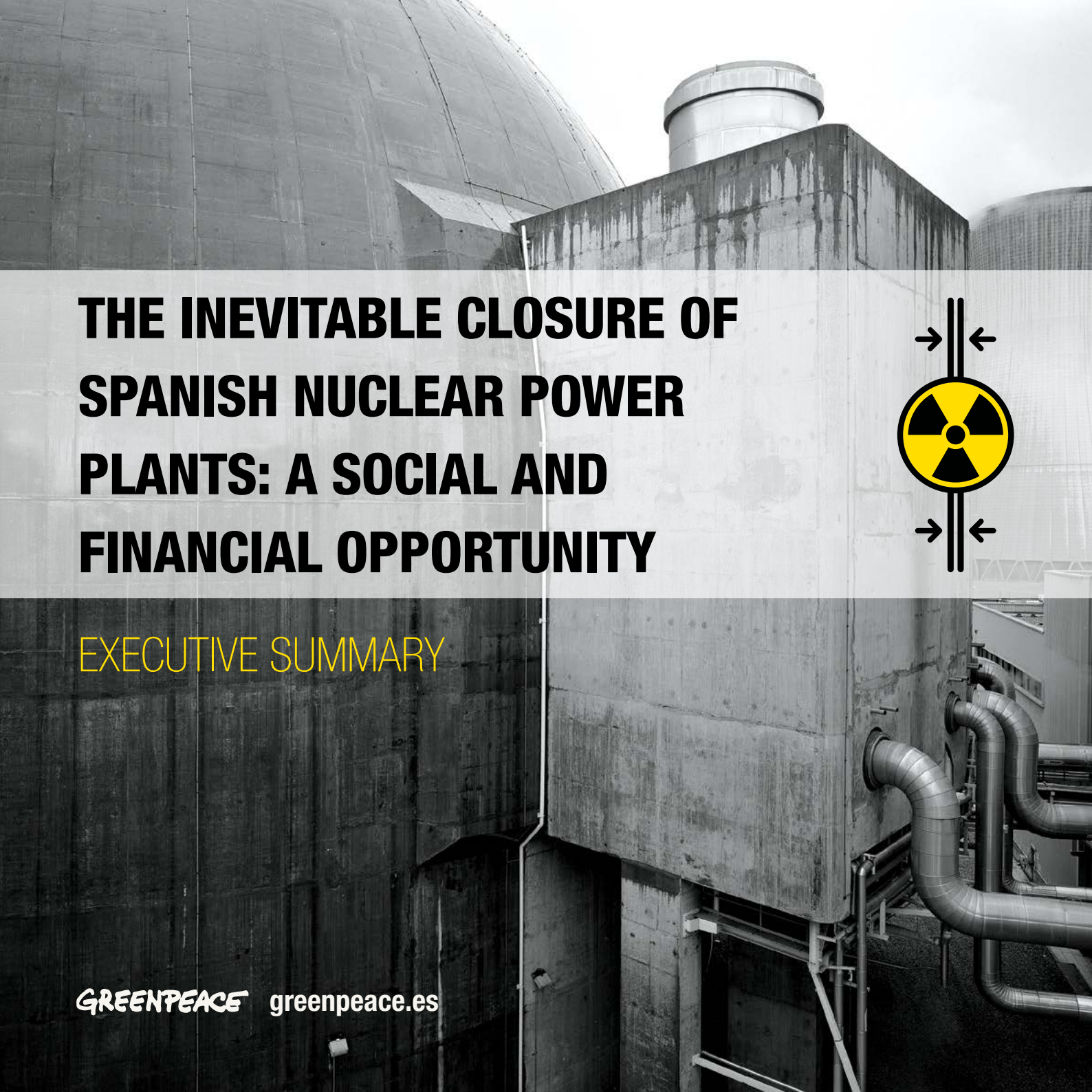

THE INEVITABLE CLOSURE OF SPANISH NUCLEAR POWER PLANTS: A SOCIAL AND FINANCIAL OPPORTUNITY

EXECUTIVE SUMMARY

GREENPEACE greenpeace.es

This summary was written by **Alicia Cantero, Marta González,** and **Raquel Montón** based on the report Greenpeace commissioned Abay Analistas: ***"El impacto económico del desmantelamiento nuclear en España"*** (only available in Spanish).

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Design and Layout: **© Cristina Jardón at Graphic Inside**
Editing: **Conrado García**
October 2016

Photo: © Greenpeace

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INTRODUCTION

Spain's nuclear park is outdated. There are seven nuclear reactors in operation which average a 33 year service life. Additionally, Santa María de Garoña nuclear power plant in Burgos was shut down more than three years ago after operating for 42 years.

During the next decade all exploitation permits will expire, the last to do so will be Trillo nuclear power plant in Guadalajara in 2024. Spanish nuclear power plants will therefore average a 38 year service life[1].

Given the situation, the progressive closure of Spanish nuclear power plants is unavoidable. This fact presents us with the dilemma of whether we want to keep using nuclear energy. A question that needs to be resolved quickly and in a responsible manner. Having a sound planning and carrying out an in-depth analysis of the financial and social implications of closing a nuclear plant will allow us to better manage the opportunities/activities involved in the closure and dismantlement processes.

At the end of their service life nuclear power plants must inevitably be dismantled and radioactive waste must be managed for a period of time which is hard to estimate. The closure of nuclear power plants is not the end of nuclear energy. Thus society must face problems that derive from managing it, for decades.

Relevant financial literature deals mainly with estimating the costs for the different activities involved in the lengthy process of the nuclear power plant dismantlement process. However, analyses on the socioeconomic impact on local communities, such as employment, or other quantitative or qualitative social and

1 Service life (or lifetime) is the time period between a nuclear power plant's startup and decommission, provided the capability of executing the functions assigned relating to safety or relevant to it. Source: CSN Safety Guide 1.10 (Rev. 1)

Photo: © Nevio Smajic / Greenpeace

economic aspects are not so numerous. Additionally, the closure of nuclear power plants means the electricity once provided by nuclear plants must now come from other sources; this in turn has implications for the energy model, the environment, and the economy.

The present document outlines the main conclusions of the study Greenpeace commissioned Abay Analistas Económicos y Sociales[2]. The main goal of the study is to measure the **economic impact** -employment and GDP- **of the dismantlement Spanish nuclear power plants and shifting nuclear energy to other sources**. It also analyses the investment needed and the type of employment created by educational level and sectors that are most benefited. Greenpeace hopes this study will facilitate the debate and decision-making process regarding the closure date of Spanish nuclear power plants and the energy model to adapt urgently for environmental reasons. The study shows that not only will this new energy model have no negative effects on the economy but it will also act as a positive catalyst.

2 Abay Analistas Económicos y Sociales for Greenpeace, October 2016. "El impacto económico del desmantelamiento nuclear en España". http://www.greenpeace.org/espana/es/reports/El-impacto-economico-del-desmantelamiento-nuclear-en-Espana

GREENPEACE ANALYSIS ON THE DISMANTLEMENT OF NUCLEAR POWER PLANTS. THE KEY: STOP GRANTING LICENSES

Three reasons why extending the service life of nuclear power plants pose unnecessary risks to people and the environment: nuclear economy is not competitive; nuclear power plants are not necessary as there are other energy alternatives; thus more nuclear waste is created for which there is no definite management solution.

At the beginning of the next decade exploitation permits of all Spanish nuclear plants will expire. Spain's nuclear park is outdated. Worldwide the average service life of nuclear power plants is around 29 years[3], yet in Spain reactors currently average 33 years of service life, given their exploitation permits they will reach an average service life of 38 years.

Nuclear reactors' exploitation permits are renewed after a binding evaluation by the Spanish regulatory agency, Consejo de Seguridad Nuclear (CSN), and the approval and authorization of the Ministry of Industry, Energy and Tourism. Spanish exploitation permits have a 10 year duration (the exception being Garoña which was granted for four years) in line with the Periodic Safety Reviews. This good praxis for nuclear and radiation safety is well established in Spain; however, there is no legal limit for service life, neither maximum nor minimum.

3 The World Nuclear Industry Status Report 2015, (pg. 14) http://www.worldnuclearreport.org/IMG/pdf/20151023MSC-WNISR2015-V4-LR.pdf

Spanish nuclear power plants were designed for a service life of 30 to 40 years[4]. Establishing a limit beyond the designed lifespan[5] increases safety and environmental risks, and any case must exceed 40 years. Yet this is exactly what was proposed for Garoña nuclear power plant and could therefore be proposed for the rest of the nuclear plants in Spain too.

Extending limits opens the door to further risks, some due to ageing such as the inability to replace key parts; new risks arise due to the incompatibility when retrofitting components; and others due to the loss of expert staff because of retirement. In addition to increasing the risk of suffering potential malicious attacks, terrorists' attacks, sabotage, natural disasters or human errors which could lead to nuclear accidents.

Extending the life of nuclear power plants also implies a greater volume of fuel spent, meaning more nuclear waste to be managed at a time when only temporary management is available. It also means that when the time for dismantling comes, owner utilities will face higher economic costs.

Therefore establishing life limits is essential to ensure the financial security needed to manage and finance nuclear waste from nuclear plants.

4 The first power plants were designed for around 30 year service life, http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/decommissioning-nuclear-facilities.aspx, according to the IAEA the service life of most nuclear power plants varies from 20 to 40 years (https://www.iaea.org/sites/default/files/29402043133_es.pdf).

5 Design lifespan refers to "the operating time contemplated in the design; during this time the plant is expected to fulfill its purpose according to the terms established in its specifications". Source: CSN Safety Guide 1.10 (Rev. 1). https://www.csn.es/documents/10182/896572/GS%2001-10%20Revisi%C3%B3n%201%20-%20Revisiones%20peri%C3%B3dicas%20de%20la%20seguridad%20de%20las%20centrales%20nucleares

As Table 1 shows, establishing a 40 year maximum life limit for nuclear power plants would imply that once their present permit expires, Ascó 2, Cofrentes, and Trillo nuclear plants could apply for a four year exploitation permit extension; while Vandellós II could do the same for a seven year permit extension.

These time extensions are not only out of sync with Periodic Safety Reviews -breaching good practices within environmental regulation- but are irrelevant to energy security yet important in terms of financial costs. Companies would not only have to manage larger quantities of nuclear waste, they would also have to make major investments to improve the plant's safety in order to operate for a short period of time, this is not very competitive economically speaking.

Taking into consideration all of the above, the simplest and safest alternative is to **stop granting operating licenses**. Nuclear power plants would thus close between 2020 and 2021, except Trillo, in Guadalajara, whose operating license expires in 2024.

Table 1 Spanish Nuclear Park

Source: Greenpeace with data from CSN

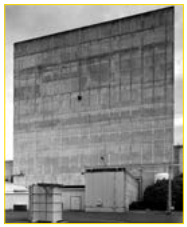
Name	Start-up Approval Date	Operating Permit in Force Approval Date	Operating Permit Valid Till	Expected Service Life	Actual Service Life
VANDELLOS-2	08/17/1987	07/26/2010	07/26/2020	32	29
TRILLO-1	12/4/1987	11/16/2014	11/15/2024	36	28
COFRENTES	07/23/1984	03/10/2011	03/20/2021	36	31
ASCO-2	04/22/1985	07/28/2011	07/28/2021	36	31
ASCO-1	07/22/1982	07/28/2011	07/28/2021	39	34
ALMARAZ-2	06/15/1983	06/07/2010	06/08/2020	36	33
ALMARAZ-1	03/10/1980	06/07/2010	06/08/2020	40	36
SANTA Mª DE GAROÑA	05/02/1966		07/06/2013	46	46
			Average	37.6	33.2

NUCLEAR SHUTDOWN SCHEDULE*

*Licenses expiration date

NUCLEAR DISMANTLEMENT, AN INEVITABLE PATH THAT IMPROVES THE FUTURE AND CREATES JOBS

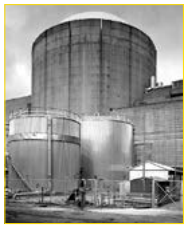
JULY 2013



STA. Mª DE GAROÑA

- IBERDROLA 50%
- endesa 50%

JUNE 2020



ALMAZAR I AND II

- IBERDROLA 52.7%
- endesa 36%
- gasNatural fenosa 11.3%

JULY 2020

VANDELLÓS II

- IBERDROLA 28%
- endesa 72%

MARCH 2021

COFRENTES

- IBERDROLA 100%

JULY 2021

ASCÓ I AND II

ASCÓ I

- endesa 100%

ASCÓ II

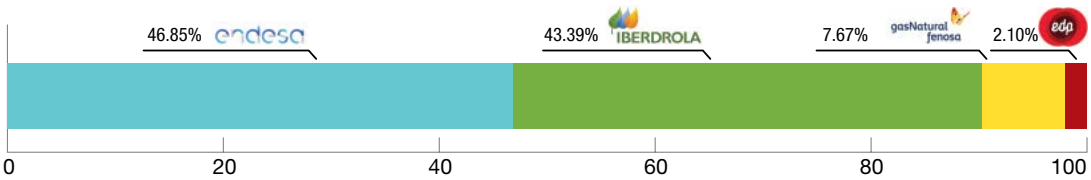
- IBERDROLA 15%
- endesa 85%

NOVEMBER 2024

TRILLO

- IBERDROLA 49%
- gasNatural fenosa 34.5%
- edp 15.5%
- endesa 1%

THE MAIN COMPANIES THAT OWN NUCLEAR POWER PLANTS ARE:



HOW TO FINANCE NUCLEAR DISMANTLING

Dismantling nuclear power plants is necessary and inevitable; law dictates owner utilities must cover costs. Spain needs to urgently make provisions for a fund destined to cover these costs.

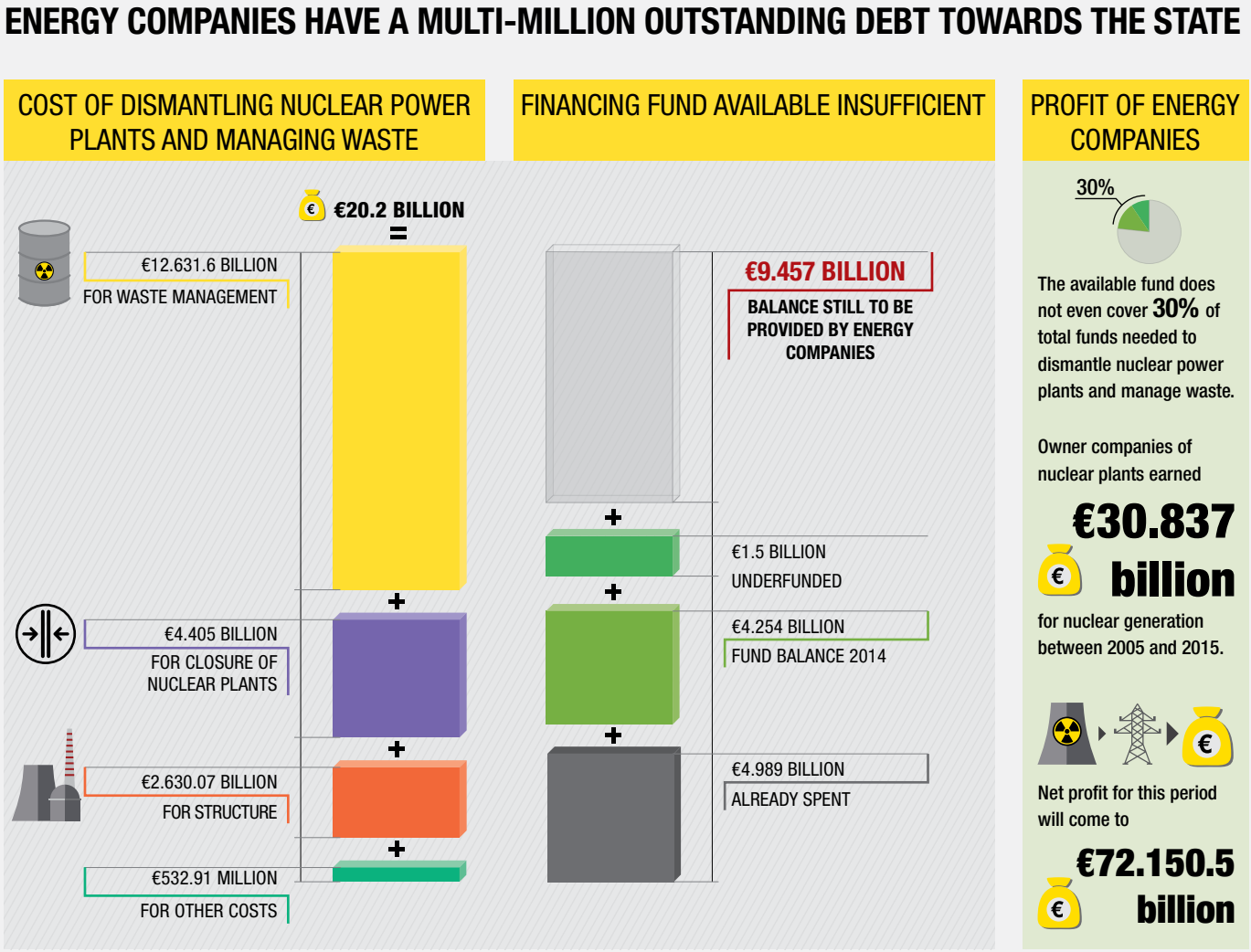
According to the latest estimation in July 2015, complying with the actual plan in force -VI Radioactive Waste Plan- dismantling Spanish nuclear power plants and managing nuclear waste would have a total cost of €20.2 billion[6]. This estimate takes into account a 40 year service life and all activities relating to managing radioactive waste till 2085[7].

To guarantee the intergenerational equity principle and ensure costs do not fall on society it is essential to make provisions for the necessary funds to dismantle nuclear plants and manage radioactive waste during the service life of nuclear power plants. Consequently, in 1983 a specific provision was allotted to a fund for this end which is managed by the public enterprise ENRESA. As Figure 1 SHOWS, in December 2014 it had €4.254 billion. The fund includes money collected from tariffs, tolls, and the financial return of the fund itself. Law 54/1997 transferred the financing of these costs to consumers up until 2005 when once again costs were internalized by owner companies of nuclear power plants. As of 2010 the portions of the fund with the two greater amounts go to owner companies of nuclear power plants, a third

6 Law 19/2013 update published by ENRESA in July 2015 indicates a total cost of €17.570 billion, however €2.630 billion need to be added which had been allocated as structure costs (see Chart nº1 of the Court of Auditors nº 1075) and are omitted in the first estimation.

7 The VI Radioactive Waste Plan estimation is based on a nuclear park of 6 nuclear power plants with 8 reactors, and a service life of around 40 years. It takes into account all activities related to managing low/medium/high-activity radioactive waste till 2085, including the storage of spent fuel, dismantlement of all nuclear power plants, constructing a Centralized Temporary Storage (CTS), and the subsequent construction of a Deep Geological Repository in 2035, to be operational in 2063.

Figure 1 Cost of Dismantling Nuclear Power Plants, Managing Waste, and Funds Available



All activities concerning dismantling nuclear power plants and managing radioactive waste till 2085 has been taken into account, including a Deep Geological Repository, and estimating a 40 year service life for nuclear power plants. Source: ENRESA and Court of Auditors (2015)

part goes to owner companies of fuel manufacturing plants, and a fourth to additional radioactive installations.

According to a recent European study[8], comparing the availability of specific funds for the dismantlement of nuclear power plants and the management of nuclear waste in different Member States shows that **the funds available in Spain do not even cover even 30% of the total funds needed**.[9] This percentage is the lowest of all Western European countries for which data is available, only former Eastern countries show lower percentages.

Additionally, a report published in 2015 by the **Spanish Court of Auditors**[10], pointed out that due to **the fund's nature, the principle of intergenerational equity is not warrantee**, a principle which is mandatory. Moreover, the Court of Auditors warned about the **under-funding of the fund by over €1.5 billion** since fees and taxes on nuclear power plants have not been updated since 2010.

The cost of dismantling a nuclear power plant is fixed regardless of how many years the plant is in service. However, the total cost of managing nuclear waste varies depending on how long the plant has been operating. According to estimates made by ENRESA in 2012, included in the report of the Spanish Court of Auditors published in 2015, if instead of the 40 years of service life contemplated in the VI Radioactive Waste Plan, service

8 European Commission (2016): Nuclear Illustrative Programme presented under Article 40 of the Euratom Treaty for the opinion of the European Economic and Social Committee {COM(2016) 177 final}

9 This percentage is lower than the total cost estimated does not take the latest update in July 2015 into account which brings it to €17.5 billion, structure costs not included.

10 Court of Auditors (2015): Informe de fiscalización de la gestión realizada por la Empresa Nacional de Residuos Radioactivos, S.A. del fondo para la Financiación de las actividades del Plan General de Residuos Radiactivos, Ejercicios 2010 y 2011, Informe nº 1075. (Report nº 1075).

life were extended to 48 years, the total cost of managing radioactive waste would come up to €769 million.

Funding is essential in order to dismantle nuclear power plants, it **requires** developing a proper **legal framework** and **estimating costs adequately**, both prior to the dismantling process and during cost reviews along the process.

The Spanish nuclear park must urgently adjust the fund's provisions to the cost of dismantling and managing nuclear waste produced during its service life.

Photo: © Francisco Rivotti / Greenpeace

METHODOLOGY USED IN THE STUDY

An "Input-Output" analysis was carried out to measure how progressively closing Spanish nuclear power plants would affect the economy and employment. This type of analysis allows measuring how different sectors affect each other financially, and provides detailed information on a number of macroeconomic variables, such as gross domestic product or unemployment.

The data base for the analysis was built using the latest national accounting data from the National Statistics Institute (INE). The time the analysis begun using this data was in 2014 onwards. Additionally, the energy sector was divided into eight sectors, six of them for renewable energy[11].

Two complementary analyses were carried out, one to study the type of employment created, the other one to analyze fiscal consequences. For the first study, employment created or lost was disaggregated by occupational field and level of education. Information on education within the employment sector was obtained from the Labor Force Survey (EPA).

11 Eólica, solar fotovoltaica y térmica, solar termoeléctrica, biomasa, geotérmica y olas, minihidráulica

TECHNICAL SCENARIOS USED IN THE ANALYSIS

To understand what the overall impact on finance and employment by progressively closing nuclear power plants would be; not only the dismantling process and the management of radioactive waste was taken into account but also the impact of substituting nuclear energy for alternative sources.

The overall technical scenario is based on the partial scenarios described below, which correspond to different phases and/or fields of action of the dismantling process:

SUBSTITUTION OF NUCLEAR ENERGY

The progressive closure of nuclear power plants means energy produced by nuclear plants –18% of the electricity mix estimated for 2020[12] – must be substituted by other sources of energy. The actions taken to make this a reality will affect employment, the economy, and the environment. Depending on the substitution energy chosen consequences will vary greatly.

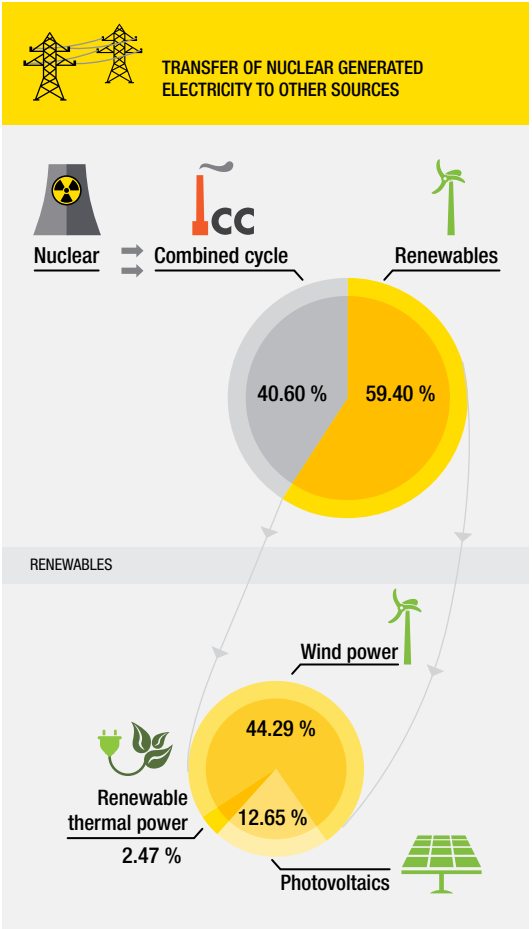
While Greenpeace is committed to a 100% renewable energy system for 2050, the technical scenario in the study is based on the prospective scenario of the Ministry of Industry. Although this scenario is more conservative than the one demanded by Greenpeace, it is presently the only electrical system plan

12 According to data for 2020, nuclear power plants will generate 59,670 GWh annually (18.01% electricity mix). Ministry of Industry, Energy and Tourism, May 2015. Informe de Sostenibilidad Ambiental de la Planificación del Sector Eléctrico 2015-2020.: http://www.minetur.gob.es/energia/planificacion/Planificacionelectricidadygas/desarrollo2015-2020/Informesostenibilidad/ISA_VERSI%C3%93N_WEB_E.pdf

for 2020[13]. As Figure 2 shows, according to this scenario 59.4% of nuclear production is substituted by new renewable facilities, while the remaining 40.6% is met by increasing electricity production of existing combined cycle power plants.

Figure 2 Transfer of Nuclear Generated Electricity to other Sources. (Percentage over total electricity production)

Source: Abay Analistas for Greenpeace



13 The forecast scenario for the electricity sector included in MINETUR's plan has been incorporated as it is the only plan available for 2020. Including this scenario does not mean Greenpeace considers it valid, viable, or that it represents the best possible option. A faster introduction of renewables, efficiency, demand management, electrification, smart grids, and interconnections will provide more favorable scenarios as studies by Greenpeace show: "Energía 3.0. Un sistema energético basado en inteligencia" (2011), or by Greenpeace and Abay Analistas: "El impacto de las energías renovables en la economía con el horizonte 2030" (2014). However, in order to quantify the best economic percentage of each option a technical analysis is required which presently is not available.

The gradual substitution of nuclear energy will have different consequences depending on the development stage. During the first stage, the construction of new renewable energy installations will be necessary in order to increase power. As shown in Figure 1, an increase of 11,312 MW in wind power is predicted; 4,511 MW for photovoltaic energy, and 257 MW for thermal energy from renewable sources. These numbers are additional to the ones already foreseen in the prospect scenario of the Ministry of Industry[14]. **The investment required to build these new plants** will affect the economy and employment positively.

Once this stage is completed and nuclear power plants are closed, **producing electricity from substituting sources** will affect employment and the economy differently than producing that same electricity from nuclear plants. The present analysis also measures these differences.

14 Nonetheless, in order to quantify the best economic percentage for each option a technical analysis is required which at present is not available. The forecast scenario trends included in MINETUR's plan for the electricity sector have been extrapolated.

DISMANTLEMENT OF NUCLEAR POWER PLANTS

When nuclear power plants reach the end of their service life they must be decontaminated from radioactive substances, and dismantled. These two operations must be executed so the original site can be put to other uses thus not pose any risk to our health or the environment.

The present technical scenario takes into account all activities the Government must undertake, from the declaration of cessation of operations and authorization to dismantlement to the restoration of the original site; including the actual dismantling of the installation. The dismantlement will be immediate and the process will last between 10 to 15 years.

RADIOACTIVE WASTE MANAGEMENT

The mass volume of low/medium[15]/ high-activity radioactive waste created by nuclear power plants during their service life and dismantling phase must be stored.

A nuclear power plant with a 40 year service life must find permanent storage for a volume of high-activity waste of 11,966 m^3, most of it (10,164 m^3) is spent fuel elemento16.

Storage estimations are presented for two scenarios. Greenpeace advocates for a decentralized system of Individualized Temporary Storage (ITS) to be located on the actual sites of nuclear power plants. The second scenario is based on the construction of a Centralized Temporary Storage (CTS) as proposed by the Ministry of Industry[17]. The ITS scenario requires the construction of new storage facilities with a total capacity of 10,507 m^3.

The scenarios take into a consideration the economic impact of constructing temporary storage facilities[18] as well as nuclear waste transportation. However, they do not cogitate on the impact of activities required while in use, such as surveillance, maintenance, etc.

15 Storage and treatment of low and medium activity radioactive waste will be done at El Cabril facility.

16 According to the VI Radioactive Waste Plan approved on June 2006.

17 Greenpeace believes that is essential to first establish a date to close the nuclear power plants so no more waste is generated thus to update the Radioactive Waste Plan as well as to manage and finance them; apply the precautionary principle and public participation to guarantee safety and democracy; take into account the safest technical alternatives, minimize transportation, ensure control and recovery so they can be accessed in the future in case a solution is found. Today Individualized Temporary Storage (ITS) exists in most nuclear power plants, therefore Greenpeace believes that presently individualizes storage in situ is the best option.

18 Valid till 2070

DISMANTLING MAIN ADVANTAGES: GENERATE EMPLOYMENT AND FINANCIAL PROFITS (NOT TO MENTION ENVIRONMENTAL BENEFITS)

Closing nuclear power plants gradually will have positive consequences on safety and the environment, plus it presents an opportunity to create employment and improve the economy as a whole.

Given the closure of nuclear power plants is unavoidable, it presents a short and long term opportunity to develop local and global economies.

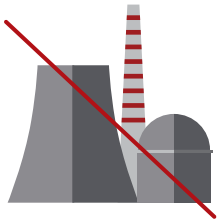
After the initial loss of employment in nuclear power plants, the dismantling process and economy diversification experimented in those areas may provide new employment opportunities.

The financial consequences of all activities linked to dismantling, managing waste and substituting nuclear energy for other sources will mean a GDP increase of around €20 billion and the creation of 300,000 jobs of which 100,000 relate to dismantling nuclear power plants and 200,000 to installing new renewable power.

Following are the main economic and employment consequences resulting from overall activities, plus details on the type of employment created according to sector and qualifications. Last, fiscal consequences are shown.

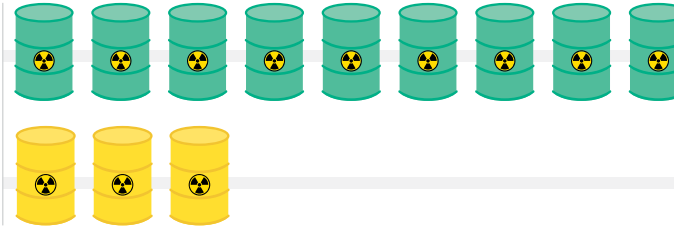
ADVANTAGES OF NOT PROLONGING...

FOR A €22 BILLION OVERALL INVESTMENT



A PUBLIC INVESTMENT OF
€4.198 BILLION
TO DISMANTLE NUCLEAR POWER PLANTS

+



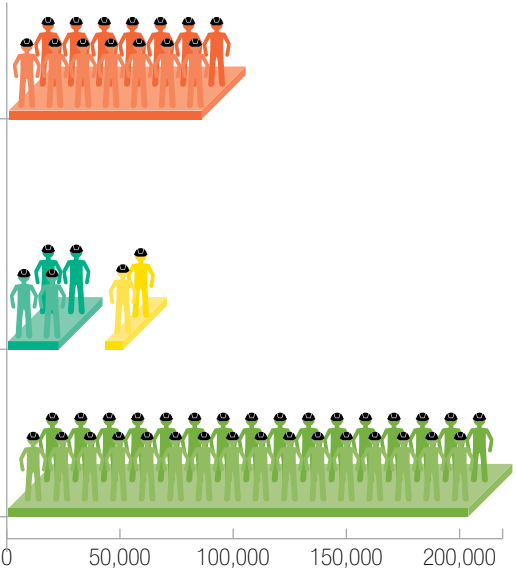
300,000 OVERALL JOBS CREATED

84,840 JOBS
IN DISMANTLING NUCLEAR POWER PLANTS

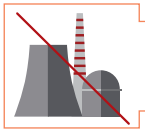
21,852 JOBS
WHEN WASTE IS STORED IN **CTS**

6,955 JOBS
WHEN WASTE IS STORED IN **ITS**

202,646 JOBS
WHEN NUCLEAR ENERGY IS SUBSTITUTED FOR OTHER SOURCES



€20 BILLION OVERALL GDP INCREASE



€5.614 BILLION
GDP INCREASE FOR DISMANTLING NUCLEAR POWER PLANTS

€1.379 BILLION
GDP INCREASE WHEN WASTE IS STORED IN **CTS**

€425 MILLION
GDP INCREASE WHEN WASTE IS STORED IN **ITS**

€13.729 BILLION
GDP INCREASE WHEN NUCLEAR ENERGY IS SUBSTITUTED FOR OTHER SOURCES

THE LIFE OF NUCLEAR POWER PLANTS

€1.232 BILLION

WHEN WASTE IS STORED IN **CTS**

€370 MILLION

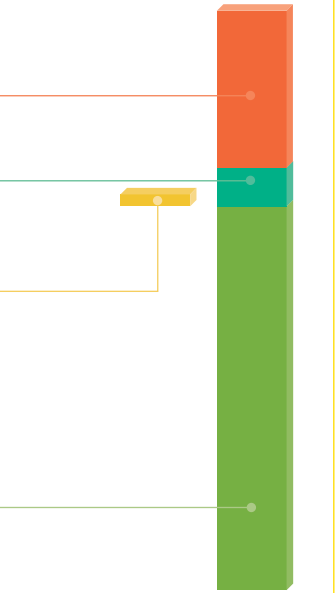
WHEN WASTE IS STORED IN **ITS**

+

Renewable
59 %

PRIVATE INVESTMENT OF **€17.199 BILLION**

WHEN 59% OF NUCLEAR ENERGY IS SUBSTITUTED FOR RENEWABLES



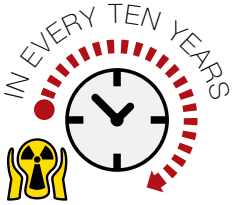
LESS RADIOACTIVE WASTE

ROLONGING EIGHT YEARS THE LIFE OF NUCLEAR POWER PLANTS ...

INCREASES BY **€769 MILLION**
WASTE MANAGEMENT COSTS

FOR A SAFER FUTURE

IN EVERY TEN YEARS A MAJOR NUCLEAR ACCIDENT HAPPENS.



€186 BILLION

IS ESTIMATED FOR INSURANCES AND COMPENSATIONS COSTS ALONE

Action timeframe till 2040. Includes all activities executed from the authorization to dismantle to the restoration of the original site, including the construction of ITS or CTS, and waste transportation.
Source: Abay Analistas for Greenpeace.

Photo: ©Greenpeace/Paul Langrock

EMPLOYMENT GENERATION AND FINANCIAL PROFITS

Overall the activities considered will require an **investment** of approximately **€22 billion** (€21.766 billion for waste management in ITS option and €22.628 billion for the CTS option).

As Table 2 shows **increasing renewables** requires the greatest investment, around **€17.2 billion** are needed, that is between 75% and 79% of the total investment. This investment is independent of the dismantlement operation yet varies depending on the energy source chosen to substitute nuclear energy[19]. Next in quantity are **investments such as the dismantlement of nuclear power plants**, estimated around **€4.198 billion** (19% of the overall investment).

The construction of **temporary nuclear waste storage** will require an investment of **€370 million in case of the ITS option and around €1.232 billion for the CTS option** (that is 2% and 5% of the total investment respectively).

Investments will come from different sources, while money to substitute nuclear energy will come from the private sector and vary depending on the alternative chosen to substitute nuclear energy. Investments to dismantle plants and build temporary storage for nuclear waste will come from public funds allocated for these endeavors, previously deposited by owner companies of nuclear plants.

The **financial impact** of the actions and investments[20] needed will mean a **GDP increase of around €20 billion** (€19.768 billion for the ITS option and €20.721 billion for the CTS option); this represents an additional increase from the basic scenario[21], of 2.1% and 2.2% respectively.

19 In this case the required investment reflects the increase in renewable power specified in the scenario described before.

20 The time period envisaged to execute all activities proposed is till 2040.

21 2014

Tabla 2 Principales cifras del impacto económico y en el empleo del cierre gradual de las centrales nucleares en España

	Substitution of Nuclear Energy	Renewable Energy Power Increase	Dismantle of Nuclear Power Plants	Radioactive Waste Temporary Storage		Total	
				Option ITSs	Option CTS	Option ITSs	Option CTS
Investment (€Million)		17,199	4,198	370	1,232	**21,766**	**22,628**
Change in Employment (Nº of Job Posts - FTE)	-6.808	209,454	84,840	6,955	21,852	**294,441**	**309,338**
Gross Domestic Product (€Million)	303	13,426	5,614	425	1,379	**19,768**	**20,721**
GDP Increase (%)	0%	1.4%	0.6%	0%	0.1%	**2.1%**	**2.2%**

Fuente: Abay Analistas para Greenpeace

Employment creation has been estimated at **300,000 net jobs**[22] 294,441 for the ITS option and 309,338 for the CTS option).

Activities involved in **dismantling nuclear power plants and building centralized or individualized temporary storage for nuclear waste** will create around 100,000 new jobs; 106,692 for option one and 91,795 for option two.

The construction of new renewable plants is the top employment generation activity **(209,454 jobs)**. Once the necessary renewable energy plants are built, generating electricity from **renewable** and combined cycle **sources** will require a total of **6,800 fewer jobs** than if that same electricity were generated by nuclear power plants. This number is negative because of the higher intermediate consumption of nuclear energy, mainly due to the cost of fuel which in the case of renewables is free.

When nuclear power plants are closed, their suppliers will lose 3,900 direct and indirect jobs. The present study shows

22 Jobs referred to in the study are the number of job posts equivalent to a person working full-time; therefore two people working part-time count as one job post, FTE (full-time equivalent).

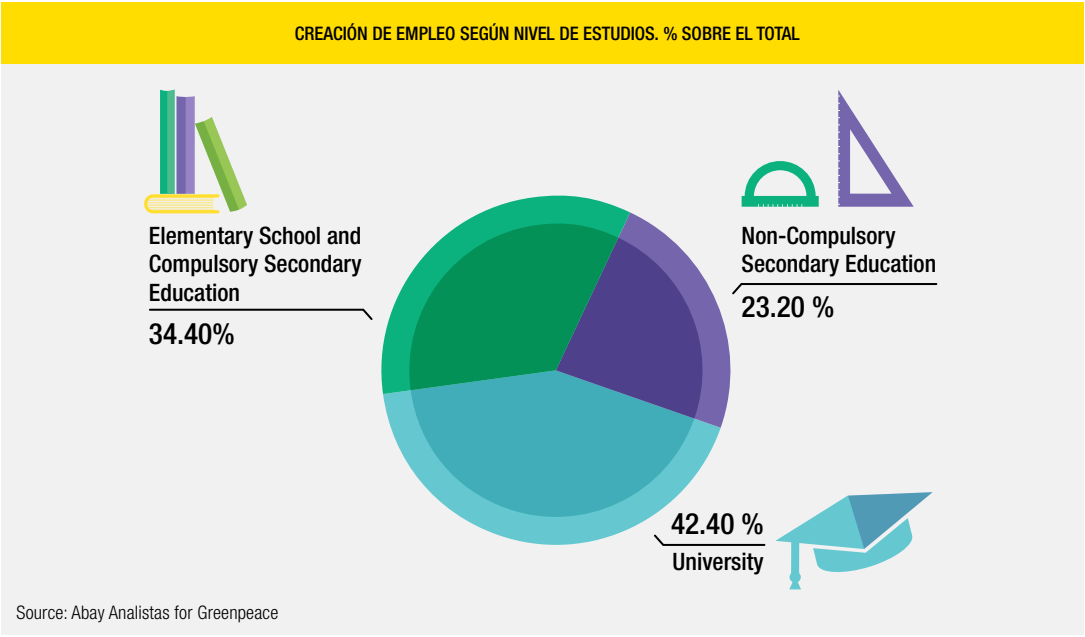
that after the initial loss of employment in nuclear plants, the dismantling process will generate employment for over a decade. Additionally, it is important for former nuclear towns to take advantage of every employment growth opportunity created by economy diversification. It is essential to pay special care and attention to the economic development of former nuclear areas.

EMPLOYMENT CATEGORY

The analysis of financial impact should evaluate what **type of employment is created. Educational level required** is closely linked to what sectors receive the highest impact.

As shown in Figure 3, in regards to educational level for jobs created, the re-

Figure 3 Job Creation by Educational Level. % over total.



sults show **42%** of net employment created during the dismantlement of nuclear power plants, nuclear waste management, and substitution of nuclear energy by other sources requires a **high educational level** (university level and/or postgraduate).

This type of employment will be mainly created in the fields of Finance, Real State, Professions, and Science; in Public Administration, Health and Education, or mechanical industry (machinery and metal goods).

35% of new jobs will require a medium-low educational level (elementary school or high school) and will especially affect those fields related to commerce, catering, hotels, construction and construction workn.

Table 3 shows the biggest employment creation will be in commerce, catering and hotels as they will be the areas which benefit the most from the impacts generated; while financial, professional, and scientific activities will concentrate a significant amount of indirect investments. **Other important sectors** in terms of employment creation are **Public Administration, Health, Education, Machinery, and Construction.**

Table 3 Sectors Benefiting from Investments Required to Close Nuclear Power Plants

	Option ITSs (Million Euros)	Option CTS (Million Euros)
Trade, Hotels, and Restaurants	65,939	69,415
Financial, Housing, Professional, and Scientific Activities	62,233	65,156
Public Administration, Healthcare, Education, and Recreational Activities	43,934	45,324
Machinery	36,792	37,062
Construction and Construction Work	33,480	34,087
Transport and Communication	12,895	15,632
Other branches	10,248	10,754
Metal Goods, except machinery and equipment	9,918	11,073
Agriculture, Farming, and Forestry	6,765	7,100
Food	5,503	5,776
Metallurgy and Metal Goods	2,453	2,767
Chemical Industry	2,205	2,323
Water Catchment, Treatment, and Distribution	2,150	2,349
Construction Materials	2,142	2,704
Conventional Energy	-2,215	-2,185

Source: Abay Analistas for Greenpeace

FISCAL CONSEQUENCES: ADVANTAGES FOR SOCIETY AS A WHOLE

Dismantling nuclear power plants will mean an increase in tax collected –income tax (IRPF) not included- close to €2.8 billion. Results are very similar for ITS and CTS scenarios. Both options analyzed include net taxes on products, which result in an increase close to €370 million. Net taxes on production [mainly tax on business activities (IAE) and property tax (IBI)] will increase around €425 million; last, social contributions will increase around €2 billion.

Photo: © Francisco Rivotti / Greenpeace

KEY FINDINGS

Dismantling nuclear power plants is necessary and unavoidable. Given the implications for local communities it must be studied and monitored by society. The findings of the present study show that gradually closing nuclear power plants over the next decade will not only benefit the environment and improve our safety but will also **act as a great incentive for Spanish economy and the creation of employment.**

CONSEQUENCES ON THE ECONOMY AND EMPLOYMENT

- The gradual closure of nuclear power plants and the substitution of nuclear energy by other sources, renewables included, will generate overall around **300,000 jobs, 100,000 of which relate to the dismantlement of nuclear power plants and the management radioactive waste. GDP will increase to around €20 billion while tax collection by around €2.800 billion.**
- The gradual closure of nuclear power plants will require public and private investments of around €22 billion. Increasing renewable sources power requires the greatest investment, 78% of the total investments (€17.2 billion). Dismantling nuclear power plants is financed through public investment from money that was already collected; it represents 19% of the total investment

(€4.198 billion).Temporary storage of radioactive waste will require €370 million for option ITS, and €1.232 billion for option CTS; 2% and 5% of the total investment respectively.

- **Dismantling nuclear power plants and building centralized or individualized temporary storage for radioactive waste will entail the creation of around 100,000 jobs; 106,692 in case of option one, and 91,795 for option two**.

- Closing nuclear power plants while increasing renewable energy will speed the transition to a more sustainable energy model. Under the scenario analyzed, the greatest number of jobs created -209,454- is related to renewables.

- 42% of net employment created requires a high educational level (university degree and/or postgraduate). 35% requires a medium-low educational level (elementary school or high school), and is mainly in commerce, catering and hotels.

- The biggest employment creation generated will be in commerce, catering and hotels as these areas will benefit the most from these of the impacts; while financial, professional, and scientific activities will concentrate a significant amount of indirect investments.

Photo: ©Greenpeace/Paul Langrock

SOCIOECONOMIC IMPACT

The closure of nuclear power plants is a done deal; jobs within these facilities cannot be perpetuated forever. Initially jobs will be lost in nuclear power plants, however new employment opportunities may rise in former nuclear areas due to the dismantling process and a diversification of the economy.

FUNDING

- Although Spanish nuclear power plants have already reached 84% of their service life, **not even 30% of the total funding needed is available**.

- To guarantee the principle of intergenerational equity, and ensure costs do not fall on future generations or society, it is essential to set aside the necessary funds for the dismantlement of nuclear plants and radioactive waste management during the service life of nuclear power plants.

- In order to establish a **funding system** to dismantle the nuclear power plants efficiently a proper **legal framework** must be developed. An **adequate estimation of costs** is also essential, both previous to the dismantlement during cost reviews along the process.

GREENPEACE PROPOSAL

Even though nuclear reactors pose unnecessary risks on our health and the environment, the decision to close them is not solely based on safety reasons, or on the existence of energy alternatives; there are also economic reasons since dismantling nuclear power plants and managing radioactive waste are involved in the process.

GREENPEACE PROPOSALS

- Do **not grant additional exploitation permits** to operational Spanish nuclear reactors once their actual validity period expires.

- Develop a **new Management Plan for Radioactive Waste** to manage all waste created up to the expiration of the exploitation permits in force. The new plan must include:

  - A technical analysis to consider all alternatives related to radioactive waste management based on the basic principles of maximum security and the best available technologies. Minimize accident risk, have control over repositories of radioactive waste which should be recoverable.

  - An economic and financial analysis based on the principle of intergenerational equity. Said principle states that those generations using nuclear energy have the obligation to maintain the scientific, technical and fi-

Photo: © Greenpeace / Ex-Press / Markus Forte

nancial resources for future generations to execute the main stage of dismantling nuclear installations, as stipulated in the Spanish legal system.

- If alternatives are to be safe, viable, and backed by society, citizens must be informed in a transparent manner and provided with all safety and financial information available so they can be involved.

- Create **a legal framework to fund the dismantling of nuclear plants and manage nuclear waste**. This framework must include:

  - An adequate estimation of costs, both previous to dismantlement as well as during cost reviews along the process. Social impact must be included in the dismantlement costs.

  - The Fund needs to be updated as the actual available funds do not even cover equal 30% of the total funding needed[23], despite the Spanish nuclear park exceeding 84% of its service life when taken in consideration the 40-year reference included in the actual Radioactive Waste Plan.

  - Guarantee the intergenerational equity principle as required by the EU and the Spanish regulation on Environmental Protection making thus necessary for the Financing Fund to be updated annually.

  - The Financing Fund must be provided right from the start with the money necessary to dismantle nuclear power plants regardless of the extent of their service life. With regards to the provision of funds in order to manage radioactive waste, allocation of funds can vary according to life service given that the amount of waste generated depends on how long the service life of nuclear power plants is.

  - Guarantee a cease of operations, for financial or whatever reasons, does not exempt operators from paying the necessary fees to cover all the costs related to the dismantlement of nuclear power plants or the management of nuclear waste generated to date.

23 This percentage is lower than the total cost estimated and does not take the latest update in July 2015 into account which brings it to €17.5 billion, structure costs not included.

- Once the financial impact of managing radioactive waste has been assessed and quantified, **modify articles on tax measures for energy sustainability of Law 15/2012**, of December 27th, so licensees of nuclear power plants pay the costs in their entirety, and they do not fall unjustly on society.

- **Plan, communicate, and invest on revitalizing those regions home of nuclear sites**. Revitalization must be linked to dismantling nuclear installations and citizens must be able to participate in the entire process.

- **Stop immediately the Centralized Temporary Storage** in Cuenca immediately until a new Radioactive Waste Plan has passed.

- Greenpeace supports a **plan to close nuclear power plants** which encourages a change in Spanish energy policy moving towards an efficient, intelligent, sustainable, and 100% renewable system; including a predictable and stable legal framework to make investments in renewables and efficiency attractive.

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GREENPEACE

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