CLIMATE POLICY INITIATIVE

The Role of Public Finance in CSP

How Spain created a world-leading industry then shattered investor confidence

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Climate Policy Initiative is a team of analysts and advisors that works to improve the most important energy and land use policies around the world, with a particular focus on finance. An independent organization supported in part by a grant from the Open Society Foundations, CPI works in places that provide the most potential for policy impact including Brazil, China, Europe, India, Indonesia, and the United States.

Executive Summary

Concentrated solar power (CSP) is an extremely promising, potentially scaleable renewable energy technology. Because it stores solar energy as heat, CSP can deliver stable, low-carbon power even after the sun sets. By supplying power reliably and flexibly whenever it's most needed, CSP can help balance gaps between supply and demand, complementing more variable supply from other renewable energy technologies.

However, CSP investment and production costs are high compared to other more established options such as fossil fuel generation and mature renewable energy technologies. At this stage, CSP requires financial support from public sources to make private investments attractive.

Over the past year, Climate Policy Initiative (CPI), with the support of the Climate Investment Funds (CIF), has undertaken a series of studies on financing models and policy instruments for CSP. The aim of this work is to distill lessons on the effectiveness of different public financing and policy tools for CSP that can help policymakers choose the most effective of these tools for reaching their goals. This series includes a background paper looking at the CSP industry and markets worldwide, two in-depth case studies on large-scale CSP projects in India and South Africa, and a lessons learned paper pulling conclusions from this case study and all the other papers together. This case study focuses on Spain, currently the largest CSP market in the world.

Spanish policy prompted CSP deployment, drove innovation, and created a world-leading industry

We find that Spanish financial incentives for renewable energy – namely, the Feed-in Tariff and Feed-in Premium – were very successful in driving CSP installations. Spain deployed 2.3 GW of CSP plants in less than five years, with an average of 300MW financed every year between 2006 and 2012.

By offering the option to earn a premium over the market price, policy also supported innovation by driving investment in thermal storage technology. Project developers who invested in storage were able to increase revenues by selling at times when daily electricity prices were highest and to reduce unit costs by increasing plants' capacity factors. From a public perspective, investments in storage facilities have significant benefits to the energy system as whole as they increase the amount of dispatchable power available, reducing the uncertainty around the availability of power flowing into the grid.

These policies were also instrumental in developing a national CSP industry. In the last ten years, the Spanish CSP industry not only dominated 75% of Spain's domestic CSP market but has also developed more than 55% of CSP capacity installed outside Spain.

CSP support proved more expensive than expected and subsequent cost-cutting measures and retroactive policy changes badly hurt investor confidence

The lack of a cap or any other kind of policy control over the amount of CSP deployed led to a situation in which support became much more expensive than planned, just as the country's economic condition deteriorated because of the global financial crisis. Further, because Spanish CSP policy was unsuccessful in driving cost reductions and fostering market competition, investment costs (as disclosed by developers) didn't fall much as installed capacity increased. This is in contrast to the latest installations in countries such as Morocco

and India have been built at almost 30% lower costs.

The policy response to this situation was twofold:

- As the cost of support became higher than what Spanish authorities deemed acceptable, the government introduced a project approval process to stagger connections on an annual basis. On one side, this allowed a more controlled commissioning of CSP power; on the other, it left several plants being excluded and shelved; and incidentally led to some cost inflation as approved projects had to rush in procuring half of the project material and equipment in a matter of few months.
- The government then approved several retroactive changes to directly reduce the cost of support to CSP plants and resulted in hurting significantly the financial performance of operating plants. This second set of changes brought Spain's domestic CSP market to a complete standstill. Existing projects face significant financial constraints and no new CSP investments have been made since 2012.

Our analysis indicates that these policy changes have increased risk aversion and financing costs to a level that Spain is now much less attractive for CSP than many other developed and emerging nations, despite the fact that Spanish companies play a leading role in the global CSP industry. As a result of current policy uncertainty, if investors' risk aversion is not mitigated, any public support policy that aimed to keep CSP investments attractive would now need to be almost 20% higher than before, even assuming a significant reduction of 30% in technology costs.

Policy recommendations

The Spanish example clearly highlights crucial lessons for policymakers both in Spain and elsewhere. In Spain in particular, we recommend that establishing a transparent and stable support framework that combats policy uncertainty should be a higher priority even over setting a different level for the support or a new tariff.

Policymakers from Spain and other countries looking to support CSP installations may want to keep the following additional lessons in mind:

- CSP support policies need to foster competition and cost reduction as well as drive deployment, while also systematically and transparently reducing subsidy levels as technology costs decrease;
- CSP support policies need to introduce differentiated remuneration profiles to stimulate innovation and investments in the technologies with the highest system benefits;
- Policymakers need to be able to control the amount of support that public budget or rate payers are liable to pay as a result of the capacity installed, plan these liabilities in advance and avoid late and retroactive cut-backs;
- Policymakers need to avoid retroactive changes to policy that can significantly damage investors' perception of policy risk and increase their overall risk aversion.

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1. Introduction

Among renewable energy technologies, concentrated solar power (CSP) is promising because of its ability to store and deliver power when it's needed. By overcoming gaps between energy supply and demand, including those arising from other, more intermittent renewable energy sources, CSP can help maintain a stable yet low-carbon energy supply.

However, CSP investment and production costs are still high compared to other more established conventional options such as fossil fuel generation and mature renewable energy technologies; at this stage, CSP requires public support to make private investments profitable and risks acceptable to support scale-up of CSP and drive its costs down.

The Climate Investment Funds, one of the major public institutions supporting CSP, has commissioned CPI to undertake the study *'The Role of Public Finance in CSP,' a series of studies* whose aim is to distil lessons on the effectiveness of different public financing approaches to promote CSP deployment and future scale-up. Alongside a background paper (Stadelmann et al, 2014a) charting the global landscape of CSP financial models and policy supports and two case studies analyzing the financial structure of large scale plants in two emerging economies (India and South Africa), **this brief looks at the evolution of CSP support policies and their impact on financial returns for the industry in Spain, historically the largest market for the technology.**

Spanish policymakers were very successful in prompting the development of a national CSP industry that is now also leading installations on a global scale. At the same time, issues in policy design led the industry to develop much faster than expected, exceeding the country's initial targeted capacity and the planned public support for the technology.[1] In the end, the government's efforts to control the industry's growth by retroactively amending support policies hurt both investors' confidence and CSP investments' financial profile in Spain, and brought the local CSP market to a complete standstill.

Section 1 provides a summary of the context in which support for CSP and renewable energy developed in Spain; Section 2 analyzes the key policy features that made the development of the CSP industry possible in a short space of time, and measures their impact on investments' profitability and other relevant measures (e.g. incentives for storage). Section 3 identifies and measures the impact of the policy changes on existing investments. Section 4 shows the impact of investors' current higher risk aversion and lower confidence on the industry's outlook in the country. The following findings are based on a literature review, interviews with stakeholders (investors, developers, and policymakers) and financial modeling (described in more detail in Annex B).

[1] The policy framework in the RD 661/2007 aimed to support up to 500 MW of CSP installations (BOE. 2007).

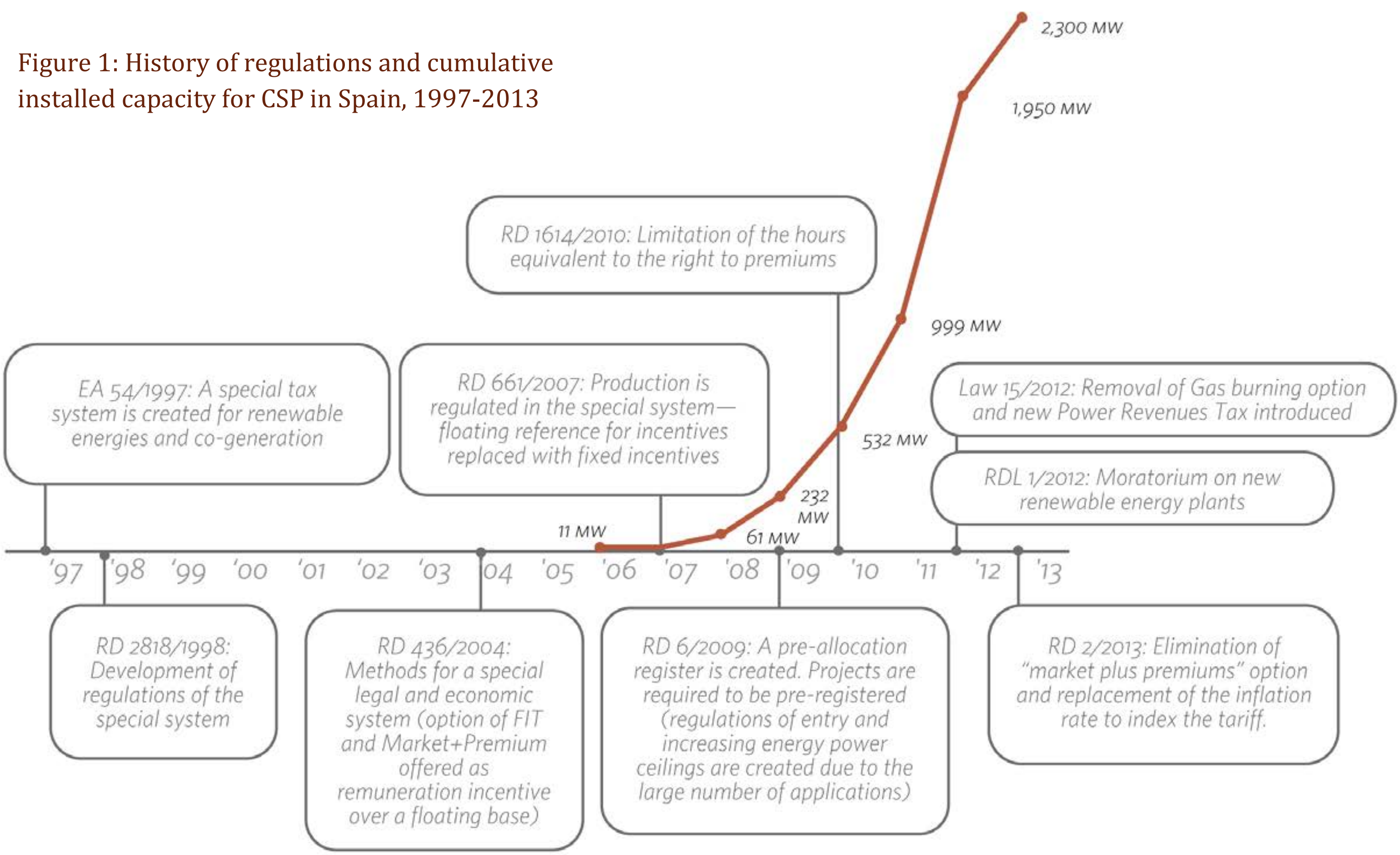
2. Evolution of the Spanish CSP policy and industry

Spanish CSP policy prompted the development of a world-leading CSP industry in a relatively short period of time. *In little more than five years (2007-2013), 2.3 GW of CSP was installed, owned mostly by Spanish companies and employing a workforce estimated at more than twenty thousand people.*

Spanish support to CSP, and renewable energy overall, has been part of a broader national effort to liberalize the national energy market. It began in 1997 with Electricity Act 54/1997 and continued in the following years with several pieces of legislation (Figure 1 summarizes the main policies - detailed descriptions can be found in Annex A). The Electricity Act 54/1997 established the "special regime" for facilities based on renewable, cogeneration, and waste energy, and set targets for energy efficiency, environmental protection, and renewable energy production.

Soon after the remuneration system for the special regime was introduced in 2004 with the Royal Decree (RD) 436/2004, several CSP plants began to be announced, and a few ones (totalling 200 MW in capacity) also

Figure 1: History of regulations and cumulative installed capacity for CSP in Spain, 1997-2013

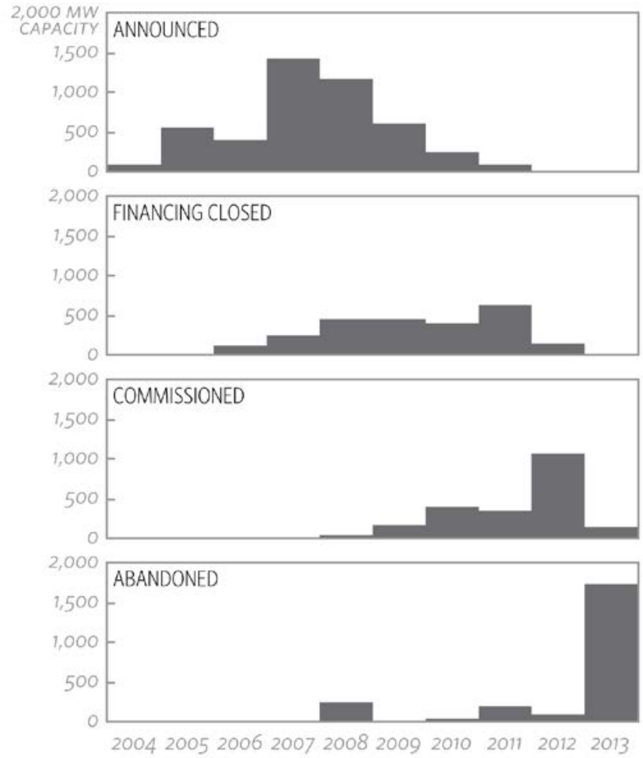


reached financial closure[2] (Figure 2). The new decree introduced two remuneration alternatives: a fixed tariff equal to 300% of the annual reference price or a premium equal to 250% of the reference price on top of the negotiated market price (the "pool price").[3] Both options had a fixed life of 25 years with a marginal reduction after that, and allowed the use of a back-up fuel (e.g. gas) for up to 15% of power produced.

However, most plants were announced and subsequently commissioned under Royal Decree 661/2007, the crucial Spanish CSP policy (see section 2). The 2007 decree replaced the variable "reference price" incentive with a fixed 26.9 €cents/kWh for the tariff and 25.4 €cents/kWh for the premium.[4] Despite RD 661/2007 targeting just 500MW of installed capacity (BOE, 2007), 4GW of plants were announced from 2005 to 2009. Of those, 2.3GW were approved for construction (see section 4) and almost 2GW were never built (Figure 2).

By 2011, the CSP industry had grown to employ more than an estimated 20,000 people and made an annual contribution to Spanish GDP of 1.65 billion Euros (Deloitte-ProtermoSolar, 2011). The plants commissioned under the 2007 regime contributed 700 GWh of electricity in 2010 (0.25% of total national demand) and more than 4,000 GWh in 2013 (1.70%) (CNMC, 2013b) saving 361,250 tons of CO_2 and more than 2 million tons of CO_2 respectively.[5]

Figure 2: CSP capacity per calendar year



Source: BNEF

Spanish companies owned more than 75% of the national CSP market, with one third of the plants financed by foreign equity investors. These same companies have developed (as sponsors or contractors) more than 55% of the global CSP capacity installed outside Spain in the last 10 years.

While Spanish policies had clear economic, energy, and environmental benefits for the country, they must be seen in the context of the cost to electricity rate-payers' budgets. **Under the 661/2007 incentive system, Spanish CSP plants required a total annual financial incentive of EUR 185 million in 2010 and up to EUR 1.1 billion in 2013.**[6]

[2] "Financial closure" is reached when investors and lenders agree on a project's financial terms and commit to provide capital.
[3] The electricity market sets the pool price by adjusting energy supply scheduled for the next day. The most expensive electricity offered sets the marginal price or "pool price". All other sources are paid at this price, even if their initial offer was lower.
[4] After 25 years these values were to be reduced to 21.5 €cents/kWh for the tariff and 20.3 €cents/kWh for the premium.
[5] CPI estimates based on Deloitte-Protermosolar 2011 parameters

[6] These are provisional numbers. Current legislation will also apply retroactively to plants which have already received incentives.

3. Benefits and limitations of the crucial 2007 policy framework

Benefits

The incentive tariff set in 2007 was the main driver for CSP installations, allowing project developers a stable and very favorable rate of return.

Favorable financing terms and the option to earn a premium over the market tariff supported innovation as project developers invested in thermal storage *to increase net profits by dispatching power at times of higher prices; increasing plants' capacity factors and decreasing levelized costs of electricity.*

Limitations

The incentivized tariff was not linked to the cost of the technology. It proved unable to exercise downward pressure on plants' costs nor to benefit from any eventual cost reduction.

Policies limited project developers to building CSP plants much smaller than the optimal efficient size with power from smaller plants costing roughly 15% more than that from comparable larger ones. *Though driven by concerns about grid stability, these limits raised costs.*

The total cost of support, which included support to CSP and to other renewables, resulted higher than expected. *This was due to the lack of a cap or quota on the overall value of the incentive and to the attractive returns from feed-in tariffs that led to more installations than planned in the initial regulation.*

Royal Decree (RD) 661/2007 was the centerpiece of the Spanish renewable energy support framework and eventually responsible for the vast majority of renewable energy installations in the country. While not very different from its predecessor RD 436/2004, the decree crucially removed the variable base on which the support was calculated and provided high certainty on investments' long-term revenues. This section examines the impact of the policy's design on CSP technology development and the energy sector.

Plant profitability and market alternatives

Under the incentive framework set out in the RD 661/2007, project sponsors could choose (annually) between a 26.9 €cents/kWh fixed regulated rate (feed–in tariff) and a 25.4 €cents/kWh premium over the market price (feed–in premium).[7] Both incentive schemes were set for the whole useful life of the plants (estimated at 40 years) but were to be marginally reduced after the first 25 years.

We estimate that these incentives allowed a generic CSP project to reach a 10% rate of return, and its equity sponsors to enjoy a levered 12.5% return (after taxes). While there were higher risks associated with an innovative technology such as CSP, these returns appear favorable compared with an estimated cost of capital for the utilities in the country at around 8%, and rates of return offered by wind investments in Europe at 8 to 16% (Macquarie, 2011). However, they appear in line if not below those offered by solar PV installations in Europe, estimated at 15 to 18% for equity owners in the year 2011 (Varadarajan et al, 2011). At market rates without the revenue support, a CSP project would not have achieved a positive rate of return.[8]

Investment in storage incentivized

The structure of the incentive, along with favorable financing terms, encouraged investment in less proven thermal storage technology. Storage helped plants to reach significantly higher capacity factors (increasing

[7] Total remuneration under the tariff plus premium option was however contained in a range between 25,4038 and 34,3976 €cents/kWh.

[8] Without an incentive, we calculate rates of return would be -2%.

from 24% without storage to 38% in our estimation) and resulted in much lower levelized costs of electricity (0.24 Eur/kWh for those with storage compared to 0.27 Eur/kWh for the others). Combined with the feed-in premium, the lower levelized costs allowed these plants to achieve internal rates of return of 11% and their sponsors to achieve levered returns of 14% (after tax).

The higher profitability induced several sponsors to invest in this more efficient technology, despite it being much less proven[9] and more capital intensive than the proven parabolic trough. Almost half of the plants commissioned in the country featured storage facilities with an average seven hours of capacity.

Very interestingly, despite the typical perception of higher risk related to thermal storage technology, banks and lenders did not demand a premium for the loans. The financing terms were basically the same for both types of plants. This is also explained by the availability - reported by stakeholders - of project developers and sponsors to offer banks comprehensive guarantees from their corporate assets, making project finance deals more similar to balance sheet financing.[10]

Impact of the plants' size on costs

The tariff in the Royal Decree 661/2007 was only offered to plants with a maximum of 50 MW capacity, far smaller than the 100- 250 MW indicated as the optimal scale for CSP (IEA, 2010). This condition was initially due to concerns from the grid operator about connecting plants generating non-dispatchable[11] power, but more importantly due to policymakers' preference to keep the approval of renewable energy projects a responsibility of regional governments (plants higher than 50 MW would have needed the approval of the central government).

As a result of this limit, all the plants installed in Spain between 2009 and 2013 had a capacity of 50 MW or below, even though many were built in adjacent 50 MW modules for a total of 100-150 MW. Considering that many parts of a generic CSP plant do not depend on scale (such as the conventional power block and project development costs), we estimate that a large plant with 150 MW capacity could have produced power at a 15% lower levelized cost and a 20% lower investment cost per MW installed than a 50 MW plant.

Evolution of technology costs

The incentive mechanism in RD 661/2007 had no systematic link to the cost of the technology or of individual plants, and no periodic price revision system[12] that would provide an incentive for developers to seek cost reductions. While it is true that developers could increase project profitability by reducing the plant's costs, the large number of installed projects, and the limited amount of both developers and suppliers meant that competition was not sufficient to prompt cost reductions. Although most of the plants were built in a relatively short amount of time, policymakers seem to have struggled to exert any downward pressure on the plants' costs as

[9] The first commercial-scale CSP plant with thermal storage to be commissioned was the Andasol I plant by ACS SA which started operations in 2008. A previous attempt with one of the plants in the SEGS project in the Mojave Desert (US) caught fire after a short period of operation and was never replaced (NREL).

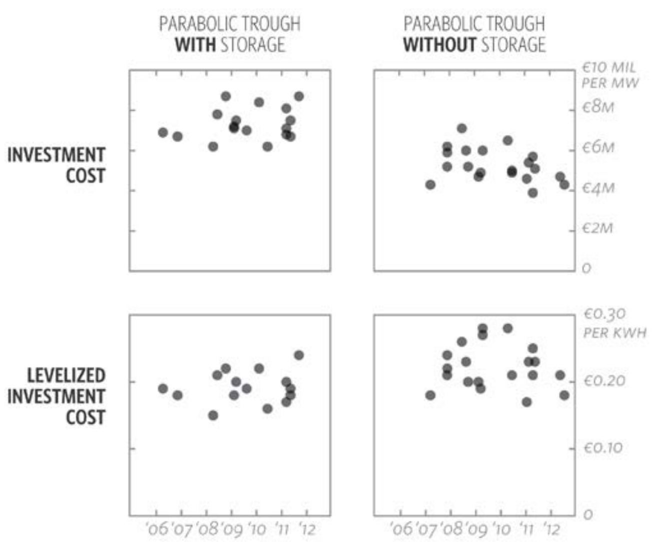
[10] The key difference between project finance financing and balance sheet financing is the limited recourse to the borrower's assets offered to the lender. In a project finance loan, in case of default, lenders have rights only to the assets owned by the project company and cannot claim any right on any other sponsors' asset outside the project.

[11] Without storage or back-up fuel, the power generated by a CSP plant follows the rise and setting of the sun and cannot be dispatched to meet the grid's needs.

[12] Policy for the solar photovoltaic project was structured differently. The RD 1578/2008 introduced in 2008 a *"quota"* system that aimed to control costs as capacity grew: installations were staggered in annual quotas that, once reached, would proportionally reduce the FIT for the following year (Del Rio, 2012).

capacity was being deployed and, the policy design meant they would not have benefitted from any cost reductions. Looking at both investment costs per capacity installed and levelized investment costs[13] for all plants financed between 2006 and 2012 and later commissioned, no downward trend emerges in Spain (Figure 3). Other markets have experienced cost reductions especially when using competitive tender auctions to award projects (Stadelmann et al, 2014c), with average technology costs outside Spain approximately 20% lower for plants with storage and more than 30% for those without.[14]

Figure 3: Investment costs and levelized costs evolution for parabolic trough plants,[15] 2006-2012



Source: BNEF

The debate on the impact of the CSP premium on the tariff deficit

Soon after electricity market liberalization in 1997, the difference between the overall regulated costs of the electricity sector[16] (generation, transportation and distribution) and the revenues obtained through regulated tariffs set by the government and paid by consumers produced a sector-wide deficit that by 2011, had reached more than 30 billion euros (Fabra, 2012; CNMC, 2013b). This tariff deficit quickly become one of the Spanish electricity sector's biggest problems and has driven most regulatory changes in the last few years. The deficit emerged before significant installations of renewable energy started, and worsened due to the financial crisis and economic downturn that reduced energy demand more than expected. Nevertheless, as renewable energy installations (including CSP plants) increased and rapidly exceeded initial expectations and national targets[17] the impact of their premium on energy production costs grew, contributing to the widening of the national tariff deficit. Support to CSP, along with other renewable energy sources, soon became a political issue despite the limited absolute size of CSP installations and their positive financial effects on the electricity market and the deficit itself thanks to savings on fossil fuel imports, and reductions in electricity market prices,[18] via the "merit order"[19] effect (see Figure 4).

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[13] Discounted at utilities' estimated cost of capital (Varadarajan et al, 2011).

[14] Average levelized investments costs estimates are USD 0.35 /kWh for Spanish plants with storage compared with USD 0.27/kWh elsewhere. For plants without storage, average values for Spain are USD 0.42 /kWh and USD 0.28/kWh elsewhere.

[15] There is not enough data for CSP power tower and linear Fresnel plants (two of the potential technical designs of CSP plants) to reach any conclusions on cost reductions.

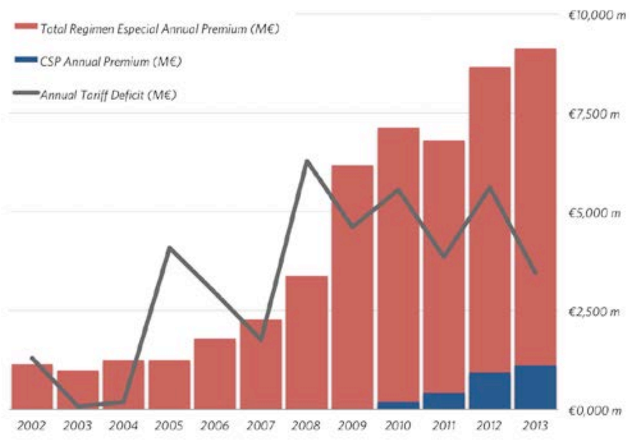
[16] Regulated access costs include, among others, transmission, distribution, costs of diversification and supply security (including the nuclear moratorium and special regime premium).

[17] Solar PV capacity installed in 2010 alone stood at 3.8GW against a target of 400MW (CNMC, 2013b).

[18] Gelabert *et al* (2011) estimated that a marginal increase of 1 GWh of electricity production from renewables and co-generation in Spain reduces electricity prices by almost 2 € per MWh (approx. 4% of the average price in the analyzed period).

[19] The merit order is a system of allocating energy production to different sources by giving priority to the ones with the lowest marginal cost of production. With no fuel costs, renewable sources' marginal cost is almost zero, so they are always granted full dispatchment and displace sources with higher costs.

Figure 4: Annual tariff deficit, renewable energy and CSP premiums



Source: CNMC (2013b)

An in-depth analysis on the net financial effect of CSP on the tariff deficit is complex and falls outside the scope of this work; we note however, that regardless of the net financial effect on the sector, budget expenditure grew beyond Spanish policymakers' zone of political tolerance driving them to make the retroactive policy changes that followed. We analyse these changes in the next section.

4. How policy changes (2009-2013) reduced returns and halted installations in the market

In order to manage and limit the cost of the subsidized CSP power installed, the Spanish government introduced several regulatory changes to the incentive system*, some of which applied to just new installations and others that also affected plants already in construction and operation.*

Since then, several announced and approved projects have been abandoned and many plants in operation are under financial stress. Ultimately, due to a moratorium on renewable energy support, no new CSP plants have been announced since 2010.

In 2009, the objective of national CSP policies switched from supporting installations to limiting connections. Five years after Royal Decree 436/2004 and two years after Royal Decree 661/2007, announcements of CSP projects had significantly overshot the 500 MW short-term targets set by the Spanish Government in the Renewable Energy Plan for 2005-2010 and in the RD 661/2007 (BOE, 2007; GDE, 2005).[20]

To better control the cost of support and manage grid connections, the Royal Decree 6/2009 published a pre-assignment register listing 51 plants (2.3GW of capacity) to be commissioned and connected between 2009 and 2013. **As a result, almost 50% of the plants that had been announced in the three years prior were put on hold**. Those plants, unable to get financial closure while outside the register, were later dropped when the Royal Decree Law 1/2012 cancelled incentivized remuneration for all new renewable energy plants.

Later in 2012, new policies first limited the amount of CSP power eligible for incentives by curtailing operating hours and making gas-fired back-up power ineligible for beneficial tariffs; then introduced new taxation to help finance the tariff deficit (Law 15/2012); and finally removed the "premium over market-price option" to make overall renewable expenditure less variable. These policy changes amended the RD 661/2007 and applied retroactively to plants already in operation.

These changes severely reduced the profitability of projects for investors and have significantly damaged projects' ability to repay debt and interest due. Our simulations (see Annex B for methodological details) for a plant with parabolic trough without storage show that the first set of 2012 policy changes reduced plants' profitability from a 12% to a 7% rate of return and decreased projects' ability to repay their loans to a very limited level.[21] The second series of changes enacted in the 2014 sector reform (CNMC, 2013c) deteriorated plants' profitability and financial health even further (CNMC, 2014).

Table 1: Effect of policy changes on plants' rates of return and debt coverage

Plant: 50MW Parabolic Trough without Storage	Equity IRR (after tax)	DSCR
RD 661/2007	12%	1.65
Hours curtailment (RD 1614/2010)	12%	1.65
Removal of Gas burning option (Law 15/2012)	10.4%	1.5
Power Revenues Tax 7% (Law 15/2012)	9.4%	1.4
Removal of Pool + Premium option (RD 2/2013)	7.9%	1.3
Change of indexation for FIT (RD 2/2013)	7.2%	1.28
Change of Tariff as per new Reform 2014	5.7%	1.12
Risk free rate (Spain Government Bond 10yr)	4%	

Acronyms: *IRR*: internal rate of return; *DSCR*: debt service coverage ratio

[20] The government had planned for total capacity of 500MW with 1 GWh of annual production forecasted for 2010 (GDE, 2005).

[21] In our simulations, following changes in remuneration profiles, projects show debt service coverage ratios (DSCR) slightly below the thresholds that lenders typically require in project finance.

5. The outlook for CSP in Spain

Retroactive policy changes and a lack of clarity on the overall framework for renewable energy have completely halted CSP investments in Spain.

Retroactive changes to Spain's CSP support policy affected investors' confidence to such a degree that it is now more expensive to build a CSP plant in Spain than in many developing countries*, such as Morocco and India, despite Spain's clear cost advantages as an industry leader.*

No new plants have been announced in Spain since 2010 and those planned prior to 2010 that did not qualify for the 2009 register have been put on hold or abandoned. Having changed policy to control CSP deployment to be within 500 MW CSP target for 2010 in Spain's Renewable Energy Plan (GoE, 2005), Spanish policymakers now **risk falling almost 2 GW short of the 5GW target set for CSP for 2020** (GoE, 2010).[22]

Given the lack of projects seeking financing and the lack of investors willing to commit resources to the Spanish renewable energy sector, it is difficult to estimate what financing terms a project developer could find in the market today. **However, stakeholder interviews suggest that risk aversion has significantly increased, leading to expectations (if a project is considered) of increased financing costs, shorter loan maturities and much lower leverage available (e.g. debt/equity ratios reduced from 75/25 to 60/40).**

These much less favorable financing terms would increase overall costs and decrease plant profitability to such a level that, even assuming 30% lower investment costs, the former RD 661/2007 feed-in tariff would need to be increased by almost 20% to make an investment profitable and bring profits in line with opportunities in countries such as Morocco and India.[23]

In Spain, restoring investors' confidence and mitigating their perception of policy risk needs to be a higher priority for policymakers than setting a new feed-in tariff or a new level of subsidy. While not advocating an even more expensive - hence less sustainable - policy for the country, we note that current high financing costs due to an increased perception of risk would make it impossible for the government to reduce the value of the incentive scheme (compared to the 2007 feed-in tariff) if 2020 renewable energy targets are to be met.

[22] We note here, that current installation plans for RES do not reflect the significant overcapacity of the Spanish market with a cumulative generation capacity of 108GW and peak demand at 40GW in 2013 (REE, 2013).

[23] In our simulation, we use current financing terms and costs for a hypothetical investment in a 50 MW plant with storage is in line with both the Spanish market and CSP investments in other countries assume profitability and investment costs are in line with the more recent installations in the MENA region and India.

6. Conclusions

The 2007 incentive framework based on a feed-in tariff/premium system was very effective in prompting installation of CSP plants and the development of a Spanish CSP industry that became a world-leader not only in the domestic but also foreign markets.

However, the lack of policy control over the level of capacity deployed and the overall public support required led to the announcement of a greater number of projects than initially targeted, and the potential of support costing much more than planned. Further, the inability of the policy to stimulate cost reductions and foster market competition meant investment costs didn't decrease as installed capacity increased.

To fight excessive installations and costs to the public, the government first introduced a project approval process that staggered connections on an annual basis; then added several retroactive changes that aimed to reduce the amount of support CSP investments were receiving. These measures directly hurt the financial performance of operating plants and brought the domestic market to a complete standstill.

Further, as a significant side effect, policy changes have now significantly increased risk aversion and financing costs for the technology in the country. Our financial simulations show that, **if investors' confidence is not restored and risk perception mitigated, any new eventual investment would need more public support than before, even assuming a significant reduction in technology costs**.

Policy uncertainty has ultimately made Spain much less attractive for CSP than many other developed and emerging countries, despite the significant national expertise of Spanish CSP companies. Therefore, we recommend, going forward, that establishing a transparent and stable support framework that can address this policy uncertainty should be a higher priority in Spain than setting a different level for the support or a new feed-in tariff.

For all countries looking to support CSP installations, several other lessons also emerge from the Spanish example:

- CSP support policies need to foster competition and cost reduction alongside deployment, while also systematically and transparently reducing subsidy levels as technology costs decrease;
- CSP support policies need to introduce differentiated remuneration profiles to stimulate innovation and investments in the technologies with the highest system benefits;
- Policymakers need to be able to control the amount of support that public budget or rate payers are liable to pay as a result of the capacity installed, plan these liabilities in advance and avoid late and retroactive cut-backs;
- Policymakers need to avoid retroactive changes to policy as they add significantly to policy support costs by damaging investors' perception of policy risk and increasing their overall risk aversion meaning they demand a greater return.

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ANNEX A: Policies and Regulatory Acts from 1997 to 2014

Year	Status	Regulation Code	Title	Description
1997	In force	**General Electricity Law 54/1997**	On the Electric Power Sector	Establishes the principles of a new operating model as regards the production of electricity based on free competition. The law's objectives include improving energy efficiency, reducing consumption and environmental protection. It could be considered as the first step in the general framework supporting RES-E in Spain.
1998	Superseded by Special Regime for the production of electricity from RES (Royal Decree 436/2004)	**Royal Decree 2818/1998**	On the generation of electric power by plants fuelled by renewable, waste, and co-generation energy resources or sources is passed.	Development of regulations of the special system.
2004	Superseded	**Royal Decree 436/2004**	On the methodology for updating and systematizing the legal and economic framework of the activity of electricity production in the special regime.	Methods for a special legal and economic system (premiums are established according to percentages based on the electricity market averages).This special regime is applicable to electricity produced from renewable energy sources.
2007	In force Last modification: 1st February, 2013, by Royal Decree-Law 2/2013	**Royal Decree 661/2007**	On the methodology for updating and systematizing the legal and economic framework of the activity of electricity production in the special regime.	Feed-in tariffs for electricity from renewable energy sources (special regime). Establishes new tariffs and premiums for each kind of facility covered and incorporates renewable energy, waste-to-energy, hybrid systems and cogeneration plants into the special regime. The cost of the regime is borne by the grid operator, who can pass on costs to consumers. The grid operators' costs are balanced monthly, and where there is a deficit, this is covered by the National Energy Committee (CNE). The new scheme applies to all technologies, with technology-specific and capacity-specific limits, as well as a combined feed-in tariff and feed-in premium scheme.

2009	In force	**Royal Decree-law 6/2009**	On certain urgent measures taken to ensure the financial stability of Spain's electrical system: Modification of the special regime	A pre-allocation register is created. Projects are required to be pre-registered (regulations of entry and increasing energy power ceilings are created due to the large number of applications).
2010	In force	**Royal Decree 1614/2010**	New regulation on electrical energy from wind and thermal electric technologies	Limitation of the hours entitled to the premiums. Once the limit is reached, the extra hours will not be financed by the FiT's.
2012	In force	**Royal Decree-law 1/2012**	On tax policy aimed at energy sustainability	Revocation of public financial support for new electricity plants from renewable energy sources, waste or CHP.
2012	In force	**Law 15/2012 of December 27th**	On tax policy aimed at energy sustainability	7% tax and withdrawal of premium of the part which is proportional to the natural gas used at the plants
2013	In force	**Royal Decree-law 2/2013**	On urgent measures in the electricity system and in the financial industry	Replacing the current system for remunerating regulated activities linked to the Consumer Price Index with a system linked to the Consumer Price Index at constant tax rates. This legislation also amends the options available to sell energy produced by CHP/renewable energy facilities.

ANNEX B: Methodology and Data

The analysis in this brief is supported by data collected from publicly available databases (Bloomberg New Energy Finance – BNEF; and the National Renewable Energy Laboratory - NREL), a literature review, and interviews with key stakeholders in the Spanish CSP industry (one policymaker from a regional government, two project sponsors, two project developers, two lenders and one representative from the national trade association).

We have simulated project financial profiles with a cash-flow model of a representative CSP plant whose investment costs, capital structure, and production estimates are based on the national averages of all the plants (divided by homogenous technology types) commissioned during the period in analysis (2007-2013).

Key variables used in the analysis are:

- **Internal rate of return**: This is a measure of the project's profitability for the project sponsors. We compare it with benchmark returns from available literature and the "risk-free" rate offered by the country's government bonds.
- **Levelized cost of electricity**: This is a measure of project costs divided by the total electricity produced and discounted by the project rate of return. It's a measure of the unit cost of the power after all resources (including financial ones) are remunerated.

Data Assumptions	Plant without storage	Plant with storage
Plant size	50 MW	50 MW
Capacity factors	24%	38%
Investment costs	€263 million	€370 million
Debt Leverage	75%	75%
Debt Maturity	20 years	20 years
Financing terms	Euribor + 150 basis points	Euribor + 150 basis points