

Uncertainties in the Future Conversion Services Market

Geoff Varley

For more or less two decades the uranium hexafluoride conversion market has been characterised by excess primary supply. The market has also seen extended periods when large amounts of inventory, from one source or another, have been liquidated. This has led to extreme competition at times, in turn leading to market prices considerably divorced from actual production costs.

Utility buyers were in a commanding position, able to take a short term position in the market and a very aggressive position regarding prices and general terms and conditions. Meanwhile the primary suppliers were anything but bullish about future prospects for the market. Figure 1, which shows the historical development of UF₆ conversion prices, illustrates why.

Prices were relatively stable for many years through about 1980. A number of events transpired to change the equilibrium. Ambitious plans for nuclear expansion were sharply revised, reducing demand. Utilities had long term fixed commitment conversion contracts that became far in excess of requirements. Large amounts of excess utility inventory were put up for sale, heralding the start of a spot market for conversion services. Eventually the spot market plummeted to "fire sale" prices. A term market did exist, with prices somewhat related to production costs. The differential between term and spot prices was large.

After a few years the inventory selling eased and spot prices recovered. However, a general downward pressure on term prices remained, driven by competition between the primary suppliers. In the late 1990s the emergence of cheap supplies from the former Soviet Union probably

exacerbated the problem. The US long term price indicator progressively fell, converging toward but not actually meeting the spot level.

Eventually market and other factors led to the exit of one primary supplier, Sequoyah Fuels, in 1992. Trade restrictions against imports of CIS-origin uranium and related front-end services were put in place at around the same time, and the combined effect of these two developments resulted in a relatively rapid upward adjustment of market prices.

However, the price rises since 1992 should not be misinterpreted. The conversion services market today is substantially cheaper than it was twenty years ago — about one-third of mid 1970s prices in real terms. This no doubt is an illustration of the long term impact on the suppliers of an intensively competitive market. Today they clearly are much more efficient and able to respond to the increasing demands of the market.

Presently we have a market in which spot and term prices are close. Prices in Europe generally are a little higher than elsewhere, particularly compared with the USA. Aside from this transatlantic differential, prices tend to differ depending on buyer, quantity and timing.

Revised Prospects for the Suppliers

The present market is tighter than for some time, with demand clearly in excess of primary supply. On the face of it, one might expect the suppliers to be in relatively buoyant mood. However, the reality is quite different. Near term opportunities are tempered by concerns over longer term developments — in respect of uncertainty over

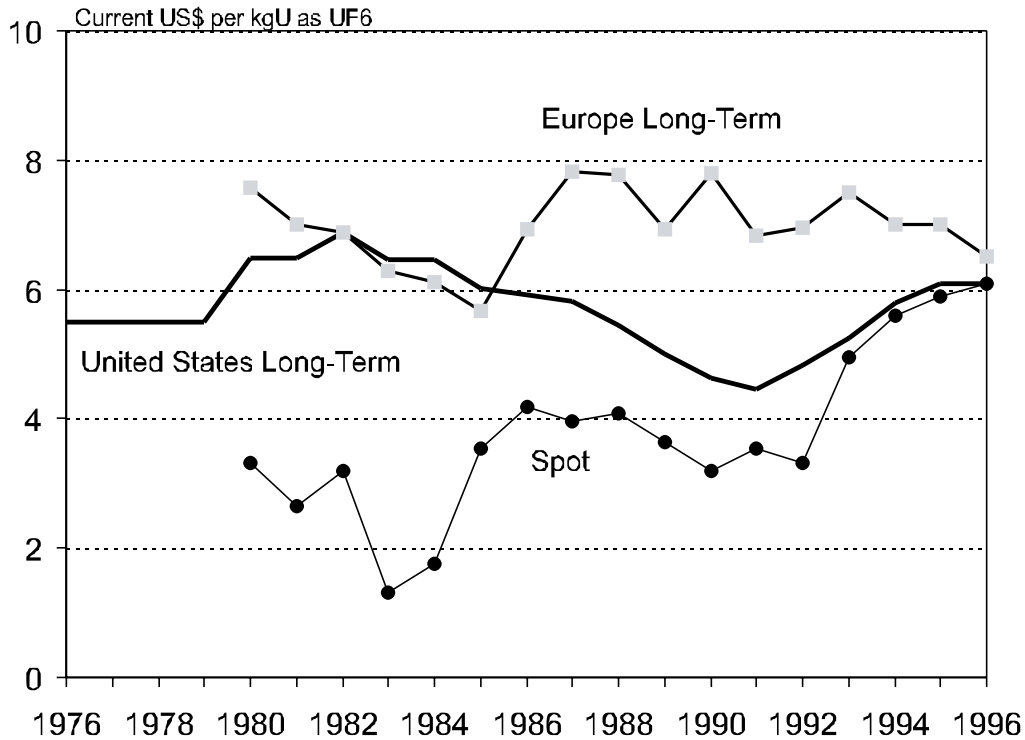


Figure 1. Historical UF₆ conversion prices.

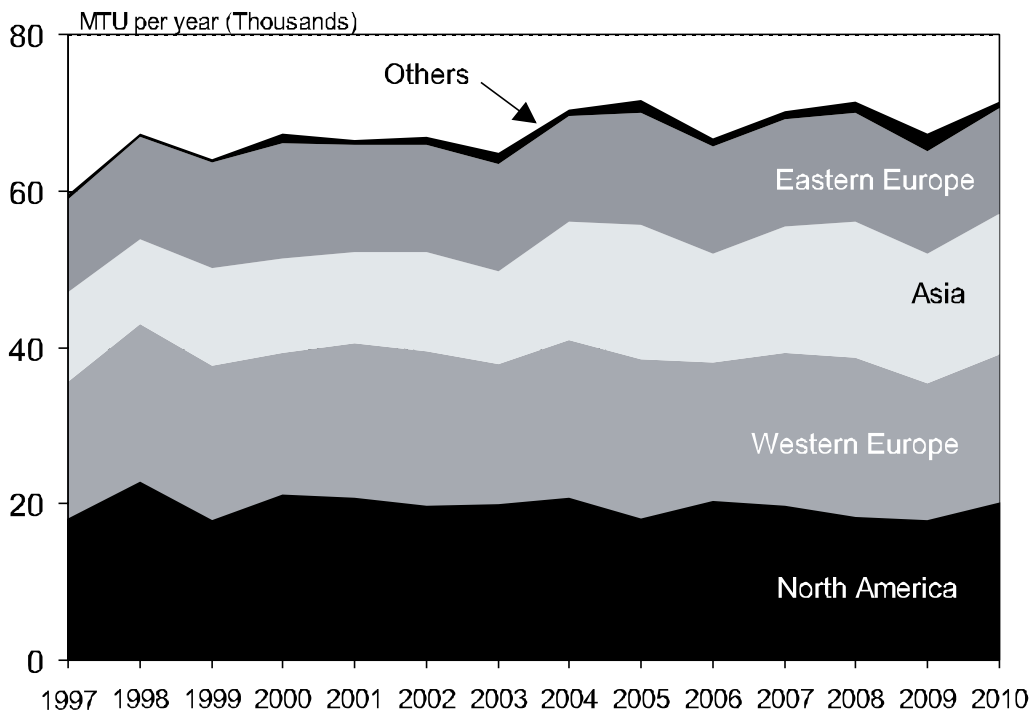


Figure 2. Future demand for UF₆ conversion services.

decisions on potential investment, and in terms of basic market stability and security of supply for the utilities. So why the apparent concern? Is there a firm basis for bullish or bearish perceptions of the market?

The confusion is caused by the nature of the supplementary supply sources that are needed to balance the market. It is necessary to analyse these in some detail to understand the forces that are going to affect the conversion services industry

Table 1. Current UF₆ conversion capacities.

Supplier	Estimated achievable output (tU/year)
BNFL	6 000
Cameco	10 000
Comurhex	13 000
Converdyn	12 000
Russia	14 000
Other	1 200

over the short, medium and longer terms.

NAC International conversion demand projections through 2010 are shown in Figure 2. Demand already exceeds what is estimated to be available primary supply. Annual reactor requirements (excluding China, India and Pakistan) will average about 64 500 tU from 1997 to 2000, exceeding primary supply of about 56 200 tU per year by 8300 tU/y, based on primary supply assumptions as presented in Table 1.

Nameplate capacities in some cases are higher than the figures in Table 1, and actual outputs also have been higher at times in the recent past (eg. BNFL has produced 6600 t/y and ConverDyn 12 500 t/y). The numbers used for this analysis are not meant to be definitive. They are, however, estimated to be close enough to likely output to provide a sound basis for review of the overall balance of supply and demand and the implications for future market developments.

The figure for Russia is the most uncertain. Published data has suggested capacity up to about 20 000 tU/y, but even if this capacity exists and is operable, it is not the effective capacity available to the world market. Utilities generally do not hold uranium concentrate stocks at sites in Russia, for reasons of supply security; in addition, there are trade restrictions that limit the amount of CIS concentrates that could be converted in Russia and legally exported to Western utilities.

Several possible sources of non-primary supply have been identified to make up the shortfall and balance supply and demand up to 2000, some of which may be considered more secure than others. This is not straightforward, because there are so many sources, and restrictions that could affect the timing of their market entry.

US Department of Energy (DOE) UF₆ inventories (including material transferred to the US Enrichment Corporation (USEC) under the terms of the USEC Privatization Act and the 13 t of US HEU already transferred to USEC) could provide approximately 2000 tU/y of conversion services on average, some of which is subject to determinations by the DOE

regarding material impact on the uranium market.

Approximately 1000 tU/y can come from the 18 t of Russian former weapons HEU already delivered to the USA in 1995 and 1996 under the terms of the US–Russia HEU Agreement. In addition, approximately 7750 tU/y on average could be physically available if the latest plan for Russian HEU deliveries is achieved. About 18 t of HEU per year would be sufficient to cover the estimated residual supply shortfall in the conversion market.

On the face of it, supply shortages seem unlikely, but the significance of Russian HEU deliveries and trade restrictions immediately becomes apparent. Figure 3 shows a comparison of planned and actual deliveries of Russian HEU.

Russian HEU Deliveries to the USA

The original plan, set out in the US–Russia HEU Agreement, was for Russia to deliver a minimum of 10 t HEU per year for five years starting around 1994 or 1995, after which this would increase to at least 30 t per year. A revised target of 12 t was set in mid 1995, with an increase to 18 t in 1996 and 1997. In fact, just 6 t was delivered in 1995 and 12 t in 1996.

A further revision in December 1996 set the targets at 18 t in 1997, 24 t in 1998 and 30 t thereafter. At the time of writing, a total of about 4 t was understood to have been delivered to the USA so far in 1997. Recent reports have strongly indicated that about a further 4 t would be delivered in August 1997. NAC understands that the parties involved expect the 18 t target to be fulfilled by the end of 1997.

On this basis, the expected total quantity delivered through the end of 1997 of about 36 t HEU equivalent will be approximately equal to, or slightly in excess of, the original plan to deliver about 10 t per year in the early years. However, the supply has been somewhat erratic and unpredictable. On top of that, at the time of writing, it remains in doubt who will control the UF₆ feed component. The general trend seems to be towards two Western converters controlling some of the material, but how much will be released by the Russians has been a point of disagreement between the parties.

If all goes well, Russian HEU will be a positive element of the conversion services market, from the utility buyer perspective. But:

- it is a political deal, which introduces considerable uncertainty in respect of stability;
- the ability of the Russians to process the weapons

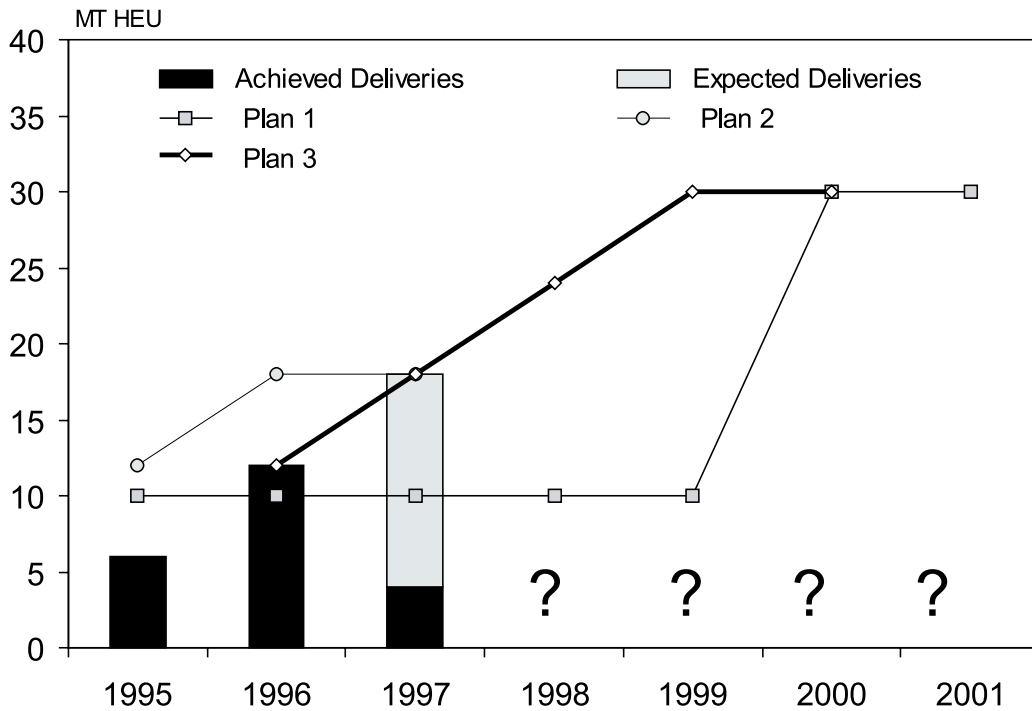


Figure 3. Russian HEU deliveries — plans and achievements.

HEU reliably at the projected levels has not yet been fully demonstrated;

- the economics of the whole deal are questionable (from both the USEC and Russian sides).

Nevertheless, the industry seems to be hooked on HEU. But the plan may not unfold as foreseen, and if something goes wrong the industry needs to be able to respond to assure supplies to utilities. By way of illustration, a 50% shortfall in the 1997 target for Russian HEU deliveries corresponds to the UF₆ feed requirements of about twenty LWRs of 1000 MWe output. A shortfall of 30 t of HEU, a full year’s worth at the maximum foreseen delivery level, would correspond to the requirements of about fifty such LWRs, or about 15% of world nuclear generating capacity.

The purpose of this paper is not to create alarm. Indeed, in the longer term it seems entirely plausible that Russian and US HEU will be used in commercial reactors, because it is not of much use for anything else. But timing and predictability are important issues. In the near term, HEU is a significant but not a critical factor in covering utility conversion services

requirements. In the first decade of the next century its significance will be amplified considerably, with implications for both buyers and suppliers.

Future Market Supply and Demand

Nuclear capacity expansion, principally in Asia, is set to increase demand for UF₆ conversion services by about 5000 to 6000 t/y by about 2005. Splitting the first decade of the next century into two five year periods, to avoid any temporary distortions that might occur in individual years, the supply demand balance is projected approximately as shown in Table 2.

The higher primary supply figures correspond to present estimated production capabilities. The lower figures correspond to progressive erosion of Russian conversion capability at a rate of 2% per year. There is no guarantee that this will happen but it might if new investments are not made. The numbers illustrate the impact if it does happen.

A balance of supply and demand is possible, based on current known sources of supplementary

Table 2. UF₆ conversion supply and demand, 2001 to 2010 (tU/year).

Time period	Reactor requirements	Primary supply	Supply shortfall
2001–2005	68 000	54 500–56 200	11 800 to 13 500
2006–2010	69 400	53 100–56 200	13 200 to 16 300

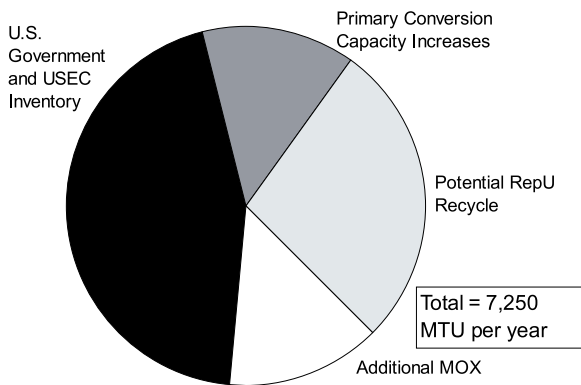


Figure 4. Supplementary UF_6 conversion supply: 2001–2005.

supply and potential future savings in reactor requirements through recycling. The pertinent factors are:

- access to government inventories;
- increased recycling using MOX fuel;
- possible increased recycling of reprocessed uranium;
- UF_6 conversion capacity increases;
- reactor lifetimes and performance;
- laser enrichment technology.

2001 to 2005

Figure 4 shows the breakdown of potential supplementary supply sources, totalling 7250 tU/y on an annual average basis for the period 2001 to 2005, excluding Russian HEU. The proportion from MOX fuel represents the additional likely MOX loadings not already included in NAC's base projections. The proportion from reprocessed uranium is considered to be somewhat optimistic. The increased output assumed from primary suppliers is relatively modest and is an indication of what might be achieved without significant new investment. The availability of DOE inventories on the timescale assumed is considered to be reasonably assured but by no means certain.

Delivery of 15 t/y of Russian HEU would add a further 4500 t/y of UF_6 conversion, and 30 t HEU would increase this to 9000 t/y. On this basis and in the absence of significant new supplier investments, there will not be a shortfall in UF_6 conversion over the first five years of the next century as long as between about 70% and 80% of identified supplementary sources of supply come to fruition. Indeed, there could be an excess of supply, which would put commercial pressure on the primary suppliers, depending on who controls the HEU feed.

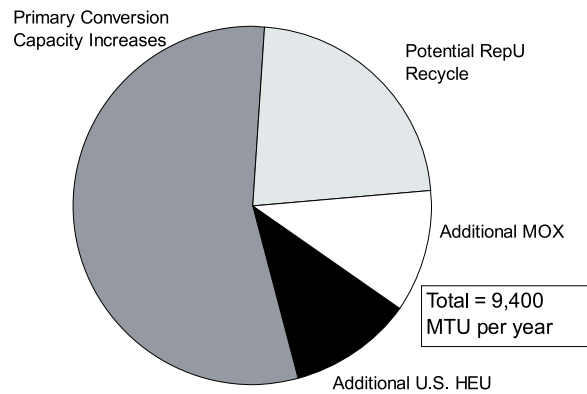


Figure 5. Supplementary UF_6 conversion supply: 2006–2010.

2006 to 2010

In the period after 2005 the supply–demand gap to be filled widens. Figure 5 presents the breakdown of potential supplementary sources, totalling 9400 tU/y on an annual average basis for the five years 2006 to 2010, once again excluding Russian HEU. The contribution of DOE inventories is reduced, with the only source assumed to be the release of additional quantities of US HEU. The other difference is the assumption on primary supplier capacities. It is assumed that some of the primary suppliers will have made more than minimal investment in their facilities to reduce bottlenecks, but will have stopped short of building completely new facilities.

Even with all of these supplementary sources, not all of which can be counted on, there is a need for large quantities of Russian HEU. Between 70% and 90% of all identified supplementary sources, including Russian HEU, will be required to balance supply and demand.

Atomic laser enrichment technology is not expected to have any market impact over the time period considered here. Reactor lifetime assumptions could change the demand forecasts but not very significantly. Some reactor shutdowns are incorporated in the basic projection, and assumed nuclear capacity growth in general is more conservative than official plans.

Summary and Conclusions

In the near and medium term there is no clear incentive for primary suppliers to invest in significant expansion capacity. Some further reduction in bottlenecks and modest additions may be warranted, but uncertainty over liquidation of government inventories is a concern that may inhibit this. For utilities there is some basis for

concern over supply security, especially after the turn of the century, when a number of different supplementary sources have to come into play in order to balance supply and demand in the market.

Indeed, in the early years of the next decade suppliers may have to reduce average annual output somewhat, depending on who has control of the Russian HEU feed. It has been suggested by some that there is a risk that one of the converters will exit the market. Ultimately only the converters themselves are in a position to comment, but there do seem to be some compelling reasons why all will probably stay the course.

BNFL and Cogema are both highly committed to providing total fuel cycle services on a global basis and the sacrifice of conversion services would not seem to fit with this fundamental approach. In addition, Comurhex is the supply security for France's major nuclear programme. Russian export capacity is not really a market influenced issue, at least not at the moment.

Cameco is a major uranium producer and the capability to provide UF₆ conversion is likely to be seen as a strategic service that will be retained for reasons broader than the direct business. ConverDyn is the only single-service supplier for whom, at the moment at least, the business decision on its future will be more or less directly based on conversion services issues alone. But ConverDyn is the only US supplier.

Pre-production of UF₆ using the potentially excess primary supply in the first five years of the next decade is, in theory, a possible approach to providing additional supply security in the subsequent five years. But suppliers cannot be expected to undertake this of their own volition and, from the author's perspective, it cannot be relied upon. If one or more converters controls a large proportion of the Russian HEU feed then this could be held back for later use, but the economics would have to be sufficiently attractive to cover carrying costs as a minimum. No one can rely on this at the moment.

In the enrichment market USEC's spare capacity provides at competitive cost a more-or-less assured backup in the event of shortfalls in anticipated Russian HEU deliveries. However, no such security exists in the conversion services supply industry. Erratic HEU supplies could cause boom and bust cycles, unless someone is willing to provide a buffer. Utilities have the ability to establish strategic inventories to protect their security of supply, come what may.

In conclusion, buyer and supplier caution is called for when considering the future UF₆ conversion services market. There is no need to panic, but now is no time to put your head in the sand and place your future supply security entirely in the hands of others.