracts and supplements to existing ones for supply of low enriched uranium to the EU, Asia and the Pacific countries for a total of $7.5 billion (Yuryeva, 2010).

4. Russian–Kazakh cooperation

Apart from Rosatom, the most active player in the CIS is Kazatomprom. Hence, successful cooperation between these two giants is a precondition for progress not only in the national nuclear energy sectors, but also in the Kazakh and Russian economies in general. Therefore, on December 7, 2006, a comprehensive programme of Russian–Kazakh cooperation in peaceful uses of nuclear energy was adopted, and on November 20, 2009 the parties signed a Roadmap of additional measures for implementing that programme.

On many occasions, the presidents of Rosatom and Kazatomprom have voiced the idea of recreating a single structure identical to the former Ministry of Medium Engineering in a new format. The fact that Russia and Kazakhstan are discussing the creation of a unified nuclear agency has been known widely for long. Respective plans were announced by the Presidents of the two states in a series of negotiations (Gilyova, 2010). The establishment of a unified structure would be beneficial to both parties: Kazakhstan would be able to create high–technology production facilities through which would address a wide range of issues (increase tax revenues, decrease unemployment rate, solve the power shortages problems, etc.), and Russia would gain access to cheaper uranium.

However, these negotiations are still dragging on. In Rosatom's opinion, the Kazakh party is deliberately protracting the process. Initially Rosatom insisted on owning 50% plus one share, and Kazatomprom stood for parity terms. In the autumn of 2008 Russia agreed to the parity terms which included, *inter alia,* exchange of all Kazakh assets for equal Russian assets (at market value). Rosatom delivered a draft of intergovernmental agreement establishing a unified company, but no reply followed.

On June 9, 2010, at the ATOMEXPO exhibition, Kazatomprom's Vice–President Nurlan Ryspanov announced a forthcoming uranium development programme under which Kazatomprom is scheduled to complete its transformation into vertically integrated company with a full nuclear fuel cycle by 2020 (ATOMEXPO, 2010a). In particular, the uranium conversion was entrusted to the specially founded joint venture Ulba Conversion LLP (with Cameco, Canada).

Notably, a feasibility study on a joint venture with Cameco should have been completed in 2007. However, according to the company's investment memorandum published in 2010, this feasibility study is still awaiting agreement. As a consequence, Ulba Conversion LLP will not achieve its full capacity until 2018 (BRCA, 2010).

In October 2006 Nuclear Stations JSC, a Russian–Kazakh joint venture, was established (Atomstroyexport – 50% and Kazatomprom – 50%) to develop and promote reactors internationally. The venture's main aim is to prepare project documents and complete an NPP in Aktau, Kazakhstan.

There is also a contradiction between Russia and Kazakhstan concerning the construction of an NPP in Kazakhstan. According to Kazatomprom, at present a respective feasibility study is being agreed. According to the Russian party, a draft agreement was approved and passed to the Kazakh Ministry of Energy and Mineral Resources in 2009. In February 2010 Russia received a new Kazakh version of the agreement. According to Russian party, this version virtually brings the discussion back to the starting point (Konstantinov, 2010).

There were also some positive developments. On July 5, 2010, during the working visit of Russian President Dmitry Medvedev to Kazakhstan, an added impetus was given to the integration of the two states' nuclear energy sectors. Rosatom's General Director Sergey Kiriyenko and Kazatomprom's President Vladimir Shkolnik signed two documents: A Memorandum on integration and cooperation in the field of peaceful uses of nuclear energy and a Joint statement on the uranium enrichment centre project.

The first document outlines a concept for gradual establishment of a Russian–Kazakh nuclear company. «The parties confirm that they shall adhere to the principles of integration and, whilst taking consecutive steps towards a unified, parity–based nuclear company, shall strive to position it

on the global nuclear fuel cycle market as a strong joint player, and make use of market conditions in the best interests of future integration», reads the memorandum (Baranov, 2010). At an initial stage, this company will sell natural and low enriched uranium, as well as other products and services produced by the joint ventures to end users.

The second document seals the parties' agreements in respect of common use of a uranium enrichment centre in Russia through Kazakhstani shareholding in the Ural Electrochemical Integrated Plant JSC. Moreover, the document outlines the principles of concerted sales and marketing policy.

Thus Kazakhstan receives access to the world's largest enrichment facility and can increase the value added of nearly a half of all uranium it is now selling to the markets as a raw material. This will reduce Kazatomprom's dependence on the volatile prices of natural uranium (enrichment services are more stable and predictable). Moreover, the enriched uranium is much more expensive than the natural one.

The two documents are equally beneficial to Russia as well. First, they provide for processing of Kazakh uranium on Russian territory, i.e. Rosatom has secured additional workload for its facilities. Second, Russia has secured the Kazakh government's support for the forthcoming purchase of assets of Canadian Uranium One by Atomredmetzoloto (see below).

In 2006 ARMZ and Kazatomprom started the consolidation of assets by creating two joint ventures, Zarechnoye and Akbastau.

In addition to the creation of joint ventures, Russian companies enter the Kazakh market by acquiring international uranium companies which operate deposits in Kazakhstan. For example, ARMZ has acquired Effektivnaya Energiya N.V. which owned 50% in Karatau LLP and 25% in the joint venture Akbastau. As a result, ARMZ consolidated Russian assets in Kazakhstan and doubled its production capacity (Vestnik Atomproma, 2010b).

In 2009 ARMZ purchased 16.6% of shares in Uranium One. To be specific, ARMZ exchanged its 50% share in Karatau LLP for 117 million ordinary shares in Uranium One Inc. plus $90 million; up to $60 million more will be paid if Karatau achieves certain financial results within three years. Therefore, ARMZ gained the right to purchase part of Uranium One products (Interfax, 2010).

In June 2010 Atomredmetzoloto entered into another agreement with Uranium One under which it will increase its share in Uranium One by purchasing an additional share issue (356 million ordinary shares) for 50% in Akbastau and 49.7% in Zarechnoye plus $610 million. After closure of this transaction ARMZ's share in Uranium One will account for at least 51% (and, as a result, ARMZ will have the right to acquire at least 51% of Uranium One's products) (Tserikh, 2010).

In 2007 Russia and Kazakhstan co–founded an international uranium enrichment centre which initially was planned in Angarsk, Irkutsk Region, on the basis of the Angarsk Electrolysis Chemical Complex JSC. However, in view of the high cost of a new facility ($2.5 billion) and the long construction time, Rosatom offered Kazakhstan a share in one of the existing plants. In March 2010 the Kazakh party accepted Rosatom's offer to buy ordinary shares (within a range of 25% plus one share to 50% minus one share) in the Ural Electrochemical Integrated Plant JSC.

The EDB is co–financing the development of the Zarechnoye deposit. In 2007 the Bank provided the shareholders with a $63–million loan for this project.

Uranium One is a major producer of uranium with low average mining costs (less than $40 per kg). Uranium One holds 70% of the Kazakh deposits Akdala and Inkai, 30% of Khorasan, 100% of the US Wyoming mine (currently under construction) and other assets in the US, and 51% of HoneyMoon (under construction) in Australia.

Transaction is subject to the approval of all regulatory authorities in Russia, Kazakhstan, the USA and Australia. According to recent reports, on October 25, 2010 the US Committee on Foreign Investment has approved the transaction. Thus, Atomredmetzoloto's assets in Kazakhstan will

comprise Akbastau, Zarechnoye, Betpak Dala, Karatau and Kyzylkum uranium fields with total reserves of 133,293 tonnes.

In terms of the number of joint projects with Kazatomprom and total uranium production Rosatom is in the lead (over 25% of Atomredmetzoloto's uranium output in 2009 was mined by joint ventures in Kazakhstan, and this figure is expected to increase in 2010).

ARMZ plans to strengthen cooperation with Kazakhstan not only through its own subsidiaries but also by supporting the Kazakh subsidiaries of Uranium One. For example, it is expected that Karatau will boost the output of processing solutions to meet the needs of the Akbastau deposit) and, in the longer term, develop refining production based on Karatau JV and build a sulfuric acid plant.

Despite the disagreements Kazakhstan and Russia recognise the need for collaboration in the nuclear industry, as illustrated by the recent bilateral initiatives. We can presume that the former management of Kazatomprom aimed to maintain a balance between the interests of Russian and other foreign investors and not to allow any particular group of investors to dominate. The current management takes a pro–Russian stance. This, in our opinion, would greatly facilitate the process of integration of two countries.

5. Joint initiatives and projects in CIS countries

Rosatom has recently been in active search of new raw materials sources. On August 25, 2009, during President Medvedev's visit to Mongolia, the parties signed an agreement on establishment of the joint venture Dornod Uran on a parity basis, which will mine uranium in the Dornod deposit and, potentially, be responsible for the marketing end (Vestnik Atompromа, 2010v). This process halted after the change of government in the country. However, according to Sergey Kiriyenko, Mongolia still could make a final decision in favour of Russia (Moskovsky Komsomolets, 2010).

Russia has also shown interest in uranium mines in Armenia. According to Armen Movsisyan, Minister of Energy and Mineral Resources of Armenia, the Armenian–Russian Mining Company CJSC (registered on July 16, 2008) has plans to start drilling operations for exploration of uranium deposits until the end of 2010. The joint venture's charter capital of 92.241 million drams (about $300,000) is divided into 300 ordinary registered shares, and each party holds

	Mining	Conversion	Enrichment	Fabrication of fuel	Construction of NPPs
Kazakhstan	2 projects, 6,200 tonnes, 2011–2020	1 project, 12,000 tonnes, 2018	2 projects, International uranium enrichment centre, Uranium enrichment centre	1 project, 400 (+800) tonnes, 2013	1 project, 300 MW, 2020, $1 billion
Russia	6 projects, 8,600 tonnes, 2015–2024, > RR100 billion		2 projects, IUEC, UEC		7 projects, 11.4 GW, 2011–2016, RR700 billion
Armenia	1 project, initial stage				1 project, 1 GW, 2017, $5 billion
Belarus					1 project, 2.4 GW, 2020, $7–9 billion
Ukraine	1 project, 1,000 tonnes		1 project, IUEC	1 project, 200 (+200) tonnes, 2013	1 project, 2 GW, 2017, $5 billion
Mongolia	1 project, 1,000 tonnes				
Total	10 projects, 16,800 tonnes, 2011–2020	1 project, 12,000 tonnes, 2018	2 projects, IUEC, UEC	2 projects, 600 (+1,000) tonnes, 2013	11 projects, 17.1 GW, 2011–2020, > $41 billion

Figure 5.1.
Nuclear energy projects in CIS countries by nuclear fuel cycle step (design capacity, year of achieving design capacity, investment volume)

Source: Eurasian Development Bank

150 shares. Experts estimate the country's uranium reserves at 10,000 to 60,000 tonnes. Uranium from Armenia will be processed at the international uranium enrichment centre in Angarsk, Russia (Interfax–Kazakhstan, 2009).

Rosatom is active on the NPP construction market of the CIS countries. The Council of Ministers of the Republic of Belarus approved an intergovernmental agreement with Russia on cooperation in peaceful uses of nuclear energy. This document was signed on May 28, 2009 in Minsk and provides for the construction of an NPP in Belarus with two generating units of 1,200 MW each. The project will use the NPP–2006 design by Atomenergoproekt Saint Petersburg Research and Design Institute. The first unit will be commissioned in 2016 and the second in 2018. The proposed location of this NPP is Ostravets in Grodno region. A credit facility for the Belarusian government is being considered (Westki.info, 2009).

The Armenian government also approved the establishment of a Russian–Armenian closed joint–stock company on a parity basis for the construction of an additional generating unit at the Armenian NPP. It is expected that a Russian–made reactor with a capacity of 1,060 MW and service life of 60 years will be used; this design has a European safety certificate (Interfax–Kazakhstan, 2010).

It is particularly worth mentioning Russian–Ukrainian initiatives. In April 2010, it was decided to found a nuclear holding company comprising Russian and Ukrainian engineering, nuclear fuel cycle and power generation assets. The mainstay of this holding company will be Atomenergomash and Turboatom (Interfax–Ukraine, 2010).

Moreover, Russia is ready to sell Ukraine up to 50% of shares in a Novosibirsk plant that supplies nuclear fuel yo Ukrainian NPPs. The parties plan to jointly construct the third and fourth generating units at the Khmelnitsky NPP. Rosatom has indicated interest in developing the Novokonstantinovsky uranium deposit which has estimated reserves of 100,000 tonnes. According to Rosatom's General Director, total investment in the joint development of the field could reach $500 million (Rosbalt Business, 2010).

Experts comment that the deepening of Russian–Ukrainian cooperation in nuclear energy is a natural tendency, as the national nuclear sectors of these countries are heavily interdependent, at least in the fuel segment (Gilyova, 2010). The former Ukrainian leadership impeded this process, but the situation has now changed for the better.

Conclusion

The main objective of this industry review was to describe the current status of the global nuclear energy market and nuclear energy market in Russia and Kazakhstan. Our analysis of integration processes in the peaceful uses of nuclear energy in the CIS shows that both Kazakhstan and Russia attach great importance to the development of nuclear industry. Possession of nuclear technology enables a nation to diversify the entire economy – this is especially relevant to large exporters of raw materials and fossil fuel such as Russia and Kazakhstan, as they are highly dependent on world prices for energy resources.

The international nuclear energy market is dominated by competing giants such as AREVA, Cameco and others. In order to keep footing on the market, a country must possess both a strong uranium base and the entire technology. Neither Kazatomprom, which controls immense reserves yet has mastered only two nuclear fuel cycle stages, nor Rosatom, which has mastered the entire nuclear fuel cycle yet has access only to expensive uranium, can boast of having access to both components. Therefore, cooperation between these two companies is the most favourable desicion. The understanding of this fact has long been there, but progress is being delayed by various contingencies, resulting in unnecessary losses.

The integration aspect of nuclear energy development in the CIS still requires scrutiny, and this paper follows up on the EDB's analytical effort in the area of CIS countries' integration into the world community.

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