

## **Ensuring Europe's security of energy supply: the role of nuclear**

*The European Atomic Forum (FORATOM) is the Brussels-based trade association for the nuclear energy industry in Europe. The membership of FORATOM is made up of 16 national nuclear associations and through these associations, FORATOM represents nearly 800 European companies working in the industry and supporting around 800,000 jobs.*

### **Summary**

Security of energy supply is enhanced by having a diverse energy mix. All things being equal, the more diversified the energy mix, the less vulnerable Member States and the EU are to shocks affecting external energy sources.

Nuclear energy generates electricity in 14 of the 28 Member States, producing almost 30% of the EU's electricity. Hence it contributes significantly to reducing dependence upon imported fossil fuels. Since reactors operate at high capacity levels – typically between 85 and 90 % – nuclear is a reliable source of base-load electricity. Nuclear fuel resources are available from a variety of countries, the majority of which are politically stable. The European commercial mining, enrichment, fuel fabrication and recycling industry stands at the very top of the list of world producers. In addition, the cost of uranium is marginal in the total cost of the electricity produced by a nuclear reactor. As the quantity of uranium necessary to produce a given amount of electricity is extremely low compared to other sources of energy, nuclear operators are able to store sufficient uranium fuel assemblies on-site for years of operation. As a mature technology, nuclear is well positioned to strengthen Europe's energy security.

Nuclear energy has a key role to play in enhancing competitiveness and promoting sustainable development. The International Energy Agency (IEA) has indicated that in nearly every region of the world, nuclear power plants have the cheapest electricity production costs. For European industry, in particular energy-intensive industries, stable, predictable, and affordable energy prices are of paramount importance to boost economic growth and create jobs in the EU. Nuclear is the largest low-CO<sub>2</sub> energy source, making it an important low-carbon contributor to climate change mitigation.

Worldwide, nuclear energy is predicted to grow significantly in the coming years. If it is to continue to make a significant contribution to the EU's energy security – and to the EU's competitiveness – appropriate market arrangements are necessary to facilitate the necessary investment.

## Introduction

In the light of the on-going Ukraine crisis, the European Council called on the European Commission (EC) on 20-21 March 2014 to carry out an in-depth study of the European Union (EU) energy security, and to deliver, by June 2014, a comprehensive plan for the reduction of EU's energy dependence. Member States requested that the plan should reflect the need to accelerate diversification of the EU's energy supply. The Commission's plan was published on 16 May 2014.

## Europe's external energy dependency

In 2013, EU energy import dependency stood at 53.2 %. The EU is reliant on imports for almost 88.4 % of its oil, 65.3 % of its gas, 44.2 % of its solid fuels<sup>1</sup> and over 95 %<sup>2</sup> of its uranium (see below). Energy dependency varies between different Member States and regions. A significant proportion of the EU's energy imports are coming from geopolitically unstable regions. Moreover, the EU is heavily dependent on one single country, the Russian Federation, which is the biggest oil (35 %), gas (26 %), coal (30 %) exporter to the EU<sup>3</sup>. Starting with 2013 and the biggest uranium exporter to the EU is Kazakhstan overtaking Russian Federation, the traditional biggest supplier. Even if there is greater exploitation of indigenous energy sources in the future, the EU's dependence on fossil fuel imports is likely to remain high for many years. The EC predicts that energy imports as a whole could increase to 55 % by 2030, up to 57 % by 2050<sup>4</sup>.

Prices of imports are expected to increase significantly by 2020: coal by 41 % and gas by 62 %. The external fossil fuel bill (coal and gas) of the EU will rise by approximately 50 % from 2010 to 2030 and exceed 2010 levels by around 80 % in 2050, reaching 500 billion € to 600 billion € (in 2010 prices) in 2030 and 2050, respectively.

In recent times, factors such as market conditions (*i.e.* attractive contract terms), convenience (reliance on longstanding energy pipeline/transport routes), and relative stability from shocks<sup>5</sup> have led to a lack of urgency in addressing security of supply questions and diversifying of the EU's import base.

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<sup>1</sup> [EUROSTAT website](#)

<sup>2</sup> [Euratom Supply Agency, Annual Report 2013](#).

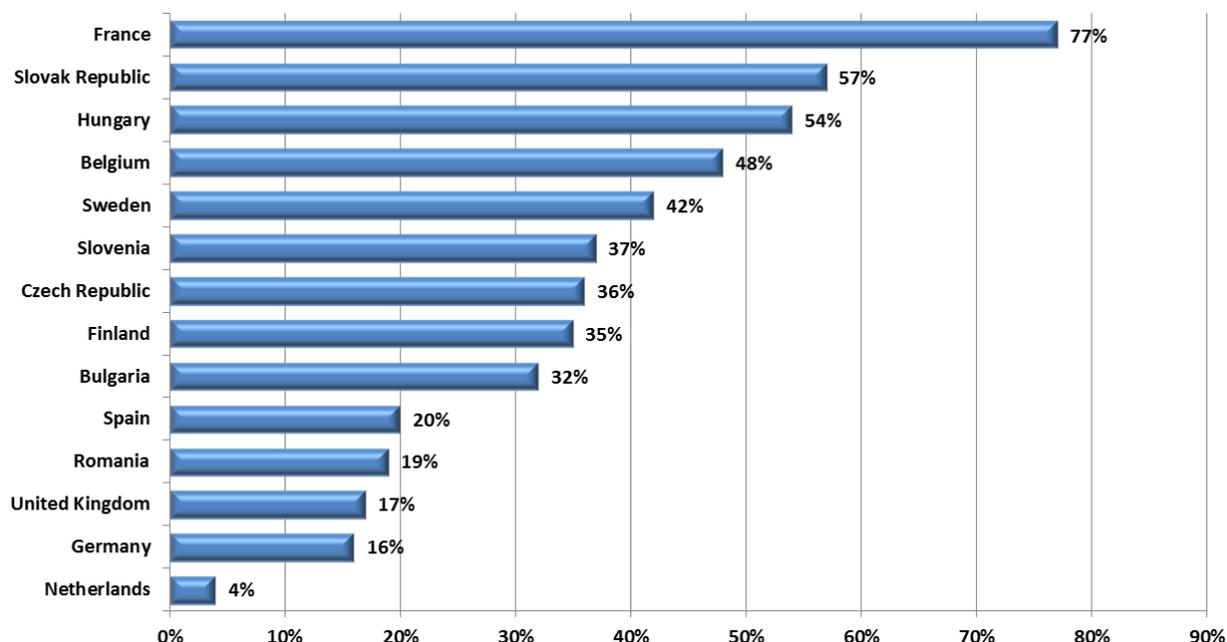
<sup>3</sup> [EC, Member States Energy Dependence, April 2013](#)

<sup>4</sup> [EC impact assessment, policy framework 2030 SWD \(2014\)15 final](#)

<sup>5</sup> The 2006 and 2009 Russia/Ukraine gas disputes offered a forewarning of potential problems in the future.

## Nuclear energy and security of supply

There are *131 operating nuclear power plants in the EU*. They currently provide 27 % of its electricity. The nuclear share of electricity varies from one Member State to another, from as much as 77 % in France to 4 % in the Netherlands (2014):



**Table 1.** Share of nuclear in the electricity generation mix of  
EU Member States operating nuclear power plants

Source: IAEA PRIS Database, December 2014

Nuclear energy contributes significantly to *reducing dependence upon imported fossil fuels*. One tiny uranium fuel pellet can produce as much energy in today's reactors as 3 barrels of oil, 1 ton of coal or 500 cubic meters of gas.

Both the transportation and storage of uranium is relatively straightforward and takes up little space. For oil and gas, new transport routes, improved port facilities and increased storage capacity within the EU will require enormous financing and long lead times.

Many years of uranium supply can be stored in a relatively small area. *It is common practice for nuclear operators to store sufficient uranium fuel assemblies on-site for a number of years of operation*, making it relatively impervious to supply constraints<sup>6</sup>. Whilst the EU's gas storage inventories are unusually high at the moment (due to a mild-winter) without consistent supply, and in the face of potential physical interruption, they could just as easily be depleted over a short period of increased demand. Likewise, any physical

<sup>6</sup> In line with a EURATOM Supply Agency recommendation, EU utilities maintain adequate strategic inventories, usually covering on a two-years-forward basis. The EU utilities inventories account for 34 % of the world total.

interruption of gas flow to the EU will have immediate impact on supply<sup>7</sup>, and potentially serious consequences for the economy.

In the face of geopolitical supply risks, nuclear energy also holds advantages that other fuels such as oil, coal and gas do not enjoy. For comparison, fossil fuel independence from fuel supply is of the order of weeks or a few months whereas for nuclear fuel it is of the order of years.

The EU *uranium production* industry, thanks to adequate and sustained investments, has been able to keep pace with global prospecting, developing, financing and mining operations. This strategy put a European company at the very top of the list of world producers.

The *world-wide and long-term availability of uranium resources is assured* by having a variety of producers. The majority of producing countries are *politically stable*. Australia (which has 29 % of the world's known recoverable resources as well as the majority of 'reasonably assured resources'<sup>8</sup>) and Canada remain reliable suppliers of uranium, in addition to which there has been recent development of mining projects elsewhere, particularly in Kazakhstan<sup>9</sup>, Namibia, and Niger.

Moreover, a Low Enriched Uranium (LEU) Bank will be established<sup>10</sup> by IAEA with the purpose to host a physical reserve of up to 90 metric tons of LEU, sufficient to run a 1,000 MWe light-water reactor. The Bank will be located in north-eastern Kazakhstan (at the Ulba Metallurgical Plant in Oskemen) and is part of global efforts to create an assured supply of nuclear fuel to countries in case of disruption of the open market or of other existing supply arrangements for LEU.

Although the EU's uranium supply demonstrates significant foreign dependence, the *geopolitical diversity* of the countries of origin contributes to a fair security: Table 2. Even if the EU were to reduce its Russian Federation fossil fuel import dependence, alternative suppliers, particularly of gas and oil, tend to be in politically unstable regions.

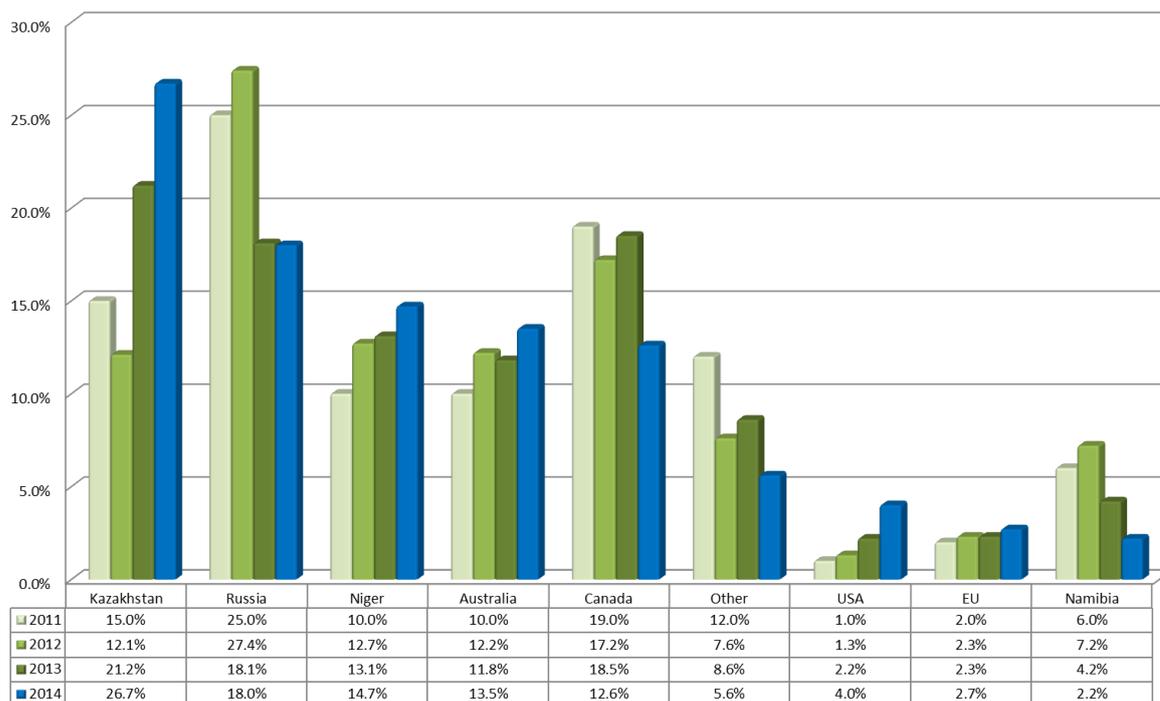
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<sup>7</sup> <http://news.bbc.co.uk/1/hi/world/europe/4574630.stm>

<sup>8</sup> <http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Uranium-Resources/Supply-of-Uranium/>

<sup>9</sup> Figures for 2013, show that Kazakhstan is the world's largest exporter of uranium with 22,500 tonnes mined – approximately 38 % of the world's uranium supply for that year.

<sup>10</sup> [https://www.iaea.org/OurWork/ST/NE/NEFW/Assurance-of-Supply/documents/Factsheet\\_LEU\\_Bank.pdf](https://www.iaea.org/OurWork/ST/NE/NEFW/Assurance-of-Supply/documents/Factsheet_LEU_Bank.pdf)



**Table 2.** Origin of uranium deliveries to EU utilities

Source: Euratom Supply Agency, 2011 - 2014.

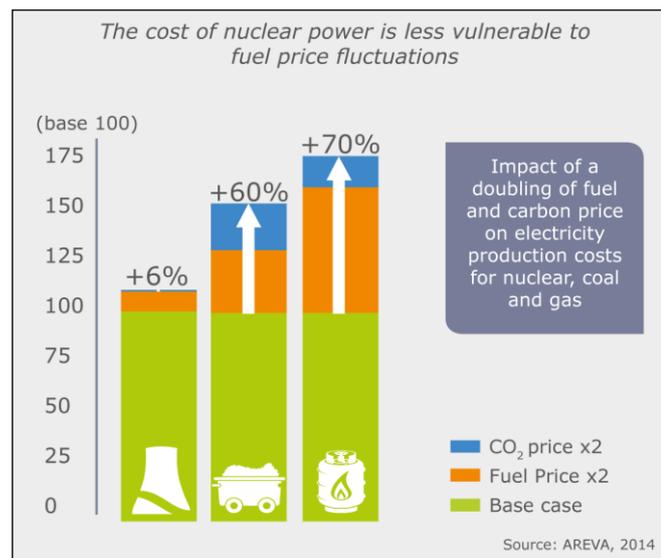
Because uranium enrichment technology is strategically sensitive and capital intensive, only a limited number of facilities worldwide are able to achieve commercial operation. *The biggest and most effective enrichment capacity is located in Europe*, combining the joint output of two major players, one single technology –gas centrifugation–, and plant location in four countries – France, Germany, the Netherlands and the UK.

The nuclear *fuel market* has become increasingly competitive. A handful of fabricators, who are also reactor vendors, share a world capacity significantly in excess of demand. The market remains primarily regionally driven, with the majority of the supply coming from the same continent. In Europe, the fuel market is shared between a few manufacturing plants in France, in Germany, in Sweden and in Spain. The EU share in the main steps of conversion, pelletizing and fuel rod manufacturing –*i.e.* 31 %– is quite in line with the global fuel requirements of EU’s reactors.

Moreover, a singularity of the European nuclear market lies in the large-scale development of spent *nuclear fuel industrial reprocessing*. Plutonium and uranium retrieved from this process can be used as MOX fuel in water reactors, extending the autonomy of utilities versus new uranium supply. The only commercial MOX fabrication facilities are operated in Europe. So far, no equivalent capacity exists anywhere else in the world.

In the long term, the uranium resource base can be further extended by extraction from unconventional sources, by recycling and improved uranium utilisation in units currently under construction and in future reactors, including fast breeders. For this reason, it is important that nuclear research is funded at an adequate level in order to contribute to security of supply in the long term.

Finally, because of the specific features of nuclear, the uranium costs, which are only a small part of the nuclear fuel costs, are marginal in the total cost of the electricity produced by a nuclear reactor. Hence uranium price changes have little effect on production costs of nuclear electricity: [Table 3](#). The same cannot be said of fossil fuels, which comprise a major proportion of operating and fuel costs, market prices of which can be volatile, especially in the face of geopolitical turmoil.



**Table 3.** Impact of a doubling of fuel and carbon price on electricity production costs for nuclear, coal and gas

Source: AREVA analysis, April 2014

As highlighted above, the EU has interests across all activities of the front-end of the fuel cycle. Uranium conversion, enrichment and fuel fabrication facilities are located in the EU, controlled by European interests and contribute to guaranteeing strategic technological and industrial energy independence to the European Union.

## Nuclear technology

### Reactors

The EU Member States using nuclear energy operate several nuclear reactor types with the majority being North American or European in design. Five Member States are also operating Russian VVER type reactors (around 8% of EU's total nuclear capacity of 134 GWe, but contributing up to 52 % of electricity in the Member States concerned).

For the VVERs in operation in those five Member States the fuel is currently 100 % supplied from Russia due to long-term contracts or technological and commercial constraints. However, Europe's nuclear industry has demonstrated its technical capability to make the fuel for these reactors<sup>11,12</sup>. Although it could take time for the EU industry to substitute for Russian Federation fuel fabrication, this would help reduce dependency on a sole external supplier.

The European reactor fleet's load factors have generally remained above 85%, making nuclear energy a reliable source of baseload electricity production.

### Long term operation and new build

The important contribution of nuclear energy to security of supply can only be sustained if long-term operation (LTO) of nuclear power plants together with strong and sustained new build programmes are implemented.

It is clear that the current market arrangements do not deliver the necessary signals for long-term investment in low carbon technologies, especially nuclear. In order to ensure a solid foundation for the necessary investments, there is a need to identify current market failures, reinforce existing financing instruments and enable new ones to be established. These measures coupled with robust political support, a transparent market framework, and a stable and predictable legal and regulatory structure should form clear energy policies.

### EURATOM Treaty

The pioneers of European integration successfully created in Rome, as early as 1957, a *European Atomic Energy Community*, better known as EURATOM. The six founding states considered that they would be stronger in joining their efforts with the goal of pooling their nuclear industries.

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<sup>11</sup> Following the successful performance of five test assemblies, a European supplier secured a contract to supply half of the fuel for Loviisa 1 in Finland, a VVER V-213 reactor, until the end of 2007. Since 2008, all fuel for Loviisa has been supplied by Russia. <http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/Finland/>

<sup>12</sup> Since 2008, fuel deliveries to Ukrainian nuclear power plants have also been secured thanks to a contract with a European nuclear fuel provider.

The EURATOM Treaty is still in force today, as a separate legal tool not embedded in the Treaty on the European Union. It includes a long list of tasks, in particular promotion of R&D, protection of the health of workers and of the general public by the means of uniform safety standards, the facilitation of investment and the introduction of a comprehensive and strict system of safeguards.

The EU has to ensure that all users receive a regular and equitable supply of ores and nuclear fuels. The *EURATOM Supply Agency* (ESA) was created in 1960 as a body with a legal identity and financial autonomy under the supervision of the European Commission. It aims to ensure security of atomic energy supply within the framework of a centralised monitoring system.

### **The mandate and the role of the Euratom Supply Agency**

The EURATOM Supply Agency has an exclusive right to conclude contracts relating to the supply of ore, source materials and special fissile materials coming from inside or from outside the Community. Additionally, operators must notify contracts they sign relating to processing, conversion, shaping, enrichment services or storage of the same materials.

The Agency aims to ensure security of nuclear fuel supply within the framework of a centralised monitoring system. In December 2009, a joint declaration by Council and the European Commission reinforced the role of the Agency as a market-monitoring agency and outlined the need to address over-dependency on any one external supplier country, to ensure the long-term diversity of conversion and enrichment supply to European utilities.

Although the EU is dependent on foreign sources for its uranium supply, the countries of origin are geopolitically diversified. Simultaneously, a prominent European mining operator is active in most of the countries from which the utilities purchase their uranium, Russia excluded. As a consequence, the EURATOM Supply Agency concludes “that, in the short and medium term, the needs of EU utilities for both natural uranium and enrichment services are well covered”.

The situation with Ukraine highlights the need for Member States to consider reducing their reliance on enrichment and fuel supply from any one country. Therefore, it would be consistent with the March 2014 Council conclusions that the 2009 declaration be recalled and enforced.

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