World uranium supply and demand: The changing market

The integration of global economic systems has compounded problems uranium producers are facing in today's uncertain market

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During the 1970s, the civilian nuclear industry of the West prepared for a high rate of growth. Uranium production facilities were expanded to meet what were subsequently found to be overly optimistic uranium requirements. Beginning in 1975, uranium production significantly exceeded requirements and a large inventory built up. By 1979, this oversupply had led to falling production and a 14-year decline of uranium prices.

In the period 1985-88, it appeared that the Western uranium market was making progress in bringing supply and demand back into balance. However, in the late 1980s, the market was further destabilized by political and economic developments resulting from the dissolution of the Soviet Union and its trading bloc.

The main result has been the onset of integration of two formerly mutually exclusive economic systems. In the 1990s, the free market system of the West and the formally centrally planned ones of the East are evolving into a free global market. This economic integration has affected nearly all commodities, including nuclear fuels.

This report provides an analysis of uranium supply and demand under the current conditions of this developing global market. While an analysis is possible, it should be borne in mind that available information is not always complete under conditions of major reorganization, and consequently some speculative assessment is required. Therefore, although this article is based on the latest information available, it should be considered as background material for further analysis rather than as an accurate forecast for the future. The level of uncertainty is particularly high regarding the future availability of nuclear materials produced in newly independent States (NIS) emerging from the former Soviet Union.

Another factor related to the end of the Cold War adds additional uncertainties to the uranium market. Political support for dismantling warheads is gaining momentum worldwide, and it is possible that recycled nuclear materials from plutonium and high enriched uranium (HEU) of the military fuel cycles could be available on the civilian market within the next decade. Analysts are attempting to understand what impact this programme could have on uranium requirements normally met by mine production.

Uranium supply and demand: Imbalances

The current uranium market is primarily determined by several related components: reactor-related demand, uranium supply, and uranium prices. In contrast to the uncertainty regarding uranium supply, the current demand is well documented. It is determined by the nuclear generating capacity in 30 countries. At the end of 1992, a total of 424 nuclear power plants having a combined nuclear generating capacity of 330.6 gigawatts-electric (GWe) were operating. The resulting reactor-related uranium requirements were about 56 800 tonnes, of which about 45 000 tonnes were required by Western consumers.

World uranium production in 1992, on the other hand, was estimated to be about 35 500 tonnes, with Canada, Niger, Kazakhstan, Uzbekistan, and Russia accounting for more than 55% of the total. When comparing production in 1992 with that in 1988, the first year for which global estimates are available, some major changes are apparent. The estimated 1988 production was about 60 000 tonnes. By 1992 production had declined by 40% to 24 500 tonnes. Production decreases occurred in nearly all countries, ranging from 25% for Canada to

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nearly 100% for the former German Democratic Republic. *(See table.)*

The falling uranium production is accompanied by many industry changes in both the East and the West. These include reorganization, falling employment levels, and redirection of resources. Since 1989, industry ownership in the East has been transferred from a few centralized government operations for which the central nuclear authority in Russia, the Ministry of Atomic Energy (Minatom), was the only customer. Now independent, decentralized, and in some cases, privatized companies produce and sell uranium in the former Soviet bloc. These new industries are aggressively seeking new customers to buy their production.

In the West, changes in ownership of both resources and production facilities have occurred frequently since the early 1980s. Many former producers have exited the industry. Ownership has been transferred from smaller firms and is increasingly concentrated under a few large mining firms and/or government-sponsored programmes.

Less efficient, higher cost production centres continue to be closed in favour of efficient, lower cost centres. Production is increasingly coming from higher grade, larger facilities, and/or more cost-efficient technologies. An estimated 27% of 1992 global production came from four large high-grade and rather unconventional deposits in Australia and Canada, while several *in-situ* leach mining (ISL) projects produced 11% of the total. An important technological change is the growing emphasis on mining from sandstone-hosted deposits using ISL technology. While the relative importance of ISL technology has grown in the West, primarily in the United States, the technology is proving to have even greater significance in Central Asia and Eastern Europe.

The cuts in worldwide production resulted from several political and technical developments. These developments started as early as 1950, with global over-production of uranium for both civil and military applications and the resulting buildup of stockpiles and inventories. The marked decrease in political tensions between the East and West, and the lower than expected growth of nuclear power in the world, additionally opened vast stockpiles to the civilian market. At present, civilian uranium stockpiles are estimated at about 240 000 tonnes worldwide, a level that has driven down market prices and forced producers to reduce output.

In addition to civil inventories, large amounts of uranium are involved in military applications. HEU, plutonium, and natural uranium held in various forms by the military is estimated to total about 360 000 tonnes natural uranium-equivalent. While the military material currently is not available to the market, both civilian and military stockpiles influence market prices.

	Production 1988 (tonnes uranium	Production 1992 (tonnes uranium)	Decrease (%)
Australia	3 532	2 346	34
Bulgaria	850	100	88
Canada	12 393	9 250	25
CSFR (former)	2 700	1 539	43
France	3 394	2 127	37
GDR (former)	3 965	232	94
Hungary	576	412	28
Namibia	2 965	1 692	43
Romania	900	100	89
South Africa	3 800	1 769	54
Soviet Union (former)	15 000	8 550	43
USA	5 040	1 808	64

Comparison of uranium production for selected countries: 1988 and 1992

Some key relationships

Data for 1992 on uranium supply and demand data indicate some key relationships. For 1992, reactor-related uranium requirements of 56 800 tonnes, and corresponding uranium production of 35 525 tonnes, yield a worldwide production deficit of 21 275 tonnes. For 1988, in contrast, available data indicates a global demand of 51 000 tonnes and uranium production of 60 800 tonnes. This equates to over-production of nearly 10 000 tonnes. In 4 years, then, the worldwide supply-demand relationship has changed from excess production with rising inventories to one of falling production and declining inventories. *(See graphs, page 11.)*

Over the last 4 years, supply-demand relationships differed substantially between, and among, Western and Eastern countries. (These countries formerly were grouped as the World Outside Centrally Planned Economic Areas (WOCA) and non-WOCA areas, respectively.) Within WOCA, demand has exceeded production since 1987. In 1992 only 50% of reactor demand (i.e., 46 000 tonnes) was met by WOCA production. In contrast, 1988 non-WOCA production of about 24 000 tonnes was about 300% of reactor demand. Only 4 years later, in 1992, non-WOCA production exceeded reactor demand of 10 800 tonnes by only about 13%.

An imbalance of production and demand is not new to Western consumers. It will not for the forseeable future have any impact on the operation of nuclear power plants, as long as material from existing stockpiles and inventories is available on the market. The production shortfall,

Uranium exports to the USA and EC from the Soviet Union and successor States, 1986-92

	USA	EC	Total
1986	87	0	87
1987	219	0	219
1988	105	0	105
1989	534	0	534
1990	2327	1100	3427
1991	2426	2057	4483
1992	1305	2500	3805
Total	7003	5657	12660

Notes: Values are in tonnes uranium.
Sources. US Energy Information Administration, Euratom Supply Agency

both in the Western world and on a global basis, is being filled from existing civilian uranium inventories.

Effects of economic integration

With a few exceptions, all uranium transactions before the late 1980s took place in the two mutually exclusive trading areas known as WOCA and non-WOCA. The first transactions between these areas occurred when the Soviet Union sold enriched uranium to the Republic of Korea, and China sold uranium to utilities in Finland, France, and Germany. The amount of material involved in the transactions was relatively small, less than 1000 tonnes per year. The sales were made under long-term contracts and had relatively little impact on the market.

In contrast, the exports from the Soviet Union and its successor States Kazakhstan, Kyrghyzstan, Tajikistan, Russia, Ukraine, and Uzbekistan were different. Significant sales to the West first started in 1989 and increased until 1992. They primarily took place on the spot market and were first conducted through partnerships with Western trading organizations in Germany and the United States.

The exports began in about 1988, with the transactions carried out through the Soviet concern, Technabexport. However, the subsequent independence of Kazakhstan and Uzbekistan led to direct negotiations and contracts between the newly independent States (NIS) and Western customers. An example is the sales agreement signed in 1992 between KATEP, the Kazakh production company, and Energy Resources of Australia. The agreement provides for the sale of as much as 1925 tonnes uranium over a 5-year period.

Chinese exports to the West were made under long-term contracts at prices generally higher than spot prices. Both the amount of uranium and the pricing mechanism were considered to be less disruptive of the market than were the exports from the former Soviet Union and the NIS. Exports from these States were sold at such low prices that they were below the production cost of all Western producers and were therefore considered as "dumping" by US producers.

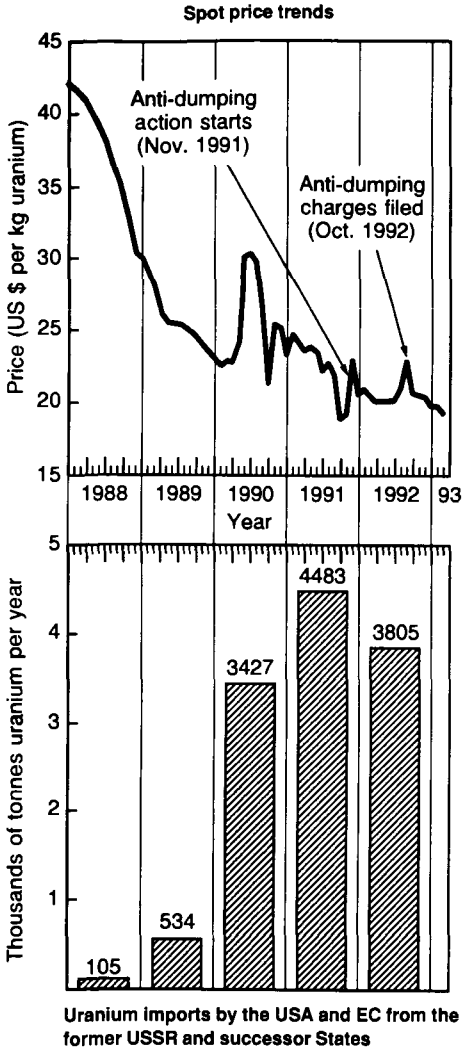
For this reason, on 8 November 1991, a coalition of 13 US uranium producers and the US Oil, Chemical and Atomic Workers Union filed an anti-dumping petition with the International Trade Administration of the US Department of Commerce (DOC) and the US International Trade Commission (ITC). Following review of materials received from both sides, the ITC made a preliminary decision on 18 December 1991 that the US industry had been injured by reasons of such imports. In order to resolve the dispute, on 16 October 1992, DOC announced that it had signed a quantitative restraint with six NIS (Kazakhstan, Kyrghyzstan, Russia, Tajikistan, Ukraine, and Uzbekistan). *(See table.)* These agreements place quotas on the annual amounts of uranium imports from these

US quota allocations for uranium imports from newly independent States

	amounts in tonnes of uranium				
Price (US$/kg U)	Russia	Kazakhstan	Uzbekistan	Ukraine	Total
33.8	192	385	385	154	1116
36.4	188	431	431	154	1204
39.0	385	538	538	192	1653
41.6	538	692	692	192	2114
44.2	769	961	961	188	2879
46.8	1269	1346	1346	188	4149
49.4	1461	1538	1538	346	4883
52.0	1846	1923	1923	385	6077
54.6	*	*	*	*	*

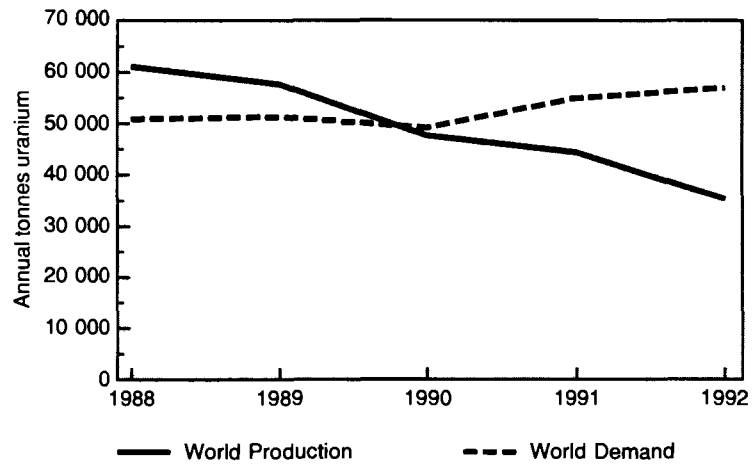
* Unlimited for all States except that Russia may import no more than 2115 U_3O_8 equivalent in the form of low-enriched uranium.
Notes: Kyrghyzstan and Tajikistan have no uranium production or enrichment capacity.

Spot prices and uranium imports from the former USSR and successor States

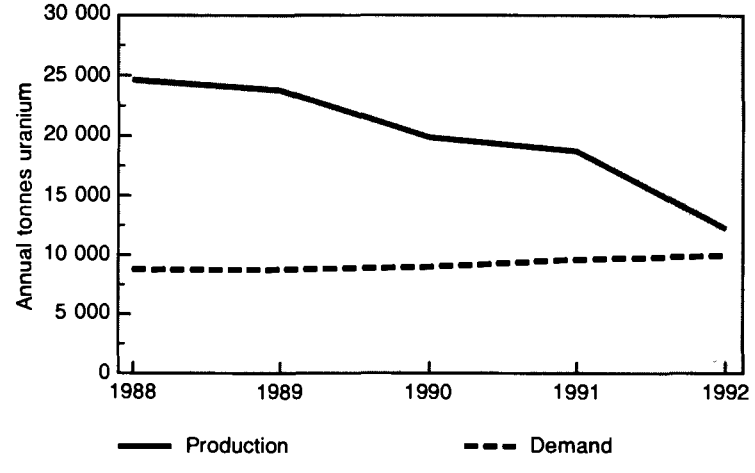


Uranium imports by the USA and EC from the former USSR and successor States

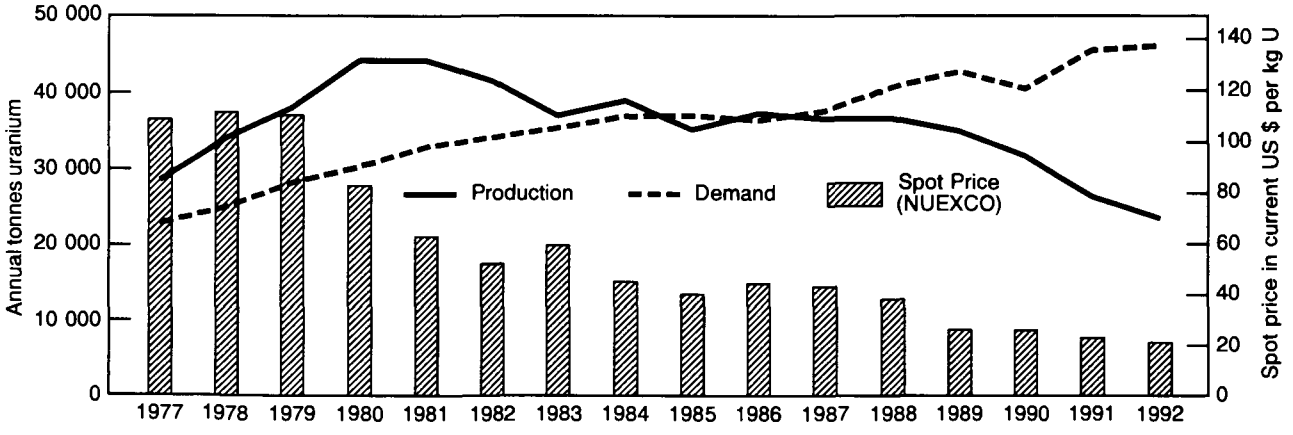
World uranium production and demand



Uranium production and demand from non-WOCA



WOCA uranium production and demand vs. the spot price



Note: Spot price as set by Nuexco Exchange Value.

countries into the United States during the next 10 years and are tied to the domestic US market price of uranium. Specified long-term uranium import contracts signed by US utilities before 5 March 1992 are grandfathered. The DOC will monitor the adherence of the six NIS to the agreements.

Since the October 1992 signing of the restraining agreements, the price of uranium sold in the US has not risen above US $33.80/kg. Therefore, new uranium exports from Kazakhstan, Russia, Ukraine, and Uzbekistan have been prohibited from entering the United States. As a result, US buyers have had to purchase uranium from other sources. During the period October 1992 and March 1993, US buyers have paid between US $5.25 and US $6.63 per kg more than unrestricted spot purchasers.

The European Community (EC) is also concerned about the impact on the uranium market of sales from the NIS. Before 1990, there had been no significant import of Soviet uranium by the EC. However, between 1990 and 1992, sales in the EC of uranium from the NIS increased from about 9% of net requirements in 1990 (which were 12 000 tonnes) to about 20% of net requirements in 1992 (which were 12 500 tonnes). Uranium imports from the NIS by the EC increased from zero in 1989 to 1100 tonnes in 1990, to 2057 tonnes in 1991, to nearly 2500 tonnes in 1992. The total for 1990-92 is about 5657 tonnes. *(See table, page 10.)*

The Euratom Supply Agency (ESA) has taken a less formal approach than the United States regarding exports from producers in the NIS. In response to the perceived destabilizing effect of the imports, ESA reviews all contracts between EC customers and NIS producers and has reserved the right to approve or deny contracts on a case-by-case basis. ESA's policy of limiting uranium imports from the NIS to about 15% of EC requirements is enforced through an informal set of guidelines that the agency has not made public.

Projections of world uranium supply and demand

(tonnes uranium)	1993	1995	2000	2005	2010
Reactor requirements	59 000	61 700	68 700	71 000	80 000
Production capability (WOCA)	23 000	39 200	37 300	40 400	38 600
Required additional production capability	36 000	22 500	31 400	30 600	41 400

Source Uranium Resources, Production and Demand jointly published by the IAEA and NEA/OECD

Projected uranium supply and demand

Projected uranium demand worldwide for the period 1993 to 2010 is derived from the expected development of nuclear electricity generating capacity. As estimated in the 1992 edition of *Uranium Resources, Production, and Demand* ("Red Book"), world capacity is expected to grow from 347.6 GWe in 1993 to about 481 GWe in 2010. This results in projected annual uranium requirements for the same period ranging from 59 000 tonnes to nearly 80 000 tonnes.

The corresponding projection for world uranium supply is not available, as the necessary information regarding production capabilities of important producers in Kazakhstan, Russia, and Uzbekistan has not yet been made public. However, an attempt has been made to relate the projected world reactor requirements with the projected WOCA production capability (based on low-cost existing and planned production centers). This was done to show how much uranium has to come from other sources. *(See table.)*

Based on this projection, the cumulative aggregate world uranium requirement for the period 1993-2010 is 1 242 950 tonnes. The WOCA production capability from existing and planned centers for the period is 676 000 tonnes. To balance supply and demand on a worldwide basis, a cumulative additional 567 000 tonnes uranium is needed.

This additional supply is expected to come from five Eastern producers — the Czech Republic, China, Kazakhstan, Russia, and Uzbekistan — as well as from material entering the market from inventories and stockpiles. Assuming the cumulative sustained production of 11 000 tonnes per year by Eastern countries (or nearly 200 000 tonnes over the period 1993-2010) there is an uncovered cumulative supply of about 370 000 tonnes of uranium. This shortfall has to be met by material from secondary sources. These include worldwide stockpiles of 240 000 tonnes, more effective use of uranium through higher burn-up of nuclear fuel, and the more speculative supply presently existing in warheads and the military nuclear cycle. The military cycle is estimated to contain over 360 000 tonnes uranium-equivalent. The use of reprocessed civilian uranium is not expected to make a significant contribution to the global uranium supply before the year 2010.

By around the year 2005, the worldwide stockpiles of 240 000 tonnes should be exhausted. This conclusion emerges by analyzing the timing of the inventory drawdown under the

assumption of a stable 11 000 tonnes per year from Eastern producers, and an estimated drawdown of stocks to fill the remaining gaps.

An evolving uranium market

Today's market is heavily influenced by the continuing oversupply, which unfortunately is perceived as a permanent condition. As indicated above, there has been a worldwide production shortfall since 1990. A similar shortfall occurred in the Western market after 1987, with little noticable effect on the overall market. Since 1987, the market has been a buyer's market, characterized by soft prices.

As with other natural resources, such as oil and copper, there are two prices for uranium: the spot price for short-term deliveries and the contract price for longer-term deliveries. The amounts of material traded under these prices differ. The volume of material traded on the spot market increased significantly in the last few years, although the large majority of the material is still traded under long-term contracts. Between 1988 and 1992, the sales of material originating in the Soviet Union and the NIS was accompanied by increasingly depressed spot market prices. *(See graph, page 11.)*

What is the outlook for uranium-related activities under current market conditions of large excess inventories and an uncertain future? Low market prices are expected to prevail until civilian inventories are exhausted sometime between the year 2000 and 2005. This will have several impacts. Western production will continue to decrease. In contrast, some of the NIS producers indicate their production costs are below world market prices, and this could mean they may be able to maintain production levels. NIS uranium production also will decline, however, unless these producers are able to sell their product in spite of the Western market restrictions. Russia has its own nuclear fuel requirements and could justify continued production to meet these needs. This is not the case for Kazakhstan and Uzbekistan which have no significant requirements. In summary then, the depressed market will be responsible for additional reductions in production capability and further erosion of the financial strength of the industry. Ownership of production facilities will continue to consolidate under the control of a few large owners. Further cuts in exploration activities also are expected.

What is the long-term effect of these conditions? Once excess inventories are exhausted, reactor operators will again turn to producers for their fuel supply. At present, producers are meeting only two-thirds of world requirements. A major expansion of uranium production will be required to meet demand, including new project development. Today a 50% increase of production would be required to meet all demand and this will increase as additional production cuts take place. The expansion will have to come from a financially weak industry and from one with limited facilities and a small number of trained and experienced personnel. Increasingly stringent standards of radiation safety and environmental protection will increase the already extended lead-times for project development that now range from 6-to-15 years. All of these factors will make it difficult for the uranium industry to meet demand, resulting in unstable market conditions and rapidly rising prices, when the long-awaited market recovery finally occurs. ❐

The Ranger uranium mine in Australia. *(Credit: ERA)*