

A Dark Outlook

The aftermath of coal





The **Instituto Internacional de Derecho y Medio Ambiente (IIDMA)** is a non-profit organization registered in Spain and founded in 1996 with the aim of contributing to environmental protection and sustainable development through the study, development, implementation and enforcement of Law from an international and multidisciplinary approach. Since 1998, IIDMA is accredited as observer to the United Nations Environment Programme Assembly. In 2001 it was declared of public interest by the Spanish Ministry of Home Affairs.

Note on the authors:

Ana Barreira López, Director of IIDMA, Graduate in Law (Universidad Complutense of Madrid), LL.M in Environmental Law (London University), LL.M in International Legal Studies (New York University).

Massimiliano Patierno, Environmental Engineer at IIDMA, Graduate in Environmental and Land Planning Engineering (Università La Sapienza of Rome).

Olaya Carlota Ruiz-Bautista, Environmental Lawyer at IIDMA, Graduate in Law and Political Science (Universidad Autónoma of Madrid).

A WORD OF THANKS:

IIDMA would like to thank Lauri Myllyvyrta (Greenpeace International) for his work in the modeling used in this report. We would also like to express our gratitude to the European Climate Foundation (ECF) for its support, which has made the elaboration of this report possible.

This report can be reproduced citing its source: Barreira, A., Patierno, M., Ruiz-Bautista, C., “A Dark Outlook: the aftermath of coal”, Madrid: Instituto Internacional de Derecho y Medio Ambiente (IIDMA), 2019.

Introduction

Air pollution, climate change and human rights

Human beings depend on the environment in which we develop. In order to enjoy rights such as the right to life, health, water and sanitation, among others, an adequate, healthy and sustainable environment is required. Environmental degradation, including air pollution, and the adverse effects of climate change affect the enjoyment of human rights. For this reason, the existence of a close relationship between the protection of the environment and the enjoyment of human rights is recognized, including from a legal point of view.

In 2016, the World Health Organization estimated that one in nine deaths worldwide is the result of air pollution-related conditions¹. In the same year, a World Bank study estimated that the global costs of air pollution exceed \$5 trillion per year².

In 2018 a European Environment Agency report attributed 483,400 premature deaths to air pollution in Europe, amounting to 38,600 in Spain. This data reveals the link between the rights to a healthy life and an adequate environment and the obligation to ensure their protection.

The Special Rapporteur on Human Rights and Environment of the United Nations has stated that "air pollution affects everyone, causing widespread violations of the right to breathe clean air"³. States have obligations to protect the enjoyment of human rights from environmental harm⁴. A group of United Nations experts said "a threat like this can no longer be ignored. States have a duty to prevent and control exposure to toxic air pollution and to protect against its adverse effects on human rights"⁵. Businesses are also obliged to respect human rights in all aspects of their operations, although they are a major source of air pollution⁶.

The link between the enjoyment of human rights and the three dimensions of sustainable development is undeniable, as evidenced by Agenda 2030 and its Sustainable Development Goals⁷. Respect for human rights such as the right to health or a healthy environment and the fight against air pollution are fundamental to achieving many of the SDGs. For example, goal 3 "to ensure healthy lives and promote well-being for all at all ages" and specifically its

target 9: "By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination" evidences this link as well as goals 7⁸ and 11⁹ as some of their targets are also linked to the human right to a healthy environment.

The primary sources of air pollution vary between and within States. The relative importance of ambient and household air pollution varies depending on the level of wealth and availability of resources¹⁰. In Spain the main sources are the burning of fossil fuels by the energy, transport and industry sectors that emit pollutants such as nitrogen oxide, sulphur dioxide and dust together with carbon dioxide which is one of the main greenhouse gases contributing to global warming. Greenhouse gas emissions are also a form of air pollution.

Our country continues to burn coal, one of the most polluting sources of energy, to produce electricity. In 2015, as part of our programme on energy transition and climate change, and with the aim of reducing CO² emissions, as well as emissions of the main pollutants that cause air pollution, IIDMA began its strategy to prevent coal from being used as a source of energy.

Therefore, in 2017 we published our first report "A Dark Outlook: The impacts on health from coal-fired power plants in Spain during 2014". The results of this study were obtained using a mathematical model to simulate the dispersion of pollutants from coal power plants and the methodology of the World Health Organization and Environmental Energy Agency, in a rigorous manner and with data based on an exhaustive research process. The study made it clear that health and economic externalities are factors that until then had not been considered. In addition, the results of the report evidenced with reliable and verifiable data that the pollution generated by coal power plants impacts on health and, therefore, violates the human right to health and a healthy environment.

Our study also linked emissions from coal-fired power plants to impacts on children's health. Specifically, more than 10,000 cases of asthma symptoms in asthmatic children and more than one thousand cases of bronchitis symptoms in children in 2014 were accounted for. This served as a basis for the United Nations Committee on the Rights of the Child to recommend Spain to "36. (...) carry out an assessment of the impact of air pollution from coal-fired power plants on children's health and on the climate as a basis for designing a well-resourced strategy to remedy the situation, and strictly regulate maximum air-pollutant emissions, including those by produced private businesses"¹¹. This recommendation was a result of the parallel report on the impacts of the energy policy in force at the time, which IIDMA submitted to the Committee in 2017. The United Nations Committee on the Rights of the Child therefore highlights the State's obligation to protect children's right to health from emissions from coal-fired power plants and recommends that measures be taken to comply with this obligation.

Since the publication of these concluding observations, there have been significant changes at the policy level that have a positive impact on the preservation of the rights to health and a healthy environment. Thus, the approval of some of the measures of the so-called Clean Energy for all Europeans package, such as the Regulation on the Governance of the Energy Union, facilitates the future National Energy and Climate Plan to introduce measures to impel coal phase-out in our country and, consequently, to ensure our right to health and a healthy environment while reducing the costs that these impacts have on the health system.

However, given that our country has not yet taken concrete steps to ensure that phase-out, we have updated our report "A Dark Outlook: the impacts on health of coal-fired power plants in Spain during 2014" and, with the same technical rigour, we have analysed the impacts of emissions from coal-fired power plants in 2015 and 2016 as well as their costs. These years have been chosen considering the emissions data available at the time of preparing this study. The outcome of this analysis shows that the introduction of this type of measures in the National Energy and Climate Plan is urgent and cannot be postponed.

The report you are reading now is our contribution to the prompt adoption of the necessary measures to guarantee the rights to life, health and a healthy environment in Spain. The omission to adopt them would constitute a breach of the obligations that the Special Rapporteur on Human Rights and the Environment of the United Nations has pointed out

in order to make effective the right to breathe clean air¹². We would like to see that progress takes place towards that direction, otherwise fundamental human rights would be violated, and, at the same time, it would involve great costs that would prevent our country to benefit from the economic, social and environmental returns that the energy transition entails.

Ana Barreira
Director

Instituto Internacional de Derecho y Medio Ambiente

Index

Executive Summary.....	8
1.- Air pollution: the invisible enemy.....	10
1.1. Air quality in the EU: a pending subject.....	10
1.2. Air quality in Spain.....	13
1.3. It is not just health.....	15
2.- The role of coal in electricity generation.....	16
2.1. The predominance of coal worldwide.....	16
2.2. The two sides of the European Union.....	18
2.3. Coal in the Spanish electricity system.....	20
2.4. The future of the energy model: renewable energies and interconnections.....	23
3.- Coal in Spain: an energy without future.....	25
3.1. The closure of coal plants: “the domino effect”.....	25
3.2. The end of coal mining.....	32
3.3. The path towards a just transition.....	33
4.- How coal is impacting our health.....	34
4.1. Coal plants emissions and pollutant dispersion.....	34
4.2. Health impacts and costs.....	38
4.3. Coal emissions make no distinctions.....	40
4.4. Reducing coal burning saves lives.....	45
5.- Recommendations.....	46
References.....	48

Acronyms

AA. CC.	<i>Autonomous Communities</i>
AQG	<i>Air Quality Guidelines</i>
BAT	<i>Best Available Technique</i>
BOE	<i>Boletín Oficial del Estado</i>
BREF	<i>(Spanish Official State Journal) Best Available Technique Reference Document</i>
CNMC	<i>National Commission for Markets and Competition</i>
CJEU	<i>Court of Justice of the European Union</i>
CRF	<i>Concentration – response function</i>
EBC	<i>Europe Beyond Coal</i>
EC	<i>European Commission</i>
ECA	<i>European Court of Auditors</i>
EEA	<i>European Environmental Agency</i>
EIA	<i>Environmental Integrated Authorization</i>
ELV	<i>Emission Limit Value</i>
EU	<i>European Union</i>
GHG	<i>Greenhouse Gas</i>
IEA	<i>International Energy Agency</i>
IED	<i>Industrial Emissions Directive</i>
IPCC	<i>Intergovernmental Panel on Climate Change</i>
LCP	<i>Large Combustion Plant</i>
Mtoe	<i>Million tonnes of oil equivalent</i>
OECD	<i>Organization for Economic Cooperation and Development</i>
PRTR	<i>Pollutant Release and Transfer Register</i>
REE	<i>Red Eléctrica Española</i>
SDG	<i>Sustainable Development Goals</i>
TNP	<i>Transitional National Plan</i>
WHO	<i>World Health Organization</i>

Executive Summary

All human beings have the right to live in an environment adequate for our health and well-being, including the right to clean air. However, since the industrial revolution, the quality of the air we breathe has been deteriorated considerably as a result of human activities.

Air pollution is a global threat that has serious impacts on human health and the environment and, therefore, on the economy. It is mainly caused by the emission of pollutants such as particulate matter (PM₁₀ and PM_{2.5}), nitrogen oxides and sulphur dioxide. The main sources of pollution include the transport sector, industrial activities, the domestic and commercial sector and the energy sector. Most part of the emissions produced by the latter come from coal-fired power generation.

In the last years, a wide number of countries and electricity companies have agreed to abandon the use of this fossil fuel as part of their energy and climate policies. According to the Intergovernmental Panel on Climate Change, coal-fired power generation should be reduced by two-thirds by 2030, and virtually phased-out by 2050. Climate Analytics follows this approach in a study of 2016, which concludes that all coal-fired power plants across Europe should close by 2030 in order to meet the Paris Agreement objectives and avoid the most serious effects of climate change. In the case of Spain, coal-fired power plants must close by 2025, at the latest. However, this fossil fuel continues to play a significant role in the country electricity production, as it represented the third source of electricity generation in 2018.

The change of Government in Spain which took place in June 2018 has meant a change of course in the national energy and environmental policy of the country. However, concrete measures towards the end of coal-fired electricity production have not been adopted yet. Furthermore, considering the country's political uncertainty and the absence of a clear date for coal phase-out, contrary to what already exists in many surrounding countries, there is a risk for coal power plants to continue operating beyond 2025.

The objective of this report is to estimate the health impacts caused by emissions of pollutants from Spanish coal-fired power plants in 2016 as well as their associated costs. Furthermore, considering the decrease of almost 30% in

electricity production from coal between 2015 and 2016, this study also aims to demonstrate how reducing emissions from coal-fired power plants has contributed to improving the health of the population. To achieve this, the study has followed the same methodology used in our previous 2017 report entitled "A Dark Outlook: the impacts on health of coal-fired power plants in Spain during 2014". In the first stage, the dispersion of pollutants (NO₂, SO₂ and particulate matter) was simulated using the CALPUFF mathematical model. This model has enabled to obtain the space-time variations of the concentrations of these pollutants throughout 2015 and 2016 all over Spain. At a later stage, the results of this simulation have been completed with demographic and epidemiological data, and the effects of these emissions on human health have been quantified at provincial, regional and national levels using a methodology recommended by the World Health Organization.

The introduction to this report explores the close relationship between air pollution, climate change and human rights. In its first chapter the report addresses the impacts on health from air pollution, analyzing air quality in the European Union and at national level. The second chapter examines the role of coal in electricity generation at global, European and national levels, while in the third chapter the report analyses the situation of coal-fired power plants and coal mines in Spain and highlights the steps that should be taken to achieve a just transition. Finally, the fourth chapter presents the main results regarding the impacts on health related to the emissions of these plants in 2015 and 2016, and emphasizes how, to a greater or lesser extent, coal affects the entire population and how reducing electricity production with coal contributes to improving the health of the population.

The study shows the following results:

- In **2015** the emissions from coal power plants were responsible for 969 premature deaths, 143 hospital admissions due to cardiovascular diseases as well as 432 due to respiratory diseases, 12,693 cases of asthma symptoms in asthmatic children, 1,282 cases of bronchitis in children and 467 cases of chronic bronchitis in adults. In addition, they were responsible for 830,248 restricted activity days and 249,421 work days lost. These impacts had associated economic costs of between 1,185 and 2,260 million Euros.

- Between 2015 and 2016 there was a reduction in coal-fired power generation of almost 30%. This contributed to reducing the impacts on health from coal-fired power plants emissions in 2016 by almost 40.5%, compared to the previous year. This reduction also saved the Spanish society between 499 and 952 million Euros.

- In **2016**, the emissions from coal-fired power plants in Spain were responsible for 560 premature deaths, the majority resulting from PM_{2.5}. In addition, 255 hospital admissions due to respiratory diseases and 84 for cardiovascular diseases were quantified, together with 273 cases of chronic bronchitis in adults. These emissions also had impacts on the health of children, with an estimated 7,419 cases of asthma symptoms in asthmatic children and 784 cases of bronchitis in children. Finally, 520,153 restricted activity days and 122,131 work days lost were quantified. Overall, the economic costs associated to these impacts reached an amount between 686 and 1,308 million Euros.

- Health impacts related to emissions from coal-fired power plants do not occur only in places where these plants are located, but also, to a different extent, all over Spain. Nonetheless, more impacts can be accounted in those places where one or more plants are located, as well as in nearby territories.

In light of the above, the *Instituto Internacional de Derecho y Medio Ambiente* makes the following recommendations:

- **Putting an end to air pollution should be one of the highest priorities of both governments and electricity companies**, due to its impacts on the health of the population. To this end, and acknowledging that within the Spanish energy system, electricity production with **coal is the one causing more impacts, it is necessary to take immediate measures to eliminate this fossil fuel as a source of electricity by 2025.**

- **It is essential to include this date in a legally binding instrument. Both the future Climate Change and Energy Transition Law or the National Energy and Climate Plan are suitable for this purpose.** However, in this sense, the draft of this plan which was sent to the European Commission on 22 February 2019 is not ambitious as it does not include a date for coal phase-out and only includes a possible scenario for this phase-out to occur by 2030.

- The closure of coal plants planned for June 2020 must become a reality. To this end, **the requests for closure already submitted by the operators must be authorised by the General State Administration.**

- The **regional administrations**, which will review the environmental permits of all coal plants that continue to operate after the finalization of the Transitional National Plan, **must establish in these permits the stricter emission limit values** based on the Large Combustion Plant Best Available Technique Reference Document.

- During the time that these plants continue in operation, **the owner companies must guarantee that the coal comes from suppliers which offer enough guarantees to ensure that their operations do not violate human rights in the places where coal is extracted from.** This is particularly relevant in countries such as Colombia, Russia or Indonesia from where Spain imports more than 70% of the coal.

- In order to provide citizens with enough information on health impacts caused by coal plants emissions, **it is urgent to provide real-time information on these emissions.**

- In order to reduce pollution levels, **it is necessary to take the World Health Organization guideline values as a standard.** These must become mandatory in our country since the ones established by EU legislation are not enough to avoid the serious consequences that pollution has on the health of citizens.

Chapter 1

Air pollution: the invisible enemy

Air pollution is a global threat that has serious implications for human health. Reducing it would save millions of lives each year.

To enjoy rights such as the right to life, health, water and sanitation, among others, an adequate, healthy and sustainable environment is necessary. Clean air is a basic requirement of human health and well-being and, therefore, of the right to health. However, since the industrial revolution the quality of the air we breathe has been deteriorated considerably because of human activities. As a result, air pollution today is a major environmental risk to health.

According to the World Health Organization (WHO), outdoor air pollution due to $PM_{2.5}$ was responsible for 4.2 million

premature deaths worldwide in 2016, and around 91% of those deaths occurred in low- and middle-income countries.

Approximately 58% of these premature deaths were due to ischaemic heart disease, including strokes, 18% were due to chronic obstructive pulmonary disease and acute lower respiratory infections, while 6% were due to lung cancer¹³. Furthermore, the WHO estimated that outdoor air pollution was related to about 300,000 premature deaths in children under 5 years of age¹⁴.

1.1. Air quality in the EU: a pending subject

According to statistics published by the European Commission (EC), air pollution represents, after climate change, the second biggest environmental concern of European citizens¹⁵. Even though air quality has improved over the last few decades due to the adoption of specific environmental policies and measures, in European Union (EU) countries this sort of pollution continues to have a negative impact on a large part of the population, especially in urban areas.

According to the latest annual report on air quality of the European Environment Agency (EEA)¹⁶, the exposure to air pollution caused by $PM_{2.5}$, nitrogen dioxide (NO_2) and tropospheric ozone (O_3) was related to approximately 483,400 premature deaths in the EU in 2015. The most affected countries were Italy and Germany, with 84,300 and 78,400 premature deaths respectively. Spain ranked sixth with 38,600 premature deaths recorded. Most of these deaths (80.9%) were due to long-term exposure to $PM_{2.5}$. This pollutant is associated with numerous cardiovascular and respiratory diseases, as it manages to penetrate deep

into the respiratory system due to its small size. Its smallest fraction ($PM_{0.1}$) even reaches the alveoli, where the exchange of gases takes place and, therefore, can pass into the bloodstream causing very harmful effects on health. In addition, around 15.7% and 3.4% of total premature deaths were attributed to NO_2 and O_3 , respectively. As for O_3 , it must be pointed out that it is a secondary pollutant, as it is not emitted directly into the atmosphere, but is formed by chemical reactions in the environment from precursor gases, mainly NO_x and volatile organic compounds (VOCs), in the presence of sunlight.

Furthermore, the EEA indicates that the major contributors to this pollution are transport, industry, fossil fuel electricity generation, the domestic sector and agriculture. In 2016, the commercial, institutional and domestic sectors were the largest contributors to total EU emissions of $PM_{2.5}$ (56%) and PM_{10} (39%). They also contributed significantly to emissions of sulphur oxides (SO_x) (17%) and NO_x (14%).

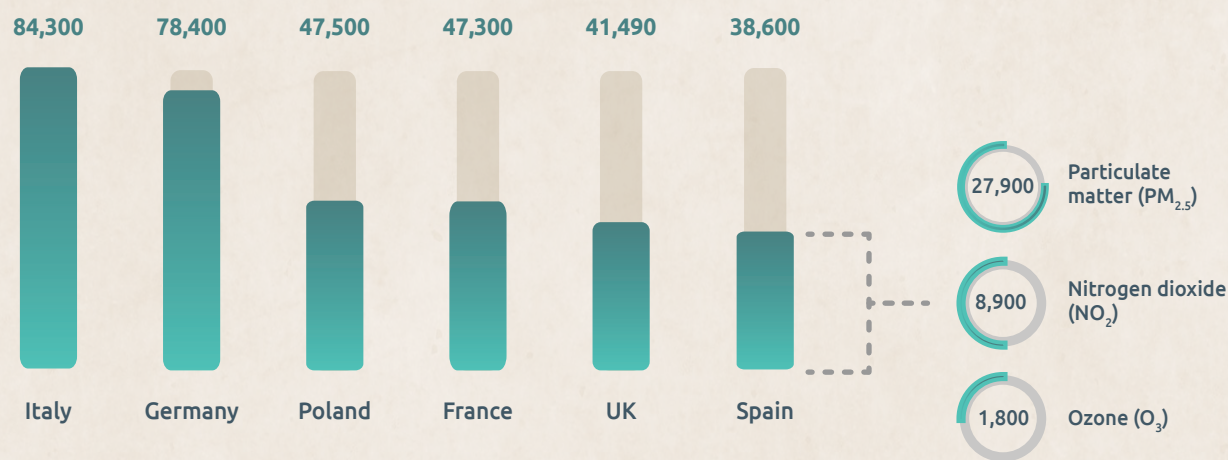


Figure 1 - Premature deaths related to air pollution in the EU (2015). (Source: EEA)

By contrast, the road transport sector was the largest contributor to total NO_x emissions (39%), in addition to PM_{2.5} (11%) and PM₁₀ (10%). Energy production and distribution was the largest contributor of SO_x (51%) and a significant contributor of NO_x (17%). Energy use in the industrial sector contributed significantly to SO_x emissions (20%), while the industrial processes and product use sector was responsible for significant PM₁₀ emissions (19%). As for the agricultural sector, it mostly contributed to PM₁₀ emissions (15%)¹⁷.

As a result of these emissions, most of the European population was exposed to levels of pollution that the WHO considers harmful, as they are above those recommended in its Air Quality Guidelines (AQG). AQG are based on a broad variety of scientific evidence relating to air pollution and its health impacts. They set the recommended thresholds and limits for the main ambient air pollutants that must be met to protect human health. AQG were last updated in 2005¹⁸ and are now under review. Its publication is planned for 2020.

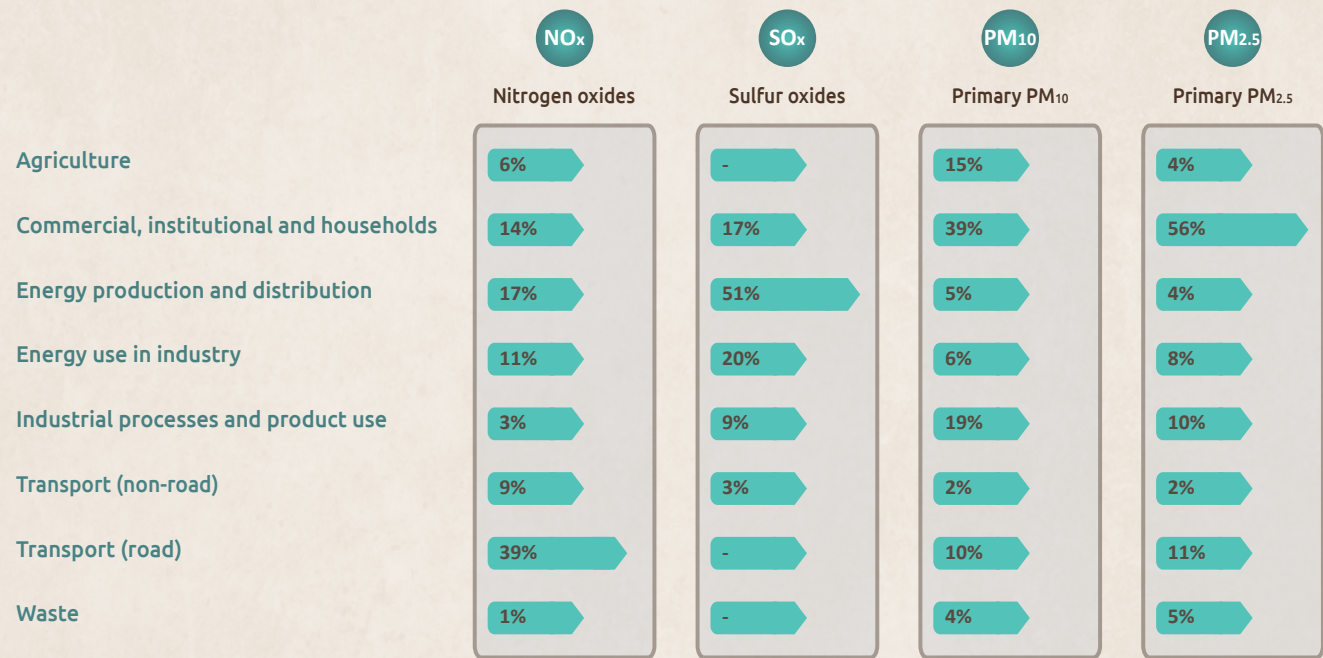


Figure 2 - Contribution to air pollution by sectors (2016). (Source: EEA)

Despite this, the limit values of pollutants for the protection of human health set by the EU in Directive 2008/50/EC¹⁹ on ambient air quality are, in large part, more permissive than those recommended by the WHO.

This explains why the EEA, when assessing the percentage of urban population in the EU exposed to pollution levels harmful to health, takes as a reference both the values set by the EU and those established in the AQG. The purpose of the EEA is to inform the public bearing into account limit values that are in line with adequate health protection, irrespective of whether EU legislation establishes them or not. In this regard, the EEA estimated that 6% of the EU urban population in 2016 was exposed to PM_{2.5} levels above the annual limit value set by the EU Directive (25 µg/m³), and approximately 74% were exposed to concentrations above the recommended value by the WHO (10 µg/m³). In the case of O₃, about 12% of the EU urban population was

exposed to concentrations above the EU limit value (120 µg/m³). However, if the WHO value (100 µg/m³) is considered, the referred percentage rises to 98%. Regarding NO₂, around 7% were exposed to an annual limit value higher than the one set by the EU Directive and the WHO (40 µg/m³), as both set the same one.

Although measures have been taken to improve air quality, they have clearly been insufficient. More ambitious measures are needed to reduce air pollution, as it has higher impacts on our health than we believe. To this end, public authorities, political representatives and all sectors of the economy at EU Member States must take a strong and urgent commitment towards a real ecological transition of the economy. This is the only way to significantly reduce pollution and consequently, improve citizens' health.



Figure 3 - Pollutant limits recommended by the WHO and Directive 2008/50/EC and percentage of population exposed in the EU (2016). (Source: EEA)

The European Court of Auditors (ECA) special report 23/2018 on air pollution, published in September 2018²⁰, follows this approach and indicates that, although EU policies have contributed to reducing emissions, air quality has not improved at the same rate. Among other issues, this is due to the fact that most Member States fail to comply with EU air quality standards and are not taking measures effective enough to improve air quality. The report also concludes that EU air quality standards are much weaker than the WHO guidelines and the recommendations of the latest scientific studies. As a result, pollution continues to have a significant impact on public health. Among the ECA recommendations, they suggest:

- a) To consider an ambitious update of the Ambient Air Quality Directive to bring it into line with the latest WHO guidance and reduce the number of cases in which the concentrations of pollutants may exceed standards,
- b) The adoption by the EC of more effective action to improve air quality by mainstreaming the air quality policy into other EU policies in order to align them with the air quality objective, and
- c) Improving the quality of the information provided to citizens to increase public awareness.

1.2. Air quality in Spain

Each year, Spain prepares and publishes a report on air quality to comply with the obligation contained in Article 26.2 of Directive 2008/50/EC. This legal provision requires to make available to the public annual reports concerning all pollutants covered by that Directive²¹, and the results must be submitted to the EC. The assessment of air quality is undertaken on the basis of the data generated by air quality monitoring networks at state, regional and local levels. Furthermore, this assessment provides the necessary information for the different administrations to adopt, within their areas of competence, the required measures for preventing, monitoring and reducing air pollution.

However, as stated by the ECA special report 23/2018, data gathered through the referred annual report is difficult to verify. This is, mainly, due to the fact that criteria on the location and number of sampling points of air quality networks are too flexible. The ECA, thus, proposed to be more precise in the requirements for locating industrial and traffic measuring stations in order to better measure the maximum exposure of the population to air pollution, and to establish a minimum number of measuring stations by type (traffic, industrial or background).

Furthermore, the information contained in this report when assessing ambient air quality, is based on the values set in Directive 2008/50/EC which, as previously said, are not in line with an adequate protection of human health. In this

regard, the report on air quality in Spain published each year by the organization *Ecologistas en Acción* aims to draw a broad and accurate picture of the situation of air quality in Spain and its relation to human health protection, among others. Based on the findings of its last published report²², in 2017 around 30 million people were exposed to levels of $PM_{2.5}$ and PM_{10} above the annual value indicated by the WHO. For NO_2 and SO_2 , around 11.2 and 6.1 million were affected, respectively. However, the largest fraction of the population (38.1 million) was affected by O_3 .

Nevertheless, excluding NO_2 , the number of people exposed decreases drastically if the less stringent limits set by the Air Quality Directive are applied. In particular exposure to PM_{10} would be reduced by 95%, and almost 70% for O_3 . Above all, it should be noted that the population exposed to values of $PM_{2.5}$ and SO_2 considered harmful to health would be 0%.

In Spain, the limits laid down in the Ambient Air Quality Directive have been systematically exceeded in recent years, especially in urban areas. A key example is the case of the city of Madrid which, since 2010, has continuously been in breach of the legal limit values for NO_2 . This has led the EC to initiate an infringement proceeding against Spain in 2015²³. According to the Ambient Air Quality Directive, where in given zones or agglomerations, the levels of pollutants in ambient air exceed any limit value set therein, air quality plans shall be established for those areas. In this regard, after the Madrid City Council decided to adopt its “Plan A”, which includes measures such as a new Anti-Pollution Protocol or the establishment of a zero-emissions area, among others, in May 2018 the EC decided not to bring Spain to the Court of Justice of the European Union (CJEU). However, the EC continues to monitor exhaustively the implementation and effectiveness of these measures.

In this line, in its special report 23/2018 the ECA recognized that most air quality plans were not designed as effective monitoring tools. In order to improve air quality, the ECA therefore recommended improving the Air Quality Plans, and the requirement to submit annual reports concerning their implementation and update. Another problem identified in this report referred to the fact that plans were not accompanied by an estimation of costs, and thus many times there was a lack of resources to finance their implementation.

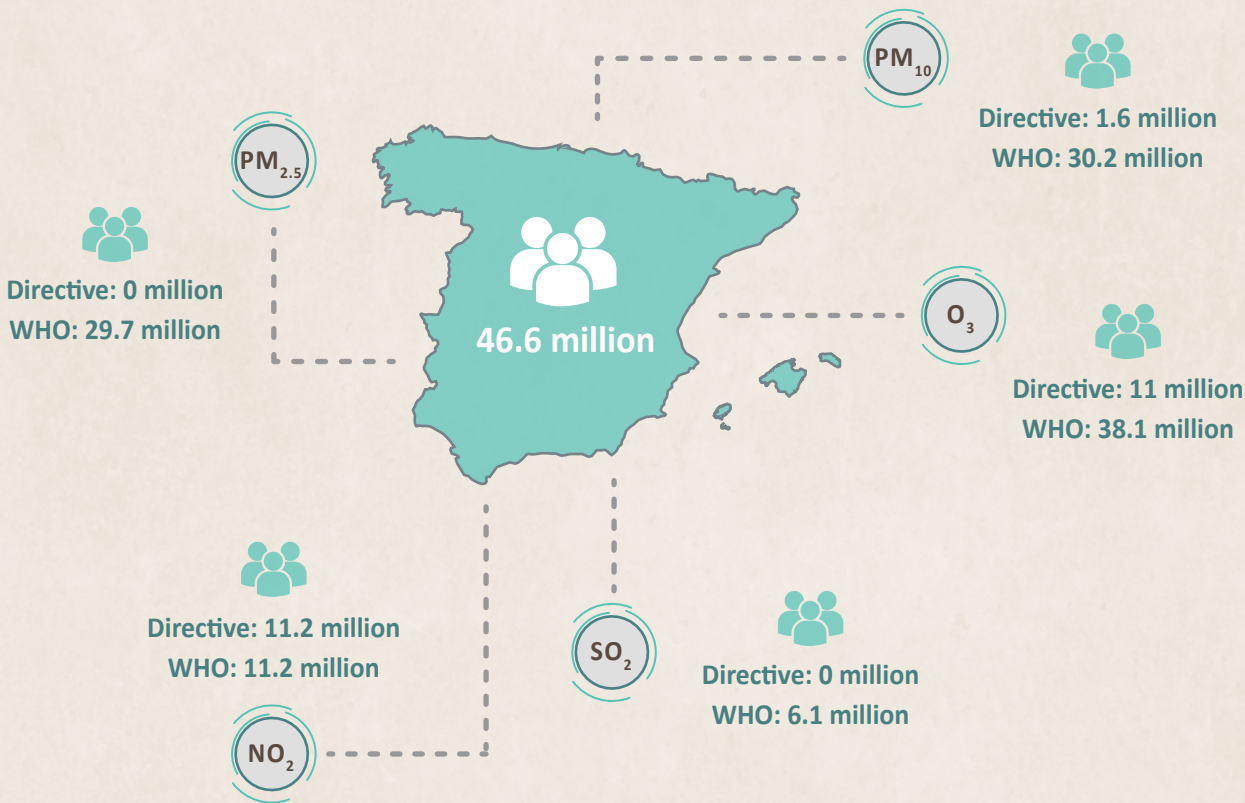


Figure 4 - Population exposed to pollutant limits considered harmful by the WHO and Directive 2008/50/EC (2017).
(Source: Ecologistas en Acción)

1.3. It is not just health

Air pollution also has significant impacts on the environment, as it can directly affect the flora and fauna, as well as the quality of water and soil, including the ecosystems they contain. In particular, the pollution produced by SO_x and NO_x also contributes to climate change. While SO_x contributes to the formation of aerosols that can have consequences on the climate, NO_x is a precursor of O₃, which is a greenhouse gas.

In addition, SO_x and NO_x pollution is responsible for acid rain, which can lead to biodiversity loss due to the acidification of soil and water bodies. It is also associated with events such as eutrophication, caused by an excess of nutrients in an aquatic ecosystem, mainly nitrogen and phosphorus. Such excess of nutrients makes plants and other organisms grow in abundance, consuming a large amount of oxygen dissolved in the water and creating abundant organic matter. This not only affects the quality of

water, but may also lead to changes in species diversity, as invasive species take advantage of changing water conditions and end up displacing local organisms. Finally, the change in water conditions may cause the appearance of bacteria which produces lethal toxins for birds and mammals.

In addition, tropospheric ozone can lead to a reduction in the growth rates of agricultural crops, as it interferes with the photosynthetic and metabolic processes of the plant. This leads to a decrease in yield with the associated economic losses.

Chapter 2

The role of coal in electricity generation

Putting an end to coal-fired power generation is one of the most important steps that governments and electricity companies must take in the fight against climate change and air pollution.

Nowadays, electricity is a major need that we cannot do without. However, the obligation to put a stop to global warming and decrease the levels of air pollution, have led to the need to undertake a process of decarbonization of the energy model at global level. This process necessarily implies putting an end to coal combustion.

Most of the emissions from the electricity sector come from coal-fired generation. Throughout the years, a wide number of countries and electricity companies have agreed, as part of their energy and climate policies, to abandon the use of coal. Thus, 30 governments at national level, 22 regional governments and 28 companies and organizations are already part of the Powering Past Coal Alliance (PPCA), a

global alliance formed by governments, companies and organizations, which was promoted by the governments of Canada and the United Kingdom in the framework of COP 23 of the United Nations Framework Convention on Climate Change in November 2017. The PPCA has the goal of promoting energy transition from unabated coal power generation to clean energy. However, there are still many other countries, especially in South and Southeast Asia, for which coal remains one of the main sources of electricity production, as this fossil fuel is considered as an indigenous and affordable source of energy²⁵.

2.1. The predominance of coal worldwide

As of today, coal still remains one of the world's main sources of primary energy, despite being highly polluting. After three consecutive years where global coal consumption decreased, it increased again by 1% in 2017, reaching 3,731 million tonnes of oil equivalent (Mtoe)²⁶. This increase was mainly due to an increase in both industrial and electricity production, caused by global economic growth.

During that year, coal was the second source of primary energy, after oil. China was responsible for consuming more than 50%, followed by India (11.4%) and the United States (8.9%). Spain consumed a total of 0.4%, corresponding to 13.4 Mtoe of coal.

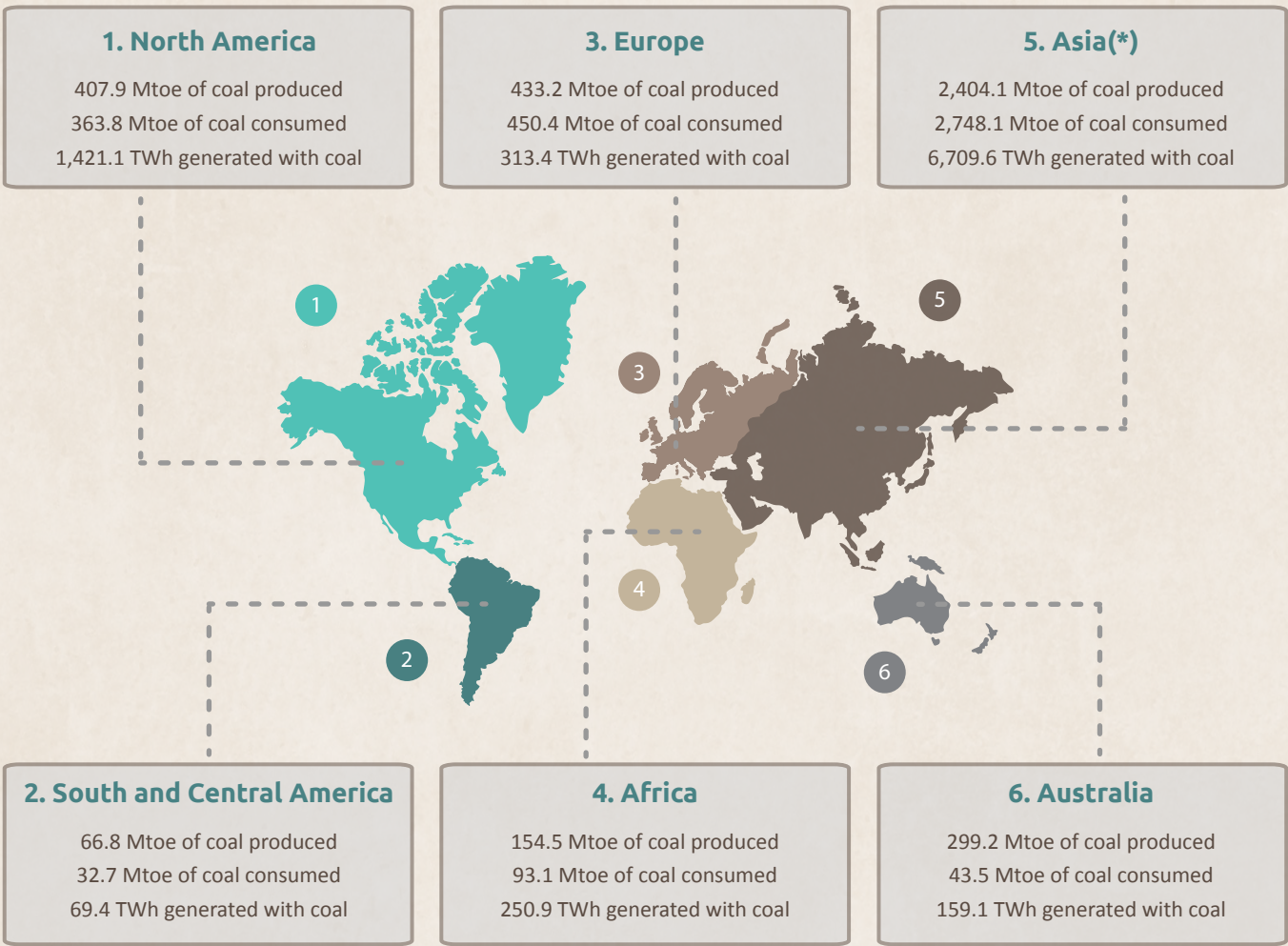
The International Energy Agency (IEA) considers it likely that coal global demand will remain stable until 2023, as in the coming years a reduction in demand is expected in Western Europe and North America, which will be offset by an increase in India and other Asian countries, mainly Indonesia, Vietnam, the Philippines and Malaysia.



Despite not being the main source of primary energy, coal remains the most widely used fuel for electricity production. According to the latest official data available, installed capacity of coal-fired generation in 2017 reached 2,067 gigawatts (GW) worldwide, accounting for 29.7% of the total installed capacity²⁷. That same year, coal-fired power plants generated almost 9,860 terawatt-hours (TWh), corresponding to 38% of global electricity. Coal-fired power generation is the main contributor to CO₂ emissions in the electricity sector, which in 2017 were 1.4 % higher than in the previous year²⁸.

However, in addition to releasing large amounts of CO₂ into the atmosphere, these installations are also responsible for the emissions of many other harmful pollutants to human health and the environment, as discussed in the previous chapter.

If we want to achieve the Paris Agreement objective of limiting global temperature increase to well below 2°C compared to pre-industrial levels, between 80 and 90% of existing coal reserves must remain underground²⁹. The latest report of the Intergovernmental Panel on Climate Change (IPCC) calls for a two-thirds reduction in coal power generation in 2030 and a near-total elimination by 2050³⁰. In particular, by 2030, all EU and OECD countries must have phased-out coal³¹. Furthermore, according to the UN Environment Emissions Gap Report 2017, building new coal infrastructure would be a serious mistake. There is no doubt that we are still a long way from complying with these recommendations.



(*) In this figure Russia has been included as part of Europe.

Figure 5 - Coal in electricity generation worldwide (2017). (Source: BP)

2.2. The two sides of the European Union

Electricity generation in the EU still depends heavily on non-renewable energy sources. Among fossil fuels, coal was the main source of electricity production in 2018, with a share in the energy mix of 19.2%³². Coal power plants across different Member States reached an installed capacity of 153.2 GW. Of these, 48 GW belonged to Germany, followed by Poland (28.7 GW), the United Kingdom (12.6 GW) and Spain (10.4 GW)³³.

Despite its important role in the EU energy mix, coal-fired power generation has been increasingly questioned due to both its significant contribution to climate change and to the air pollution it generates. In 2016 alone, the 250 coal-fired power plants in the EU were responsible for 11,910 premature deaths, 5,482 cases of chronic bronchitis in adults and 231,099 asthma attacks in children, together with 9,168 hospital admissions and almost four million work days lost³⁴.

Environmental and energy laws and policies promoted both at EU level and by the different Member States have among their objectives to reduce greenhouse gas emissions and air pollution. This necessarily involves imposing stricter emission limits for combustion plants, increasing the price of CO₂ emission rights, putting an end to State aid for fossil fuels and promoting renewable energies, which are becoming increasingly competitive. All this impacts

negatively on coal-fired electricity generation. This energy transition process towards a decarbonized model with no room for coal has already started in some countries, although it is not being carried out at the same speed within the whole EU.

In Western Europe, an accelerated process towards coal phase-out is now underway. Belgium closed its last coal-fired power plant in 2016. Since then, ten other countries have also announced an official date for coal phase-out. Among the most ambitious are France (2021) and Sweden (2022), while Austria, Ireland, Italy and the United Kingdom have set 2025 as the deadline. Other countries that have announced that they will abandon coal are Finland and the Netherlands, both in 2029, and Denmark and Portugal, both in 2030. This represents the withdrawal of around 39.64 gigawatts (GW), which corresponds to 25% of the coal fleet currently operating in the EU. In addition, it will lead to a significant reduction in pollutant emissions and thus a significant improvement for human health and the environment.

Coal phase-out announced

10

Austria (2025), Denmark (2030), Finland (2029), France (2021), Ireland (2025), Italy (2025), Netherlands (2029), Portugal (2030), UK (2025), Sweden (2022)

No phase-out under discussion

7

Bulgaria, Croatia, Slovenia, Greece, Poland, Czech Republic, Romania

Coal phase-out under debate

4

Germany (2038), Slovakia (2023), Spain (2025), Hungary (2030)

No coal plants

7

Belgium, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Malta

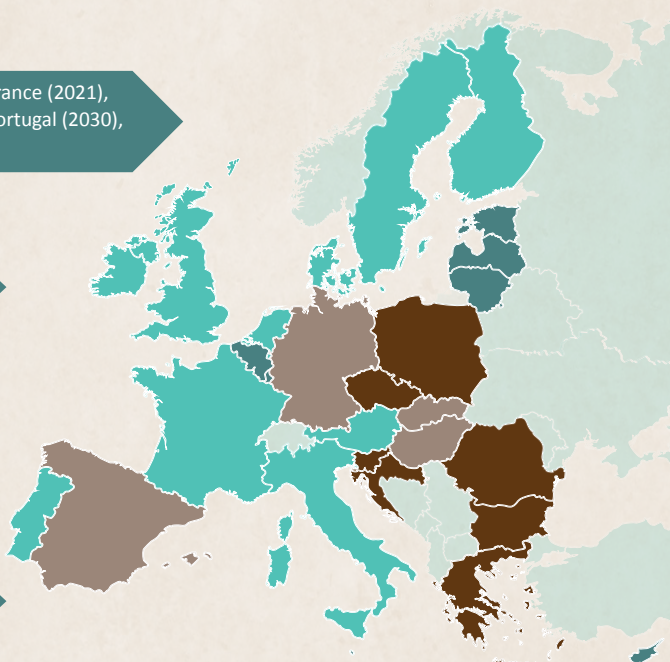


Figure 6 - The future of coal in the EU. (Source: Europe Beyond Coal)

However, according to data from the IEA, by 2023 Germany is expected to be the only remaining major coal consumer in Western Europe. This country, together with Slovakia, Spain and Hungary, has not reached a firm commitment to phase-out coal. However, discussions are currently underway in all of them. Although the report of the German Commission on Growth, Structural Change and Employment was published in 26 January and recommended 2038 as the date to phase-out coal, this report is not binding and the German Government has yet to decide whether or not to endorse it. However, it is necessary to underline that this proposal is far from achieving the goal of the Paris Agreement to keep the global temperature well below 2°C. Spain, should be the next EU country to make a firm commitment to phase-out coal by 2025 at the latest, including that date in its final version of the National Energy and Climate Plan (NECP), whose first draft was submitted to the EC on 22 February, without having previously undergone the public participation procedure required by the Aarhus Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters³⁶, to which Spain is a Party³⁷.

Regarding the remaining EU countries, there is still strong support for coal-fired electricity generation and they are far from adopting measures for its gradual phase-out. In fact, countries such as Poland or Greece are already building or are planning to build new plants, with the intention of continuing to burn coal even until 2050.

Without a doubt, in order to meet the objectives of the Paris Agreement, it is necessary that all EU countries phase-out coal by 2030. To achieve this, an in-depth restructuring of the energy sector in all Member States is needed. Governments must therefore adopt and subsequently implement much more ambitious, detailed and transparent energy policies. These policies must contain clear targets for emission reduction, renewable energy penetration, energy efficiency, and interconnections. They should also contain medium and long-term milestones demonstrating how these targets will be achieved, including clear scenarios showing how coal will be phased-out by 2030. In addition, the 103 electricity companies with coal-fired plants within the EU must include clear decarbonization commitments in their business strategies, detailing how they are to be achieved. These commitments must necessarily include no further investment in new coal infrastructure.

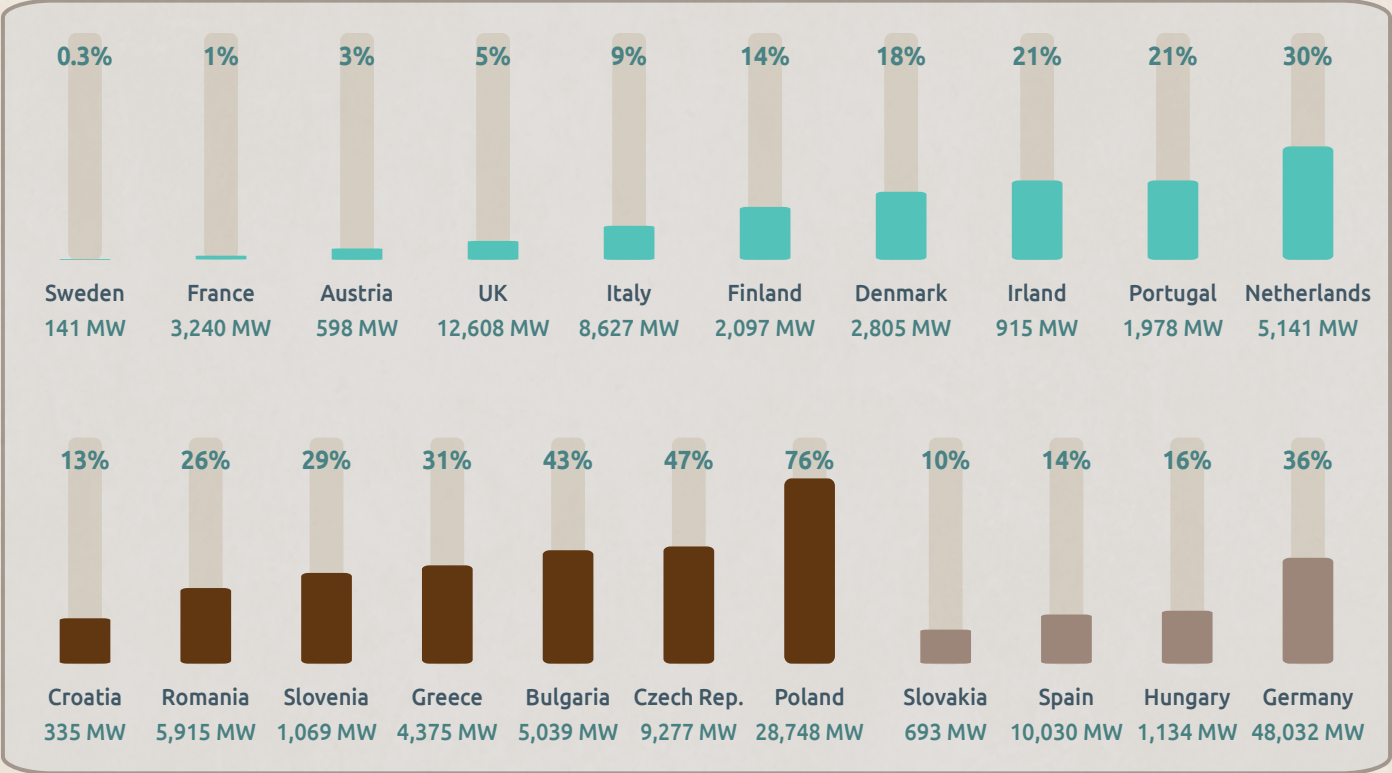


Figure 7 - Installed capacity of coal (MW) and its contribution to the electricity sector (%) in the EU (2018). (Source: Sandbag)

2.3. Coal in the Spanish electricity system

At the end of 2018, the Spanish electricity generation system had a total installed capacity of 104,053 MW - slightly lower than the previous year (-62 MW). This capacity is divided between the mainland system (98,593 MW) and non-mainland systems (5,460 MW). The latter are made up of the Balearic Islands system, the Canary Islands system and the Ceuta and Melilla systems.

Despite the increase in the installed capacity of renewable energies, with an increase of 336 MW of wind power and 19

MW of solar PV, among others, most of the installed capacity (53.3%) belonged, once again, to non-renewable energy sources.

Despite a reduction of almost 400 MW of combined cycle generation due to the closure of a plant in Tarragona owned by Viesgo, this technology continued to have the highest installed capacity, followed by wind and hydro. Far behind are nuclear, cogeneration and solar (PV and thermo-solar) power plants.

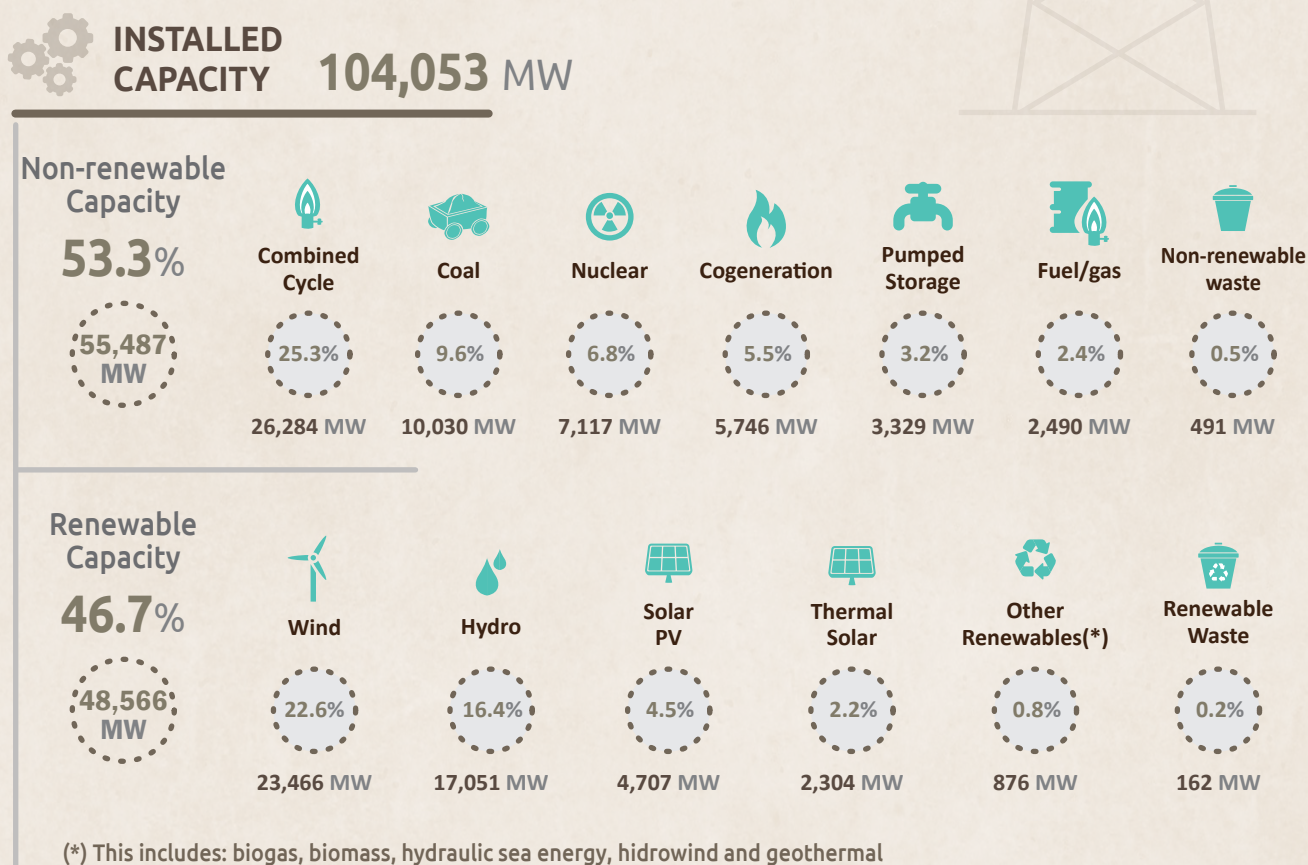
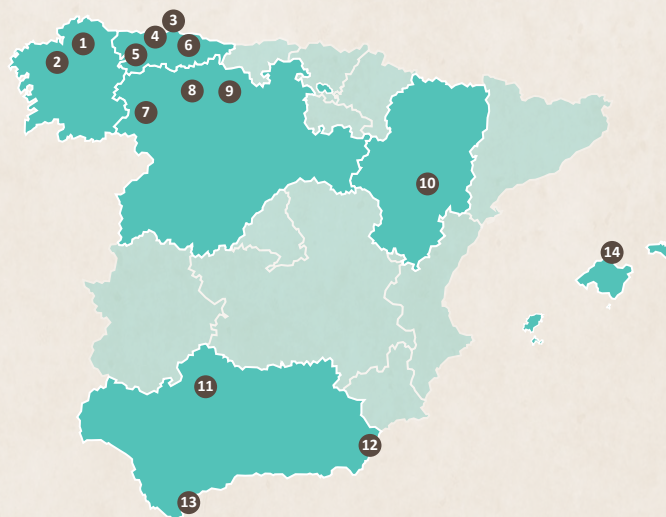


Figure 8 - Installed capacity in the national electricity system by 31 December 2018. (Source: REE)

Regarding coal, in 2018 it was the fourth source in terms of installed capacity. There was a total of 15 coal power plants in operation throughout the country³⁸ amounting to 10.3 GW³⁹, which represented 9.6% of the total capacity in Spain. However, on 1 December, Anllares⁴⁰, a coal plant of 350 MW located in León and owned by Naturgy and Endesa, was shut down. Therefore, as of March 2019, coal capacity in Spain amounts to 9.6 GW. Coal plants are located in 6 autonomous communities (AA.CC.) and make Spain the fourth country in the EU with the highest number of coal-fired power plants, behind Germany, Poland and the Czech Republic⁴¹.



	Province	Operator	Net installed capacity (MW)
1 As Pontes	La Coruña	Endesa	1,403.3
2 Meirama	La Coruña	Naturgy	557.2
3 Aboño	Asturias	EDP España	903.7
4 Soto de Ribera	Asturias	EDP España	346.3
5 Narcea	Asturias	Naturgy	501.8
6 Lada	Asturias	Iberdrola	347.7
7 Compostilla	León	Endesa	1,005.2
8 La Robla	León	Naturgy	619.1
9 Velilla	Palencia	Iberdrola	485.6
10 Andorra	Teruel	Endesa	1,055.7
11 Puente Nuevo	Córdoba	Viesgo	299.8
12 Litoral de Almería	Almería	Endesa	1,119.6
13 Los Barrios	Cádiz	Viesgo	570.1
14 Alcudia	Balears	Endesa	468.4

Figure 9 - Coal plants currently operating in Spain (March 2019). (Source: Own elaboration)

In terms of generation, coal was the third source with 37,274 GWh produced of a total of 260,906 GWh. This corresponded to 14.3% of total generation. With respect to the previous year, coal decreased its contribution by 17.2% in both the peninsular and non-peninsular system of the Balearic Islands⁴².

However, it is necessary to highlight the decreasing role which indigenous coal has played in the energy mix over the years. According to the latest official data available, in 2017 it only represented 2.3% while imported coal reached up to 14.9%⁴³. According to the former Ministry of Industry, Energy and Tourism (MINETUR), imports of thermal coal to Spain in 2017 amounted to 19,178 million tonnes (Mt) and came mainly from Russia (26.37%), Colombia (23.82%) and Indonesia (22.2%)⁴⁴. However, multiple examples of human

rights violations in relation to mining activities have been identified in these countries. In fact, the Bettercoal initiative defines them as “high-risk” countries, including in this category those at risk on the following fields: “social, environmental, governance and reputation risk”⁴⁵.

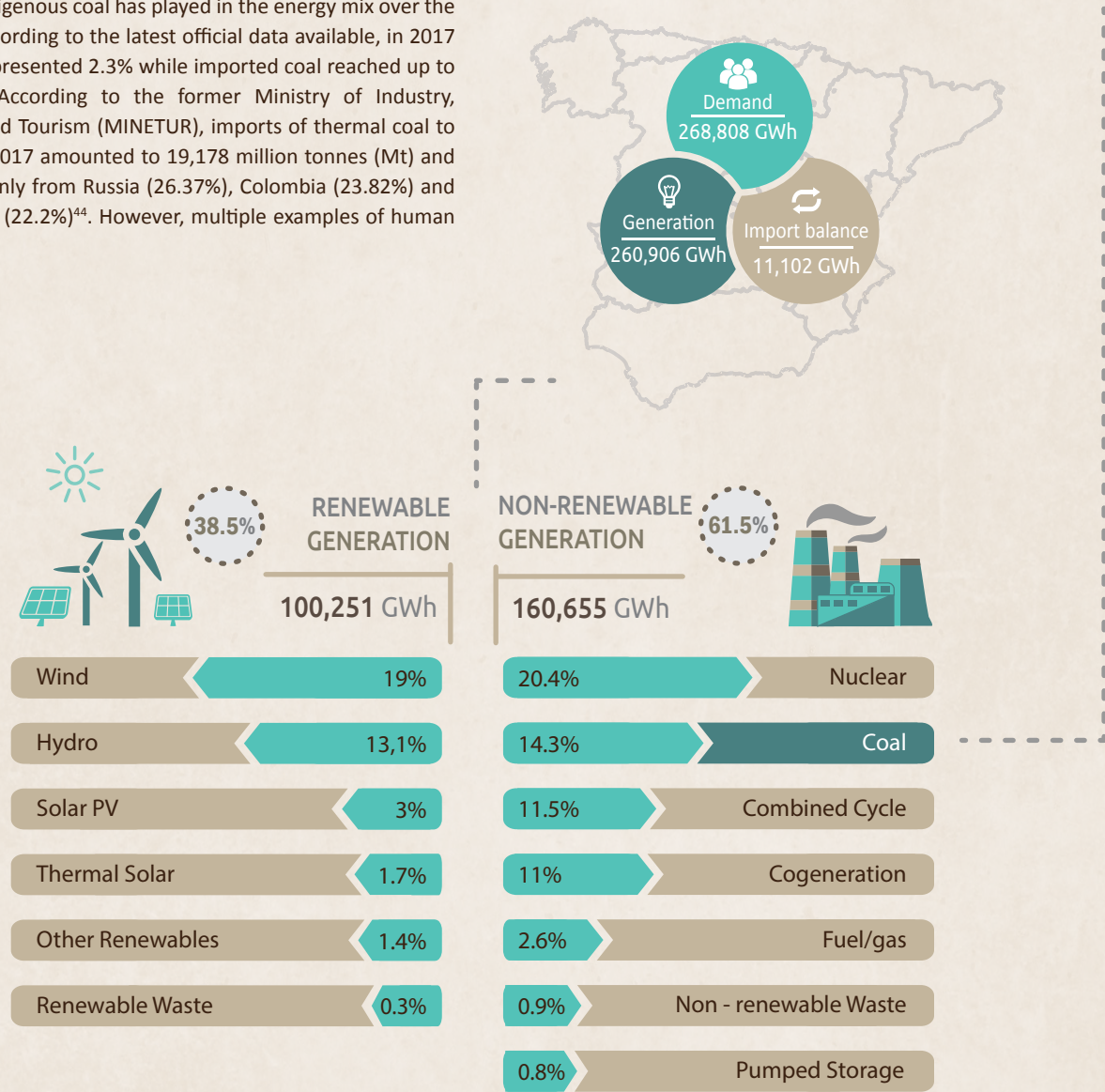


Figure 10 - Data on electricity generation in Spain (2018). (Source: REE)

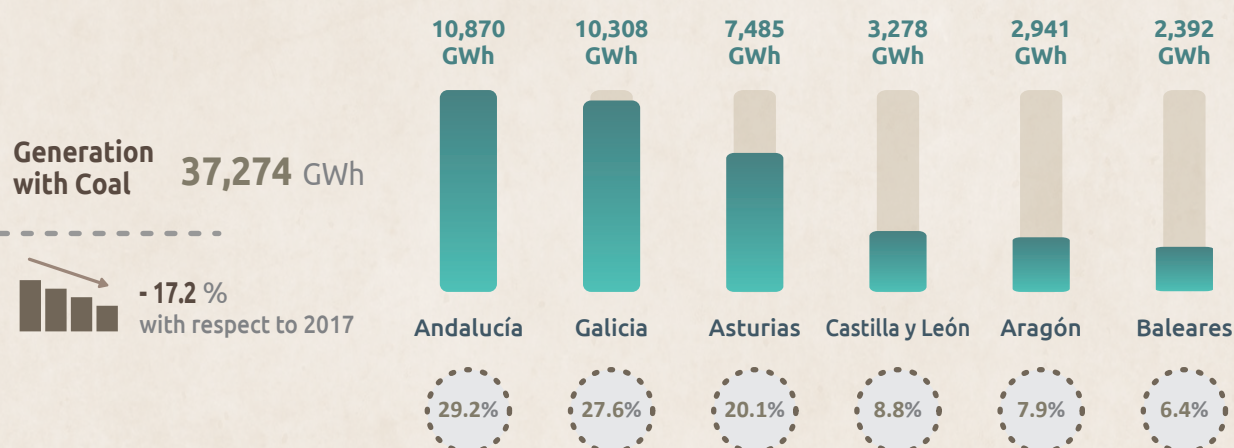


Figure 10 (continuation) - Data on electricity generation in Spain (2018). (Source: REE)

2.4. The future of the energy model: renewable energies and interconnections

To reduce emissions and advance in the decarbonization process, one of the fundamental measures is to achieve a greater integration of renewable energies in the electricity system and to strengthen international interconnections.

In its 2020 Climate and Energy Package, the EU set a binding target by which at that date, 20% of the EU's gross final energy consumption⁴⁶ should come from renewable sources. To achieve this target, each Member State adopted a binding national target to increase the share of renewable energy in its energy consumption. These targets range from 10% in Malta to 49% in Sweden, while Spain has a target of 20%⁴⁷. According to the latest information published in Eurostat, the total share of renewable energy in the gross energy consumption of the EU reached 17.5% in 2017⁴⁸. However, there are still countries that are far below their 2020 targets, such as the Netherlands, France, the United Kingdom and Poland, among others. In the case of Spain, energy from renewable sources represented a 17.5% in 2017. The share of renewable energy in total energy consumption has increased from the 8.3%, registered in 2004. However, from 2016 to 2017 it increased by only one tenth, going from 17.4% to 17.5%. Spain should install, before 2020, around 8,000 MW of renewable power to reach its 2020 target set by the EU⁴⁹. The three renewable

energy auctions held in 2016 and 2017, which together totaled 8,737 MW and ended the standstill of several years in which there were no increases in installed renewable power, would allow Spain, in principle, to achieve this objective. However, they were held late and without planning and, to date, it seems unlikely that Spain will reach its target, due to bureaucratic and technical difficulties⁵⁰.

With regards to the 2030 horizon, the current binding target for all Member States is 32%, although a review of this target is planned for 2023 at the latest, which can only be increased⁵¹. This review will depend on the reduction of costs in the production of renewable energy, the Union's international commitments for decarbonization, or a significant reduction in energy consumption in the Union⁵².

Each Member State should set out its contribution to achieving this target as part of its NECP. Spain intends to be among the countries that contribute most to it, as it has expressed its willingness to increase the share of renewables to 42% by 2030. In order to reach this threshold, Spain will have to around 60,000 MW of renewable energies, which will involve an investment estimated by the Government of approximately 101,636 million Euros.

This is one of the milestones reflected in the draft NECP sent by Spain to the EC on 22 February 2019, which leaves behind the "improvisation" that has marked the country's energy policy in recent years.

Another essential element for an electricity system to work properly is the strengthening of international interconnections, especially for peripheral countries such as Spain. A greater capacity for electricity exchange with neighboring countries brings multiple benefits: it not only favors a better integration of renewable energies, since it allows the variability of their generation to be compensated, but also contributes to the security and continuity of the electricity supply in the interconnected systems. The EU recommends that all Member States reach a minimum interconnection ratio of 10% by 2020⁵³, and a minimum of 15% by 2030⁵⁴. However, Spain is still well below the recommended target. At present, the Spanish electricity

system has interconnections with France and Portugal, as well as with Morocco, reaching an interconnection ratio of less than 5%. Therefore, it will be necessary to continue developing new interconnections. In this respect, it is worth highlighting the existence of a project for a new submarine interconnection with France through the Gulf of Biscay, which will increase the exchange capacity between Spain and France to 5,000 MW, compared to the current 2,800 MW. The construction of this new interconnector will begin in 2021 and will come into operation in 2025⁵⁵.

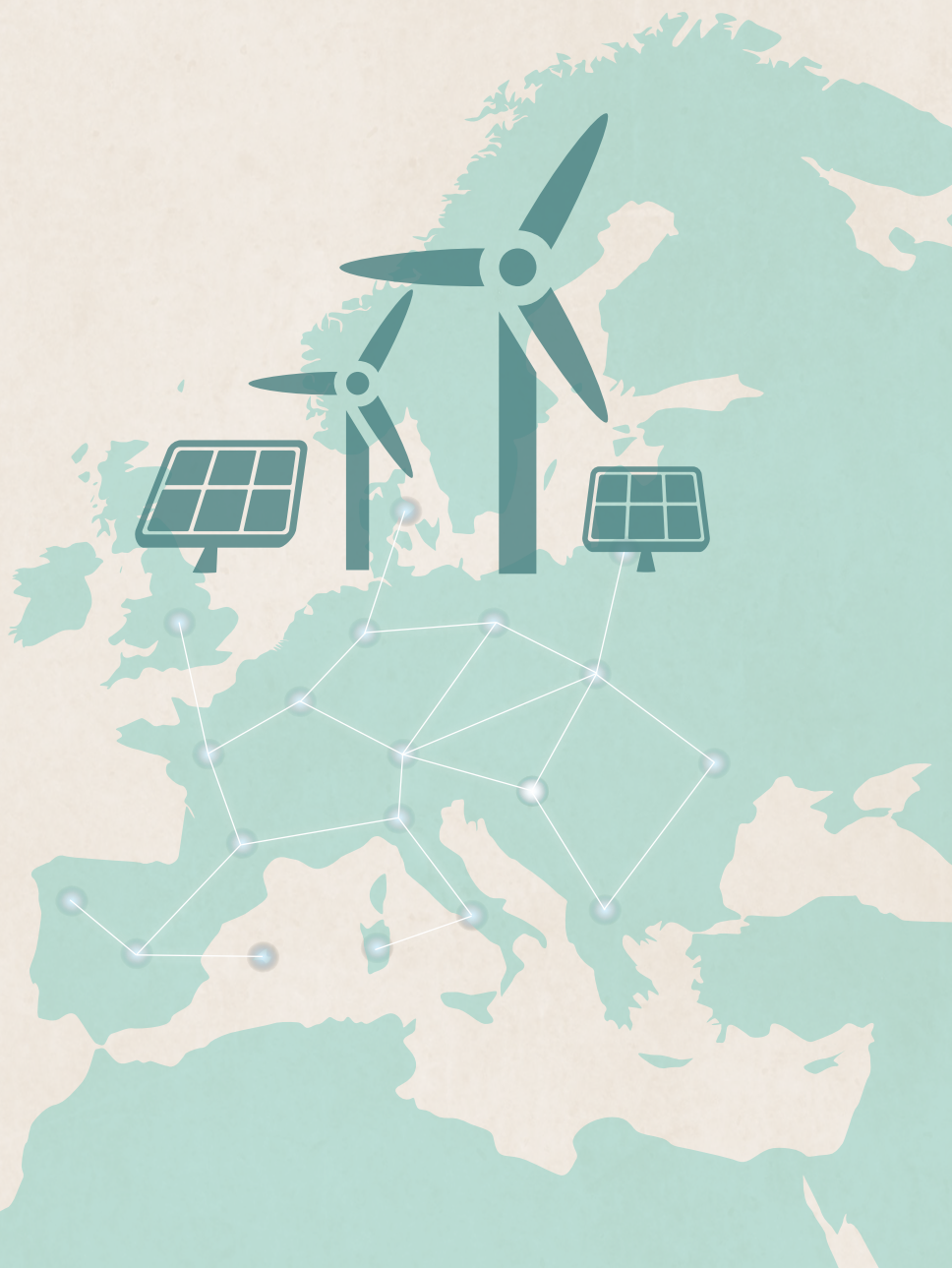
EU Objectives (2020)

- 20% ENERGY FROM RENEWABLE SOURCES
- 10% INTERCONNECTIONS

EU Objectives (2030)

- 32%* ENERGY FROM RENEWABLE SOURCES
- 15% INTERCONNECTIONS

* Might be reviewed upwards by 2023



Chapter 3

Coal in Spain: an energy without future

The fight against climate change and air pollution requires a reduction in greenhouse gas emissions and other pollutants as well as a rapid transition to a low-carbon energy model.

In Spain, coal plays an increasingly residual role. Although its use was fundamental in the industrial revolution and for decades it played a vital role in the country's energy structure, it is clear that to achieve a decarbonized energy model by 2050, electricity production with this fossil fuel must be stopped as soon as possible. Existing renewable energy technologies as well as their potential, the rapid decrease in the costs of onshore wind and solar energy and advances in storage technologies are completely remodeling the electricity system. Therefore, it is increasingly feasible to have an energy model based 100% on renewables.

In Europe, all coal-fired power plants should shut down between 2020 and 2030 in order to meet the objectives of the Paris Agreement and avoid the most serious effects of

climate change. In the case of Spain, they must be closed by 2025 at the latest. Although until last year the measures taken by the Spanish Government diffculted these closures, the change of Government that took place in June 2018 changed the course of the country's energy and environmental policies. This has favored obtaining the conditions for the closure of coal plants to be authorized.

However, since the start of the new government, only one coal plant has been authorized to close. Moreover, there has been no legally binding instrument adopted which sets a clear date for coal phase-out. Therefore, and taking into account the country's political uncertainty, as there will be general, regional and local elections in Spring 2019, there is a risk that coal plants will continue to operate beyond 2025.

3.1. The closure of coal plants: "the domino effect"

Under Directive 2010/75/EU (Industrial Emissions Directive, IED), all large combustion plants, including coal-fired power plants, are required to operate in accordance with an environmental permit, which, in the case of Spain, is called the Integrated Environmental Authorization and is issued by the competent regional authorities.

In order to reduce the air pollution caused by these installations, each permit incorporates emission limit values (ELVs) for NO_x, SO₂ and particulate matter (PM₁₀) which, from January 2016, had to be in line with the values set out in Annex V Part 1 of the IED.

In spite of this, all Spanish coal plants, currently have higher authorized ELVs. This is due to the fact that most of them are under the so-called Transitional National Plan (TNP), a derogation set out in the IED, which allows them to emit

above the ELVs set therein until 30 June 2020, in exchange for respecting annual emission ceilings. On the other hand, the coal plant of Alcudia (located in Mallorca) is exempt from complying with these limits only until 31 December 2019, as it is under another derogation: the small isolated system one⁵⁶. Both derogations came into force on 1 January 2016.



CHAPTER 3. Coal in Spain: an energy without future

The decision to opt for the TNP and the small isolated system derogation was mainly due to the impossibility of these plants to comply with the ELVs set out in the IED as of 1 January 2016, as they did not have adequate emission reduction systems installed (mainly denitrification and desulphurization systems). When these derogations come to an end, all plants that have not carried out the necessary works to comply with the limits set by EU legislation will have to shut down.

To this regard, Article 21(3) of the IED states that within four years of the publication of decisions on Best Available Techniques (BAT) conclusions, which partially include what is provided in the so-called BAT reference documents (BREF), the competent authority shall ensure that all permit conditions of concerned installations are reconsidered, and if necessary updated to take into account the BAT conclusions.

	Environmental Permit			Directive 2010/75/EU (IED)		
	NO _x	SO ₂	PM	NO _x	SO ₂	PM
As Pontes	650	1,200	100	200	200	20
Meirama	650	2,400	150	200	200	20
Aboño (G1)	650	1,600	100	200	200	20
Aboño (G2)	650	484	50	200	200	20
Soto de Ribera	650	400	50	200	200	20
Narcea (G2)	1,200	1,200	100	200	200	20
Narcea (G3)	1,200	400	75	200	200	20
Lada	1,000	400	50	200	200	20
Compostilla (G3)	1,300	1,200	200	200	200	20
Compostilla (G4+G5)	1,300	1,100	100	200	200	20
La Robla (G1)	1,500	2,000	400	200	200	20
La Robla (G2)	1,200	400	50	200	200	20
Velilla (G1)	1,750	3,000	280	200	200	20
Velilla (G2)	1,200	400	100	200	200	20
Andorra	1,200	2,500	130	200	96% (*)	20
Puente Nuevo	850	200	50	200	200	20
Litoral de Almería	500	400	50	200	200	20
Los Barrios	500	200	50	200	200	20
Alcudia (G1+G2)	500	400	20	200	200	20
Alcudia (G3+G4)	500	800	20	200	200	20

(*) Minimum desulphurization index

Table 1 - Comparison of the ELVs (mg/Nm³) of environmental permit of coal plants with the ones set out in the IED and the LCP - BREF.
(Source: Own elaboration)

In addition, it places particular emphasis on the fact that such permit review procedure should be used to adapt the emission limit values to the ones associated with BATs. This article is transposed into the Spanish legal system in an almost identical manner through Article 26(2) of Royal Legislative Decree 1/2016⁵⁷. **This means that once the BAT conclusions are published, any permit review which takes place afterwards, must already take into account these conclusions, without having to wait until the end of the**

4-year period provided in the law. In August 2017, the BAT Conclusions Document for Large Combustion Plants (LCP) was published⁵⁸. Therefore, considering that all combustion plants which intend to continue operating after the end of the TNP should review their permits before 1 July 2020, these reviews should be carried out taking into account these BAT conclusions and therefore, the basis of the stricter emission limit values laid down therein.

	LCP BREF (stricter limits)**			LCP BREF (less strict levels)**		
	NO _x	SO ₂	PM	NO _x	SO ₂	PM
As Pontes	65	10	2	150	130	8
Meirama	65	10	2	150	130	8
Aboño (G1)	65	10	2	150	130	12
Aboño (G2)	65	10	2	150	130	8
Soto de Ribera	65	10	2	150	130	12
Narcea (G2)	65	10	2	150	130	12
Narcea (G3)	65	10	2	150	130	12
Lada	65	10	2	150	130	12
Compostilla (G3)	65	10	2	150	130	12
Compostilla (G4+G5)	65	10	2	150	130	8
La Robla (G1)	65	10	2	150	130	12
La Robla (G2)	65	10	2	150	130	12
Velilla (G1)	65	10	2	150	130	12
Velilla (G2)	65	10	2	150	130	8
Andorra	< 85	10	2	175	130	8
Puente Nuevo	65	10	2	150	130	12
Litoral de Almería	65	10	2	150	130	8
Los Barrios	65	10	2	150	130	8
Alcudia (G1+G2)	65	10	2	150	130	12
Alcudia (G3+G4)	65	10	2	150	130	12

(**) These values refer to the annual mean

Table 1 (continuation) - Comparison of the ELVs (mg/Nm³) of environmental permits of coal plants with the ones set in the IED and the LCP BREF.
(Source: Own elaboration)

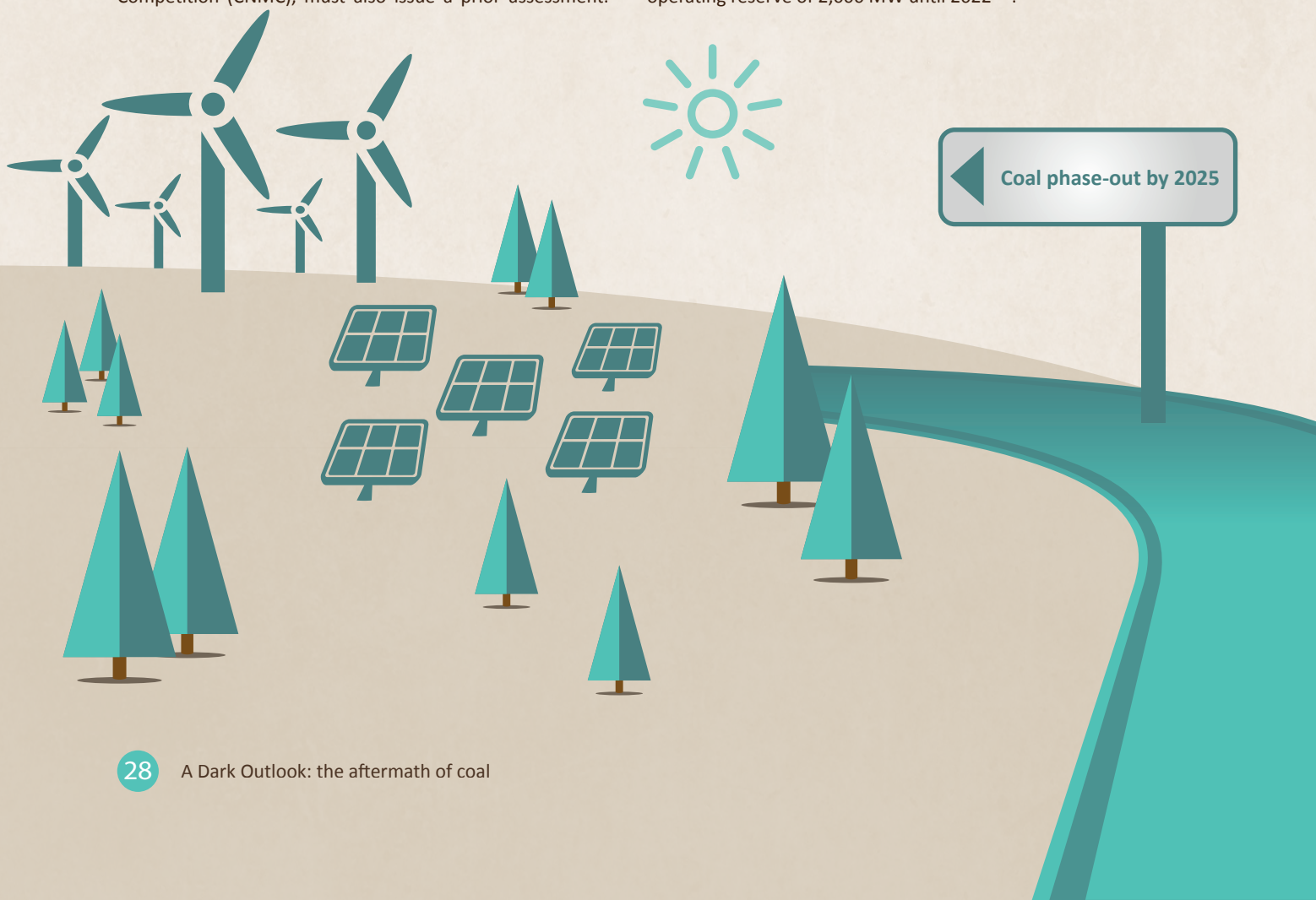
Carrying out the works to install the emission reduction systems which are necessary to comply with these new ELVs requires significant investments. Up to now, 5 plants have already decided to carry out these investments: As Pontes and Litoral, both owned by Endesa, Aboño (Group 2) and Soto de Ribera, owned by EDP and Los Barrios, owned by Viesgo. These investments are not economically profitable for many other plants. For this reason, at the end of 2018 the two companies with the highest installed coal capacity in Spain -Endesa and Naturgy- submitted closure requests for several plants to the Ministry for the Ecological Transition (MITECO). Specifically, for the plants of Andorra, Compostilla and Alcudia (groups 1 and 2), owned by Endesa, and for Meirama, Narcea and La Robla, owned by Naturgy. In addition, Iberdrola, in line with its commitment to be carbon neutral by 2050, submitted in November 2017 to the former Ministry of Energy, Tourism and Digital Agenda two authorizations to close their two coal-fired power plants in the country: Lada and Velilla. However, it was not until last November that the MITECO sent the administrative file for the closure to the transmission system operator, Red Eléctrica de España (REE). In order for the authorization to be granted, REE must issue a prior assessment analyzing whether these closures will affect security of supply.

Together with this prior assessment of REE, the energy regulator in Spain, the National Commission on Markets and Competition (CNMC), must also issue a prior assessment.

Both are mandatory for the closure to be authorized, in accordance with the current legislation in force. Likewise, in order to grant closure authorization, the current government requires electricity companies to establish just transition plans designed not only to relocate workers but also to promote the development of economic activities and employment generation in the areas affected by the closures.

Although these closure requests were filed by the operators at a time when there was a favorable political scenario for them to be authorized, they have not been granted. In light of the political uncertainty in Spain at the time of publication of this report, there is a risk that, finally, they will not be authorized.

On the basis of the legislation in force⁵⁹, the only possible argument for refusing to grant these authorizations for closure would be that by doing so, it poses a risk to security of supply. However, it's important to highlight that, according to the REE report elaborated in July 2017 following the request for closure of the coal plant of Anllares, "under the hypothesis of the withdrawal of an additional 4,000 MW of coal-fired power plants beyond 2019 and without considering the incorporation of new thermal or pumping generation, a sufficient margin is assessed to cover the expected peak demand plus an operating reserve of 2,000 MW until 2022"⁶⁰.



Furthermore, it should not be forgotten that every resolution authorizing the closure of an installation must expressly indicate "the period of time by which the installation must be closed and where appropriate, dismantled, from the date on which the resolution was granted". If the closure has not taken place at the end of this period, the authorization will expire. Therefore, even if the closures were authorized, electricity companies could finally choose not to shut down their plants and continue operating them beyond 2020, provided that the necessary emission reduction systems are installed, which, given the date, seems unlikely.

Finally, groups 3 and 4 of the Alcudia coal plant will also be closed in 2025, or alternatively when a second cable linking the peninsula to the Balearic Islands is installed. This is provided for in the Fourth Additional Provision of the Law on Climate Change and Energy Transition of the Balearic Islands, approved on 12 February 2019, which also provides for the closure of groups 1 and 2 for January 2020.

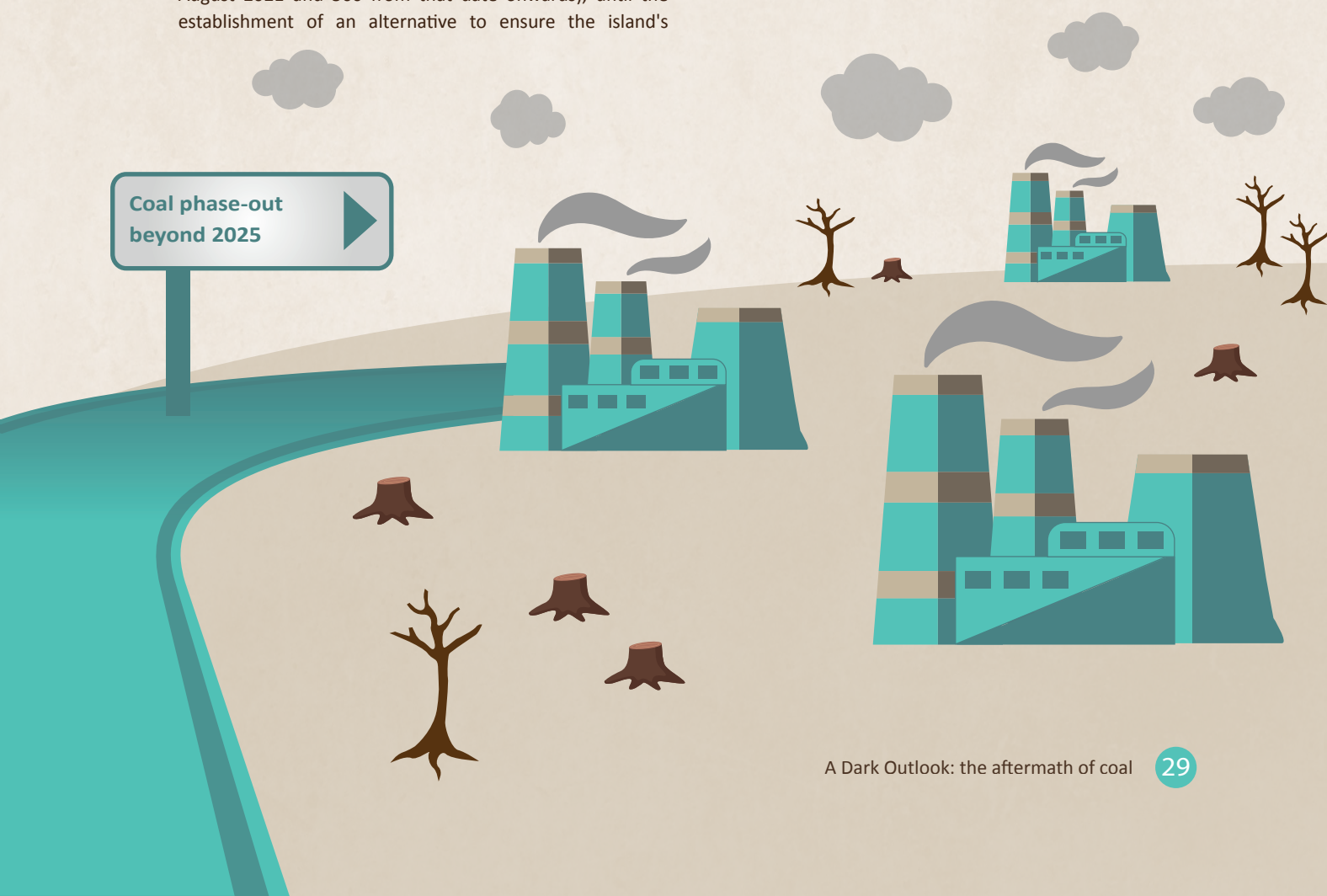
This law was approved less than a week after an agreement was signed between the Balearic Government, Endesa and MITECO on the closure of the coal plant of Alcudia. This agreement established, the closure of Groups 1 and 2 by 1 January 2020, while authorizing the operation of Groups 3 and 4 for a limited number of hours (1,500 per year until August 2021 and 500 from that date onwards), until the establishment of an alternative to ensure the island's

electricity supply. This hour-limitation responds to the provisions set out in both the IED and the BREF for LCPs.

With regards to the remaining coal plants, Puente Nuevo (Viesgo) and Aboño Group 1 (EDP), the operators have not yet announced what their plans are.

Bearing in mind that investments have already been made for some plants to continue operating and that the future of others is still uncertain, it is crucial to set a date for the end of coal in Spain by 2025 at the latest. This must be done either in the future Climate Change and Energy Transition Law or in the final version of the NECP, whose draft was sent to the European Commission on 22 February this year. However, the draft does not contain such date as it provides the following: "**coal plants will cease to provide energy to the system by the year 2030 at the latest**, as they will have serious difficulties in being competitive with other technologies in an environment highly conditioned by Europe's response to climate change, in which the cost of CO₂ will tend to be increasingly higher. (...) In any case, it is not impossible to maintain part of the installed capacity where investments have been made to comply with the EU framework"⁶¹. Without setting a specific coal phase-out date in a binding instrument, there is a risk that some of these plants will continue to operate, which would jeopardise the emission reduction targets agreed in Paris.

Coal phase-out
beyond 2025



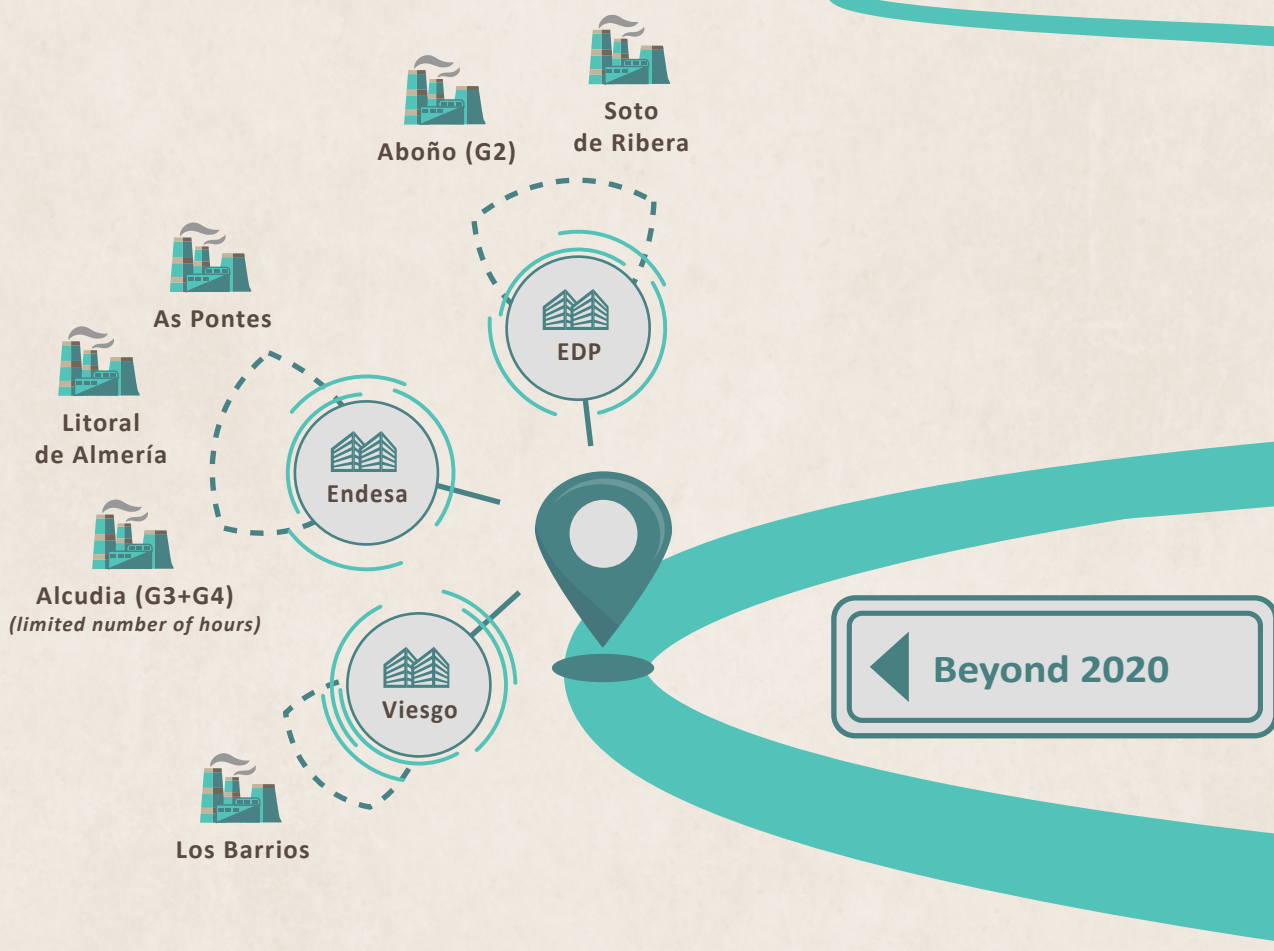
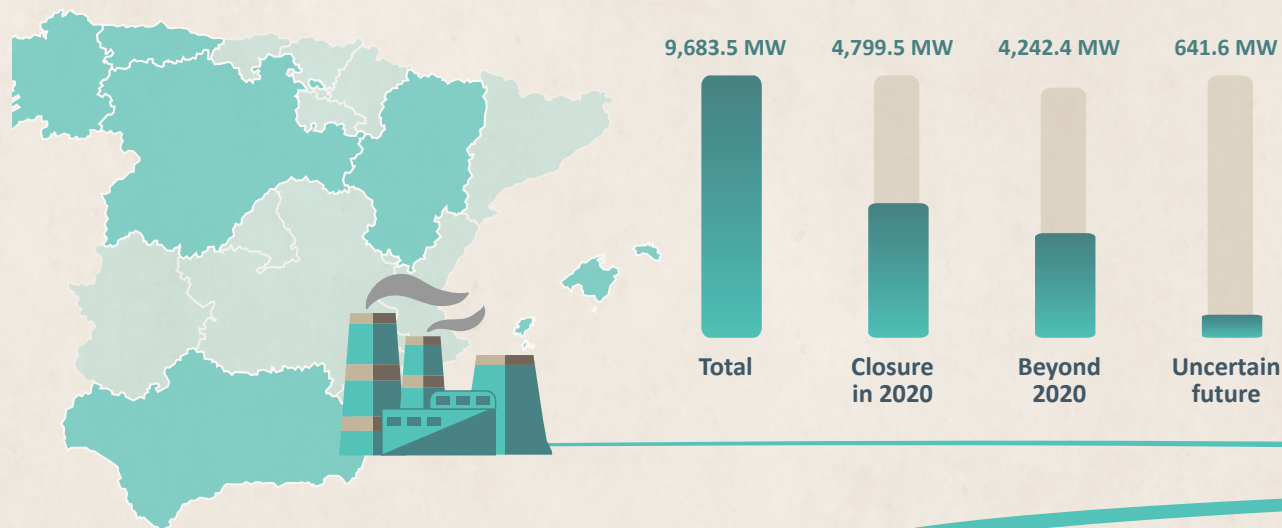
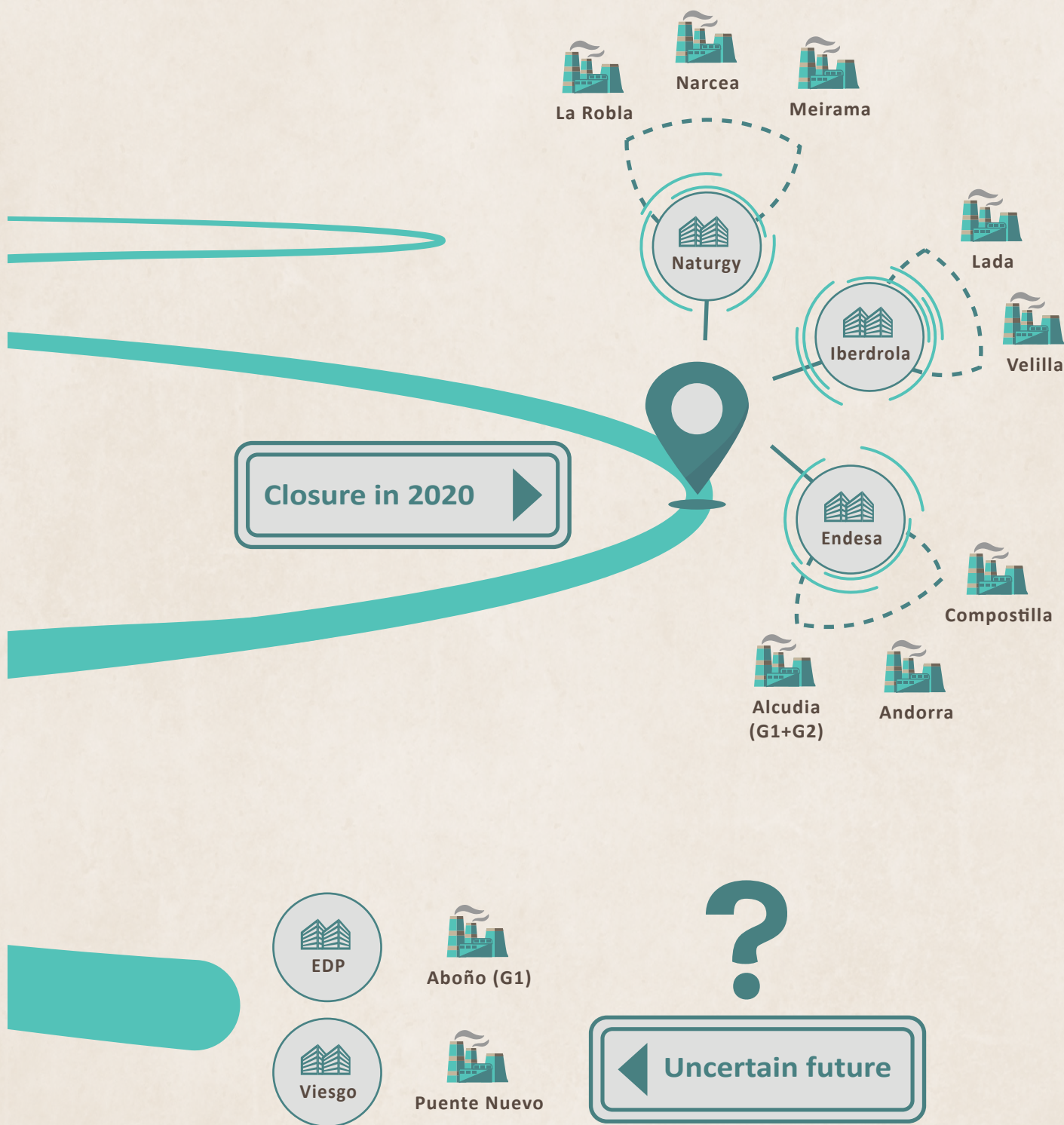


Figure 11 - The future of coal plants in Spain (Source: Own elaboration)



3.2. The end of coal mining

Over the past decades, coal mining in Spain has experienced a slow but unavoidable decline, which has led to a progressive reduction in the number of companies operating in the sector, as well as in their workforce and production. Compared to the situation at the beginning of the 1990s, the sector has experienced the disappearance of more than 25,000 jobs - by the end of 2018 there were only about 2,000 workers left between Asturias, Castilla y León and Aragón⁶² - and a 90% reduction in the amount of coal extracted, which in 2017 failed to reach 3 million tons⁶³. Thus, during that year, of the total coal-fired power generation in our country, only 13.4% was produced through indigenous coal, while the remaining 86.6% was produced through imported coal⁶⁴.

One of the problems of indigenous coal, in addition to it being incompatible with the protection of the environment and the fight against climate change, is that it is not competitive in comparison with imported coal, due to its poorer power quality and its high extraction costs. Despite this and the fact that the production of electricity with this fuel was diminishing considerably, the "need" to have a source of "autochthonous and reliable" fuel has justified the continuous State aid that has been given to this sector.

Since 1986, the coal industry has been receiving aid from the EU which should have ceased in 2002, when it was estimated that all unprofitable mines across the EU would be closed. However, this aid was extended⁶⁵ until, finally, in 2010, Decision 2010/787/EU⁶⁶ was approved. This Decision agreed to extend it for the last time until 31 December 2018, considering "that the small contribution of subsidized coal to the overall energy mix no longer justified the maintenance of such subsidies for securing the supply of energy in the Union".

Spain, in accordance with this Decision, decided to prepare a Mining Closure Plan which was approved by the EC in May 2016⁶⁷ and published in the Official Journal of the EU in December that year⁶⁸. All coal production units⁶⁹ included in this Plan were eligible for aid to cover their production losses, subject to their closure by 31 December 2018 at the latest. If they wanted to operate beyond that date, mining companies had to repay all aid received since 2011. The Mining Closure Plan also provided for aid for exceptional costs arising from production losses, in line with Decision 2010/787/EU⁷⁰. Costs for environmental rehabilitation or compensations for early retirements fell under this category and could be granted until 2021.

Afterwards, in October 2018, the Government reached an agreement with the trade unions and the "Framework Agreement for a Just Transition for Coal Mining and Sustainable Development of Mining Regions for the period 2019 – 2027" was signed. This Agreement lays the foundations for the measures necessary for a just transition of coal mining and coal mining regions beyond 31 December 2018, allocating a sum of 250 million Euros for them to be implemented. This Agreement was formalized by the Council of Ministers on 21 December⁷¹ through Royal Decree-Law 25/2018 on urgent measures for a just transition of coal mining and sustainable development of mining regions and ratified on 22 January 2019⁷² by the Spanish Parliament.



By the end of 2018, most part of the 26 production units - owned by 15 companies - that were under this Plan had closed. Only two mining companies, SAMCA and Hijos de Baldomero García, initially showed their intention to continue extracting coal, aware of the obligation to repay the aid received. However, both companies finally announced the closure of their mines. In the case of SAMCA, the closure of the Santa María open-cast mine in Teruel was motivated by Endesa's refusal to maintain the supply contract since it has enough coal to feed the Andorra until June 2020, when it is scheduled to close⁷³. On the other hand, the decision of Hijos de Baldomero García to dismantle the mine of La Escondida was taken due to the fact that it could not return the 8.3 million Euros received within the deadline indicated by the MITECO⁷⁴.

However, it should be noted that Hunosa still plans to keep the Nicolasa shaft in Asturias in operation as it intends to use its coal to feed the nearby coal plant of La Pereda, owned by the same company. The company states that it has not received any State aid. However, this shaft was part of the coal production unit "Caudal", included in the Mining Closure Plan and was therefore a beneficiary of this aid⁷⁵. In accordance with the EC decision approving the Spanish Mining Closure Plan and with Decision 2010/787/EU, the aid is granted to the production unit as a whole. It is therefore not possible to separate a shaft from the coal production unit which it is part of in order to keep it in operation without repaying the aid received. This case has been communicated to the EC, which is now investigating how to proceed with this shaft.

3.3. The path towards a just transition

The end of coal mining in Spain, with the closure of the last mines, constituted one of the most controversial elements of the energy transition in this country, despite the residual role that this sector played in the Spanish economy in the last years and its reduced number of workers.

The difficulties in dismantling this sector are due to a complete lack of long-term planning from authorities at different levels, despite the fact that for years coal mining had been showing signs of its inevitable decline.

All the mining regions which for decades have organized their economies around this sector and which, until now, heavily depended on it, must now dismantle it. To ensure their survival, they need to adapt their economy to the demands of the fight against climate change, implementing alternative economic activities which cannot be relocated. The success of this reconversion lies in green sectors, circular economy and research and development which will in turn contribute to combating depopulation by attracting qualified young people to these areas. Tourism can also be a driver for revitalizing the socio-economic structures of these areas, through the creation of recreational areas and leisure parks or by enhancing mining heritage through the conversion of mines into museums.

The priority now is to ensure that the transition process of coal mining regions takes place progressively and is supported by an appropriate legal framework that guarantees a just transition for all workers and affected communities. While the first step towards such a just

transition has been taken with the Agreement between the Government and Trade Unions of 24 October, carrying out this process will not be easy. Industrial monoculture, the absence of alternative sectors, depopulation and ageing, mining identity of the population and personnel with low training will be the main obstacles they will have to face. Planning, cooperation between the different actors, the participation of civil society in decision-making and the promotion of specific trainings depending on the future activity to be implemented are some of the "fundamental" elements for this transition to be successful.

There are plenty of successful examples of reconversion of mining areas throughout the EU, such as Loos-en-Gohelle or Albi Carmaux in France, as well as Beal in England or Bottrop in Germany⁷⁶.

Workers in power stations that close will also be affected. In order to lessen the social impacts of these closures and achieve a just transition, one of the current government's conditions for authorizing the closure of these plants, as has been said before, is that the operators submit a just transition plan in advance, ensuring the relocation of the workers.

Chapter 4

How coal is impacting our health

In our report published in 2017 entitled “A Dark Outlook: the impacts on health of coal-fired power plants in Spain during 2014”⁷⁷, it was made clear that pollution from coal burning is related to the appearance and development of various types of diseases, increasing morbidity and mortality as well as work days lost in the exposed areas. All of this entails associated economic costs.

Coal phase-out offers a unique opportunity to reduce pollutant emissions and mitigate climate change. The resulting improvement in air quality will also lead to a higher level of protection of human health, preventing the premature death of hundreds of people each year.

4.1. Coal plants emissions and pollutant dispersion

Burning coal releases pollutants into the atmosphere that have harmful effects on human health. These pollutants include NO_x, SO₂, dust and heavy metals such as mercury (Hg).

The annual amount of pollutant emissions differs according to different factors, including the hours of operation of the plant, the type of coal burnt, the type and size of the boiler, the parameters used for the combustion process and the emission reduction systems installed.

In particular, the amount of NO_x produced depends fundamentally on the type of boiler, the fuel properties and the conditions under which the combustion takes place, such as the temperature, the excess of air and the length of time the gases are in the combustion zone. According to the latest data available in the Spanish Pollutant Release and Transfer Register (PRTR – Spain), in 2017 the plants that emitted the highest amount of NO_x were As Pontes with 8,650 tons, followed by Andorra (5,890), Anllares (5,770), Compostilla (5,330) and Litoral (5,270).

As for SO₂, emissions are mainly due to the sulphur present in coal. According to the data collected in the PRTR-Spain, coal plants are the main sources of SO₂ emissions at national level among all the industrial facilities included in this register. Out of the top ten SO₂ emission sources, seven of them were coal plants. Of all the coal plants, Andorra is by far the one responsible for most SO₂ emissions in 2017. This is because it uses black lignite as its main fuel, which is characterized by a high sulphur content in comparison with the coal used in the other plants, which is mainly hard coal.

PM₁₀ emissions are also significant. Despite the fact that coal plants have already installed specific emission reduction systems for this pollutant, in 2017, of the ten main sources of PM₁₀ emissions, seven were coal plants.

At EU level, these plants are also a major source of environmental pollution. According to the latest data published by the Europe Beyond Coal network, the Andorra and As Pontes plants are included among the 30 coal-fired power plants that cause the greatest impacts on health, ranking twentieth and twenty-seventh, respectively.

Also, according to the report “Last Gasp: the coal companies making Europe sick”⁷⁸, published in November 2018, the emissions in 2016 from all the coal plants owned by Endesa, made this company the sixth most polluting in Europe, among all those electricity companies that have coal-fired plants.



(*)Data obtained from total suspended particles (TSP) data.

Figure 12 - Annual emissions of NO_x, SO₂ and PM₁₀ of coal plants in Spain in 2017. (Source: PRTR-Spain)

As explained in chapter 3 of this study, and as announced by Endesa, Andorra and Compostilla will close by 1 July 2020, when the TNP expires. In the case of As Pontes and Litoral the retrofit works are being carried out in order to comply with the ELVs established in the LCP BREF, by this date.

Once pollutants emitted by coal plants are in the atmosphere they travel, to a greater or lesser extent, depending on both the type of pollutant and the meteorological conditions. The parameters that most influence the dispersion process are wind speed and direction, as well as vertical thermal stratification. As they move away from the source of emission, these pollutants are subject to different phenomena that cause their concentration to progressively decrease. These phenomena include dry and wet deposition, as well as chemical reactions with other atmospheric components that lead to the formation of new (secondary) pollutants.

Because these pollutants are able to travel very long distances, they also affect the health of the population in areas far away from the source of emission.

Nowadays, there are mathematical models that allow to recreate the dispersion of pollutants and obtain an estimate of how their concentrations vary according to time and space. The maps shown below have been obtained by using one of these models (the CALPUFF model). The maps show how average annual concentrations of dust ($PM_{2.5}$ and PM_{10}), NO_2 and SO_2 coming from coal plant emissions in 2016 were distributed throughout Spain⁸⁰.

CALPUFF can be used to simulate dispersion of pollutants at different spatial scales, as it contains both algorithms for describing effects in the vicinity of the emitting source, and algorithms for events on a regional scale. The first group includes phenomena such as building downwash (interaction between the plume and buildings near the chimney), transitional plume rise (elevation of the plume with respect to the source) and partial plume penetration (partial penetration of the plume in the atmospheric boundary layer). The second group is formed by phenomena of dry and wet deposition of pollutants in the soil, by their chemical transformations and by the vertical wind share: change of direction and wind speed with altitude, which causes the transport of pollutants to vary - in direction and speed - depending on altitude.

CALPUFF is part of a modeling chain that essentially consists of three modules:

- the CALMET meteorological model, used for the reconstruction of the three-dimensional meteorological field;
- the CALPUFF model which, using the field generated by CALMET and information on pollutant emissions, studies their dissemination and transport;
- a package of post-processors, among which CALPOST stands out, used to statistically analyse the data obtained from CALPUFF. The numerical results extracted through CALPOST are then transformed through a graphical visualization software to be superimposed on a map of the study area. This allows to obtain a greater visualization and a better interpretation of the results.

With regards to the data required by CALPUFF, in addition to the meteorological input from CALMET, information is needed on the emission sources: geographical coordinates, height and diameter of the chimneys, temperature and speed of exit of the combustion gases expelled into the atmosphere and the emission rates for each of the pollutants considered. The data related to the location and geometric characteristics of the chimneys, as well as the information on the combustion gases, have been obtained either through an analysis of the environmental permits of each of the coal plants, or through access to environmental information requests filed by IIDMA before different authorities, in accordance with the provisions of Law 27/2006 of 18 July, which regulates the rights of access to information, public participation and access to justice in environmental matters.

As regards emission rates, constant values have been used, as it has been necessary to consider that all coal plants have operated continuously throughout the entire simulation period. These rates have been extrapolated from the total annual emissions reported by the installations to the competent environmental authorities. This information has been extracted from the E-PRTR website.

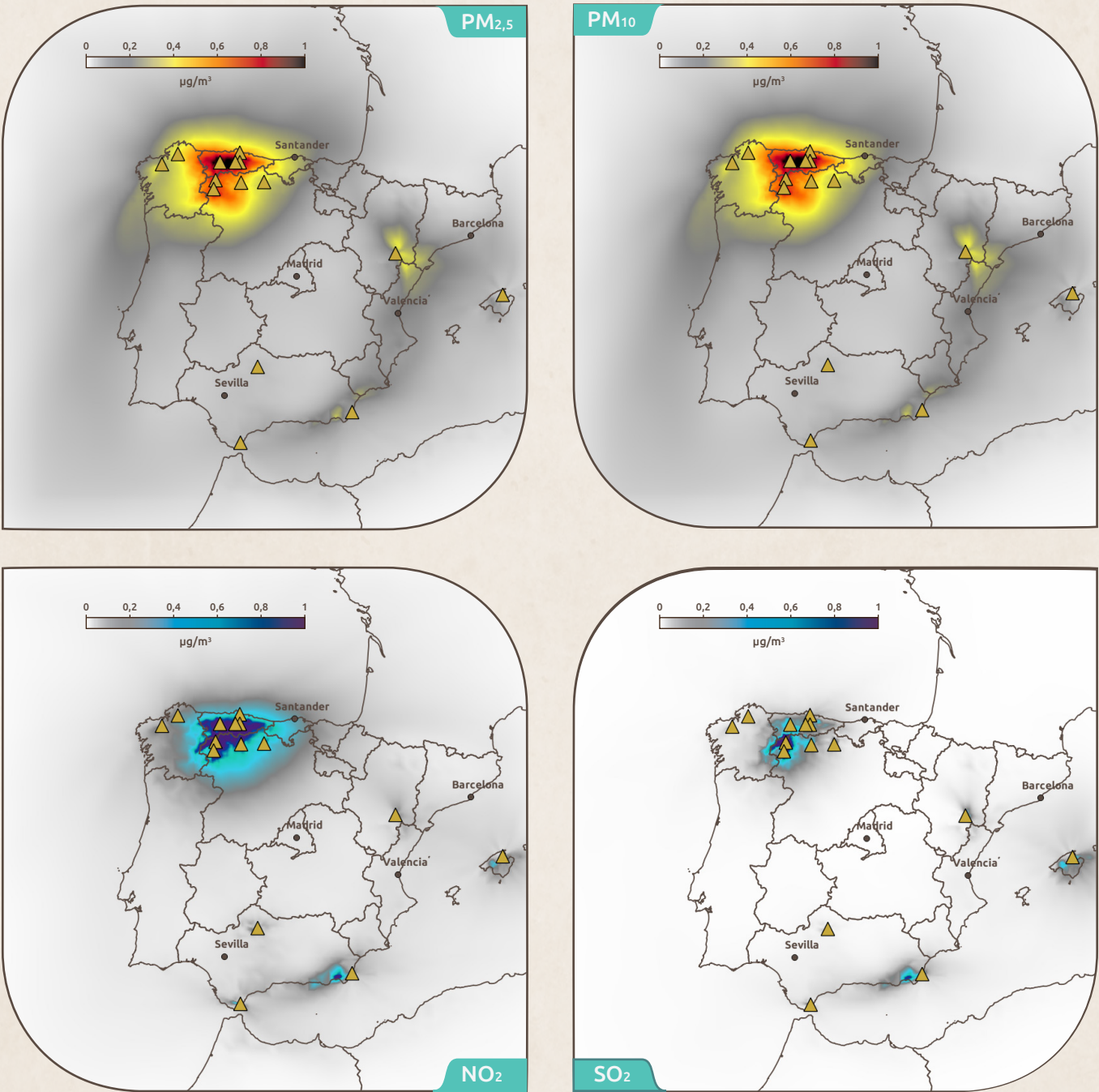


Figure 13 - Estimation of the average annual concentrations of particulate matter (PM_{2.5} y PM₁₀), NO₂ and SO₂ in 2016. (Source: Own elaboration)

4.2. Health impacts and costs

Based on the pollutant concentration figures obtained through the dispersion model, it has been possible to quantify the impacts on health of emissions from coal plants during 2016 at provincial, regional and national levels. For this purpose, the methodology and concentration – response functions (CRFs)⁸¹ recommended by the WHO⁸², other CRFs recommended by the latest available scientific studies and demographic and epidemiological data from the National Statistics Institute have been used.

The results of this analysis show that, in 2016, emissions from coal plants in Spain can be related to 560 premature

deaths, most of them derived from the exposure to PM_{2.5}. In addition, 255 hospital admissions due to respiratory diseases and 84 hospital admissions due to cardiovascular diseases were quantified, as well as 273 cases of chronic bronchitis in adults. These emissions also had an impact on children's health, with an estimation of 7,419 cases of asthma symptoms in asthmatic children and 784 cases of bronchitis in children. Finally, they were responsible for 520,153 restricted activity days and 122,131 work days lost.

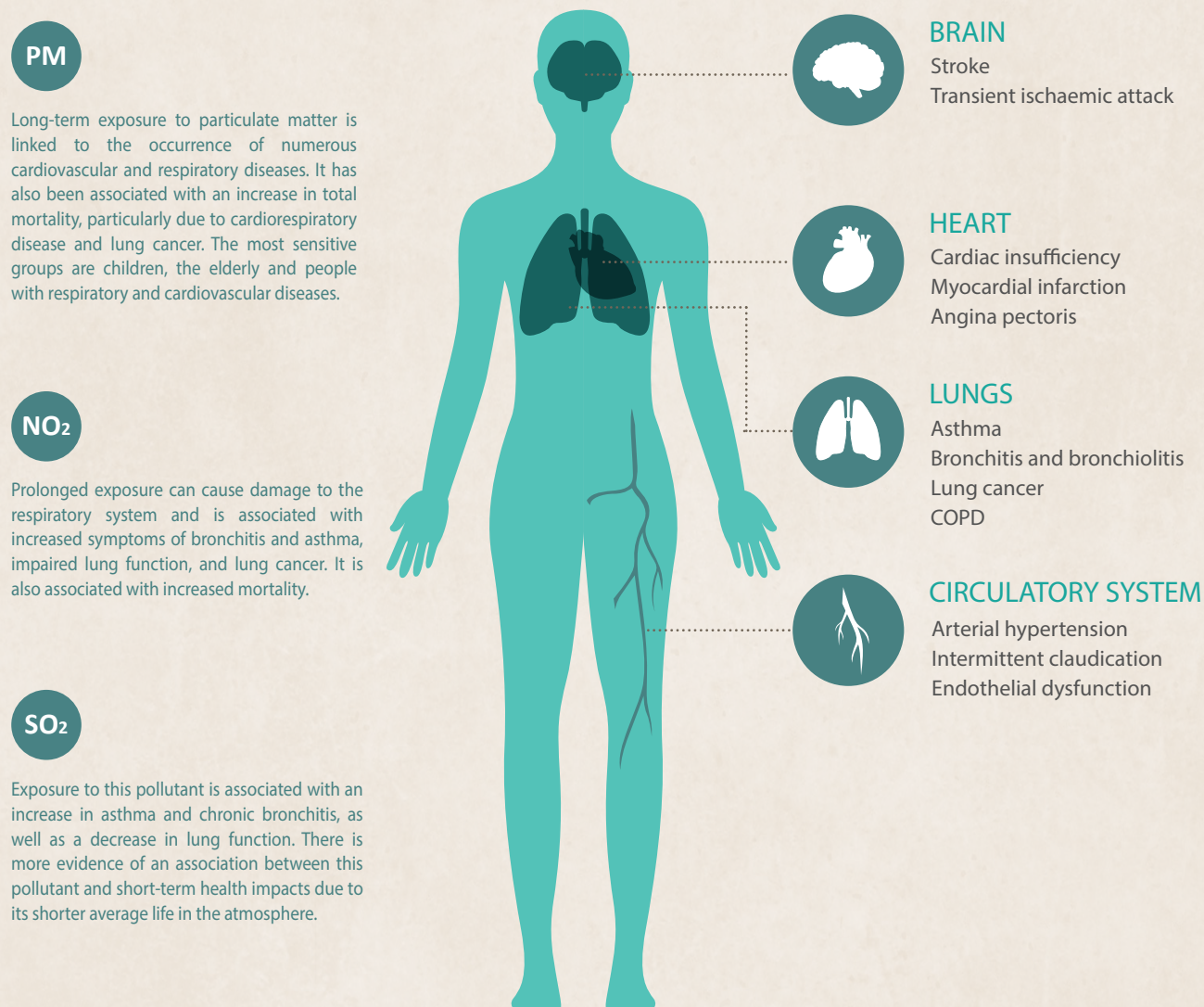


Figure 14 - Main impacts on health related to PM, NO₂ and SO₂. (Source: Own elaboration)

PM _{2.5}	Mortality (all-natural causes)*	450
	Mortality (cardiovascular diseases)	127
	Mortality (respiratory diseases)	29
	Mortality (lung, trachea and bronquial cancer)	35
	Mortality (cerebrovascular diseases)	122
	Stroke events (fatal and non-fatal)	248
	Hospital admissions (cardiovascular diseases)	84
	Hospital admissions (respiratory diseases)	154
	Restricted activity days	520,153
	Work days lost	122,131
PM ₁₀	Mortality (lung, trachea and bronquial cancer)	30
	Mortality (cerebrovascular diseases)	39
	Stroke events (fatal and non-fatal)	118
	Prevalence of bronchitis in children	784
	Incidence of chronic bronchitis in adults	273
	Incidence of asthma symptoms in asthmatic children	7,419
NO ₂	Mortality (all-natural causes)*	89
	Hospital admissions (respiratory diseases)	102
SO ₂	Mortality (all-natural causes)*	21

* Includes cardiovascular, respiratory and cerebrovascular mortality, among others.

Table 2 - Health impacts from coal plants emissions in Spain in 2016.
(Source: Own elaboration)

These impacts have associated costs that are due both to a decrease in productivity caused by work absenteeism and health costs. The latter are covered by society through

expenses such as medicines, consultations or hospitalizations, among others. These expenses, as a whole, reached an amount between 686 and 1,308 million Euros.

	Number of cases due to coal	Unit costs (€) Spanish Prices 2013	Total costs due to coal (M€)
Mortality (all-natural causes)	560	1,080,000/2,190,000	604.8/1,226.4
Non-fatal stroke events	126	16,195	2.040
Hospital admissions (CDV and respiratory diseases)	340	2,192	0.745
Restricted activity days	520,153	91	47.334
Work days lost	122,131	128	15.633
Prevalence of bronchitis in children	784	575	0.451
Incidence of chronic bronchitis in adults	273	52,948	14.455
Incidence of asthma symptoms in asthmatic children	7,419	41	0.304

Table 3 -Health costs caused by emissions from coal plants in Spain during 2016. (Source: Own elaboration)

4.3. Coal emissions make no distinctions

Emissions from coal-fired power plants do not only impact in the health of citizens living where the plants are located. They impact, to a different extent, throughout the whole Spanish territory.

In order to quantify how the presence or proximity to one or more coal plants impacts on the population's health, a comparison has been carried out both at regional and provincial level, reflecting the incidence of $PM_{2.5}$ in mortality throughout 2016.

As expected, the AA. CC. in the northwest of the peninsula have the highest incidence rates. In other words, $PM_{2.5}$ emissions in those areas are related to a higher number of premature deaths per 100,000 inhabitants at risk. This is because the levels of $PM_{2.5}$ concentration resulting from coal are higher in these AA. CC. in comparison with others, due to the high number of coal plants in these territories.

The maximum concentration value of $PM_{2.5}$ was seen in Asturias, which presented an incidence rate of 8.37 premature deaths per 100,000 inhabitants at risk with an estimated average annual concentration of $0.807 \mu g/m^3$. Asturias was followed by Galicia and Cantabria, whose $PM_{2.5}$ concentrations reached 0.39 and $0.38 \mu g/m^3$, respectively. This resulted in incidence rates of 3.48 and 3.28 premature

deaths per 100,000 inhabitants at risk, respectively. Despite the fact that there are no coal-fired power plants in Cantabria, its inhabitants are affected, to a large extent, by emissions from the power plants in Asturias. On the other hand, the regions that are furthest away from the coal plants are generally those with the lowest levels of pollution and, therefore, the lowest incidence rates. This is the case of Madrid, with 0.56 deaths per 100,000 inhabitants at risk, or Castilla La Mancha, with 0.79. It should be noted that in these areas the estimated annual concentrations of $PM_{2.5}$ produced by emissions from coal did not reach $0.1 \mu g/m^3$. The cases of the Balearic Islands and Andalucía should be highlighted. Despite that there are coal plants in both AA. CC., their incidence rates have been lower than in many other places where there are no coal plants. In the case of the Balearic Islands, due to the location of the Alcudia coal plant, it is probable that the meteorological conditions and wind direction were favorable to a dispersion of the pollutants mainly towards the North and East, which caused the pollution to be deposited in the sea, not affecting the population of the islands significantly. In the case of Andalucía, factors such as the location of the coal plants, at a great distance from one another, the extension of the territory, the direction of the winds and the orography of the area, resulted in the incidence rate in that territory not being so high.

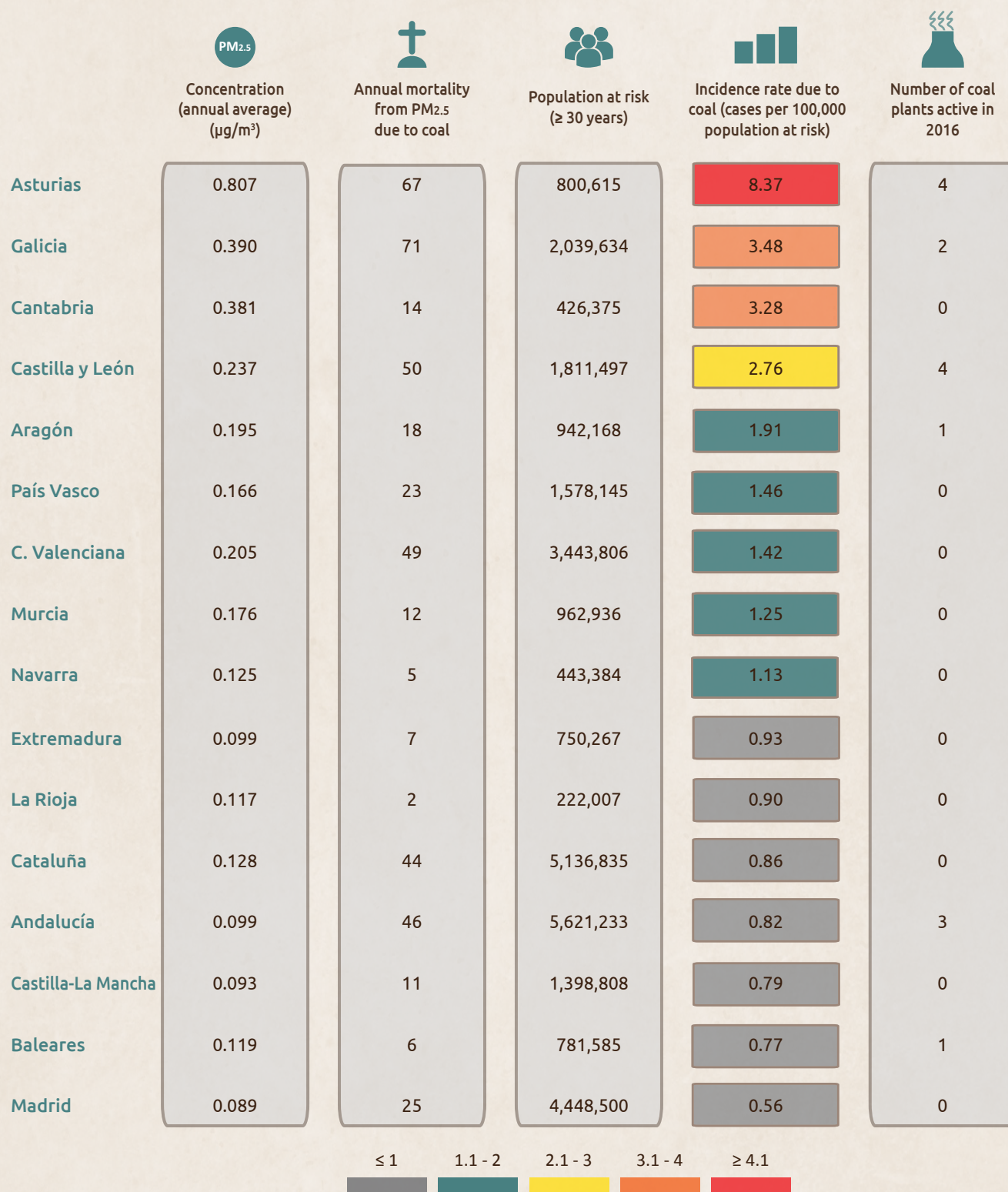


Table 4 - Comparison at AA. CC. level: Annual mortality incidence rate due to PM_{2.5} emissions from coal plants in Spain (2016).
(Source: Own elaboration)

CHAPTER 4. How coal is impacting our health

Finally, the incidence rates of all AA. CC. have been compared in order to obtain the respective risks of mortality due to PM_{2.5} emissions. A higher value of the risk index corresponds to a higher risk of mortality. For example, the probability of an inhabitant of Asturias dying due to PM_{2.5}

emissions from coal in 2016 was 14.9 times higher than that of a resident of Madrid, while a resident of Galicia had a risk 4.4 times higher compared to the population of Castilla-La Mancha. The table below summarizes the comparison at regional level of the different risk indices.

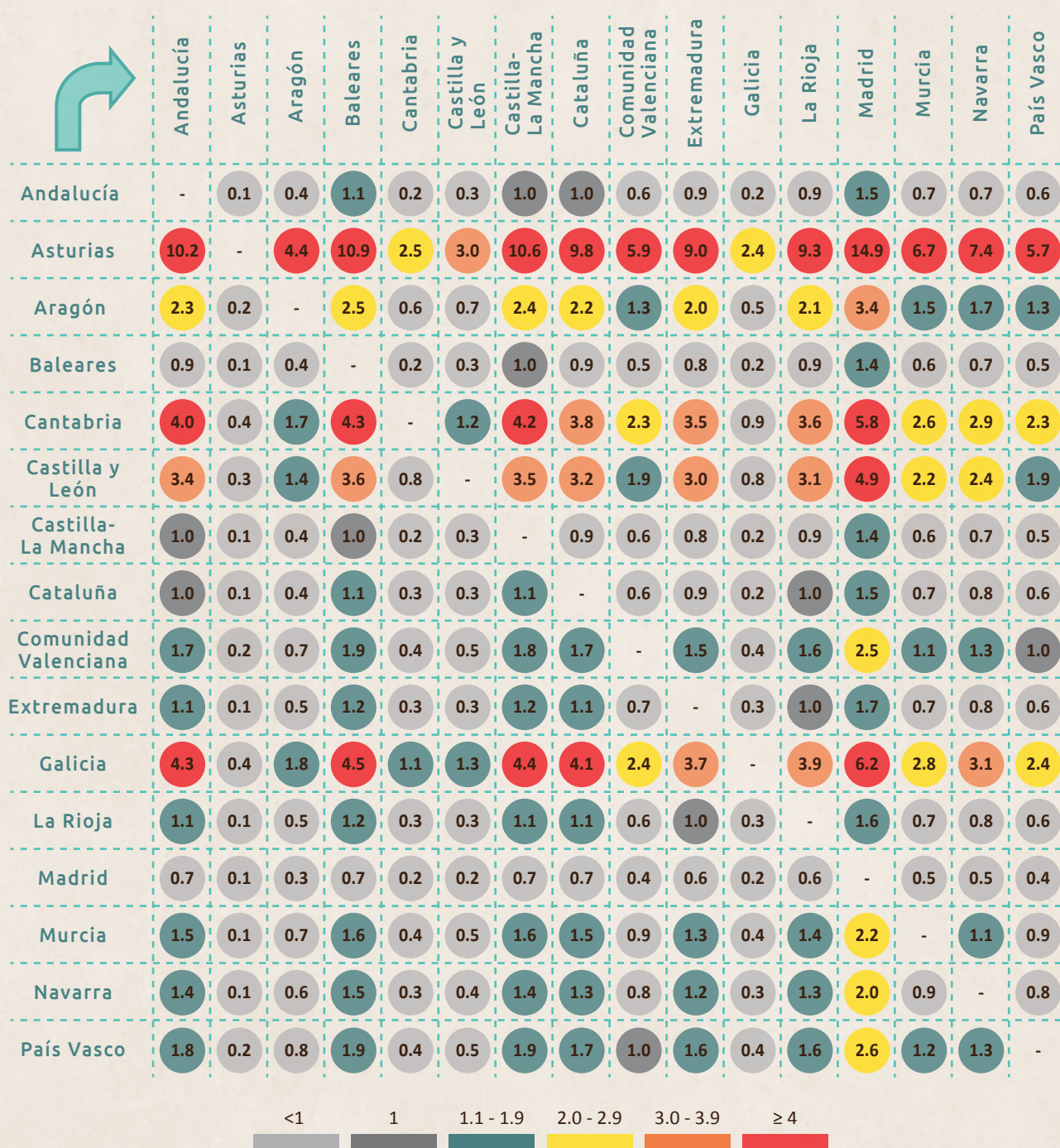


Figure 15 - Comparison at AA. CC. level of the risk indexes of annual mortality due to PM_{2.5} emissions from coal plants in Spain (2016).
(Source: Own elaboration)

A similar comparison at provincial level was carried out in the regions where the coal-fired power plants are located. It shows that the highest incidence rates are not only found in the provinces where the power plants are but that, in most cases, the impacts are greater in neighboring provinces due to how the pollution travels. This is the case of Galicia, where in spite of the fact that the two plants are located in the province of A Coruña, emissions mainly affect the provinces of Lugo and Orense, with incidence rates of 6.12 and 5.7, respectively. Another example is that of Castilla y León. Although the plants are located in León and Palencia,

there is a higher incidence rate in Zamora (5.44) than in Palencia (3.24). In the case of Aragón, incidence rates decrease depending on the distance from the coal plant of Andorra. Meanwhile, the incidence rates in Andalucía are quite similar between the provinces where the plants are located (Almería, Córdoba and Cádiz) and the nearby provinces (Granada, Jaén and Málaga). However, the province of Almería has the highest rate, given that this is where the plant Litoral is located. The provinces with the lowest incidence rates are Huelva and Seville, as they are further away from the coal plants.

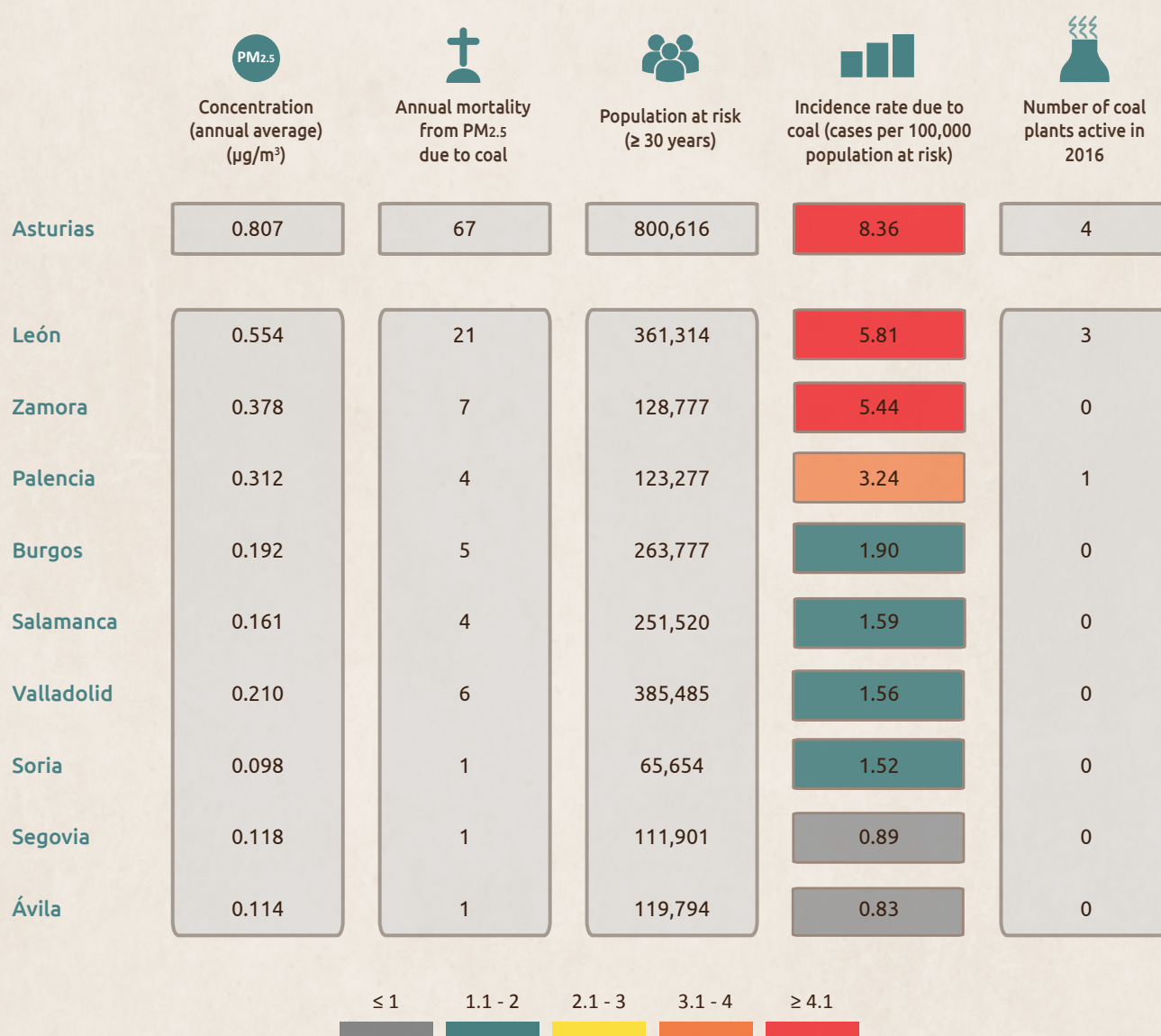





Table 5 - Comparison at provincial level: Annual mortality incidence rates due to PM_{2.5} emissions from coal plants in Spain (2016).
(Source: Own elaboration)

CHAPTER 4. How coal is impacting our health

	 Concentration (annual average) ($\mu\text{g}/\text{m}^3$)	 Annual mortality from PM _{2.5} due to coal	 Population at risk (≥ 30 years)	 Incidence rate due to coal (cases per 100,000 population at risk)	 Number of coal plants active in 2016
Lugo	0.481	16	261,254	6.12	0
Orense	0.483	14	245,465	5.70	0
La Coruña	0.308	24	843,631	2.84	2
Pontevedra	0.289	17	689,285	2.47	0
Teruel	0.222	2	98,158	2.04	1
Zaragoza	0.227	14	684,876	2.04	0
Huesca	0.136	2	159,135	1.26	0
Baleares	0.119	6	781,585	0.77	1
Almería	0.188	6	454,703	1.32	1
Córdoba	0.095	5	535,678	0.93	1
Cádiz	0.108	7	830,984	0.84	1
Granada	0.103	5	609,716	0.82	0
Málaga	0.118	9	1,117,375	0.80	0
Sevilla	0.095	9	1,288,937	0.70	0
Jaén	0.081	3	433,549	0.69	0
Huelva	0.083	2	350,294	0.57	0

≤ 1
1.1 - 2
2.1 - 3
3.1 - 4
 ≥ 4.1

Table 5 (continuation) - Comparison at provincial level: Annual mortality incidence rate due to PM_{2.5} emissions from coal plants in Spain (2016).
(Source: Own elaboration)

4.4. Reducing coal burning saves lives

In order to carry out the simulation on which this study is based, it is necessary to have emission data from each of the stacks of the coal plants in Spain. At the time of writing this report, the latest data available in the E-PRTR, broken down by stack, corresponded to the years 2015 and 2016.

In 2016 there was a sharp reduction in coal-fired electricity generation in comparison to the previous year, decreasing by almost 30%. This led to a sharp reduction in emissions of pollutants, namely -1.35% of NO_x, -38% of SO₂ and -40% of PM₁₀. For this reason, a comparison has been made between the health impacts caused by emissions from coal plants in both years to show how a reduction in burning coal contributes positively to the health of the population.

In order to carry out this comparison, it is essential to use the same weather pattern for both years in the pollutant dispersion model. Thus, the only relevant factor when estimating pollutant concentrations, on which health impacts will depend, is the amount of pollutants emitted.

The results show that in 2015 emissions from coal plants in Spain were related to 969 premature deaths, 143 hospital admissions due to cardiovascular diseases and 432 due to respiratory diseases, 12,693 cases of asthma symptoms in

asthmatic children, 1,282 cases of bronchitis in children and 467 cases of chronic bronchitis in adults. They were also responsible for 830,248 restricted activity days and 249,421 work days lost. In other words, as a whole, the impacts on health in 2015 were 40.5% higher than in 2016.

With regards to the economic impacts, in 2015 it was estimated that health impacts had associated costs between 1,185 and 2,260 million Euros. This implies that the reduction in coal-fired generation in 2016 saved the Spanish population between 499 and 952 million Euros.

This clearly shows that reducing the operation of coal-fired power plants or limiting their emissions are determining factors when it comes to contributing to the improvement of the health of the population. However, this is not enough to completely eliminate the impacts caused by these emissions. Putting an end to atmospheric pollution should be one of the top priorities of both governments and electricity companies, due to the impacts it causes on the health of the population. Therefore, knowing that within the Spanish energy system the production with coal is responsible for a big part of these impacts, it is necessary to take immediate measures to completely eliminate this fuel as a source of electricity by 2025.

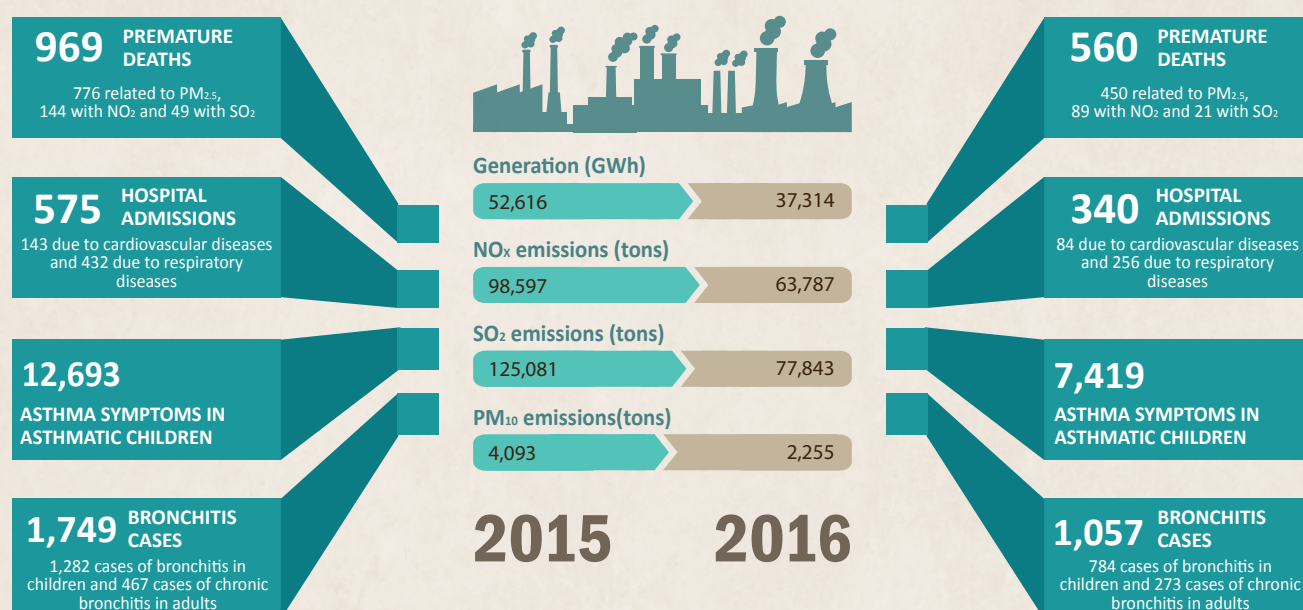


Figure 16 - Comparison of health impacts of coal plants in Spain during 2015 and 2016. (Source: Own elaboration)

Chapter 5

Recommendations

This study highlights the many negative impacts on health, the economy and the environment generated by emissions from coal-fired power plants. Impacts on health and the environment interfere with the enjoyment of the rights to life, health and a healthy environment.

In order to meet the Paris Agreement and the EU climate objectives, as well as many of the SDGs and their targets, a firm commitment to ensure that coal is no longer used as a source of electricity production in our country is needed. As other countries have done, **this commitment must set a date that is binding in order to design and establish the measures that will make it possible to achieve it. 2025 is a feasible date for this closure** to take place in light of the characteristics of our electricity system, technological progress, the upward trend in the price of a ton of CO₂ and the urgent need to put a stop to global warming that is severely affecting our country, among other factors. This would have a positive effect on air quality and, therefore, on our health.

For all the above, **it is essential to include this date in a legally binding instrument. To this regard either the future Climate Change and Energy Transition Law or the NECP** are suitable for this purpose. However, in this sense, the draft NECP sent to the EC on 22 February 2019 is not ambitious as it does not include a phase-out date and only includes a possible scenario for this phase-out to occur by 2030. To this regard, the draft NECP provides the following: However, the draft does not contain such date as it provides the following: **“coal plants will cease to provide energy to the system by the year 2030 at the latest**, as they will have serious difficulties in being competitive with other technologies in an environment highly conditioned by Europe's response to climate change, in which the cost of CO₂ will tend to be increasingly higher. (...) In any case, **it might be possible to maintain part of the installed capacity where investments have been made to comply with the EU framework”**.

In the same way, **the closure of coal plants planned for June 2020 must become a reality. To this end, the closures of Andorra, Compostilla, Alcudia (G1 y G2), Lada, Velilla, La Robla, Narcea y Meirama which have already been requested by the operators must be authorised by the General State Administration.**

At the same time, **the regional administrations, when reviewing the environmental permits of those coal plants that want to continue operating after the finalization of the TNP, must establish in these permits the stricter ELVs based on the BATs included in the LCP BREF.** This review will have to be operational as of 1 July 2020 and will allow to reduce the health impacts of emissions from these coal plants, although it will not prevent them.

Moreover, during the time that these plants continue in operation, the operators must guarantee that the coal comes from suppliers which offer enough guarantees to ensure that their operations do not violate human rights in the places where coal is extracted from. This is particularly relevant in countries such as Colombia, Russia or Indonesia from where Spain imports more than 70% of the coal and which are considered high-risk areas by Bettercoal.

In order to provide citizens with enough information on health impacts related to emissions from coal plants, it is urgent to provide real-time information on these emissions. This was already proposed in our first study published in 2017. In fact, these plants have the obligation to continuously monitor the emissions of NO_x, SO₂ and dust of these plants given they are combustion installations with a total rated thermal power equal to or greater than 100 MW⁸³.

The existence of an instrument letting any user obtain, for every combustion plant, “non - validated” emission data of pollutants into the atmosphere in real-time or “validated data” within 24 hours would favour transparency. **Therefore, we propose to create a tool that allows to visualize in a simple manner SO₂, NO_x and dust emissions of all the combustion plants that could be included in the website of the Spanish Transmission System Operator, REE.**

A similar tool is already available on the REE website that allows tracking in real time of estimated CO₂ emission data from the different electricity generation technologies. Currently, there are countries that already have similar tools for NO_x, SO₂ and particulate matter, such as China through an app known as Blue Map.

In this country, provincial environmental protection offices must establish platforms for the dissemination of emission data from all industrial sources. Specifically, the hourly emission data measured by automatic continuous emission monitoring systems. The Blue Map application collects data from each of these platforms and places them on a map, also showing how many facilities do not report the data and how many violate the limit values they have authorized in their permits.

On the other hand, as examined in this study, the effects of air pollution on our health are alarming. In order to reduce pollution levels, **it is necessary to take the World Health Organization guideline values as a standard.** These must become mandatory in our country since the ones established by EU legislation are not enough to avoid the serious consequences that pollution has on the health of citizens.

If these recommendations are considered and action is taken, we are sure that they will benefit our health, the fight against climate change and consequently will positively impact on the enjoyment by both present and future generations of the rights to life, health and a healthy environment.

References

- ¹ World Health Organization, *Ambient air pollution: A global assessment of exposure and burden of disease*, 2016.
- ² World Bank, *The cost of air pollution: strengthening the economic case for action* (English). Washington D.C. World Bank Group, 2016.
- ³ A/HRC/40/55, *Issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment*. Report of the Special Rapporteur, par. 31, 8.01.2019.
- ⁴ A/HRC/25/53.
- ⁵ OHCHR, *Toxic air pollution: UN rights experts urge tighter rules to combat 'invisible threat'*, 24.02.2017.
- ⁶ A/HRC/40/55, pár.79.
- ⁷ A/RES/70/1, *Transforming our world: the 2030 Agenda for Sustainable Development*, 21.10.2015.
- ⁸ Ensure access to affordable, reliable, sustainable and modern energy for all. Targets 7.2: By 2030, increase substantially the share of renewable energy in the global energy mix, and 7 a) and 7 b).
- ⁹ Make cities and human settlements inclusive, safe, resilient and sustainable. Target 11.2: "By 2030, provide access to sustainable transport systems for all". Target 11.6: "By 2030 reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality".
- ¹⁰ A/HRC/40/55, par. 19.
- ¹¹ Concluding observations on the combined fifth and sixth periodic reports of Spain (CRC/C/ESP/CO/5-6). 5.03.2018. Para. 36 focused on environmental health.
- ¹² "60. With respect to substantive obligations, States must not violate the right to breathe clean air through their own actions; must protect the right from being violated by third parties, especially businesses; and must establish, implement and enforce laws, policies and programmes to fulfil the right. States also must avoid discrimination and retrogressive measures."
- ¹³ WHO, *Ambient (outdoor) air quality and health*, May 2018.
- ¹⁴ WHO, *Air Pollution and Child Health: prescribing clean air*. Summary 2018.
- ¹⁵ European Commission, 2017b, *Special Eurobarometer 468: Attitudes of European citizens towards the environment*.
- ¹⁶ AEMA, *Air quality in Europe - 2018 report*, 2018.
- ¹⁷ This report analyses air quality at European level in 2016. However, it provides information on the health impacts of air pollution in 2015 because the methodology used to carry out the simulation uses maps of interpolated concentrations of air pollutants, with information on the spatial distribution of the concentration of pollutants from the European Monitoring and Evaluation Programme (EMEP) model. At the time of writing the report, the most up-to-date data from the EMEP model (2015) were used. Source: Ibid.
- ¹⁸ WHO, *Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, Global update 2005. Summary of risk assessment.
- ¹⁹ Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on air quality and cleaner air for Europe (OJ L 152, of 11.6.2008).
- ²⁰ European Court of Auditors, Special Report 23/2018. *Air pollution: our health still insufficiently protected*, septiembre 2018.
- ²¹ These pollutants are: SO₂, NO₂, nitrogen dioxides (NO₂), particulate matter (PM₁₀ y PM_{2,5}), lead (Pb), benzene (C₆H₆), carbon monoxide (CO) and O₃. In addition, according to article 4.1 of Directive 2004/107/EC, ambient air quality shall be also assessed for the following pollutants: arsenic (As), cadmium (Cd), nickel (Ni) and benzo(a)pyrene (B(a)P).
- ²² Ecologistas en acción, *La calidad del aire en el Estado español durante 2017*, June 2018.
- ²³ Spain has an overall 32 cases, and closed 2018 being the Member State of the EU with the higher number of open proceedings for non-compliance with environmental regulations (Source: European Commission).
- ²⁴ Article 23(1), Directive 2008/50/EC.
- ²⁵ AIE, *Coal 2018 Analysis and Forecasts to 2023*, Carlos Fernández Álvarez – Senior Coal Analyst, Madrid, January 2019.
- ²⁶ BP, *Statistical Review of World Energy*, June 2018.
- ²⁷ IEA, *World Energy Outlook 2018*. Available at: <https://www.iea.org/weo/>
- ²⁸ IEA, *Global Energy and CO2 Status Report 2017*, 2018.
- ²⁹ United Nations Environment Program (UNEP) (2017). *The Emissions Gap Report 2017*, Nairobi.
- ³⁰ IPCC, *Special report: Global warming of 1.5°C*, 2018.
- ³¹ Climate Analytics, *Coal phase-out*. Available at: <https://climateanalytics.org/briefings/coal-phase-out/>

- ³² Agora Energiewende and Sandbag, *The European Power Sector in 2018. Up-to-date analysis on the electricity transition*, p. 10, 2019.
- ³³ Europe Beyond Coal (EBC), *European Coal Plants Database*. Available at: <https://beyond-coal.eu/data/>
- ³⁴ Ibid.
- ³⁵ Also known as the Coal Commission, it was created in June 2018 by the German Government with the objective of developing a phase-out plan for coal to meet the objectives of the Paris Agreement, taking into account the structural development needed for coal mining regions.
- ³⁶ BOE N. 40, 16.02.2005.
- ³⁷ Instituto Internacional de Derecho y Medio Ambiente (IIDMA), *Public participation in the preparation of the Integrated National Energy and Climate Plan: an obligation*, 2018.
- ³⁸ There is another coal plant in Spain called La Pereda, owned by the HUNOSA Group and located in Asturias. However, the Spanish TSO does not account for it within the national electricity generation system. This plant, with an installed capacity of 50 MW, burns very low-quality coal and waste. The electricity which it produces is sold to the general grid. Source: HUNOSA Group.
- ³⁹ In 2018 there was an increase of 26 MW of coal with respect to the previous year. This was due to an increase in power of group 2 of coal plant Aboño, owned by EDP Spain S.A. Source: CNMC, *Acuerdo por el que se emite el informe sobre la potencia instalada en la central térmica de Aboño (Grupo II) situada en Gijón (Asturias), a solicitud de la Dirección General de Política Energética y Minas*, november 2018.
- ⁴⁰ The former Gas Natural Fenosa and Endesa filed the request for closure to the former Minister of Energy, Tourism and Digital Agenda in May 2017. However, the authorization for closure was granted in November 2018. Source: *Resolución de 13 de noviembre de 2018, de la Dirección General de Política Energética y Minas, por la que se autoriza a la Comunidad de Bienes Central Térmica de Anllares el cierre de la Central Térmica de Anllares, en Páramo del Sil (León)*, (BOE N. 295, 07.12.2018).
- ⁴¹ EBC, *European Coal Plants Database*.
- ⁴² Red Eléctrica de España (REE), *Preview of the Report on the Spanish Electricity System 2018, Data Tables*.
- ⁴³ Framework Agreement on Just Transition for Coal Mining and Sustainable Development of Coal Mining Regions for the period 2019 – 2027, October 2018.
- ⁴⁴ Ministry of Industry, Commerce and Tourism, *Datacomex, External Trade Statistics*.
- ⁴⁵ Bettercoal, *Country Prioritisation 2018*, Version 3.0, 2018, p. 4.
- ⁴⁶ Article 2(4) of Directive (EU) 2018/2001 (OJ L 328 of 21.12.2018) defines “gross final consumption of energy” as: “the energy commodities delivered for energy purposes to industry, transport, households, services including public services, agriculture, forestry and fisheries, the consumption of electricity and heat by the energy branch for electricity, heat and transport fuel production, and losses of electricity and heat in distribution and transport”.
- ⁴⁷ Annex I, part A, Directive (EU) 2018/2001.
- ⁴⁸ Eurostat.
- ⁴⁹ La información, *Las renovables vuelven a ser pasto de la especulación tras los años de moratoria*, February 2019.
- ⁵⁰ La Información, *El reto imposible de España: debe instalar más de 8.000 MW renovables en 15 meses*, October 2018.
- ⁵¹ Article 3(1), Directive (EU) 2018/2001.
- ⁵² Ibid.
- ⁵³ Communication from the Commission to the European Parliament and the Council, *Achieving the 10% electricity interconnection target. Making Europe’s electricity grid fit for 2020*. COM M (2015) 82 final, 25.02.2015.
- ⁵⁴ Article 3(5)(c), Directive (EU) 2018/2001.
- ⁵⁵ INELFE, *The electricity interconnection across the Biscay Gulf*. Available at: <https://www.inelfe.eu/en/projects/bay-biscay>
- ⁵⁶ Article 34(1), IED.
- ⁵⁷ Royal Legislative Decree 1/2016, which approves the consolidated text of the Integrated Law on Pollution Prevention and Control (BOE N. 316, of 31.12.2016).
- ⁵⁸ Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants (OJ L 212, 17.08.2017).
- ⁵⁹ Articles 137 and 138(1) of Royal Decree 1955/2000 (BOE N. 310, 27.12.2000) and Article 7(34) of Law 3/2013 (BOE N. 134, 05.06.2013).

- ⁶⁰ CNMC, *Acuerdo por el que se emite informe a solicitud de la Dirección General de Política Energética y Minas sobre la propuesta de resolución por la que se autoriza a la Comunidad de bienes central térmica de Anllares el cierre de la central térmica de Anllares, en Páramo del Sil (León)*, June 2018.
- ⁶¹ Summary of the draft National Energy and Climate Plan (2021 – 2030), February 2019, p. 9.
- ⁶² Employment data until 2016 was extracted from the Spanish Geological and Mining Institute, while for the 2017 – 2018 period the data comes from the Ministry of Employment, Migrations and Social Security.
- ⁶³ Framework Agreement for a Just Transition for Coal Mining and Sustainable Development of Coal Mining Regions for the period 2019 – 2027, October 2018.
- ⁶⁴ Ibid.
- ⁶⁵ Overseas Development Institute, *Cutting Europe's lifeline to coal: tracking subsidies in 10 countries*, 2017. 10 países, 2017.
- ⁶⁶ Council Decision 2010/787/EU of 10 December 2010 on State aid to facilitate the closure of uncompetitive coal mines (OJ L 335, 21.12.2010).
- ⁶⁷ European Commission Decision C (2016) 3029 final in the subject State aid SA.34332 (2012/NN) - Spain- Aid to facilitate the closure of coal mines in Spain, 27.05.2016.
- ⁶⁸ OJ C 471, 16.12.2016.
- ⁶⁹ Article 1(d) of Decision 2010/787/EU, defines as coal production unit “underground or opencast coal workings and related infrastructure capable of producing raw coal independently of other parts of the undertaking”.
- ⁷⁰ Article 4, Ibid.
- ⁷¹ BOE N. 308, 22.12.2018.
- ⁷² Resolution of 22 January 2019, of the Spanish Parliament, which orders the publication of the validation agreement of Royal Decree – law 25/2018, of 21 December, of urgent measures for a just transition of coal mining and the sustainable development of coal mining regions (BOE N. 25, 29.01.2019).
- ⁷³ SER, *Samca reacciona al cierre de la mina de Ariño con una inversión de 50 millones*, 16.01.2019.
- ⁷⁴ SER, *La Escondida a desmantelamiento para evitar la devolución 8,3 millones de euros*, 11.01.2019.
- ⁷⁵ See table 3 of Commission Decision C (2016) 3029 final.
- ⁷⁶ For more information see document entitled “Coal Mining in Spain”, published by IIDMA in December 2018.
- ⁷⁷ Barreira, A., Patierno, M., Ruiz-Bautista, C., *A Dark Outlook: The impacts on health of coal-fired power plants in Spain during 2014*, Madrid: Instituto Internacional de Derecho y Medio Ambiente (IIDMA), 2017.
- ⁷⁸ Europe Beyond Coal, *Last Gasp: the coal companies making Europe sick*, November 2018.
- ⁷⁹ For more information regarding the methodology please see the Annex of the report mentioned in reference number 77.
- ⁸⁰ To carry out this simulation it is necessary to use emission data from each of the stacks. In this report, impacts on health caused by emissions from coal plants have been calculated for the years 2015 and 2016 as they were the last available data divided by stacks and not by industrial complex.
- ⁸¹ These functions reflect the relationship between the increase in concentration of a given pollutant and its impact on health. Each pollutant-impact pair has an associated CRF. CRFs are expressed in the scientific literature in terms of relative risk, which represents the probability that a certain disease will develop in individuals exposed - to a certain exposure factor - as opposed to those not exposed.
- ⁸² WHO, *Health risks of air pollution in Europe - HRAPIE Project. Recommendations for concentration - response functions for cost-benefit analysis of particulate matter, ozone and nitrogen dioxide*, 2013.
- ⁸³ IED, Annex V, Part 3, para 1.



international
institute for law
& the environment

Law at the service of the environment