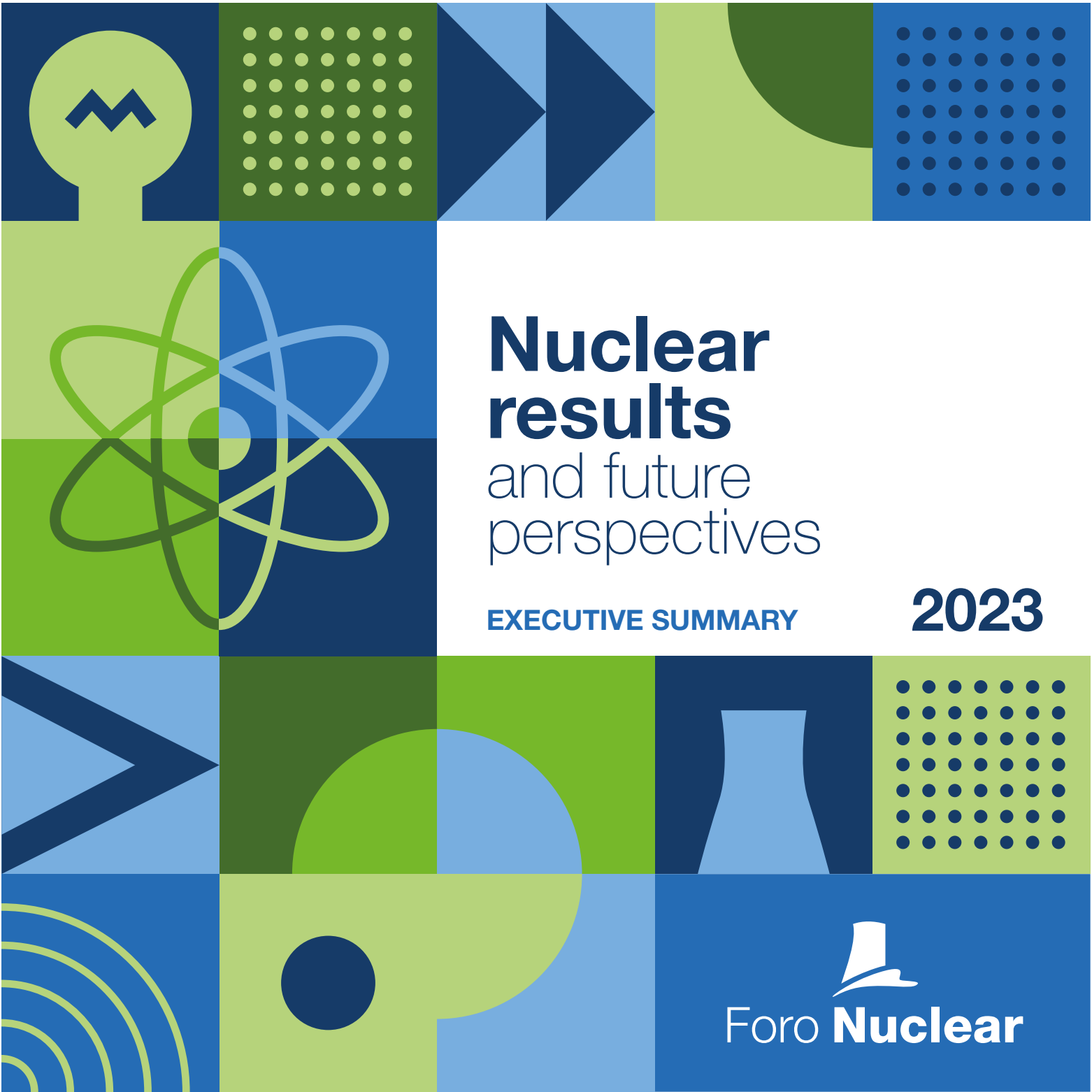




Nuclear results

and future
perspectives

EXECUTIVE SUMMARY

2023



Foro **Nuclear**



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Foro de la Industria Nuclear Española

Nuclear results and future perspectives

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www.foronuclear.org



A LETTER FROM THE CHAIRMAN

Ignacio Araluce



Nuclear power generation becomes, once again, a strategic solution in a time of greater commitment to fighting climate change and ensuring the supply of electricity and economic competitiveness. Beyond **its capacity to constantly produce electricity without releasing greenhouse gas emissions**, nuclear power stands out for its key role in the energy transition.

2023 saw the consolidation of the substantial, positive shift in the perception of nuclear power that had already started the previous year as a result of the energy crisis. Increasingly more national and international voices, institutions and bodies are taking

a stand in favor of nuclear power, highlighting its advantages and its role in decarbonization.

The International Energy Agency said as much **when it confirmed that nuclear power was making a strong comeback all over the world** and warned of the risks that discarding it would pose. On the other hand, **the European Council included it among the strategic technologies** to achieve climate neutrality. The conclusion document from **the last Climate Summit had nuclear power down as a means of accelerating the reduction of greenhouse gas emissions. Indeed, within the framework of COP28, 24 coun-**

tries undertook to triple the installed nuclear capacity until 2050 to achieve a net zero balance by then.

More and more countries support this pledge in their energy plans, which endorse the continued operation of their reactors and the construction of small and big nuclear units as an integral part of their energy matrix, thus acknowledging their ability of provide electricity continuously and without emissions.

“Spain needs to reconsider the future of its nuclear power plants and the conditions ensuring their viability”

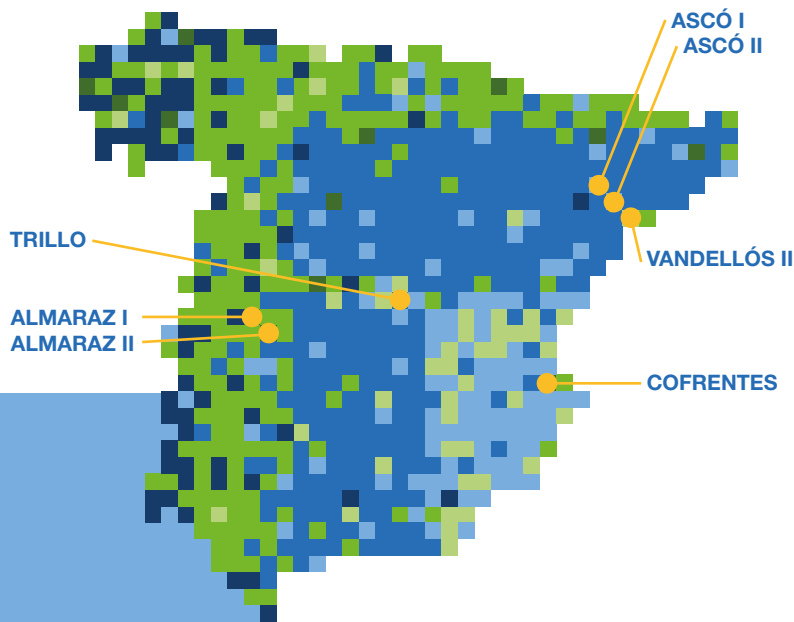
Nuclear power faces significant challenges in Spain despite its unquestionable importance—it accounts for more than 20% of all electricity produced in the country year in, year out. On the one hand, **it would be advisable to reformulate the nuclear power plant closure timeline** given the marked difference between the energy, economic and environmental situation now and that in

2019. On the other, the discriminatory tax burden the Spanish nuclear industry has to bear compared to other technologies should be discussed. **This undue burden (taxes and levies) is not only unjust and redundant in some cases but also jeopardizes the viability of our plants.** Thus, it should be revised and considerably reduced, without in any case considering further rises.

“The Spanish nuclear industry and its employees have worldwide renown for their capabilities, commitment and experience”

Apart from the relevant role the seven nuclear units in operation in our country play, **the Spanish nuclear industry as a whole and its employees not only have shown to be pioneers when it comes to technology and safety but have also gained worldwide renown** thanks to their capabilities, commitment, experience, and innovation. With an active involvement in the development and maintenance of reactors in 40+ countries, the Spanish nuclear industry is a global actor in the promotion of this CO₂ free energy source.

I would like to finish highlighting once more the necessary role nuclear power has to play as a bridge to a sustainable, secure future. Its importance in the fight against climate change, self-sufficiency and a competitive energy supply is undeniable. **I would like to invite you to read our annual report, where we detail all nuclear results in Spain and the rest of the world.** This report has been possible thanks to the support from our members and is an opportunity to find out in detail the contribution of nuclear power and the activity of the companies that make up the Spanish nuclear industry.



Spanish nuclear power plants produce in excess of 20% of all electricity and are essential in the transition to a decarbonized economy

NUCLEAR POWER IN SPAIN

PERFORMANCE INDICATORS

Load Factor

87.75%

Time Availability Factor

90.67%

Unit Capability Factor

89.47%

Unplanned Capability Loss Factor

2.16%

There are seven operating nuclear reactors in five sites in Spain: Almaraz I and II, Ascó I and II, Cofrentes, Trillo, and Vandellós II. The Spanish nuclear fleet outputted 54,276.12 GWh of net electricity in 2023, which represented 20.34% —almost the same percentage as in the previous year—of the country's total net electricity production, which stood at 266,806 GWh.

Nuclear production accounted for 27.46% of all emissions-free electricity generated in Spain, thus becoming a key source in the energy transition and in curbing polluting emissions.

Nuclear power is the only source that has produced more than 20% of all the electricity consumed in Spain for 12 years in a row. It has achieved this with just 5.69% of the total net capacity installed in the country and, moreover, with **its performance indicators having outstanding results, which is proof of its degree of excellence in terms of both operation and safety.**

OPERATING LICENSES

The operating licenses of Spanish nuclear power plants are renewed once the Spanish Nuclear Safety Council assesses their condition. This renewal is then granted by the Ministry for Ecological Transition and the Demographic Challenge (MITECO).

The protocol of intentions signed in March 2019 laid down a timeline for the orderly cessation of the operation of Spanish nuclear power plants from 2027 through 2035. Thus, unless this timeline is reconsidered, Almaraz I would cease operating in 2027, Almaraz II in 2028, Ascó I and Cofrentes in 2030, Ascó II in 2032, and Vandellós II and Trillo in 2035.

On March 30, 2023, Centrales Nucleares Almaraz - Trillo (CNAT) filed a request with MITECO to renew the Trillo NPP's operating license for another 10 years, until November 2034.

OPERATING LICENSE DATES

Nuclear power plant	Current license date	Valid until	Next renewal
Almaraz I	07/23/2020	11/01/2027	---
Almaraz II	07/23/2020	10/31/2028	---
Ascó I	09/27/2021	10/02/2030	---
Ascó II	09/27/2021	10/02/2031	October 2031
Cofrentes	03/18/2021	11/30/2030	---
Trillo	11/17/2014	11/17/2024	November 2024
Vandellós II	07/23/2020	07/27/2030	July 2030

Source: Foro Nuclear

Spain will stop having nuclear power plants in operation in 2035 unless the closure is reconsidered

Photo: CNAT





SPENT FUEL MANAGEMENT

Radioactive waste is not all the same. Radioactive waste is classified according to the nature of the radioactive isotopes it contains. Consequently, it is divided into two main groups: very low-, low- and intermediate-level radioactive waste—which is kept stored on a permanent basis at the El Cabril disposal facility (Cor-

doba) belonging to the Spanish National Radioactive Waste Company (Enresa)—and high-level radioactive waste, which is mostly irradiated and spent fuel.

Spanish nuclear power plants keep their irradiated fuel stored inside the pool that was built for this specific purpose under wet storage conditions, and, once it is full, in an Individual Temporary Storage Facility (ATI) under dry storage conditions; both the pool and the ATIs are located within the station's site proper. There are currently ATIs in operation in José Cabrera, Santa María de Garoña (which are both currently undergoing decommissioning), Almaraz, Ascó, Cofrentes and Trillo nuclear power plants. In 2023, Vandellós II began the procedures for the construction of its own.

As of December 31, 2023, there were 17,354 irradiated fuel assemblies temporarily stored at the Spanish nuclear power plants, of which 14,153 were kept in spent fuel pools and 3,201 in ATIs.



Photo: Enresa



On December 27, 2023, the Government of Spain's Council of Ministers approved the 7th National Radioactive Waste Plan (PGRR), which represents a substantial shift in terms of irradiated fuel management compared to the previous plan. This plan envisages the construction and operation of seven Decentralized Temporary Storage Facilities (ATD) and of a Deep Geological Storage Facility (AGP) for its ultimate storage, which is expected to come into service in 2073.

The new Plan also contemplates having a full-capacity individualized temporary storage facility (ATI-100) at the site of all Spanish nuclear power plants. These storage facilities should come into service in 2026 at the latest; otherwise, some of the plants would have to shut down because of a lack of enough space to store their irradiated fuel. **The 7th PGRR cancels the project for the construction of a Centralized Temporary Storage Facility (ATC) in the town of Villar de Cañas.**

Spain has a new National Radioactive Waste Plan, which opts for having an individualized temporary storage facility in each plant instead of there being a centralized storage facility for all

Photo: CN Cofrentes





NUCLEAR POWER AROUND THE WORLD

At the end of 2023 there were 413 reactors in operation in 32 countries around the world. Another 59 new reactors were under construction in 17 countries. Over the past few years, nuclear output has amounted to about 2,700 TWh, which represents approximately 10% of all the electricity consumed in the world and almost one third of all the electricity generated without releasing polluting emissions.

In 2023, five reactors started to be built in China and Egypt and five units were connected to the grid in Belarus, China, Slovakia, South Korea, and the U.S. In addition, many countries committed to building new reactors, including Small Modular Reactors, and to the long-term continuity of their existing reactors.

In the second half of 2023, **the European Council added nuclear power to its list of strategic technologies in the Net-Zero Industry Act**, the European law that supports the manufacture

of net-zero technologies. Furthermore, **nuclear power was for the first time explicitly included in the conclusion document of COP28**, the Conference of the Parties to the United Nations Framework Convention on Climate Change held in Dubai in November 2023, **where it was acknowledged as an effective means to achieve decarbonization.**

Within the framework of COP28, **24 countries from four continents pledged to triple their installed nuclear capacity by 2050** by jointly signing a declaration acknowledging the key role of nuclear power in achieving a net-zero greenhouse gas emission balance by said year. On the other hand, **the International Energy Agency again recognized nuclear power's energy security role.**



Photo: EDF

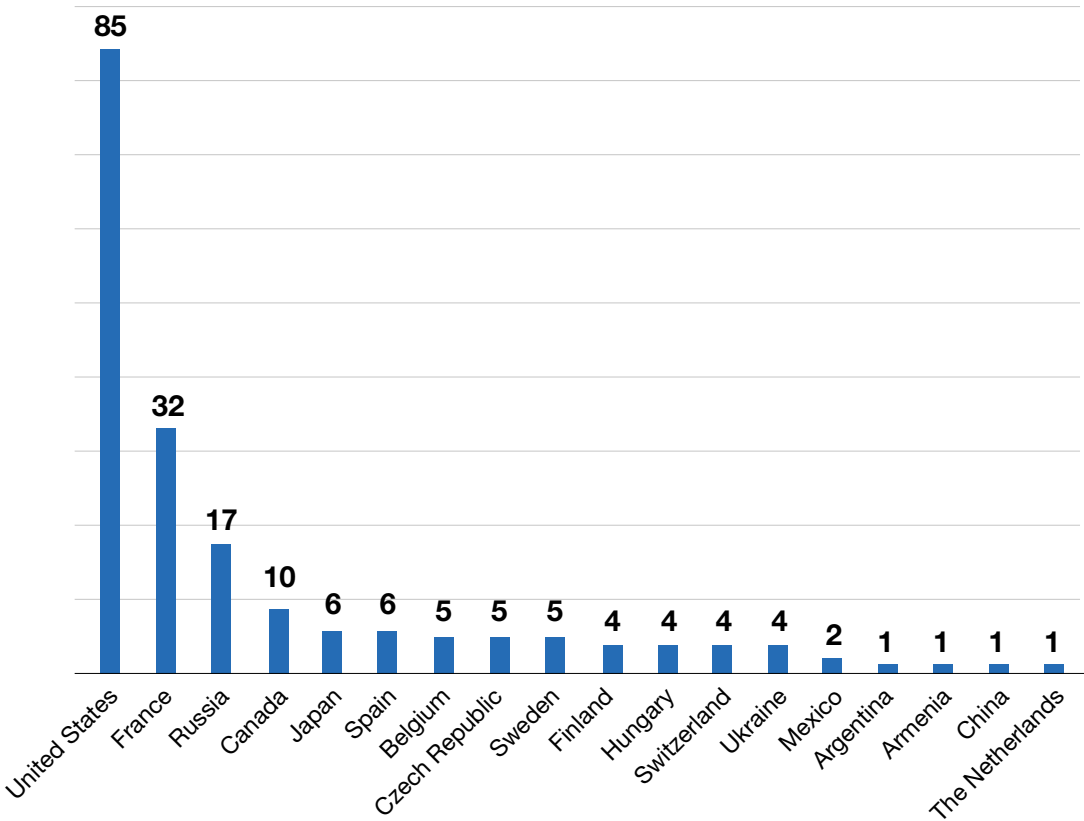
CONTINUITY OF OPERATION OF THE WORLD'S NUCLEAR FLEET

The long-term operation of nuclear power plants so as to ensure the supply of electricity and reduce polluting emissions is standard practice around the world. In particular, at the end of

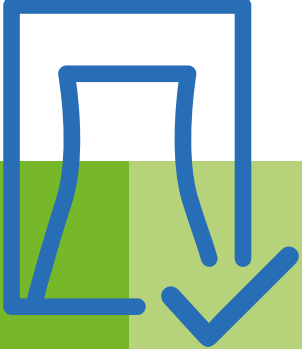
2023 there were 193 nuclear reactors around the world that had been authorized to operate for 40+ years by the regulatory bodies of 18 different countries. All in all, they account for more than

45% of all existing nuclear reactors. In the U.S., where most reactors have 60-year operating licenses, 6 of them have now been authorized to operate 80 years.

REACTORS IN THE WORLD LICENSED TO OPERATE BEYOND 40 YEARS



Data valid as of December 31, 2023.
Source: Foro Nuclear with data from PRIS-IAEA, NRC, ASN, Rostechnadzor/Rosatom, CNSC, NRA/Jaif, MITECO, FANC, SÚJB, SSM, STUK, HAEA, ENSI, SNRIU, SENER/Gobierno de México, ARN, ANNP, CNNC and ANVS.



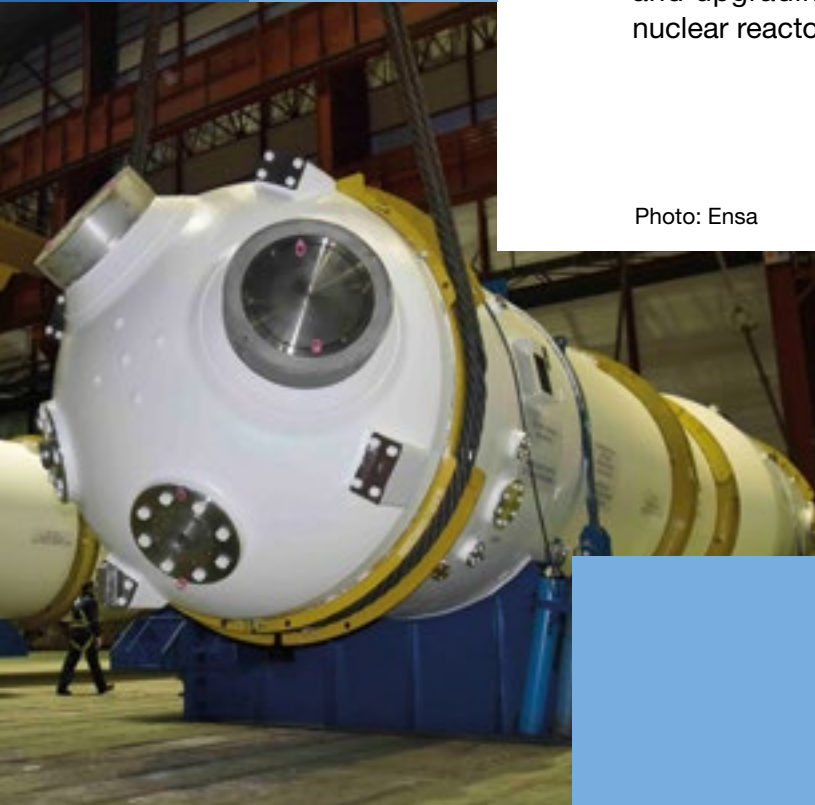
THE SPANISH NUCLEAR INDUSTRY

In 2023 the Spanish nuclear industry stepped up its participation in numerous projects both in Spain and abroad and continued to create quality jobs, which were filled by highly qualified candidates with broad capabilities in different disciplines. Yet again, its endeavors and the professionalism of its workers have been essential for the operation, servicing and upgrading of the country's nuclear reactors.

Photo: Ensa

The contribution to the development of the Spanish nuclear program for more than 60 years has resulted in a robust and competitive industry. This experience has made it possible for **these companies to be present today throughout the entire value chain of the nuclear business and have achieved great national and international renown by exporting products, services and cutting-edge technology to 40+ countries.**

The companies that make up the Spanish nuclear industry are increasingly committed to research, development and innovation, which enables them to take part in development projects for new models of advanced nuclear power plants and Small Modular Reactors as well as in high energy physics- and nuclear fusion-based programs, such as the ITER project.



WHAT IS FORO NUCLEAR?

Foro de la Industria Nuclear Española has been representing the interests of the Spanish nuclear industry since 1962. It is made up of almost 50 companies and organizations, including electric utilities, nuclear power plants, engineering firms, service companies, nuclear fuel manufacturer, system and large-component suppliers, universities, and industry and professional associations.

It underscores the value of the industry's activities, products, technology, and services and supports its members so that they may reach their commercial and business goals. Furthermore, **it boost its international presence as a competitive, qualified and technological industry that operates in 40+ countries.**

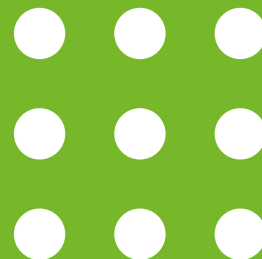
It stands for the continued operation of the Spanish nuclear fleet as competitive, stable, constant,

reliable and CO₂-free source of electricity. **It considers nuclear power to be an essential technology in the fight against climate change and the energy transition**, so it believes it is absolutely necessary to ensure its economic viability and regulatory stability.

It encourages better and greater knowledge of nuclear energy and its different applications by disseminating and providing rigorous, proven and specialized information, as well as advertising its significant contribution to Spain's technological development and the creation of wealth and jobs in the country.

Foro Nuclear is able to carry out all of its activities thanks to the contributions of its member companies, which can be looked up on its institutional website foro-nuclear.org and its social media accounts.

Foro Nuclear
defends the
Spanish nuclear
industry as a whole
and the continuity
of operation of the
Spanish nuclear
fleet



OUR MEMBERS



ORDINARY MEMBERS

- AMPHOS 21
- CEN SOLUTIONS
- CENTRAL NUCLEAR DE ALMARAZ
- CENTRAL NUCLEAR DE ASCÓ
- CENTRAL NUCLEAR DE COFRENTES
- CENTRAL NUCLEAR DE TRILLO
- CENTRAL NUCLEAR DE VANDELLÓS II
- COAPSA CONTROL
- EDP
- EMPRESARIOS AGRUPADOS
- ENDESA
- ENSA
- ENUSA INDUSTRIAS AVANZADAS
- ENWESA
- GD ENERGY SERVICES
- GE-HITACHI NUCLEAR ENERGY
- GHESA INGENIERÍA Y TECNOLOGÍA
- GRUPO EULEN
- IBERDROLA
- IDOM CONSULTING, ENGINEERING & ARCHITECTURE
- INGENICID
- KONECRANES
- NATURGY
- NEWTESOL
- NUCLENOR
- NUSIM
- PROINSA
- RINGO VÁLVULAS
- VIRLAB
- WESTINGHOUSE SPAIN

ASSOCIATE MEMBERS

- AEC (Asociación Española para la Calidad)
- AMAC (Asociación de Municipios en Áreas de Centrales Nucleares)
- Aseguradores de Riesgos Nucleares
- CEMA (Club Español del Medio Ambiente)
- Colegio Oficial de Ingenieros de Minas del Centro de España
- Consejo Superior de Colegios de Ingenieros de Minas de España
- Departamento de Ingeniería Química y Nuclear de la Universidad Politécnica de Valencia
- Escuela Superior y Técnica de Ingenieros de Minas de la Universidad de León
- Escuela Técnica Superior de Ingenieros Industriales de Bilbao
- Escuela Técnica Superior de Ingenieros Industriales de Madrid
- Escuela Técnica Superior de Ingenieros Industriales de la UNED
- Escuela Técnica Superior de Ingenieros de Minas y Energía de Madrid
- OFICEMEN (Agrupación de fabricantes de cemento de España)
- SEOPAN (Asociación de Empresas Constructoras y Concesionarias de Infraestructuras)
- SERCOBE (Asociación Nacional de Fabricantes de Bienes de Equipo)