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Sunshine and silicon

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Is Spain ready for a real PV boom?

Spain's photovoltaic sector grew rapidly in 2004, only to slow down in 2005. While a state-guaranteed feed-in tariff is in place to drive a take-off, some of the smaller administrative cogs are buckling under the pressure. Projects are being further slowed by soaring world silicon prices and module shortages. Nevertheless, market volume is higher than ever before, and big capital from both home and abroad is betting that the Spanish take off is around the corner. By [Mike Stirzaker](#).

Although the sun fuels Spain's single biggest industry, tourism, there has, until recently, been little support for converting all that sunshine into electricity, fuelling the grid with photovoltaic power (PV). But that has all changed and suddenly the sector is buzzing with talk of 'take-offs' and 'world PV leadership.'

During 2004, Spain installed 10 MWp of solar PV, a 54% increase on the previous year, bringing the cumulative total to 37 MWp. By the end of 2005, another 12.5 MW had been installed, bringing the cumulative figure close to the 50 MWp. This represented a slowdown in the rate of growth to around 25% – largely due to administrative bottlenecks. This means that there is an ever-growing backlog of large developments in the pipeline. Renewables firm Acciona Energía, which directly owns over 1700 MW of renewables capacity, has just connected Spain's biggest PV plant, a 2.44 MWp facility in the Castejón district of Spain's northern Navarre region. And there are even bigger projects under construction, such as the 6 MWp Carmona plant in Seville province, being developed Catalana Andaluza de Energías Renovables, (CAENRE). Utility Iberdrola, the world's biggest renewables operator with over 3800 MW, is currently fitting 3 MW of PV modules at the new Madrid headquarters of Spain's main telephone operator, Telefónica with connection scheduled for the end of 2006.

Spain's PV development comes from hundreds of 100 kW projects, grouped into complexes of 1–2 MW known as 'solar allotments'



The forum in Barcelona with its photovoltaic sun shading system

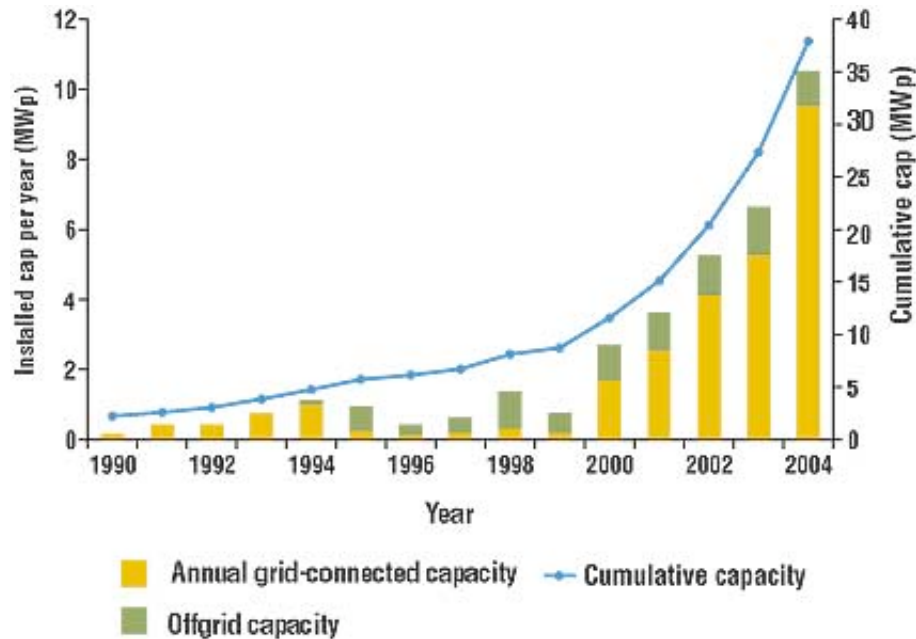
Leaving aside these large arrays, the bulk of Spain's PV development comes from the hundreds of 100 kW projects, often grouped into complexes of 1–2 MW and known as *huertos solares* (solar allotments). The developer asks private investors, often locals, to buy at least one module. The modules are usually mounted on an automatic solar tracking system, optimizing their angle relative to the sun from dawn to dusk. Compared to fixed-position modules, tracker-mounted units increase yields by 25%, according to state energy efficiency agency, Instituto para la Diversificación y Ahorro de la Energía (IDAE). Overall costs, not just for modules but also for feed-in infrastructure, maintenance, security and plant management, are shared by module owners and developer. Including Castejón, Acciona now operates six solar allotments totalling 10.2 MW, with a combined total of 1673 trackers and over one thousand module owners. The company also claims to be developing further solar allotments totalling around 30 MW. Acciona is by no means the only company developing solar allotments, however, and small businesses across the country are cashing in on the format, some developing projects as big as 3 MW.

WORLD CLASS

Indeed, two solar allotments, one at 25 MWp and 15 MWp, are being developed by the Canary Islands renewables technology institute, Instituto Tecnológico de Energías Renovables (ITER). The 25 MWp could become the biggest PV plant in the world if a (curiously) low-profile 64 MW project in Portugal fails to get off the ground. ITER reckons the 15 MWp project is otherwise beaten only by an 18 MW development in Nevada, USA. Acciona is also rumoured to be developing a 13–15 MW plant in the Navarre district of Milagros, though the company declines to comment.

GOVERNMENT SUPPORT

So what was the catalyst behind the sudden spurt? The answer is Royal Decree 436 (RD 436). Rubberstamped in March 2004, RD 436 revised the feed-in tariffs paid to Spanish renewables, with solar PV as a main beneficiary. The regulation provided, for the first time, long-term, state-guaranteed and bankable earnings over the life cycle of grid-connected PV systems. Previously, feed-in rates for existing systems were subject to review every four years, and the top rate was paid to installation up to 5 kW only. Now the bar is at 100 kW, 'opening the way to business-scale PV development,' according to Javier Anta of PV industry association, Asociación de la Industria Fotovoltaica (ASIF).



Operators of systems up to 100 kW now receive 575% of electricity sector billings (also called the average electricity tariff or AET), as forecast annually by the government for the year ahead. Roughly, the figure translates to 5.75 times the average consumer tariff. Currently, this is worth around 42 eurocents/kWh. The rate then drops to 460% AET after the 25th year. 'It could hardly be better,' says Anta. He points out that the tariff alone, without investment subsidies, is now enough to make grid-connected PV projects viable, both on a domestic and business scale. In fact, state level subsidies for standard grid connected systems have now ended. Previously, the publicly owned credit institute, Instituto de Crédito Oficial (ICO) and IDAE jointly issued the subsidies, allocated through periodical calls for proposals. The final call was announced in December. Now, only off-grid and R&D grid-connected projects are now eligible for state subsidies. While some town halls and regional governments maintain their own subsidies, Anta says projects are now free of the lengthy application and processing procedures at state level that had hitherto slowed the market down. Underpinning RD 436, in November 2005, the central government passed the national renewable energy plan – or Plan de Energías Renovables (PER) – raising Spain's installed PV target for 2010 from 135 MW to 400 MW. The 400 MW objective includes the 37 MW already installed by the end of 2004 (Figure 1), meaning 363 MW of *new* capacity is targeted for 2005–2010.

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Meanwhile, however, RD 436 has yet to be revised to incorporate the new target and retains the former 135 MW cap, beyond which, officially, the special feed-in rate ends. Cayetano Hernandez of IDAE is confident it will happen before the summer. 'It better had,' says Bart Goossens of Dutch PV consultancy and broker firm, SolarPlaza: 'This will be the real test of the government's determination for a PV take-off.'

ATTRACTION ABROAD

No such doubts seem to tarnish the rosy view of foreign observers and those involved in the sector. In a 2005 end-of-year report, financial analysts Ernst & Young listed Spain as 'the most attractive renewables market in the world' for investors and, jointly with Germany, the second most attractive PV market. The United States came first.

Riding the feel-good factor, SolarPlaza organized a PV business tour of Spain in November 2005, introducing the country to companies and organizations from China, the US, Germany, Switzerland and Holland. Goossens claims some sizeable contracts were signed during the tour, though cannot breach confidentiality and release details. Nevertheless, around that time, one Spanish participant, Ecotècnia Solar – already a major player in Spain's huge and dynamic wind market – signed up for 6–10 MW from German PV module manufacturer Solon AG. At the same time, Solón sealed a cell sale totalling 8 MW with Spanish PV developer Geosol Ibérica. On the heels of the Solón deals, Atersa, a PV module manufacturer – and the third of Spain's three PV cell manufacturers – signed up to buy 73 MW of polycrystalline silicon cells from Q-Cells. The deal covers the three years to 2009.

BACK TO REALITY

Given the sector euphoria, together with a national project pipeline far outstripping the 2010 target, the 400 MW ceiling was broadly received as very conservative. When IDAE consulted ASIF on drawing up the PER, the association had recommended a 1100 MW target. However, 'the figure is neither ambitious nor conservative,' insists Cayetano Hernández of IDAE, which was responsible for compiling the PER. 'It's simply realistic, given our analysis of current market conditions.'

CONCENTRATING ON EFFICIENCY



Soaring global demand for solar-grade silicon has spurred plans from some companies in Spain to boost the emergence of concentrating PV cell (CPV) technologies (for more information on concentrating PV see *Time to concentrate – REW Sept–Oct 2005*). According to company representative Ernesto Macias Spain's biggest PV cell producer, Isofotón – which also assembles its own modules – will manufacture 'around 5 MW' of CPV cells in 2007. At the same time, a new R&D institute, Instituto de Energía Solar (IES), has received financing to build a 2.7 MW concentrating PV demonstration plant. Both plans are ambitious, considering global installed CPV capacity was only around 1 MW in 2004.

'Speculative tendencies' are pushing silicon prices 'artificially high,' says Macias. 'All we can do is try to attain more kilowatts for every tonne of silicon.' Hence, Isofotón has dedicated a small production line to CPV cells, with which 'we aim to bring installed costs down to half current levels,' says Macias. In concentrating technologies, lenses and mirrors focus magnified sunlight on the PV cells in order to increase yields, attaining efficiencies as high as 38%. 'The concentrating cells will go to a very specific kind of client, probably a utility, in order not to alter our established market,' he adds.

Meanwhile, Antonio Luque, a Spanish PV guru and director of the IES, says the demonstration project will compare performance from a series of prototypes. 'Currently, PV yields don't go beyond 14%,' says Luque. 'In many cases, with the concentrating cells, it will rise to 20%, later to reach even greater efficiencies.'

Luque expects all major international firms developing concentrating PV cells to respond to the call for tender. The R&D plant, which earmarks 55,000 m² in the arid Puertollano area of the south-central region of Castile-La Mancha, will be connected to the grid, generating payback on a €20 million financing deal clinched with the central education and science ministry.

Hernández's 'realism' gradually began to appear less conservative as last year's growth-rate deceleration became increasingly apparent. During 2005, 11 MW of new PV capacity were officially billing local electricity distributors for power delivered to the grid, according to regulator Comisión Nacional de Energía (CNE). The figure does not include off-grid capacity, which is not yet accounted. But assuming new stand-alone capacity was the same as 2004, at 1.5 MW (a generous estimation given the downward off-grid trend), total new capacity for 2005 is likely to have been around 12.5 MW. That translates to growth of 25% – way short of 2004's 55% increase. Worse, it also lags a good field behind PER's 90% growth expectation for 2005 (see Figure 1) which would have translated to 19 MW of new capacity. Furthermore, the 2005 figure is over a 12 month period of sector action, compared to the nine-month period of 2004's record activity, following the end-of-March rubberstamp on RD 436.

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TIGHT SUPPLIES

Back at the SolarPlaza tour, such was the organizer's enthusiasm that it announced – perhaps over exuberantly in retrospect – that: 'The major companies developing large projects could, on their own, sell 100 MW and more in 2006 if solar modules were to be available.' That is still a very big 'if', and, behind its upbeat tone, SolarPlaza admits as much, adding, in the same statement: 'The module shortage is an enormous problem and is interrupting the steep growth of the Spanish market.'

Indeed, world demand for silicon and modules was up 60% at the turn of 2004–2005, according to ASIF, making supply chains extremely tight. José María Rodríguez of the Spanish branch of BP Solar – Spain's second biggest cell producer, in Tres Cantos, Madrid – says silicon shortages 'could affect module output over 2006.' Rodríguez expects 30% installed capacity growth across Spain, again, below even the pre-2004 trend.



Based in Spain, BP Solar is one of the world's leading manufacturers of solar cells
BP SOLAR

'The silicon shortage is temporary but it's a situation, as far as we can see, that will not be resolved in the next year or so'. Says Ernesto Macias of Isofotón, the biggest of Spain's three PV cell producers (BP Solar and Atersa are the other two). 'Sure, there are plans to ramp up world silicon production 2007–2008 but it is unlikely to keep up with demand growth.' To keep supplies going, Macias claims Isofotón and other big cell and module manufacturers are signing 10-year silicon contracts. He says a good part of the deals are paid in advance. 'In effect, as the penultimate link in the whole PV chain – before it reaches the client – we, the manufacturers, are financing the seven or eight big polycrystalline producers,' he argues. 'At a conservative estimate, I'd say we currently have €60 million in advanced payments for silicon supplies.' The situation has also led to rampant speculation, with silicon prices soaring over the past two years.

On the up side, ASIF reckons that the 5% downward trend in Spain's installed costs has offset the impact of rising silicon prices, which has raised installed costs, also by 5%. Notwithstanding silicon costs, the otherwise downward trend arises from increased market volume and experience. Indeed, the PER estimates, from the German experience, that doubling market size can lead to an 18% drop in installed costs, 'though costs of silicon and other electrical components can severely alter this equation,' the document states.

While admitting its role in the temporary slow-down, Anta argues that silicon shortages also present an opportunity for new PV-specific silicon purification. A mere 2% of global silicon is used by the PV sector, ASIF reckons, and, with the current demand, there is plenty of scope for new purification facilities. However, neither Anta nor other sector specialists know of any specific plans to establish silicon production in Spain, though ASIF is pushing the central government into helping assess the viability of such a move, which, after all, could finally break the sector's dependency on silicon cast-offs from the electronic industry. R&D is also spurred on by the



supply problems, especially related to ambitious projects for concentrated PV modules (see boxed text – *Concentrating on efficiency*).

Anta also offers a reminder that the tight silicon supply chain is a problem that the sector almost wished to reach. 'It was fully predictable but impossible to forestall,' he says. Companies like BP had entered the sector on already very tight margins. 'It was impossible to ask such companies to invest even more in new silicon facilities. We're just going to have to wait until demand drives up supply, and we'll all come out stronger,' he says.



The 150 kW Villa de don Fadrique PV array, with trackers, in Toledo province
GEA

The tight silicon supply chain 'was predictable but impossible to forestall'

RED TAPE

Meanwhile, ASIF, IDAE and practically all sector observers agree on one other major hurdle delaying the beginning of the upward spiral and major economies of scale in Spain – bureaucracy. Here, lack of public administration experience compounds the growing logjam of project applications. The PER itself states: 'Administrative processing is very complex and often little understood by some regional government technicians.' ASIF's report agrees: 'It is not strange to come across cases where developers simply abandon a project due to obstacles or extra cost.' SolarPlaza reckons it can take 'anything from nine to eighteen months' to develop a largescale project. 'Contacts with the local mayor, regional government and local utility are needed to obtain a connection point to the grid. Permits and legislation can differ per region.' Goossens adds: 'We've known a case in one province where just one person alone was responsible for logging a project in the electricity generator register. He was on special leave for three months, during which time all new projects were kept on hold.' Forced to bet on new installed capacity for 2006, Goossens ventures 'anything between 10 and 100 MW. It depends on how the many parameters align. Our next commercial tour [in June 2006] will give us a clearer idea.'

FINAL HURDLES

At the same time, IDAE is working to help define the technical rules for grid connection of large systems. Anta points out that towards the end of the 1990s, local utility distributors, trained in large-scale connections, were often stumped by applications to connect small PV systems. Now after gaining experience from the growing number of applications over the past few years, distributors have to face connection of much bigger systems of up to 100 kW, with no clear rules or precedents concerning behaviour or standard requirements of PV inverters or other components. Hernández adds that IDAE's task now is to help bring rules and regulations into line and to help inform installers, developers and utilities on procedure.

Another glaring hurdle is the 100 kW eligibility limit for the top-rate feed-in tariff. The dozens of developments in the multi-megawatt range get around the problem by subdividing into smaller projects. For instance, regarding Iberdrola's plans for a series of 10 MW projects, the company's Roberto Legaz explains it's simply a case of registering one hundred 100 kW projects, otherwise the plant would drop to the lower tariff rate, at 22 eurocents/kWh, just over half the top rate. However, he admits that the legal basis for the many developers grouping together 100 kW projects is not watertight and needs defining.



The PV-clad walls of a solar cell manufacturing plant in Malaga, Spain
ISOFOTÓN

The 100 kW limit, together with the PER target, will be tackled in the government's summer review of RD 436. Spanish renewables magazine, *Energías Renovables*, mentions rumours of government plans to remove the installed capacity limit for the top-rate tariff. However, there are no indications that the government is intending to adjust the tariff itself, either upwardly or downwardly. 'After two years in force and with growth below government provisions, a cut would make no sense at all,' says *Energías Renovables*' Pepa Mosquera. 'It would make even less sense considering the governments determination to correct Spain's soaring CO₂ emissions, in flagrant breach of its Kyoto commitment, which is one of the driving forces behind RD 436.' In the worse case of a tariff reduction, it would only affect new projects approved as of 1 January 2008. Earnings for existing installations and any developments licensed before that date cannot be affected. The problem is pushing new projects through the bottleneck and then finding the silicon to build them. Those issues alone are enough to keep the sector lobbyists more than busy for a good while to come.



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