



# The Melancholic Lock: High-Level Radioactive Waste Governance in Spain

# 6

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## 6.1 Introduction

Nuclear waste management shows the Spanish evolution from top-down, unidirectional strategies applied in the earlier decades since the 1960s, to more comprehensive, bidirectional and participative approaches for interacting with society since the end of the 1990s. The internalisation of European Directives has increasingly required more public transparency and openness to citizen participation. This has been reflected in the approach to managing the location of the repository for high-level nuclear waste (HLW), so far without success due to the peculiar structure of the nuclear conflict in Spain, which relegates the role of science and technology to marginal positions in the debate. This process, initiated in 2004 by national politics but as yet unfinished, illustrates the challenges that inclusive nuclear waste governance entails in a country with a multi-level governance system, characterised by a complex and intertwined political decision-making process, where the nuclear issue is used instrumentally by political parties (for electoral purposes), and in a social context with highly sceptical public opinion towards nuclear energy.

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The Spanish institutional context leaves little room for fact-based argumentation based on experience. In this way, instead of opening up the nuclear issue to a broad public debate, counter-expertise has tended to be excluded from formal debates, finding its leading role in social conflicts outside institutional frameworks. Factors leading to public acceptance of radioactive waste repositories go beyond the competence and capabilities of Spanish institutions, since none of them is in a position to prevail in the political game and prevent the partisan use of the nuclear waste issue, which means that, no matter how much technical data they can offer, this will never be enough to win the public's trust. As we will see in this chapter, without substantial structural changes in the Spanish political and institutional system, the conflicts surrounding nuclear waste management will continue for a long time.

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## 6.2 The Spanish Nuclear Program in Context

Despite being a relatively poor country under a dictatorship regime, Spain belonged in the mid-1950s to the group of pioneering nuclear countries, connecting its first nuclear reactor to the grid by 1968. This happened due to the full support of the government, the commitment of the private utilities which controlled the oligopolistic electricity market, and the transfer of technology and funds, mostly from the United States but also from France and Germany (Rubio-Varas et al., 2018). The geopolitical position of the Spanish dictatorship (Francoism) during the first part of the Cold-War period (1947–1962) favoured its integration into the Western-capitalistic bloc, allowing international recognition of the regime and access to US commercial funds and technology in exchange for American military sites in Spain, among other diplomatic commitments.

An ambitious nuclear programme, set up in the 1960s and 1970s, foresaw the construction of almost 40 nuclear reactors. By the mid-1970s, the government pre-authorised the installation of over 15,000 MWe. Yet, a combination of economic, political and social factors led to the contraction of the Spanish nuclear program to only 10 reactors connected to the grid by 1988, with just over 7,500 Mwe; at that time around 35% of national electricity consumption. The 7 reactors still in operation in 2022 provide about 20% of Spanish electricity.

The early nuclear projects faced barely any opposition. Yet competing uses of territory and resources (tourism along the coast, and agricultural water needs inland) brought critical voices and administrative complaints through the late 1960s and 1970s (Lemkow, 1984; Rubio-Varas et al., 2018). The dictatorship regime forbade civil activism, but informal and unstructured social antinuclear

groups arose from the mid-1970s, led by a handful of people, mainly to defend local livelihoods such as tourism and agriculture (Costa Morata, 2001).

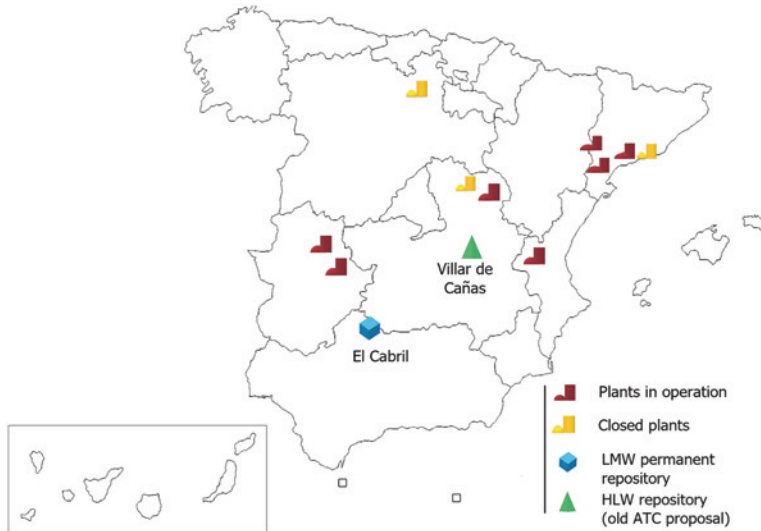
The oil crises in the 1970s contracted the economy and the expected electricity demand, increasing the financial burden of nuclear projects and making them unsustainable for the private utilities. So, beyond the social critical voices at the local and regional level, the national and international economic and political cycle played a crucial role in slowing and eventually paralysing the expansion of the Spanish nuclear program. The economic crisis was paired with the uncertainties of the transition to democracy (1977–1982), and the nuclear program was drastically reduced in 1979 by the first elected parliament in 40 years.

In this context, democratic Spain emerged as one of the societies most opposed to nuclear power in Europe, with a latent public opposition acknowledged by all actors (Espluga et al., 2017; Rubio-Varas et al., 2018). Nuclear development was targeted for a long time as a dictatorship project, so the popular struggle against nuclear energy (expanding throughout the Western world since the Three Mile Island incident in the US in 1979) was equated with the struggle against Francoism. All the left-wing opposition political parties relied on the antinuclear flag (despite the fact that some of them had been earlier supporters of nuclear energy). This sociopolitical dynamic influenced the public image of nuclear energy in Spain for decades, and is still shaping some of the contemporary responses to radioactive waste management.

In 1984, the Spanish government, then ruled by the socialist party (PSOE), approved a moratorium for the nuclear programme, for which the private utilities obtained large compensation. After the abandonment of the programme, the nuclear industry opted to keep a low public profile, focusing its efforts on taking advantage of the accumulated technical expertise and human capital, becoming a strong international player in engineering services and components. The moratorium generated some local and national debate during the 1980s, yet waste management and the reactor lifetime extensions remained the only truly contentious issues in recent times.

Much of these debates have been related to the search for a location for a centralised repository (Almacén Temporal Centralizado; ATC), an unfinished process that has been greatly influenced by deep-rooted institutional mistrust, in a country with a complex multi-level governance system that favours permanent tensions between central and regional governments, whose political parties tend to leverage comparative grievances in the distribution of risks and benefits between regions or territories, often for instrumental purposes.

Although it has been possible to establish a permanent site for low- and medium-level nuclear waste (LILW), it has not been possible so far to do the



**Fig. 6.1** Spanish nuclear power plants and waste repositories sites. (Source: authors)

same for HLW. An ambitious plan to build a centralised temporary warehouse, which could house all this type of waste, started almost two decades ago, and has been the subject of numerous vicissitudes and social and political conflicts, so that it remains a pending and difficult issue to solve (Fig. 6.1).

### 6.3 Evolution of Radioactive Waste Management in Spain

The generation of radioactive waste in Spain began in the 1950s as a result of early research into the use of radioactive isotopes in medicine, industry and agriculture, as well as in particular research centres. Since 1968, nuclear power plants (NPPs) have become the main source of radioactive waste production, due both to normal operation and the dismantling of some NPPs. Spain currently has 7 reactors in operation, in 5 locations. In addition, there are 3 shut down reactors, which are in different administrative situations (figure 6.1). The Vandellós I NPP, which ceased operation in October 1989 after a serious incident, is currently in a dormant phase after partial decommissioning, pending total decommissioning. The José Cabrera NPP (a.k.a. Zorita) ended operation in April 2006, and is currently

in the total decommissioning phase. The Santa María de Garoña NPP, which has been shut down since December 2012, ceased operation in August 2017, pending decommissioning.

Other radioactive waste-generating facilities in Spain include a fuel assembly factory, research centres, universities, hospitals, industries, etc. The uranium oxide fuel assembly factory for light-water reactors (LWRs)—like pressurised water reactors (PWRs), their Russian counterpart Vodo-Vodjanoi Energetitsjeski Reactor (VVERs), and boiling water reactors (BWRs)—located in Juzbado, Salamanca province, started operation in 1985, with an annual production capacity of about 500 tons of enriched uranium (by 5%) (MITERD, 2020, p. 19). In addition, the public National Radioactive Waste Company, (Empresa Nacional de Residuos Radioactivos; ENRESA), has signed collection contracts with 934 Spanish companies and facilities, and also manages waste from conventional companies, mainly from the steel industry and metal recovery (MITERD, 2020, p. 19).

It is also necessary to manage spent nuclear fuel (SNF) produced by all Spanish NPPs, both those in operation and those in shutdown, with the exception of the SNF produced at the Vandellós I NPP, which was sent to La Hague (France) to be reprocessed and should have been returned to Spain years ago.

In Spain, LILW has had a consolidated and efficient management system for years. But that is not the case with regard to HLW, the management of which is still a pending issue, and likely to be troublesome in the future, as is also the case in most countries with nuclear installations (Di Nucci et al. 2018).

### **6.3.1 Low- and Intermediate-Level Radioactive Waste: Learning on the Job**

The management of LILW in Spain is based on an integral and consolidated system with a centralised permanent repository in El Cabril, a former uranium mine located in the municipality of Hornachuelos, in the Province of Córdoba. El Cabril dates back to 1935 when uranium ore was discovered, intensively exploited from the 1940s until its closure in 1959, and had informally operated as a repository since the 1960s. From 1961, the Nuclear Energy Board (JEN) started to use the former uranium mine for storing low-level radioactive waste (LLW). Storage was first regulated by the Nuclear Energy Law of 1964. In October 1975, El Cabril was formally licensed as a deposit for radioactive waste, with more than 3000 drums already stored (Rubio-Varas et al., 2018), and it was at this time,

when the existence of the deposit became public, that the first social protests took place.

In the 1990s, the waste stored at El Cabril was moved from the mine into new buildings, becoming a near-surface disposal facility with engineering barriers, taking the French Centre de L'Aube as reference. Designed by INITEC Nuclear (Westinghouse Electric Spain), preparatory work started in 1986, construction in January 1990, and authorisation for start-up was granted in October 1992. ENRESA, the public company in charge of radioactive waste management, has operated El Cabril since then, when it began to receive LILW. El Cabril is considered by the United States Nuclear Regulatory Commission (NRC) as a good model for other countries (ENRESA, 2017).

As of 2018, it is calculated that more than three quarters of the low-, very low- and medium-level waste generated in Spain are permanently deposited in El Cabril (69% of the 22,457 m<sup>3</sup> of radioactive waste of very low activity, and 83% of the 40,300 m<sup>3</sup> of LILW) (MITERD, 2020, pp. 20–21).

Six decades of operation of the El Cabril repository has entailed different phases and types of management, from initial secrecy, through timid attempts at transparency in the 1990s, to the recent implementation of deliberative actions with local society. In this sense, the management of LILW has been an interesting learning field for all the involved institutions (also for civil society and social movements). The sparse available evidence on public perception indicates that, at first, in a context of lack of information and, consequently, distrust towards ENRESA, the facility was perceived as being imposed on local residents. The media echoed this distrust, emphasising the fear of the unknown. The Anti Cabril movement, supported by environmentalists, politicians and trades unions, argued that the facility has hindered the development of the region. This opposition included anti-ENRESA demonstrations outside the main entrance of El Cabril (years 1987–1989).

During the licensing process of El Cabril in the late 1980s and early 1990s, the legislation in force requested an environmental impact assessment to evaluate the suitability of the site. That assessment was carried out in the context of the construction authorisation of an existing facility which was expanded. A number of local institutions were involved in this communication process, although the Town Council played the main role. One of the first actions was the opening of an information bureau to explain the details of the disposal facility, and its socio-economic impacts (such as job-related opportunities, and requirements for workers and contractors). In this way, ENRESA, in collaboration with the local authorities, provided training to the local population and gave priority to local companies in any service contract (Molina, 1996).

From 1989, ENRESA commissioned several studies to track public perceptions of the facility and its economic and social impacts in the area (in 2009, 2010 and 2014). In addition, the Chair on Sustainability created at Cordoba University in 1996, has been active in promoting deliberative workshops in the area of influence of El Cabril (Local Encounters for Sustainable Development; ELDS). Thus, stakeholders who believed they could contribute to the sustainable development of their villages were invited to present opinions and proposals and discuss them with local institutions, including ENRESA.

In terms of economic compensation, measures to provide financial allocations to the municipalities have been in force since 1988. Such financial allocations were taken from the Fund to perform the activities of the General Radioactive Waste Plan (Plan General de Residuos Radioactivos; PGRR), managed by ENRESA. Besides Hornachuelos (the municipality hosting El Cabril), the Spanish legislation provides financial allocations to villages located up to 8 km from the facility. Studies on the economic impact of El Cabril indicate a positive effect. This indicator is manifested in the index of job creation and the impact on the remuneration of the work of residents in the local municipalities, as well as the direct allocations linked to the operating company ENRESA (Rubio-Varas et al., 2018).

Key findings from the local participatory workshops show that the original local rejection was mainly based on the perceived negative socio-economic impact in nearby villages, which felt they were not sufficiently compensated. Notably, dissatisfaction was not limited to El Cabril, with other local matters also perceived to be restricting the sustainable development of the area (public policies on natural environment or rural development). The environmental mediation led by the local university allowed the integration of ENRESA's representatives in local debates for the first time. This change in the institutional image of ENRESA fostered the creation of the 'Group for active social dialogue towards local sustainable development'. Tensions were reduced, and smooth interactions were promoted between ENRESA and local residents. Finally, following suggestions by the ELDS-mediators, any change in El Cabril activities that may provoke social destabilisation or damage the fruitful relationship between ENRESA and the local communities would require special communication and engagement actions at the local level. In fact, although with a low profile, new and limited social opposition appeared when the economic funds transferred to the municipalities in the area were reduced from 2014 onwards.

Recent debates on lengthening the operating time for Spanish NPPs has put local social movements on the defensive, as they fear the repository will receive more waste than planned. This fear is coupled with concern that the Spanish gov-

ernment is unable to find a place to store HLW, and that HLW will also be deposited in El Cabril in the long term. This, together with the reduction of economic funds for nearby municipalities, has reactivated local opposition to El Cabril in recent times (since 2014), although the social climate is still calm and the facility can operate normally (Table 6.1).

**Table 6.1** Decision-making process around low- and intermediate-level radioactive waste management in Spain

Time	Event
1951	Establishment of the Spanish Nuclear Energy Board (Junta de Energía Nuclear, JEN)
1961	The Nuclear Energy Board (JEN) started to use the former uranium mine in El Cabril (Córdoba) for storing low-level radioactive waste. No regulation at that time
1964	Nuclear Energy Law, first attempt to regulate nuclear waste storage
1975	El Cabril was formally licensed as a deposit for radioactive waste (ending the period of illegality). Start of early social protest
1978	New democratic system in Spain led to the adoption of international standards on nuclear management. Increasing social protests against El Cabril
1980	Establishment of National Safety Council (CSN), independent regulatory body
1984	(scientific body) and the Sociedad Estatal de Participaciones Industriales (SEPI) (a conglomerate of public companies that depend on the government)
1986	Establishment of the Center for Energy, Environment and Technical Research (CIEMAT), the scientific body ENRESA takes over the El Cabril facilities
1988	Start of economic compensation for the surrounding municipalities
1992	Start of operation of the new near surface disposal site (inspired by the French Centre of l'Aube) Start of a new phase of social protest mobilisations (lasting several years)
1996	Setting of El Cabril Information Center
2004–2012	Deliberative workshops with local society (led by the ENRESA Chair of the University of Córdoba)
2008	Facilities expanded with complementary modules
2016	Facilities expanded again with more complementary modules



### 6.3.2 High-Level Radioactive Waste: The Great Unfinished Business

The situation for HLW is quite different. After decades without planning or taking any action, the 6th Spanish Plan for the Management of Radioactive Waste (released in 2006) considered the centralised temporary waste store (ATC) as a suitable transitional strategy for the management of HLW and SNF (MITC, 2006). It was argued that the ATC option was economically, strategically and technically better than the Individualised Temporary Stores at the NPPs, as it provides more time to adopt ‘final solutions’ and reduces the number of nuclear installations.

The decision to build the ATC seems to be initially related to the Spanish Government’s obligation to prepare the return of radioactive waste reprocessed in France (with a contract expired in 2011) (Costa Morata & Baños, 2010), originated by the dismantling of the Vandellós I NPP (13 m<sup>3</sup> of vitrified HLW). Thus, the Spanish Parliament approved in December 2004 a resolution urging the government to solve this pressing problem by installing an ATC. It was assumed that the ATC would provide the system with a framework of sufficient reliability and flexibility during the time necessary for the development of the definitive management program (MITERD, 2020, pp. 23–24). To this end, the government created an Inter-ministerial Commission (IC) and a Dialogue Table to determine the most suitable location; a complex process illustrative of the sociopolitical conditioning factors of nuclear management in Spain, which is analysed (Sect. 6.3) from a governance-ecosystem perspective (Kool et al., 2017).

Meanwhile, SNF has been temporarily deposited in the storage pools of NPPs and in individual dry warehouses (Temporary Individual Warehouses; ATI) located in the NPPs. Despite the absence of a more definitive location, the government always warned that these ATIs were only complementary to ATC, not substitutes. However, in November 2022, the Spanish Ministry of Ecological Transition published an amended version of the 7th General Plan for Radioactive Waste draft. In this new version, the centralized temporary warehouse (ATC) project seems to be definitively rejected, and replaced by seven decentralized temporary repositories (ATD), one for each nuclear plants site. These decentralized temporary warehouses will include, in an expanded form, the current individual temporary warehouses (ATI) of the respective nuclear plants. The 7th General Plan for Radioactive Waste is (February 2023) still pending approval by the Spanish Parliament, so it is not definitive yet, although it seems reasonable to think that it will remain as it is now.

On December 31, 2018, the total volume of nuclear fuel elements in the NPP pools or the ATIs was approximately 7300 m<sup>3</sup>. Forecasts indicate that the 7 reactors in operation will produce an additional 3100 m<sup>3</sup> of HLW. Altogether, it is expected that those with high activity will account for 4% of the total volume of radioactive waste in Spain (MITERD, 2020, p. 29).

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## 6.4 The Actors

Following the scheme proposed by Kool et al. (2017, p. 95), in this section we describe the main actors corresponding to the four social domains of the governance-ecosystem: politics & administration, laws and regulations, science & technology, and civil society. Later, we address the complex interactions between these actors and domains around the ATC development, which have led to the current situation of political stalemate.

### 6.4.1 Politics and Administration

The political and administrative actors involved in the management of radioactive waste in Spain have evolved over time. In a first phase, during the Francoist dictatorship, everything related to nuclear energy was managed by a single institution of a military nature, the Spanish Nuclear Energy Board (Junta de Energía Nuclear, JEN), formally created in 1951. With the transition to a democratic regime, with the Spanish Constitution of 1978 and after the dissolution of the JEN, several key institutions were created to adapt the sector to international standards, which are those in force today.

In 1980, the Nuclear Safety Council (Consejo de Seguridad Nuclear; CSN) was set up as the regulator of the Spanish nuclear sector. It is a public body, independent from the General State Administration, with legal personality and its own assets, and is not accountable to the government, but to the Spanish Parliament. The mission of the CSN is to protect workers, the population and the environment from the harmful effects of ionising radiation, ensuring that nuclear and radioactive facilities are operated safely by licensees, and establishing prevention and correction measures against radiological emergencies. It has the power to propose regulations on nuclear safety and radiological protection to the government, and to adapt the national legislation to international requirements. The CSN can also dictate mandatory regulations, which may determine the immediate cessation of the activity of nuclear facilities. The Plenary board of the CSN is made up of a

president and four councillors, normally well-known experts, who are elected for six years after consultation with the Industry Commission of the Spanish Parliament. This institutional design favours substantial changes in its composition, depending on the ruling parties at each legislative stage.

At present, the Ministry for the Ecological Transition and the Demographic Challenge (MITERD, formerly the Ministry of Industry) is in charge of the radioactive waste management policy of the Spanish Government, with particular prominence by the Secretary of State for Energy, and the Secretary of State for the Environment.

The other two basic institutions in the field of radioactive waste management are ENRESA, established in 1984, and the Center for Energy, Environmental and Technological Research (CIEMAT), created in 1986 as a public body dedicated to R&D on energy and its environmental impacts. These institutions, due to their design, function in a coordinated manner, the first being a management body and the second a research body.

ENRESA was established to provide services and special facilities for storage, transportation, disposal and handling of radioactive waste. It was set up as a state-owned limited liability company, independent of waste producers, and is supervised by the government. It also deals with decommissioning disused nuclear and radioactive facilities and the environmental restoration of uranium mines. ENRESA's shareholders are CIEMAT and the Sociedad Estatal de Participaciones Industriales (SEPI) (a conglomerate of public companies that depend on the government). ENRESA is obliged to periodically inform the Spanish Parliament on its activities and projects, to express its legislative needs, and to report on technological innovations that arise in its field of action. ENRESA is funded by the contribution of companies that generate radioactive waste and, ultimately, by citizens through the electricity bill.

## 6.4.2 Science and Technology

The main scientific institution in Spain producing knowledge about radioactive waste management is CIEMAT, although ENRESA has a wide scientific competence and devotes important resources to R&D activities too. It is important to keep in mind that the activities of these two entities are strongly interrelated.

Both CIEMAT and ENRESA, in collaboration with various research groups (mainly from the Polytechnic Universities of Madrid, Barcelona, Valencia, among others), have developed an important scientific-technical program around nuclear energy, including waste. For example, since 1987 numerous studies have been

carried out on the geology of Spanish territory and its different types of lithologies (in particular granite, clay and salt), to propose designs for deep geological storages, and evaluate the behaviour of the land in the very long-term (MITERD, 2020), which has allowed the establishment of potential territorial areas to host a future deep geological repository.

These scientific groups have also participated in the dismantling of uranium ore treatment facilities (such as the old uranium factory in Andújar/Jaén, or La Haba/Badajoz and Saelices el Chico/Salamanca), as well as the restoration of mining operations, the deferred partial dismantling of the Vandellós I nuclear NPP, the closure of two research reactors (Argos, in Barcelona, and Arbi, in Bilbao), or the dismantling of research facilities of CIEMAT itself (PIMIC plan). Since 2010, they have been involved in the dismantling of the José Cabrera NPP.

Two research areas in CIEMAT explicitly address the issue of nuclear waste. The Scientific Area of Ionising Radiations carries out Research and Development plus Innovation (R&D+i) programmes and technical services related to radiological protection of the public and the environment. Their expertise is on methodologies for the recovery and rehabilitation of contaminated land, and on processes that affect the migration/retention of radionuclides in the natural environment or in radioactive waste storage barriers. The CIEMAT Nuclear Fission Area provides scientific and technical support to the management of radioactive waste, through activities such as its radiological and physicochemical characterisation, or the analysis and evaluation of the stability and separation of high-activity waste from nuclear irradiated materials.

As far as radiological characterisation is concerned, non-destructive methods for determining the activity in medium-to-low activity waste containers are being developed and applied at CIEMAT itself (as support to other divisions and decommissioning), at ENRESA-El Cabril Storage Centre, and at Spanish NPPs. Destructive characterisation methods have also been developed, and sample and chemical separation procedures are being applied to over 20 low and/or medium-energy alpha, pure beta and gamma radionuclide emitters, in addition to spectrometric procedures for high-energy.

In the field of HLW, CIEMAT carries out research on the stability of high-activity waste (irradiated nuclear fuels) under storage conditions (temporary or final), and studies radionuclide separation. Thus, CIEMAT provides scientific and technological support to the main Spanish nuclear entities, mainly NPPs and ENRESA.

ENRESA also dedicates part of its activities to scientific-technical research. ENRESA's 8th Research and Development Plan (2019–2023) is divided into four

technical work areas and a fifth horizontal one: i) activities related to the physical and chemical properties of the components of radioactive waste, as well as their temporal evolution and the influence of their irradiation history; ii) actions related to the conditioning of radioactive waste before its deposit, to reduce its volume and radiotoxicity, or those other actions applicable to the dismantling of nuclear or radioactive facilities; iii) materials and containment systems, with the aim of acquiring and expanding knowledge and technologies related to the materials used in storage facilities as barriers between the waste and the biosphere, such as cement, clays, metals, etc., considered both individually and collectively; and iv) radiation protection and safety studies, such as improvement of the numerical models used in evaluations of the safety of storage facilities in the short-, medium- and long-term. Additionally, ENRESA has developed activities of support, coordination and knowledge management, in order to integrate existing research results and transfer them to potential recipients (scientific-technological dissemination).

ENRESA currently has the Mestral Technological Center, dealing with the dismantling and decommissioning project for the Vandellós I NPP in Tarragona, whose lines of research are related to the exchange of experiences in the dismantling of nuclear facilities. In the future, ENRESA plans to start up another Technology Center associated with the hypothetical ATC, with the aim of developing the R&D projects necessary for the correct management of SNF. This is one of the main assets argued to convince potential host municipalities that the ATC will mean the creation of quality jobs in the area.

Given the “long periods of management, development, operation and surveillance” (MITERD, 2020, p. 85) inherent to the management of radioactive waste, ENRESA expresses serious concern about the management of the knowledge generated through the different R&D programs. A design of institutional mechanisms to ensure knowledge transfer to new generations of technicians (from ENRESA itself) has already been suggested.

In addition, both ENRESA and CIEMAT participate in initiatives and projects of international organisations such as NEA/OECD and IAEA, and other national and European R&D forums related to the generation of knowledge on radioactive waste management. In addition, both institutions actively participate in the Spanish R&D platforms CEIDEN (Fission Nuclear Energy Technology Platform), PEPRI (National R&D Platform in Radiological Protection), and in the European IGD-TP (European Platform for geological storage), SNE-TP (European Platform for Sustainable Fission Energy), as well as other European R&D platforms in radiation protection.

### 6.4.3 Laws and Regulations

The legislative domain plays an important role in the long-term governance of nuclear waste management. Directives of the Council of the European Union (Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste; and Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations) impose a series of obligations for the establishment of a national nuclear safety framework applied to nuclear installations.

In Spain, the Law 25/1964, of April 29, on nuclear energy (LEN), contains the requirements and basic principles for the management of radioactive waste, providing that the management of radioactive waste and SNF, and the dismantling and closure of nuclear facilities, constitute an essential public service that is reserved to the ownership of the State, as stated in the Spanish Constitution of 1978 (Article 128.2). ENRESA is entrusted with the management of such public service, its activities and financing system, as set out in Royal Decree 102/2014, of February 21, for the responsible and safe management of spent fuel and radioactive waste. The financing system of this public service consists of a system of four rates, due to the producers of radioactive waste. Law 24/2005 of November 18, of reforms to boost productivity, regulates the fees for the provision of its services, the collection of which will be used to provide the Fund for the financing of the activities of the General Radioactive Waste Plan (PGRR).

The government is responsible for approving the regulatory developments of the laws approved by Parliament, and MITERD is currently the ministerial department in charge of processing regulatory proposals in the field of nuclear energy. When the proposals refer to matters that may affect nuclear safety or radiological protection, the initiative corresponds to the CSN, which transmits the proposals to MITERD for processing.

The PGRR collects the strategies and activities to be carried out in Spain in relation to radioactive waste, the dismantling of facilities and its economic-financial study. It is approved by the government and is periodically reviewed and updated. Since ENRESA was created in 1984, there have been six PGRRs, which have set the lines of action and objectives for a comprehensive waste management system that the company has been developing and implementing. The 6th PGRR, currently in force and approved in 2006, was the first to undergo a public information and consultation process with the Autonomous Communities (regional governments). This illustrates the changes in the radioactive waste management practices in Spain over time. This PGRR established the need for an ATC for the management of SNF and HLW generated in Spain.

In more detail, the 6th PGRR (MITC, 2006) contemplates the following strategies:

- Maintaining LILW management, in particular to the definitive storage in El Cabril.
- Maintaining the unified temporary management strategy for spent fuel, HLW and special waste in a single facility, the most important milestone being the start-up of the ATC.
- Providing additional radioactive waste storage capacity in those NPPs requiring it (either in operation or decommissioning), while the ATC is not built.
- Developing technological and social acceptance capabilities to guide and implement the future definitive storage solution for high-activity radioactive waste and SNF in a Deep Geological Warehouse (AGP, by Almacenamiento Geológico Profundo, in Spanish).
- Maintenance of the dismantling and closure strategy of nuclear facilities until the release of their sites in the shortest possible time, in accordance with the criteria of minimising doses and protecting human health and the environment.

The recent draft of the 7th Radioactive Waste Management Plan (still preliminary and pending approval) establishes that most of these strategic approaches will continue to be valid in the future and, consequently, will remain as the foundation of the new PGRR, varying its timeframe (MITERD, 2020). However, in November 2022, the MITERD approved a new updated versión of the 7th PGRR draft, with the great novelty that the centralized temporary storage (ATC) is left aside, and instead it is proposed to create seven decentralized temporary repositories, one at each nuclear site. It is a temporary strategy with the purpose of finding a deep geological storage for the year 2073.

#### 6.4.4 Civil Society

Spanish public opinion tends to be largely anti-nuclear. The scant longitudinal evidence at the country level (based on data from Eurobarometer and the Spanish Sociological Research Center, ranging from the early 1990s to the present) shows that the majority of Spaniards (around 2/3) tend to be against nuclear energy (Espluga et al., 2017). Data from the last Eurobarometer on public attitudes towards nuclear (Eurobarometer, 2010) shows 73% of Spaniards consider that NPPs represent a risk rather than a benefit. Spain shows the highest percentage, together with Greece and France, which all score above the 52% average for Europe.

After the turbulent decades of the 1970s and 1980s, with numerous anti-nuclear mobilisations during the transition to democracy, from the 1990s the social pressure decreased considerably. In recent years, the most intense popular mobilisations in this field have been directed against the ATC site. The announcement of the participatory procedure for the location of the ATC in 2006 (see below) triggered numerous local social movements, either for or against, depending on the interests they claimed to defend. At the same time, the main environmental organisations, such as Greenpeace, Ecologistas en Acción, or Amigos de la Tierra (local branch of Friends of the Earth), actively re-engaged in the social conflicts related to nuclear energy, which originally gave them prominence in the 1980s and allowed their expansion and consolidation as large and influential environmental social movements. These processes will be further developed in the following sections.

Another key actor representing civil society is the Association of Municipalities Affected by Nuclear Power Plants (AMAC). Formed in 1990, it brings together a series of municipalities geographically close to the Spanish NPPs, to demand greater safety measures and guarantees of future economic diversification. Although AMAC has become a key actor in the Spanish nuclear sector, some authors consider it is not a classic environmental social movement, as it tends to instrumentalise a process based on “(1) arguing fear and unsafety, (2) asking for money and investments and, after obtaining it, (3) prolong this spiral strategy, exploiting the circumstances to the maximum and always bartering, ultimately, material compensation in exchange for their conformity with regard to nuclear safety. In short, it thus becomes an invaluable aid to the nuclear sector; companies, Government and, singularly, ENRESA” (Costa Morata & Baños, 2010, pp. 153–154). However, AMAC claims that a large part of its activity focuses on generating alternative economic paths, and that it has established fruitful and sustainable economic development programmes in all nuclear areas. AMAC provides consultancy and coordination services to facilitate access opportunities that may arise, for example, in the current context of the energy transition. AMAC has been a pioneer of exchanges between nuclear municipalities in different European countries, and as such was a leading promoter of a network of European nuclear municipalities known as GMF (Group of European Municipalities with Nuclear Facilities). In any case, AMAC has become a powerful actor without whom it is very difficult to legitimise decisions on nuclear issues, especially in relation to the management of radioactive waste.



## 6.5 High-Level Nuclear Waste Management: The Vicissitudes of the ATC

The 2006 6th PGRR, drawn up by ENRESA, gave priority to the ATC. Notably, a major requirement was that the decision-making process should comply with the principles of voluntarism, transparency and openness; something really new in the nuclear management approach in Spain. This is a substantial milestone, when issues like transparency, trust, and reliable information and communication—including new forms of engagement and participation—became essential elements for the new institutions in their communication strategies and missions for interacting with society. Lessons learnt at El Cabril repository could probably contribute to inspire this new approach.

In this context, a relevant antecedent was the creation of the Dialogue Board for the evolution of nuclear energy in Spain (“Mesa sobre energía nuclear”) in 2005. The Dialogue Board was chaired by the General Secretary of Energy and included representatives from all political parties in Congress and Senate, public bodies in charge of nuclear, environmental and industrial matters, trade unions, municipalities, consumers and environmental groups. The Dialogue Board concluded that the ATC was a need for the country, with only the environmental groups disagreeing. It should be noted that as long as there are NPPs in operation in the country, the Spanish environmental groups refuse to participate in any negotiation on waste management policy. Their precondition is first to have agreed to the closure of the Spanish nuclear program (Costa Morata & Baños, 2010).

Another milestone was the launch of the Community Waste Management (COWAM) Spain initiative (2004–2006) with the involvement of AMAC, the CSN and ENRESA. Based on the COWAM experiences at the EU (and its methodology to search suitable candidate sites), AMAC announced its commitment to support the government in the ATC siting process, and organised a number of information meetings, seminars and debates in the nuclear areas (Vila d’Abadal, 2006).

Taking into account these institutional, political and social contexts, we now look at the evolution of the process, where the interactions between the four social domains of the governance-ecosystem (Kool et al., 2017) become highly visible.

### 6.5.1 Phase 1: The Preparation

The need for an ATC was fully debated in, and supported by parliament on at least three occasions between 2004 and 2006. Thus, in April 2006, an Inter-ministerial Commission (IC) for the ATC was set up by the government to look at the transparency and openness of the decision-making process around the siting of the ATC (RD 775/2006). With the support of a Technical Advisory Committee, the IC defined the basic criteria for the ATC and facilitated all the necessary information to municipalities and entities potentially interested in hosting the ATC. This preparation phase took place with a ruling socialist government (PSOE).

In December 2009, a public call was launched which gave any interested municipality a month to apply as candidate to host the ATC. The call defined the basis and the procedure of the decision process, specifying that the Spanish Government would designate the ATC site once the process ended. The IC deployed a series of informative and support actions to help potentially interested municipalities. All documents produced by the IC during the selection process were uploaded to the web ([www.emplazamientoatc.es](http://www.emplazamientoatc.es)). In February 2010, the IC reported on the selection process and presented the final list of selected candidate sites. It should be noted that most candidate municipalities were rural, isolated, underdeveloped areas, and/or already nuclear areas.

A month later, a Public Information and Participation (PIP) procedure was opened so that any interested party could present arguments and request clarifications on the decision-making process. In addition, individual notifications on the PIP procedure were sent to municipalities, councils, Autonomous Communities (regional governments), the Spanish Federation of Municipalities and Provinces, associations and organisations.

Finally, and taking into account the considerations (if any) by the Autonomous Communities, in September 2010, the IC published a report with the proposed candidate sites. A total of 8 municipalities from 5 Autonomous Communities were finally accepted. The accepted sites were then evaluated against the pre-defined quantitative and qualitative criteria that had been favourably valued by the CSN. The IC concluded that although all sites were technically viable, Zarra, Ascó, Yebra and Villar de Cañas (in this order) were the most suitable, with little technical differences among them.

### 6.5.2 Phase 2: The Decision

Although the most feasible candidates seemed to be Yebra and Ascó (Ansele, 2010) due to their geographical position, communications, proximity to existing

nuclear facilities, and a population accustomed to living with them, both cases ran into political opposition that made their candidacy difficult. The Catalan village of Ascó, which was probably the main candidate because it had 2 reactors in operation and a railway line, collided with the refusal of the autonomous Catalan government, then in the hands of the socialist party (PSC, the Catalan branch of PSOE), with a President (José Montilla) who a few years before had been the Minister of Industry who launched the ATC project (which gives an idea of the interference of the political system in the matter).

On December 30th 2011, the Spanish Government (ruled by PP, the right-wing Popular Party since December 20th) designated Villar de Cañas, a very small rural municipality in the province of Cuenca, far from nuclear facilities and without rail communication, as the site to host the ATC. It should be noted that the regional government (of Castilla-La Mancha Autonomous Community) was also in the hands of the Popular Party (PP), since May 2011.

ENRESA started the licensing process by sending the corresponding formal request to the Ministry of Industry, Energy and Tourism (currently MITERD). The process took over 4 years. In July 2015, the CSN issued the favourable siting license report and established the limits and conditions to be met in terms of nuclear safety and radiological protection. By law, all the information related to the nuclear-related ATC licensing process was made available at the CSN website ([www.csn.es/almacen-temporal-centralizado](http://www.csn.es/almacen-temporal-centralizado)).

The Plenary Session of Villar de Cañas City Council unanimously agreed to present its candidacy to host the ATC. The first and main argument was the need to stop the increasing depopulation in the area. But as in other candidate sites, platforms and movements emerged at the local level to both support and reject the ATC candidacy. On the one hand we find the 'Platform Yes we want the ATC in Villar de Cañas' and the Association of Companies of Villar de Cañas; on the other, the 'Platform against the nuclear repository in Cuenca'.

The pro-ATC collective claims that the facility is the best solution for the huge depopulation problem in Villar de Cañas. They argue that ATC will transform the area in an internationally recognised research, development and innovation reference in the search for solutions to radioactive waste management. The Yes Platform became very active throughout the decision-making process, collecting signatures and presenting their arguments.

The 'Platform against the nuclear repository in Cuenca' rejects the ATC, not only for Villar de Cañas but for any other municipality in the region (Castilla—La Mancha), and commits to mobilising citizens to avoid it. It was formed by 49 organisations, including public and private bodies. A key argument in their manifesto relates to the decision-making process. They argue that in a complex, long-term, and global issue (such as radioactive waste management), the final

responsibility cannot be assigned to local entities. They support a new energy model based on renewables, sustainable tourism, and high-quality foodstuffs; a model that enhances local values and resources (historical, archaeological, natural, etc.). They claim to represent the opinion of a majority of Cuenca's society. The anti-platform was also very active throughout the process, organising protests, demonstrations, and deliberative workshops at the local and regional level.

At the wider level, Spanish environmental groups are opposed to any type of radioactive waste policy, as long as NPPs are in operation. Two of the main environmental NGOs (Greenpeace Spain and Ecologistas en Acción) were also actively engaged in the ATC decision-making process. For instance, Ecologistas en Acción presented a request for a negative Environmental Impact Assessment for the ATC at the Government Delegation in Cuenca. Their request was mainly grounded on the need to preserve the Natura 2000 network, and on the lack of appropriate geological or accident risk assessments. In 2015, Greenpeace asked the government to recognise that the ATC is not a viable option, and to definitively cancel the project. They argued for a dialogue process to find a solution for radioactive waste, involving the whole society, which should start with an agenda to close the NPPs. Greenpeace also published a document highlighting the ATC transport risks: radioactive waste will pass through 216 municipalities in the way from the NPPs to the ATC. Lastly, and in line with the Anti Platform at Villar de Cañas, a relevant argument in the environmentalist narrative is that radioactive waste management is a global, transboundary, issue which cannot be just "confined to a limited piece of land" (Costa Morata and Baños, 2010, p. 151). In their view, as for other techno-environmental problems, social legitimacy does not necessarily come together with the municipal-administrative one.

### **6.5.3 Phase 3: The Stalemate**

A crucial element in the licensing process was a combination of the complex Spanish political system and the changing position of the affected Regional Government (Castilla-La Mancha). In February 2010, the Regional Parliament, ruled by the socialist party (PSOE), declared that no ATC (or any other nuclear facility) should be installed in any of the provinces or municipalities under their control, as they supported a sustainable development model based on renewables. In 2012, with the conservative Popular Party (PP) now ruling the region, the ATC was fully supported. Yet, in July 2015 the PSOE took over power in the region again, oust-

ing the conservative Popular Party, which rules at the national level, and the ATC was (once again) fully rejected at the regional level. The collision of interests between the national and the regional government was set. The regional government strategy focussed on expanding a Specially Protected Bird Area (ZEPA in Spanish) known as Laguna del Hito (from 1000 Ha to 25,000 Ha) to include ATC land.

ENRESA insisted on the arguments of job creation, economic investment, and a pioneering technological infrastructure. The Spanish Government, in turn, argued that stopping the work would cause economic losses, €51 million per year (and an increase in the electricity bill of 25–30%), and insisted that the decision had been made with an important social, territorial and institutional consensus.

However, the regional government (of Castilla-La Mancha) argued irregularities in the planning, warned about contradictory external reports on safety guarantees, highlighting the need to expand the ZEPA zone. The Official College of Geologists and experts from the CSN (Earth Sciences Area) also expressed their doubts about the viability of the site, warning of possible additional economic costs.

The pro-ATC platform reacted against the extension of the ZEPA area proposed by the Autonomous Community. Signatures were collected through the change.org platform, and citizens travelled to the province capital (Cuenca) to demonstrate against the uncertainty created by such a 'stand-by' situation, and its implications for the local economy. More than 1500 individual allegations were presented at Villar de Cañas municipality.

Nearby town councils expressed their concern about the expansion of the ZEPA, as it could cause losses to farmers and to the development of the ATC. The mayor of Alconchel de la Estrella (neighbouring municipality) affirmed that ENRESA offered them 12,000 euros per year until the ATC began to function. Meanwhile, Greenpeace and Ecologistas en Acción continued to argue their position against the ATC.

This decision by the regional government of Castilla La Mancha was challenged by the (central) State's Attorney, and the final statement by the Courts is still pending, but ENRESA finally revoked to continue with the process. After long negotiations between the national and regional governments, following multiple swings in political power constellations, the project was on hold for a long time, and ENRESA was looking into alternatives. Even in 2022, the project has been officially suspended, and a new PGRR is currently being drawn up that will try to find new solutions (Table 6.2).

**Table 6.2** Decision-making process around high-level radioactive waste management in Spain

Time	Event
2004	The Spanish Parliament urged the Government to solve the pressing problem of HLW by installing a Centralised Temporary Waste Repository (ATC)
2005	Creation of the Dialogue Board for the evolution of nuclear energy in Spain, which included representatives from all political parties in Congress and Senate, public bodies in charge of nuclear, environmental and industrial matters, trades unions, municipalities, consumers and environmental groups
2004–2006	Community Waste Management Initiative (COWAN, which was formed in 1990; part of European GMF: Group of European Municipalities with Nuclear Facilities), including Association of municipalities affected by NPPs (AMAC), CSN (Nuclear Safety Council), ENRESA
2006	6th Spanish Plan for the Management of Radioactive Waste (PGRR published by ENRESA). Announced the wish to develop a Centralised Temporary Waste Storage for HLW (ATC). The first plan to undergo a public information & consultation process
2009	A public call was launched to search for interested municipality candidates to host the ATC. Institutional participative process
2010	Inter-ministerial Commission and Dialogue Table publish the final list of selected candidate sites. 8 municipalities meet the criteria, from which 4 were the most suitable
2011	Choice for Villar de Cañas (province of Cuenca) City Council agreed. ‘Platform Yes we want the ATC in Villar de Cañas’ (solution for huge depopulation trend) versus ‘Platform against the nuclear repository in Cuenca’ (procedural argument: such a discussion should not be based on local decision; content: there is a need for a new energy and economic model)
2012	Regional government: Conservatives fully supported ATC
2015	Regional government: Socialist ruled and fully rejected the ATC. Expansion of a Specially Protected Bird Area (ZEPA) to make it impossible
2020	Draft of the 7th PGRR (still pending approval). Commitment to the ATC is maintained, suggesting restarting all the procedures to search for a suitable location
2022	HLW remain stored at the respective NPPs in the so-called ‘individualised temporary storage’ (Decentralised storage of HLW), waiting for the approval of the 7th PGRR (which will supposedly dismiss the ATC and promote decentralized storage).

## 6.6 Conclusion: Interactive Dynamics within the Country's Governance Ecosystem

Radioactive waste management shows the Spanish evolution from top-down, unidirectional, strategies applied in the earlier decades since the 1960s to more comprehensive, bidirectional and participative approaches for interacting with society since the end of the 1990s. In that sense, the management of the near surface disposal site of LILW at El Cabril from the early 1990s exemplified how continuous and direct contacts with local populations, incorporating some participatory methods, contributed to generate local trust-building processes, although resistance from local environmental groups remains active.

In turn, the decision-making process for siting the ATC for HLW, initiated in 2004 by national politics but yet unfinished (and probably discarded in the future management plan), illustrates the challenges that inclusive nuclear waste governance entails in a country with a multi-level governance system, characterised by a complex and intertwined political decision-making process, where the nuclear issue is used instrumentally by political parties (for electoral purposes), and in a social context with sceptical public opinion towards nuclear energy, inheritance of the social movements of transition from dictatorship to democracy during the 1970s.

Despite the willingness to define and implement an inclusive decision-making process (based on public information and participation procedures, and open and transparent principles), the final result of the process—the selection of Villar de Cañas—did not obtain the expected support, and the ATC remained politically blocked for long time. In the Spanish case, HLW management seems to be weaponised in national and regional political struggles, and the Spanish political party system seems willing to take advantage, for its own electoral benefit. This has made it difficult to decide on the location of the ATC: The central national government launched the process to decide on the location, and several municipalities presented their candidacy. One of these municipalities (Ascó) was located in the territory of the Autonomous Community of Catalonia, whose regional government (ruled by a political party other than the central one) decided to oppose it, arguing unfair imbalances between what the central government offers and takes, and blaming it for imposing its decisions over regional self-government. Meanwhile, general elections were celebrated and a new political party took over the central government, which decided to locate the ATC in a municipality in the Autonomous Community of Castilla-La Mancha, ruled then by the same party. When the procedure was already underway, regional elections occurred and the regional government fell in the hands of the political party which previously

launched the ATC process at national level, which was now totally opposed to the ATC being installed there, arguing unfair distribution of territorial risks and benefits. The paradox about the case is that all these political parties are, in principle, in favour of nuclear energy, but in practice they alternatively support or oppose it for reasons of electoral tactics.

In Spain, a deep mistrust of state institutions and instrumentalisation of nuclear issues for political purposes can be found (Espluga et al., 2018), which limits the space for fact-based argumentation based on expertise, which would correspond to what Ylönen et al. (2017) call “depoliticization” of nuclear issues. Depoliticization can be defined as the scientisation, technicisation, economisation and/or legalisation of issues, which are thus transferred from the public sphere to the “closed circles of experts and their organisations”. Through depoliticization, political actors express and seek to build trust in technical and matter-of-fact arguments. Politicisation, by contrast, would be a strategy designed to open up the issue at stake to a broad public debate, facilitating democratic deliberation on the various technical and non-technical issues (Ylönen et al., 2017). As stated by Lehtonen et al. (2021), in the Spanish case, mistrust of institutions has been spurred by the view that the state has granted undue privileges to the private utilities, and by the instrumental use of nuclear issues in battles between the central and regional governments, with politicians shifting their positions on nuclear according to political constellations. According to the available data on the Spanish case, instead of a “politicization of nuclear issues”, which would have led to opening the nuclear issue to a broad public debate, in Spain a “nuclearization of politics” has taken place, leaving limited room for counter-expertise, as nuclear-related arguments are employed opportunistically to serve broader political aims (Lehtonen et al., 2021, p. 15).

Another issue to take into account in the Spanish case is the tension between territories with different development models. It is no coincidence that ATC sites are always located in economically depressed areas, with little industrialisation and distant from large conurbations. As seen in the case of the LLW (El Cabril), local pressure decreased significantly when the surrounding municipalities obtained economic compensation allowing them new economic activity options. Often, the arguments to oppose any nuclear facilities, not only the disposal of waste, have to do with the attempt to maintain certain types of economic activities and ways of life (agricultural, tourism, etc.), which are perceived as threatened by the new nuclear infrastructures. This brings us back to the delicate public sensibility regarding the fair distribution of risks and benefits, and the hard and complex game between political parties and their different territorial levels.



One of the main lessons of the Spanish case is that the principles of transparency and participation are not easy to put into practice, at least regarding finding a place for HLW temporary centralised storage, and that much more long-term work is required to generate trust between actors. In the case of LILW, public acceptance has been more favourable, and a timid participative approach has allowed better management, although its location has also suffered conflictive episodes in the past, especially with local environmental groups, which are still monitoring any changes in the management of radioactive waste.

Nuclear waste management in Spain has been influenced by environmental legislation that increasingly requires more public transparency and openness to citizen participation, mainly due to the internalisation of European Directives. This has been reflected in the way of managing the location of the repository for HLW, without success so far due to the peculiar structure of the nuclear conflict in Spain, which relegates the role of science and technology to marginal positions in the debate.

It seems clear that currently, the Spanish context does not allow a discussion based on data (and expertise), since actors respond to logic based on the mobilisation of emotions and feelings of grievance in the public sphere. The generally negative public perception of nuclear energy that prevails in Spanish society may be conditioning the erratic behaviour of political parties, which despite being mostly in favour of nuclear energy, do not dare to maintain this option in public in the long-term, especially in territories that they consider sensitive for their electoral interests. Generating trust between actors becomes quite difficult in a political-institutional context in which nuclear issues have already been used too many times in a tactical and instrumental way by political parties, in accordance with their conjunctural electoral interests at each historical moment.

The stalemate has become melancholic because the process entailed a loss of enthusiasm by the most active professionals in institutions in charge of radioactive waste management, as they had high expectations of the (limited) new participatory and transparent procedures. It became clear that the factors that can lead to public acceptance of a radioactive waste repository go beyond the competence and capabilities of the involved institutions, since none of the institutions in charge of managing nuclear waste in Spain, much less ENRESA, is in a position to prevail in the political game and prevent the partisan use of nuclear waste, which means that, no matter how much technical data they can offer, this will never be enough to win the public's trust.

Looking to the future, the management of radioactive waste in Spain could only be carried out through a serious investment of resources dedicated to building trust between the different actors, on at least two levels: On the one hand,

trying to minimise territorial tensions (the perception of comparative grievances between territories) through a redesign of the political and institutional system that currently promotes and favours them. On the other hand, it would be necessary to build trust between public administrations and social movements around nuclear issues, which would require a long-term process of mutual recognition and potential convergence of objectives. However, it is foreseeable that all this would require long-term planning and temporal rhythms that neither the political system nor the nuclear management may have.

Finally, a novelty in this scenario is that from 2019 the Spanish government will close all NPPs as their operational life is considered fulfilled. This was one of the essential conditions for environmental groups to agree to discuss the management of radioactive waste, which may lead to a new scenario more favourable to the management of HLW. However, the future scenario also foresees a decarbonisation of the European economies (in 2022 pushed by the war in Ukraine and the associated energy requirements) that, indirectly, may favour an extension of the NPPs' operational life, which in turn could shift that window of opportunity over time.

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