

# Market competition in the nuclear industry

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**The nuclear industry provides a wide variety of specialised equipment and services to support the construction and operation of nuclear power plants (NPPs). This includes the supply of NPPs themselves, the range of materials and services required in the nuclear fuel cycle, and the services and equipment needed for maintenance and upgrading. The markets to provide these have changed substantially as they have evolved from the government-led early stages of the nuclear industry to predominantly competitive, commercial markets today.**

Since the 1980s and until recently, the nuclear industry has undergone considerable consolidation and retrenchment in response to generally low demand, which have resulted in a small number of large, global players in certain sectors. This partly reflects special factors in the nuclear industry, but also the more general trend towards globalisation of major industrial activities. Meanwhile, the liberalisation of electricity markets in many OECD countries has changed the business environment for NPP owners/operators. Electricity utilities have been exposed to increased competition, requiring them to improve their business performance and making them more cost-conscious.

A recent NEA study on *Market Competition in the Nuclear Industry*<sup>1</sup> set out to examine how the

industry's major sectors are performing in present market conditions and, with an expansion of nuclear power expected over the coming years, how these markets will likely evolve in response to the significant upturn in demand. The study also considered the potential implications for market competition of the multilateral, assured fuel supply arrangements being proposed by several governments.

The study notes that there are some areas of nuclear activity where competition is necessarily limited or even absent. This includes many research and development activities, especially those with long-term goals, and for which international co-operation and government support are necessary until new technologies are ready for commercialisation. Within existing commercial sectors, certain limitations also necessarily exist, notably non-proliferation controls on sensitive materials, equipment and technologies.

Furthermore, nuclear power involves very large investments in complex plant and equipment, and requires a high level of specialised expertise. This often results in long-term relationships between suppliers and customers, who work together to ensure that plants operate safely and efficiently, and that improvements and upgrades can be made effectively. The study notes that in nuclear energy markets, quality and reliability are often at least as important to customers as prices.

## Assessing the competitiveness of markets

In the absence of detailed statistical information about each market sector, it was decided to consider a set of market characteristics which could act as indicators of competitiveness. Although the assessment of each indicator involved a degree of subjective judgement, taken together they provided a useful overall impression of the effectiveness of competition in each sector. These indicators were:

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- market shares of major participants,
- degree of vertical integration,
- proportion of long-term contracts,
- barriers to entry,
- transaction costs and market segmentation,
- product differentiation,
- balance of capacity and demand,
- market alliances and supplier co-operation,
- public goods aspects,
- trade barriers and restrictions.

Where possible, market shares were used to calculate the Herfindahl-Hirschman Index (HHI) for the market sector, defined as the sum of the squares of the percentage market shares of all market participants. If the value of the HHI is greater than 1 800, this is often taken as a sign that a market may be over-concentrated.

## Main findings for each major market sector

### *Design, engineering and construction of NPPs*

This sector appears poised for a major expansion in the coming decade and beyond. Despite the prolonged market depression since the 1980s and the consolidation which resulted, the remaining NPP vendors have continued to develop their designs and are now offering considerably improved products. At least in the major markets, where there is the potential for a series of orders, there is likely to be strong competition between four or five vendors. Despite some market distortions, a global market with several independent and competing vendors has emerged which provides a genuine choice of supplier to potential customers. However, different regulatory requirements for NPP designs between countries, which can lead to significant up-front costs for vendors, may effectively limit the choices available, particularly in smaller markets. In the longer term, there is the prospect of the emergence of additional important NPP vendors, notably in Korea and China.

### *Uranium supply*

A significant number of new uranium production facilities is expected to enter operation over the coming years in response to rising demand. Many of these will be owned by new entrants or smaller producers with growing production. Although some consolidation is likely to occur, the trend is expected to be towards reduced market concentration. However, the possibility of a merger of two of the major producers could be a cause for concern if it led to the merged company controlling a very large share of global production. Trade restrictions on uranium imports into the United States and the European Union since the early 1990s have

affected market competition. However, increased demand and the reduced availability of supplies from existing stockpiles is likely to limit the practical impact of these restrictions on the market, even if the measures themselves remain in force.

### *UF<sub>6</sub> conversion services*

There are effectively only three major suppliers of UF<sub>6</sub> conversion services worldwide, with a fourth supplier which is mainly limited to providing uranium, conversion and enrichment as a package. From a market competition perspective, this indicates that the market is more concentrated than would be desirable. However, the role of conversion plants as the main storage locations and clearing houses of the uranium market may mean that it is more convenient for market participants if there is a relatively limited number of sites. Together with the fact that conversion represents only a small fraction (around 5%) of the total cost of nuclear fuel, this means that new conversion facilities on new sites may have difficulty in establishing themselves. Present expansion plans indicate that the existing major suppliers will expand their capacity as required and little change is expected in the degree of market concentration.

### *Uranium enrichment services*

Enrichment technology is among the most sensitive in terms of non-proliferation, which means that it is possessed by a limited number of countries, and is entrusted by governments to only a small number of commercial operators; this inevitably limits market competition in this sector. However, the enrichment industry is undergoing major changes which will reshape it over the next ten years and beyond. The remaining older gas diffusion plants in France and the United States will be replaced by new centrifuge plants, while there is also the prospect of laser enrichment technology being commercialised. There will be at least two and possibly as many as four new enrichment plants in the United States by 2015, each operated independently by competing suppliers. The large enrichment capacity in the Russian Federation is also expected to play a growing role in the international market. These developments are likely to lead to shifts in the market shares of the existing suppliers.

### *Fuel fabrication services*

Unlike other fuel cycle services, fuel fabrication is essentially a bespoke service to prepare fuel assemblies to the exact requirements of each NPP. For a new NPP, fuel is initially supplied by the NPP vendor. Only later in the NPP's operating life does the

possibility of choosing between competing suppliers open up. Furthermore, some NPP operators may not consider that the commercial risk involved in changing suppliers is justified by the potential savings on fuel costs. Nevertheless, significant competition does exist in the fuel fabrication market, and for NPPs of more common designs there may be a choice of up to three fabricators. However, the fuel fabrication market has consolidated over recent years, as the main NPP vendors have consolidated. It now appears that the market for fuel fabrication is more concentrated than would be desirable. For some market sub-sectors there is effectively no competition.

### *Back-end of the nuclear fuel cycle*

Much of the capacity of the limited number of spent fuel reprocessing plants is devoted to domestic arisings of spent fuel, but some also reprocess spent fuel from other countries under contracts with foreign utilities. Thus, a limited international market does exist. With the prospect of significant future expansion of nuclear power, the potential for spent fuel reprocessing and recycling is attracting renewed interest. However, reprocessing technology is highly sensitive from a non-proliferation perspective. Reprocessing is likely to be restricted to a small number of countries, or be subject to multilateral control. Its wider use is also likely to depend on the adoption of advanced reactor designs which allow full advantage to be taken of the recycled materials. The commercialisation of such designs is not expected to occur until well after 2020.

In general, utilities remain responsible for the management of radioactive waste arising in their plants, at least until it is transferred to a national authority or agency responsible for disposal. A similar situation exists for the decommissioning of disused facilities and the waste generated during such activities. Thus, commercial activity in these sectors is generally limited to the provision of services, technology and equipment. Many specialised companies are involved, as well as many of the main nuclear industry companies. Overall, there is considerable competition and innovation in the provision of services, technology and equipment for radioactive waste management and decommissioning.

### *Services for maintenance and upgrading of existing NPPs*

With the lack of orders for new NPPs in recent years, reactor vendors and other nuclear engineering companies have been increasingly reliant on the business of maintaining, back-fitting and upgrading

the existing reactor fleets. With life extensions now planned for a large number of existing NPPs, the demand for major upgrading projects is likely to remain high. At present, there appears to be a good balance between capacity and demand in this sector with a good degree of competition in most sub-sectors. However, if there is a significant increase in orders for new NPPs in the coming years this situation could change, as construction of new plants will often involve the same companies. It could potentially become more difficult to find competing suppliers able to undertake routine maintenance tasks and larger upgrading projects in a timely fashion.

### *Overall assessment and conclusions*

The study's analysis shows that the most concentrated nuclear industry market sectors are enrichment and fuel fabrication, with in each case one supplier having over 30% of the market and others in the 20-30% range. Reprocessing is also concentrated, although this is a smaller and less well-developed market. Overall, however, no sector in the front-end of the fuel cycle has a single company with an overwhelming dominance, with each having at least four competing suppliers. There was no indication from presently available information that market shares of leading suppliers would increase significantly as the sectors expand over the next ten years. Indeed, in some sectors, notably uranium supply, it appears that the market may become less concentrated over the coming years.

As regards the market for new NPPs, it is difficult to assess future market shares as this will depend on the relative success of the vendors in winning orders. However, in most regions there is significant competition between at least three or four suppliers. In this, the NPP market compares favourably with certain other engineering-based industries with complex high-technology products, notably the aerospace industry. Early indications are that each major NPP vendor will win a significant share of new orders over the next decade. The future market for fuel fabrication services will to a large extent also be shaped by the market for new NPPs.

Several major nuclear companies have a significant share of more than one sector, meaning that there is a degree of vertical integration across several of the market sectors. Insofar as such companies supply nuclear equipment, services and materials as a package, this may lead to a reduction in competition in some sectors. Such comprehensive arrangements are so far rare, but in future some customers may prefer the perceived security

**Summary of major suppliers in nuclear industry sectors  
by approximate market share**

Market sector	Share > 30%	30% > Share > 20%	20% > Share > 10%
NPP construction*	—	AREVA Westinghouse	Atomenergoprom General Electric
Uranium supply	—	Cameco	AREVA Atomenergoprom Rio Tinto
UF <sub>6</sub> conversion	—	AREVA Atomenergoprom Cameco	ConverDyn
Enrichment	Atomenergoprom	AREVA United States Enrichment Corp. (USEC)	Urenco
Fuel fabrication	AREVA	Westinghouse	Global Nuclear Fuel (GNF)
Reprocessing	AREVA	Japan Nuclear Fuel Limited (JNFL) Nuclear Decommissioning Authority (NDA)	Atomenergoprom

\* Including consolidated companies, based on all operating NPPs.

of receiving a complete package of services from a single, large supplier. If comprehensive provision is preferred by some customers, it is likely that an increasing number of companies will try to position themselves to meet this requirement.

In its conclusions, the study offers the following key findings and recommendations:

- ⇒ Competitive markets for the supply of goods and services for the construction, operation and fuelling of nuclear power plants are an important factor in ensuring the overall competitiveness of nuclear power, thus helping its benefits to be more widely spread. Governments should encourage and support competition in these markets, and actively seek to prevent concentration of market power where it unduly limits competition.
- ⇒ An important policy aim of some national nuclear programmes is the development of a domestic nuclear energy capability. This may necessarily involve some protection of infant industries, with national investment focused on a single supplier to avoid duplication. However, care should be taken not to permanently exclude competitive pressures, which should be allowed to strengthen as market and industrial sectors mature.
- ⇒ While longer-term development and demonstration of new nuclear power technologies may require government support and funding, competition is a great spur to innovation and technological development, helping to improve the products and services available. As fledgling technologies mature and reach the stage of com-

mercial deployment, they should be increasingly subject to the competitive pressures which will allow them to achieve their full potential.

- ⇒ Strong non-proliferation controls on sensitive nuclear materials and technologies are vital to the existence of an open and competitive global market in the nuclear industry. Although such controls will necessarily involve some market restrictions and limitations, they are consistent with the development of new capacities by competing suppliers to meet the growing requirements of nuclear energy programmes around the world.
- ⇒ Other restrictions and tariffs on international trade in goods and services for nuclear power plants can unnecessarily add to the costs of nuclear power. Governments should aim to eliminate or reduce them to the extent possible.
- ⇒ The best assurance of supply of nuclear fuel and other essential goods and services to NPPs is the existence of a geographically diverse range of independent suppliers competing on commercial terms in all market sectors. Governments should seek to create the necessary legal and regulatory frameworks in which such a situation can develop. Furthermore, the harmonisation of such frameworks between countries, especially for the approval of new NPP designs, would increase customer choice and enhance competition in nuclear markets. ■

1. NEA (2008), *Market Competition in the Nuclear Industry*, OECD, Paris. Online ordering: [www.oecd.org/bookshop](http://www.oecd.org/bookshop).