

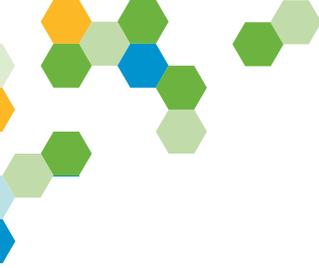


SPECIAL REPORT

Energy 2050. The required changes to the energy model

Madrid, May 2016

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1. INTRODUCTION

The recent Paris Agreement that was reached at the 21st Conference of Parties (COP21) within the United Nations Framework Convention on Climate Change aims to maintain the increase in the global temperature to below 2 °C in 2100 and to pursue efforts that limit the temperature increment to 1.5 °C.

The instruments used to reach this goal are the Intended Nationally Determined Contributions, which represent the international community's commitment to lowering greenhouse gas emissions within the framework of the obligations imposed by the Convention.

According to studies performed by the Intergovernmental Panel on Climate Change, despite the agreed upon limitations, the contributions announced by the countries involved will result in a 3 °C temperature increment in 2100. In fact, the agreement notes that the estimated greenhouse gas emissions for 2025 and 2030 resulting from the planned contributions of nations are not compatible with the desired 2 °C scenario, and instead lead to a projected level of 55 gigatons in 2030.

“The UN will analyze the implementation of the agreement and its progress every five years as of 2023”

2. THE PARIS AGREEMENT

The Agreement states that in order to meet the temperature goal, “an emissions peak must be reached as soon as possible” and progress must be made towards net-zero emissions during the second half of the century through a 40 gigaton reduction. To do so, the “Parties” are requested to submit specific emission reduction goals to the UN that are in line with the global objective before 2020.

The primary mechanism for reaching these emission reduction goals is the set of actions known as mitigation. This refers to the policies, technologies, and measures that tend to limit or reduce greenhouse gas emissions and improve their elimination.

The UN will analyze the implementation of the agreement and its progress (the impact of contributions, the mobilization of financial and technological resources, projected planet temperature levels, etc.) every five years as of 2023.

This periodic analysis will guide the revision of the climate contributions of countries and also determine whether target levels should be increased. The analysis of global actions will also assess adjustment efforts, which are defined as the ability of

a system (human or natural) to adapt to climate change (including climate variability and extreme changes) in order to reduce potential damage, take advantage of positive consequences or withstand negative consequences.

The Paris Agreement has had its ups and downs, but it has also shown that there is a global willingness towards decarbonizing the economy. One of the positive aspects of the agreement worth highlighting is that it has set the goal of limiting the temperature increment to two degrees (compared to the pre-industrial period) with the aim of lowering this limit to 1.5 degrees in the future. We have also made the commitment to reach zero carbon emissions between 2050 and the end of the century. It has also established transparency and accountability obligations, as well as mechanisms for the upwards review of national commitments, which will enable reciprocal surveillance and serve as a basis, if necessary, for establishing coercive systems in the future.

This requires a new energy model that is more environmentally friendly, especially in terms of the potential aspects derived from increased CO₂ levels in the atmosphere, which affect the planet’s average temperature.

“The need to decarbonize energy policies must touch all areas of society”

3. A NEW ENERGY MODEL

As opposed to recent general opinions, the energy model's transformation throughout this century will not be driven by the depletion of fossil fuels because the current crisis of oil prices shows that it is not only due to slumping demand, but rather that it is primarily caused by excess supply resulting from the introduction of unconventional hydrocarbons into the market. This transformation will become a reality thanks to two fundamental vectors: technology and the aforementioned fight against climate change. Both vectors are present in renewable energy and the technological progress that positions it on the edge of competitiveness, and they also refer to environmentally clean and neutral technologies.

The consulting firm Deloitte has written a study titled “A sustainable energy model for Spain in 2050. Energy policy recommendations for the transition” that explains in detail the implications of fulfilling the commitments made in the Paris Agreement and the need to create an energy model aimed at those goals. In other words, it is based on decarbonizing the existing model in order to provide recommendations for the energy transition between now and 2050.

The need to decarbonize energy policies must touch all areas of society because zero carbon levels cannot be reached unless action is taken in the energy sector as well as in other industries (such as mobility, construction, urban development, occupational organization, etc.) that affect all areas of society. The study also states that in order to reduce emissions, it is essential to change how energy is produced and consumed between now and 2050.

To reach the planned objective for 2050, there must first be a transition period in which the following matters are addressed:

What economic sectors should contribute the most to decarbonization in order to meet the planned targets for 2030? How should we handle the existing uncertainty regarding emerging technologies? What should we do with nuclear power plants? What role should natural gas play during this transition period?

In addition, and with an eye on 2050, the questions we should begin to answer today are: What are the implications of the 2050 environmental commitments for the energy industry and the economic sectors? What volume of investments and of what type should we implement in order to meet the 2050 goals?

Given the increased responsibility of the electrical industry on power generation and of the mobility sector (especially road transportation) on CO₂ emissions, we should focus on these areas.

In order to reach the proposed emission objectives, between now and 2050 a power generation depot based almost entirely on renewable energy should be developed. This will require the installation of 145-200 GW, except in less than 10%, to guarantee the electrical system. Given the high variability and unpredictability of these energy sources, natural gas should be used as

a backup (in combined cycles or in open cycle turbines) because it is the fossil fuel that produces the lowest CO₂ emission levels when burned.

A factor to consider is the high cost of building the necessary infrastructures in certain countries (such as Spain) for the significant rise in transported electricity and the environmental issues involved in multiplying high-voltage grids. Heat production in homes (for heating, hot water, and cooking) should also include natural gas in order for the system to be economically viable and to maintain low emission levels.

Figure 1. Recommendations for sustainable decarbonization

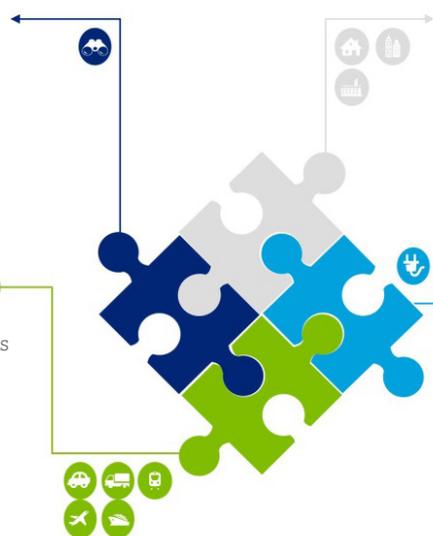
A set of energy policy recommendations are proposed in order to guide our energy model towards decarbonization

Defining fiscal policies and objectives

1. Determining related objectives for all the sectors.
2. Developing an effective pricing signal for the cost of emissions.

Transportation industry

3. Promoting electric/hybrid vehicles and charging stations
4. Encouraging the change to railway for heavyweight transport.
5. Promoting NGVs in the transition of heavyweight roadway transport.
6. Developing sustainable maritime shipping; NGVs and green ports.



Residential, service, and industry sectors

7. Promoting lower emissions in the residential sector.
8. Promoting lower emissions in the service sector.
9. Promoting change in the energy vector and energy efficiency in the industry.

Electrical industry

10. Establishing a framework for installing the necessary power capacity (renewable and backup).
11. Optimizing the preexisting backup generation capacity.
12. Extending the authorization of nuclear power plant operations up to 60 years.
13. Providing incentives for required grid investments.
14. Transforming power rates into an efficient pricing signal.

Source: Deloitte Consulting, S.L.U.

“Renewable energy has high fixed costs but the variable costs are close to zero”

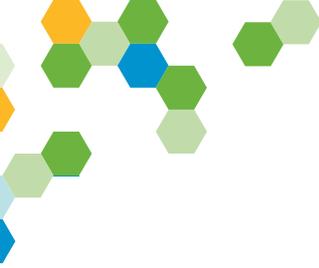
Renewable energy should be included in the electrical system without affecting the system's security and based on the principle of optimizing its integration, thereby avoiding a surplus and waste of renewable energy if it is unable to fit in the power curve. In this regard, the System Operator (SO) must be equipped with the necessary tools, such as greater flexibility in the technical minimums of combined cycles in order to guarantee operation with minimal waste, being able to manage fast-response generation in order to guarantee demand coverage despite a shortage of renewable energy due to a lack of primary resources, and improved coordination with nearby SOs so they are able to use surplus renewable energy in their adjustment services.

In addition, an electrification level between 35 % and 39 % of total energy consumption should be reached, which means that the penetration of electric vehicles among cars should have a market share between 7 % and 10 % of the entire fleet. In this regard, hybrid vehicles could act as a bridge towards 100 % electric vehicles because in order to reach the necessary emission levels by 2050, nearly all privately-owned vehicles must be electric. In addition, during the transition period, between

20 % and 25 % of heavyweight roadway transport should be carried out by electric railways by 2030, and then between 40 % and 60 % by 2050.

However, natural gas should play an important role in heavyweight roadway transport. It will also be necessary to significantly increase gas consumption in residential, service, and industrial sectors during this time.

In addition, although renewable energy currently has high fixed costs, the variable costs are close to zero because the primary resource (wind or sun) is abundant and unlimited. Since the variable costs are close to zero, rates on the wholesale market are obtained at increasingly lower prices (because the energy obtained from conventional plants that have higher variable costs is replaced). In other words, renewable energy lowers prices in the electricity market. As progress is made towards a zero carbon sector, this impact will lead to progressively lower average prices in the wholesale electrical energy market. This will intensify the shortage of revenue for recovering investments, thereby hindering investments and endangering the reliability of power supplies.



“These additional regulatory payments should be implemented to guarantee that investments are recovered”

This effect on average wholesale market prices can be slowed down—but not completely avoided—with a higher CO₂ price profile. Prices during the hours when the variable costs of fossil fuel (gas or carbon) technologies set the market price will be higher, but the number of hours when this occurs will decrease progressively. The gap between the average prices of the wholesale electrical energy market and the average cost of a potential new player, which is very significant in all European wholesale markets, will continue to increase along with the price of decarbonizing the electrical system.

This gap should be balanced out with a growing number of “capacity payments” and “remuneration supplements”

for renewable energy. These additional regulatory payments should be implemented to guarantee that investments are recovered without compromising reliable power supplies due to a shortage of generation investments.

In summary, in order to create a future that includes a mix of generation sources based almost entirely on renewable energy, it will be necessary to implement measures that promote this mix as well as to integrate other low-emission energy sources. It will also be necessary to establish a regulatory framework that, considering the above, sends economic signals so investments with a guaranteed return on investment take place.

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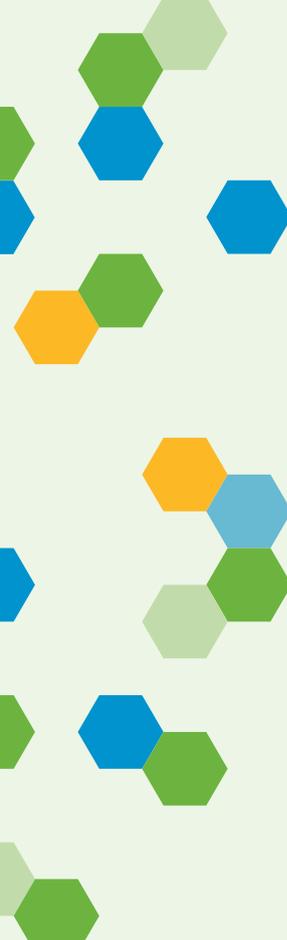
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