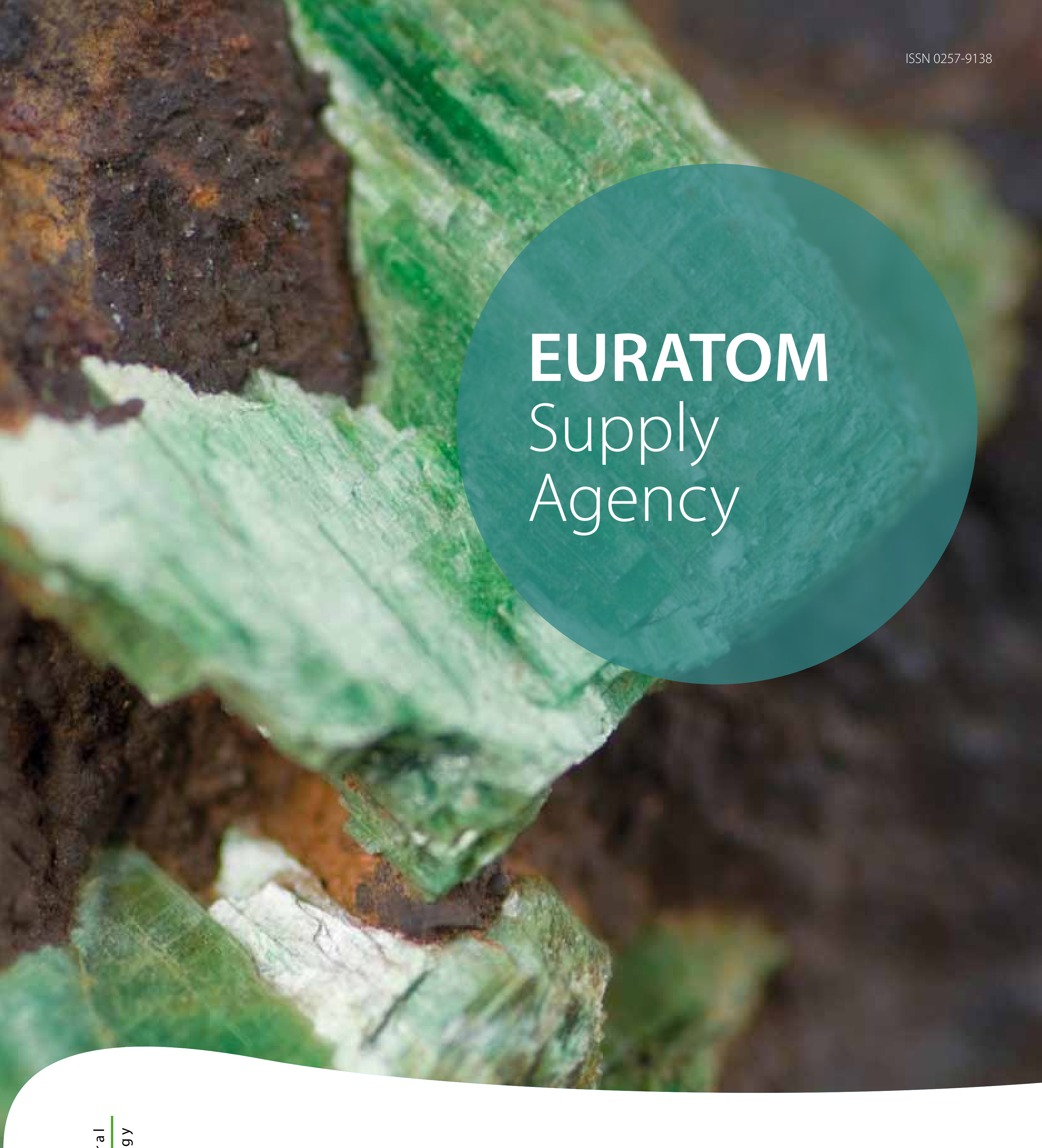
ISSN 0257-9138



EURATOM Supply Agency

Directorate-General for Energy

ANNUAL REPORT 2010

EUROPEAN COMMISSION

EURATOM
Supply
Agency

ANNUAL REPORT 2010

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Luxembourg: Publications Office of the European Union, 2011

ISBN 978-92-79-20610-8
doi:10.2833/94175

Cover photo: Torbernite uranium ore crystals
Photographer: © iStockphoto/Darren Falkenberg

Printed in Belgium
PRINTED ON WHITE CHLORINE-FREE PAPER

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Executive summary

The year 2010 was marked by major developments in the EU's energy policy and in its nuclear energy framework. In particular, the Commission adopted a proposal for a directive on nuclear waste and spent fuel management and a European nuclear sustainable industrial initiative was launched. With regard to use of nuclear energy, a number of EU Member States revealed plans or took decisions which could increase the share of nuclear energy in their future energy mix. In the EU's neighbourhood, Russia, Belarus and Turkey made further progress on constructing new nuclear power plants. At global level, Asian countries pursued their plans to expand or develop their fleet of nuclear reactors in order to meet their growing energy requirements.

In 2010, global uranium production increased by 6 % to over 53 000 tonnes of uranium (tU). Kazakhstan once again accounted for the bulk of this rise in output, with a 27 % year-on-year increase, followed by some African countries. Less spectacular increases or no change in output were recorded in Russia, Uzbekistan and the USA. By contrast, production decreased in Australia and Canada. Uranium is now mined in 20 countries, seven of which account for 90 % of world production (Australia, Canada, Kazakhstan, Namibia, Niger, Russia and Uzbekistan).

Natural uranium supplies to the EU continued to come from diversified sources. Uranium originating from Russia, Kazakhstan, Canada, Australia and Niger made up more than 80 % of total deliveries. Although the EU has no significant uranium resources on its territory, several EU companies are active in uranium mining in other parts of the world. As in previous years, uranium originating in the EU met around 3 % of the EU's needs.

In 2010, 96 % of total deliveries of natural uranium to EU utilities were covered by long-term contracts and only 4 % were purchased under spot contracts. Long-term supplies remain the main source for securing the demand in the EU.

The average price index of uranium delivered under multiannual contracts in 2010 was EUR 61.68/kgU contained in U_3O_8, 10.7 % up from the EUR 55.70/kgU in 2009 (or USD 31.45/lb U_3O_8 v USD 29.88/lb U_3O_8 in 2009). The MAC-3 average price index rose to EUR 78.12/kgU contained in U_3O_8 (or USD 39.83/lb U_3O_8), up by 23 % from last year, whereas the average spot price index for natural uranium delivered was EUR 79.48/kgU, an increase of 2 % compared with the 2009 price of EUR 77.96/kgU. However, the price in dollars per pound of U_3O_8 decreased from USD 41.83 in 2009 to USD 40.53 in 2010. These contradictory price trends in the two currencies are due to the appreciation of the dollar in 2010.

As regards providers of enrichment services, almost 60 % of the EU's requirements were met by the two European enrichers. Separative work performed in Russia for deliveries to EU utilities under purchasing contracts met 33 % of their total needs, while the American-based company USEC delivered 7 % of the total enrichment services supplied to EU-27.

Based on the results of surveys, ESA concluded that the aggregate level of stocks and the contractual coverage are adequate to meet the needs of utilities in the years ahead.

The events at the Fukushima Daiichi nuclear power plant in Japan, in March 2011, as a result of the tsunami following the earthquake, have affected nuclear energy prospects in other countries to varying degrees. The Fukushima reactors shut down safely, as designed, in response to the earthquake; it was the flooding of support systems as a result of the tsunami which caused the subsequent incident.

At EU level, as a first reaction, agreement was reached to launch comprehensive risk and safety assessments for all nuclear power plants in the course of 2011. Neighbouring countries were encouraged to conduct similar tests.

Chapter 1

Nuclear energy developments in the EU and ESA activities

EU nuclear energy policy in 2010

In 2010, major developments were seen in EU energy policy. After a number of public discussions, the European Commission published the EU Energy 2020 strategy [1] in November 2010. This stresses the importance of guaranteeing solidarity between Member States and of diversifying sources of supply — two principles that have driven ESA's activities since it was established. The Commission will continue to further enhance the legal framework for safe and sustainable use of nuclear energy inside the EU and will promote high standards of nuclear safety and security outside the EU too, both bilaterally and in close cooperation with the International Atomic Energy Agency.

Other significant developments in 2010 included the start of activities on the low-carbon energy roadmap towards 2050 and the launch of the European nuclear sustainable industrial initiative on 15 November 2010 under the Belgian Presidency.

Nuclear Safety Directive

Nuclear safety is and will remain an absolute policy priority for the EU. The Nuclear Safety Directive adopted in 2009 [2] will have to be transposed by Member States by 22 July 2011. The main objective of this directive is to establish a Community framework to maintain and promote continuous improvements in nuclear safety.

Safe management of radioactive waste and spent fuel

Following the adoption of the Nuclear Safety Directive, on 3 November 2010, the Commission presented a revised proposal for a Council directive on the management of spent fuel and radioactive waste [3]. The general objective of the proposal is to establish a Community framework for responsible management of spent fuel and radioactive waste, ensuring that Member States make appropriate national arrangements guaranteeing a high level of safety while maintaining and promoting public information and participation. Once this directive enters into force, the EU will be the first major regional nuclear player with binding rules on nuclear safety and waste management.

In the area of nuclear decommissioning, a Council Regulation adopted in 2010 extended the EU financial support to the Kozloduy programme in Bulgaria, committing an additional EUR 300 million for the period 2010–13.

(1) COM(2010) 639 final, 'Energy 2020 – A strategy for competitive, sustainable and secure energy', 10.11.2010.
(2) Council Directive 2009/71/Euratom, OJ L 172, 2.7.2009, p. 18.
(3) COM(2010) 618 final, 3.11.2010.

Supply of radioisotopes

In August 2010, the Commission adopted a communication on medical applications of ionising radiation and security of supply of radioisotopes for nuclear medicine [(4)]. This proposes a way forward to resolve the urgent issue of the shortage of supply of radioisotopes for nuclear medicine. It maps out a long-term approach to medical applications of ionising radiation in the EU to stimulate discussions on the action, resources and distribution of necessary responsibilities. It also identifies key issues to improve radiation protection for patients and medical staff and avoid a rise in exposure associated with the technological advances in X-ray computed tomography imaging and any increase in accidental or unintended exposure in radiotherapy.

The Council adopted conclusions on this communication on 6 December 2010.

Bilateral nuclear cooperation agreements

Australia, Canada and the USA

Implementation of the nuclear cooperation agreements between the European Atomic Energy Community (Euratom) and Australia, Canada and the USA continued throughout 2010 to the satisfaction of all involved. Regular consultation meetings were held.

Based on the negotiating mandate adopted by the Council in 2009, the Commission engaged in renegotiating the existing agreement between Euratom and Canada for cooperation on peaceful uses of atomic energy. Since the initial agreement was signed in 1959, it has been amended five times. This agreement therefore needs to be revised and consolidated.

Likewise, the existing Euratom–Australia agreement is being renegotiated, since the original agreement, concluded in 1982, was for 30 years and will expire in January 2012. The Council adopted the negotiating mandate in July 2010 and negotiations were completed in early 2011, with a view to formally concluding the new agreement later in the year.

Russian Federation

Based on the negotiating mandate adopted by the Council in December 2009, discussions have started on a new and comprehensive cooperation agreement on peaceful uses of nuclear energy between Euratom and the Russian Federation, setting up an overall framework for political, technical and industrial cooperation.

South Africa

The Council adopted a negotiating mandate for a new agreement between Euratom and South Africa in October 2010. Negotiations have started.

Nuclear Energy Technology Platforms

The Sustainable Nuclear Energy Technology Platform (SNETP), launched in 2007, aims to promote research, development and demonstration of the nuclear fission technologies necessary to achieve the goals of the Strategic Energy Technologies Plan (SET Plan). The medium-term goals for nuclear energy are to maintain competitiveness in fission technology and to provide long-term waste management solutions, whereas in the longer term the SET Plan aims to complete demonstration of more sustainable Generation IV fission reactors and to expand applications of nuclear fission beyond electricity production.

(4) COM(2010) 423 final, 6.8.2010.

Furthermore, the European nuclear sustainable industrial initiative was officially launched during the SET Plan conference in November 2010. Work will now proceed over the next few years to design and construct prototype and demonstration fast reactors to make this reactor line available to secure the long-term sustainability of nuclear fission energy in the EU low-carbon energy mix.

Also in 2010, the Technology Platform for Implementing Geological Disposal defined its strategic research agenda addressing the remaining scientific, technological and socio-political challenges to be met before proceeding towards effective geological disposal.

European Nuclear Safety Regulators Group (ENSREG)

ENSREG is made up of senior officials from the national regulatory authorities responsible for nuclear safety, radioactive waste safety or radiation protection from all 27 Member States in the EU plus representatives of the Commission. Its objective is to further a common approach to the safety of nuclear installations and to safe management of spent fuel and radioactive waste.

ENSREG held three meetings in 2010. Its main activities included advising the Commission on the planned Community legislation on radioactive waste and spent fuel management, supporting transposition and implementation of the Nuclear Safety Directive – including establishing a common method for the periodic safety self-assessments and a system for coordinating the international peer reviews – and preparing guidelines on regulators' transparency. A dedicated ENSREG website was also launched in 2010 [(5)].

European Nuclear Energy Forum (ENEF)

ENEF was established in November 2007, as a platform to promote a broad discussion among stakeholders on the opportunities, risks and transparency of nuclear energy. Between its annual plenary sessions, ENEF's work is divided between three working groups focusing on opportunities, risks and transparency respectively.

The role of nuclear energy in the gradual transition towards a low-carbon economy in Europe was discussed at the fifth plenary session of ENEF attended by 300 participants in Bratislava, in May 2010.

As regards the risks of nuclear energy, the Forum has recognised the need for a legally binding Community instrument for radioactive waste. ENEF has also highlighted the need to ensure a sufficient level of training and qualified staff, in particular technicians and engineers in the nuclear industry. One practical result of the preparatory work is the European Nuclear Energy Leadership Academy (ENELA), founded in early 2010.

Main developments in the EU Member States

In the course of 2010, EU Member States made a number of statements or decisions in favour of further development of nuclear energy in the EU. Examples include the Finnish Parliament's decision to construct two new reactors in Finland, the law providing for further extension of nuclear power plants' operating lifetime in Germany (reversed in 2011), the conversion of the Nuclear Safety Department of the Institute for Environmental Protection and Research in Italy into an independent nuclear safety agency, the decision by the Belgian government to construct the 'Myrrha' fast spectrum research reactor as well as decisions to uprate reactors' capacity or extend their lifetime – to mention just a few.

(5) http://www.ensreg.eu

However, it has to be added that (as this report was finalised in mid-2011) after the earthquake and tsunami which hit Japan in March and triggered a nuclear accident, the EU Heads of State or Government agreed to launch a review of the safety of all nuclear plants in the EU, based on a comprehensive and transparent risk and safety assessment. This assessment will be carried by independent national authorities and peer reviews in the course of 2011.

Furthermore, it should be noted that many figures and aggregates, outlooks, etc. used in this report are based on data received by ESA as of 31 January 2011. Recent political decisions in two Member States taken right before finalising and releasing this report and the developments derived therefrom, may have serious impacts on the future of nuclear energy. By the end of May, the German government announced its decision concerning an irrevocable gradual phase-out of nuclear energy in the country by 2022. The necessary laws for this gradual phase-out should be finalised in July 2011. In addition, in a referendum held on 12 and 13 June, Italian voters rejected a recent law that could have allowed construction of nuclear power plants in the country.

As shown in Table 1, in 2010, a total of 143 nuclear power reactors were in operation in the EU and six under construction.

Table 1: Nuclear power reactors in the EU in 2010

Country	Reactors in operation (construction)	Nuclear electricity as % of total electricity generated
Belgium	7	51.2
Bulgaria	2 (2)	33.1
Czech Republic	6	33.3
Finland	4 (1)	28.4
France	58 (1)	74.1
Germany	17	27.3
Hungary	4	42.1
Romania	2	19.5
Slovakia	4 (2)	51.8
Slovenia	1	37.3
Spain	8	20.1
Sweden	10	38.1
The Netherlands	1	3.4
United Kingdom	19	15.7
Total	143 (6)	

Sources: IAEA and WNA.

Bulgaria: Bulgaria has not accepted the EUR 2.4 billion price increase that the Russian supplier Atomstroyexport is claiming due to delays in construction of the twin VVER-1000 units, for which a price of EUR 3.9 billion was agreed in January 2008.

Czech Republic: now that the original 10-year licence has expired, the Czech Nuclear Safety Authority has granted CEZ a further 10-year operating licence for the first unit of the Temelin NPP. Westinghouse, Areva and a consortium formed by Skoda JS, Atomstroyexport and Gidropress took part in the tender for the project to add two new reactors at the Temelin site. These new reactors are expected to come into operation in 2024 until 2025. Talks are in progress about the prospect of building a fifth unit at the Dukovany site.

Finland: in July, Parliament approved Fennovoima's and TVO's projects to build one new reactor each. The generally agreed view is that this future increase of up to 3 600 MWe of nuclear capacity would prevent possible shortages and lessen the dependence on imported electricity. Finland's Talvivaara Mining Company is interested in obtaining a permit for uranium extraction as a by-product from its Sotkamo nickel mine in Finland and put forward a project where Canada-based Cameco would participate as the investor. The 1 600 MWe Olkiluoto-3 unit being built by a consortium formed by Areva and Siemens will begin generating electricity during the second half of 2013.

France: the French Nuclear Safety Authority has issued a further 10-year operating licence to EDF's Tricastin unit 1 (955 MWe PWR), which becomes the first reactor in France to have passed three successive 10-yearly safety reviews. With a view to creating a strong and united national nuclear industry and improving the security of uranium supplies, the French government has asked for a strategic partnership between EDF and Areva. The two companies have started preliminary talks to this end.

Germany: a law passed in December cleared the way for further extension of nuclear power plants' operating lifetime. Depending on whether they started operating before or after December 1980, German nuclear reactors were to be allowed to continue running for another 8 or 14 years, respectively. A tax on nuclear fuel used in nuclear reactors was also introduced, which was expected to raise more than EUR 2.3 billion a year for the government.

Hungary: is in favour of expanding the Paks nuclear power plant to contribute to the nation's energy security. A tender is to be launched in early 2012. The new units would add some 2 000 MWe to electricity output and could come on stream by 2022.

Italy: the government approved the framework law on nuclear power which lays down the criteria for selecting nuclear power reactor sites and possible locations for spent fuel repositories. The Nuclear Safety Department of the Institute for Environmental Protection and Research has been converted into an independent nuclear safety agency which will be responsible for supervising NPP selection, construction and operation, an essential step towards integrating nuclear power into Italy's energy strategy. The government expects nuclear power to generate a quarter of the country's future energy production. Also, Areva signed an agreement with Ansaldo Energy to work together on the ENEL-EDF project to construct four European pressurised reactors (EPRs) in Italy.

Lithuania: the tender for construction of the Visaginas NPP, with a possible maximum capacity of 3 000 MWe and where the first unit was due to come into operation in 2018, failed after the only proposal meeting the requirements, from South Korea, was withdrawn at the end of November. The government has entered into bilateral discussions with possible strategic investors and operators.

Poland: Poland joined the OECD Nuclear Energy Agency (NEA) in November and is currently preparing to launch its nuclear programme. The government envisions establishing the legal framework by mid-2011, with plans to build capacity totalling 6 000 MWe at two sites.

Romania: Romania is about to re-launch the process to find investors for the Cernavoda 3 and 4 project (which received a favourable opinion from the European Commission) after CEZ, RWE, Iberdrola and GDF-Suez withdrew their bids.

Slovakia: further progress was made on building the new reactors (units 3 and 4) at the Mochovce nuclear power plant which are planned to come into operation in 2012 and 2013. In addition, CEZ's and Slovak state-owned JAVYS's venture to build a new nuclear power plant at Jaslovske Bohunice is currently subject to a feasibility study.

Slovenia: GEN Energija has applied for a licence for a second unit at the Krsko NPP, to be known as NEK-2. The Croatian state-owned power company, Hrvatska Elektroprivreda, is interested in participating in building this second reactor.

Spain: a 10-year extension has been granted for the operating licence for the Vandellós II NPP, owned jointly by Endesa (72 %) and Iberdrola (28 %), which will thus operate until 2027. The Nuclear Safety Commission has recommended granting government approval for another 10-year extension of operation of units 1 and 2 of the Almaraz NPP too.

Sweden: Sweden's nuclear regulator has approved a 38 % uprate of unit 2 of the OGK nuclear power plant, which will increase the current reactor's capacity to 840 MWe. The bill allowing Swedish firms to build new reactors to replace the 10 existing reactors, currently providing over 40 % of the country's electricity, came into force on 1 January 2011.

The Netherlands: in September, Energy Resources Holding submitted a notification of intent to build some 2 500 MWe of additional nuclear generating capacity at the Borssele site, where construction could begin in 2015. This notification follows an earlier expression of intent made by Delta to build a new 2 500 MWe NPP at the same site. In addition, NRG has submitted a notification of intent to replace the research reactor at Petten (Pallas).

United Kingdom: in March, Horizon Nuclear Power, a joint venture between E.ON and RWE, announced that it proposes to have its first reactor at Wylfa nuclear power plant in Wales which could begin operation in 2020 at the earliest. According to the Nuclear Installations Inspectorate, the UK's reactor design reviews of the Areva EPR and the Westinghouse AP1000 types are currently underway under the generic design assessment programme.

ESA operations

Mandate and core activities

A common nuclear market in the EU was created by the Euratom Treaty. Articles 2(d) and 52 of the Treaty established ESA to ensure a regular and equitable supply of nuclear fuels to EU users. To perform this task, ESA applies a supply policy based on the principle of equitable access to sources of supply.

In this context, ESA focuses on enhancing the security of supply of users located in the European Union and shares responsibility for the viability of the EU nuclear industry. In particular, it recommends that EU utilities operating nuclear power plants maintain stocks of nuclear materials, cover their requirements by entering into long-term contracts and diversify their sources of supply.

ESA's mandate is, therefore, to exercise its powers [6] and, as required by its statutes, to monitor the market to make sure that the activities of individual users reflect the values set out above.

The Euratom Treaty requires ESA to be a party to supply contracts for nuclear material whenever one of the contracting parties is an EU utility, an operator of a research reactor in the EU, or a producer/intermediary selling nuclear material (imports into or exports from the EU, plus intra-Community transfers). When exercising its rights of co-signature ESA implements the EU supply policy for nuclear materials. ESA also has a right of option to purchase, with the right of first refusal over nuclear materials produced in the Member States.

Based on the Euratom Treaty, ESA also monitors transactions involving services in the nuclear fuel cycle (conversion, enrichment and fuel fabrication). Operators are required to submit notifications giving details of their commitments. ESA verifies and acknowledges these notifications.

In 2010, ESA processed 312 transactions, including contracts, amendments and notifications of front-end activities. In this way, ESA ensured security of supply of nuclear materials.

Market observation

Besides this *Annual Report*, which is the Agency's main publication and is available on the ESA website, the Nuclear Observatory also offers the News Digest, Price Trends, Quarterly Reports and descriptions of the Global Nuclear Fuel Cycle.

(6) Under the supervision of the European Commission (Article 53 of the Euratom Treaty).

ESA's functional website, known as the Nuclear Observatory, was created in 2009 to mirror the latest developments on the nuclear market in the EU. Data are published with the aim of making the EU nuclear market more transparent and providing a better insight into developments on the market. In 2010, ESA launched a new bi-monthly publication, *Nuclear News Digest*.

ESA publishes, on an annual basis, different types of natural uranium prices that are in line with other traditional price indicators. Greater transparency about the EU natural uranium market reduces uncertainty and strengthens security of supply.

Since the end of 2009, ESA has been publishing the *Quarterly Uranium Market Report*, which reflects global and EU-specific developments on the nuclear market. This includes general data about natural uranium supply contracts signed by EU utilities and descriptions of activity on the natural uranium market in the EU. In 2011, there are plans for the *Quarterly Uranium Market Report* to include the quarterly spot price index for natural uranium (based on a minimum of three ordinary spot contracts).

The feasibility study on new statistics on the EU market was carried out with the assistance of the working groups of the ESA Advisory Committee. ESA also contributed to the quarterly publication of the European Commission's energy observatory with an article entitled 'Focus on the front end of the nuclear industry'.

The reliability of market analyses depends largely on the accuracy of the data collected. This is ensured by requiring EU nuclear energy users and producers to provide information on their estimated future requirements, contracted purchases and the quantities of nuclear materials actually delivered (*ex ante*, current and *ex post* market data) and by screening open source information.

Activities of the Advisory Committee

The Advisory Committee assists the Agency in carrying out its tasks by giving opinions and providing analyses and information. This assistance also extends to preparation of various reports. It acts as a link between ESA and both producers and users in the nuclear industry.

In 2010, the Advisory Committee held two meetings — one on 20 May, the other on 9 December. The main items on the agenda were: reports of the working groups on prices and security of supply, presentation of the ESA Nuclear Observatory, opinions on ESA's 2009 *Annual Report* and on ESA's 2010 work programme, assessment of ESA's budget situation in 2009 and 2010, opinion on ESA's 2011 work programme and presentations on the latest developments in EU energy policy.

During 2010, working groups of the ESA Advisory Committee held three meetings: on 11 February, 24 June and 16 November. Their activities included analysis and development of the methodology for nuclear statistics provided by ESA, improvement of the yearly data reporting by EU utilities and discussions on the contribution by nuclear energy to EU energy policy developments in the context of 'EU energy trends to 2030' (Primes model used by the European Commission).

As a result, it was suggested that ESA publish in the 2010 *Annual Report* such new data as 'Natural uranium stocks held by EU utilities' and 'Natural uranium coverage rate for EU utilities'. The working groups established a methodology for other statistical reports provided by ESA, such as 'MAC-3 index with and without amendments', a new quarterly spot price index.

International cooperation

ESA has a long-standing and well-established relationship with two major international organisations in the field of nuclear energy: the IAEA and the NEA, the latter of which is a specialised agency of the OECD. During 2010, ESA continued its cooperation with both these organisations, by taking part in discussing and preparing IAEA and OECD/NEA publications on electricity generation costs [7], on trends in the nuclear fuel cycle and on global uranium resources.

(7) 'Projected costs of generating electricity', a joint report by the IEA and the OECD/NEA, Paris, May 2010.

The Joint NEA/IAEA Uranium Group is a permanent body in which ESA regularly participates as a member. It meets regularly twice a year and its main output is the *Red Book on Uranium*[8] series, which is the most authoritative biannual publication on uranium resources and demand.

In addition, ESA took part in the OECD/NEA working group on trends in the nuclear fuel cycle which focuses on the sustainability dimension of the nuclear fuel cycle. The final study is to be published by mid-2011.

Another ad hoc body was the working group on security of supply and nuclear energy[9], which was operational between 2007 and 2009 and in which ESA participated actively. Its final study was released as an OECD publication in November 2010.

Furthermore, ESA participates, on an ad hoc basis, in working groups and the nuclear fuel plenary sessions of the World Nuclear Association, where it reports on the latest developments on the nuclear market or on uranium pricing methods.

ESA administrative issues

Implementation of the budget

Following the European Parliament vote on the EU budget, the Commission's budget covered ESA's administrative expenditure in 2010. The 2010 annual accounts are available on ESA's website at: http://ec.europa.eu/euratom/index_en.html

Evaluation by the Court of Auditors

The Court of Auditors audits ESA's operations on an annual basis. ESA has taken due account of the opinions expressed by the Court.

(8) 'Uranium 2009: Resources, production and demand', a joint report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency, Paris, July 2010.
(9) The Security of energy supply and the contribution of nuclear energy, Published by the OECD/NEA, Paris, December 2010.

Chapter 2

World market for nuclear fuels

This chapter presents an overview of the main developments affecting the global supply and demand balance and security of supply at different stages of the fuel cycle in 2010.

In 2010, the world reactor requirements for natural uranium were estimated to be around 69 000 tU. Many countries, especially China, India and other rapidly growing economies are planning significant increases in their nuclear power generation capacity. This increase in demand will have to be covered mostly by an increase in primary supply in the decades ahead.

Supply of nuclear fuels

In 2010, uranium mine development responded to the market signals of rising prices and growing demand. According to the latest projections in the *Red Book on Uranium*(10), provided proper development efforts are made and prove successful, primary uranium production capability, including existing, committed, planned and prospective production centres could satisfy the projected world uranium requirements throughout the period 2028–35, when they are estimated to be in the range of 87 000 to 135 000 tU (depending on low- or high-demand projections). Beyond these dates, if production is to provide fuel for all reactors for their entire operational lifetime, including new reactors added to the grid up to 2035, additional resources will need to be identified and new mines and mine expansions will have to be completed in time, taking into account that exploration and development would take at least 10 years on average.

Should demand increase, uranium prices and/or cooperation between utilities and producers would be expected to stimulate additional investment in mine production capacity in order to cover the new demand and replace the production from some existing mines; both of which are forecast by the end of the decade. Secondary sources will continue to be required, supplemented as far as possible by uranium savings achieved by specifying low tails assays at enrichment facilities and developments in fuel cycle technology.

The latest *Red Book on Uranium* also notes that uranium resources are adequate to meet projected requirements but that the challenge remains to develop environmentally sustainable mining operations and to supply the market with more uranium on time. As for mining costs, the same study states that a higher cost category of USD 130-260/kgU was added to supplement previous editions that tabulated resources available at costs of up to USD 130/kgU (or USD 50/lbU_3O_8). Identified uranium resources recoverable at costs of under USD 130/kgU decreased by some 65 000 tU between 2007 and 2009 to 5 404 000 tU, mainly as a result of significant reductions reported in Kazakhstan, Russia, South Africa, Ukraine and the USA which outweighed the additions reported in Argentina, Australia, Canada, China, India, Malawi and Namibia. Despite the decline in resources recoverable at costs of under USD 130/kgU, the overall increase in identified resources recoverable at less than USD 260/kgU between 2007 and 2009 added up to over 837 000 tU, equivalent to over 13 years of supply of uranium requirements at 2009 levels.

The European nuclear fuel market makes up around one third of the world market. In 2010, more than 10 different sources continued to supply natural uranium to the EU. Its largest supplies come from Russia, Kazakhstan, Canada, Australia and Niger, which cover more than three quarters of the EU's total needs. As in previous years, uranium originating in the EU meets around 3 % of the EU's needs. Several EU companies are active in uranium mining in other parts of the world. Nevertheless, rising demand for uranium originating from Asia could potentially cause some uncertainties on the uranium market.

(10) 'Uranium 2009: Resources, production and demand', a joint report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency, Paris 2010.

Natural uranium production

Global production in 2010 increased by 6% to around 53700 tonnes of uranium (tU), mainly due to the steadily increasing production from Kazakhstan (see Table 2). With an increase of 27% in production from 2009 to 2010, this country reported the largest increase in output, followed by some African countries. However the production growth varied from country to country in Africa. The most considerable growth in nominal terms was in Niger, where the uranium production increased by 955 tU or 29% as compared with 2009. Malawi increased its production by 566 tU, or 544% from last year. The growth in South Africa was modest, with an increase of 20 tU or 4%. In turn, in Namibia there was a slight decline in the production level, 130 tU or 3% less than in 2009. In Canada, the uranium production declined by 4%, mainly due to the fact that in McClean Lake the uranium production was halted in June 2010. Uranium production in Australia shrank by 26%; the reason for this adverse development was lower than expected mined ore grade. The uranium production in USA increased by 14% and totalled 1660 tU. Uranium is mined in 20 countries, seven of which account for 90% of world production (Australia, Canada, Kazakhstan, Namibia, Niger, Russia and Uzbekistan).

The relatively diverse geographical distribution of uranium resources and fuel fabrication activities allows confidence that the risk of disruption is low. However, signs of uncertainties about the long term have appeared, as fast growing economies are entering the market.

Table 2: Natural uranium production in 2010 (compared with 2009, in tonnes of uranium)

Region/ Country	Production 2010 (tU)	Production 2009 (tU)	Share in 2010 (%)	Share in 2009 (%)	Change 2010/2009 (%)
Kazakhstan	17803	14020	33%	28%	27%
Canada	9783	10173	18%	20%	– 4%
Australia	5900	7982	11%	16%	– 26%
Namibia	4496	4626	8%	9%	– 3%
Niger	4198	3243	8%	6%	29%
Russia	3562	3564	7%	7%	0%
Uzbekistan	2400	2429	4%	5%	– 1%
USA	1660	1453	3%	3%	14%
Ukraine	850	840	2%	2%	1%
China	827	750	2%	1%	10%
Malawi	670	104	1%	0%	544%
South Africa	583	563	1%	1%	4%
Others	931	1025	2%	2%	– 9%
Total	53663	50772			

Source: Nuclear data from industry and WNA. Totals may not add up due to rounding.

Secondary sources of supply

Worldwide, natural uranium supply and demand remained in balance. There have been no supply shortages recently. Primary production of uranium in 2010 satisfied some 75% of world requirements. The remainder has been provided or derived from secondary sources including stockpiles of natural and enriched uranium, downblending of weapons grade uranium, reprocessing of spent fuel and re-enrichment of depleted uranium tails.

The secondary sources are set to decline by 2030. Uranium production covered by new mining projects should provide 38% of the primary supply by 2020 and 60% by 2030. In the light of the uncertainty about the availability of secondary supplies, decisions on longer-term mining projects have to be taken now, as new uranium deposits take an average of 15 years to develop from scratch.

Re-enrichment of depleted uranium tails in Russia will be terminated in 2011, as Rosatom confirmed that the current contracts with European enrichers expired in 2010 and no new re-enrichment contracts for foreign customers are to be concluded. Nevertheless, Rosatom might continue to re-enrich its own stock of tails. EU enrichers have to put in place long-term strategies to manage tails arising from material stocks, including by deconversion of UF_6 to the more stable form of U_3O_8. Today deconversion takes place in France, while in the UK Urenco is constructing a tails management facility.

Conversion

During 2010 world conversion capacity was estimated to be unchanged compared with the previous year, at around 75 000 tU as UF_6. However, renewal of conversion facilities continued in France. The capacity is well above the global demand for conversion services, which is currently estimated to be around 60 000 tU per year. Demand could rise to about 80 000 tU per year for 2015 and 120 000 tU for 2030. However, when looking at the total present conversion capacity surplus, careful attention should also be paid to aspects like the market availability of Russian conversion capacity or natural UF_6, the age of conversion plants and the need for renovation and related regulatory requirements.

Table 3: Uranium conversion companies worldwide

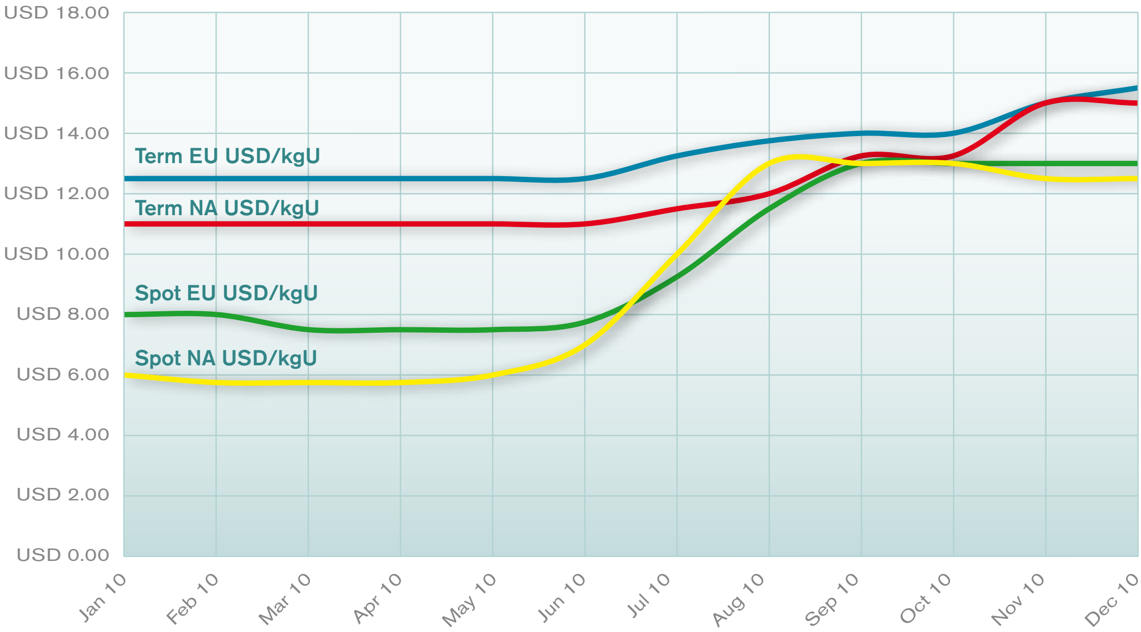
Company	Capacity in 2010 (tU as UF_6)	Share of global capacity (%)
Atomenergoprom (RUS)	25 000	34
Cameco (CAN + UK)	17 500	23
ConverDyn (USA)	15 000	20
Areva (FR)	14 000	19
CNNC (China)	3 000	4
Ipen (Brazil)	90	–
World total	74 590	*

Source: Estimates based on data published by institutions and the industry.
** Totals may not add up due to rounding.*

As can be seen from Figure 1, conversion prices worldwide remained rather stable during the first half of 2010, despite a slight upward movement of the North American spot market indicators. Then, starting from July, conversion prices increased markedly, especially in North America and Europe. This price increase can be attributed mainly to a strike at the Metropolis (ConverDyn) conversion plant. Market analysts point out, however, that the long-term conversion prices were not affected in the same way during the two-year shutdown of the Port Hope (Cameco) conversion plant. Uranium conversion facilities continued to operate in France, the United Kingdom, Russia, the USA and Canada.

The forecast increase in enrichment capacity in the USA could accentuate the imbalance in conversion services capacity between the USA and the EU, as long as no new conversion services capacity is planned in the USA.

Figure 1: Uranium conversion price developments



Source: The Ux Consulting Company.

Enrichment

There is currently significant overcapacity in enrichment services worldwide, as total enrichment capacity worldwide is estimated to be around 61 000 tSWU, whereas global demand is only about 47 000 tSWU.

Table 4: Major enrichment companies with approximate 2010 capacity

Company	Nameplate capacity (thousand SWU) (11)	Share of global capacity (%)
Atomenergoprom (Russia)	27 500	45
Urenco (UK-DE-NL)	13 000	21
Eurodif (France)	10 800	18
USEC (USA)	8 000	13
CNNC (China)	1 300	2
JNFL	150	0
World total	60 750	*

Source: Estimates based on data published by institutions and the industry.
** Totals may not add up due to rounding.*

Construction of new uranium centrifuge enrichment plants continued throughout 2010. The US Nuclear Regulatory Commission issued its final safety evaluation report for the Eagle Rock centrifuge enrichment plant run by Areva. The report concluded that the plant would pose no undue safety or health risk to the public or employees. The plant has a nameplate capacity of 3 200 tSWU per year and is due to come into operation in 2014, with the possibility of extending it if market conditions require it.

France, in turn, has announced that the Areva Eurodif gaseous diffusion plant in southern France will remain in operation throughout 2012. The plant has a nameplate capacity of approximately 10 000 tSWU per year but has been operating at about 5 000 tSWU.

(11) SWU stands for 'separative work unit' which measures the effort made in order to separate the fissile, and hence valuable, U-235 isotopes from the non-fissile U-238 isotopes, both of which are present in natural uranium (see the glossary for further details). 1 tSWU equals 1 000 SWU.

In parallel, Areva inaugurated the Georges Besse II facility which is based on centrifuge enrichment technology and had production capacity of 7 500 tSWU by the time it started up in April 2011. Depending on market conditions, this capacity could be increased later to 11 000 tSWU. The Georges Besse II facility includes two units – a south unit, where final testing and initial production were achieved in April 2011, and a north unit, which is under construction and scheduled to start up in 2012.

LES's new uranium enrichment facility in New Mexico, USA, came into operation in mid-2010. Its capacity will be built up to 5 700 tSWU in the years ahead to meet long-term customer needs. LES is a 100 % subsidiary of Urenco.

In the first quarter of 2010, USEC reached a new milestone in its American Centrifuge Project, as two dozen commercial AC100 centrifuge machines came into operation. In May, USEC signed a Three-Party Agreement with the Toshiba Corporation and Babcock & Wilcox Investment Company to invest USD 200 million in USEC over three phases.

Argentina is to restart a uranium enrichment facility as the first major step towards expanding its nuclear programme. The Pilcaniyeu gaseous diffusion enrichment plant operated from 1983 to 1989 at a capacity of 20 000 SWU per year. It will now be re-commissioned and is expected to be back in operation by September 2011 with the possibility of building up its capacity to about 3 000 tSWU.

Fabrication

Entering the fabrication market is especially challenging, because fuel assembly itself is a highly engineered, technologically specific product with significant intellectual property embedded in it. In addition, fuel assembly is a component affecting the overall safety of the plant and requires extensive licence approval. Fuel assemblies from different suppliers are not easily interchangeable, although many utilities do change suppliers to maintain competition.

The largest fuel manufacturing capacity can be found in France, Germany, the Russian Federation and the USA, but fuel is also manufactured in other countries, often under licence from one of the main suppliers. The main fuel manufacturers are also the main suppliers of nuclear power plants or closely connected to them.

During 2010, European fabrication facilities continued to cover the EU utilities' needs adequately. The bulk of the needs for fabricated fuel are covered by EU producers for the western-type reactors. On the market for Russian-design (VVER) fuel, the Russian supplier TVEL maintained its market share of nearly 100 %.

As for company developments during 2010, Areva and Kazatomprom established a fuel fabrication joint venture which is owned 51 % by Kazatomprom and 49 % by Areva. The design capacity could be up to 400 tU per year. Areva will provide the fuel manufacturing technology and Kazatomprom fuel pellets for the assemblies.

Westinghouse Electric Co. has completed preparatory work on fuel for its AP1000 reactors and manufactured the first four fuel assemblies at the company's Columbia fuel fabrication facility in South Carolina.

A draft safety evaluation report by the US Nuclear Regulatory Commission concluded that allowing operation of the MOX fabrication plant at the Savannah River Site (South Carolina) would lead to no public health or safety hazards. Scheduled to begin operation in 2016, the MOX plant still needs to obtain a licence for possession and use of radioactive materials.

Reprocessing

Worldwide, reprocessing is considered when it is economically attractive compared with natural uranium fuel. Recycling reprocessed fuel not only reduces natural uranium requirements but can also spectacularly decrease the quantities of radioactive waste which have to be safely stored.

Today there are reprocessing plants in France, Japan, the Russian Federation and the United Kingdom, but only about 50 % of their capacity is used due to uncertainties about the future use of the reprocessed material.

Chapter 3

Supply and demand for nuclear fuels in the EU

This overview of supply and demand for nuclear fuels in the EU is based on information provided as of 31 January 2011 by the EU utilities or their procurement organisations concerning the amounts of fuel loaded into reactors, estimates of future fuel requirements and the quantities, origins and acquisition prices of natural uranium and separative work. In 2010, there were 19 nuclear utilities in the EU, operating 143 reactors located in 14 Member States.

Fuel loaded into reactors

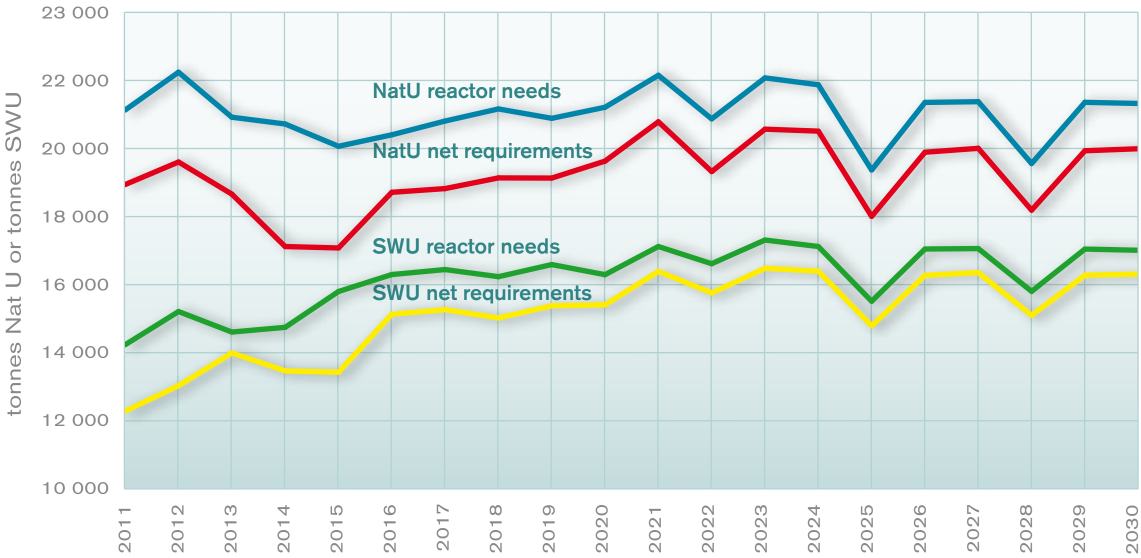
During 2010, 2 712 tU of fresh fuel were loaded into commercial reactors in EU-27 containing the equivalent of 18 122 tU as natural uranium and 13 043 tSWU. In comparison with 2009, the quantity of fresh fuel loaded decreased by 95 tonnes of uranium. Consequently, the quantities of separative work decreased by 711 tSWU and feed by 1 211 tU. The overwhelming majority of utilities put their tails assays in the range of 0.20 % to 0.30 %, the average being 0.25 %.

Reactor requirements for the next 20 years

Estimates of future EU reactor requirements for uranium and separative work, based on data supplied by all EU utilities, are shown in Figure 2 (see Annex 1 for the corresponding figures). Net requirements are calculated on the basis of reactor needs minus the contributions from currently planned uranium/plutonium recycling and taking account of inventory management communicated to ESA by utilities.

For EU-27 average gross reactor requirements (or reactor needs) for natural uranium over the next 10 years are forecast to be in the order of 20 954 tU/year and average net requirements 18 683 tU/year. These values are expected to rise to 21 130 tU/year and 19 720 tU/year respectively for the period between 2021 and 2030. The average gross requirements for enrichment services over the next 10 years are forecast to be 15 646 tSWU/year and net requirements 14 241 tSWU/year. These values are expected to rise to 16 764 tSWU/year and 16 013 tSWU/year respectively for the period between 2021 and 2030.

Figure 2: Reactor requirements for uranium and separative work (EU-27)



The data show an increase in future requirements compared with last year's survey. However, recent developments could challenge previously agreed political decisions to continue and expand nuclear projects worldwide.

Supply of natural uranium

Conclusion of contracts

In 2010, ESA processed 55 contracts and amendments relating to ores and source materials (essentially natural uranium). In addition, ESA co-signed four contracts involving depleted uranium. Table 5 gives further details of the type of supply, terms and parties involved.

Table 5: Natural uranium contracts [12] concluded by or notified to ESA (including feed contained in EUP purchases)

Type of contract	Number of contracts concluded in 2010	Number of contracts concluded in 2009
Purchase/sale by an EU utility/user	21	15
– multiannual [1]	4	8
– spot [1]	17	7
Other purchase/sale	9	13
– between intermediaries [2] (multiannual)	4	2
– between intermediaries [2] (spot)	5	11
Exchanges and loans [3]	10	8
Amendments	15	16
Total	55	52

(1) Multiannual contracts are defined as contracts providing for deliveries extending over more than 12 months, whereas spot contracts provide for either only one delivery or for deliveries extending over a maximum of 12 months, whatever the time between conclusion of the contract and the first delivery.
(2) Purchase/sale contracts between intermediaries – neither the buyer nor the seller are EU utilities/end-users.
(3) 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.

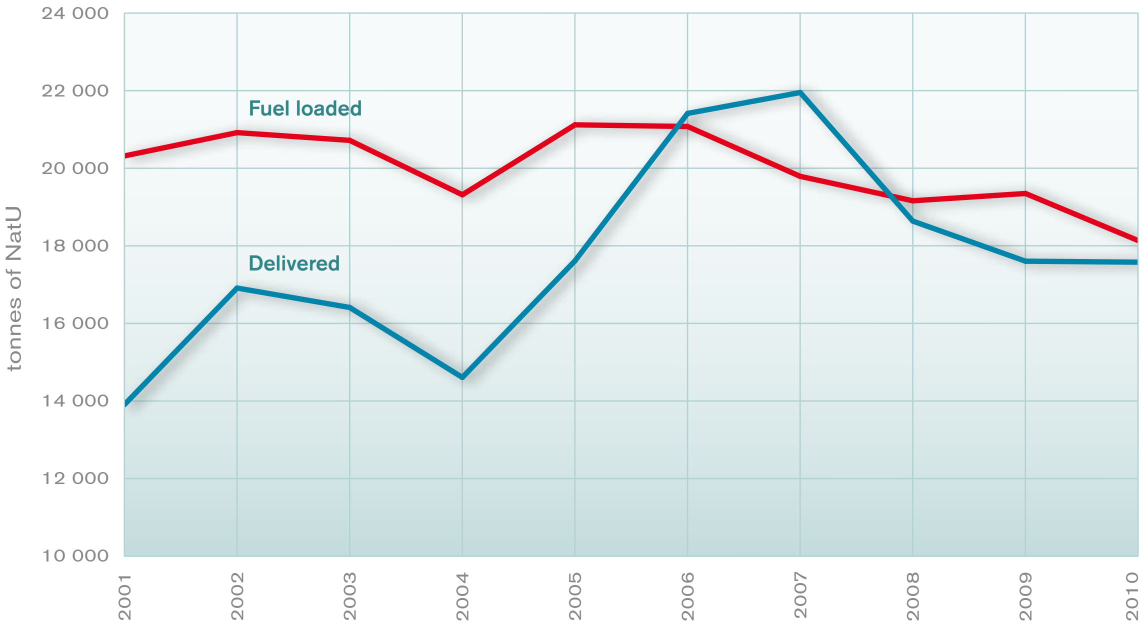
Volume of deliveries

The deliveries taken into account are those made to EU utilities or their procurement organisations in 2010, excluding research reactors. They also include the natural uranium equivalent contained in enriched uranium purchases. Deliveries and fuel loaded into reactors by EU utilities since 2001 are shown in Figure 3 (see Annex 2 for the corresponding table from 1980 to 2010).

Quantitative analysis shows that 17 566 tU were delivered to EU utilities during 2010, a decrease of 25 tU from 17 591 tU. Natural uranium loaded into reactors totalled 18 122 tU. The difference between natural uranium delivered and loaded remained negative for the third year in a row – in 2010 the difference narrowed slightly to 556 tU or 3 %.

(12) Since 2010, in the Quarterly Uranium Market Report, ESA publishes the number of natural uranium supply contracts (including purchases, sales and loans) concluded by EU utilities on a quarterly basis. In 2010, 18 new spot contracts were concluded and only one new multiannual natural uranium supply contract. These figures differ from the data reported in Table 5, as the table also includes contracts that reassign the ownership rights over the nuclear material in the context of structural changes within the utilities and does not necessarily reflect changes in the uranium market.

Figure 3: Natural uranium feed contained in fuel loaded into EU reactors and natural uranium delivered to utilities under purchasing contracts (tU)



Average prices of deliveries

In order to reduce market-related uncertainty, ESA publishes different natural uranium price indices for the EU and other market-related information. The methods have been discussed by the working group of the Advisory Committee.

In 2010, deliveries of natural uranium to EU utilities under long-term contracts accounted for 95.9 % of total deliveries and only 4.1 % of all uranium deliveries to EU utilities were purchased under spot contracts. As in previous years, long-term supplies remain the main source for meeting the demand in the EU.

The spot uranium price is considered the most transparent on the market. However, globally, the spot market handles no more than 15 % of the total quantity of uranium traded. In the EU, the share is much smaller and the traded price is very close to the spot price indicators published by various consulting companies.

In order to provide reliable objective price information comparable with previous years, only deliveries made to EU utilities or their procurement organisations under purchasing contracts are taken into account for calculating the average prices.

Definitions for uranium prices (13)

In order to ensure statistical reliability (sufficient amounts) and to safeguard the confidentiality of commercial data (make sure that no individual contracts are revealed), ESA price indices are calculated only if there are at least five relevant contracts.

The average price index of uranium delivered under multiannual contracts reflects the average long-term price paid by European utilities. Multiannual contracts are defined as contracts for multiple deliveries extending over more than 12 months.

The average spot price index reflects the most recent developments on the uranium market. Contracts provide for either only one delivery or deliveries extending over a maximum of 12 months.

In 2008, ESA introduced a new category of average prices, the ESA long-term historical average uranium price index (MAC-3), which is based on the prices of the natural uranium delivered under long-term contracts concluded during the last three years, including relevant amendments to the price levels (14).

Starting from 2011, ESA intends to publish a quarterly spot price indicator, provided at least three spot contracts are concluded by EU utilities. ESA considers that more comprehensive reporting of market price indicators increases transparency and helps market participants to secure their supplies.

To calculate the average price, the original contract prices are converted, using the average annual exchange rates published by the European Central Bank, into euro per kilogram of uranium in the chemical form U_3O_8 and then weighted by the quantities covered by each contract. In 2010, the dollar appreciated by 5 % to USD 1.33 against the euro, from USD 1.39 in 2009. This exchange rate movement influenced the price indices calculated, as the main trading currencies are both the US dollar and the euro.

To establish a price which excludes the conversion cost if it was not specified, ESA applied a rigorously calculated average conversion price of EUR 8.76/kgU (USD 11.61/kgU). For comparison, the conversion price calculated by ESA in 2009 was EUR 7.92/kgU (USD 11.04/kgU).

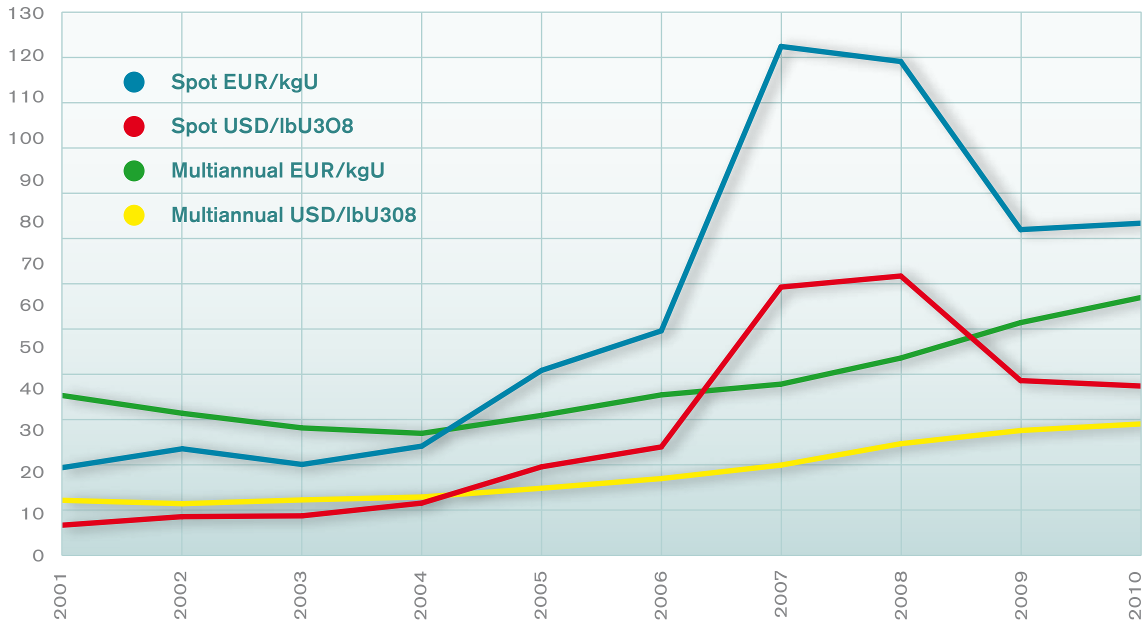
The average price index for uranium delivered under multiannual contracts in 2010 was EUR 61.68/kgU contained in U_3O_8, 10.7 % up from the EUR 55.70/kgU in 2009 (or USD 31.45/lb U_3O_8 v USD 29.88/lb U_3O_8 in 2009). In 2010, the long-term natural uranium prices reported to ESA were spread over a wide range.

The average long-term prices paid for natural uranium originating in the Commonwealth of Independent States (CIS) remained above the prices for non-CIS uranium. However, the average spot prices calculated by ESA for natural uranium from the CIS were lower than the non-CIS spot prices.

Figure 4 shows the ESA average prices for natural uranium since 2001. The corresponding data are presented in Annex 3.

(13) ESA excluded from the calculations notified prices which include other costs such as packaging, handling, book transfer, insurance and other charges to the point of delivery.
(14) In 2008, the ESA MAC-3 price indicator did not include amendments. However, starting from 2009 the MAC-3 price indicator fits the definition given above.

Figure 4: Average prices for natural uranium delivered under spot and multiannual contracts, 2001–10 (in EUR/kgU and USD/lb U_3O_8)



The MAC-3 average price in 2010 (including eligible amendments) was EUR 78.12/kgU contained in U_3O_8 or USD 39.83/lb U_3O_8 (see Annex 3 for detailed price information and Annex 6 for the price calculation method). In 2010, the MAC-3 average price index in euro increased by 23 % and was only slightly below the ESA spot price.

During the last three years the natural uranium delivery price in the purchase contracts was mainly agreed using price formulas made up of different price indices available on the market.

The average spot price index for natural uranium delivered in 2010 was EUR 79.48/kgU, an increase of 2 % compared with the 2009 price of EUR 77.96/kgU. However, the price in dollars per pound of U_3O_8 decreased from USD 41.83 in 2009 to USD 40.53 in 2010. The contradictory price movements in the two currencies are due to the appreciation of the dollar in 2010.

Origins

In 2010, although the origins (15) of natural uranium supplied to EU utilities did not change, their shares in total deliveries shifted substantially.

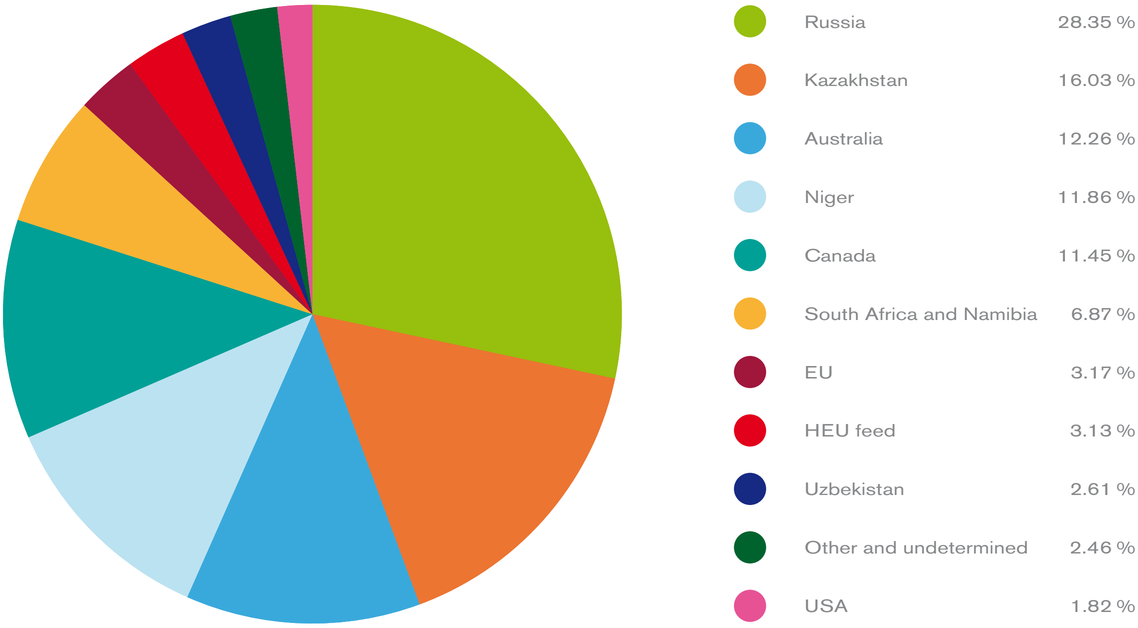
The overall shares of uranium of CIS or African origin in total deliveries increased, leaving behind Australian and Canadian origin materials, whose shares decreased.

In 2010, uranium of Russian origin took the largest share with 4 979 tU or 28.3 %, an increase of 7.9 percentage points compared with 2009. It was followed by Kazakhstan with a 16.0 % share (2 816 tU), an increase of 7.0 percentage points.

The share of uranium of Australian origin decreased by 9.4 percentage points compared with last year to 12.3 % (2 153 tU) in 2010. Similarly, the share of Canadian-origin uranium declined to 11.5 % (2 012 tU), a decrease of 7.2 percentage points.

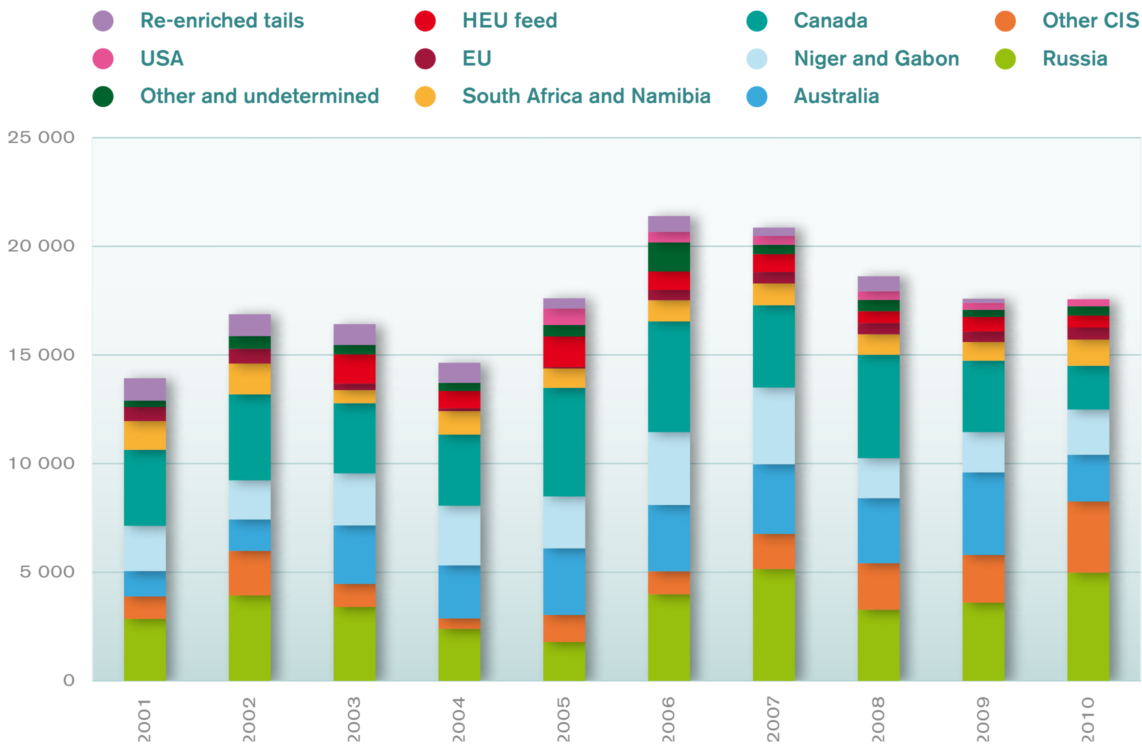
(15) The uranium mined in a certain country also includes uranium mined by companies owned outside that country.

Figure 5: Origins of uranium delivered to EU utilities in 2010 (% share)



European uranium delivered to EU utilities originated mainly from the Czech Republic and Romania and covered 3.2 % of the EU's total needs (a total of 556 tU). The amount of HEU feed used decreased slightly, to 550 tU in a year, while no deliveries of re-enriched tails material were reported by EU utilities.

Figure 6: Purchases of natural uranium by EU utilities by origin, 2001–10 (tU)



Special fissile materials

Conclusion of contracts

Table 6 shows the aggregate number of contracts, notifications and amendments [16] relating to special fissile materials (enrichment services, enriched uranium and plutonium) dealt with during 2010 in accordance with ESA's procedures.

Table 6: Special fissile material contracts concluded by or notified to ESA

Type of contract	Number of contracts 2010	Number of contracts 2009
A. Special fissile materials	**61**	**65**
Purchase (by an EU utility/user)	11	13
Sale (by an EU utility/user)	7	10
Purchase/sale (between two EU utilities/end-users)	3	4
Purchase/sale (intermediaries)	15	15
Exchanges	13	10
Loans	1	0
Pool	0	6
Total (1)	**50**	**58**
Contract amendments	**11**	**7**
B. Enrichment notifications (2)	**21**	**18**
Notifications of amendments	**17**	**23**

(1) In addition, there were 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 2010, the enrichment services (separative work) contained in the fuel supplied to EU utilities totalled 14 855 tSWU, delivered in 2 677 tonnes of low-enriched uranium (tLEU) which contained the equivalent of 20 948 tonnes of natural uranium feed. In 2010, enrichment service deliveries to EU utilities increased by 25 % compared with 2009. The average for tails assays [17] used by EU utilities was 0.25 %. However, the tails assays applied for EUP delivered to EU utilities ranged widely, from a lowest reported value of 0.17 % to a highest of 0.33 %.

As regards the providers of enrichment services, almost 60 % of the EU requirements were met by the two European enrichers (Areva-Eurodif and Urenco).

Table 7: Providers of enrichment services delivered to EU utilities

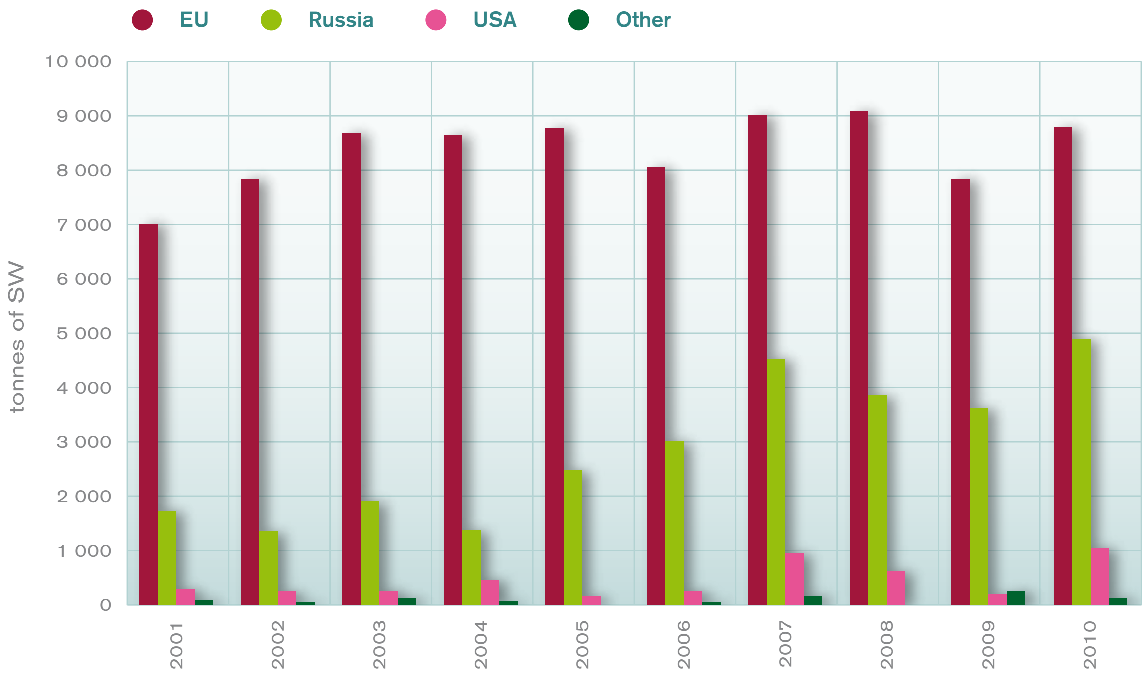
Enricher	Quantities in 2010 (tSWU)	Share in 2010 (%)	Quantities in 2009 (tSWU)	Share in 2009 (%)	Change over 2010/2009 (%)
Eurodif + Urenco (EU)	8 785	59.1	7 833	65.8	12.2
Tenex/TVEL (Russia)	4 896	33.0	3 619	30.4	35.3
USEC (USA)	1 047	7.0	195	1.6	436.9
Others (1)	127	0.9	258	2.2	– 50.9
Total	14 855		11 905		24.8

(1) Including reprocessed re-enriched uranium.

(16) The aggregate number of amendments includes all the amendments to existing contracts processed by ESA, including technical amendments that do not necessarily lead to substantial changes to the terms of existing agreements.
(17) The tails assays used to calculate the natural uranium feed and separative work components have a significant impact on the values of these components. An increase in the tails assays increases the amount of natural uranium and reduces the amount of separative work required to produce the same amount of enriched uranium. The optimum tails assay level is dictated by the prices of natural uranium and separative work.

Deliveries of separative work from Russia (Tenex/TVEL) to EU utilities under purchasing contracts totalled 4 896 tSWU, an increase of 1 277 tSWU compared with 2009 but still just above 30 % of the total enrichment services supplied to EU utilities. The aggregate total includes SWUs delivered under 'grandfathered' contracts under Article 105 of the Euratom Treaty, which covered 7 % of total requirements in the EU. The fuel supply contracts concluded before accession to the EU remained in force. Russian enrichment services delivered under regular contracts accounted for 26 % of total requirements. Enrichment services provided by USEC totalled 1 047 tSWU and accounted for 7 % of the total enrichment services supplied to EU utilities, which is a substantial increase from last year.

Figure 7: Supply of enrichment to EU utilities by provider, 2001–10



Plutonium and mixed-oxide fuel

Mixed-oxide (MOX) fuel is produced by mixing the uranium (depleted, natural or reprocessed) and plutonium recovered from used fuel. Use of MOX fuel has an impact on reactor performance and safety measures. Reactors therefore have to be adapted for this kind of fuel (if the percentage of MOX fuel in the core rises beyond a certain percentage) and to obtain a licence before using it. MOX fuel behaves similarly (though not identically) to the enriched uranium feed used in most reactors. The main reasons for using MOX fuel are the possibility to use plutonium recovered from spent fuel, non-proliferation and economic aspects. It is widely recognised that reprocessing spent fuel and recycling recovered plutonium used together with uranium in MOX fuel increase the availability of nuclear material and, hence, security of supply.

MOX fuel is used in a number of reactors in Germany, France and Belgium. The quantity of MOX fuel loaded into nuclear power plants in the EU totalled 10 636 kg Pu in 2010, up from 10 282 kg Pu in 2009. Table 8 shows the estimated natural uranium and separative work savings from use of MOX. In the calculations, ESA assumes that 1 tonne of plutonium saves the equivalent of 120 tonnes of natural uranium and 80 tonnes of separative work.

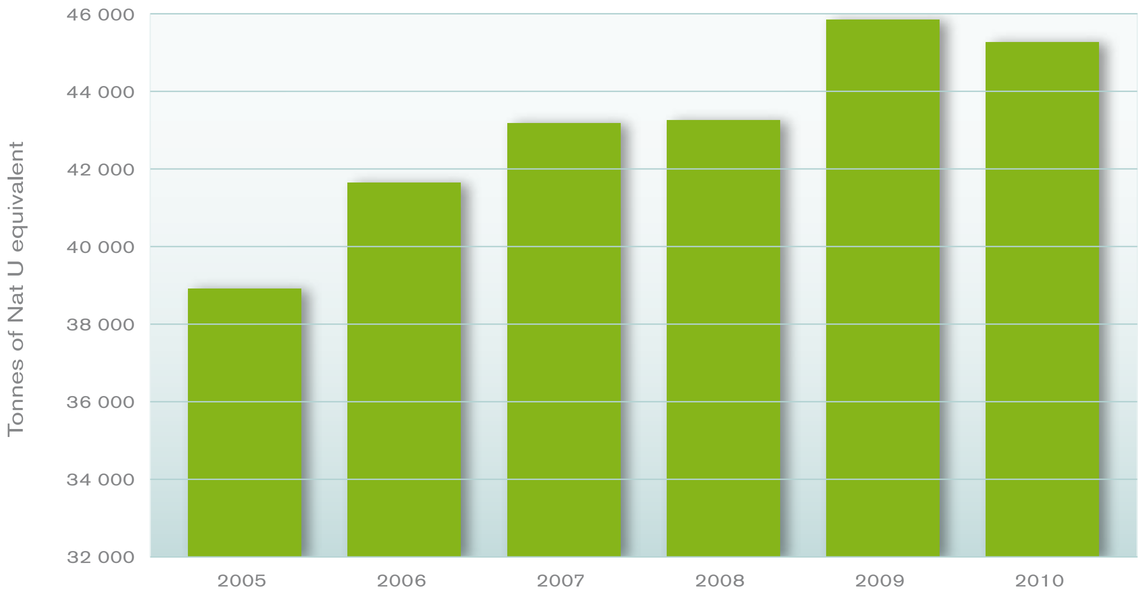
Table 8: Use of plutonium in MOX in EU-27 and estimated natural uranium (NatU) and separative work savings

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
2005	8 390	1 010	670
2006	10 210	1 225	815
2007	8 624	1 035	690
2008	16 430	1 972	1 314
2009	10 282	1 234	823
2010	10 636	1 276	851
Grand total	141 772	17 032	11 338

Inventories

Figure 8 shows the level of total uranium inventories owned by EU utilities at the end of the year, expressed as natural uranium equivalent. The total level of inventories at the end of 2010 stood at 45 272 tU.

Figure 8: Total uranium inventories owned by EU utilities at the end of the year, 2005–10



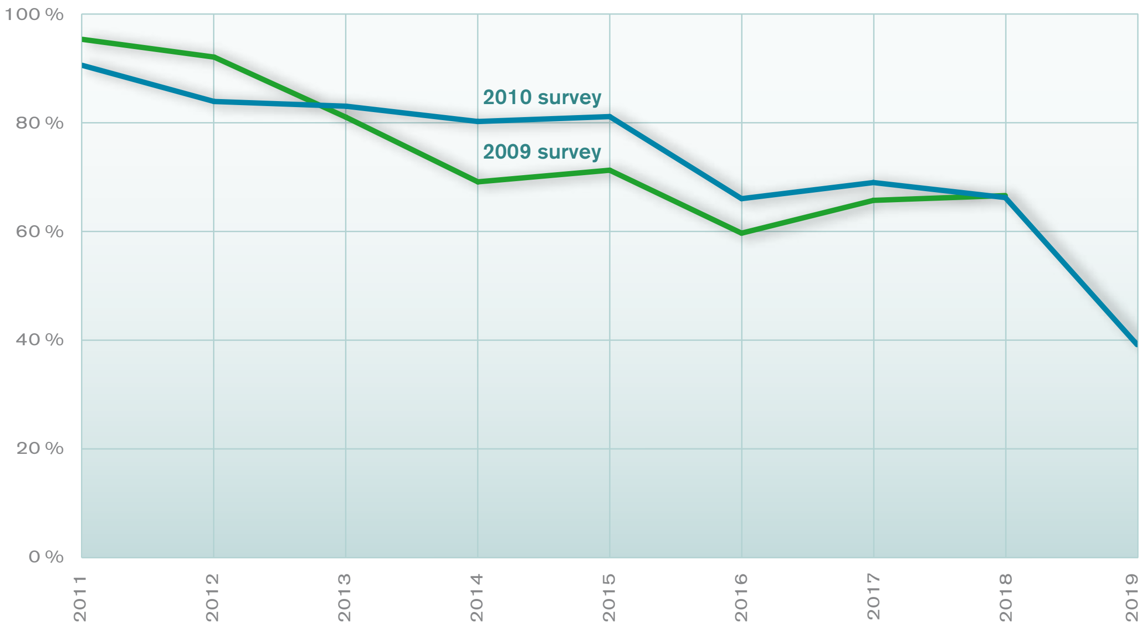
The aggregate inventories owned by EU utilities increased substantially between 2005 and 2009, before a slight decline in 2010. The average annual growth rate for total uranium inventories was 3 % from 2006 to 2010.

The dynamics of the aggregate natural uranium inventories do not necessarily reflect the difference between the total natural uranium equivalent loaded into reactors and uranium delivered to EU utilities, as the level of inventories is subject to movements of loaned material, sales of uranium to third parties and one-off national transfers of material.

Contractual coverage rate

Figure 9 shows the contractual coverage rate for natural uranium for EU utilities. The aggregate contractual coverage rate for natural uranium is calculated as the percentage of net natural uranium requirements covered by scheduled deliveries under signed contracts.

Figure 9: Natural uranium coverage rate, 2011–19



The natural uranium coverage rate for the next five years, together with the inventories owned by EU utilities, point to the conclusion that the current and medium-term needs of EU utilities are well covered.

ESA findings, recommendations and diversification policy

The Supply Agency continues to monitor the market, especially supplies of natural and enriched uranium to the EU, in order to ensure that EU utilities have diversified sources of supply and do not become over-dependent on any single source. This is achieved by validating or refusing to sign contracts and by comprehensive statistical reporting on developments on the nuclear market. One key goal for long-term security of supply is to maintain the viability of the EU industry at every stage of the fuel cycle.

In 2010, natural uranium continued to be supplied to the EU from diversified sources, although the share of individual producer countries changed dramatically. The shares of natural uranium of CIS and African origin delivered to EU utilities increased substantially, whereas the shares of natural uranium from Canada and Australia decreased at the same time.

Regarding diversification of sources of supply of enriched uranium to EU utilities, almost two thirds of the separative work required was performed by the two European enrichers (Areva-Eurodif and Urenco). The US-based enricher USEC supplied 7 % of the total enrichment services needed in the EU, a significant increase compared with 2009.

However, the bulk of external supplies of separative work came from Tenex/TVEL (Russia) which supplied 33 % of the enriched uranium delivered to the EU. This includes enrichment services delivered under 'grandfathered' contracts under Article 105 of the Euratom Treaty. Around 7 % of the total enrichment services required by the EU were delivered under 'grandfathered' contracts and 26 % under ordinary contracts. In practice, 'grandfathered' contracts keep certain EU utilities entirely dependent on a single external supplier [18].

As regards enrichment of reprocessed uranium by downblending HEU or by re-enrichment (in Russia), ESA generally welcomes reprocessing of spent fuel and considers that the availability of recycled uranium is increasing the security of supply of EU users. Furthermore, blending recycled uranium with HEU of military origin is beneficial for nuclear disarmament and non-proliferation of nuclear materials. Therefore, when implementing its diversification policy, ESA takes into account these positive aspects of use of reprocessed fuel. In 2010, some 1 % of the EU's total enrichment needs were covered by using reprocessed uranium.

With regard to uranium tails stocks already existing or arising in future, EU enrichers have strategies in place to manage these in the long term, including by deconversion of the material to a more stable form.

The Euratom Supply Agency continues to recommend that EU utilities maintain an adequate level of strategic inventories and use market opportunities to increase their inventories, depending on their individual circumstances. It also recommends that utilities cover most of their needs under long-term contracts with diversified sources of supply.

EU utilities mainly use long-term contracts to cover their current and future requirements. This is in line with ESA's recommendations. The aggregate stock level at the end of 2010 stood at 45 272 tU, enough to cover more than two years of estimated demand for natural uranium. The overview of EU utilities, produced by ESA on the basis of information received under the 2010 survey, points to the conclusion that the current and medium-term needs of the EU utilities are covered. However, in the long term, potentially strong demand from Asia for nuclear material should be closely monitored by all market participants.

(18) The significant differences in supply patterns and, therefore, in diversification of sources of supply is due to the fact that utilities with western technology traditionally obtain uranium and services (for example, enrichment) under separate contracts from diversified sources, whereas utilities using Russian technology usually purchase fabricated fuel assemblies under the same contract (including supply of uranium and enrichment) with a single supplier.

Chapter 4

ESA work programme for 2011

In line with the tasks conferred on it under Chapter 6 of the Euratom Treaty and its revised statutes, ESA's 2011 work programme is built around four major objectives:

1. **Implementing the security of supply policy, including promoting diversification of sources of supply**

   The limited production of nuclear materials within the EU itself creates a need to diversify sources of supply to a satisfactory degree in order to guarantee security of supply of nuclear fuel to utilities in the EU. By evaluating and signing supply contracts for nuclear materials and acknowledging the transactions covering provision of the entire cycle of nuclear fuel services, ESA will continue to guarantee security of supply.

2. **Further developing a nuclear market observatory**

   ESA will continue to seek advice from the Advisory Committee on further development of the Nuclear Observatory, including assessment of information tools created by the Agency. In parallel, ESA will pursue measures to improve its data processing system.

3. **Intensifying international relations**

   In order to carry out its tasks of nuclear observatory efficiently and to contribute to security of supply, ESA will actively pursue relations with international entities.

4. **Closely monitoring technological developments**

   ESA will continue monitoring developments in nuclear technology in order to acquire the latest available knowledge on possible changes in demand for nuclear fuel and, thus, be able adequately to evaluate the impact on security of supply of nuclear fuels to EU utilities.

Implementing the security of supply policy, including promoting diversification of sources of supply

Since the Agency was established in 1960 its main task has been to put into practice the principle of equal access to supplies of nuclear materials for EU Member States, paying particular attention to diversification of sources of supply, a key priority of EU energy policy [19].

By evaluating and signing the supply contracts for ores, source materials and special fissile materials produced within or outside the EU (Article 52 of the Euratom Treaty), ESA monitors diversification of sources. Notifications to ESA of contracts for processing, converting or shaping materials (Article 75 of the Treaty) also give the Agency an overview of needs and industrial capacity in the Union.

The existing exemption from the principle of diversification applied to Member States equipped with Russian-design reactors and which had concluded long-term supply contracts before they joined the EU runs until the supply contracts expire [20]. New supply contracts for these utilities are being assessed against the principles of diversification policy.

(19) Europe 2020: A strategy for smart, sustainable and inclusive growth, COM(2010) 2020 final.
Energy 2020: A strategy for competitive, sustainable and secure energy, COM(2010) 639 final.
(20) Article 105 of the Euratom Treaty protects the rights acquired under these contracts until they expire.

As an additional contribution to the security of supply guarantees, ESA intends to evaluate commercial and security stocks of nuclear materials available in the EU. An evaluation report will be prepared by the end of 2011. Furthermore, the Agency will assess the share of the EU's uranium needs for the years ahead not yet covered by supply contracts already concluded against the uranium resources available worldwide.

Taking into account the importance of making use of secondary sources, ESA will also assess the state of play with use of reprocessed uranium and of HEU of military origin by EU utilities in the light of security of supply objectives. An analysis will be made in 2011.

Specific objective N° 1

1. Exercise ESA's exclusive rights to conclude supply contracts in order to continue to guarantee security of supply of nuclear materials to users in the EU.

2. Acting in compliance with the principles established by the Euratom Treaty and with the guidelines developed by the Council and the Commission, strive to optimise the Agency's signature and acknowledgement procedures for contracts in the light of developments on the nuclear fuel cycle market.

3. Issue a report on commercial and security stocks of nuclear materials available in the EU by the end of 2011.

4. Assess the implications for security of supply policy of use of secondary sources by EU utilities by the end of 2011.

Further developing a nuclear market observatory

ESA will continue to participate in and facilitate activities of the working group on prices and security of supply of the Advisory Committee which aim to increase the transparency of the nuclear fuel cycle market in the EU.

The continuous upgrading of its data processing methods should allow ESA to fine-tune its market observation capacity and respond to the expectations of operators better.

These measures will also lay the foundation for building up comprehensive overviews of the situation and trends on the nuclear fuel cycle market. ESA's *Annual Report*, *Quarterly Uranium Market Report* and weekly *Nuclear News Digest*, circulated within the Commission, will remain the main ways to present the analyses by the nuclear market observatory. ESA's website will also include a special page on the activities of the Nuclear Observatory offering direct access to information about market developments.

In addition to its ongoing activities, ESA will assess the availability of uranium resources in the world and issue its own study by the end of 2011.

ESA's nuclear market observatory will seek to cooperate more closely with the energy observatory of the European Commission Directorate-General for Energy (Energy DG).

Specific objective N° 2

To boost its market observation and monitoring activities ESA will:

1. monitor general trends on the nuclear market and publish an overview of market developments in ESA's *Annual Report* and *Quarterly Uranium Market Report*, with the support of the Advisory Committee;

2. increase its capacity for analysing developments in natural uranium prices and supply, in close cooperation with the Advisory Committee;

3. gradually widen the range of data processed by the Nuclear Observatory to be made available on ESA's website and cooperating with the energy observatory of Energy DG;

4. present a study about the availability of uranium resources in the world by the end of 2011.

Intensifying international relations

The quality and neutrality of the analyses of the nuclear fuel cycle market provided by ESA are being sought more and more by groups of international experts. In order to raise the profile of its activities as a market observatory and to carry out its other tasks efficiently, ESA will keep in regular contact not only with international nuclear organisations such as the IAEA and the OECD's Nuclear Energy Agency (NEA) but also with a number of market players outside the EU.

Specific objective N° 3

1. Intensify the frequency of exchanges with international organisations and the nuclear industry.

2. Intensify contacts with key players on the nuclear market outside the EU.

Closely monitoring technological developments

ESA will actively monitor research and development activities, especially within the Sustainable Nuclear Energy Technology Platform and the Technology Platform for Implementing Geological Disposal, launched with the support of the Commission, and also in other EU or international R&D forums which will have an impact on nuclear fuel cycle management — i.e. reprocessing waste, reducing the volume of waste, improving reactor efficiency, etc. — and thus directly influence the nuclear fuel market.

Specific objective N° 4

1. Review the latest technological developments related to fuel cycle management in Advisory Committee meetings or at specifically organised events.

2. Take account of the knowledge acquired from the latest technological developments in the security of supply policy applied by the Agency.

3. Take part in relevant R & D activities.

Contact information

ESA address for correspondence

Euratom Supply Agency
European Commission

EUFO 1
Rue Alcide de Gasperi
L-2920 Luxembourg

Office address

Complexe Euroforum
10, rue Robert Stumper
L-2557 Luxembourg
Tel. (352) 43 01-36738
Fax (352) 43 01-38139

E-mail

Esa-AAE@ec.europa.eu

Website

This report and previous editions are available on ESA's website at:
http://ec.europa.eu/euratom/index_en.html

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

Further information

Additional information can be found on Europa, the European Union server, at:
http://europa.eu/index_en.html
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 is:
http://ec.europa.eu/energy/index_en.html
This website contains information on, for example, security of energy supply, energy-related research, nuclear safety and liberalisation of the electricity and gas markets.

Glossary

CIS	Commonwealth of Independent States
ESA	Euratom Supply Agency
Euratom	European Atomic Energy Community
IAEA	International Atomic Energy Agency
(US) DoE	United States Department of Energy
(US) NRC	United States Nuclear Regulatory Commission
USEC	United States Enrichment Corporation
EUP	Enriched uranium product
HEU	Highly enriched uranium
LEU	Low-enriched uranium
MOX	Mixed-oxide fuel (uranium mixed with plutonium oxide)
RET	Re-enriched tails
RepU	Reprocessed uranium
SWU	Separative work unit (see below for detailed definition)
tSWU	1 000 SWU
tU	Metric tonne of uranium (= 1 000 kg)
BWR	Boiling water reactor
EPR	Evolutionary/European pressurised water reactor
LWR	Light water reactor
NPP	Nuclear power plant
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 (= one thousand kWh)
GWh	gigawatt-hour (= one million kWh)
TWh	terawatt-hour (= one billion kWh)

MW stands for megawatt or one billion watts, which measures electric output. **MWe** refers to electric output from a generator, **MWt** to thermal output from a reactor or heat source (e.g. the gross heat output of a reactor itself, typically around three times the MWe figure).

Generation IV (or Gen-IV) reactors are a set of nuclear reactor designs currently being developed in the research cooperation within the 'Generation IV International Forum'. Current reactors in operation around the world are generally considered second- or third-generation systems. The primary goals of Gen-IV are to improve nuclear safety, improve resistance to proliferation, minimise waste and consumption of natural resources and decrease the cost of building and running such plants. These systems employ a closed fuel cycle to maximise the resource base and minimise the high-level waste to be sent to a repository. Most of them are fast neutron reactors (only two operate with slow neutrons like today's plants) and they are not expected to be available for commercial construction before 2030.

SWU stands for 'separative work unit' which measures the effort made in order to separate the fissile, and hence valuable, U-235 isotopes from the non-fissile U-238 isotopes, both of which are present in natural uranium. As a standard indicator of enrichment services, the concept of SWU is very complex, as it is a function of the amount of uranium processed and the degree to which it is enriched, i.e. the extent of increase in the concentration of the U-235 isotope relative to the remainder. The unit is strictly 'kilogram separative work unit' or kg SWU (but in graphs is usually shown as SWU or tSWU for thousands) and measures the quantity of separative work (indicative of energy used in enrichment) when feed and product quantities are expressed in kilograms.

To **produce one kilogram of uranium enriched** to 3.5 % U-235 typically requires **4.3 SWU** if the plant is operated at a tails assay of 0.30 % or 4.8 SWU if the tails assay is 0.25 % (thereby requiring only 7.0 kg instead of 7.8 kg of natural U feed).

Between **100 000** and **120 000 SWU** are required to enrich the annual fuel loading for a typical **1 000 MWe** light water reactor.

Enrichment costs are related to the electrical energy used. The gaseous diffusion process consumes some 2 400 kWh per SWU, whereas gas centrifuge plants require only about 60 kWh/SWU.

Annexes

Annex 1

EU-27 reactor needs (or gross requirements) and net requirements (quantities in tU and tSWU)

(A) From 2011 until 2020

	Natural uranium		Separative work	
Year	Reactor needs	Net requirements	Reactor needs	Net requirements
2011	21 130	18 940	14 236	12 286
2012	22 240	19 603	15 210	13 032
2013	20 918	18 659	14 608	13 994
2014	20 720	17 120	14 746	13 466
2015	20 065	17 078	15 798	13 428
2016	20 401	18 712	16 297	15 133
2017	20 806	18 822	16 444	15 264
2018	21 162	19 136	16 234	15 022
2019	20 886	19 131	16 590	15 378
2020	21 211	19 629	16 293	15 409
Total	209 540	186 830	156 456	142 412
Average	20 954	18 683	15 646	14 241

(B) Extended forecast from 2021 until 2030

	Natural uranium		Separative work	
Year	Reactor needs	Net requirements	Reactor needs	Net requirements
2021	22 151	20 784	17 120	16 391
2022	20 870	19 323	16 615	15 756
2023	22 074	20 567	17 311	16 482
2024	21 872	20 510	17 120	16 396
2025	19 368	18 006	15 512	14 788
2026	21 353	19 890	17 047	16 273
2027	21 375	20 005	17 060	16 355
2028	19 558	18 188	15 803	15 098
2029	21 355	19 932	17 045	16 277
2030	21 323	19 993	17 010	16 310
Total	211 298	197 197	167 643	160 126
Average	21 130	19 720	16 764	16 013

Annex 2

Fuel loaded into EU-27 reactors and deliveries of fresh fuel under purchasing contracts

Year	Fuel loaded			Deliveries		
	LEU (tU)	Feed equivalent (tU)	Enrichment equivalent (tSWU)	Natural U (tU)	% spot	Enrichment (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	17.0	
1988		12 900		12 500	4.5	
1989		15 400		13 500	11.5	
1990		15 000		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	21.0	9 800
1995	3 040	18 700	10 400	16 000	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	12.0	10 100
1998	2 830	18 400	10 400	16 100	6.0	9 200
1999	2 860	19 400	10 800	14 800	8.0	9 700
2000	2 500	17 400	9 800	15 800	12.0	9 700
2001	2 800	20 300	11 100	13 900	4.0	9 100
2002	2 900	20 900	11 600	16 900	8.0	9 500
2003	2 800	20 700	11 500	16 400	18.0	11 000
2004	2 600	19 300	10 900	14 600	4.0	10 500
2005	2 500	21 100	12 000	17 600	5.0	11 400
2006	2 700	21 000	12 700	21 400	7.8	11 400
2007	2 809	19 774	13 051	21 932	2.4	14 756
2008	2 749	19 146	13 061	18 622	2.9	13 560
2009	2 807	19 333	13 754	17 591	5.2	11 905
2010	2 712	18 122	13 043	17 566	4.1	14 855

Annex 3

ESA average prices for natural uranium

	Multiannual contracts		Spot contracts		New multiannual contracts		Exchange rate
Year	EUR/kgU	USD/lb U_3O_8	EUR/kgU	USD/lb U_3O_8	EUR/kgU	USD/lb U_3O_8	EUR/USD
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 (*)	7.23 (*)			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
2005	33.56	16.06	44.27	21.19			1.24
2006	38.41	18.38	53.73	25.95			1.26
2007	40.98	21.60	121.80	64.21			1.37
2008	47.23	26.72	118.19	66.86			1.47
2009	55.70	29.88	77.96	41.83	63.49	34.06	1.39
2010	61.68	31.45	79.48	40.53	78.12	39.83	1.33

(*) The spot price for 2001 was calculated on the basis of an exceptionally low total volume of only some 330 tU under four transactions.

Annex 4

Purchases of natural uranium by EU utilities by origin, 2001–10 (tU)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Russia	2 849	3 931	3 400	2 391	1 788	3 984	5 144	3 272	3 599	4 979
Other CIS	1 035	2 052	1 059	481	1 246	1 057	1 618	2 143	2 195	3 275
Australia	1 168	1 442	2 695	2 443	3 065	3 053	3 209	2 992	3 801	2 153
Niger and Gabon	2 085	1 806	2 396	2 746	2 390	3 355	3 531	1 845	1 854	2 082
Canada	3 496	3 954	3 229	3 274	4 998	5 093	3 786	4 757	3 286	2 012
South Africa and Namibia	1 325	1 422	604	1 080	951	978	1 003	944	860	1 207
EU	647	680	298	129	5	472	526	515	480	556
HEU feed	0	0	1 348	800	1 407	850	825	550	675	550
Other and undetermined	295	583	433	373	529	1 336	432	520	329	432
USA	0	0	0	0	757	488	402	398	318	320
Re-enriched tails	1 031	1 007	958	925	474	728	388	688	193	0
Total	13 931	16 877	16 420	14 642	17 610	21 394	20 864	18 622	17 591	17 566

Annex 5

Uranium suppliers to EU utilities in 2010

Areva NC and Areva NP (formerly Cogema)
BHP Billiton (formerly WMC)
Cameco
CNU
Cominak (a subsidiary of Areva)
Diamo
ERA
Internexco
Itochu International
Kazatomprom
Nufcor International
Rossing Uranium
RWE Nukem
Tenex
TVEL
UEM
UG
Urenco
USEC

Annex 6

Calculation method for ESA U_3O_8 average prices

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

The ESA weighted average U_3O_8 'MAC-3' price index is calculated using natural uranium deliveries under new multiannual contracts in the reporting year, i.e. contracts concluded between 1 January 2008 and 31 December 2010, with deliveries made during 2010. In this context, ESA regards amendments which have a direct impact on the prices paid as separate contracts.

The difference between multiannual and spot contracts is that:

- multiannual contracts provide for deliveries extending over more than 12 months;
- spot contracts provide for either only one delivery or for deliveries extending over a maximum of 12 months, whatever the time between conclusion of the contract and the first delivery.

Method

Prices

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

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

Data requested on natural uranium deliveries during the year

The following details are requested: ESA contract reference number, quantity (kgU), delivery date, place of delivery, mining origin and natural uranium price specifying the currency, unit of weight (kg, kgU or lb), chemical form (U_3O_8, UF_6 or UO_2), 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 EU electricity utilities or their procurement organisations during the relevant year. They also include the natural uranium equivalent contained in enriched uranium purchases.

Other categories of contracts, such as between intermediaries or for sales by utilities, purchases by non-utility industries or barter deals, are excluded. Deliveries for which it is not possible reliably to 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 of the feed and enrichment components).

Checking

ESA compares the deliveries and prices reported with the data collected at the time of conclusion of the contracts, taking into account any subsequent updates. 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 euro per kgU contained in U_3O_8 using the average annual exchange rates published by the European Central Bank.

Prices which include conversion

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

Independent verification

Two members of ESA staff independently verify spreadsheets from the database.

Despite all the care taken, errors or omissions are discovered from time to time, mostly in the form of missing data, e.g. on deliveries under options, which were not reported. As a matter of policy, ESA never publishes a corrective figure.

Data protection

Confidentiality and physical protection of commercial data are ensured by using stand-alone computers, which are neither connected to the Commission Intranet nor to the outside world (including the Internet). Contracts and back-ups are kept in a secure room, with restricted key access.

European Commission

Euratom Supply Agency — Annual Report 2010

Luxembourg: Publications Office of the European Union

2011 — 44 pp. — 21 x 29.7 cm

ISBN 978-92-79-20610-8

doi:10.2833/94175

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MJ-AA-11-001-EN-C

Publications Office

ISBN 978-92-79-20610-8

9 789279 206108