



## The Nuclear Fuel Market in Russia and the Former Soviet Union: The Dreams and the Reality

Alexander Pavlov & Nigel Mote

From the early 1970s the Soviet Union played a significant role in the international nuclear fuel market: first, as an exporter of uranium enrichment services, and later as an exporter of enriched and natural uranium. Since the collapse of the Soviet Union, Russia has continued to export the same commodities, while two other former Soviet republics, Kazakstan and Uzbekistan, have entered the international market and are currently selling natural uranium.

The roles of these countries in the international nuclear fuel market have been discussed and analysed extensively by other authors. The topic tackled in this paper touches a different issue: have commercial market relationships been established in the nuclear fuel cycle industry within Russia and other former Soviet Union (FSU) countries? An equally important follow-up question: have market relationships been established by these countries among themselves?

The change in political systems and the introduction of market economies in these countries evidently had an important impact on their various industries, including their nuclear enterprises. Did these changes transform the internal relationships between domestic producers, traders and consumers of nuclear materials, and how have the new internal relationships in the industries of these countries influenced their export policies and their activities in the international market?

To answer these questions we need to examine whether the features characteristic of commercial

markets are present in particular cases under consideration. The key features to look for would be:

- the presence of multiple producers and consumers for each commodity;
- the presence of specialised traders;
- prices established as a function of production costs, production capacities and demand for products and services;
- the existence of competition;
- the circulation of marketing information and advertising material.

In order to better understand the FSU nuclear market, it is necessary to establish what is being produced and for which consumers in each of the former Soviet republics. These data are summarised in Table 1.

To better understand the table, a few clarifications are helpful:

- The table shows only those producers, consumers and traders who are involved in the supply and consumption of products and services used for nuclear power generation; no other nuclear activity is considered.
- The Ulba fuel fabrication plant in Ust-Kamenogorsk, Kazakstan, is part of the state nuclear company, Kazatomprom; it produces  $\text{UO}_2$  powder and pellets to be shipped to a fuel fabrication plant in Russia.
- For its “internal” needs (meaning Russia, FSU, Eastern Europe), Minatom of Russia currently uses uranium accumulated in different stockpiles,

Table 1. Nuclear fuel cycle suppliers and customers in the Former Soviet Union

	Russia	Ukraine	Kazakstan	Uzbekistan
<b>I. Producers:</b>				
Uranium	1 (PCPA) <sup>a</sup>	1 (VMC)	1 (KAP)	1 (NMMC) <sup>a</sup>
Enrichment	1 (Minatom)	No	No	No
Fuel	1 (Tvel)	No	1 (KAP) <sup>b</sup>	No
Power	1 (REA)	1 (GKA)	1 (ME)	No
<b>II. Consumers:</b>				
Uranium	1 (Minatom)	1 (GKA)	1 (KAP)	No
Enrichment	1 (Tvel)	1 (GKA)	1 (KAP)	No
Fuel	1 (REA)	1 (GKA)	1 (KAP)	No
Power	1 (RAO EES)	2 (NDC,ER)	1 (ME)	No
<b>III. Internal traders:</b>				
Uranium	No	No	No	No
Enrichment	No	No	No	No
Fuel	No	No	No	No
Power	1 (RAO EES)	1 (ER)	1 (ME)	No
<b>IV. External traders:</b>				
Uranium	1 (TENEX)	No	1 (KAP)	1 (NMMC)
Enrichment	1 (TENEX)	No	No	No
Fuel	1 (Tvel)	1 (GKA)	No	No
Power	1 (RAO EES)	1 (ER)	1 (ME)	No
<b>V. Competition</b>				
	No	No	No	No
<b>VI. Information Availability:</b>				
Uranium	Irregular	Classified	Irregular	Irregular
Enrichment	Classified	—	—	—
Fuel	No	—	—	—
Power	Available	Available	Irregular	—
a	Currently all new uranium is produced for export			
b	Currently all powder and pellets are produced for export			
PCPA	Priargunsky Chemical Production Association, Krasnokamensk, Russia			
Minatom	Ministry of Atomic Energy, Russia			
Tvel	Joint Stock Company Tvel (Russian fuel fabricator)			
REA	Joint Stock Company Rosenergoatom (Russian nuclear utility)			
RAO EES	Joint Stock Company Unified Energy Networks of Russia			
TENEX	Joint Stock Company Techsnabexport, Russia			
VMC	Vostochny Mining Combinat, Zheltye Vody, Ukraine			
GKA	Goskomatom, State Committee for Atomic Energy, Ukraine			
NDC	National Distribution Centre, Ukraine			
ER	State Company Energorynok (Ukrainian electricity trading company)			
KAP	State Joint Stock Company Kazatomprom, Ust-Kamenogorsk, Kazakstan			
ME	Ministry of Energy, Kazakstan			
NMMC	Navoi Mining and Metallurgical Combinat, Navoi, Uzbekistan			

including enrichment tails and uranium recovered from reprocessing; however, this situation may soon change and Minatom may well absorb all new domestic production of uranium leaving none for export.

Sections I through IV of the table show the number of participants in each field of activity within each

country. In all cases except one, each country has no more than one entity in each — not a strong sign of developing commercial enterprise.

Sections V and VI of the table qualitatively characterise other indicators of commercialisation. These two sections also show little sign of a move towards more open markets. Clearly, there can be

no competition if there is only one player. Equally clear is that with no competition there is no need for marketing activities and no need to make marketing information available.

However, despite a closed domestic market, it may be surprising that no marketing information is available to promote international trade. This is the result of the separation of responsibilities, with the producer not being responsible for export sales. Because of this separation, the producer does not feel that advertising is his responsibility and does not consider that release of production information has any merit to him.

Probably the most important feature related to commercialisation, however, is not reflected in Table 1. This is the formation process by which prices are established. Prices established by Russian, Kazak and Uzbek negotiators in international deals are based on world market prices, particularly on existing market conditions. But it is with internal prices that the puzzles start. To be able to establish the correct price, it is necessary to start with real productions costs and real financing costs.

Until recently, both were nearly impossible to assess accurately in the FSU countries. The perception of cost was so distorted by the centrally planned economy, and even more in the later period of *perestroika*, that now no-one can be sure which figures are meaningful. It may be fortunate for the producers that they are relieved of this impossible task as it is currently not their responsibility to establish prices for their products. The state government takes this responsibility on its shoulders. However, more often than not the result is very far from economic reality.

It is interesting to look at some examples how prices are established. The price for electrical energy in Russia is established by the single monopolist energy distributing company, Unified Energy Networks of Russia (RAO EES), reportedly on the basis of average costs of energy produced by the system. At the same time, RAO EES is the owner of most of the conventional electrical power plants — thermal and hydroelectric. Nuclear power plants belong to another state owned company, Rosenergoatom.

According to official sources, the 1996 average cost of electrical power produced at Russian nuclear power plants was US\$0.0125 per kWh. This is at least a factor of two less than the cost of energy produced by conventional plants. All power is supplied to the single distributor, RAO EES, which sells it on to the customers. Due to the difference in average costs, this monopolist distributor makes

a profit on nuclear power of between 63% and 250%. By comparison, the calculated profit to be received by the nuclear plants (at current prices) is 24%.

At the same time, only 1.6% of payments to Rosenergoatom for its power is in real money. The remainder of the payments come in other forms, such as barter for materials and supplies or mutual cancellation of debts. Of the total payments due for power delivered by nuclear plants in 1996, 40% was not paid at all. Obviously, this situation leaves the Russian nuclear power plants far from being ready to survive in a true market economy.

In Ukraine, electrical power production and distribution — including power produced at nuclear plants — are managed and regulated by the Ministry of Energy. The electrical power produced by a power plant is delivered to the National Distribution Centre (NDC), the ministry's power distribution organisation. The prices are established centrally as follows. NDC pays a fixed price to the power plants of around US\$0.027 per kWh. NDC supplies energy to regional energy distribution centres at a different fixed price of US\$0.031 per kWh. Regional distributors deliver energy to customers for US\$0.037 per kWh.

All of the members of this chain are state-owned organisations with no interest in creating a market economy. The difference between the price paid to the producer and the price paid by the customer is used to cover operational costs of these organisations and to supply some revenue to the national budget. It is evident that fixed price of US\$0.027 per kWh paid to all producers has very little relation to market realities like production costs or market demand.

However, it would be wrong to say that there is no such thing as market price for electricity in Ukraine. Recently another distributor was introduced into this process — Energorynok, a company created to start introducing market relationships into this branch of the industry. Currently, Energorynok is allowed to buy electrical power in those areas of the country where the supply exceeds a target set by the ministry, which is required to be delivered to the NDC.

Energorynok will negotiate a price for that extra energy with the supplier, buy it and sell for a profit to any customer prepared to pay the price, including any customers outside the country. The only limitation imposed on these deals is that the payments should be in real money. No surrogates are allowed, such as letters of credit or mutual cancellation of debts. If this mechanism works it

may become the beginning of an electrical power market in Ukraine. At this point it is too early to judge.

A similar process is forcing its way into Russia as well. The government has decided to create a federal wholesale market for electrical power, to break the monopoly of RAO EES. This is supposed to be a kind of energy stock exchange where all producers and buyers can buy electrical power on the basis of competing offers. However, the prices are not going to be established through market conditions. Special commissions have been formed to calculate energy prices for every region. Nevertheless, because it represents progress compared to the existing system, this concept is being welcomed by many members of the community except, understandably, the most powerful one: RAO EES. Whether it will work or not, we shall see, and it may not take long.

However, the greatest progress towards a real energy market has been made in Kazakstan. Electrical power production there is decentralised and, to a large extent, is privatised. Many conventional power plants belong to different owners and sell energy to different customers. Their prices are also different, although they are regulated by the Ministry of Energy in each region of the country. In addition to purchasing from domestic producers, energy consumers can also import electricity from Russia. However, while there is competition in the power generation market, this competition does not include nuclear power. The only nuclear power plant in Kazakstan, at Aktau, belongs to the Ministry of Energy, which channels its generation through networks that are under the same Ministry of Energy management.

Nuclear fuel commodities, as will now be apparent, are not produced, distributed or purchased in the FSU countries in a free commercial market. Supply is highly monopolised, generally in the hands of state-owned companies or government departments.

Of course, upon closer examination the unique situation in each particular country becomes more clearly defined. For example, in Russia there is a greater variety in the forms of ownership and management than in Uzbekistan or Ukraine. Some plants in the Russian fuel fabrication industry have gained a considerable degree of independence from Minatom. Many parts of the Russian fuel cycle industry have succeeded in liberating themselves from the heavy load of social infrastructure, which until recently contributed substantially to their production costs.

In contrast, the Uzbek uranium mining company still carries that load, which deters foreign investments in that industry. The existence of an energy market in Kazakstan has already been noted. Many other differences between these countries could be addressed, but each of them is only an island in a general picture in all those countries of a government-owned and centrally-controlled nuclear industry.

What are the reasons for the current situation, more than five years after the economic systems in these countries started to change and after the world economic community accepted Russia into the Group of Seven, apparently recognising it as a country with a market economy? Why is the nuclear industry still subject to government administration and control? The reasons become more logical, and justifiable, upon closer analysis.

First, we must not lose sight of the fact that these new and fledgling separate nuclear industries emerged not as a result of a natural progressive development in their countries of origin, but in the course of the dramatic collapse of an enormous and well-organised military-industrial system. If these pieces of the broken system were subjected to the brutal realities of a real market economy none of them would be likely to survive.

This has happened in some of the less protected branches of the Russian economy, which disappeared under the flood of cheaper imported goods. For example, last year most of the Russian liquor plants, which produce the famous Russian vodka, were on the brink of closure. Only swift protection measures by the government, which introduced import barriers for foreign liquors, saved this delicious drink from extinction.

As for the nuclear industries in the FSU countries, despite being a fraction of the nuclear industry in the Soviet Union, each had the ability to survive in a hostile environment because it was unique and was an essential component of an integrated system. However, because of this delicate balance between them, none dared start to introduce commercial changes for fear that upsetting the equilibrium would threaten their existence.

Consequently, the industry leaders deliberately chose to protect their industries against outside competition. By being heavily involved in the Russian political scene, industry leaders were able to protect the main nuclear institutions. Several decrees were issued by President Yeltsin that limited privatisation in the nuclear industry and provided for centralised budget funding of Minatom activities and its subordinate enterprises. In reality, this

was natural because of the strategic importance of nuclear energy, especially in Russia, which inherited the status of a nuclear superpower. The essential role of protecting the industry's structure and resources is the responsibility of the Minatom minister.

Similar factors that worked against the rapid introduction of a market economy in the nuclear industries of other FSU countries included:

- Nuclear power is of strategic importance for Ukraine, with more than 30% of electrical generation coming from nuclear power plants.
- Uranium and gold, produced at the same mines and mills, are essential to the economy of Uzbekistan.
- Natural uranium mining and sales are essential to the economy of Kazakhstan.

Part of the strategy adopted by each country was to introduce legislation preventing privatisation of these industries or even of their subsidiaries. Another aspect was to preserve the veil of secrecy over all nuclear activities, which provided an image of stability and did not advertise the internal problems to the outside world. The third component — preservation of the state monopoly on international trade in nuclear materials — also protected the industry from the risks of sudden changes, which could be introduced by inexperienced commercial organisations if allowed to control these industries. However, while these protection measures successfully avoided any components of the industry failing, they also precluded any real development of domestic or international commercial market relationships.

There was another reason for not immediately introducing a market economy. This factor, common to all FSU nuclear countries, could help ruin the industries if they were allowed to travel unguided down the road to free market competition. All countries with established market economies have very detailed and well-developed legislation governing the commercial relationships between participants in markets. The countries of the FSU are still a long way from that level of legal order. Even though the legislative situation has improved rapidly, and now in Russia, for example, there is none of the legal chaos that existed around 1992, the legal system still is not sufficiently well-developed to allow the predictable and smooth functioning of market institutions.

Finally, the lack of experience and understanding of how to survive in a market economy also worked against the fast introduction of market relations into the industry. Those factors still play a

considerable role in hindering progress in that direction.

However, now is a time of optimism and the current situation is very different from what it was five years ago. The Russian nuclear industry is far better prepared now to accept the realities of trading in the open international market, maybe even more so than the nuclear industries in Kazakhstan, Ukraine and Uzbekistan. So, let us consider which sectors of the industry are likely to enter the real market first. We shall take Russia, as it is the most important country in terms of the size of its operations and because it has all elements of the fuel cycle in its nuclear industry.

At present, uranium production in Russia remains heavily dependent on centralised resources and administrative decisions. Moreover, Minatom is today making a significant commitment of funds, obtained from the HEU deal, into exploration for new uranium deposits and the introduction of new uranium extraction technologies. The production costs of the only existing underground mine are high and continue to grow. Thus without production at new sites the Russian strategy for using natural uranium will need to shift from meeting export commitments to satisfying domestic demand. Strategy will be prompted by the depletion of the national stockpile and limited production capacities.

At the same time, there is increasing confidence that the Russian nuclear power programme will be revitalised soon and will start to require more uranium. This scenario leads to the conclusion that future uranium production will stay in the hands of the single state-controlled producer, Atomredmetzoloto, and will be consumed by the single customer, Minatom (or Rosenergoatom). There is thus little chance for the development of market relations in this branch of the industry.

The existing export of Russian uranium into the international market is likely to gradually disappear, or even reverse into imports. If this happens, the result could be competition within Russia between imported and domestically produced uranium. Although not truly the start of a Russian uranium market, if by the time this happens the purchasing of uranium is also decentralised, it may mark the start of the development of a competitive domestic uranium market. When may it happen? The only certain answer is — not next year.

Let us turn now to the fabrication industry. Currently it is also highly centralised, with the state-owned joint-stock company Tvel being the only fuel manufacturer. This branch of the industry,

however, probably has the greatest need for independence of the individual production plants, whose future progress is vital if Russian-made fuel is to successfully compete. There are two fabrication plants, Electrostal and Novosibirsk, both with great potential for a successful independent existence. The current policy of Tvel and Minatom, however, is to preserve the monopoly, continue with centralised resource supplies, and keep the old-style system of price formation.

Certainly, there are positive sides to that strategy, given the current economic situation in the country, and it is impossible to judge from outside whether this strategy is better than the strategy of independence and competition. The fact remains that no fresh fuel market exists in Russia, and there are no signs of it emerging without some external influence.

But what has already entered the picture is the competing Western product in what used to be captive markets in the FSU and Eastern Europe, and this cannot be stopped as easily by administrative measures. There is strong pressure from such important customers as Ukraine and Eastern European countries in favour of such competition, which may prompt the accelerated transformation of Tvel into a more market-driven organisation.

The enrichment industry, although considered domestically to be the most technically advanced in the world and the most competitive from the market point of view, is the least advanced in commercial terms. The reasons are the same as those already mentioned, magnified by the strategic importance of enrichment and its direct involvement in the weapons programme.

Minatom enrichment plants have not even been formally converted to joint-stock companies, as has been done with fuel fabrication and uranium enterprises. All four plants still report directly to Minatom, in the same way as the US Enrichment Corporation (USEC) used to be a part of the US Department of Energy (DOE). The product from all four plants is sold to international customers through contracts signed by one trader, Tenex. As for domestic consumers, they buy enrichment through the fuel fabricator, Tvel. So for the enrichment plants, there is no competition, no independent pricing policy and no market. Will it come one day? Maybe; more on that later.

For the nuclear power plants, it is seemingly the same picture again: a state-owned joint-stock company, Rosenergoatom, a monopolist, buys

supplies from one source, Tvel, and sells energy to one customer, RAO EES. Production costs are not known for certain and prices are dictated from above. However, this scenario has some very important distinctions, which make us think that this entity is probably closer than others to developing a Russian market for a nuclear product.

Rosenergoatom is the only nuclear operator whose output leaves the Minatom system — the product is not consumed inside the system, it is delivered to an external customer. This makes life much tougher and requires involvement with the outside world, requiring Rosenergoatom to try to be more efficient. Effectively, there is a competition at this end of the process. The competing power producers, ie. the conventional power plants, are certainly more costly and suffer greater economic difficulties. But still they do exist and provide some measure of competition.

Furthermore, this is not the only difference. As we have said, the Russian nuclear power programme shows new signs of potential expansion — which may happen very soon. A number of factors point to this. For one thing, in recent years the Russian economy has become uncomfortably dependent on a single source of energy supply: natural gas. In European Russia, natural gas makes up 80% of fuel consumption and is responsible for 60% of electrical energy production. This dependence is doubly risky: it is a monosource and it is monoregional (that is, all the gas is produced in the same region of northern Siberia, Tyumen).

This situation has recently set off a number of alarming voices in the Russian economic press. The logical answer is to accelerate nuclear power development. It is most likely that, with improving economic stability, the nuclear power industry will soon start to expand rapidly. The investments needed for that growth will most likely come not only from the government but from the private sector as well. Inevitably this will mean a move towards the privatisation of nuclear power plants and consequently the break-up of the Rosenergoatom monopoly.

The seeds of this can already be seen. Mr Gusarov, the director of the Kursk nuclear plant, has suggested that Kursk 5, construction of which is 90% complete, may be completed with the help of private investment. Similar ideas were voiced by Minatom first deputy minister, Mr Ryabev. Steps have also been taken to create industrial consortiums for nuclear power plant construction at the South Urals and Leningrad power plant sites. To use Mr Gorbachev's favourite saying: "The process has

started to move!" In Russia it will not be surprising to see in few years, instead of one state-owned consolidated nuclear power utility, maybe four or five independent nuclear power producers.

Now it is probably time to return to the other members of the nuclear industry family and dream a little about their future.

Imagine that independent nuclear power plants succeed in breaking the Rosenergoatom monopoly and form a group of independent companies representing the basis of a Russian nuclear power market. Which sector of the industry is the most likely to follow next in this process? It is not unlikely that the two Russian fabrication plants will be allowed to compete between themselves for fuel supply orders to stop their traditional customers from moving to ABB, BNFL and Westinghouse.

Naturally, independent utilities will also want to buy other commodities on the open market to minimise their costs and obtain the most favourable prices. Atomredmetzoloto, or by that time possibly its subsidiary uranium production companies, will then have to compete in that market, as will the Kazak and Uzbek producers. This will probably stimulate better and faster growth in the Russian uranium industry.

However, the most interesting consequences could occur in the enrichment industry. Modern Russia is well-known for copying everything which is good, and everything which is bad, in the West. One of the recent actions of the US government,

which attracted a great deal of attention in the Russian nuclear community, was the move to privatise USEC. In line with the developing Russian national characteristic of taking its lead from the West, it is not impossible that the Russian enrichment industry may follow the same road.

Will it result in the emergence of four independent enrichers? Or even more? Surprisingly, even today nothing theoretically prevents the creation of multiple independent uranium enrichment companies in Russia. What is more, private isotope separation companies have for some years been working and selling stable isotopes on the domestic and international markets. There are probably no more than three or four of them and they are small, but they are well-known in the world stable isotope market. They possess and use exactly the same advanced gas centrifuge separation technology used by the four big Minatom plants. Some of them actually participated in the development of that technology in cooperation with Minatom research institutes. So it is not impossible that these small companies will give birth to a uranium enrichment market community in Russia, probably even before the four big plants have realised what is happening.

So what do we conclude about the nuclear fuel cycle markets in the FSU? The reality is that at present they do not exist. The dream is that in the future they will — and it may not be long before the dream comes true.