

Duffield, John S.

Article

The politics of renewable power in Spain

European Journal of Government and Economics (EJGE)

Provided in Cooperation with:

Universidade da Coruña

Suggested Citation: Duffield, John S. (2020) : The politics of renewable power in Spain, European Journal of Government and Economics (EJGE), ISSN 2254-7088, Universidade da Coruña, A Coruña, Vol. 9, Iss. 1, pp. 5-25,
<https://doi.org/10.17979/ejge.2020.9.1.5231>

This Version is available at:

<https://hdl.handle.net/10419/298613>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by-nc/4.0/>



***European Journal of
Government and
Economics***

Vol.9 • No.1
2020
ISSN: 2254-7088



Servizo de Publicacións
UNIVERSIDADE DA CORUÑA



Number 9, issue 1, June 2020

DOI: <https://doi.org/10.17979/ejge.2020.9.1>

- The politics of renewable power in Spain** 5-25
DOI: <https://doi.org/10.17979/ejge.2020.9.1.5231>
John S. Duffield
- Voting turnout in Greece: expressive or instrumental?** 26-45
DOI: <https://doi.org/10.17979/ejge.2020.9.1.5426>
Irene Daskalopoulou
- The effect of reduced unemployment duration on the unemployment rate:
a Synthetic Control Approach** 46-73
DOI: <https://doi.org/10.17979/ejge.2020.9.1.5714>
Luzius Stricker and Moreno Baruffini
- Do confidence indicators have an impact on macro-financial indicators?
An analysis of the financial service and real sector confidence indexes:
evidence from Turkey** 74-94
DOI: <https://doi.org/10.17979/ejge.2020.9.1.5948>
Esra N. Kilci
- A comparative analysis of the European Union member states
in terms of public spending on environmental protection in 2004-2017** 95-114
DOI: <https://doi.org/10.17979/ejge.2020.9.1.5847>
Barbara Pawetek



The politics of renewable power in Spain

John S Duffield^{a*}

^a Department of Political Science, Georgia State University, Atlanta, United States

* Corresponding author at: duffield@gsu.edu

Article history. Received 3 April 2019; first revision required 8 October 2019; accepted 13 January 2020.

Abstract. Government support for renewable power in Spain has varied over time. After fostering a boom in the first decade of the 2000s, public support dried up in the early 2010s before making a reappearance in the last several years. This paper details and explains the fluctuating political fortunes of renewable power in Spain. It argues that the recent revival of support for renewable power should no come as no surprise. Rather, it reflects a reassertion of the underlying imperatives that prompted support by governments of different parties in previous years. Nevertheless, the role of government in promoting renewable power is now undergoing a fundamental change, as it shifts from directly subsidizing new generating capacity to removing barriers that might discourage private investment and facilitating the operation of market forces.

Keywords. Spain; Spanish politics; renewable power; wind power; solar power

JEL Codes. Q42; Q48

DOI. <https://doi.org/10.17979/ejge.2020.9.1.5231>

1. Introduction

In the first decade of the 2000s, Spain emerged as a global leader in the deployment of renewable power. A series of support schemes triggered rapid growth in first wind, then solar photovoltaic (PV), and finally concentrated solar power (CSP, also called solar thermoelectric) installations. As a result, the country attained some of the highest levels of generating capacity and electricity output by these technologies in the world.

Then, in the early 2010s, the deployment of renewable power in Spain ground to a halt. To close a growing gap between the revenues and expenditures of the electric power system, successive governments reduced the remuneration that renewable power plants could receive and then imposed a moratorium on subsidies for new installations. As a result, almost no renewable generating capacity was added after 2012.

In the past several years, however, renewable power, especially wind and solar PV, has experienced a revival in Spain. The People's Party government of Mariano Rajoy (2011-2018) held a series of auctions for renewable generating capacity to be built by 2020. Then, the subsequent Socialist government of Pedro Sánchez (2018-2019) took steps to remove obstacles that had blocked some forms of renewable power and threatened to hinder the deployment of the capacity awarded in the actions. And independently, a growing number of

private actors decided to build new wind and PV power plants without any government subsidies. As a result, thousands of new megawatts of renewable capacity went online in 2019, with more expected to follow.

This paper describes and explains the fluctuating political fortunes of renewable power in Spain. The focus is on broad trends in central government support for renewable power rather than the details of various promotional schemes¹. Along the way, it makes three main arguments. First, the recent revival of support for renewable power should come as no surprise. Rather, it reflects a reassertion of the underlying imperatives that prompted government support for renewable power in previous years. The pause in subsidies and deployment was just a temporary departure from the norm, reflecting an unusual concatenation of circumstances.

Second, precisely because of these strong long-standing motivations, support for renewable power has enjoyed substantial cross-party political support at the national level. The ups and downs in renewable capacity deployment are not primarily the result of political differences, despite changes of government every seven to eight years. With one principal exception, which is described below, the major parties have generally pursued similar goals with regard to renewable power.

Third, the role of government in promoting renewable power is now undergoing a fundamental change. In the past, the central government played a critical role by providing financial support for investments that would otherwise be unprofitable. Increasingly, as renewable power has become cost competitive with conventional sources of power, the government's principal task has become removing barriers that might discourage private investment and facilitating the operation of market forces, not directly subsidizing new power plants.

The paper begins by identifying the motivations that have undergirded Spain's support for renewable power over the years. It then reviews the country's initial efforts to promote renewable power and the boom and bust that followed. The following section examines the recent revival of government support for renewable power, and a final section explores the longer-term prospects for renewable power in Spain and the changing role of government in promoting it.

The paper focuses on two particular sources of renewable electricity: wind and solar PV. Wind was the primary beneficiary of initial efforts to promote renewable power and has become the largest single source of renewable electricity in Spain. Solar PV, for its part, has always had the greatest resource potential, although that potential took longer to be realized because of higher costs, and it is now poised to become the leading area of investment. In contrast, hydropower, the traditional source of renewable electricity in Spain, has been a much more mature technology, with relatively few remaining opportunities for exploitation. Finally, although Spain has been the world leader in CSP, which uses mirrors to concentrate the sun's rays, it constitutes a smaller share of Spain's renewable capacity than either wind or PV and is likely to continue to do so because of its relatively higher cost.

¹ For the latter, particularly useful sources are del Río 2008, Mir-Artigues 2012, and del Río 2017.

A further limitation in scope is the paper's focus on politics at the national level. Spain has a relatively decentralized political system, and the regions (autonomous communities) have at times played important roles in both promoting and hindering the growth of renewable power. The authority to approve power plants of up to 50 megawatts (MW) of capacity has resided with regional governments, and many have engaged in extensive planning and offered their own promotional schemes. Nevertheless, the principal impetus for the growth of renewable power, whether in the form of legislation, regulation, or financial support, has come from the central government, with regional policies tending to shape the outcomes mainly at the margins.

2. Why Promote Renewable Power in Spain?

Successive Spanish national governments have been motivated to promote renewable power for multiple reasons. These reasons have not been unique to Spain, but they have been powerful motivations nonetheless. Three general imperatives have stood out: the desire for greater security of energy supplies, environmental protection, and expected socioeconomic benefits.

The security benefits of renewable energy were noted as early as the 1980 Energy Conservation Law, the first major energy legislation adopted under the 1978 constitution, which aimed to reduce Spain's dependence on external sources of hydrocarbons (Ley 82/1980). Since then, they have been a constant theme in Spain's successive renewable energy plans. Indeed, the importance of this motivation only grew in the 1980s, 1990s, and early 2000s, as Spain's dependence on fossil fuels from foreign sources steadily increased, both in absolute and relative terms, with rapidly rising energy consumption. Until the economic crisis of 2008, fossil fuels accounted for roughly 50 percent of electricity generation, and the share of coal, the one fossil fuel that had been produced domestically, had been steadily declining, especially after imported natural gas was introduced in the early 2000s (British Petroleum 2018). Renewable energy would contribute to energy security not only by reducing imports but also by diversifying Spain's primary energy sources (PFER 1999, p. 1; PER 2005, pp. 13, 332-34; PER 2011, p. xxxiv).

The environmental benefits of renewable energy gained prominence in the 1990s, especially after the adoption of the Kyoto Protocol, which committed Spain to limiting the growth of its greenhouse gas emissions. Along with energy conservation and efficiency, the substitution of renewable energy for fossil fuels, especially in the generation of electricity, was regarded as a key tool for reducing emissions of greenhouse and other noxious gases and for limiting the environmental impact of the energy system more generally. By one estimate, the renewable energy sources in place by 2010 were already reducing CO₂ emissions by more than 50 million tonnes per year, or approximately one-sixth of Spain's actual emissions, and about two-thirds of the reductions were attributable to renewable power (PFER 1999, pp. 9-15; PER 2005, pp. 8-9, 23-24; PER 2011, pp. 654-660).

The potential socioeconomic benefits of renewable energy were also recognized by the

1990s, but the importance attributed to them grew in tandem with actual--and estimates of potential future--renewable energy deployments. The specific benefits were manifold and included technological development leading to greater industrial competitiveness, the creation of new businesses and jobs, especially in rural and remote areas, and thus regional development, and overall economic growth. Indeed, the number of companies and jobs in the sector as well as its contribution to Spain's GDP grew steadily in the 1990s and 2000s. By 2011, the renewables sector was expected to support some 300,000 jobs and generate about 18 billion euros in wealth per year by 2020, with renewable power again contributing about two-thirds of the total (PFER 1999, pp. 16-25; PER 2005, pp. 14, 25-27, 337; PER 2011, pp. 627-33, 646-52).

Underpinning these views about the benefits of renewable power was Spain's prodigious resource potential. From the beginning, Spain's solar resources were regarded as immense, as much as several terawatts, or much more than the country could ever use, thanks to Spain's extensive land area and some of the highest levels of solar radiation in Europe. For many years, the challenge consisted primarily of bringing down the price of PV installations to the point where the resource could be exploited cost-effectively. Meanwhile, estimates for Spain's wind power potential marched steadily upward, from about 15 gigawatts (GW) in 1999 to more than 40 GW in 2005 and then to as many as 330 GW in 2011, as technology improved over time (PFER 1999, pp. 58-59; PER 2005, pp. 42, 161; PER 2011, pp. xxxvi, 237, 379-81).

Further shaping Spanish policy on renewable power have been a series of national targets generated by the European Union. A 1997 White Paper established a goal of providing 12 percent of primary energy consumption from renewable sources by 2010. A 2001 directive set a target of 29.4 percent of electricity from renewables by 2010. And a 2009 directive required Spain to generate 20 percent of its final energy consumption from renewable sources.

These targets in turn were incorporated into the series of energy plans developed by successive governments between 1999 and 2015. Because of rising energy consumption, however, the specific targets for renewable power sources grew steadily during the first decade of the 2000s. For example, the 2010 target for wind more than doubled, from 8974 megawatts (MW) in 1999 to 20,155 MW in 2005, while that for solar PV jumped from 144 MW in 1999 to 400 MW in 2005. And in 2010, even higher targets were set--38,000 MW for wind and 8367 MW for solar PV--for 2020, although these were subsequently reduced by about one-quarter (PFER 1999; PER 2005; PANER 2010; MINETUR 2015b).

These consistent motivations have been the basis for a national consensus on the importance of promoting renewable power. With one principal exception, discussed in the last section, there has been little difference in the degree of support offered by the major parties². As the following sections demonstrate, governments of different political orientations have pursued similar goals in similar ways.

² See also del Río 2008 (pp. 2917-18), which notes continuity and stability in the promotion of renewable power under different governments.

3. Initial Efforts to Promote Renewable Power

Efforts to promote renewable energy date back at least as far as the Energy Conservation Law of 1980, which was adopted at the height of the second oil shock (Ley 82/1980). It was not until the following decade, however, that the Socialist government of Felipe González (1982-1996) undertook the first comprehensive effort to promote renewable power generation. A 1994 regulation established a 'special regime' for new renewable power installations of up to 100 MW. Qualifying installations would receive access to the grid and the right to sell any surplus production to power distribution companies at a price determined by a complex formula and under contracts lasting at least five years (RD 2366/1994).

The special regime was further developed by the subsequent People's Party government of José María Aznar (1996-2004), which initiated the liberalization of the Spanish electricity market in consonance with EU Directive 96/92/EC via the Electricity Sector Act of 1997. Although the regime was now limited to installations of up to 50 MW (and only 10 MW for hydroelectric plants), qualifying producers would receive a premium (prima) set at somewhere between 80 and 90 percent of the average electricity price, and possibly higher for solar power (Ley 54/1997).

Over the following 10 years, successive governments of both parties made repeated efforts to fine tune the details of the special regime so that Spain would meet its growing renewable power targets³. In 1998, the Aznar government adopted a regulation that sought to incentivize investment in several ways. It gave producers a choice between two alternative forms of support--either a fixed premium on top of the market price or a fixed total price (feed-in tariff or FIT)--that could be adjusted annually. It waived any time limit on how long producers could receive support. And it differentiated support levels by technology (solar, wind, geothermal, hydro, biomass, etc.), offering particularly large subsidies to solar installations (RD 2818/1998).

In 2004, shortly before the Spanish general election that year, the Aznar government made a second attempt to get the incentives right. The new regulation created an additional incentive for renewable producers to sell their electricity directly to the wholesale market. It also sought to stabilize subsidy levels and create more certainty for investors by guaranteeing support for the lifetime of the plant and reviewing FITs and premiums only every four years (instead of annually, as under the previous regulation). And it raised the threshold for the highest level of support for solar PV installations, from 5 kilowatts (kW) to 100 kW (RD 436/2004).

A third effort was made in 2007 by the Socialist government of José Luis Rodríguez Zapatero (2004-2011). Under the existing regulation, the tariffs, premiums, and other incentives fluctuated with the average electricity tariff and there were no lower or upper bounds, creating uncertainty and risks for both investors, the government, and consumers, who would ultimately pay for the support. To address the problem, a new regulation delinked support levels from electricity prices while setting caps and floors for the amount of support that generators opting for the premium would receive. Although the premium option was eliminated for solar PV, it continued to receive by far the highest FITs, and the FIT for PV installations of between 100 kW

³ For additional details, see especially del Río 2008 and del Río and Mir-Artigues 2012.

and 10 MW was increased by 82 percent, or to nearly the level of the smallest installations (RD 661/2007).

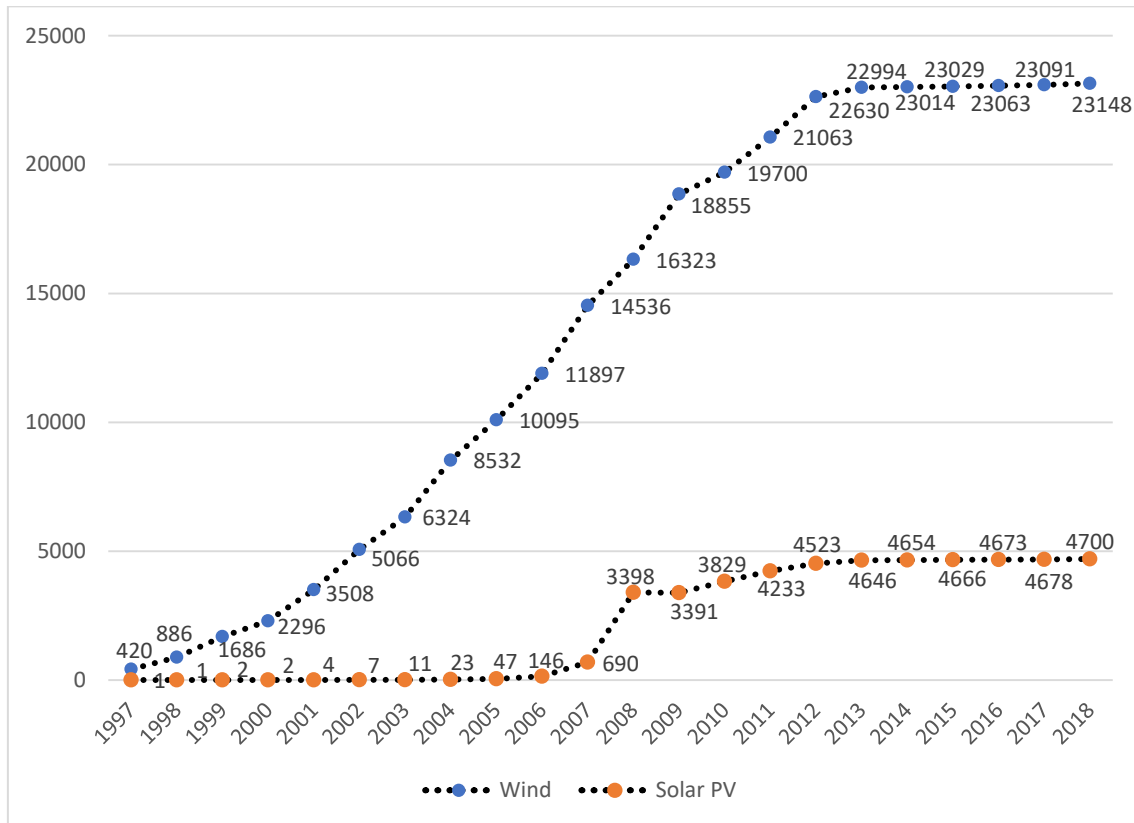


Figure 1. Renewable Power Capacity (Megawatts). Source: CNMC.

Thanks in no small part to these consistent efforts to promote renewable power by successive governments, the amount of generating capacity grew substantially between 1997 and 2010 (Figure 1). Wind was the first technology to take off. By 2002, Spain had more wind power capacity than any country but Germany, and it remained in the top three through the end of the decade, when it nearly achieved the much higher target of 20,155 MW set in 2005 (British Petroleum 2018). Solar PV took longer to gain momentum, but investment in it eventually exploded. In 2007, when capacity almost quintupled, and in 2008, it increased by 400 percent. Suddenly, Spain ranked second in the world in PV capacity, and it exceeded its 2010 target by nearly ten-fold.

4. The Tariff Deficit and Spain's Response

Primarily because of the growth in first wind and then solar PV power, Spain experienced a rapid rise in the amount of electricity generated from renewable sources, which roughly doubled during the first decade of the 2000s. Because of the decline in electricity consumption occasioned by the economic crisis at the end of the decade, moreover, the relative share of

renewable power grew even faster. By 2010, approximately one-third of all electricity generated in Spain came from renewable sources (CNMC 2013).

The growth in renewable power came at a substantial cost, however, in the form of an even more rapid increase in the support renewable generators received. These payments jumped from less than 1 billion euros per year in the mid-2000s to more than 5 billion euros per year after 2010, of which approximately half went to solar PV installations because of their much higher support levels. These payments, in turn, contributed to a large and expanding 'tariff deficit' (*déficit de tarifa*), which reflected the difference between the regulated costs of the electric power system and the access tariffs paid by consumers. Between 2008 and 2011, the tariff deficit grew at an average rate of around 5 billion euros per year, reaching some 30 billion euros. This amount represented approximately three percent of Spain's GDP, at a time when the government was under intense pressure to reduce spending (CNMC 2013; CNMC 2017).

To be sure, support for renewable power was not the only cause of the tariff deficit. A more fundamental reason was the government's policy, in place since the liberalization of the power market in 1997, of controlling electricity prices to protect consumers against sudden increases. Nor were payments to renewables the only regulated costs of the system. Others included transmission and distribution, subsidies for non-peninsular systems and energy poverty, the annuities required to cover the deficits of previous years, and support for the non-renewable power sources— co-generation and waste – in the special regime. As a result, the annual deficit had reached high levels even in years before renewables took off. But by the late 2000s, support for renewable power had become the single largest component of the regulated costs, and, for that reason, the subject of particular scrutiny, with solar PV heading the list of perceived culprits. (Espinosa 2013; Gómez, Dopazo, and Fueyo 2016, 435; IEA 2015, 129; UNEF 2013).

It should also be noted that the growth of renewables also exerted downward pressure on wholesale electricity prices by displacing other forms of electricity generation with higher marginal costs, especially fossil fuels. A substantial technical literature exists on the overall impact of renewables on electricity prices, and whether the cost of support was greater or less than this positive market effect. In fact, fine-grained studies have found that it varied substantially by technology, with wind yielding a net gain and solar PV a net loss (Sáenz, del Río, and Vizcaino 2008; Ciarreta, Espinosa, and Pizarro 2014; Costa-Campi and Trujillo-Baute 2015; Carvalho Figueriredo and Pereira da Silva 2018). In any case, this benefit tended to be overlooked in the rush to address the burgeoning tariff deficit.

A further impetus to take action was provided by the negative impact of renewables on other power sources. The boom, along with a decline in demand associated with the economic crisis, resulted in a substantial overcapacity in Spain's generation system, which saw the overall average load factor decrease from 44 percent in 2000 to 31 percent in 2012. That, in combination with the downward pressure on wholesale electricity prices, threatened the finances of the major utilities. Particularly hard hit were the 26 GW of natural gas-fired combined cycle (GFCC) plants built after 2000 in anticipation of substantial growth in Spain's electricity demand, making gas the single largest source of installed capacity. This brand new fleet saw its

overall load factor drop from around 50 percent in the mid-2000s to below 20 percent in 2011 and then continue to fall, almost to single digits in 2014 (Moreno and Martínez-Val 2011; McGovern 2011; Gómez, Dopazo, and Fueyo 2016, 434, 436, 444).

As a result of these developments, the promotion of renewable power went, in just a few years, from enjoying broad public support, or at least tolerance, to facing substantial opposition. Particularly outspoken in their criticism were large electricity consumers and the major utilities, whose returns on investment in non-renewable generating capacity was being put at risk (Linares and Labandeira 2013). These various pressures in turn prompted similar policy responses by successive governments led by different parties. Beginning as early as 2008, the Zapatero government took steps to control the cost of renewable power. When these actions proved inadequate, the subsequent Rajoy government adopted even stronger measures, culminating in a complete overhaul of the renewable support system⁴.

One set of common efforts focused on slowing the growth in renewable power support (del Río 2016). Targeting solar PV initially, the Zapatero government limited the size of the plants that could receive subsidies, established an overall quota of new capacity per quarter, cut the size of the FIT, and added a mechanism for automatically reducing the FIT if more than 75 percent of the quarterly quota was met (RD 1578/2008). Then, it further reduced the FIT for new PV installations by applying 'correction' factors of up to 55 percent and extended similar measures to renewable power installations of other types (RD 1565/2010; RDL 6/2009; RD 1614/2010). Unsatisfied with the results of these efforts, the new Rajoy government took the drastic step of imposing an open-ended moratorium on support for new renewable power plants as one of its first actions, in January 2012 (RDL 1/2012)⁵.

Governments of both parties also adopted measures aimed at generating additional revenues to help reduce the tariff deficit directly. The Zapatero government imposed a grid access charge for all power producers (RDL 14/2010). The Rajoy government then established a generation charge and created new taxes on nuclear spent fuel and the use of coal and oil to generate electricity (Ley 15/2012).

Finally, neither government shied away from controversial measures to modify, retroactively, the terms of compensation for pre-existing renewable power plants. The Zapatero government limited the years solar PV installations could receive the FIT and capped the number of equivalent operating hours that were eligible for compensation. For its part, the Rajoy government revised the formula for updating the tariffs for all renewable sources in a way that was expected to result in slower growth--and possibly even negative growth, in real terms—and eliminated the option of receiving a premium on top of the wholesale price of electricity (RD 1565/2010; RDL 14/2010; RDL 2/2013).

Ultimately, in 2013 and 2014, the Rajoy government replaced the FIT/premium model for promoting renewable power with an entirely new legal and regulatory framework involving primarily investment-based support. At that point, the tariff deficit had continued to grow, despite the previous efforts by both governments to reduce it, and Spain was under pressure from both

⁴ For a much more detailed discussion, see del Río and Mir-Artigues 2012.

⁵ Table A5 in del Río and Mir-Artigues (2014, p. 51) shows the evolution of the FIT for PV from 1998 to 2011.

the EU and the IMF to take more decisive action to reform the electricity sector (IEA 2015, pp. 100-102; Espinosa 2013, pp. 1-2). In a series of laws and regulations (RDL 9/2013; Ley 24/2013; RD 413/2014), the Rajoy government abolished the special regime and required all renewable producers to sell their power directly to the wholesale electricity market. Instead of a FIT or premium based on the amount of power generated, they would receive, if necessary, a subsidy designed to ensure a reasonable profitability (*rentabilidad razonable*) on their investments, which would closely track the amount of installed capacity, not output (IEA 2015, pp. 129-130; Espinosa 2013, p. 35; del Río 2016, pp. 9-12).

All in all, these measures contributed to a significant slowdown and then a virtual halt in the deployment of new renewable generating capacity. From 2009 to 2013, wind power grew at roughly half the previous rate and then stalled at about 23 GW. Over the same period, solar PV capacity rose by just 1250 MW before plateauing at about 4.6 GW. The boom in renewable power was over⁶.

5. The Revival of Renewable Power

This pause would be only temporary, however. Indeed, hardly had the new legal and regulatory framework been put in place in 2013 and 2014 than pressure began to mount for a further increase in Spain's renewable power output. This pressure would eventually result in a series of auctions through which the government would authorize nearly 9 GW of new renewable capacity, to be completed by 2020, most of which would be eligible for remuneration under the new system.

Although Spain had been meeting its annual renewable power targets, by 2015 it appeared that more capacity would be needed to reach the overall goal of 20 percent renewable energy in the country's final energy consumption by 2020 (RD 947/2015; EC 2015). The 2011 renewable energy plan had set targets—35,750 MW of wind and 7250 MW of solar PV—that substantially exceeded the actual capacity, and even Spain's 2015 energy planning document anticipated the need for nearly 8 GW in additional wind and solar PV capacity by 2020 (PER 2011, p. 469, MINETUR 2015b, p. 28). At the same time, the Rajoy government desired to demonstrate its support for renewable energy prior to the general elections scheduled for December 2015 (del Río 2016, pp. 12, 26). Thus, widespread agreement existed on the need to increase Spain's renewable capacity. The principal question was how to do so at the lowest possible cost (del Río 2017, p. 17).

One promising approach was suggested by the guidelines for state aid issued by the EU in 2014, which proposed that members use auctions in the future to provide support for new renewable energy installations (EC 2014). In addition, the new electricity sector law and the subsequent regulation concerning renewable power had provided for the use of 'competitive contests' (*concurrència competitiva*) to promote more renewable production when needed to meet EU targets or to reduce foreign energy dependence (Ley 24/2013; RD 413/2014).

⁶ del Río and Mir-Artigues (2012, p. 5562) also point to reduced access to credit following the economic crisis as a cause of the stagnation, but that alone cannot explain the abrupt halt in deployment that occurred after 2011.

As the 2015 elections approached, the Rajoy government issued a further set of regulations and statements that laid the necessary groundwork for Spain to proceed with its first auction (subasta). Under the terms set by the government, the auction would be limited to small amounts of wind (500 MW) and biomass (200 MW) capacity; solar power in particular was excluded. And in contrast to most renewable power auctions held elsewhere, but in keeping with the new emphasis on investment-based support, bidders would offer a discount on the rate of return for the initial investment in a standard reference plant. Government support would be provided only if the market price fell below the level needed to achieve the discounted rate of return, and winning bidders would have to complete their projects by the beginning of 2020 (RD 947/2015; MINETUR 2015a; MINETUR 2015c)⁷.

This initial, very modest auction took place in January 2016, and was regarded as a success. The volume of wind power bids totaled five times the amount that could be awarded, and all the winning bids offered a 100 percent discount on the rate of return, meaning the government would never have to provide remuneration to the successful proposals. Nevertheless, the renewable energy industry criticized the auction for its small size and the neglect of other technologies, especially solar PV (APPA 2016; del Río 2016, pp. 31-34; del Río 2017, pp. 18-20; MINETUR 2016).

Partly in response to these criticisms and in view of the continuing need to raise renewable power output by 2020, the government announced in mid-2016 that it would hold a second, much larger auction. Because Spain needed to hold a second round of national elections, however, the details were not worked out until early the following year, after a new Rajoy government had finally been seated, and the auction did not take place until May 2017. In addition to the much greater volume--up to 3000 MW--the auction was open to all technologies (RD 359/2017; MINETUR 2017a; MINETUR 2017b).

Once again, the auction was greatly oversubscribed, this time by approximately 300 percent, with bids roughly evenly divided between wind and solar PV projects. And as before, all the winning bids offered the maximum possible discount, although it was set at less than 100 percent of the investment this time. Because of a provision that ties would be broken in favor of projects with greater hours of operation, however, virtually all of the capacity was awarded to wind projects, triggering an outcry from the solar PV sector (UNEF 2017; MINETUR 2017c).

Then, just days later, the government announced that yet another large auction would be held that summer. Based on the experience of the May auction, officials realized that much more capacity could be available at a deep discount in the guaranteed rate of return, and there was no time to spare if new capacity were to be approved soon enough to come on line before 2020. Because by far the greatest potential for low cost capacity lay with wind and PV, however, this third auction would be limited to those two technologies (RD 650/2017; MINETUR 2017d).

The July auction was also massively oversubscribed. This time, however, changes in the parameters made PV relatively more attractive. Some 3900 MW of PV and 1100 MW of wind were awarded at the maximum discount, making it the largest renewable power auction to date

⁷ A detailed description of the auctions can be found in del Río 2016, pp. 11-20.

in terms of capacity (MINETUR 2017e).

Overall, the three auctions appeared to be a great success. If all the awarded capacity were built, Spain would nearly double its solar PV capacity and would increase that of wind by about 20 percent. To be sure, some observers expressed concerns. One was that much of the awarded capacity might never materialize, because the winning offers appeared too low to be profitable, the result of strategic bidding based on the assumption that the last accepted bid – which would determine the rate of return – would be higher. Second, the short time frame for completing projects increased the potential for bottlenecks in the supply chain, especially for wind (del Río 2016; inspiriata 2017). And the deployment of much new capacity was threatened by the scheduled expiration of many existing permits for grid access and connection at the end of 2018 as well as insufficient connection capacity in some regions (Ojea 2018a; Ojea 2018b).

Over the next two years, however, the obstacles were largely overcome, especially as the Socialist government installed in June 2018 made the success of the auctions a priority. Among other things, the new government extended the expiration dates of grid connection permits and, along with regional governments, took steps to expedite the approval processes (Ojea 2018c; EPE 2018a; EPE 2018b; RDL 15/2018). Partly as a result, the completion of new power plants surged in 2019. By the end of October, more than 3 GW of new capacity had been installed, and additional projects were coming on line at an accelerating rate as the end-of-year deadline approached. As much as 5 GW of new capacity was expected to be in place by then – what would constitute a single year record in Spain – and most of the rest of the capacity awarded in the auctions was expected to follow in 2020. One reason for the lag was that some developers were intentionally delaying the completion of their projects while attempting to secure financing on more favorable terms, even if it meant losing the guarantees that they had been required to deposit (Roca 2019; Ojea 2019b; EPE 2019a).

6. Future Prospects for Renewable Power in Spain

What are the longer-term prospects for renewable power in Spain, once the new capacity authorized by the auctions has been largely installed? The motives – security of supply, environmental protection, and socioeconomic benefits – that, along with Spain's abundant resource potential, shaped Spanish policy in the past are likely to remain strong. Indeed, they are being reinforced by important external developments. Thus we should expect the recent revival of renewable power, especially solar PV and wind, to continue over the next decade. What will change is the role of the Spanish government, which is shifting from providing financial support to renewable installations to facilitating private investment.

6.1. Future Prospects for Renewable Power in Spain

One development likely to drive additional renewable power deployment is the adoption of new, higher targets. In 2018, the European Union established a framework for the promotion of

renewable energy over the next decade (EC 2018a). The overall binding target for 2030 of at least 32 percent represented a substantial increase over the 2020 goal. As a first step, specific national objectives would be set by the EU member states themselves. In February 2019, after months of speculation, the Sánchez government provided Spain's initial response in the form of a long-awaited draft for a Law on Climate Change and the Energy Transition (MITECO 2019a) and the EU-mandated Integrated National Plan for Energy and Climate for 2021-2030 (Plan Nacional Integrado de Energía y Clima 2021-2030, PNIEC) (MITECO 2019b). The latter set an ambitious overall renewable energy target of 42 percent of final energy consumption by 2030, more than double the target for 2020, with no less than 74 percent of electricity coming from renewable sources.

How much renewable generating capacity was Spain likely to require? A first glimpse of what might be needed was provided by the report of the Expert Commission that was established in 2017 to analyze scenarios that would lead to the achievement of likely European energy and climate objectives. The report, issued in April 2018, employed a somewhat lower baseline scenario for 2030 in which 62 percent of electricity came from renewable sources. To achieve that level, Spain would need a total of 31,000 MW of wind capacity and 47,150 MW of PV (Comisión 2018, p. 8). Given its more ambitious renewable electricity goal, the draft PNIEC set even higher targets. It called for 50,258 MW in wind, 36,882 MW in solar PV, and 7303 MW in CSP power generating capacity (MITECO 2019b). To achieve these objectives, the government would hold auctions of at least 3 GW in renewable capacity each year (MITECO 2019a), although the details of the auctions remained to be worked out through late 2019, at least in part because of the delay in forming a new government following the April national elections (EPE 2019b).

6.2. Falling Costs of Renewable Power Plants

A second important development is the steady decline in the cost of renewable power, especially solar PV, to the point at which it can compete with conventional power sources without any financial support. By 2019, the cost of PV modules and entire PV systems had plunged by 90 percent and 80 percent, respectively, in a decade. As a result, the levelized cost of electricity in parts of Spain had dropped as low as 24 ¢/MWh, well below the wholesale market price, and it was expected to continue to fall (Vartiainen et al. 2019).

The sharp decline in costs is one reason for the success of the recent auctions, in which winners all submitted the lowest possible bids. But it is also behind a development of perhaps even greater potential to transform the renewable power landscape in Spain: the decision of a many actors to invest in renewable power without reliance on any government financial support. In a growing number of cases, large electricity consumers have entered into power purchase agreements (PPAs) with renewable producers, whereby the former will buy electricity directly from the latter rather than from traditional utilities. By offering long-term contracts at fixed prices, PPAs enable consumers to hedge their electricity costs in the face of unpredictable and

generally rising fossil fuel prices while ensuring producers and their financial backers of a steady income stream. In addition, such agreements can help companies burnish their environmental image by using non-CO₂ producing electricity to power their operations (Bellini 2017; Gómez 2019). By late 2019, PPAs involving some 1500 MW of PV alone had been signed (Pérez Galdón 2019). Other cases have involved purely speculative merchant projects that would sell their electricity directly to the wholesale market. And in at least one case, the project developer entered into a financial hedge arrangement that would lock in prices for a number of years (Ellomay Capital 2018).

As a result, Spain has seen a steady drumbeat of announcements for new solar PV plants in particular, beginning in 2017, that were unrelated to the auctions. The first PPA was signed in July 2017, and by early 2018, according to one estimate, a new PPA was being reached every week (EDPR News 2017). By mid-2018, some 23 GW in PV projects beyond those awarded in the auctions had submitted applications for approval (Monforte 2018; Parnell 2018). And by October 2019, the Spanish national grid operator, Red Eléctrica de España, had granted access permits to new renewable projects totaling nearly 100 GW, with another 36 GW of capacity waiting for approval and some 58.5 GW in applications denied because of a lack of connection points or capacity on the grid (REE 2019; see also Ojea 2019a).

6.3. A New Role for Government

As the costs of new renewable power installations continue to decline, the need for government financial support should decline as well, unless wholesale prices drop so much as to make renewables unprofitable. Instead, the primary role of the central government is likely to shift to removing obstacles that would otherwise inhibit private investment and the operation of market forces. Indeed, the draft PNIEC anticipated that virtually all of the new investment in renewable energy will come from private sources (MITECO 2019b, pp. 145-146).

A good example of this shift is Spain's evolving policy toward demand-side generation (DSG), and specifically the version involving the production of electricity primarily for one's own use, or self-consumption (autoconsumo). This has been the aspect of renewable power over which the major political parties have been most deeply divided.

In the late 1990s and 2000s, renewable support policy in Spain gave priority to utility scale power plants designed to inject their output into the grid. It was not until 2010 that self-consumption began to receive serious consideration in national planning. Over the following year and a half, the Zapatero government developed a set of regulations, but these were put on hold with the election of the Rajoy government in late 2011 (Mir-Artigues 2013, pp. 668-669).

Following the new government's moratorium on subsidies for new renewable installations in early 2012, many regarded self-consumption as a way to boost the fortunes of the struggling PV sector in particular. When the Rajoy government finally revealed its own draft regulation in mid-2013, however, it contained provisions that would make the deployment of DSG with self-consumption unprofitable. Of particular concern was a special back-up charge (peaje de

respaldo) on self-consumed electricity. Although intended to ensure that self-consumers would help pay for the fixed costs of the power system, the charge had the effect of making self-consumed power more expensive than electricity bought from the grid (UNEF 2013; Mir-Artigues, del Río, and Cerdá 2018).

The proposed regulation was roundly criticized by environmentalists and the renewable power industry. Even the National Energy Commission (CNE) issued a report calling the proposal 'discriminatory' in comparison with other measures consumers could take to reduce their purchases from the grid (CNE 2013). In the face of this criticism, the Rajoy government waited until October 2015, shortly before the next national election, to issue a final regulation. This version contained most of the barriers found in the original draft, including the back-up charge (RD 900/2015). The conservative government continued to prioritize reducing the tariff deficit over promoting renewable power.

The Rajoy government's approach to self-consumption prompted widespread political opposition. Prior to the December 2015 general election, all the opposition parties signed a letter promising to eliminate the back-up charge if they were to win a majority in the Congress, and early the following year they committed to removing the obstacles in the 2015 regulation. In 2017 and again in 2018, the opposition parties even introduced bills to promote self-consumption. Nevertheless, the Rajoy government was able to use its control over the legislative process, even after losing its majority in the Congress in 2015, to prevent any such proposals from advancing (Kenning 2015; Kenning 2016; Fernández 2018).

The prospects for self-consumption suddenly brightened in mid-2018, when the Socialists took the reins of power following a successful vote of no confidence in the Rajoy government. A substantial majority of representatives quickly voted to lift the obstacles to adopting a new law to promote self-consumption (Ojea 2018d). In the fall, the Sánchez government eliminated the back-up charge and simplified administrative procedures for approving self-consumption projects as part of a broader package of urgent measures to promote the energy transition (RDL 15/2018). And in April 2019, the government issued a comprehensive new regulation for self-consumption that received a positive reception from the renewable power industry (RD 244/2019). As a result, the PV sector anticipated that the amount of such capacity would grow by 400 MW per year (UNEF 2019).

Nevertheless, the job of the government will not be completely confined to removing administrative, technical, economic, and fiscal barriers to investment. There will continue to be areas where a more active government role will be needed. An important one will be balancing supply and demand. Unlike conventional sources of power, most renewable power is intermittent and cannot be simply dispatched as needed. Thus, as the share of renewable power grows, there could increasingly be occasions when the amount of electricity available exceeds or falls short of demand.

The government could help address this challenge in several ways. On the demand side, Spain has recently established an interruptibility service whereby large consumers agree, for a fee, to reduce their usage by pre-determined amounts when ordered by the grid operator, but

there is much more the government can do to promote demand-side management more broadly, as recognized in the draft PNIEC (Roldán, Burgos, Riquelme, and Trigo 2016; MITECO 2019b, pp. 67-69). Similar opportunities exist on the supply side in the form of capacity mechanisms, whereby the system operator pays producers to create or maintain backup power plants that can be brought online as needed. Alternatively, and of particular interest in the case of renewable power, the government could help to promote various forms of electricity storage. Thus far, Spain's efforts have focused on pumped hydroelectric storage, but the draft PNIEC anticipated a growing reliance on battery storage on a large scale, possibly facilitated by the use of auctions, as well as thermal storage associated with CSP installations (MITECO 2019b, pp. 67, 170).

Finally, the government will be central to developing additional interconnections with the broader EU electricity market through France. Because Spain, and the Iberian Peninsula more generally, is an isolated 'energy island,' interconnections that enable Spain to export and import electricity as needed are vital for balancing supply and demand. Recently, Spain doubled the amount of power it can export across its northern border, to nearly 3 GW or about six percent of peak power consumption, and Spain and France plan to build an underwater interconnection in the Bay of Biscay with a capacity of 2 GW, to be completed by 2025, while two additional crossings in the Pyrenees that could increase the total to 8 GW are under consideration. The ultimate goal is to bring Spain's total interconnection capacity, including that with Portugal, up to the EU's target for 2030 of 15 percent of Spain's electricity consumption (EC 2018b; MITECO 2019b: 14, 28).

7. Conclusions

Over more than thirty years, the fortunes of renewable power have waxed and waned in Spain. In the 1990s and much of the 2000s, renewable power received substantial government support, primarily in the form of generous feed-in tariffs and premiums. Then, for the better part of a decade, that support was steadily cut back and, in some respects, eliminated. In the last several years, however, renewable power has experienced a resurgence of support, although not to the extent previously enjoyed. The deployment of new renewable generating capacity has paralleled these fluctuations in support levels, first rising, then stagnating, and once again increasing in recent years.

One striking aspect of this story is that it cannot simply be attributed to shifting political winds. Although the center-left and center-right parties have differed on many issues, they have generally shared similar views when it comes to support for renewable power. Both conservative and Socialist governments backed the incentives that made possible the initial take off of renewable power. Likewise, governments of both parties participated in the cuts that followed. And although less government support has been needed in recent years, thanks to the declining cost of renewable projects, both conservative and Socialist governments have taken steps to ensure that Spain deploys enough new generating capacity to meet its overall

renewable energy targets for 2020. Policy on renewable power, whether supportive or restrictive, has generally enjoyed a broad consensus.

Of course, this finding raises the question of what will happen in the future, given the recent fragmentation and polarization of the party system. Since 2015, Spain has been ruled by minority governments that have been less able to pass new laws, such as the long promised Law on Climate Change and Energy Transition. Nevertheless, when it comes to renewable power, these political developments may matter less than they might have in the past, because of the changing role of government. In the future, thanks to the increasing cost competitiveness of renewables, government will be needed less to provide financial support, a potentially controversial role, than to facilitate the operation of market forces. And whatever the precise role that Spanish governments end up playing, the overall trend is clear. Future governments, regardless of their political orientations, are likely to preside over a prolonged and substantial increase in renewable power that reflects the country's long-standing security, environmental, and socioeconomic motivations as well as its extensive renewable resources. That rising EU targets and declining costs point in the same direction will only reinforce these underlying forces.

Less clear is what lessons can be generalized from the Spanish case. Is it unique, or at least rare, in the extent to which renewable power has enjoyed – and may continue to enjoy -- broad political support? A potentially fruitful line of research would be to examine where, when, and why support for renewables has tended to command political consensus. A quick look at the United States, for example, indicates that consensus can be elusive and that support for renewables, like the closely related issue of climate change, can be a divisive political issue. The U.S. case also suggests some potential hypotheses to explore with regard to the causes of such differences, such as the strength of interest groups that might benefit from or be harmed by the growth of renewable power and the scope and geographical distribution of renewable resources. Suffice it to say, the examination of the politics of renewable power in comparative perspective is likely to yield fruitful insights.

Acknowledgements

This work was supported by funding from the College of Arts and Sciences and the Department of Political Science at Georgia State University. I also wish to thank the many Spanish experts in government, universities, research centers, industry associations, and advocacy groups who have helped me to understand this subject. Nevertheless, I am responsible for any errors of fact or interpretation.

References

Asociación de Empresas de Energías Renovables (APPA) (2016). El resultado de la subasta eléctrica añade más incertidumbre al sector renovable (15 Jan.). Retrieved from <https://www.appa.es/el-resultado-de-la-subasta-electrica-anade-mas-incertidumbre-al->

sector-renovable

- Bellini, E. (2017). Spanish PV could go merchant but market must change. *PV Magazine* (3 Nov.). Retrieved from <https://www.pv-magazine.com/2017/11/03/spanish-pv-could-go-merchant-but-market-must-change>
- British Petroleum. (2018). *Statistical Review of World Energy*. Retrieved from <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>
- Carvalho Figueriredo, N., and Pereira da Silva, P. (2018). The price of wind power generation in Iberia and the merit-order effect. *International Journal of Sustainable Energy Planning and Management* 15: 21–30.
- Ciarreta, A., Paz Espinosa, M., and Pizarro-Irizar, C. (2014). Is green energy expensive? Empirical evidence from the Spanish electricity market. *Energy Policy* 69: 205-215. <https://doi.org/10.1016/j.enpol.2014.02.025>
- Comisión de Expertos de Transición Energética. (2018). Análisis y propuestas para la descarbonización: Resumen Ejecutivo. Retrieved from <https://elperiodicodelaenergia.com/wp-content/uploads/2018/04/Resumen-20180402-Veditado.pdf>
- Comisión Nacional de la Energía (CNE). (2013). *Informe 19/2013* (4 Sept.). Retrieved from https://www.cnmec.es/sites/default/files/1552840_7.pdf
- Comisión Nacional de los Mercados y la Competencia (CNMC). Información mensual de estadísticas sobre las ventas de régimen especial (various months and years). Retrieved from <https://www.cnmec.es/estadisticas?hidtipo=12749>
- Costa-Campi, M.T., and Trujillo-Baute, E. (2015). Retail price effects of feed-in tariff regulation. *Energy Economics* 51: 157-165. <https://doi.org/10.1016/j.eneco.2015.06.002>
- del Río González, P. (2008). Ten years of renewable electricity policies in Spain: An analysis of successive feed-in tariff reforms. *Energy Policy* 36, 2917-2929. <https://doi.org/10.1016/j.enpol.2008.03.025>
- del Río, P. (2016). Implementation of Auctions for Renewable Energy Support in Spain, *Report D7.1-ES* (March). Retrieved from http://auresproject.eu/sites/aures.eu/files/media/documents/wp7_-_case_study_report_spain_1.pdf
- del Río, P. (2017). Assessing the design elements in the Spanish renewable electricity auction: an international comparison, *Working Paper 6/2017*, Real Instituto Elcano (17 April). Retrieved from <http://www.realinstitutoelcano.org/wps/wcm/connect/435f8ff1-8e2d-498b-9c60-9ac1183d2fa0/DT6-2017-DelRio-Design-Spanish-renewable-electricity-auction.pdf?MOD=AJPERES&CACHEID=435f8ff1-8e2d-498b-9c60-9ac1183d2fa0>
- del Río, P., Mir-Artigues, P. (2012). Support for solar PV deployment in Spain: Some policy lessons. *Renewable and Sustainable Energy Reviews* 16, 5557-5566. <https://doi.org/10.1016/j.rser.2012.05.011>
- del Río, P., Mir-Artigues, P. (2014). A Cautionary Tale: Spain's Solar PV Investment Bubble, International Institute for Sustainable Development (Feb.). Retrieved from https://www.iisd.org/gsi/sites/default/files/rens_ct_spain.pdf
- EDPR News (2017). The EDP Group and Calidad Pascual sign the first power purchase agreement (PPA) (25 July). Retrieved from <https://www.edpr.com/en/news/edp-group-and-calidad-pascual-sign-first-power-purchase-agreement-ppa>
- Ellomay Capital (2018). Ellomay Capital Enters Into a Binding Term Sheet for a Power Financial Hedge for the Talasol Project (24 Jan.). Retrieved from <https://ellomay.com/press-releases/ellomay-capital-enters-into-a-binding-term-sheet-for-a-power-financial-hedge-for-the-talasol-project>
- El Periódico de la Energía (EPE). (2018a). Apoyo unánime del Parlamento andaluz para simplificar la normativa de trámites administrativos para proyectos renovables (18 July). Retrieved from <https://elperiodicodelaenergia.com/apoyo-unanime-del-parlamento-andaluz-para-simplificar-la-normativa-de-tramites-administrativos-para-proyectos-renovables>
- El Periódico de la Energía (PE). (2018b). El Gobierno de Aragón autoriza la construcción de 53 proyectos eólicos para cumplir con los plazos del Ministerio (6 August). Retrieved from <https://elperiodicodelaenergia.com/el-gobierno-de-aragon-autoriza-la-construccion-de-53-proyectos-eolicos-para-cumplir-con-los-plazos-del-ministerio>

- El Periódico de la Energía (PE). (2019a). La fotovoltaica duplicará su potencia en 2020, hasta los 9.000 MW, y la eólica crecerá un 20%, según Informa. (24 Sept). Retrieved from <https://elperiodicodelaenergia.com/la-fotovoltaica-duplicara-su-potencia-en-2020-hasta-los-9-000-mw-y-la-eolica-crecera-un-20-segun-informa>
- El Periódico de la Energía (PE). (2019b). Ribera: las nuevas subastas de renovables se aprobarán «en cuanto puedan». (21 Nov.). Retrieved from <https://elperiodicodelaenergia.com/ribera-las-nuevas-subastas-de-renovables-se-aprobaran-en-cuanto-puedan>
- Espinosa, M.P. (2013). An austerity-driven energy reform (Oct. 2013), ResearchGate. Retrieved from https://www.researchgate.net/publication/258809913_An_austerity-driven_energy_reform
- European Commission (EC). (2014). *Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01)*. Retrieved from [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0628\(01\)&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0628(01)&from=EN)
- European Commission (EC). (2015). Renewable energy progress report. *COM(2015) 293 final* (Brussels: 15 June). Retrieved from https://eur-lex.europa.eu/resource.html?uri=cellar:4f8722ce-1347-11e5-8817-01aa75ed71a1.0001.02/DOC_1&format=PDF
- European Commission (EC). (2018a). Europe leads the global clean energy transition (14 June). Retrieved from http://europa.eu/rapid/press-release_STATEMENT-18-4155_en.htm
- European Commission (EC). (2018b). European solidarity on Energy (27 July). Retrieved from http://europa.eu/rapid/press-release_IP-18-4621_en.htm
- Fernández, M. (2018). La oposición (sin Ciudadanos) lleva de nuevo al Congreso una iniciativa para tumbar el 'impuesto al sol'. *El Boletín* (10 May). Retrieved from <https://www.elboletin.com/noticia/162920/economia/la-oposicion-sin-ciudadanos-lleva-de-nuevo-al-congreso-una-iniciativa-para-tumbar-el-impuesto-al-sol.html>
- Gómez, A., Dopazo, C., and Fueyo, N. (2016). The “cost of not doing” energy planning: The Spanish energy bubble. *Energy* 101: 434-446. <https://doi.org/10.1016/j.energy.2016.02.004>
- Gómez, R. (2019). El Auge de los PPAs (14 Jan.). Retrieved from <https://elperiodicodelaenergia.com/el-auge-de-los-ppas/>
- Inspiriata. (2017). *Financing Spanish Renewables Projects*. Retrieved from https://www.capitaliq.com/CIQDotNet/CreditResearch/RenderArticle.aspx?articleId=1990704&SctArtId=448388&from=CM&nsl_code=LIME&sourceObjectId=10410209&sourceRevId=3&fee_ind=N&exp_date=20280213-22:39:51
- International Energy Agency (IEA). (2015). *The Energy Policies of IEA Countries: Spain: 2015 Review*. Paris: IEA.
- Kenning, T. (2015). Spanish government under fire after approving “sun tax”. *PV Tech* (12 Oct.). Retrieved from https://www.pv-tech.org/news/spains_sun_tax_approved_to_avoid_development_of_pv
- Kenning, T. (2016). Spanish parliament rallies against punitive “sun tax”. *PV Tech* (9 March). Retrieved from <https://www.pv-tech.org/news/spanish-sun-tax-on-brink-of-removal>
- Ley 82/1980, de 30 de diciembre, sobre conservación de energía (30 Dec. 1980). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-1981-1898
- Ley 54/1997, de 27 de noviembre, del Sector Eléctrico (27 Nov. 1997). Retrieved from <https://boe.es/buscar/doc.php?id=BOE-A-1997-25340>
- Ley 15/2012, de 27 de diciembre, de medidas fiscales para la sostenibilidad energética (27 Dec. 2012). Retrieved from <https://www.boe.es/buscar/doc.php?id=BOE-A-2012-15649>
- Ley 24/2013, de 26 de diciembre, del Sector Eléctrico (26 Dec. 2013). Retrieved from <https://www.boe.es/buscar/doc.php?id=BOE-A-2013-13645>
- Linares, P., and Labandeira, X. (2013). Renewable electricity support in Spain: A natural policy experiment. *Economics for Energy* WP 04/2013.
- McGovern, Mike. (2011). ¿Los eólicos prefieren el gas? *Energías Renovables* (6 June). Retrieved from <https://www.energias-renovables.com/eolica/iquest-los-eolicos-prefieren-el-gas>
- Ministerio de Industria, Energía y Turismo (MINETUR). (2015a). Orden IET/2212/2015, de 23 de octubre (23 Oct.). Retrieved from <https://www.boe.es/boe/dias/2015/10/24/pdfs/BOE-A-2015-11432.pdf>

- Ministerio de Industria, Energía y Turismo (MINETUR). (2015b). Planificación Energética: Plan de Desarrollo de la Red de Transporte de Energía 2015-2020. Retrieved from https://www.mincotur.gob.es/energia/planificacion/Planificacionelectricidadygas/desarrollo2015-2020/Documents/Planificaci%C3%B3n%202015_2020%20202016_11_28%20VPublicaci%C3%B3n.pdf
- Ministerio de Industria, Energía y Turismo (MINETUR). (2015c). Resolución de 30 de noviembre de 2015 (30 Nov.). Retrieved from <https://www.aeeolica.org/uploads/documents/10228-resolucirn-de-30-de-noviembre-de-2015-por-la-que-se-convoca-la-subasta-para-la-asignacirn-del-rrgimen-retributivo-especrfico-a-nuevas-instalaciones-de-produccirn-de-energra-elrctrice-a-partir-de-bioma.pdf>
- Ministerio de Industria, Energía y Turismo (MINETUR). (2016). Resolución de 18 de enero de 2016. Retrieved from http://www.subastasrenovables.omie.es/files/boe-a-2016-552_0.pdf
- Ministerio de Industria, Energía y Turismo (MINETUR). (2017a). Orden ETU/315/2017, de 6 de abril (8 April). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-2017-3880
- Ministerio de Industria, Energía y Turismo (MINETUR). (2017b). Resolución de 10 de abril de 2017 (12 April). Retrieved from <https://www.boe.es/boe/dias/2017/04/12/pdfs/BOE-A-2017-4094.pdf>
- Ministerio de Industria, Energía y Turismo (MINETUR). (2017c). Resolución de 19 de mayo de 2017 (26 May). Retrieved from http://www.subastasrenovables.omie.es/files/resultados_i_subasta_ifer_0.pdf
- Ministerio de Industria, Energía y Turismo (MINETUR). (2017d). Orden ETU/615/2017, de 27 de junio (28 June). Retrieved from <https://www.boe.es/boe/dias/2017/06/28/pdfs/BOE-A-2017-7389.pdf>
- Ministerio de Industria, Energía y Turismo (MINETUR). (2017e). Resolución de 27 de julio de 2017 (28 July). Retrieved from <http://www.subastasrenovables.omie.es/files/boe-a-2017-8997.pdf>
- Ministerio para la Transición Ecológica (MITECO). (2019a). Anteproyecto de Ley de Cambio Climático y Transición Energética (20 Feb.). Retrieved from https://www.miteco.gob.es/images/es/1anteproyectoleyccyte_tcm30-487336.pdf
- Ministerio para la Transición Ecológica (MITECO). (2019b). Borrador del Plan Nacional Integrado de Energía y Clima 2021-2030 (Feb.). Retrieved from https://www.miteco.gob.es/images/es/documentoparticipacionpublicaborradordelplannaciona lintegradodeenergiayclima2021-2030_tcm30-487344.pdf
- Mir-Artigues, P. (2012). *Economía de la generación eléctrica solar: La regulación fotovoltaica y solar termoeléctrica en España*. Civitas/Thomson Reuters. <https://doi.org/10.32796/cice.2012.83.6039>
- Mir-Artigues, P. (2013). The Spanish regulation of the photovoltaic demand-side generation. *Energy Policy* 63, 664-273. <https://doi.org/10.1016/j.enpol.2013.09.019>
- Mir-Artigues, P., del Río, P., and Cerdá, E. (2018). The impact of regulation on demand-side generation. *Energy Policy* 121, 286-291. <https://doi.org/10.1016/j.enpol.2018.05.008>
- Moreno, F., and Martínez-Val, J. (2011). Collateral effects of renewable energies deployment in Spain: Impact on thermal power plants performance and management. *Energy Policy* 39:6561-6574. Doi: <https://doi.org/10.1016/j.enpol.2011.07.061>
- Monforte, C. (2018). La fotovoltaica tramita proyectos por 20.000 millones de inversión. *Cinco Días* (19 March). Retrieved from https://cincodias.elpais.com/cincodias/2018/03/16/companias/1521226891_225916.html
- Ojea, L. (2018a). Las renovables temen que el RD de acceso y conexión no llegue a tiempo y pierdan sus permisos y avales. *El Periódico de la Energía* (4 July). Retrieved from <https://elperiodicodelaenergia.com/las-renovables-temen-que-el-rd-de-acceso-y-conexion-no-llegue-a-tiempo-y-pierdan-sus-permisos-y-avales>
- Ojea, L. (2018b). Todos los proyectos de renovables ganadores de las subastas estarán en funcionamiento el 1 de enero de 2020. *El Periódico de la Energía* (24 Sept.). Retrieved from <https://elperiodicodelaenergia.com/todos-los-proyectos-de-renovables-ganadores-de-las-subastas-estaran-en-funcionamiento-el-1-de-enero-de-2020>

- Ojea, L. (2018c). El Gobierno agilizará los trámites de impacto ambiental de las nuevas plantas de renovables para llegar al 20% en 2020. *El Periódico de la Energía* (22 June). Retrieved from <https://elperiodicodelaenergia.com/el-gobierno-agilizara-los-tramites-de-impacto-ambiental-de-las-nuevas-plantas-de-renovables-para-llegar-al-20-en-2020>
- Ojea, L. (2018d). La ley que acabará con el 'impuesto al sol' tendrá que esperar a septiembre. *El Periódico de la Energía* (25 June). Retrieved from <https://elperiodicodelaenergia.com/la-ley-que-acabara-con-el-impuesto-al-sol-tendra-que-esperar-a-septiembre>
- Ojea, L. (2019a). Locura renovable en España. *El Periódico de la Energía* (31 Jan.). Retrieved from <https://elperiodicodelaenergia.com/locura-renovable-en-espana-quieren-instalarse-mas-de-87-gw-la-mitad-ya-con-el-permiso-de-acceso-concedido-por-ree>
- Ojea, L. (2019b). Los proyectos renovables ganadores de las subastas prefieren perder los avales a cambio de firmar un PPA. *El Periódico de la Energía* (26 Sept.). Retrieved from <https://elperiodicodelaenergia.com/los-proyectos-renovables-ganadores-de-las-subastas-prefieren-perder-los-avales-a-cambio-de-firmar-un-ppa>
- Parnell, J. (2018). Economics not tenders driving Spain's solar resurgence. *PV Tech* (23 April). Retrieved from <https://www.pv-tech.org/news/economics-not-tenders-driving-spains-solar-resurgence>
- Pérez Galdón, B. (2019). Don Rodrigo inicia la nueva era de plantas solares sin subvención. *Cinco Días* (Nov. 9). Retrieved from https://cincodias.elpais.com/cincodias/2018/11/09/companias/1541758756_915913.html
- Plan de Acción Nacional de Energías Renovables de España (PANER) 2011 – 2020 (2010). Retrieved from https://www.mincotur.gob.es/energia/desarrollo/EnergiaRenovable/Documents/20100630_PANER_Espanaversion_final.pdf
- Plan de Energías Renovables en España (PER) 2005-2010 (2005). Retrieved from [http://www.idae.es/uploads/documentos/documentos_PER_2005-2010_8_de_gosto-2005_Completo.\(modificacionpag_63\)_Copia_2_301254a0.pdf](http://www.idae.es/uploads/documentos/documentos_PER_2005-2010_8_de_gosto-2005_Completo.(modificacionpag_63)_Copia_2_301254a0.pdf)
- Plan de Energías Renovables (PER) 2011-20 (2011). Retrieved from <http://www.idae.es/file/9712/download?token=6MoeBdCb>
- Plan de Fomento de las Energías Renovables en España (PFER) (1999). Retrieved from http://www.idae.es/uploads/documentos/documentos_4044_PFER2000-10_1999_1cd4b316.pdf
- Real Decreto (RD) 2366/1994, de 9 de diciembre (9 Dec. 1994). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-1994-28980
- Real Decreto (RD) 2818/1998, de 23 de diciembre (23 Dec. 1998). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-1998-30041
- Real Decreto (RD) 436/2004, de 12 de marzo (12 March 2004). Retrieved from <https://www.boe.es/buscar/doc.php?id=BOE-A-2004-5562>
- Real Decreto (RD) 661/2007, de 25 de mayo (25 May 2007). Retrieved from <https://www.boe.es/buscar/act.php?id=BOE-A-2007-10556>
- Real Decreto (RD) 1578/2008, de 26 de septiembre (26 Sept. 2008). Retrieved from <https://www.boe.es/buscar/doc.php?id=BOE-A-2008-15595>
- Real Decreto (RD) 1565/2010, de 19 de noviembre (19 Nov. 2010). Retrieved from <https://www.boe.es/buscar/doc.php?id=BOE-A-2010-17976>
- Real Decreto (RD) 1614/2010, de 7 de diciembre (7 Dec. 2010). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-2010-18915
- Real Decreto (RD) 413/2014, de 6 de junio (6 June 2014). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-2014-6123
- Real Decreto (RD) 900/2015, de 9 de octubre (10 Oct. 2015). Retrieved from <https://www.boe.es/buscar/act.php?id=BOE-A-2015-10927>
- Real Decreto (RD) 947/2015, de 16 de octubre (16 Oct. 2015). Retrieved from <https://www.boe.es/boe/dias/2015/10/17/pdfs/BOE-A-2015-11200.pdf>
- Real Decreto (RD) 359/2017, de 31 de marzo (1 April 2017). Retrieved from <https://www.boe.es/buscar/doc.php?id=BOE-A-2017-3639>
- Real Decreto (RD) 650/2017, de 16 de junio (17 June 2017). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-2017-6940
- Real Decreto (RD) 244/2019 de 5 de abril (6 April 2019). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-2019-5089

- Real Decreto-ley (RDL) 6/2009, de 30 de abril (30 April 2009). Retrieved from <https://www.boe.es/buscar/doc.php?id=BOE-A-2009-7581>
- Real Decreto-ley (RDL) 14/2010, de 23 de diciembre (23 Dec. 2010). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-2010-19757
- Real Decreto-ley (RDL) 1/2012, de 27 de enero (28 Jan. 2012). Retrieved from <https://www.boe.es/buscar/doc.php?id=BOE-A-2012-1310>
- Real Decreto-ley (RDL) 2/2013, de 1 de febrero (1 Feb. 2013). Retrieved from <https://www.boe.es/buscar/pdf/2013/BOE-A-2013-1117-consolidado.pdf>
- Real Decreto-ley (RDL) 9/2013, de 12 de julio (12 July 2013). Retrieved from <https://www.boe.es/buscar/doc.php?id=BOE-A-2013-7705>
- Real Decreto-ley (RDL) 15/2018, de 5 de octubre (6 Oct. 2018). Retrieved from https://www.boe.es/diario_boe/txt.php?id=BOE-A-2018-13593
- Red Eléctrica de España (REE). (2019) Evolución de la tramitación de los procedimientos de acceso a la red de la generación eólica y solar fotovoltaica gestionados por Red Eléctrica (Oct.). Retrieved from https://www.ree.es/sites/default/files/01_ACTIVIDADES/Documentos/AccesoRed/Informacion_gestion_acceso_oct19.pdf
- Roca, R. (2019). España bate el récord de potencia instalada con más de 106 GW gracias a la nueva capacidad de renovables. *El Periódico de la Energía* (20 Nov.). Retrieved from <https://elperiodicodelaenergia.com/espana-bate-el-record-de-potencia-instalada-con-mas-de-106-gw-gracias-a-la-nueva-capacidad-de-renovables/>
- Roldán Fernández, J.M., Burgos Payán, M., Riquelme Santos, J.M., and Luis, A. (2016). Renewables versus efficiency: A comparison for Spain. *Energy Procedia* 106, 14-23. <https://doi.org/10.1016/j.egypro.2016.12.101>
- Sáenz de Miera, G., del Río, P., and Vizcaino, V. (2008). Analysing the impact of renewable electricity support schemes on power prices: The case of wind electricity in Spain. *Energy Policy* 36: 3345-3359. <https://doi.org/10.1016/j.enpol.2008.04.022>
- Unión Española Fotovoltaica (UNEF). (2013). El Ministerio de Industria impide el autoconsumo de electricidad (19 July). Retrieved from http://www.energiza.org/index.php?option=com_k2&view=item&id=608:unef-%E2%80%98el-ministerio-de-industria-impide-el-autoconsumo-de-electricidad
- Unión Española Fotovoltaica (UNEF). (2017). El resultado de la subasta demuestra que la fotovoltaica ha sido discriminada (17 May). Retrieved from <https://unef.es/2017/05/el-resultado-de-la-subasta-demuestra-que-la-fotovoltaica-ha-sido-discriminada>
- Unión Española Fotovoltaica (UNEF). (2019). El RD de Autoconsumo sitúa al ciudadano en el centro del modelo energético al garantizar el libre acceso a la energía (5 April). Retrieved from <https://unef.es/2019/04/el-rd-situa-al-ciudadano-en-el-centro-del-modelo-energetico-al-garantizar-el-libre-acceso-a-la-energia>
- Vartiainen, E., Masson, G., Breyer, C., Moser, D., and Román Medina, E. (2019). Impact of weighted average cost of capital, capital expenditure, and other parameters on future utility-scale PV levelised cost of electricity. Retrieved from <https://onlinelibrary.wiley.com/doi/epdf/10.1002/pip.3189>. <https://doi.org/10.1002/pip.3189>