

## Success story:

### Feed-In Tariffs Support Solar Thermal Power in Spain

The Spanish renewable energy industry as a whole has experienced rapid growth since the introduction of a Feed-In Tariff (FIT) that helps to ensure a stable income for investors. One technology that has particularly benefited from this is that of solar thermal power, also known as Concentrating Solar Power (CSP). Using mirrors to concentrate the sun's heat, boil water and drive a steam turbine, CSP is the cheapest form of solar energy, and has huge growth potential.

Today, Spanish companies are leading the world in the development of CSP both in the construction of CSP plants in Spain and around the world. Spain's FIT legislation has provided the necessary incentive to encourage the growth and development of the CSP industry.

This document will show how this success story has been brought about and is made up of the following sections:

1. What is a Feed-In Tariff?
2. Why Concentrating Solar Power?
3. How Spain adapted the FIT to suit CSP
4. Key elements of the legislation
5. Contacts for advice on replicating this idea

### 1. What is a Feed-In Tariff?

Feed-In Tariffs encourage entrepreneurs to produce electricity through renewable sources by guaranteeing that the entrepreneurs' electricity will be bought at a guaranteed rate and for a fixed period by the established utility companies.

The most important elements of every Feed-In Tariff are the level of the tariff and the length of time that it is guaranteed for. Obviously the higher the price, the more likely it is that business is going to be interested in developing renewable technologies. But the time factor is also important. Developers need the security of knowing that they will be able to achieve a guaranteed rate over a long period of time. This ensures proper compensation for the risks and costs of research, development and start-up that accompany renewable technologies.

Feed-In Tariffs were first developed in America in the 1970s. Spain first introduced them in the 1980s but only applied them to Concentrating Solar Power (CSP) in 2002.



## 2. Why Concentrating Solar Power?

CSP, or concentrating solar power, is a very promising technology that could potentially provide a large percentage of the world's energy needs simply by harnessing the direct sunlight that shines virtually non-stop during the day in desert and dryland regions.

It works as follows: mirrors are used to concentrate the sun's rays onto a black heat-absorbent pipe. The pipe contains water or another liquid which heats up to around 400 degrees Centigrade, producing steam which is used to drive a turbine which produces electricity in the conventional way.

The best place for generating solar thermal power is in dry regions that have little cloud cover, as CSP power plants require direct sunshine. Best of all are deserts, which have the added advantage that they generally contain plenty of land that is not being used for other purposes.

CSP is the cheapest type of solar technology and it also has the potential to produce electricity in large quantities that are comparable to the output from coal-fired or nuclear power stations. Indeed studies in the US have calculated that if an area in the South-Western States of 92 miles by 92 miles square were to be covered with solar thermal power stations, it would produce as much electricity as the entire United States produces today.

CSP has an advantage over some solar technologies because it transforms the sun's energy directly into heat. Heat can be stored and this means that steam turbines attached to CSP plants can continue running well into the night. If the heat runs out, fossil fuels can be used as a back-up, meaning that CSP plants can potentially produce reliable power 24 hours a day.

Two studies were recently carried out for the German Government on the potential of solar thermal power in the Europe-Mediterranean region. They concluded that this single energy source could provide a large part of the region's energy.

The reports recommend using modern high-voltage direct current (HVDC) transmission lines to transport the CSP-generated electricity across large distances – from North Africa to Europe, for example. There is very little energy loss from HVDC lines: only about 3% of the power is lost for each 1000 km that electricity is transported. This would mean that less than 10 percent of the power would be lost in transmitting from Southern Spain to the UK for example.

Solar thermal electricity has been generated on a modest scale for more than 20 years in California's Mojave Desert. Southern Spain, however, with its semi-arid landscape and year-round sunshine, is similarly well-suited to the technology. All that was needed was legislative measures to create adequate financial incentives and security for those going into the business.



### 3. How Spain adapted the FIT to suit CSP

Spain became the first country in the world to introduce a FIT for solar thermal power when it introduced **Royal Decree 841 in 2002**. This Decree introduced a FIT rate of €0.12 per kilowatt hour of electricity produced from solar thermal power plants between 100kW – 50MW of capacity.

This amount was increased in 2004, in **Royal Decree 436**, to €0.18 per kWh. This higher rate more adequately covered the costs and risks associated with solar thermal projects, and made the first projects more feasible. Royal Decree 436 guaranteed this tariff rate to solar thermal power producers for 25 years, with annual adaptation to average electricity price increases.

This increase in the FIT rate for solar thermal power made CSP projects bankable and attractive, and encouraged investors, banks and industrial suppliers to enter this new field of renewable energy production. Royal Decree 436 basically put solar thermal on the same footing as Photovoltaic solar systems, which had received a FIT for years, by guaranteeing the same tariff rate for installations of both technologies generating between 100kW to 50MW.

In addition to this, Decree 436 added a premium on top of the €0.18 per kWh tariff price for the first 200MW of solar thermal power installed in Spain, which effectively increased the total tariff rate to €0.21 per kWh of electricity produced. As a result, the major Spanish power market players began a race to install the first 200MW of solar thermal power. This incentive has motivated firms in the Spanish power market to launch more than twelve 50MW solar thermal plants, which should be completed by 2010.

Several other aspects of Royal Decree 436 have also been important in encouraging the growth of the solar thermal sector in Spain. These include the 25 year tariff guarantee, a commitment to conduct annual adaptation to electricity price changes, and a clause allowing solar thermal plants to contain 12-15% natural gas back-up. Allowing solar thermal plants to use natural gas – or indeed other fuels – as back-up increases the capacity of the plants. The gas can be utilised in order to maintain the temperature of the heat storage during times when solar thermal electricity production is interrupted.

Building on their success, the Spanish parliament passed a further decree in 2007: **Royal Decree 661**. This increased the fixed tariff rate for electricity generated from CSP plants to €0.269 per kWh, guaranteed for 25 years for installations up to 50MW. This rate will increase yearly with inflation minus one percent point. This Decree also increased the CSP target to 500MW by 2010 – moving beyond the first 200MW of capacity outlined in Decree 436.



## 4. Key elements of the legislation

It was with **Royal Decree 436** in 2004 that solar thermal power really began to take off in Spain. This was due largely to four factors:

- **High tariff rate.** The rate for electricity produced from solar thermal plants was guaranteed at €0.18 per kWh of electricity produced. This high tariff rate covered the costs and the risks associated with constructing the first solar thermal plants, and made those first projects feasible.
- **Added premium for first 200MW of installed solar thermal capacity.** In addition to the €0.18 tariff, Decree 436 added a premium for the first 200MW of solar thermal power installed in Spain, effectively increasing the total price to €0.21 per kWh of electricity produced. This added premium further encouraged investment, and began a race towards the first 200MW of installed solar thermal capacity in Spain.
- **Long term guaranteed tariff rate.** The tariff was guaranteed for a period of 25 years, with annual adaptation to the annual electricity price increase. This long term price guarantee helped to alleviate the concerns of investors and industrial suppliers, and made solar thermal a predictable investment over a long term period.
- **Allowance for natural gas back up.** The Decree also contained an allowance for solar thermal plants to contain up to 12-15% natural gas back up. This increases the reliability of the plants, because natural gas can be used to maintain the temperature of the heat storage during periods of interruption in solar thermal electricity generation.

Since 2004 FIT regulations have been refined further, with **Royal Decree 661**, which was introduced in 2007. This decree contained two elements that further encouraged investment in solar thermal:

- **Increase in tariff rate.** The fixed tariff for solar thermal generated electricity was increased to almost €0.27 per kWh, encouraging even greater investment.
- **Raising of the CSP target to 500MW for 2010.** Decree 661 increased the CSP target for Spain to 500MW by 2010, extending the 'race' to install CSP capacity beyond 200MW.

### Copy of the legislation

Royal Decree 436 (In Spanish):

<http://www.solarpaces.org/Library/Legislation/docs/040327RD436-2004.pdf>

Royal Decree 436 (English translation):

[http://onlinepact.org/fileadmin/user\\_upload/PACT/Laws/Spain\\_436\\_2004\\_english.pdf](http://onlinepact.org/fileadmin/user_upload/PACT/Laws/Spain_436_2004_english.pdf)



Royal Decree 661 (In Spanish):

<http://www.solarpaces.org/Library/Legislation/docs/RD6612007.pdf>

## 5. For advice on replicating this idea in your country

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