

Spain's Capacity Market: Energy Security or Subsidy?



**Institute for Energy Economics
and Financial Analysis**
IEEFA.org

December 2016

**By Gerard Wynn, Energy Finance Consultant, and Javier
Julve, Renewable Energy Consultant**

Table of Contents

Introduction	4
Spanish Electricity Demand and Supply	5
Spanish Capacity Payment Model	7
Spain's Energy Market Hinders Integration of Renewable Power	9
Conclusions and Recommendations	12

Note

The Institute for Energy Economics and Finance (IEEFA) is producing this briefing on the Spanish capacity market in advance of a fuller review of similar schemes around the world, to be published in early 2017.

Executive Summary

A dozen European countries, including France, Germany, Italy and the U.K., are either considering or implementing capacity markets, mechanisms by which power plant owners are paid regardless of whether their plants generate power.

The main justification for capacity markets is that they are needed supposedly to preserve security of electricity supply. The argument in support of such markets goes something like this: As growth in wind and solar power drive energy prices lower and force declines in generation by many coal- and gas-fired power plants, these plants cannot survive without subsidies.

The truth is that capacity mechanisms typically retard energy security progress by distorting power markets in fundamental, damaging ways. First, they add unnecessary costs that are shouldered by taxpayers and ratepayers—burdens that hurt economic growth. Second, they prop up outdated legacy generation that thwarts modernization of electricity production and leads to system over-capacity and sustains a cycle of dependency that delays the transition to a grid better suited to integrating renewables.

There are exceptions in which capacity markets may be justified. Such mechanisms can make sense, at least temporarily, in countries with a thin surplus of generating capacity over peak demand.

But for the most part capacity markets can be replaced by more cost-effective alternatives.

In this report, IEEFA notes some instructive lessons from capacity markets in Spain.

By way of background, Spain is of interest because it was one of the first countries to introduce capacity payments, in 1997. It has a high grid penetration of wind and solar power. And it is an energy island within Europe, with few cross-border interconnections, a circumstance that complicates the integration of renewables.

Spain is also of special interest because it has a new government (and a new energy minister), which means it has an opportunity now to review and modernize its energy policy.

This report describes some of the core flaws in Spain's capacity mechanism:

1. It follows a price- rather than a quantity-based approach. The country pays for capacity rather than determining how much capacity it needs and then letting a competitive auction set the price. An auction-led approach would prevent paying too high a price for little-used or unused generators.
2. It is biased in favor of coal and gas-fired generators rather than new renewable technologies or new transmission interconnections.
3. It is overly insular, excluding generation from neighboring France and Portugal, participation that would reduce costs and increase grid flexibility.
4. It lacks transparency, leading to questions, for instance, as to why certain, large energy-intensive industries are paid to be included in demand-side response (DSR) programs, while smaller or aggregated units are not.

IEEFA in this report also identifies wider flaws in Spain's power markets, which contribute to faults in its capacity market. Spain has a low price cap in day-ahead power markets, which undermines remuneration in and effectiveness of a true energy-only market (one that does not include payments for non-energy services such as capacity). And Spain does not have a truly independent energy regulator, making it vulnerable to lobbying by special interests (big utilities, energy-intensive industries and domestic coal producers).

While the original motive for capacity payments in Spain was to meet rapidly rising energy demand in the late 1990s, power demand peaked in 2007. Yet the capacity payments remain. Regulators estimate that about 80 percent of gas-fired power generators in Spain today would be unable to cover their fixed costs without capacity payments, and that most of its coal-fired electricity industry is similarly dependent on capacity payments and other subsidies.

Many deficiencies in Spain's capacity markets could be overcome by common sense steps that would include transitioning to a quantity-based auction, increasing market transparency, and promoting participation of technologies better suited to balancing variable demand and supply, and stronger interconnection.

However, full modernization of Spain's electric grid may allow replacement of the capacity mechanism altogether with a true energy-only market model, one that supports trade in and delivery of energy without provision for back-up capacity.

IEEFA makes the following recommendations for Spain's transition to an energy-only market and for the reduction or elimination of wasteful capacity payments:

1. Early retirement of surplus, uneconomic coal and gas capacity, to restore remunerative pricing in energy-only markets.
2. Reduction, or perhaps outright elimination, of the power price cap to further restore an appropriate energy market price signal.
3. Greater independence for Spain's energy regulator.

4. Changes to imbalance pricing to ensure that suppliers who fail to meet electricity demand in real-time markets are charged the full cost to the system operator for plugging resulting shortfalls in supply.
5. Support for workers in the transition from coal and to address energy poverty through targeted support for vulnerable consumers.

An energy-only market would see Spain's transmission system operator pass costs more directly to suppliers responsible for shortfalls or excesses in electricity in real-time balancing markets. The operator would thus punish imbalances more severely and better reward fast-response generation. Such an approach would drive suppliers to invest in flexible generation themselves, to adopt cost-saving demand-side response contracts with customers, and to do a better job of forecasting demand and supply. IEEFA notes on this point that forecasts for wind and solar power production are improving, and that by adopting a decentralized market approach Spain would be following an example being incrementally implemented by system operators in some European countries already.

Compared with capacity markets, this approach is better matched to addressing actual system scarcity, rather than relying on utility estimates for theoretical scarcity. It avoids paying needlessly for swathes of unused generation. And an energy-market approach rewards more flexible generation that is far better adapted to volatility, for example, than coal-fired power. An energy-market approach would also reduce the outside influence of powerful special interests and encourage a more diversified, modern and competitive economy.

Introduction

European electricity markets are in a period of great change as they transition to a low-carbon grid built around renewables. Countries large and small are at a crossroads in their approach to assuring security of supply. One path continues a more than 20-year project toward greater energy market liberalization and integration. The other turns back to a more interventionist, nationalist approach, one favored by many utilities through capacity markets.

To minimize costs to consumers, electricity is generally dispatched to the grid in a "merit order" determined by operating cost. Because wind and solar power have zero fuel costs, they are dispatched ahead of electricity generated by plants that burn fossil fuels. The rapid growth in renewables has pushed gas and coal-fired power plants down in this merit order, which means many gas- and coal-fired generators produce far less power than previously. In some cases, power plants generate no electricity at all. The notion behind capacity payments is to ensure that they remain "economic" and so can back up renewable power when wind and solar are unavailable.

However, evidence suggests that there are more cost-effective approaches to securing electricity supplies in high-renewables scenarios. These approaches are rooted in further power market liberalization and integration that offer a more cost-effective, modern, low-carbon and technology-neutral vision for assuring security of electricity supply. Capacity markets to date have largely incentivized existing gas and coal baseload generation. Such

payments by-pass the wholesale power market, distorting price signals that would otherwise drive new investment.

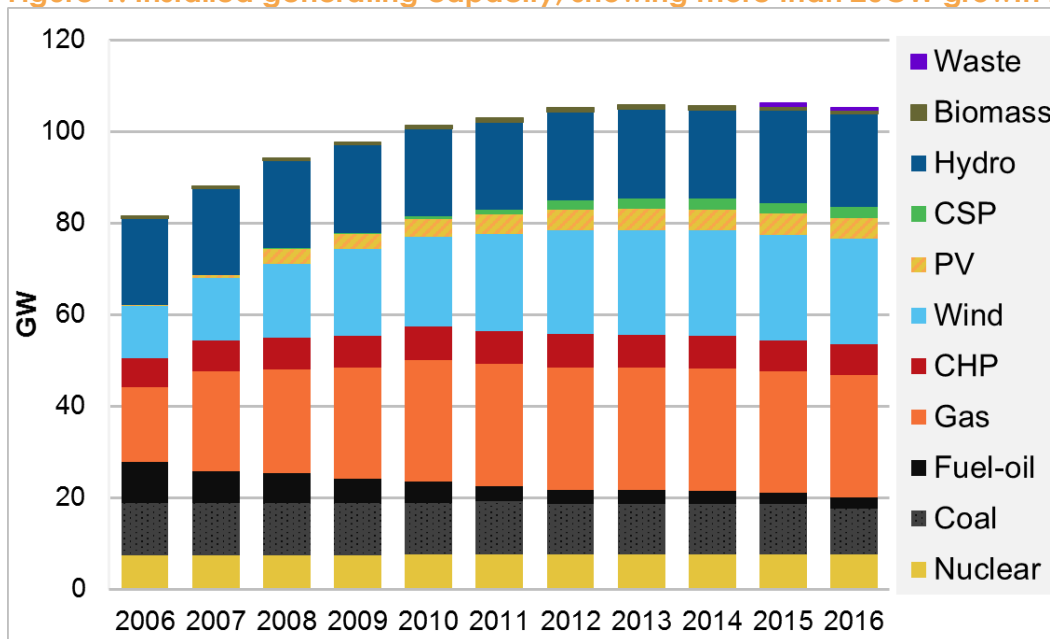
According to the European Commission, 12 European countries have introduced, or plan to introduce, capacity mechanisms: Belgium, Croatia, Denmark, France, Germany, Ireland, Italy, Poland, Portugal, Spain, Sweden and the U.K. In its recent inquiry on capacity markets, the Commission notes that the EU economy as a whole is burdened by over-capacity.

Spanish Electricity Demand and Supply

Spain's previously state-run energy sector was liberalized in 1997 with the establishment of five main utilities: Endesa, Gas Natural, Iberdrola, Union Fenosa, and Hidroeléctrica del Cantabro. Endesa and Gas Natural purchased various parts of Union Fenosa, while EDP purchased Hidroeléctrica del Cantabro.

In the decade that followed, electricity demand in Spain rose by an annual average of 5%. The utilities focused on meeting this demand with new combined-cycle gas turbine (CCGT) power plants, installing some 26 GW of CCGT from 2002-2011, supplied by imported liquefied natural gas (LNG) and pipeline gas connections to Algeria. Gas generation is now a major component of the country's energy mix, by capacity, in almost equal part alongside hydropower and wind. At the end of 2015, Spain had an installed generation capacity of 106 GW, according to the Spanish TSO Red Eléctrica de España (REE) (see Figure 1).¹

Figure 1. Installed generating capacity, showing more than 20GW growth in past decade²

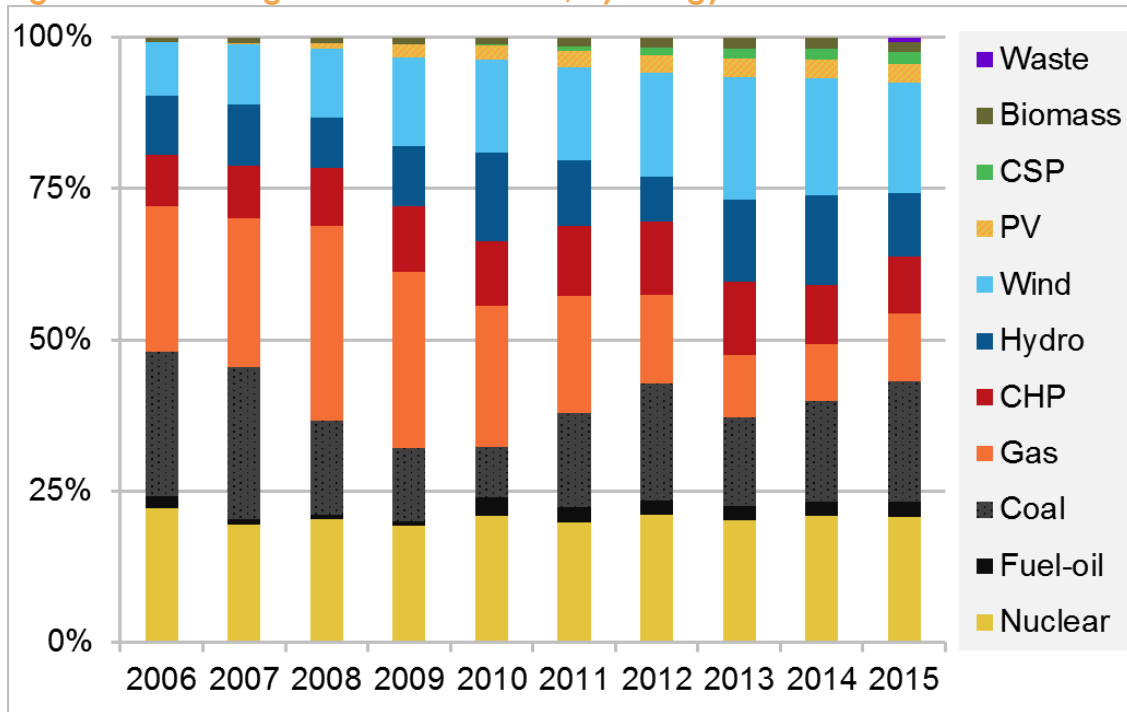


¹ REE is a partly state-owned Spanish corporation which operates the national electricity grid in Spain

² Concentrated Solar Power (CSP), Photovoltaic (PV), Combined Heat and Power (CHP)

As a fraction of total capacity, gas has remained steady at just over 25% since 2010. However, as a share of generation, gas has halved (see Figure 2). That is partly because of support for coal power: in 2010, Spain introduced a €1.3 billion scheme through 2014 to pay for some 5GW of power plants to burn domestic coal.³ In 2016, the government agreed in a deal with the EU to cease support for national coal production in 2018. These coal power plant will now almost certainly close. Gas generation has also been disadvantaged by relatively high LNG prices. As a result, while the amount of gas capacity has remained fairly constant, the share of Spain's energy generated by gas has roughly halved, and gas has slipped into fourth or fifth place in the country's energy mix, as measured by the amounts of energy generated (gigawatt hours) versus capacity (gigawatts).

Figure 2. Percentage Power Generation, by Energy Source⁴



Growth in Spain's generating capacity has coincided with falling demand (see Figure 3). Installed capacity is now more than double peak demand of around 40 GW, down from a peak, in 2007, of 45 GW.⁵ Even after excluding all variable renewables and hydropower, Spain has severe over-capacity. When calculating security of supply, REE considers that aggregate de-rated capacity for nuclear, gas, coal and renewables should

“Even after excluding all variable renewables and hydropower, Spain has severe over-capacity.”

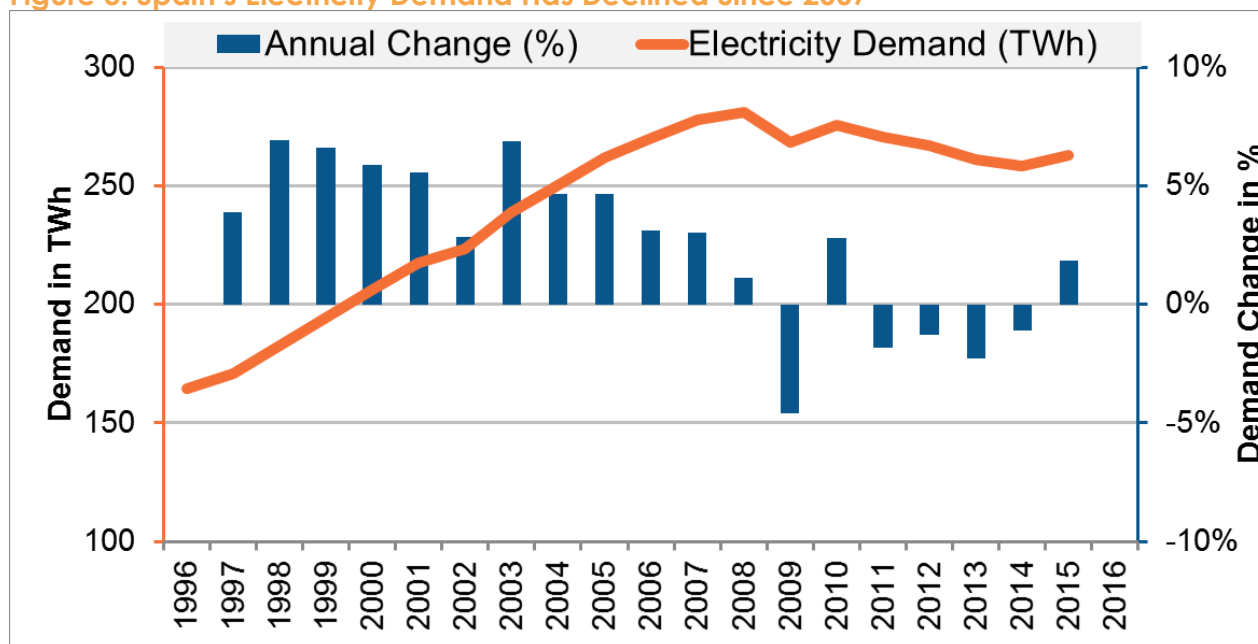
³ <https://www.boe.es/boe/dias/2010/02/27/pdfs/BOE-A-2010-3158.pdf>

⁴ Concentrated Solar Power (CSP), Photovoltaic (PV), Combined Heat and Power (CHP)

⁵ Red Eléctrica de España, *Annual Report 2015*, 2015. Available at: http://www.ree.es/sites/default/files/downloadable/ree_annual_report2015summary.pdf

be at least 1.1 times expected peak demand.⁶ This margin was achieved in 2008, and has since risen to more than 1.4 times.⁷

Figure 3. Spain's Electricity Demand Has Declined Since 2007



Spanish Capacity Payment Model

Spain's energy liberalization in 1997 introduced parallel energy-only markets and guaranteed capacity payments ("garantía de potencia") for conventional generation.

Since 2007, two main capacity subsidies have been given to electric generators:

1. An availability subsidy to some 50GW of generation capacity including to CCGT, hydropower, natural gas, fuel-oil and coal-fired generators regardless of whether they are running. In 2011, the latest year for which data are available, these subsidies totaled about €4,500-€4,700/ MW/ year for CCGT, fuel oil and coal, and about €1,200 for hydropower.
2. An investment subsidy to all 26 GW of CCGT capacity built after 1997 and selling into wholesale power markets. In 2013, this investment incentive rate was halved to €10,000/ MW/ year, but extended over 20 years, from 10 years. Ten CCGT power

⁶ https://www.cnmec.es/Portals/0/Ficheros/Energia/Publicaciones_Anuales/Anuales_inf_marco_2012.pdf

⁷ Red Eléctrica de España, *Annual Report 2014*, 2014. Available at: http://www.ree.es/sites/default/files/downloadable/inf_sis_elec_ree_2014_v2.pdf

plants, amounting to 5GW, have now received their full allocation of investment incentive capacity payments, but can still receive the availability incentive.

The costs of these two forms of capacity payments are passed on to consumers. Today, they are equivalent to about 8% of the wholesale power price, according to REE, the system operator. From 2011-2015, these capacity payments totaled some €2.9 billion.⁸

Coal power plants operators additionally are paid an environmental incentive to subsidize the financing of sulfur-scrubbing units and other upgrades. Some 6GW of a total 11GW of coal power capacity in Spain received these payments, amounting to €8,750/ MW/ year, over a period of 10 years. In addition, some 5GW of coal power received subsidies from 2011-2014, partially extended to 2018, to burn domestic coal and thus support the mining industry (for technical reason, not all coal plants in Spain can burn domestic coal). This capacity is expected to close after the last such subsidies are withdrawn.

Separately, energy-intensive industries including metals and concrete manufacturers are paid to be available to reduce energy demand, as required, to maintain system stability. In total, the system operator contracts some 3GW of demand-side response (DSR) capacity annually. Since 2014, payments have been allocated by competitive tender, instead of fixed price, under a €550 million budget. The auction is limited to large bids from energy-intensive industries. In November 2016, some 415 blocks of 5MW in size were allocated at an average price of €127,536/ MW, and 10 blocks of 90MW at an average price of €289,125/ MW.⁹ These price levels are high compared with some comparative capacity market auctions. In Britain in 2016, for instance, the system operator contracted some 475MW of DSR at £27.50/ kW (about €33,000/ MW) with an average unit size of 13MW.

Allocating a separate tranche of capacity payments exclusively for DSR is worthwhile, given the importance of DSR going forward in matching demand and supply, allowing load shifting, and for cost-effective integration of renewables. However, the Spanish model is costly. It also excludes small or aggregated DSR units, and it lacks transparency. Spain's industry minister stated in 2015 that one goal of the DSR scheme was to maintain jobs in energy-intensive industries in Spain amid concerns that without the payments some companies might relocate overseas.¹⁰ Payments totaled €3.7 billion for the period 2008-15.^{11,12} These costs are added to consumer energy bills.

⁸ http://www.ree.es/sites/default/files/downloadable/inf_sis_elec_ree_2015.pdf

⁹ <http://www.ree.es/es/sala-de-prensa/notas-de-prensa/2016/11/las-subastas-asignan-2975-mw-de-potencia-interrumpible-para-grandes-consumidores-temporada-2017>

¹⁰ <https://plataforma.quieroauditoriaenergetica.org/blog/14-categoria-blog-1/148-interrumpibilidad>

¹¹ https://energia.cnmec.es/cne/doc/publicaciones/cne88_13.pdf

¹² <http://www.ree.es/es/sala-de-prensa/notas-de-prensa/2015/09/las-subastas-de-interrumpibilidad-del-ano-2015-han-sido-mas-competitivas-que-las-del-2014>

Spain's Energy Market Hinders Integration of Renewable Power

Various features of the Spanish power market prevent the cost-effective integration of renewables and undermine new approaches that could reduce capacity payments if not eliminate them altogether.

“Various features of the Spanish power market prevent the cost-effective integration of renewables and undermine new approaches that could reduce capacity payments if not eliminate them altogether.”

Capped Wholesale Power Prices

On a grid with high integration of renewables—like Spain's—responsive, flexible back-up generation is important to balance out wind and solar power when these are unavailable. Such generation provides value that should be reflected in higher prices at times of scarce or volatile supply. Higher prices are vital to helping back-up power plants cover their fixed costs, given their lower running times. In Spain, however, wholesale power prices in day-ahead markets are capped at between €0 and €180/ MWh.¹³

While flexible generation is paid high prices in intraday balancing markets, pass-through of higher (or negative) prices to day-ahead markets would further increase the market signal to balance undersupply (or oversupply). Spain's energy regulator, CNE (Comisión Nacional de Energía), has argued that capacity payments are necessary because of price caps in the energy-only market.¹⁴ The reverse argument may hold true: without a price cap, there is less need for a capacity market. In its recent inquiry into capacity mechanisms, the European Commission stated that price caps were the number one market failure that countries had to address before thinking of introducing new capacity mechanisms.¹⁵

Over-Capacity

In an energy-only market, wholesale power prices are supposed to reflect the economic value of power supply. However, Spain's electricity system suffers from chronic over-capacity, a circumstance that suppresses power prices and has been used as a justification for capacity payments to help generators cover their fixed costs. A more cost-effective solution than capacity payments would be to close surplus capacity.

¹³ Law 54/1997

¹⁴ https://energia.cnmec.es/cne/doc/publicaciones/cne195_11.pdf

¹⁵ <http://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/COM-2016-752-F1-EN-MAIN.pdf>

Spain has almost doubled its installed generating capacity in the last 15 years, largely as a result of growth in renewable power and CCGT. Today CCGT power plants have an average capacity factor of less than 10%.¹⁶ In 2015, 5GW of CCGT produced no power at all. Spain's energy regulator estimates that some 80% of CCGT power plants are unable to recover their fixed cost on wholesale power markets without capacity payments. The industry ministry stated in 2015 that some 6GW of CCGT could be retired without affecting system stability.

Spain's over-capacity is exacerbated by regulation that prevents mothballing of idle generation.¹⁷ This rule was introduced in 1997, at a time of rapidly rising demand.

Spanish regulators appear oblivious to the opportunity for mandated retirement of older or more carbon-intensive generation as a prudent way to offset recent growth in renewables and to restore a price signal and a functioning energy market. In 2011, regulators stated that the value of capacity payments should be calculated to equal the fixed costs which power plants cannot cover through power market revenues.¹⁸ In 2012, regulators justified capacity payments because renewables had reduced the market share of competing technologies. In 2015, the energy minister went so far as to suggest that a levy on renewable energies might finance capacity payments for their competitors.

Low Interconnection

Build-out of the electric grid, including interconnection with neighboring countries, can smooth variability of wind and solar power and improve access to cheaper generation at times of system stress. Spain presently has total interconnections equivalent to about 6.6GW, or some 6% of installed capacity.¹⁹ Half of this is to Portugal, a smaller country whose own interconnections depend entirely on Spain.

European Union rules require member states to achieve at least 10% interconnection with neighboring countries by 2020. Even though Spain is lagging this target, its capacity mechanism does not allow payments to interconnectors, which might support new construction, and neither does it support payments to capacity in France or Portugal.²⁰

Spain's energy regulator has justified capacity payments on the basis of the country's low interconnection. However, one might instead justify investment in interconnectors on the basis of the country's costly capacity mechanism. Even long-distance sub-sea interconnectors may provide better value than continuing to subsidize legacy coal-fired generators. For example, Britain is building a 730-kilometre, 1.4GW sub-sea interconnector to Norway at an estimated cost of €2 billion, equivalent to about two years of capacity payments in Spain (see Figure 4).²¹

¹⁶ <http://www.ree.es/es/estadisticas-del-sistema-electrico-espanol/indicadores-nacionales/series-estadisticas>

¹⁷ https://energia.cnmc.es/cne/doc/publicaciones/cne51_12.pdf

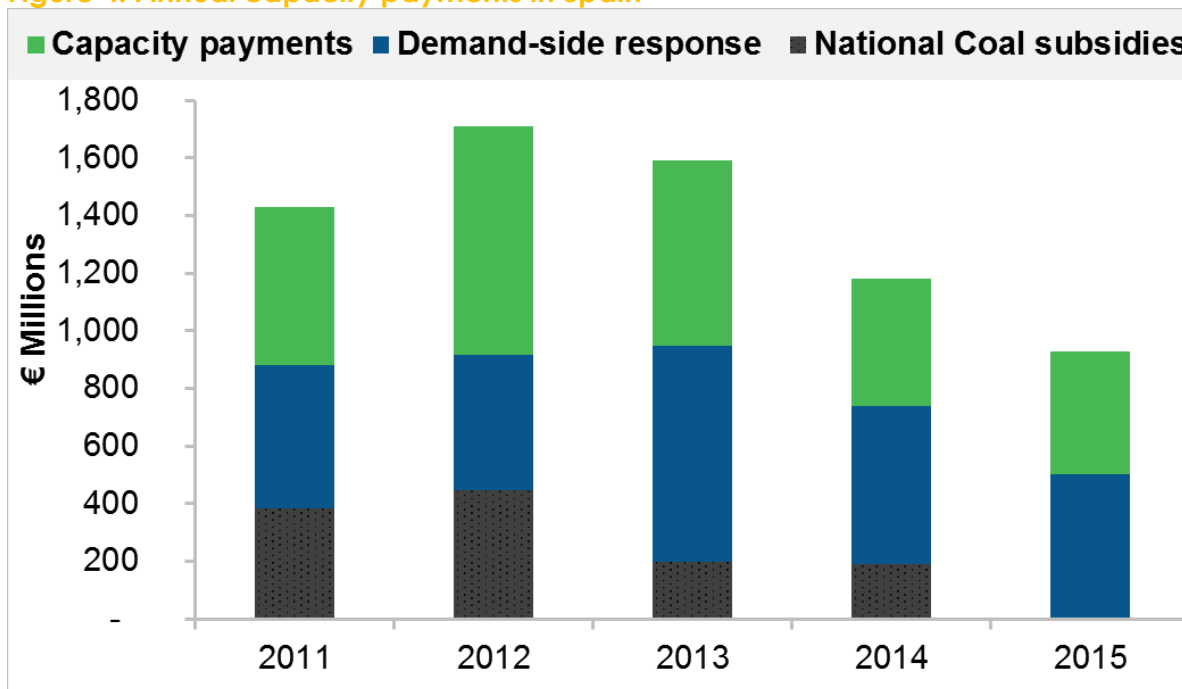
¹⁸ https://energia.cnmc.es/cne/doc/publicaciones/cne195_11.pdf

¹⁹ http://www.ree.es/sites/default/files/downloadable/electricity_interconnections.pdf

²⁰ <https://www.boe.es/buscar/act.php?id=BOE-A-1997-27817>

²¹ <http://www2.nationalgrid.com/Mediacentral/UK-Press-releases/2015/The-world-s-longest-interconnector-gets-underway/>

Figure 4. Annual capacity payments in Spain



Perverse Incentives for High-Carbon Generation

In less-connected grid systems with fewer interconnectors, the premium on flexible backup for variable renewables, such as gas generation, is greater. However, Spain has recently supported coal generation at the expense of gas.

Lack of a Truly Independent Regulator

Spain would benefit from having a more independent energy regulator. The present regulator, the Comisión Nacional de Mercados y la Competencia (CNMC), is responsible for enforcing competition law in different sectors, including in energy. CNMC says that it lacks the ability to take binding action, and that many of its former powers, including the establishment of feed-in tariffs and market abuse penalties, have been removed or reduced, taken away by the Spanish government's industry ministry.²²

²² <http://www.efe.com/efe/espana/economia/la-cnmc-pide-mas-competencias-y-poder-sancionador-plantea-retocar-ley/10003-3072174>

Conclusions and Recommendations

IEEFA concludes that Spain's electricity market is hobbled by fundamental weaknesses. By addressing these weaknesses, the country can develop a more effective power market, and so reduce or eliminate the use of consumer-subsidized capacity payments.

Recommendations:

- **To improve the present capacity mechanism.**
 - Switch to a quantity-based capacity market, where the system operator determines a desired level of capacity and the clearing price is set by competitive auction.
 - Widen participation to include interconnectors and battery and other storage technologies, as well as smaller DSR units.
- **To reduce over-capacity.**
 - Eliminate subsidies for coal.
 - Terminate regulations that prevent mothballing of idle capacity.
 - Allow the retirement of less efficient, more costly CCGT
- **To strengthen the price signal for flexible generation.**
 - Raise or eliminate the cap on wholesale power prices in day-ahead markets.
 - Implement reforms to ensure the full costs of balancing supply and demand in real time are passed to suppliers that fail to meet consumer demand.
- **To increase transparency in the power market.**
 - Empower a more independent regulator, to prioritise cost-effective security of supply, according to the capability and flexibility of various competing technologies.

The Institute for Energy Economics and Financial Analysis

The Institute for Energy Economics and Financial Analysis (IEEFA) conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy and to reduce dependence on coal and other non-renewable energy resources. More can be found at www.ieefa.org.

About the Authors

Gerard Wynn

Energy Finance Consultant Gerard Wynn is a U.K.-based 10-year veteran of energy and economics reporting at the Thomson Reuters News Agency and has authored numerous papers on energy issues ranging from solar power in Great Britain to coal-burning in China and India. He blogs at EnergyandCarbon.com.

Javier Julve

Javier Julve works as an independent consultant in renewable energy and information and communication technology, and is based in Germany. His main focus is analyzing how new energy technologies can reshape energy systems through scenario analysis. Javier has eight years' experience in renewable project development and in smart grid technologies. Javier holds a Masters in Production Engineering from the Technical University of Berlin and an electrical engineering degree from the Polytechnic of the University of Catalonia.