

CLEAN-kWAT Project [2016-1-TR01-KA202-033958]

NATIONAL REPORT SPAIN

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1. Introduction.

1.1. Geographic situation.

Spain is located in south-western Europe and in North Africa. It covers 505,955 km, occupying most of the Iberian Peninsula and shares borders with Portugal. The rest (12,500 km) are islands: the Canary Islands in the Atlantic Ocean and the Balearic Islands in the Mediterranean Sea, and two autonomous cities (Ceuta and Melilla) in North Africa. Only 14 km. Separate Spain from the African continent, which gives it a great strategic value

1.2. Population.

The population of Spain is 46,745,807 inhabitants, which gives a population density of 92.61 inhabitants per square kilometer. The distribution of the population is very irregular, concentrating on the coast and leaving large areas of the interior sparsely inhabited. 77% of the population lives in urban areas.

As for religion, Catholics are 94%. The official language is Spanish or Castilian, which speaks 74% of the population as the mother tongue; Other official languages in some autonomous communities are Catalan (which speaks 17% of the population), Galician (7%) and Basque (2%).

The capital is Madrid, other important provincial capitals by the number of inhabitants are: Barcelona, Valencia, Seville, Zaragoza and Malaga.

1.3. Administrative and political organization.

Spain is administratively divided into 17 autonomous communities: Andalusia, Aragon, Principality of Asturias, Balearic Islands, Canaries, Castile and Leon, Castile-La Mancha, Catalonia, Extremadura, Galicia, La Rioja, Madrid, Region of Murcia, Navarre , Basque Country and Valencian Community.

The political system is Democracy, in addition there is a constitutional monarchy, in which the King is the Head of the State.

The Autonomous Communities have Parliament, which makes possible that there is an autonomous government in each of them.

Since 1,978 the Spanish Constitution governs the government of the State.

1.4. Economy.

The economy in Spain is based on the services sector. In the 1970s there was a high presence of the industrial sector and the production of energy. The services sector has gone from 46% of GDP in 1970 to 75% in 2015. Spain has competitive companies in banking, distribution, engineering, infrastructure management and construction, water and waste management, hotels, energy production and distribution, renewable energy, insurance and telephony. Tourism represents an important source of income for the country's economy.

2.Current environmental situation in Spain.

Climatic change.

By means of Royal Decree 376/2001 of 6 April, the Spanish Climate Change Office (OECC) was created as a collegiate body under the General Direction of Quality and Environmental Assessment of the Ministry of the Environment to develop policies related to climate change.

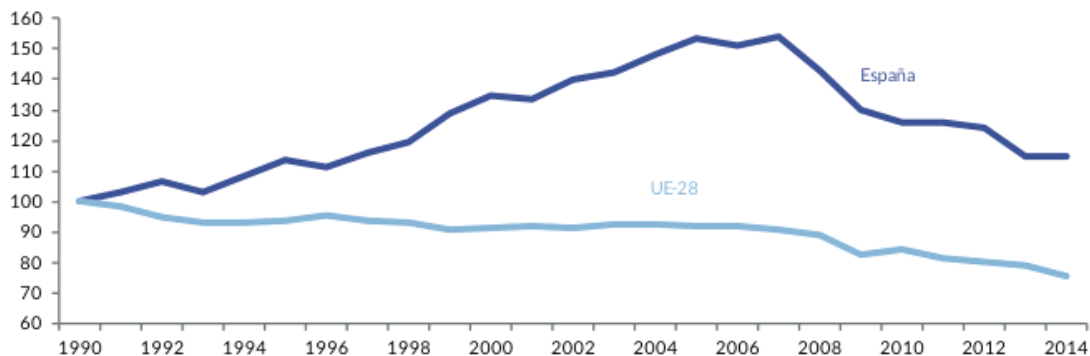
In Spain has been observed during the twentieth century and part of the s. XXI the following:

- Warming has been more pronounced in spring and summer, and in the maximum temperatures.
- By regions, the most affected by the warming are those located in the eastern half in torrn to the Mediterranean (from Girona to Malaga) and the Canary Islands.
- Decrease in cold days and increase in warm weather.

Greenhouse effect.

The following graph shows the emission of greenhouse gases in Spain and the EU.

Emissions of greenhouse gases in Spain and EU



Fuente: AEMA

In 2014, GHG emissions increased by 0.45%. This is the first increase since the decline started in 2007

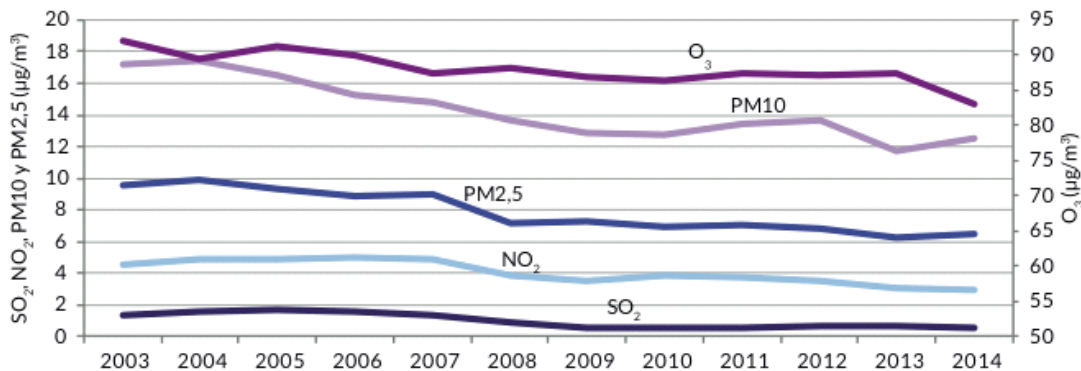
- Between 1990 and 2014, GHG emissions increased by 15%
- In 2014 Spain contributed 7.7% of all EU-28 GHG emissions

- Spain was the thirteenth EU-28 country with the lowest CO2-eq per euro of GDP in 2014 and the 11th with the lowest per capita emissions

The overall emissions of the country up to 2.040 are expected to be 353.7 million tonnes of CO2 equivalent. This is 18 million more than what Spain expelled to the atmosphere in 2015, ie Spain is one of the European countries most exposed to the harmful effects of warming, not only will not reduce its emissions, but will increase them in the coming years. 25 years.

Quality Air.

Average concentrations SO2, NO2, PM10, PM2,5 y O3



Nota: Partículas: datos diarios; SO₂ y NO₂: datos horarios; O₃: datos máximos diarios octohorarios

Fuente: MAGRAMA

Over the period from 2003 to 2014 there was an improvement in the quality of the regional background air in Spain, characterized by a marked decrease in the average concentrations of SO₂ and significant reductions in NO₂ and particulate matter. The reduction of ozone concentrations has been less marked than the rest of the pollutants. In particular, SO₂ levels have been reduced by 57.9%, with a particularly intense decline between 2007 and 2009. On the other hand, the NO₂, PM_{2,5} and PM₁₀ concentrations offer drops of 35, 1%, 32.8% and 27.4%, respectively.

Carbon footprint

Known as "the totality of greenhouse gases (GHG) emitted by direct or indirect effect of an individual, organization, event or product".

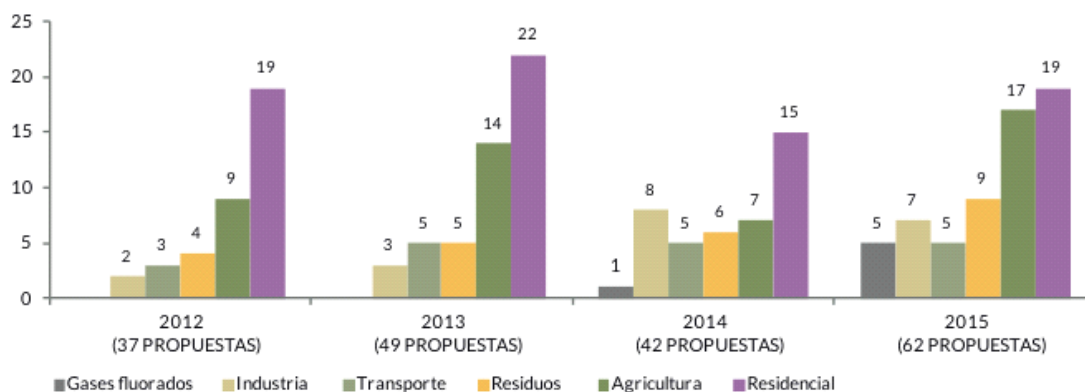
Such environmental impact is measured by carrying out an inventory of GHG emissions or a life cycle analysis according to the type of footprint, following recognized international standards such as ISO 14064, PAS 2050 or GHG Protocol, among others. The carbon footprint is measured in mass CO₂ equivalent. Once the size and the

footprint are known, it is possible to implement a strategy of reduction and / or compensation of emissions, through different programs, public or private.

Part of the environmental impact control policies in Spain include the development of projects:

European Climate Fund projects in Spain

On the 29th of July 2014, the Decree 163 / 2014 issued Decree-Law notices, as it implements the carbon record, compensation and carbon dioxide absorption projects. The voluntary registration was born with the vocation of encouraging the calculation and reduction of the carbon footprint by Spanish organizations, as well as promoting projects that improve the sink capacity of Spain, thus constituting a measure of Fight against climate change of a horizontal nature.



Fuente: MAGRAMA

The year 2015, with 62 selected projects, has been the one that has had a greater number of projects since in 2012 the first summons was launched

- The residential and agricultural sectors are the ones with the highest number of proposals selected in 2015 (19% and 17%, respectively).
- Climate Projects aim to avoid emissions in diffuse sectors, such as transport, residential, waste, agriculture and livestock, industry (not included in emissions trading) and fluorinated gases.

Contamination of waters.

Currently there are rivers with worrying levels of pollution, due to human activities (domestic, industrial and agricultural), which add to the water these substances: detergents, fertilizers, pesticides, nitrates... or are the landfills of some cities (organic remains).

Another problem is the use of water to irrigate crops and transfers between rivers, which makes the watershed biodiversity suffer. In the southern area the most important problem is water scarcity. In the northern part of the country, the black waters, rivers near the industrial zones.

3. Spanish geological context and its relation with renewable energies.

In our country we can find a variety of landscapes and climates that can favor the installation of certain types of renewable energy sources, for this we must place ourselves in the Spanish geological context.

The Iberian peninsula is the most southern and westernmost of Europe, the only one between two seas and the closest to the African continent, is in a temperate zone of the north hemisphere and enjoys a Mediterranean climate in most of its territory except in the northern zone that predominates a more continental climate.

The special characteristics of the relief organization also singles out Spain are:

- The solid form, as a consequence of the great extension in latitude and longitude of the Peninsula, of the little articulated character of its coasts, giving a marked continental character to the interior of the Peninsula
 - The high average altitude resulting from the existence of the Castilian Plateau
- The ring road arrangement of the mountain systems that are established around or independent of the Castilian Plateau. This singularity of relief gives the country a continental character in much of the territory and explains its hydrographic network



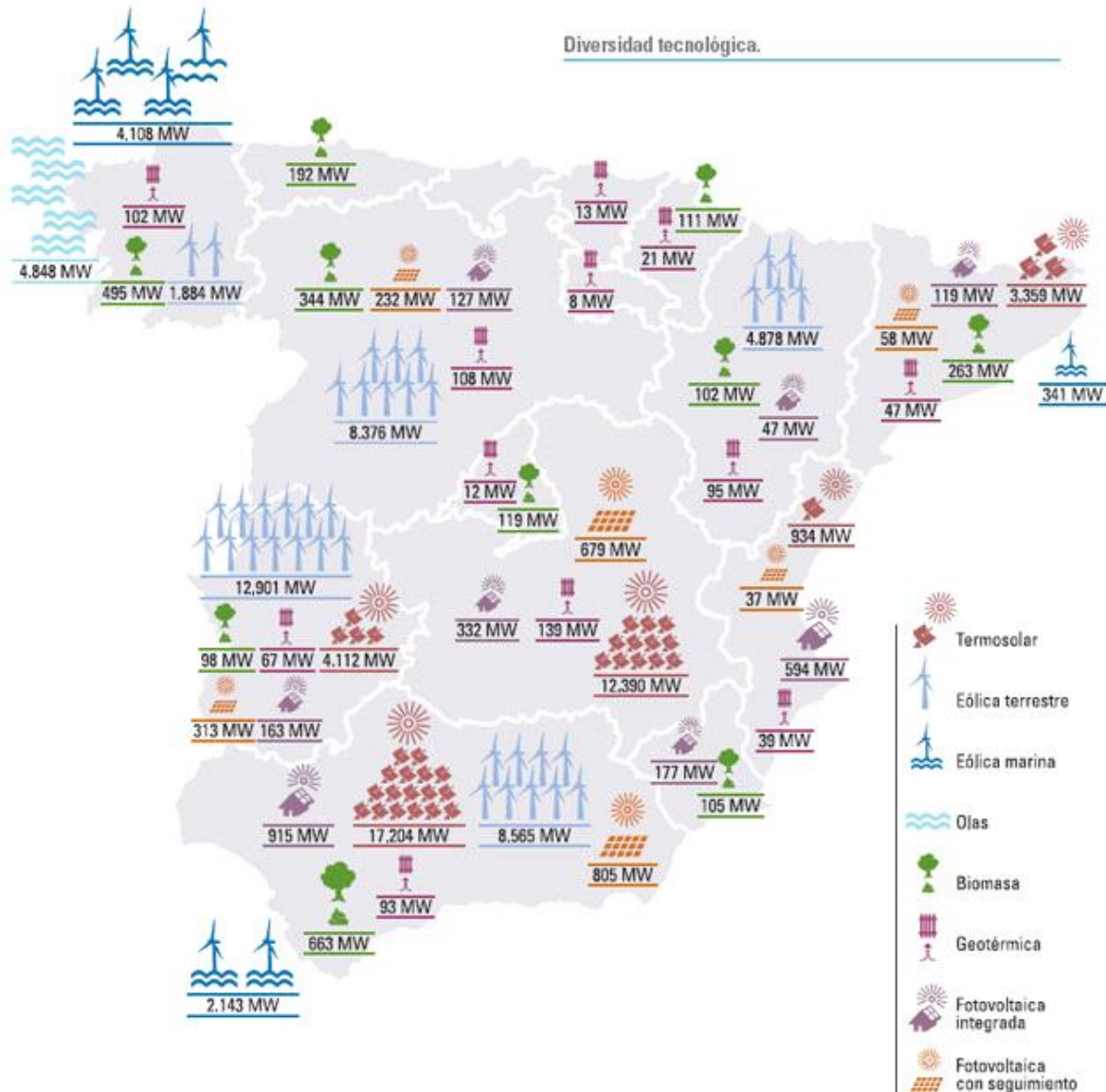
Spain is also a country known for having many hours of sunlight which helps to proliferate energies such as thermosolar.

We conclude that Spain has a good capacity to install different types of renewable energy thanks to its geographical singularity.

Most of the renewable energy produced was hydro, followed by wind after it, the biofuels.

Spain for its climatic conditions has been the first country in the world to require the installation of solar panels in its new buildings since according to some reports like those of Greenpeace solar energy could provide seven times the electrical demand that would have the peninsula in 2050.

In this map we can see the distribution of renewable energies in Spain



In Spain the renewable source that stands out is undoubtedly the wind, but also the hydroelectric and the solar have their weight.

Hydroelectric:

Historically this has been the first way to exploit a renewable energy source that was used in the world, in fact, already in the early twentieth century began to build large hydraulic dams in Spain. These plants that are built on the river channels, are based on the creation of a reservoir of water in order to have a reserve of energy, which at certain moments is released. By making it fall on the blades that constitute the driving force of the turbines, electric energy is generated.

Solar thermal and photovoltaic solar:

Thermoelectric solar energy, since its technology is still expensive, its deployment in Spain is still insignificant. Photovoltaic solar technology is used more generically. Its use is becoming popular all over the world, since it is the most suitable source for self-consumption. In Spain from 2015 governs the RD of the Autoconsumo, colloquially denominated Tax to the Sun, that limits the expansion of the photovoltaic solar energy, but it is expected that this one is abrogated and Spain joins to the majority of the countries of the world that bet by this technology Clean and accessible.

Wind:

Wind energy is an indirect way of harnessing solar energy. The greater the size of the wind turbines (taking into account the diameter of their rotor and the height of the towers) the lower the cost of the energy obtained, although it is being innovated to obtain increasing profitability and efficiency. The wind power installed in Spain is the most abundant.

However, in Spain it stagnates in the use of renewable. The final gross energy consumption in 2015 from clean sources was almost the same as the previous year. In addition, it is not part of the group of 11 countries that have already met their European commitments for 2020.

In the use of biomass Spain has made a significant increase.

Situation in Andalusia of renewable energies.

Andalusia, due to its climate and geographic location is currently considered as one of the most privileged enclaves for the promotion and development of renewable energies.



The Andalusian Autonomous Community is the European region that receives the highest solar radiation on its surface, is well-endowed with climatological characteristics very suitable for the energetic use of the wind and generates large amounts of biomass from its powerful agricultural sector.

It also has autochthonous energy resources, with renewable sources accounting for a higher percentage of domestic production.

In order to take advantage of these resources, the Andalusian Government is committed to a sustainable energy model, which will combine the diversification of energy sources, savings and science, while attending the Andalusian Energy Plan (PLEAN), whose main objective was that in 2.010 the 15 % of the total energy demanded by the region had its origin in renewable sources.

Wind energy is in a favorable situation (almost 3,000 MW installed), solar thermal concentrates a sensational takeoff, photovoltaic is suffering a break due to regulatory uncertainty, solar collectors have not just deployed their potential in building (will not be achieved The 1.3 million m² planned for 2013) and biofuels continue to suffer from a lack of sustainability, while biomass does not come out of stagnation. Thermal solar panels for hot water are being wasted. Also the opportunity of the offshore wind is being lost, by the unfounded rejection of the concerned municipalities.

The Andalusian Plan for Energy Sustainability, with the objective that in 2.013, 18.3% of energy consumption comes from renewable sources has failed to meet its objectives.

4. National energy policies.

The regulation of Renewable Energies in Spain, begins in the 80's with the *Law (82/1980) that promotes mini-hydropower*, to deal with the oil crisis and improve energy efficiency. Also developed are:

* *National Energy Plan 1.991-2.000.*

Aim: to encourage the production of electricity with renewable energy.

* *Law 40/1994 of the national electrical system.*

Aim: to consolidate the special regime of energy production

* *Royal Decree 2366/1994 on the production of electrical energy by hydraulic, cogeneration and other facilities supplied by renewable resources or sources.*

Aim: to regulate the electrical energy of the special regime.

Current regulations in force:

* *Royal Decree 661/2007, of 25 May, regulating the activity of production of electricity in special regime.*

Aim: The condition of installation of special regime is granted by the corresponding Autonomous Community, with the final registration of the installation in the administrative Register of production facilities under special regime the necessary condition to access the economic regime regulated by said Royal Decree.

* *Royal Decree 1028/2007 of 20 July, establishing the administrative procedure for processing applications for authorization of electricity generation facilities in the territorial sea.*

Aim: It regulates the administrative procedure that must be followed and that must necessarily include an Environmental Impact Assessment prior to authorization.

* *Royal Decree-Law 6/2009, of 30 April, which adopts certain measures in the energy sector and approves the social bond.*

Aim: It created the mechanism of registration of preallocation of remuneration for the facilities of the special regime.

* *Royal Decree 1003/2010, of August 5, which regulates the settlement of the premium equivalent to the installations of electricity production of photovoltaic technology under special regime.*

* *Royal Decree-Law 14/2010, of 23 December, which establishes urgent measures for the correction of the tariff deficit of the electricity sector.*

* *Royal Decree 1597/2011, of November 4, regulating the sustainability criteria of biofuels and bioliquids, the National System of Verification of Sustainability and the double value of some biofuels for the purpose of computing.*

Aim: It explains biomass sources from which biofuels and bioliquids can be obtained to be considered as sustainable and contribute to the reduction of greenhouse gas emissions.

* *Royal Decree-Law 9/2013, of July 12, which adopts urgent measures to ensure the financial stability of the electricity system.*

Aim: It approves a new legal and economic regime for existing electric energy production facilities from renewable energy sources, cogeneration and waste.

* *Royal Decree 413/2014, of June 6, regulating the activity of production of electric energy from renewable energy sources, cogeneration and waste.*

Aim: It regulates the incentives received by renewable energy installations, so that only those that have not exceeded the legal life (20 years for wind, 30 for photovoltaic and 25 for the rest) will continue to receive premiums.

* *Royal Decree 110/2015, of February 20, on waste electrical and electronic equipment.*

Aim: Photovoltaic panels are considered for the first time as electrical and electronic devices and the correct management of their residues is established when they reach the end of their useful life.

* *Royal Decree 900/2015 of 9 October, which regulates the administrative, technical and economic conditions of the electric power supply with self-consumption and production with self-consumption.*

Aim: It taxes the self-consumption facilities and the non-registration of the facilities. It does not affect isolated installations, ie not connected to the mains.

The regulation of renewable energies in **Andalusia** is developed through these laws:

* *Law 2/2007, of 27 March, on the promotion of renewable energies and energy saving and efficiency in Andalusia.*

Aim: to promote the use of renewable energies, increasing energy saving and efficiency.

* *Decree 2/2013, of 15 January, approving the Regulations for the Promotion of Renewable Energies, Savings and Energy Efficiency in Andalusia.*

Aim: to facilitate administrative procedures for agencies.

5. National environmental policies.

In Spain there are many policies and innumerable instruments of action to improve the environmental quality.

The development of renewable energy sources is one of the most important aspects of the national energy policy, for the following reasons:

- They contribute efficiently to the reduction of greenhouse gas emissions, in particular CO₂.
- The greater participation of renewable energies in the energy balance reduces our dependence on petroleum products and diversifies our sources of supply by promoting indigenous resources.

Although some renewable sources are economically competitive with conventional energies at the moment the vast majority will be in the short or medium term. Wind power plants, mini-hydro plants (<10 MW nominal power) and low-temperature solar thermal plants have reached practically the profitability threshold.

However, others such as photovoltaic solar or high temperature solar need a strong support that allows the development of technology and the promotion, where appropriate, of demonstration facilities.

The current national renewables plan states that 16.7% of total energy consumption would come from clean sources by 2015. But according to a report by the European Commission, that percentage was 15.6%, more than one point under. Despite this difference, Brussels believes that Spain is on track to meet its target in 2020, 20% of total energy consumption must come from renewable sources.

However Spain, according to the Commission forecast, will not be in the package of defaulters in 2,020 and will reach the 20% to which it is bound. How is it possible? For the purpose of analyzing the degree of compliance, Brussels does not use as an indicator the annual objectives that each country has in its national plans. It uses a trajectory indicator included in the European directive of 2.009. This indicator is not

annual, but sets averages for biennia. For example, in the case of Spain, the "indicative trajectory" of the use of renewables sets a 13.8% average in the use of renewables for the period 2,015-2,016.

As a result of the policy of support for renewable energies, in the framework of the Renewable Energy Plan 2005-2004, the growth of these in recent years has been remarkable, and thus, in terms of primary energy consumption, Cover a share of 6.3% in 2004 to reach 11.3% in 2010.

The contribution to GDP of renewable energies in 2011 represented 0.95% of the national Gross Domestic Product.

As regards the role of renewables in electricity generation, its contribution to gross final consumption of electricity has increased from 18.5% in 2004 to 29.2% in 2010.

Lastly, renewables in transport have given a great leap forward in recent years, based on the incentives to consume biofuels in that sector. In this way, the favorable tax treatment and the obligation to use have led to a constant growth of the consumption of biofuels on the consumption of gasoline and diesel.

Energy objectives of the Plan in the period 2.011-2.020

Directive 2009/28 / EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources lays down general objectives to achieve a minimum quota of 20% of energy from renewable sources in the final gross energy consumption of the European Union and a minimum share of 10% of energy from renewable sources in the energy consumption in the transport sector in each Member State by 2020.

To this end, it sets targets for each of the Member States in 2020 and a minimum indicative trajectory up to that year. In Spain, the objective is that renewable sources account for at least 20% of final energy consumption in 2020, together with a minimum contribution of 10% of renewable energy sources in transport for that year. Objectives that, in turn, have been included in Law 2/2011, Sustainable Economy.

Regarding the objectives in the electricity sector, it should be pointed out that for both hydro and wind energy, Directive 2009/28 / EC establishes a standardization method that smoothes the potential annual variability of both productions, which Accentuates in years of high / low hydraulicity or high / low wind resource, respectively. The calculation formulas for carrying out such production normalization are specified in Annex II of Directive 2009/28 / EC and its main objective is to define average operating hours, over fifteen years of production in the case of hydraulics, And five years in the case of wind power. Table 5.2 shows both normalized and non-normalized values.

With the aim of achieving a proportionate development of the whole basket of renewable technologies, in order to obtain the maximum benefit from these energy sources, in addition to advancing in technologies that have already reached a certain

degree of implementation, in the second half of the decade Will begin to incorporate technologies such as geothermal energy or the energies of the sea, in order to prepare for its progressive maturation during the decade 2020 - 2030.

With respect to thermal biomass, consumption in 2020 will be distributed fairly evenly between the industrial sector and the domestic sector and buildings. In the solar thermal sector, despite the slowdown due to the housing crisis, the installed solar thermal area has continued to develop and is expected to continue its upward path. On the other hand, geothermal evolution for thermal applications will be developed in two types of applications: geothermal energy, excluding low temperature geothermal heat in heat pump applications, and renewable energy from geothermal heat pumps. Likewise, the aerothermal heat pump is expected to double its energy production by 2020. Therefore, renewable energy for thermal uses will have an impact on reducing emissions in diffuse sectors.

Special Regime of electricity generation with renewables.

It is proposed to adapt the remuneration framework for the electric energy generated with renewable energies contemplating levels of remuneration to the electricity generation that allow the obtainment of reasonable rates of return on investment. The specific technical and economic aspects of each technology, the power of the installations, the number of annual operating hours and the date of commissioning will be taken into account for its determination, all using economic efficiency criteria in the system. In order to guarantee the sustainability and effectiveness of the support framework, the evolution of the levels of remuneration for each technology will seek to converge over time to that perceived by the rest of conventional generation technologies in the Regular Regime, taking into account the results Of the "Prospective Technological Study", carried out for the elaboration of the PER 2011-2020.

The support framework for the production of electricity from renewable sources must have sufficient mechanisms to plan and adapt the growth of technologies to the objectives set out in this renewable energy plan. Likewise, the levels of remuneration may be modified according to the technological evolution of the sectors, the market behavior and the degree of fulfillment of the objectives of renewable energies.

In Andalusia.

* *Law 7/2007, of July 9, on Integrated Management of Environmental Quality.*

Aim: To use the necessary instruments for integrated prevention, assessment and control of pollution.

* *Law 21/2013 of 11 December on Environmental Assessment.*

Aim: The evaluation of environmental impact plans, programs and projects.

6. Dilemma between energy production and protection oh the environment.

Advantages of Renewable Energies:

Renewable energies are clean and barely emits greenhouse effect gases. They are not depleted of natural resources and have few impacts on the environment, without waste products, CO2 emissions, as with other more traditional energy sources. The environmental benefits of renewable energy are many and will greatly contribute to improving air pollution.

Below we will see some of the advantages of the use of General Energies, for example that are more environmentally respectful, non-polluting and represent the cleanest alternative energy until now, are easy to dismantle and do not need to guard their residues during millions of years, as for example with nuclear energies, makes the region more autonomous, since it develops in the same region where it is installed, industry and economy, generates very many jobs, which are foreseen in a greater increase from here to a few years keeping it in mind their demand and implementation, they are safe energies because they do not pollute, nor do they suppose a risk to health, and their waste also do not create any kind of threat to anyone, finally, these are energies from sources that are inexhaustible, like the sun or the water, and furthermore its different origins allow for its application in all type of scenarios.

Advantages of solar energy:

One of the main advantages of solar energy is that it is also a totally clean energy. No chemical elements are needed to convert it to heat or electricity and does not send out contaminating substances into the atmosphere.

Solar energy is much cheaper in the mid-term and long-term and allows for to progress in the direction of self-sufficiency. As well as, it serves both to produce heat or electricity in homes and public places, for example for lighting (there are solar streetlights that accumulate energy during the day to produce light at night).

It is a soundless energy and does not require expensive maintenance.

In Spain it is one of the most used renewable energies since the climate is the most propitious.

Advantages of eolian energy:

In the same way that solar energy is completely renewable since its source is wind. It is also a clean energy, almost as much as solar energy and much more than fossil fuels. Wind energy does not contribute to climate change nor the greenhouse effect.

Wind turbines are getting increasingly more modern and efficient and are capable of producing more energy. There is even an island in Hong Kong where 100% energy is produced by a single turbine.

Wind power can also be used both on a small and large scale, although in most countries it is only used to generate electricity at the industrial level.

Advantages of Hydrogen as renewable energy:

It can be used as a fuel directly and as an energy vector for energy storage, it is non-toxic, it is abundant in nature, it is considered a clean energy by its production by renewable energies, its combustion does not generate pollutant emissions, it has a high efficiency energy, low density and high volatility, is safe in open spaces, in its use in fuel cells takes advantage of 100%, and its quiet operation recommended it for urban use.

Advantages of Biomass as renewable energy:

It is an energy easily accessible since it is found in the remains of crops, trash, manure... In a year all these sources are converted into biofuels and in turn are generated again in cities, fields and farms, so that the rate of transformation is equivalent to the rate of growth. There is a balance between the amount of carbon that the biomass fuel releases into the atmosphere and the amount that the plants extract from it, because of this, the fuels from the biomass do not contribute to global warming. It should be noted that it is a very economical energy.

Disadvantages of renewable energies:

In renewable energies not all are advantages, there are also certain disadvantages that make these energies difficult to use.

Firstly, the high investment in the use of renewable energies is an important feature that makes a lot of money move and with what it may appear to be unprofitable.

In relation to the profitability of these energies, we can talk about the reliability of the supply, since the majority of energy sources will be more or less available depending on certain factors like the weather or the precipitations and considering when the sources will be available can be studied the profitability of renewable energies.

On the other hand, the construction of solar plants, wind fields or any other installation prepared to take advantage of a renewable energy requires of great extensions, which produces an important visual impact and the destruction of habitats that can be of great ecological value. It is true that these facilities can be used domestically, but for the exploitation of these energies is profitable for the country requires facilities that take up large areas.

When large quantities of energy are needed to make production profitable, it is necessary to establish new production plants, which means a greater investment. It is therefore difficult to produce in large quantities.

Focusing on specific renewable energy, eolian energy needs a place where there are no physical barriers, whether natural or artificial and where there is enough wind to move the wind turbines. This wind turbines cause a brutal landscape impact and also interfere with the migrations of the birds, diverting them and even killing them.

Solar energy also has disadvantages as they are the extensive extensions that are necessary and the limitation that exists for its use depending on where we are. In Spain there is enough sun to supply this time of facilities, but for example in England this energy would not be effective due to the little sun that there is.

Energy from biomass in some areas can be expensive and difficult to extract. Large areas are required for the processes of obtaining energy from biomass and for its storage. In some cases, large areas of forest are allocated for biomass production, destroying habitats of great ecological value and causing the disappearance or movement of animal species by destroying their refuges or food sources.

In the context of Spain

Renewable energy in Spain has had a small weight in relation to the demand for primary energy and electricity generation, and has been mainly represented by hydraulic energy. However, since the late twentieth century has received a strong impetus by the different governments. Spain presented in 2010 the first version of the National Action Plan for Renewable Energies. In that document, the Government undertook to reach a quota of 20.8% of renewables on total energy consumption in 2020.

In 2015 the Government approved the so-called "Energy Planning. Plan for the Development of the Electric Energy Transport Network 2015-2020 ", developed according to the Ministry of Industry to meet the objectives committed to Europe in energy subject.

According to REE, renewable energies generated 40.8% of electricity in Spain in 2016, wind power 19.3% higher than coal, solar thermal 2.1% and photovoltaic 3.1%.

After having been among the first European countries to implement eolian energy, Spain has accumulated four consecutive years of losing positions on an international scale. Regarding solar energy, despite being a country in a more than favorable situation to the capture of this renewable source, Spain is located each more far from the countries that bet by the implantation of panels and solar plants of great capacity.

In the context of Andalusia

This autonomous community of Spain has gone from producing in 2007 the 7.2% of the energy consumption from renewable energies to 37.7% in 2015, which is equivalent of the annual consumption of 3 million homes.

At present, 43.2% of the electricity consumed by the Andalusians is of renewable origin. According to data from the end of 2016 is the top Spanish region in thermosolar energy and also in use of biomass with up 18 plants. Also, is the second Spanish region that takes advantage of photovoltaic energy.

This great use of renewable energies has caused that in Andalusia are created many plants for the manufacture of components needed for power plants, such as control systems and towers. This contributes positively to the economic impact in this region, especially our industries that arise by the boom renewable energies.

In the short term, the objectives of this Autonomous Community to continue developing this type of energy are included in the Energy Strategy of Andalusia 2020, which will be carried out from two action plans, the first corresponding to the years 2016- 2017.

The global strategy has 5 action programs: Intelligent Energy, Improvement of Competitiveness, Improvement of Infrastructure and Quality of Energy Services, Energy Culture and Energy Management in the Public Administrations of Andalusia.

In addition, given the ideal position of Andalusia to develop renewable energies, the energy strategy also proposes 5 aims by 2.020 that would be way over the minimum requirements proposed from Europe. These are: reduce primary energy consumption by 25%, contribute 25% of gross final energy consumption with renewable energy, decarbonize energy consumption by 30% compared to 2.007, self-consuming 5% of energy Electricity generated from renewable sources and improve the quality of energy supply by 15%.

The 2.016-2.017 action plan includes 117 which will aim to meet the objectives of the Andalusia 2.020 Energy Strategy, with the majority of them concentrating on the Energy Management programs of the Andalusian Public Administrations and the Improvement of Competitiveness.

6.1. Benefits and impacts of renewable energies in Spain and Andalusia.

The renewable energy sector has special interest in our country. Unlike in fossil resources, we have comparative advantages in this field. This is the case, for example, with high-temperature solar energy by concentration in towers, where Spain is better off because of its greater solar irradiance compared to the rest of Europe.

The *Economic Office of the President of the Government* highlights the shortcomings that must be overcome:

- Small participation of the private sector in R & D & I tasks.
- Reduced innovation capacity.
- Little participation in European programs

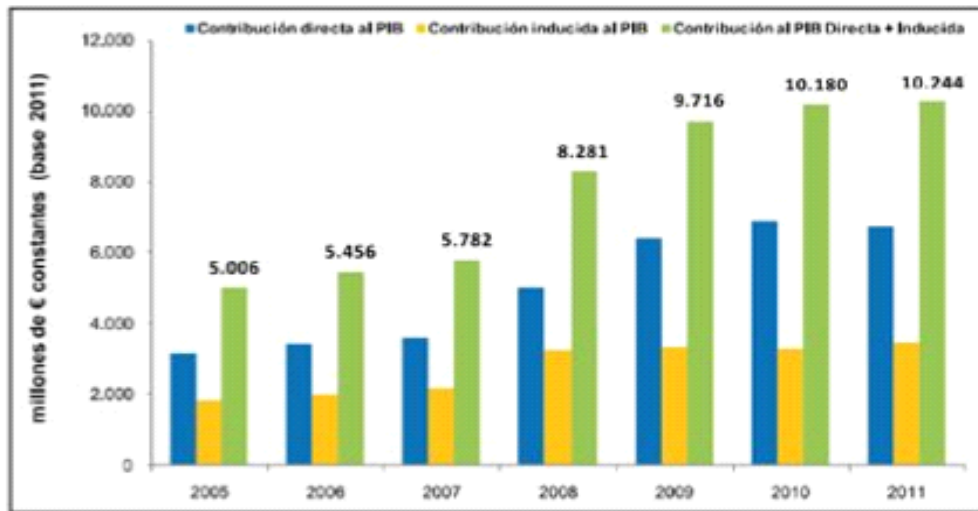
Wind energy: its development in our country is already considerable and is due to: that wind turbines and components are designed, parks are built in Spain and abroad, and the export is already considerable.

Solar energy: its technical development progresses and its costs are already competitive. Spain in this energy has advantage due to the hours of light a year. Throughout the country, park facilities are extended and subsidized. Solar power may be the future, but in the short and medium term it is expensive and unusable.

The future lies in clean and sustainable energies, such as renewables, but these energies are expensive at the moment and need to decrease their cost to make them more accessible to people. In the medium and long term, large-scale use is necessary for ecological and sustainability reasons. But pollution produced by generating units such as noise pollution, damage to birds and loss of landscape must be avoided.

In Spain:

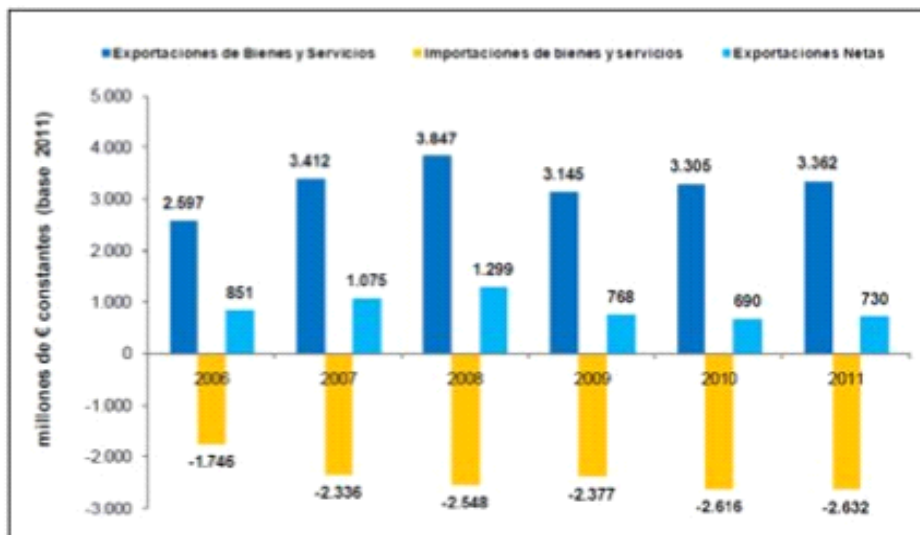
Contribution to GDP: In 2011, renewable energy accounted for 0.95% of the national Gross National Product.



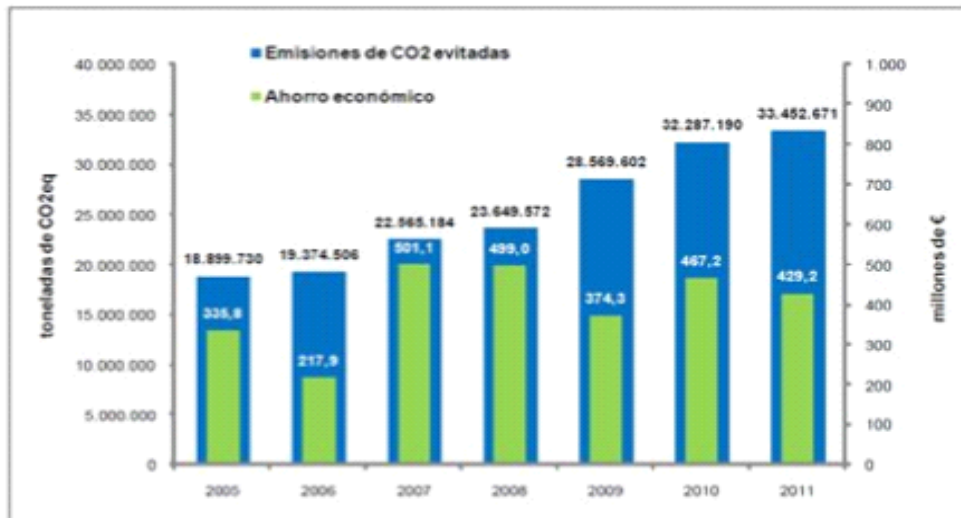
As can be seen, renewable energies have been increasing their contribution to the national GDP. But between the years 2010 and 2011 can be observed as the difference is smaller compared to the years 2007 and 2008.

Creation of Employment: Renewable energies create two types of jobs, direct and indirect. The indirect ones being the workstations that are created the most.

Economic and Fiscal Balance: The renewable energy sector not only contributes to reducing energy dependence; Being a purely exporting sector helps to balance our trade balance.



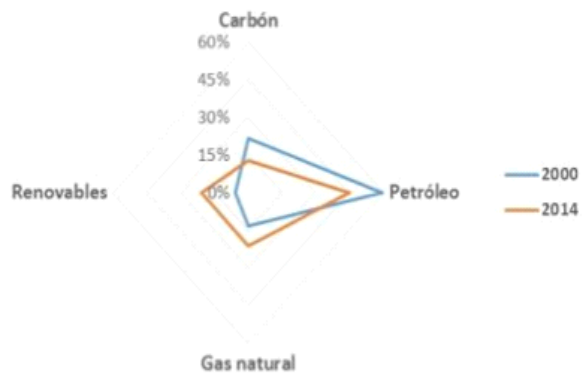
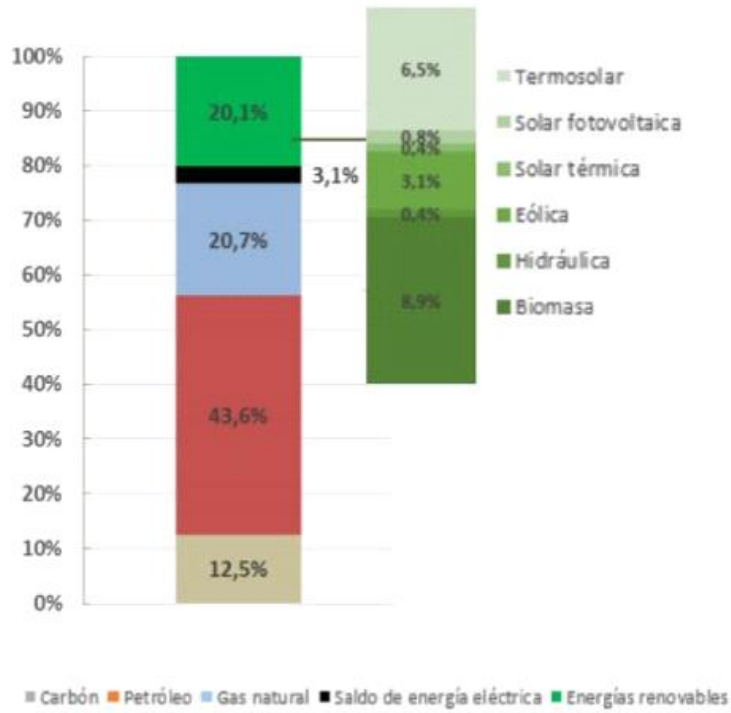
Emissions avoided: renewable energy avoided more CO2 emissions than in 2010. However, due to the reduction in the price of a tonne of CO2, the savings in this concept were lower.



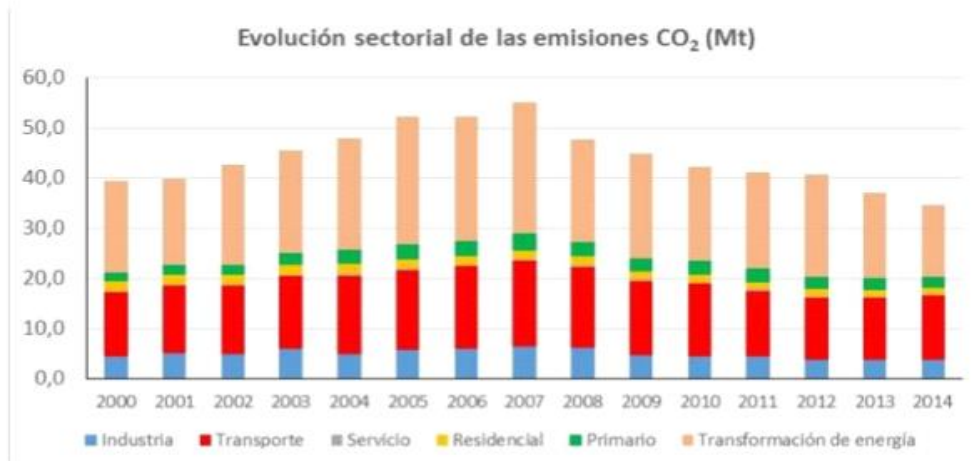
Clean energies also prevented the emission of other gases, perhaps less known but more harmful to health. In 2011, the emission of 27.6 million tons of NOx and 45.3 million tons of SO2 was avoided.

In Andalusia:

Structure of primary energy consumption: with respect to 2013 renewables increase by 0.9%



Here we see how renewables and natural gas have been gaining ground, and we have reduced dependence on oil



This graph shows how CO₂ emissions increased until 2007, but after that date begins to decrease from 55% to 36%

7. Estudios related to renewable energy in Spain.

UNIVERSITY DEGREES	CITIES WHERE THEY ARE TAUGHT	SUBJECTS ON ENERGY
ENVIRONMENTAL SCIENCES	SEVILLA, VALENCIA, CÁDIZ, MADRID, JAÉN, GIRONA, BARCELONA, ÁLAVA, TOLEDO, ALMERÍA.	HYDROLOGY EDAPHOLOGY ENERGY OPTIMIZATION AND RENEWABLE ENERGIES ENERGY AND THE ENVIRONMENT
ENGINEERING OF INDUSTRIAL TECHNOLOGIES	CÁDIZ	THERMOTECHNIA HYDRAULIC MACHINERY AND INSTALLATIONS MACHINERY AND ELECTRICAL INSTALLATIONS FOUNDATIONS OF NUCLEAR ENERGY THERMOELECTRIC PLANTS

		HYDRAULIC OIL AND PNEUMATIC OIL
AGRO-ENVIRONMENTAL ENGINEERING	ALMERÍA, MADRID, BARCELONA, ÁVILA	ENVIRONMENTAL HYDRAULIC AND HYDROLOGY AGRO ENERGÉTICA INTEGRAL MANAGEMENT OF WATER RESOURCES
ENGINEERING OF ENERGY	ASTURIAS, MADRID, VALENCIA, SEVILLA, BARCELONA, MÁLAGA, LEÓN, PONTEVEDRA	GEOLOGY AND EDAFOLOGY FLUVIAL HYDRAULICS WATER RESOURCES AND WASTE MANAGEMENT ENERGY ACTIVITIES IN THE NATURAL ENVIRONMENT

PROFESSIONAL TRAINING CYCLES	CITIES WHERE THEY ARE TAUGHT
SUPERIOR TECHNICIAN IN RENEWABLE ENERGY	BARCELONA, MÁLAGA, VIGO, SEVILLA, HUESCA, LAS PALMAS, TENERIFE, CANTABRIA, CIUDAD REAL, TOLEDO, LLEIDA, TARRAGONA, CÁCERES, A CORUÑA, PNTEVEDRA, LA RIOJA, NAVRRA, CASTELLÓN, ALICANTE, VALENCIA.
DEGREE OF DEVELOPMENT OF PROJECTS OF THERMAL AND FLUID INSTALLATIONS	BARCELONA
ENERGY EFFICIENCY AND THERMAL SOLAR ENERGY	BARCELONA, GRAN CANARIA
ENERGY AUDITS AND REHABILITATION MANAGEMENT	MADRID

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