

Euratom research and training programme

In a nutshell

The Euratom research and training programme is an important tool that implements the European Union's nuclear policy. Its main aim is to enhance the role of the European Union as a global leader in nuclear research, while efficiently managing its nuclear market.

EU's Multiannual Financial Framework (MFF) heading and policy area

Heading 1 – Smart and Inclusive Growth

Subheading 1a – Competitiveness for growth and jobs

2014-2020 financial envelope (in current prices and as a % of total MFF)¹

Commitments: €2 373.5 million (0.22 %)

2018 budget (in current prices and as a % of total EU budget)

Commitments: €355.7 million (0.22 %)

Payments: €315.5 million (0.22 %)

2019 budget (in current prices and as a % of total EU budget)

Commitments: €373.6 million (0.22 %)

Payments: €370.0 million (0.25 %)

Methods of implementation

Direct management (European Commission) and *indirect management* (implementing bodies).



In this Briefing:

- EU role in the policy area: legal basis
- Objectives of the Euratom research and training programme
- Funded actions
- Assessment of the Euratom programme
- Other EU programmes and actions in the same area

EU role in the policy area: legal basis

All EU Member States are party to the Treaty establishing the European Atomic Energy Community (Euratom). Signed in 1957, it is one of the three main founding treaties of the EU and the only one that has remained largely unchanged. It has been adapted on numerous occasions to take account of other Treaty changes, but has not been altered substantively. While Euratom is a separate legal entity from the EU, the two have a common history and membership; furthermore, Euratom is governed by many of the EU institutions, including the European Commission and the Council of the EU, and is under the jurisdiction of the European Court of Justice (ECJ). The European Parliament has a consultative role.

In accordance with the Euratom Treaty, the Commission has adopted recommendations and decisions setting common standards for the nuclear industry over the years. Furthermore, the application of the Euratom Treaty has created a significant body of secondary legislation, such as Council or Commission decisions, in some cases as a result of clarifications from the ECJ. Consecutive Euratom research and training programmes are established by Council regulations and are based on Article 7 of the Euratom Treaty, which stipulates that programmes shall be drawn up for a period of not more than five years and agreed by the Council acting unanimously on a proposal from the Commission.

Objectives of the Euratom research and training programme

In its preamble, the Euratom Treaty states that the purpose of the Community is to create the conditions necessary for the development of a powerful European nuclear industry. To achieve this goal, the Community shall, among others, promote research and establish safety standards.

To support the aims of the Community, the Euratom research and training programme has identified two sets of specific objectives.² The indirect actions under the programme have the following specific objectives:

- supporting the safety of nuclear systems;
- contributing to the development of safe longer-term solutions for the management of ultimate radioactive waste, including final geological disposal as well as partitioning and transmutation;
- supporting the development and sustainability of nuclear expertise and excellence in the EU;
- supporting radiation protection and development of medical applications of radiation, including, inter alia, the secure and safe supply and use of radioisotopes;

Nuclear energy in the EU

Nuclear power plants are operational in [30 countries](#) worldwide, 14 of which are EU Member States. Furthermore, 128 of the 450 nuclear power reactors worldwide are in the EU, producing roughly a third of the electricity generated globally using nuclear power. Power reactors in Europe have an average age close to 30 years.

Nuclear energy production in the EU is gradually [decreasing](#), and is now around 28 % less than at its peak in 2004. Nevertheless, nuclear energy remains important. Looking at the overall energy mix, nuclear plants generated around 25.1 % of the [electricity](#) produced in the EU in 2017, or 53 % of the carbon-free electricity. France was the largest producer of nuclear power among the EU-28 that year, with a 48 % share of the total output, followed by Germany (9.2 %), the United Kingdom (8.4 %), Sweden (7.9 %) and Spain (7.0 %), which together accounted for more than 80 % of the total amount of electricity generated in nuclear facilities. France generates around three-quarters of its electricity from nuclear energy; Hungary, Slovakia and Ukraine (which is an associate member of Euratom) more than half, whilst Belgium, Sweden, Slovenia, Bulgaria, Finland, the Czech Republic and Switzerland (a second associate member) one-third or more. Furthermore, through regional transmission grids, other countries depend in part on nuclear-generated power; Italy and Denmark, for example, get almost 10 % of their electricity from imported nuclear power.

- moving towards a demonstration of the feasibility of fusion as a power source, by exploiting existing and future fusion facilities;
- contributing to the creation of fusion power plants by developing materials, technologies and conceptual design;
- boosting innovation and industrial competitiveness;
- ensuring the availability and use of research infrastructures of pan-European relevance.

The direct actions, managed by the Commission's Joint Research Centre (JRC), have the following specific objectives:

- improving nuclear safety, including: nuclear reactor and fuel safety, waste management, including final geological disposal as well as partitioning and transmutation; decommissioning, and emergency preparedness;
- improving nuclear security, including with regard to: nuclear safeguards, non-proliferation, combating illicit trafficking, and nuclear forensics;
- increasing excellence in the nuclear science base for standardisation;
- fostering knowledge management, education and training;
- supporting the EU policy on nuclear safety and security.

Funded actions

Financial envelope and scope

The Euratom Treaty is a separate legal basis from that of the EU, and the Euratom budget is established for a period of five and not seven years as in the case of the EU MFF. Funding is channelled via the [Euratom research and training programme](#), which complements the EU Horizon 2020 programme in the area of nuclear research and training, and sets itself the aim of improving nuclear safety and radiation protection, and contributing to the development of a safe and low-carbon energy system. The Euratom programme is designed to bolster results achieved under the [three priorities](#) of Horizon 2020: excellent science, industrial leadership and societal challenges.

The programme is implemented through [indirect actions](#) using the forms of funding envisaged by the [Financial Regulation](#), in particular grants, prizes, procurement and financial instruments, mainly used to fund projects undertaken by multi-partner consortia. Indirect actions in fusion and fission are supported through competitive calls for proposals and a co-fund action (fusion energy) managed by the Commission's Directorate-General for Research & Innovation (RTD). Community support also consists of direct actions in the form of research and innovation activities undertaken by the JRC.

The total [budget](#) of the Euratom programme for the 2014-2018 period, set by [Council Regulation No 1314/2013](#), amounted to €1 603.3 million and was allocated to three programmes:

- the first funded indirect actions in fusion energy research and development (€728.2 million);
- the second funded indirect actions for nuclear fission, safety and radiation protection (€315.5 million);
- the third funded direct action in the field of nuclear safety, nuclear waste management, safeguards and security, carried out mainly by the Commission's JRC (€559.6 million).

In October 2018, the Council extended the Euratom programme to the 2019-2020 period, to synchronise its duration with the EU MFF, through [Council Regulation 2018/1563](#). The objectives of the programme remain unchanged, but there is now increased focus on nuclear safety and security aspects that are dealt with by the JRC. The €770.2 million financial envelope for the implementation of the 2019–2020 programme is allocated among the three above-mentioned strands of actions, with respectively €349.8 million for indirect actions in the field of nuclear fusion research, €151.6 million for indirect actions for nuclear fissions, and €268.8 million for direct actions in the field of nuclear safety. Switzerland and Ukraine are associated to the [programme](#).

Indirect actions

Euratom [fusion](#) research targets the long-term challenge of developing [magnetic-confinement fusion energy](#) as a safe and secure carbon-free source of electricity that is both sustainable and competitive. Fusion energy research contributes to constructing the [International Thermonuclear Experimental Reactor](#) (ITER), an experimental facility aimed at demonstrating the scientific and technical feasibility of this new technology. Via the [grant agreement](#), the programme provides multiannual support to a co-funded action of the [European joint programme](#) (EJP) of the members of the [EUROfusion](#) consortium.³ Their work is guided by a [roadmap](#) developed under the European Fusion Development Agreement (EFDA) and has the aim to achieve fusion electricity by 2050. Furthermore, EUROfusion has 30 members representing 26 EU Member States plus Switzerland and Ukraine, alongside 100 third-party signatories, which include universities, fusion laboratories and industry.⁴ Thanks to a €425 million Euratom grant coupled with the members' contributions, EUROfusion has a total budget of €857 million for the 2014-2018 period.

Furthermore, Euratom supports the operation of the [Joint European Torus](#) (JET), which is a research device used to advance the fusion research as well as the only existing fusion device capable of operating with deuterium-tritium fuel. The Commission pays annual instalments for the operation of JET, following the approval of the annual reports and work plans submitted by EUROfusion and the JET operator. Over the 2014-2018 period, Euratom contributed €283 million to JET.

In [nuclear fission](#) research, the majority of the resources are used to fund three main fields of research, namely nuclear safety, radiation protection and radioactive waste management, followed by support for research infrastructures, education and training. The JRC is involved in these activities by doing research on the safety of both current and future nuclear technologies.

Waste management projects help to increase the understanding of issues relevant to the effective management of radioactive waste in the EU, such as the safety of geological

Figure 1 – Aggregated budget of the Euratom programme (€ million)



Data source: European Commission. Figures come from the Council regulations establishing the 2014-2018 programme and its extension for 2019-2020.

waste disposal facilities, the conditioning of radioactive waste, the long-term behaviour of spent fuel in a repository, and the clean-up of decommissioned sites.

With regard to radiation protection, Euratom research seeks to deepen the knowledge of the effects of low doses of ionising radiation on the human biota, so as to increase effectiveness and safety when using radiation and radionuclides in medical diagnostic and therapeutic practices. Euratom supports [CONCERT](#), another EJP co-funded action that pools national research efforts and Euratom research to use public resources more efficiently with a view to achieving added value by joint research efforts in radiation protection.

Education and training are supported through targeted actions and through the requirement that each research and innovation action dedicate at least 5 % of its total budget to education and training activities for PhD students, researchers and trainees.

Safe disposal of dangerous nuclear waste underground

Many types of nuclear waste remain dangerous for thousands of years, due to their high level of radioactivity. Discarding these materials through deep geological disposal – a complex process requiring high-level expertise – is considered the safest and the most sustainable option. Euratom funded the [SITEX II](#) network of experts, who defined a research and development programme in the field, developed pilot training activities, defined procedures to involve civil society, and laid the basis for creating a permanent association of experts necessary to advance impartial high-level knowledge independently of industrial operators.

Direct actions by the JRC

In its work, the [JRC](#) focuses on issues related to nuclear safety, safeguards and security research. Its activities complement those carried out either directly by Member States or within the context of indirect actions, and form an independent scientific and technical basis for EU policies, helping in the implementation of Council directives and conclusions. The centre contributes to ensuring the safety of current reactors by developing codes, standards and test methods for reactor materials as well as software tools for accident modelling and management. That way, it also helps to assess the potential of ageing nuclear power plants for long-term operation. Furthermore, the JRC develops tools and data for the safety analysis of nuclear fuels; reviews national programmes on nuclear waste and spent fuel management; and takes part in the elaboration of the related inventory report.

The JRC also harmonises the radioactivity measurements carried out by Member States' laboratories and trains their staff to ensure that they collect information on radioactivity levels in the environment in a uniform manner. To reduce the risk of nuclear proliferation, the centre supports and trains Euratom inspectors and is engaged in open-source information collection, strategic trade analysis and studies on export control of dual-use goods. The JRC also provides scientific and technical expertise contributing to the detection of and response to the illicit trafficking of nuclear and other radioactive materials.

Next-generation nuclear energy systems

The JRC acts as Euratom's implementing body of the Generation IV International Forum ([GIF](#)), which develops innovative nuclear energy systems. The GIF has selected six out of 100 proposed systems, as the next generation technologies. The JRC mainly carries out research on the safety of fuels for five Generation-IV systems, focusing on the four [prototype reactors](#) being developed in the EU: ASTRID, ALFRED, MYRRHA, and ALLEGRO, which use three of these selected technologies.

The centre also works with nuclear reference materials and data, and affords access of its nuclear facilities to European researchers and young scientists. Furthermore, it provides training to Member States' officers and experts and aids their research on nuclear detection technologies and nuclear forensics.

Assessment of the Euratom programme

In December 2017, the Commission published an [interim evaluation](#) covering the first half of the 2014-2018 programme. It stated that progress has been made on all Euratom objectives in direct and indirect actions, as set by the 2013 Council Regulation. Areas requiring improvement included increasing synergies between radiation protection research associated with medical exposure, on the one hand, and health research supported under Horizon 2020, on the other, and defining more specific objectives for education and training actions in nuclear fission research. It recognised that some delays had occurred, due to the inherent features and unpredictability of the pioneering scientific research, particularly the unavailability of crucial research infrastructure.

The interim evaluation concluded that there is good overall efficiency in areas such as grant management, proposal evaluation for indirect actions, and programme implementation. Furthermore, it underlined the importance of the JRC's involvement in the indirect actions programme, as it helps to improve interaction with Member State bodies and achieve better alignment with their needs and priorities. Furthermore, JRC involvement in the indirect actions increases the relevance and effectiveness of both parts of the Euratom programme, which can be illustrated by the synergies obtained between the direct research projects on advanced nuclear systems and the centre's participation in indirect research in this area.

The evaluation stated that the internal coherence of the programme is ensured by the Commission, as it is responsible for establishing adequate links between fission and fusion research by supporting projects and addressing issues, such as materials research and tritium management, which are relevant to both fields. To ensure synergies between direct and indirect actions under the programme, the JRC institutes take part in consortia implementing indirect actions projects, where they contribute by granting access to the centre's research infrastructures.

Regarding the added value of indirect actions under the programme, the evaluation pointed out that Euratom 'mobilises a wider pool of excellence, expertise and multi-disciplinarity in nuclear research, than is possible at the level of individual Member States'. This is demonstrated by a diverse portfolio of projects as well the launch of both the EJP co-fund actions (in fusion and radiation protection research) and the shared exploitation of fusion research infrastructures such as JET. Other examples of added value include EU-level coordination of education and training, access to research facilities, and international cooperation, which are particularly beneficial to smaller Member States, allowing them to find their scientific 'niche' or specialisation, while taking advantage of the economies of scale and maintaining their visibility in the European consortium.

A separate 2017 [evaluation](#) of the JRC argued that the centre is on track with its targets, and its relevance is ensured both through its participation in various fora together with Member State and international organisations, and its interaction with the main research and scientific institutions. Furthermore, the JRC implements a strategy of concluding agreements with key stakeholders,⁵ and its research publications performance, measured by the number of quotations in leading peer-reviewed journals, is well above

average. To improve the efficiency of communication between the different areas of the Euratom programme, the JRC has adopted a new governance model. The centre also implements standardisation, which could not be done at the national level.

There is room for improvement in the management of the knowledge generated by the JRC, to ensure greater visibility and availability of the results to the various JRC stakeholders. More effort in this area would benefit not only the direct actions under the programme but also the overall nuclear research knowledge produced in Europe.

The Commission also carried out a public consultation among the stakeholders in 2017.⁶ Four out of five respondents agreed that the Euratom programme is relevant, showing the strongest support for education and training, disposal of nuclear waste and safety of existing reactors. Research in nuclear fusion received the highest number of positive indications (56 %), as an area in which the Euratom programme has played an adequate role in positioning Europe as a leader.

Furthermore, the EU added value of the programme was rated high or very high by 72 % of respondents, with the following impacts enjoying the strongest support: improving knowledge-sharing and dissemination, mobilising a wider pool of high-level multi-disciplinary competences than at national level, and undertaking programmes and achieving objectives that would not have been possible at Member State level. As many as 84 % of respondents agreed that the current objectives should remain in the next Euratom programme. One out of three respondents stated that education and training are not sufficiently supported by the current programme. Furthermore, support for mobility of researchers received a mixed response: while 34 % agreed that it is sufficient, 29 % disagreed with that statement.

Other EU programmes and actions in the same area

The International Thermonuclear Experimental Reactor

[ITER](#) is an important international collaborative energy research and engineering project, which is currently developing the world's largest nuclear fusion reactor in Cadarache, France.⁷ Its aim is to demonstrate the feasibility of nuclear fusion as an unlimited, sustainable energy source. By virtue of their membership in Euratom, EU Member States take part in ITER by drawing up procurement contracts, making in-kind contributions, assigning qualified staff and providing funding for the manufacture of the reactor's components. These activities are managed by the Barcelona-based Fusion for Energy (F4E) agency, a joint undertaking established under the Euratom Treaty. Currently, the launch of the reactor is scheduled for December 2025.

The Euratom Supply Agency

The Euratom Supply Agency ([ESA](#)) ensures a regular and diversified supply of nuclear fuels to the EU by concluding relevant contracts inside or outside the Community. The agency is responsible for a common supply policy based on developing optimal conditions for the nuclear sector and equal access to sources of supply. The trading parties are usually allowed to negotiate transactions among themselves, with the ESA being responsible for the final review and conclusion of these transactions. The ESA also monitors the EU nuclear fuel market to identify trends that may have an impact on the security of supply and services. While the ESA has legal personality and financial autonomy, it is under the supervision of the Commission, which has a right of veto over its decisions and appoints its director-general. The Council adopts the statutes of the Agency, which address its operational and financial provisions.

Nuclear decommissioning programme

The EU funds the nuclear decommissioning assistance programmes ([NDAPs](#)) to help Member States, such as Bulgaria, Lithuania and Slovakia, to deal with the Soviet-era legacy. These programmes assist the recipients to safely close and dismantle old reactors and offer them financial support for radioactive waste management. The 1999-2020 financial envelope for NDAPs will have amounted to approximately €3.8 billion.

EU energy research

Providing financial support for energy projects is one of the main goals of the EU research and innovation programmes, particularly within the present Europe 2020 agenda. The MFF 2014-2020 supports such initiatives through the [Horizon 2020](#) framework programme, the European structural and investment funds ([ESIF](#)), the [NER 300 programme](#), the European fund for strategic investments ([EFSI](#)), the [LIFE+](#) climate action, the Connecting Europe Facility ([CEF](#)), the [COSME](#) programme, EU [international cooperation and development](#) assistance, and [European Investment Bank](#) financing.

Main references

[Euratom research and training programme website](#), Horizon 2020, European Commission.

M. Szczepański, [European Atomic Energy Community \(Euratom\) – structures and tools](#), European Parliamentary Research Service, European Parliament, September 2017.

M. Parry, [The International Thermonuclear Experimental Reactor \(ITER\)](#), European Parliamentary Research Service, European Parliament, September 2017.

Endnotes

- ¹ Euratom financing is normally based on a five-year cycle. Total commitments agreed for the 2014-2020 period represent a sum of the budget agreed under [Council Regulation No 1314/2013](#) (for 2014-2018) and [Council Regulation 2018/1563](#) (for 2019-2020).
- ² As stipulated in Article 3 of Council Regulation (Euratom) No 1314/2013.
- ³ The non-participating Member States are Luxembourg and Malta.
- ⁴ Co-funded actions are those with variable EU funding rate. The EU, national governments, industry or other bodies contribute jointly.
- ⁵ For more details, please refer to the evaluation.
- ⁶ A detailed summary of the responses can be found in Annex 2 of [SWD/2017/0427 final](#).
- ⁷ The international parties that are co-operating to develop ITER are: China, the EU, India, Japan, Russia, South Korea, and the United States. Switzerland contributes to the project as a country associated with Euratom.

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