EURATOM
SUPPLY AGENCY

Annual Report 2004

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Euratom Supply Agency

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Contents

Overview

For the global nuclear supply chain, 2004 was a more stable year after some production disruptions in 2003. Security of supply of all energy sources received ever more interest and media exposure, the nuclear renaissance showed more signs of gathering momentum, uranium prices continued to rise, the US dollar kept declining, and uranium production finally started to rise, although it still remains below actual reactor requirements. World production increased in most geographic areas, including Australia and southern Africa, despite the unfavourable currency exchange rate situation for producers operating in those areas.

For the EU, 2004 was the year of its most important enlargement: 10 new Member States joined the Union on 1 May. Five of them have nuclear power production, and while some reactors are being shut down, new ones are planned. Altogether, the share of nuclear power in electricity generation in the EU-25 is around 32 %, which makes it the largest single source of electricity. In France, EdF made the decision to construct a new European pressurised water reactor (EPR) in Flamanville, and several countries inside and outside of Europe announced plans for new nuclear reactors.

The Kyoto Protocol was finally ratified by Russia and came into force in early 2005. This, together with the start of emissions trading in the EU as of 1 January 2005, has contributed to a more favourable view of nuclear power as a necessary part of energy generation. In order to further improve its prospects, it would be most useful if nuclear energy became eligible to join the mechanisms of the Kyoto Protocol.

This more positive view of the prospects for nuclear energy, together with generally rising energy and commodity prices, has also contributed to rising prices for uranium and related fuel cycle services. The uranium price increase in turn seems to have encouraged more exploration both by the major producers and by many new companies. It remains to be seen how much of this sudden interest translates into real production in the years to come, but one important piece of news at the end of 2004 was the decision of the Cigar Lake joint venture partners to bring the Cigar Lake mine (Saskatchewan, Canada) into operation in 2007. Another important recent development was the toll-conversion agreement concluded in March 2005 between BNFL and Cameco for 10 years. This will keep the Springfields (UK) conversion facility operating instead of closing down in 2006 as previously announced.

Uranium purchases by EU-15 utilities in 2004 were 17 300 tU and deliveries to EU-15 utilities 14 600 tU. Russia remained the largest overall supplier to the EU utilities in 2004 (28 % of deliveries to the EU-15), with deliveries in the order of 2 400 tU, plus 900 tU in the form of re-enriched tails through the EU enrichers and in addition some 800 tU of highly enriched uranium (HEU) feed. In terms of natural uranium, the largest supplier was Canada with 3 400 tU (23 %).

During the year, the joint venture between Urenco and AREVA moved forward in a decisive way. Construction of the Georges Besse II plant is expected to start in 2005. A consortium including Urenco is also on track with the LES II enrichment facility in the United States, which confirms the advanced position of European technology in this sector.

Chapter 1
General developments

Main developments in the Member States

In France, EdF announced its decision to construct its first EPR (European pressurised water reactor), a demonstration reactor of 1 600 MWe, at Flamanville in Normandy. Construction is expected to start in 2007 and the reactor should be operational between 2010 and 2012, for a planned life of 60 years.

AREVA Group of France and Urenco of Germany, the Netherlands and the United Kingdom moved forward with their Enrichment Technology Company (ETC) joint venture. The European Commission (Competition DG) conducted an investigation into the competition aspects of the proposed joint venture and the Commission gave its approval in October 2004, subject to certain conditions. Furthermore, the four governments involved need to approve the joint venture by way of a quadripartite agreement. The construction of the new Georges Besse II plant at the Tricastin site is expected to start in 2005, with production starting in 2007 and reaching its nominal level around 2016.

Groundwork for the construction of the first EPR in Finland for the operator TVO started in 2004, while the actual construction licence was granted in early 2005 after the safety assessment by the Finnish nuclear safety authorities.

In Germany, one reactor, Stade (640 MWe), was shut down in 2004 and another, Obrigheim (340 MWe), is due to be shut down in 2005.

In the United Kingdom, the utility British Energy successfully completed its restructuring and was relisted on the London Stock Exchange in January 2005.

One of the two RBMK reactors at Ignalina in Lithuania was shut down at the end of 2004 according to Lithuania's commitments relating to its access to the EU. The second unit is scheduled to be shut down in 2009. The country has traditionally had 80 % of its electricity produced by nuclear power, and it is now considering options to build a new plant. In the near term, electricity supply will be covered by the remaining Ignalina-2 reactor and by existing conventional power plants.

After an open bid for the sale of the State-controlled utility Slovenske Elektrarne (SE), the Slovak government decided to sell a majority stake in SE to the Italian utility Enel, on the condition that Enel will invest in finishing units three and four of the Mochovce nuclear power plant.

Main developments in the EU

Enlargement of the EU

The accession of 10 new Member States occurred on 1 May 2004. Five of these countries (Czech Republic, Lithuania, Hungary, Slovenia and Slovakia) have active nuclear power programmes. After the closure of Lithuania's Ignalina-1 at the end of 2004, a condition for Lithuania's EU membership, the new Member States account for 18 nuclear power reactors (with about 9 700 MWe of net capacity). Ignalina-2 is due to be shut down in 2009.

Accession negotiations with Bulgaria and Romania were finalised during 2004 and their act of accession is expected to be signed in the second quarter of 2005. The start of negotiations with Croatia has been postponed. At the end of 2004, the EU decided to open negotiations with Turkey in late 2005. Of these candidate countries, Bulgaria and Romania have active nuclear power programmes, Croatia shares the Krško NPP with Slovenia, and Turkey announced in 2004 plans to build nuclear power by 2012.

Convention on the Future of Europe and the Euratom Treaty

In the framework of the new EU Constitution, of the earlier treaties only the Euratom Treaty establishing the European Atomic Energy Community will remain in force. This Community is not to be merged with the Union and will therefore keep a separate legal personality. The convention has specified the amendments that need to be made to the Euratom Treaty in the 'Protocol amending the Euratom Treaty', which will be annexed to the Constitution. Consequently, the amendments made to the Euratom Treaty by the Constitution consist only of adaptations to the new rules established by the Constitution, particularly in the institutional and financial field.

The EU Constitution was signed on 29 October 2004 by the Heads of State or Government of the 25 Member States and the candidate countries. Member States will now have to ratify the Constitution in accordance with their respective constitutional requirements, in some cases directly by the national parliaments and in other cases subject to a referendum. The ratification process is expected to take until 2006.

New EU Commission

The five-year mandate of the Members of the European Commission ended in 2004 and the new Members took office in November. Whereas energy and transport were part of the same portfolio in the past, they are now divided in the new Commission. The announced priorities of the new Commission in the energy sector are the security of energy supply and energy efficiency. The Commission also intends to move forward on the liberalisation of the gas and electricity markets, and to promote high nuclear safety standards and renewable energy sources.

Status of the EU Commission's legislative proposals in the nuclear field

The Commission followed the discussions at the Council and the European Parliament on the proposals for Council directives dealing with the safety of nuclear facilities and the safe management of spent fuel and radioactive waste, presented in 2003. Two revised proposals were adopted by the Commission on 8 September 2004 ([1]), taking into account the Parliament's position and discussions at the Council.

The Commission also participated actively in the Council action plan on nuclear safety and the safety of the management of spent fuel and radioactive waste, developed on the basis of the Council's conclusions of June 2004, in order to carry out a debate in this field.

The Commission adopted a proposal ([2]) for a Council directive on the control of shipments of radioactive waste and spent fuel with the aim to revise and replace the existing Directive 92/3/Euratom. The new directive, which also applies to spent fuel intended for reprocessing, simplifies the procedures and ensures consistency with other Euratom directives and international conventions. In November 2004, the proposal was transmitted to the European Economic and Social Committee for opinion, and to the Council and the Parliament, for information, at this stage of the procedure.

International relations

Bilateral nuclear cooperation agreements

Euratom's nuclear cooperation agreements with three major suppliers – Australia, Canada and the United States – continued to be implemented normally. Cooperation under these agreements, which have been running for many years, functions well, and supplies made under them continue satisfactorily.

EURATOM–UNITED STATES OF AMERICA

Concerning the EU enlargement of 2004, the bilateral cooperation agreements between the USA and some of the new Member States (Czech Republic, Hungary, Poland, Slovakia and Slovenia) were intended to be terminated as of 1 May. As of this date, nuclear material and equipment shall be transferred only under the Euratom–USA agreement.

EURATOM–CANADA

Concerning the EU enlargement of 2004, the folding in of the bilateral nuclear cooperation agreements between some of the new Member States (Czech Republic, Hungary, Slovenia and Slovakia) and Canada is still ongoing. As of 1 May 2004, Lithuania has terminated its bilateral agreement with Canada. Also as of 1 May 2004, nuclear material and equipment shall be transferred only under the Euratom–Canada agreement.

EURATOM–UZBEKISTAN

A nuclear cooperation agreement between the Community and Uzbekistan was signed on 6 October 2003. This agreement covers, *inter alia*, transfers of nuclear material. The agreement entered into force on 1 August 2004.

([1]) COM(2004) 526 of 8.9.2004.
([2]) COM(2004) 716 of 12.11.2004.

EURATOM–UKRAINE

The negotiations between Euratom and Ukraine on the cooperation agreement in the peaceful uses of nuclear energy were completed. The agreement covering the transfer of nuclear materials was to be signed at the end of April 2005.

EURATOM–JAPAN

Concerning the agreement with Japan, after scrutiny, the Japanese side proposed some amendments to the text already initialled in 2002. Following discussions on both sides, the amended text was initialled again on 6 January 2004 to take account of subsequent amendments requested by Japan. The final Euratom–Japan agreement should be signed in 2005, subject to final agreement by the Japanese side. The agreement covers, *inter alia*, transfers of nuclear material and equipment.

EURATOM–KAZAKHSTAN

Euratom–Kazakhstan negotiations on the cooperation agreement in the peaceful uses of nuclear energy are still ongoing. The scope of the draft agreement covers the transfers of nuclear material.

EURATOM–RUSSIA

The Commission received negotiating directives from the Council in November 2003, to start negotiations with Russia for a nuclear trade agreement. The Commission presented a draft agreement to Russia in May 2004, and the experts of the Commission and of the Russian government should begin discussions on this draft agreement. As recognised in the negotiating mandate, the Euratom Supply Agency, in light of the powers conferred by Chapter VI of the Euratom Treaty, has a relevant role to play in the negotiation process and in the administration of the future agreement.

International thermonuclear experimental reactor (ITER)

The European Council of Research Ministers unanimously selected Cadarache in November 2003 as its preferred location for the ITER project. Since then, negotiations have continued between the participants of the ITER project – China, the European Union, Japan, South Korea, Russia and the United States – on the choice of the location between Cadarache and Rokkasho-mura in Japan. A final decision was still not reached at the end of 2004.

The USA, Japan and South Korea favoured the site in Rokkasho-mura; the EU, Russia and China prefer Cadarache. The Council of European Union ministers adopted a new negotiating mandate on 26 November, recommending the widest possible cooperation but not excluding the possibility of launching the ITER project in France with fewer than six partners.

Industry developments

Joint venture between AREVA and Urenco on enrichment technology

After a detailed investigation by the Directorate-General for Competition, the European Commission approved in October 2004 the joint venture between the French nuclear group AREVA and Urenco (company established on the basis of the Treaty of Almelo by the governments of Germany, the Netherlands and the United Kingdom). According to the joint venture agreement, AREVA will acquire 50 % of Urenco Enrichment Technology Company (ETC). ETC will be responsible for the development and manufacturing of the centrifuges for both parent companies. AREVA will replace its current enrichment plant, which uses the gaseous diffusion process, with the new Georges Besse II plant, using the much more energy efficient centrifuge technology. The construction of the plant is expected to start in 2005 and production from 2007 on. The nameplate capacity of around 7.5 million SWU/year could be reached by 2016. The global financial investment is around EUR 3 billion.

Following initial concerns expressed by the Competition DG regarding some potentially anti-competitive aspects of the operation, the Commission received guarantees that AREVA and Urenco will each remove their respective veto rights in relation to any future capacity expansions. Secondly, the flow of commercially sensitive information between ETC and its parents should be prevented by a series of measures which will be closely monitored. Thirdly, AREVA and Urenco will continue to act independently in the market for enriched uranium, in particular when deciding on future production capacities. The Commission will put in place, with the help of the Euratom Supply Agency, a monitoring mechanism to prevent anti-competitive pricing practices in the market.

While the Commission has approved the joint venture, its final completion was still pending in early 2005, awaiting approval of all four governments involved (Germany, France, the Netherlands and the United Kingdom).

LES II national enrichment facility

The LES II national enrichment facility project comprises a consortium that includes Westinghouse, Entergy, Exelon, Duke Power and Urenco. After choosing the site of the new facility in Eunice, New Mexico, in 2003, the project continued to advance in 2004. The LES consortium has submitted a licence application to the US NRC which is now examining the application. The request for licence applies to a yearly production capacity of 3 million SWU.

USEC's American centrifuge plant

USEC (United States Enrichment Corporation) also made good progress in 2004 towards its American centrifuge uranium enrichment plant, which would replace the Paducah gaseous diffusion plant. USEC submitted a licence application to the NRC in August. The American centrifuge plant would have an initial annual production capacity of 3.5 million SWU/year, with the possibility of expanding it later to 7 million SWU/year. It is also seeking permission to enrich uranium up to 10 % U-235.

New nuclear generation and power plant projects

In the EU, the main development regarding new generation was that the French operator EdF finally made the decision to build an EPR reactor (1 600 MWe) at Flamanville in Normandy as the first unit of its kind. Construction of the new reactor is expected to start in 2007 and the reactor should be operational in 2012, for a planned life of 60 years. The site already hosts two 1 300 MW pressurised water reactors.

Elsewhere in the EU, the Finnish Olkiluoto 3 project continued as planned. Groundwork on the reactor site started in 2004, but the actual construction of the reactor will start only in the spring of 2005. The operator TVO received the construction licence in early 2005 following a detailed safety assessment by the Finnish nuclear safety authorities.

Elsewhere in the world, eight reactors were connected to the grid: two both in South Korea and Ukraine, and one each in China, Japan, Russia and Canada. The net increase in nuclear generation capacity was 6 240 MWe. Plans for new reactors are heavily concentrated in Asia (China, India, Japan, South Korea) and Russia. However, the scale of the Chinese nuclear build-out has been somewhat reduced, with the latest plans calling for 40 000 megawatts of installed capacity by 2020 instead of 50 000 MW as foreseen two years ago.

Russia announced plans to raise its nuclear generating capacity from the current 22 000 MWe to at least 32 000 MWe – possibly as much as 42 000 MWe – by 2020.

Some other countries, like Poland and Turkey, announced that they are considering the possibility of building nuclear power in the future. Rising energy demand, rising prices for hydrocarbons and the entry into force of the Kyoto Protocol seem to be the main drivers of this new interest in nuclear generation.

In the United States, further steps towards new nuclear plants were taken, as two industry consortiums were going forward with the US Nuclear Regulatory Commission's (NRC) combined construction and operating licence procedure. So far, no firm decisions about new plants have been made. Updates and life extensions of existing plants have continued to contribute to a rising generation capacity.

Climate change

After several years of internal and international discussions, the Russian parliament finally ratified the Kyoto Protocol on global warming on 22 October, followed by the signature of President Putin. Therefore the Kyoto Protocol stage 1 (up to 2012) came into effect in February 2005. Since Russia accounts for 17 % of global CO_2 emissions, and since the USA has decided not to participate in the Kyoto Protocol, Russia's ratification was essential to reach the 55 % threshold of world total emissions required for the protocol to enter into force. Of the 38 industrialised countries which signed the protocol, only the USA and Australia have not ratified it. However, several coastal States in the USA have indicated their interest either in joining the EU emissions trading scheme or in setting up a similar scheme.

In November 2004, a conference held in Buenos Aires focused on phase 2 of the Kyoto mechanism (post-2012). However, little progress was made since developing countries, led by China, India and Brazil, made it clear that they would not be ready to discuss reducing their emissions.

Emissions trading

The EU emissions trading scheme (ETS) for carbon credits applicable to heavy industry started on 1 January 2005. Its first phase, from 2005 to 2007, covers only carbon dioxide emissions credits, but in the longer term it will cover five other greenhouse gases as well. The scheme covers about half of the carbon emitted in the EU, and is focused on 12 000 sites in five sectors: cement, glass, iron and steel, paper and pulp, and electricity generation.

Under the scheme, governed by Directive 2003/87/EC, adopted in October 2003, each industrial site in Member States is allocated an annual quota of emissions through a national plan validated by the Commission. Sites which release too much CO_2 will have to buy credits from others or face a penalty. Full-scale trading was expected to begin in March 2005, once Member States have set up the emission 'accounts' for the industrial sites on their territories.

Chapter 2
Nuclear fuel, policies and markets

Nuclear fuel cycle

Natural uranium

Supply of natural uranium to the EU-15 utilities (3) remained steady, with most deliveries taking place under long-term contracts. The amount of uranium delivered under spot contracts dropped back to levels seen in the past, to about 4 % of total deliveries, after a peak of 18 % in 2003. The Supply Agency average price for deliveries under spot contracts was clearly higher in US dollars (at USD 12.51/lbU_3O_8) and in euro (at EUR 26.14 /kgU).

As expected, the price increase under multiannual contracts was more subtle, with the USD price slightly higher, at USD 13.97/lbU_3O_8, while the euro price decreased due to exchange rate variations, to EUR 29.20/kgU (see Annex 4).

Exchange rates continued to play a very significant role (as for all commodities priced in US dollars), both for buyers and for producers, many of the latter incurring a large share of their costs in non-USD currencies while a large part of their sales are in USD. In 2004, the euro reached a high level of USD 1.24 on a yearly average basis (+ 10 % above the 1.13 level in 2003 and + 31 % above the 0.95 value of 2002).

Russia remained the largest supplier of uranium to the EU, mainly in the form of feed contained in low-enriched uranium (LEU). Taking into account the downblended HEU material and the re-enrichment of depleted uranium ('tails'), the total share of Russia in uranium deliveries to EU utilities would amount to some 28 %.

In 2004, intra-Community supply to the EU utilities represented less than 1 %, most of it associated with existing stocks or uranium recovered as a result of the clean-up operations of mines which have been closed. With the entry of the Czech Republic into the EU, one uranium mine was operating in the EU during 2004, but even this mine will cease commercial operation at the end of 2005; however, some residual uranium production will continue until 2006.

In 2004, preliminary figures indicate that worldwide uranium production amounted to some 40 475 tU, compared with 35 772 tU in 2003 (+ 13 %). Compared with the total worldwide needs of some 67 000 tU/year, primary production remains well below reactor needs. Current mine production covers barely 60 % of the reactor requirements, and the balance continues to be made up by stockpiles, recycling and military origin HEU stockpiles.

Canadian production increased at the Rabbit Lake and McClean Lake complex, and at the McArthur River mine (getting back to normal levels after the flooding incident in 2003). Canada's total production was 11 597 tU, compared with 10 457 tU in 2003.

Total Australian production in 2004 was 9 010 tU, 19 % more than in 2003 and a new record.

Kazakhstan, Niger, Namibia and Russia followed with production between 3 700 and 3 000 tU.

(3) All data, unless otherwise specified, refer to the EU-15, since the EU enlargement occurred on 1 May 2004, and complete data are not available for the full year for all new Member States.

Table 1: Natural uranium production in 2004 ([4])

	Tonnes uranium	Share (%)
Canada	11 597	28.7
Australia	9 010	22.3
Kazakhstan	3 719	9.2
Niger	3 282	8.1
Russia	3 200	7.9
Namibia	3 038	7.5
Uzbekistan	2 050	5.1
Ukraine	1 000	2.5
United States	862	2.1
South Africa	755	1.9
Others	1 962	4.8
Total	40 475	

Exploration activity and production plans

Uranium reserves are not considered to be the limiting factor for new production. The difficulties arise mostly from the long lead times between exploration and discovery and the start of actual production. These lead times tend to be longer in the uranium mining sector than for other basic materials, because of the extremely tight licensing and environmental regulations governing nuclear related activities.

Despite the difficulties associated with new mining developments, global uranium exploration activity increased significantly in 2004, although part of that activity seems driven by speculation on the part of numerous junior mining companies and their investors. Both the major producers and many new small companies have announced increased exploration activity in the Athabasca basin of Saskatchewan, in Labrador, Quebec, Canada's Northwest Territories, Mongolia, Kazakhstan, Russia, southern Africa and Latin America. There has also been talk about trebling the uranium production of the Olympic Dam mine in Australia to make it the biggest uranium mine in the world.

Minatom of Russia announced that it intends to increase uranium mining up to 5 000–6 000 tonnes annually by 2020 by exploring new deposits. Russia's current annual mining output is around 3 200 tonnes, while the requirements are about 10 000 tonnes (considering national consumption and export supplies) and expected to rise.

Kazakhstan has an ambitious programme to quadruple its uranium mining output from around 3 000 tU in 2003 to 6 500 tU by 2007 and to 12 000 tU in 2015. This might be achieved through strategic partnerships with customers.

Conversion

For the global conversion industry, 2004 meant seeking stability after the incidents in 2003 at ConverDyn's Metropolis conversion facility. After having received clearance from the NRC, Metropolis returned to production in March 2004 and resumed full capacity during the year, but virtually all of ConverDyn's product inventories were used up during the temporary shutdown of the facility. The company has undertaken new investments to improve its production facilities and to increase its production capacity over time.

([4]) Figures published by producers or industry estimates.

Another unexpected event for the conversion industry was a labour dispute at Cameco's Port Hope conversion facility in August–September 2004, which resulted in the loss of about one-month supply. While the consequences were not serious in this case, the incident serves as a reminder that various and often unexpected causes can affect the supply chain.

A much more positive development was the toll-conversion agreement concluded in March 2005 between BNFL and Cameco for 10 years. The BNFL Springfields facility was due to be closed down in 2006 but will now keep operating. This alleviates some of the concerns regarding the future supply of conversion services, although it does not remove all concerns.

Enrichment

As anticipated, some utilities moved in 2004 towards slightly lower tails assays, which helps to a certain extent to reduce their natural uranium needs. This trend naturally increases demand for enrichment, but since worldwide enrichment capacity still exceeds current requirements, the effect on prices has so far been limited. Published enrichment price indicators did show a small uptick in USD prices from USD 108 to 110/SWU, although the very low volume of the spot SWU market decreases the relevance of this price indicator. As for natural uranium, most of the supply to the EU utilities continued to take place under long-term contracts.

The operation of the enrichment industry continued in a relatively smooth fashion, and the focus was on the announced new plants (see Chapter 1). The lowered anti-dumping duties against Eurodif in the USA improved the prospects for European exports, but the still ongoing administrative reviews of the anti-dumping procedure contribute to some uncertainty in the market.

The Western enrichment industry is poised for a transition in the next years, since both USEC and AREVA/Eurodif are moving from the gaseous diffusion process to modern centrifuge enrichment technology. While these projects and other expansions by Urenco or by the new LES II consortium in the USA seem to bring online a lot of new capacity, it should be taken into account that two big gaseous diffusion plants are due to be shut down as new plants ramp up their production. Modular expansion of the new plants is easier but still requires time due to licensing requirements.

Fabrication

European Union fabrication facilities continued to provide adequate coverage of the utilities' needs.

MOX fuel fabrication continued in Belgium and France.

Reprocessing

Reprocessing of irradiated fuel continued at the plants at La Hague in France and Sellafield in the United Kingdom. Under the amended German Nuclear Energy Act, shipments from Germany for reprocessing abroad will not be permitted from mid-2005. Instead, the spent fuel elements are to be taken to decentralised on-site interim storage facilities and transferred directly to final storage later after suitable processing.

Instead of having the reprocessed uranium re-enriched by conventional enrichment, some utilities, often in partnership with European fabricators, are sending the material to Russia where it is blended with HEU of military origin. After blending, the material is sent back to the EU in the form of enriched uranium product (EUP) for further fabrication of fuel elements.

Secondary sources of supply

The 'Megatons to megawatts' programme agreed between the USA and Russia in 1993 for a period of 20 years has the objective to contribute to non-proliferation of nuclear weapons by diluting Russian highly enriched uranium for use in commercial power reactors. Since its beginning, the programme has been a very important addition to meeting Western fuel requirements. However, the current 'Megatons to megawatts' programme will end in 2013. No new indications about a potential extension of this programme were received during 2004. Russia maintained that it is too early to discuss what will happen post 2013, but did not exclude the possibility of continuing the sale of this HEU feed material. It does appear, however, that Russia's own needs and the needs for its fuel exports will be given priority.

In the USA, the Department of Energy's (DoE's) National Nuclear Security Administration (NNSA) announced plans to sell high-enriched uranium from the government's excess stockpile of 174 tonnes for downblending and use as commercial nuclear fuel. Some concern was expressed by market players about the potential effects and uncertainty created by such sales, although DoE has assured that the sales would be done in a way to minimise market impact.

Research reactors' fuel cycle

International cooperation continued in order to find new processes that would allow the fabrication of fuels with LEU to replace HEU without major penalties to the operators.

Worldwide, over 100 research reactors should eventually be converted to use low-enriched fuel. Of these, 38 have so far been changed over and another 36 are currently considered as being convertible, while more than 30 others cannot be converted until new fuels are developed with greater uranium density to compensate for the lower enrichment.

Security of supply

During 2004, the security of all energy supplies received much attention in light of the rise in prices. Nuclear energy does have the advantage that uranium resources are relatively well dispersed around the globe. While the EU does not have significant uranium resources on its territory, several EU companies are active in uranium mining elsewhere. It is also important for the EU security of supply that significant parts of the needed conversion, enrichment and fuel fabrication are performed in the EU.

Following the recommendations of its Advisory Committee in 2002, the Supply Agency and the Advisory Committee set up a task force focusing on the security of supply in the nuclear fuel cycle. The task force met several times during 2004 and finalised its report, which includes an assessment of the risks to supply security, mitigation measures and recommendations (see 'Joint ESA/Advisory Committee activities – Task force on security of supply', Chapter 4).

While there is enough uranium in the world to ensure supply of this source material over the very long term, there is concern for the security of supply over the next 10 to 15 years before new industrial sources can be developed, as world uranium production is today substantially below demand and processing facilities are limited in number. The task force and also many other market observers are concerned by uncertainties about future secondary supplies, transportation problems of various origins (regulatory, lack of ports), permanent closure of a mine or a conversion facility, and the difficulties and lead times related to the opening of new mines. The importance given to secondary supplies reflects the share of this supply source especially in the USA, which in turn affects all regional markets. Transportation problems are considered as very serious essentially because of their potential to occur in the short term and because of their potentially severe consequences. Generally, conversion is considered the weakest link of the fuel cycle, and for the EU the situation is especially acute, since about 60 % of the Western world conversion capacity is in North America. Therefore, the problems of conversion and transport are closely linked together.

Regarding the primary production of natural uranium, current production continues to be far below the actual requirements, despite a substantial rise in production in 2004. The appearance of new mining companies in the uranium market and the increasing exploration activity are both welcome, but these developments must be followed closely to see how much real production will come out as a result. Some companies may be more interested in stock market returns than in developing new mines, but the inflow of capital into the sector is definitely needed to start new projects.

Due to the continued weakness of the US dollar, the situation of producers in Canada, Australia, South Africa and Namibia has not improved to the same extent as uranium prices have risen in US dollars. This is a common feature for most commodities.

In the longer term, there is no alternative for increased primary production. Canada and Kazakhstan seem the most likely candidates for new mines in the short and medium term, but Australia, which has the largest proven uranium reserves, may also finally be adopting a less restrictive position to new mining. Still, even in favourable conditions, opening a new uranium mine takes years because of the strict licensing requirements imposed on nuclear related activities. In comparison, coal mines can sometimes be opened much more quickly, despite the proven environmental impact of coal use.

The uncertainty about secondary supplies also makes mining companies reluctant to commit large amounts of capital unless they are very confident that prices will not fall back because of an unexpected release of secondary supply to the market. Therefore, it would be very important for all parties to have as much transparency as possible regarding plans for disposing of Russian and US highly enriched uranium and eventually other inventories into the market.

The situation of the conversion market remains somewhat problematic, especially in the EU, since most of the Western conversion capacity is in North America. For enrichment, the situation remains the opposite, with most of the capacity in the EU. Overall, enrichment capacity is not as tight as for conversion, but in the coming years several new enrichment plants are due to become operational worldwide, some current ones will be closed, others extended. It is essential that these changes occur smoothly and that producers build up sufficient pipeline inventories in anticipation of the transition to new facilities, in order to avoid any disruptions.

ESA recommendations and diversification policy

The Supply Agency continues to recommend to EU utilities that they maintain an adequate level of strategic inventories and use market opportunities to increase their inventories, according to their individual circumstances. In some cases, a very low level of inventories is a cause for concern. Some utilities may prefer to hold U_30_8 or UF_6, others fabricated fuel assemblies or a combination thereof. While fabricated fuel is the most expensive form, it is also the least exposed to disruptions. Furthermore, it is recommended that utilities cover most of their needs under long-term contracts with diversified supply sources.

Producers and fuel fabricators are also encouraged to consider whether their inventory levels are adequate to cover unforeseen disruptions. It would seem prudent to establish sufficient lead times before delivery to the customers.

The Supply Agency continues to monitor the market, especially the supply of natural and enriched uranium to the EU, to ensure that EU utilities have diversified sources of supply and do not become over-dependent on any single source. Maintaining the viability of the EU industry at all stages of the fuel cycle remains an important goal for long-term security of supply. In recent years, restrictions on imports of natural uranium have not been deemed necessary. Regarding enrichment, the supply policy remains unchanged.

Chapter 3
EU supply and demand in 2004

This chapter presents an overview of supply and demand for nuclear fuels in the European Union. As before, this is based on information provided by the EU utilities or their procurement organisations concerning the amounts of fuel loaded into reactors, estimates of future fuel requirements, and on the quantities, origins and prices of acquisitions of natural uranium and separative work.

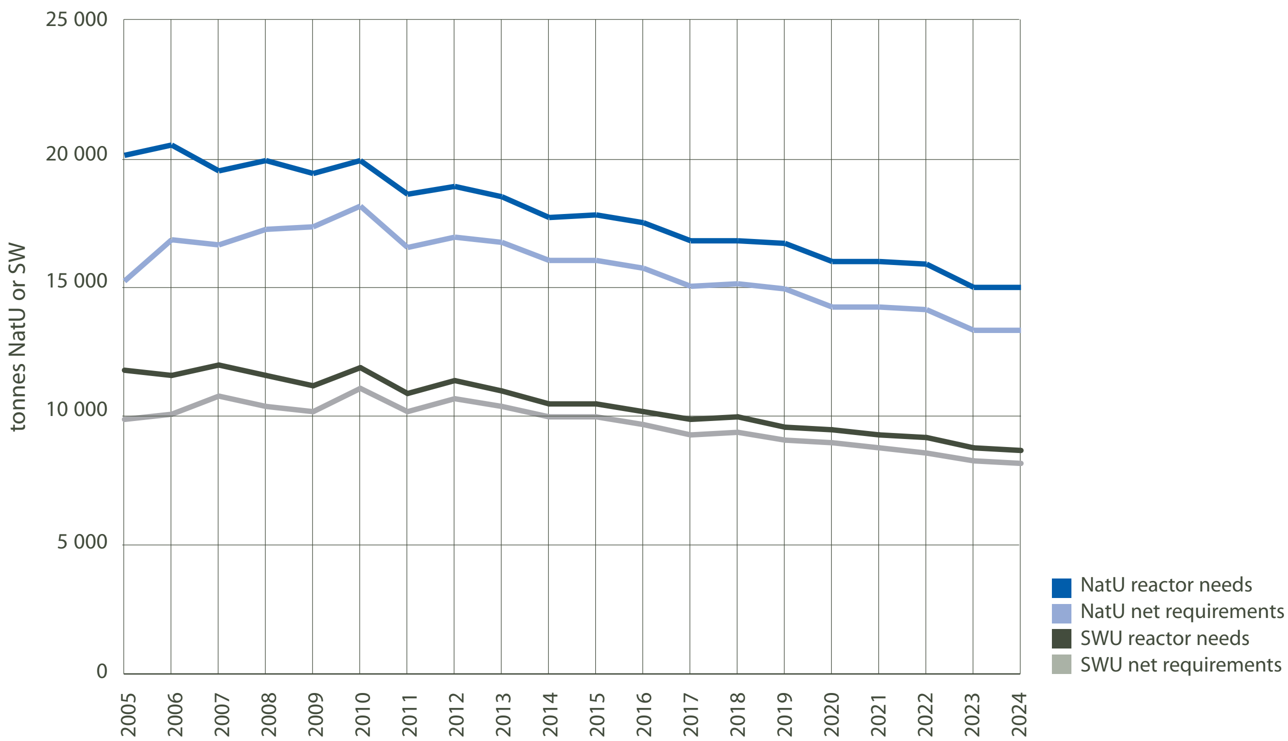
Fuel loaded into reactors

During 2004, about 2 600 tU of fresh fuel were loaded in EU-15 reactors (including Magnox reactors) containing the equivalent of 19 300 tU as natural uranium and 10 900 tSWU; most tails assays were in the range of 0.25–0.35 %.

Reactor needs/net requirements

Estimates of future EU reactor needs and net requirements for uranium and separative work, based on data supplied by EU-15 utilities, are shown in Graph 1 (see Annex 2 for the corresponding table). Net requirements are calculated on the basis of reactor needs less the contributions from currently planned uranium/plutonium recycling, and taking account of inventory management as communicated to the Agency by utilities.

Graph 1: Reactor needs and net requirements for uranium and separative work



Average reactor needs for natural uranium over the next 10 years will be 19 300 tU/year, while average net requirements will be about 16 800 tU/year. Relative to 2003, average future reactor requirements decreased by some 400 tU/year. This is explained by the planned closure of several reactors, while decisions to build new reactors have been made only in Finland and France.

Average reactor needs for enrichment over the next 10 years are now expected to be 11 400 tSWU/year, while average net requirements will be in the order of 10 400 tSWU/year. Relative to 2003, total future enrichment needs increased slightly (100 tSWU) but net requirements decreased (by 200 tSWU).

Natural uranium

Conclusion of contracts

The number of contracts and amendments relating to ores and source materials (essentially natural uranium) which were dealt with in accordance with the Supply Agency's procedures during 2004 is shown in Table 2. Transactions totalled approximately 24 900 tU, some 17 300 tU of which were the subject of new purchase contracts by EU-15 utilities (spot and multiannual). Some 3 000 tU transacted related to purchases between producers, intermediaries or between EU-15 utilities. An additional 4 600 tU have been transacted under exchanges and loans. In addition, amendments to existing contracts resulted in an increase of some 9 100 tU of the total quantities contracted.

Table 2: Natural uranium contracts concluded by or notified to the Supply Agency (including feed contained in EUP purchases)

Contract type	Number	Quantity (tU) (1)
Purchase/sale by an EU utility/user		
— multiannual (2)	9	16 600
— spot (2)	8	700
Other purchase/sale		
— between EU utilities (multiannual)	2	
— between EU utilities (spot)	1	
— between intermediaries (3) (multiannual)	2	
— between intermediaries (3) (spot)	4	700
Exchanges and loans (4)	20	4 600
Total	49	24 900
Amendments to purchasing contracts (5)	12	9 100

(1) In order to maintain confidentiality, the quantity has been indicated only when there were at least three contracts of each type, but all quantities have been included in the total.
(2) Multiannual contracts are defined as those providing for deliveries extending over more than 12 months, whereas spot contracts are those providing for either only one delivery or deliveries extending over a period of a maximum of 12 months, whatever the time between the conclusion of the contract and the first delivery.
(3) Purchase/sale contracts between intermediaries – both buyer and seller are not EU utilities/end users.
(4) This category includes exchanges of ownership and U_3O_8 against UF_6. Exchanges of safeguards' obligation codes and international exchanges of safeguards' obligations are not included.
(5) The quantity represents the net increase (or decrease) in material contracted for.

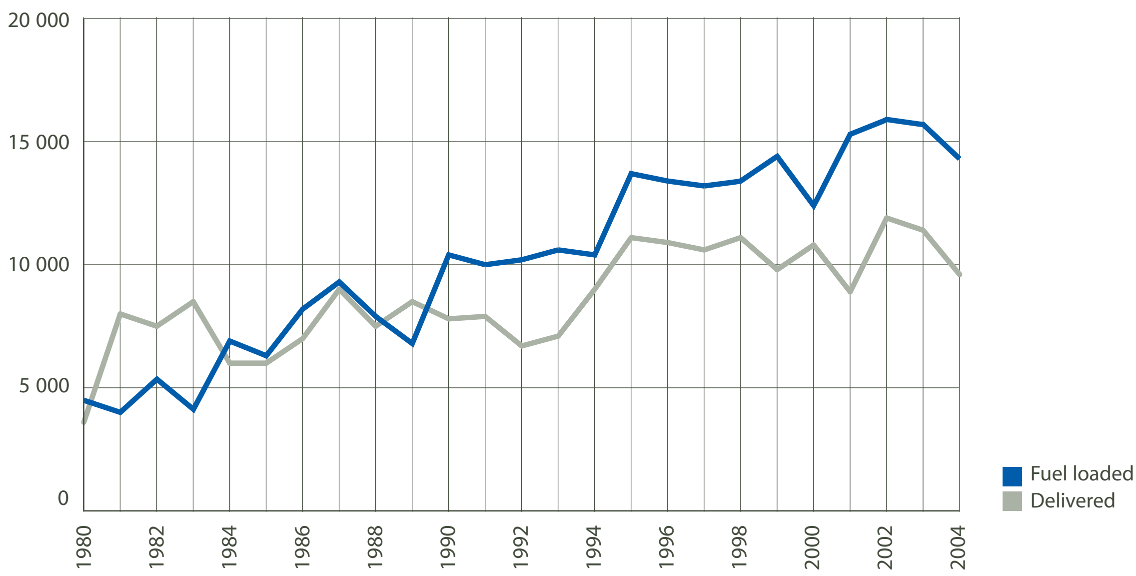
Volume of deliveries

During 2004, natural uranium deliveries to EU-15 utilities amounted to approximately 14 600 tU compared with 16 400 tU in 2003. Deliveries under spot contracts represented about 4 % of the total (compared with 18 % in 2003).

The deliveries taken into account are those made to the EU-15 utilities or their procurement organisations (excluding research reactors); they also include the natural uranium equivalent contained in enriched uranium purchases.

Deliveries and fuel loaded into reactors by EU-15 utilities since 1980 are shown in Graph 2. The corresponding table is in Annex 3. The difference between deliveries and the amount of fuel loaded can be partly explained by the use of reprocessed uranium, MOX fuel and drawing down of inventories.

Graph 2: Natural uranium feed contained in fuel loaded into EU reactors and natural uranium delivered to utilities under purchasing contracts (tU)



Average prices of deliveries

The deliveries taken into account in the average price calculations are those made to the EU-15 utilities or their procurement organisations under purchasing contracts; they also include the natural uranium equivalent contained in enriched uranium purchases. Excluded from the calculations are a number of contracts where it was not possible to establish reliably the price of the natural uranium component (e.g. some cases of enriched uranium deliveries priced per kg EUP). To calculate the average price, the original contract prices are converted (using the average annual exchange rates as published by the European Central Bank) into euro per kgU in U_3O_8 and then weighted by quantity. To establish a price excluding conversion cost when it was not specified, the Supply Agency applied, in 2004, an estimated average conversion price of EUR 5.65/kgU (USD 7.00/kgU).

Prices for deliveries under multiannual contracts (i.e. providing for deliveries extending over more than 12 months) were expressed in three different currencies: euro, US dollar and Canadian dollar.

The average prices of such deliveries in 2004 were:

EUR 29.20/kgU contained in U_3O_8	(EUR 30.50/kgU in 2003)
USD 13.97/lb U_3O_8	(USD 13.27/lb U_3O_8 in 2003)

Spot contracts are those providing for either only one delivery or deliveries extending over a period of a maximum of 12 months, whatever the time between the conclusion of the contract and the first delivery.

The average price of material delivered in 2004 under spot contracts was as follows:

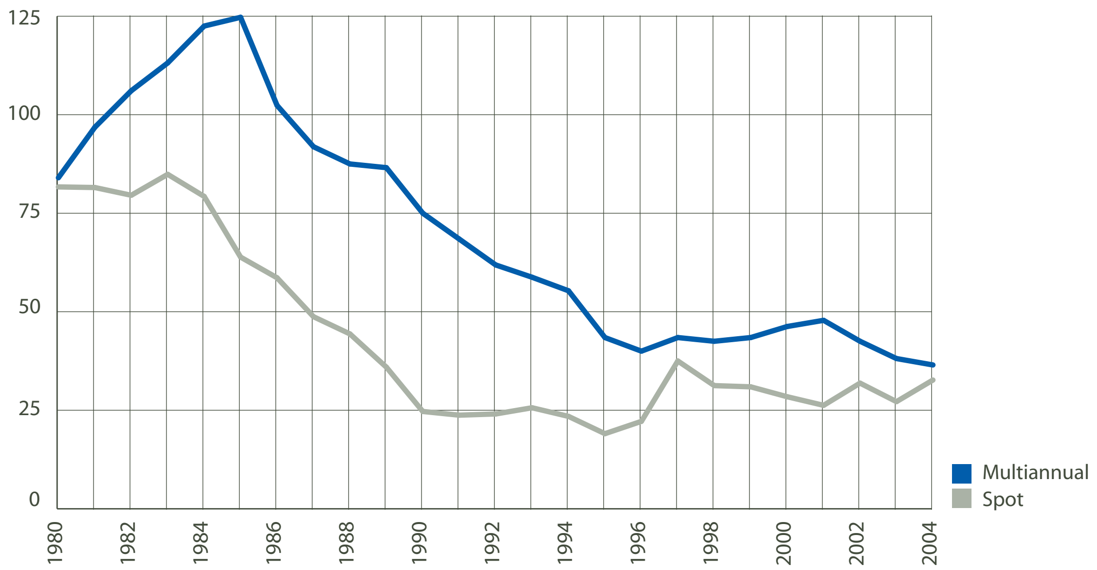
EUR 26.14/kgU contained in U_3O_8	(EUR 21.75/kgU in 2003)
USD 12.51/lb U_3O_8	(USD 9.46/lb U_3O_8 in 2003)

See Annex 4 for further information.

Price history

Graph 3 shows the ESA average prices for natural uranium since 1980; the corresponding data are presented in Annex 4 (note: the euro replaced the ecu on 1 January 1999 with a conversion rate of 1:1).

Graph 3: Average prices for natural uranium delivered under spot and multiannual contracts, 1980–2004 (EUR/kgU)



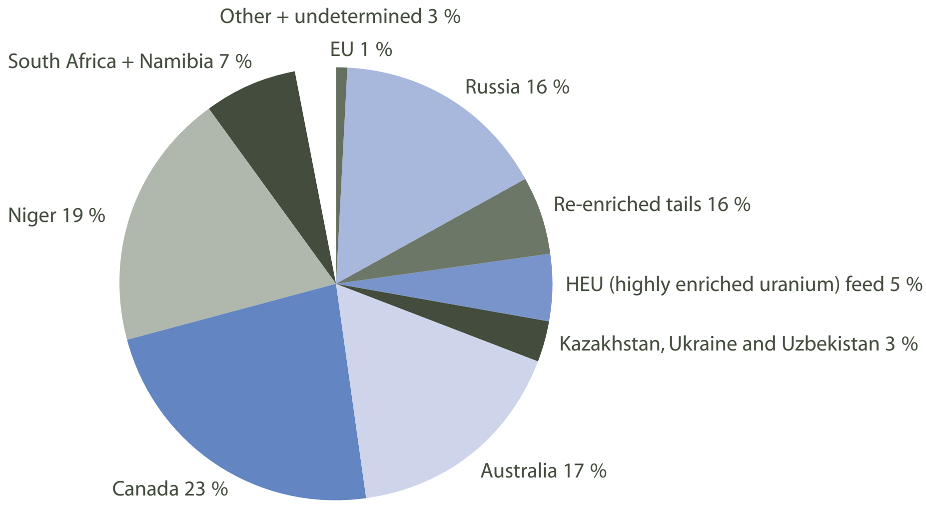
Origins

EU-15 utilities or their procurement organisations obtained, in 2004, the vast majority of their supplies from 10 countries outside the EU. Supply from within the EU represented only some 1 %.

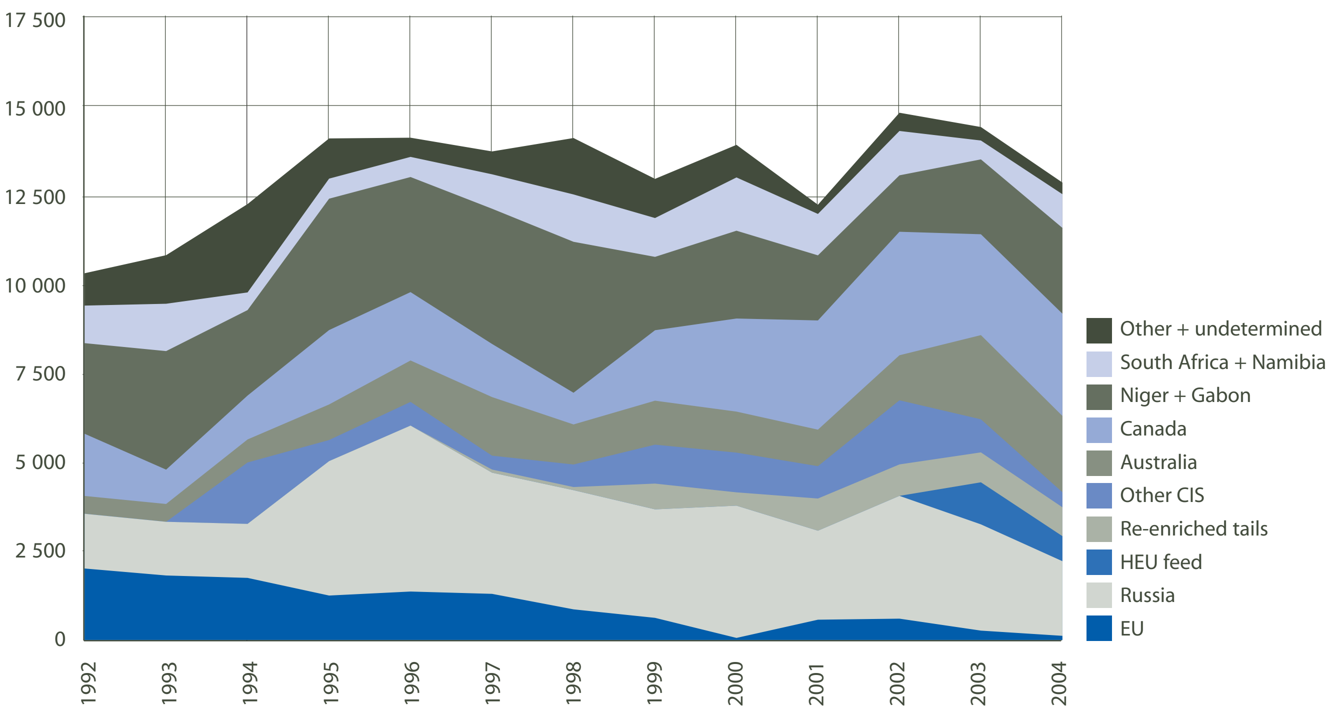
Russia remained the largest overall supplier to the EU-15 utilities in 2004, with deliveries in the order of 2 400 tU, plus 900 tU in the form of re-enriched tails (RET) through the EU enrichers. Most transactions for the supply of Russian natural uranium were linked to enrichment contracts. In addition, some 800 tU of HEU feed were delivered to EU utilities.

Canada was the second largest overall supplier and the largest supplier of natural uranium to the EU-15 utilities with deliveries in the order of 3 300 tU, followed by Niger (2 700 tU) and Australia (2 400 tU) (see Graph 4). Canada's share of natural uranium supplies to EU-15 utilities was around 23 %.

Graph 4: Origins of natural uranium delivered to EU-15 utilities in 2004 (% share)



Graph 5: Purchases of natural uranium by EU-15 utilities by origin, 1992–2004 (tU)



The Commonwealth of Independent States' (CIS) countries formed the second largest regional source of supply of natural uranium to the EU, with their share amounting to 20 % of deliveries in 2004. EU-15 utilities took delivery from this source of about 2 900 tU as natural uranium or feed contained in EUP, excluding re-enriched tails and HEU feed (see Annex 1).

Physical imports of CIS origin material

Total physical imports from the CIS of natural uranium, re-enriched tails and feed contained in EUP amounted to 11 400 tU in 2004 for the EU-15 and to 12 500 tU for the EU-25.

As mentioned above, physical imports of CIS material continued to be essentially in the form of feed contained in EUP or re-enriched tails (natural UF_6 equivalent) for Western enrichers (see Annex 1). Imports of fresh natural uranium represented about 1 200 tU.

Special fissile materials

Conclusion of contracts

Table 3 shows the number of contracts and amendments relating to special fissile materials (enrichment, enriched uranium and plutonium for power and research reactors) which were dealt with during 2004 in accordance with the Supply Agency's procedures.

Table 3: Special fissile material contracts concluded by or notified to the Supply Agency

Contract type	Number
A. Special fissile materials	
Purchase (by an EU utility/user)	
— multiannual	4
— spot	7
Sale (by an EU utility/user)	
— multiannual	—
— spot	4
Purchase/sale (between two EU utilities/end users)	
— multiannual	—
— spot	5
Purchase/sale (intermediaries)	
— multiannual	3
— spot	21
Exchanges	17
Loans	3
Total (1)	64
Contract amendments	9
B. Enrichment contracts (2)	
Multiannual	11
Spot	3
Contract amendments	23

(1) In addition, there were 20 transactions for small quantities (Article 74 of the Euratom Treaty) which are not included here.
(2) Contracts with primary enrichers only.

Deliveries of low enriched uranium

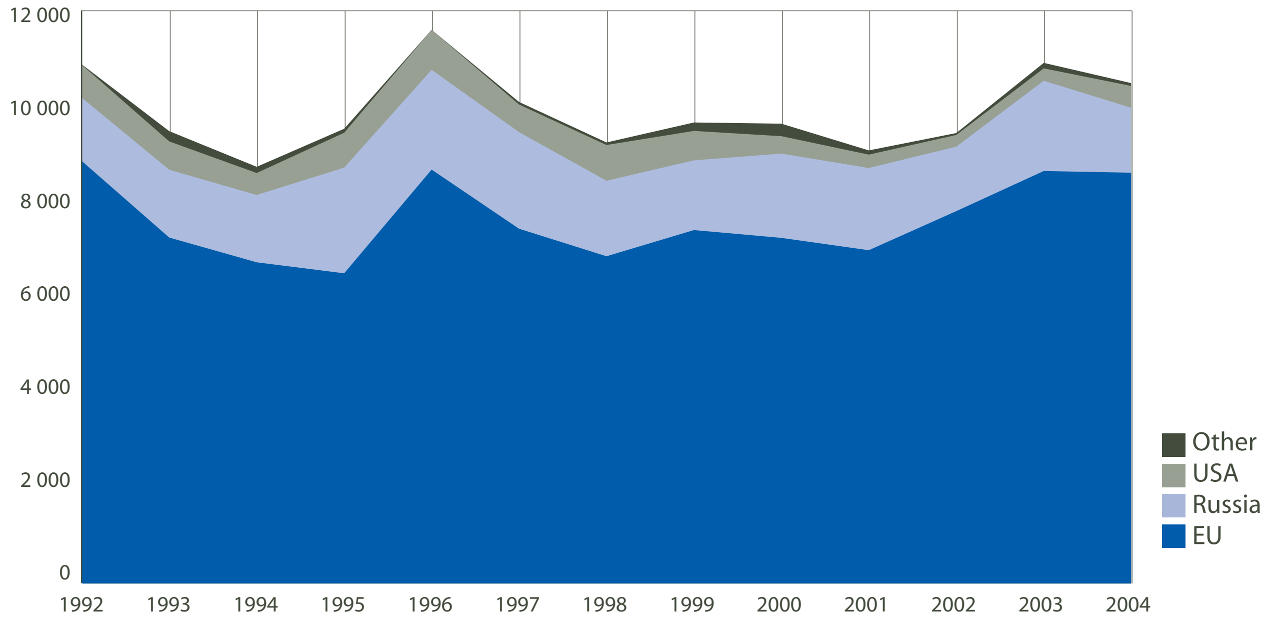
In 2004, supply of enrichment (separative work) to EU-15 utilities totalled approximately 10 500 tSWU, delivered in 2 100 tLEU which contained the equivalent of some 18 500 tonnes of natural uranium feed (5). Some 82 % of this separative work was provided by EU companies (Eurodif and Urenco).

Deliveries of Russian separative work to the EU-15 utilities under purchasing contracts represented 1 400 tSWU or 13 % of the total. However, taking into account the re-enrichment of tails for Eurodif and Urenco, the total imports of Russian enrichment by the EU, and therefore the volume of trade with Russia, are significantly higher.

Supplies from the USA accounted for some 4 % of the total.

Supply of enrichment to EU-15 utilities by origin since 1992 is shown below.

Graph 6: Supply of enrichment to EU-15 utilities by origin, 1992–2004



Enriched uranium for research reactors

Enriched uranium for research reactors is normally supplied in two enrichment assays: just under 20 % (LEU) and about 90 % (HEU). Although the quantities involved represent a minor amount in terms of EU needs for enriched uranium, LEU and HEU supply is very important to the scientific community and for the production of isotopes for medical and industrial applications.

(5) The tails assay used for the calculation of the natural uranium feed and separative work components has a significant impact on the values of these components. An increase in the tails assay increases the amount of natural uranium and reduces the amount of separative work required to produce the same amount of EUP. The optimal tails assay is dictated by the prices of natural uranium and separative work. For its calculations the Supply Agency used the contractual tails assay declared by the utilities or, when this was not available, a standard 0.30 %. It should also be noted that enrichers do not always use the contractual tails assay at their plants; as a result, they may become major users or 'producers' of natural uranium according to the circumstances. The real figures for supply and demand of natural uranium and separative work may be influenced in one or the other direction by the real tails assay.

Supply of LEU to research reactors continued unhindered. Reactor requirements for HEU were met, but the source of future supplies continued to be the object of considerable attention. The Supply Agency continued to provide support to reactor operators in the procurement of fuels.

Plutonium and mixed-oxide fuel

The use of MOX has contributed to a significant reduction in requirements for natural uranium and separative work in recent years. However, reprocessing and the use of MOX fuels continue to face difficulties because of the political decisions in some countries to postpone or to abandon this solution for the management of irradiated fuels.

The quantities loaded into EU-15 reactors and the estimated savings from the use of MOX fuel are shown in Table 4. The quantity of MOX fuel loaded was 10 730 kg plutonium (Pu) in 2004, somewhat below the level in 2003. It should be noted that published figures on natural uranium and separative work savings vary considerably; here, it was assumed that 1 tPu saves the equivalent of 120 tU as natural uranium and 80 tSWU.

Table 4: Utilisation of plutonium in MOX in the EU-15 and estimated natural uranium (NatU) and separative work savings

Year	kg Pu	Savings	
		tNatU	tSWU
1996	4 050	490	320
1997	5 770	690	460
1998	9 210	1 110	740
1999	7 230	870	580
2000	9 130	1 100	730
2001	9 070	1 090	725
2002	9 890	1 190	790
2003	12 120	1 450	970
2004	10 730	1 290	860
Total	77 200	9 280	6 175

Chapter 4
Administrative report

Personnel

The number of staff at the Supply Agency at the end of 2004 was 17.

Creation of a branch in Luxembourg

Following the decision made by the Commission in 2003 to concentrate all activities related to the implementation of Chapters 3 to 10 of the Euratom Treaty in Luxembourg, the Director-General of the Supply Agency decided on 30 January 2004 to establish a branch of the Supply Agency in Luxembourg as of 1 February 2004.

New staff was recruited in Luxembourg from March 2004 onwards, and the transfer of activities from Brussels to Luxembourg occurred gradually.

Finance

The Supply Agency is financed principally by a subvention from the budget of the Commission, as a result of a Council decision of 1960 to postpone the introduction of a charge on transactions to defray the operating expenses of the Supply Agency as provided by the Euratom Treaty.

The Supply Agency's expenditure in 2004 amounted to EUR 139 295.

Costs relating directly to the Supply Agency's staff and its office are borne by the European Commission.

Activities of the Advisory Committee

The Advisory Committee held one meeting during 2004. At this March meeting the Committee, in fulfilment of its statutory duties, examined and gave opinions on the Supply Agency's annual report for 2003, its balance sheets and accounts for the same year as well as its budget for 2005. The term of the Chairman and of the Executive Bureau was extended until November 2004.

Observers of the then still acceding countries attended this meeting. After 1 May, full members have been nominated to the Advisory Committee from the new Member States.

The chairman of the task force on security of supply reported to the Committee members on the status of the work.

The Commission gave an update on negotiations between Euratom and third countries, including Russia.

The Supply Agency expresses its appreciation to the Committee and especially to the task force on security of supply for its excellent cooperation and assistance during the year.

Joint ESA/Advisory Committee activities

Task force on security of supply

The task force, which was created jointly by the ESA and the Advisory Committee in 2003, held five meetings in 2004 and finalised its work at the end of the year.

The mandate of the task force was to help the ESA to establish an action plan to deal with the selected recommendations made by the Advisory Committee in 2002 and to provide technical assistance in its implementation, in particular in the following areas:

- analysis of market data and review of the scenarios of supply and demand;
- identification and monitoring of market trends;
- assessment of the security of supply through the different stages of the fuel cycle, considering possible scenarios, and review of the question of stocks of natural and enriched uranium as well as fabricated fuel.

The task force developed a method in order to evaluate potential risks according to their probability of occurrence, the time frame involved (short-term or long-term risks) and their consequences for power generation.

Using this method, the task force drew up an inventory of potential risks with regard to disruptions in the supply of nuclear fuel within the EU and also an inventory of possible mitigation measures. The final report includes an analysis on future demand and supply in the nuclear fuel market and recommendations to the industry and authorities. The conclusions indicate that, although the security of supply for nuclear fuel in the European Union is better than for other energy sources, it has become weaker than in the recent past.

- The large and durable inflow of secondary supplies (up to 50 % of demand and mainly from weapons dismantlement) has created a market environment that is prone to volatility, and has induced a reduction of primary supplies below reactor needs and an adjustment of investment in exploration and production facilities.
- Reactor performance has improved and needs have increased while new reactors appear likely.
- Inventories have been reduced, under competitive pressures.
- During 2003/04, a series of supply shocks occurred that increased reliance on non-US mined production at a time of significant US dollar weakness.

Subsequently, the risk of a delivery disturbance has increased. Over the short term, this can be mitigated by an adequate inventory of nuclear material adjusted to each utility's special needs and situation. In the long term, new facilities are needed.

The industry is aware that this necessary supply infrastructure is capital intensive and requires stable and predictable markets to guarantee the required return on an investment.

Based on the analysis, the task force recommended that:

- the industry look at their supply chain including the inventory and adjust their policies (purchasing, logistics, inventory, etc.) accordingly;
- utilities enter into long-term business relationships at reasonable price levels with suppliers in order to secure the visibility of their own supplies and make it easier for their suppliers to decide on new investments;
- cooperation between the users of the nuclear fuel (utilities) and the producers be improved;
- a stable regulatory context be promoted to facilitate new investments for the new builds or extensions;
- the close monitoring and analysis of price-insensitive secondary supply be conducted.

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This report and previous editions are available from the Supply Agency's website:

http://europa.eu.int/comm/euratom/

A limited number of paper copies of this report may be obtained, subject to availability, from the above address.

Further information

Additional information may be found on Europa, the European Union server at
http://europa.eu.int/index_en.htm.
It provides access to the websites of all European institutions and other bodies.

The Internet address of the European Commission's Directorate-General for Energy and Transport is
http://europa.eu.int/comm/energy/index_en.html.
It contains information, for example, on the security of energy supply, energy related research, nuclear safety, and electricity and gas market liberalisation.

Additional information about EU policies regarding climate change can be found on the website of the European Commission's Directorate-General for the Environment:
http://europa.eu.int/comm/environment/climat/home_en.htm

List of abbreviations

CIS	Commonwealth of Independent States
ESA	Euratom Supply Agency
ETS	Emissions trading scheme
Euratom	European Atomic Energy Community
IAEA	International Atomic Energy Agency
(US) DOE	United States Department of Energy
(US) NRC	US Nuclear Regulatory Commission
USEC	United States Enrichment Corporation
EUP	Enriched uranium product
HEU	Highly enriched uranium
LEU	Low-enriched uranium
MOX	Mixed-oxide fuel (fuel of uranium and plutonium oxide)
RET	Re-enriched tails
SWU	Separative work unit
tSWU	tonne separative work (= 1 000 SWU)
tU	tonne U (= 1 000 kg uranium)
BWR	Boiling water reactor
EPR	European pressurised water reactor
LWR	Light water reactor
NPP	Nuclear power plant
PBMR	Pebble bed modular reactor
PWR	Pressurised water reactor
RBMK	Light water graphite-moderated reactor (Russian design)
VVER/WWER	Pressurised water reactor (Russian design)
kWh	kilowatt-hour
MWh	megawatt-hour = 10^3 kWh
GWh	gigawatt-hour = 10^6 kWh
TWh	terawatt-hour = 10^9 kWh

Annexes

Annex 1: CIS supplies

(A) Russian supply of natural uranium and feed contained in EUP to the EU-15

Year	Deliveries (1)	Exchanges (2)	Subtotal (1+2)	Re-enriched tails (3)	Total (1+2+3)	Total as % of supply
1992	1 800	900	2 700	0	2 700	23
1993	1 700	600	2 300	0	2 300	19
1994	1 700	500	2 200	0	2 200	16
1995	4 300	200	4 500	0	4 500	28
1996	5 100	700	5 800	0	5 800	36
1997	3 900	500		—	4 400	28
1998	3 900	600	4 500	—	4 500	28
1999	3 500	400	3 900	1 100	5 000	34
2000	4 200	0	4 200	1 200	5 400	34
2001	2 850	200	3 050	1 050	4 100	29
2002	3 900	600	4 500	1 000	5 500	33
2003	3 400	0	3 400	1 200	4 600	28
2004	2 400	0	2 400	900	3 300	23
Total	42 650	5 200	47 850	6 450	54 300	28

(1) Operators include producers, users and intermediaries.
(2) Including exchanges but excluding re-enriched tails except for 1997–98 as explained under (4).
(3) Supply to EU utilities covers total deliveries to EU-15 utilities under purchasing contracts during the respective year.
(4) Deliveries of re-enriched tails (RET) to EU utilities started in 1997 but were negligible (<1 % of total supply) during the first two years. For confidentiality reasons they have been included under 'Deliveries' for 1997 and 1998. The figures include RET acquired as a result of exchanges.

NB: For 1997 and 1998, re-enriched tails are included under 'Deliveries' because quantities were small and could not be shown separately for confidentiality reasons.

(B) Physical imports by EU-15 operators (1), and deliveries to EU-15 utilities of natural uranium and feed contained in EUP from the CIS (tU)

Year	Physical imports	Deliveries to EU-15 utilities (2)			
		Quantity tU	as % supply (3)	incl. RET (4)	incl. RET as % of supply (3)
1992	9 500	2 700	23		
1993	12 100	2 700	22		
1994	12 200	4 500	32		
1995	12 100	5 200	32		
1996	17 600	6 800	43		
1997	12 200	5 000	32	—	—
1998	11 600	5 600	35	—	—
1999	9 400	5 100	34	6 200	42
2000	8 700	5 800	37	7 000	44
2001	8 600	4 100	29	5 100	37
2002	8 600	6 900	41	7 900	47
2003	9 200	4 500	27	5 700	35
2004	11 400	2 900	20	3 800	26
Total	143 200	61 800	32		

(1) Operators include producers, users and intermediaries.
(2) Including exchanges but excluding re-enriched tails except for 1997–98 as explained under (4).
(3) Supply to EU utilities covers total deliveries to EU-15 utilities under purchasing contracts during the respective year.
(4) Deliveries of re-enriched tails (RET) to EU utilities started in 1997 but were negligible (<1 % of total supply) during the first two years. For confidentiality reasons they have been included under 'Quantity tU' for 1997 and 1998. The figures include RET acquired as a result of exchanges.

Annex 2: EU-15 reactor needs and net requirements (quantities in tU and tSWU)

(A) From 2005 until 2014

Year	Natural uranium		Separative work	
	Reactor needs	Net requirements	Reactor needs	Net requirements
2005	20 100	15 300	11 800	9 900
2006	20 500	16 900	11 600	10 100
2007	19 500	16 700	12 000	10 800
2008	19 900	17 300	11 600	10 400
2009	19 400	17 400	11 200	10 200
2010	19 900	18 200	11 900	11 100
2011	18 600	16 600	10 900	10 200
2012	18 900	17 000	11 400	10 700
2013	18 500	16 800	11 000	10 400
2014	17 700	16 100	10 500	10 000
Total	193 000	168 300	113 900	103 800
Average	19 300	16 800	11 400	10 400

(B) Extended forecast from 2015 until 2024

Year	Natural uranium		Separative work	
	Reactor needs	Net requirements	Reactor needs	Net requirements
2015	17 800	16 100	10 500	10 000
2016	17 500	15 800	10 200	9 700
2017	16 800	15 100	9 900	9 300
2018	16 800	15 200	10 000	9 400
2019	16 700	15 000	9 600	9 100
2020	16 000	14 300	9 500	9 000
2021	16 000	14 300	9 300	8 800
2022	15 900	14 200	9 200	8 600
2023	15 000	13 400	8 800	8 300
2024	15 000	13 400	8 700	8 200
Total	163 500	146 800	95 700	90 400
Average	16 400	14 700	9 600	9 000

Annex 3: Fuel loaded into EU-15 reactors and deliveries of fresh fuel under purchasing contracts

Year	Fuel loaded			Deliveries		
	LEU (tU)	Feed equiv. (tU)	Enrich. eq. (tSWU)	Natural U (tU)	% spot	Enrich. (tSWU)
1980		9 600		8 600	(4)	
1981		9 000		13 000	10	
1982		10 400		12 500	<10	
1983		9 100		13 500	<10	
1984		11 900		11 000	<10	
1985		11 300		11 000	11.5	
1986		13 200		12 000	9.5	
1987		14 300		14 000	17	
1988		12 900		12 500	4.5	
1989		11 800		13 500	11.5	
1990		15 400		12 800	16.7	
1991		15 000	9 200	12 900	13.3	10 000
1992		15 200	9 200	11 700	13.7	10 900
1993		15 600	9 300	12 100	11.3	9 100
1994	2 520	15 400	9 100	14 000	21	8 800
1995	3 040	18 700	10 400	16 100	18.1	9 600
1996	2 920	18 400	11 100	15 900	4.4	11 700
1997	2 900	18 200	11 000	15 600	12	10 100
1998	2 830	18 400	10 400	16 100	6	9 200
1999	2 860	19 400	10 800	14 800	8	9 700
2000	2 500	17 400	9 800	15 800	12	9 700
2001	2 800	20 300	11 100	13 900	4	9 100
2002	2 900	20 900	11 600	16 900	8	9 500
2003	2 800	20 700	11 500	16 400	18	11 000
2004	**2 600**	**19 300**	**10 900**	**14 600**	**4**	**10 500**
Total	30 670	381 800	145 400	341 200		138 900

Annex 4: Supply Agency average prices for natural uranium

Year	Multiannual contracts		Spot contracts		Exch. rate
	EUR/kgU	USD/lbU_3O_8	EUR/kgU	USD/lbU_3O_8	USD/EUR
1980	67.20	36.00	65.34	35.00	1.39
1981	77.45	33.25	65.22	28.00	1.12
1982	84.86	32.00	63.65	24.00	0.98
1983	90.51	31.00	67.89	23.25	0.89
1984	98.00	29.75	63.41	19.25	0.79
1985	99.77	29.00	51.09	15.00	0.76
1986	81.89	31.00	46.89	17.75	0.98
1987	73.50	32.50	39.00	17.25	1.15
1988	70.00	31.82	35.50	16.13	1.18
1989	69.25	29.35	28.75	12.19	1.10
1990	60.00	29.39	19.75	9.68	1.27
1991	54.75	26.09	19.00	9.05	1.24
1992	49.50	24.71	19.25	9.61	1.30
1993	47.00	21.17	20.50	9.23	1.17
1994	44.25	20.25	18.75	8.58	1.19
1995	34.75	17.48	15.25	7.67	1.31
1996	32.00	15.63	17.75	8.67	1.27
1997	34.75	15.16	30.00	13.09	1.13
1998	34.00	14.66	25.00	10.78	1.12
1999	34.75	14.25	24.75	10.15	1.07
2000	37.00	13.12	22.75	8.07	0.92
2001	38.25	13.18	21.00 ([1])	7.23 ([1])	0.90
2002	34.00	12.37	25.50	9.27	0.95
2003	30.50	13.27	21.75	9.46	1.13
2004	**29.20**	**13.97**	**26.14**	**12.51**	**1.24**

([1]) The spot price for 2001 was calculated on the basis of an exceptionally low total volume of only some 330 tU under four transactions, one of which accounted for two thirds of this quantity. Some 300 tU were delivered as UF_6 without a price being specified for the conversion component. To establish a price excluding conversion costs for these deliveries, the Supply Agency applied an estimated average conversion price of EUR 5.70/kgU (USD 5.10/kgU).

Annex 5: Calculation methodology for ESA U_3O_8 average prices

The Euratom Supply Agency collects two categories of prices on an annual basis:

- ESA weighted average U_3O_8 price for multiannual contracts, paid by EU utilities for their deliveries in a given year;
- ESA weighed average U_3O_8 price for spot contracts, paid by EU utilities for their deliveries in a given year.

The differences between multiannual and spot contracts are defined as follows:

- 'multiannual' contracts are defined as those providing for deliveries extending over more than 12 months;
- 'spot' contracts are those providing for either only one delivery or deliveries extending over a period of a maximum of 12 months, whatever the time between the conclusion of the contract and the first delivery.

Methodology

Prices

Prices are collected directly from utilities or via their procurement organisations, through:

- contracts submitted to the ESA;
- end-of-year questionnaires, completed if necessary by visits to the utilities.

Data requested on natural uranium deliveries during the year

These include the following elements: ESA contract reference, quantity (kgU), delivery date, place of delivery, mining origin, natural uranium price with specification of currency, unit of weight (kg, kgU, lb), chemical form (U_3O_8, UF_6, UO_2), indication of whether the price includes conversion and, if so, the price of conversion, if known.

Deliveries taken into account

The deliveries taken into account are those made under purchasing contracts to the EU electricity utilities or their procurement organisations during the respective year. They also include the natural uranium equivalent contained in enriched uranium purchases.

Other categories of contracts are excluded ([6]).

Deliveries for which it is not possible to reliably establish the price of the natural uranium component are excluded from the price calculation (e.g. uranium out of specification or enriched uranium priced per kg of EUP without separation for the feed and enrichment components).

([6]) Such as contracts between intermediaries, sales by utilities, purchases by non-utility industries, barter deals.

Checking

ESA compares the deliveries and prices reported with the data collected at the time of the conclusion of contracts as subsequently updated. It compares, in particular, the actual deliveries with the 'scheduled deliveries' and options. Where there are discrepancies between scheduled and actual deliveries, clarifications are sought from the organisations concerned.

Exchange rates

To calculate the average prices, the original contract prices are converted into EUR per kgU contained in U_3O_8 using the average annual exchange rates as published by the European Central Bank.

Prices which include conversion

For the few prices which include conversion and where the conversion price is not specified, the ESA, given the relatively minor cost of the conversion, converts the UF_6 price to a U_3O_8 price using an average conversion value based on its own sources of information, specialised trade press publications and confirmed by discussions with the converters.

Independent verification

Two members of the ESA staff independently verify calculation sheets from the database.

In spite of all the care, errors/omissions are uncovered from time to time, mostly on missing data, e.g. deliveries under options, which were not reported. As a matter of policy, the ESA never publishes a corrective figure.

Data protection

Confidentiality and physical protection of commercial data is provided through use of stand-alone computers, not connected either to the Commission Intranet or to the outside world (including Internet). Contracts and backups are kept in a safe room, with restricted key access.

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