



Activity Report 2009
ABENGOA

7.1 Solar

Abengoa Solar develops and applies solar power technologies in order to combat climate change and ensure sustainability through the use of proprietary Concentrating Solar Power (CSP) and photovoltaic technologies.

www.abengoasolar.com

International Presence



Key figures 2009

Revenue (M€)	116
Gross Cash Flows (M€)	73
Capacity of plants in operation and under construction (MW)	493
Capacity in advanced development (MW)	1,500
Patents requested since December 2007	55
Average number of employees	358
Hours of training	39,094

Our Business

In 2009, the solar electricity generation market continued to grow in many territories worldwide despite the gloomy economic backdrop:

- Various key markets introduced or bolstered existing regulations on the use of renewable energy, particularly solar. Prime examples of this trend are the United States, in which the new administration unveiled legislative changes, Spain, which introduced reforms relating to solar thermal energy; as well as markets with future potential, such as India and Australia.
- Construction of solar plants worldwide has reached around 6.8 GW in photovoltaic and 1 GW in concentrating solar power.

Although the financial crisis has delayed the start of new construction projects worldwide, there has been an improvement over recent months following the introduction of economic stimulus schemes, which should enable the sector to grow significantly in 2010.

Abengoa is convinced that solar energy can meet a significant part of society's demand for clean and efficient energy sources. Each year, the sun casts down on the earth enough energy to surpass the energy needs of our planet many times over, and there are proven commercial technologies available today with the capability of harnessing a portion of this energy in an efficient way. With this in mind, the mission of Abengoa Solar is to develop technologies and apply them to solar plants in order to generate clean solar power at prices that prove competitive with fossil fuels, bearing in mind the cost of emissions.



Abengoa Solar believes that solar energy can change the world and is committed to the following goals:

- Contributing to ensure that up to a 50 % of electricity comes from renewable sources in the countries where Abengoa Solar operates, by offering clean, efficient and manageable solutions.
- Developing the most efficient and easy to manage in a grid solar technologies.
- Efficiently operating a geographically and technologically diversified global portfolio of solar power assets.
- Attracting the very best in human talent.

Abengoa Solar is involved in five core activities:

- Plant operation and management.
- Plant engineering and construction through the use of proprietary technologies and always with the backing of a specialized construction company.
- Development of solar plants and installations, requiring the company to identify suitable sites, obtain the necessary licenses and finance the corresponding projects.
- Development of efficient technologies for generating solar energy, for which the company has its own R&D teams both in Spain and the U.S. and collaborates with leading research centers from around the world.
- Manufacture and supply of key components for plants in certain cases.

Abengoa Solar is committed to becoming a global company with local presence in those markets offering the greatest solar resource and potential for future growth. The company is currently organized around three key geographical areas:

- Spain.
- United States.
- International, particularly North Africa, the Middle East, India, China and Australia.

Abengoa Solar operates in a rapidly growing global market that promises to continue expanding by catering to the widespread need for clean energy solutions aimed at combating climate change and increased energy independence. This arises from the toll of the CO₂ emissions generated by fossil fuels, and the volatility and rising cost of, oil and gas.

Abengoa Solar customers are essentially electric utilities, public administrations, large companies that require technology or installations, and society in general as an energy consumer. With regard to the development, construction and operation of solar power plants, in certain countries, the customer is often an electric utility with which Abengoa Solar signs a long-term electricity supply agreement. In others, the customer is the local government and the network operator, or an electric company when different tariffs for solar power sales are in place.



The Abengoa Solar team has grown rapidly since the start of operations. This sharp jump is largely due to an increase in business and the consolidation and expansion of the company's project portfolio in various countries. During this period, Abengoa Solar sought to attract and develop the skills of the best human talent. In this regard, Abengoa Solar has implemented an integral and integrated management system composed of individuals charged with meeting the needs of both the employees and the company:

- Integral, in that it covers all human resource processes: identification, description and classification of jobs; selection process to attract the best professionals to be found in the market; training and development, including career plans, assessments, performance management and remuneration, all geared towards retaining talent; and also internal communication and social action.
- Integrated, in that it extends not only to interrelated processes, but also to the global nature of Abengoa Solar as a whole, encompassing numerous companies unrelated by sector, territory or business line. The human resources policy has been shaped from the mission, vision and values of Abengoa Solar, from the company's strategic objectives, and from implementation of its strategic plan.

Abengoa Solar has a risk analysis and management system that is used in each of its lines of business, and which hedges against five kinds of risk:

- Business.
- Regulatory.
- Financial.
- Credit.
- Operational.

Risk control at Abengoa Solar is based on two core priorities: corporate management systems and internal audit services.

The corporate management systems develop the internal rules governing Abengoa Solar and its chosen approach to assessing and controlling risk. The systems cover the entire organization at all levels of responsibility and for all kinds of operations.

The Internal Audit Services are in place to prevent the risks to which the different companies are exposed, and to control the application of the appropriate management procedures in accordance with the corporate management systems.

For a company such as Abengoa Solar, which is founded on the notion of sustainable development, the task of managing relations with the following stakeholders is of paramount importance:

- The local communities located in the vicinity of Abengoa Solar's electrical power plants. The company makes every effort to prevent any possible negative impact from its operations on such communities.
- Partners with whom the company collaborates on many of its projects.
- Customers and suppliers, who are required to bring their sustainability policies in line with those of Abengoa Solar. For example, all suppliers must calculate the emissions generated by the products and services they supply to Abengoa Solar. This information is, in fact, an important variable in the decision-making process.

During 2010, Abengoa Solar will continue to consolidate the strategy it has pursued in recent years, a process that will be key to implementation of the company's growth plan. The strategy will therefore continue to be founded on the cornerstones underpinning business at Abengoa Solar:

- Global presence, with special emphasis on the United States and Spain, but with ventures into other international markets which are already beginning to bear fruit.
- Bolstering the strategy of striking up alliances in plan development and operation.
- Controlled technological diversification as a platform to ensure the company's future capacity to compete effectively in terms of costs and its ability to offer a portfolio of solutions tailored to existing demand.
- Constant innovation, particularly for those technologies that Abengoa Solar has identified as key. This will be achieved through the company's own teams and via agreements with leading R&D institutions.

2010 is set to be a key year for the implementation of this strategy and for Abengoa Solar's expectations of further growth. The company's main objectives are as follows:

- To make Abengoa Solar the world's only solar energy company to be successfully operating both power tower technology and parabolic trough plants. This will become a reality following the start-up of the first Solnova plants at the Solúcar Platform.
- To expand operations on the international stage.
- To consolidate its leadership in those concentrating solar power and photovoltaic technologies that the company considers key.

2009 in Review



2009 was another key year in terms of business performance, with Abengoa Solar laying the foundations for healthy, sustained and global growth throughout all its business lines.

- The world's second power tower technology plant, PS20 (20 MW), was brought into operation
- Construction continued on the three 50 MW parabolic trough plants, located at the Solúcar Platform.
- Construction work got underway in Écija (Seville) on two 50 MW parabolic trough plants, Helioenergy 1 and Helioenergy 2 and in Extremadura on one 50 MW parabolic trough plant, Solabén 3.
- In the field of photovoltaic energy, the first 1.2 MW plant, Sevilla PV, has now completed its third year in commercial production, thereby demonstrating the commercial viability of the low concentration technology it utilizes. The 1 MW Copero plant in Seville is also in operation, as does the 1.9 MW Casaquemada PV plant in Sanlúcar la Mayor (Seville), the 1.9 MW Linares PV plant in Linares (Jaén) and the 5.7 MW Las Cabezas PV plant in Las Cabezas de San Juan (Seville), all of which reached expected levels of performance.



- On the international stage, Abengoa Solar made progress, along with Abengoa's industrial engineering and construction business units, on the construction of the world's first two Integrated Solar Combined Cycle (ISCC) power plants to incorporate a natural gas combined cycle with a parabolic trough field. These two plants are located in Algeria and Morocco.
- In the United States, the company continued to obtain the licenses needed to begin construction on a 250 MW (net) parabolic trough plant, which will be the world's largest. The plant, called Solana, will sell all the electricity it generates under a power purchase agreement to Arizona Public Service (APS), an electric utility.
- Another solar power supply agreement was signed in 2009 with California's Pacific Gas and Electric Company (PG&E), marking the start of the Mojave Solar Project, a 250 MW (net) plant featuring parabolic trough technology.
- The year also included various new projects for industrial solar energy installations to supply heat and steam to industrial customers, including a project at a coal power plant owned by Xcel Energy, Colorado's largest electric utility, and another project for the U.S. Department of Energy (DOE) at its facilities in Arizona.
- 2009 saw the company enhance its capacity in Spain to simultaneously operate and manage next year the two power towers currently in operation, the first parabolic trough plants and its photovoltaic plants.
- In R&D the Solúcar Platform consolidated its standing during 2009 as one of the world's leading centers in solar energy research. The platform currently features various groundbreaking and fully operational research facilities, including a high temperature power tower plant, a parabolic trough plant for direct steam generation, a heat accumulation demonstration project utilizing molten salt storage, a Stirling dish facility, various high concentration photovoltaic installations and a photovoltaic laboratory.
- Abengoa Solar has been using its two parabolic trough assembly factories to supply the entire solar field for the Solnova 1, Solnova 3 and Solnova 4 plants, each of which is 50 MW in capacity, and located at the Solúcar Platform in Spain.
- Abengoa Solar has signed an agreement to adhere to the Desertec Industrial Initiative project as a founding partner. The project has been designed to increase production of renewable energy in the desert regions of North Africa and the Middle East for local consumption and exportation to Europe.

Our Activities

Abengoa Solar possesses both know-how and technology in relation to power tower plants, parabolic trough plants, industrial heat and steam production facilities, photovoltaic solar power plants, with and without concentration, and in the manufacturing of key components.

Abengoa Solar is engaged in five core lines of business:

- Plant operation and management.
- Plant engineering and construction through the use of proprietary technologies and always with the unwavering backing of a specialized construction company.
- Development of solar plants and installations, requiring the company to identify suitable sites, obtain the necessary licenses and finance the corresponding projects.

- Development of efficient technologies for generating solar energy, for which the company has its own R&D teams in both Spain and the U.S. and collaborates with leading research centers from around the world.
- Manufacture and supply of key components for plants in certain cases.

MW	Spain	USA	International	Total
In operation	43	-	-	43
Under construction	300	-	150	450
Advanced development	1,000	500	-	1,500
Total	1,343	500	150	1,993

Abengoa Solar currently has a significant number of projects in each of its lines of business.

Plant Operation

Abengoa Solar currently operates roughly 43 MW in Spain.

PS10

The solar field has 624 heliostats, each spanning 120 m². The heliostats concentrate solar radiation onto a receiver located at the top of a 120 m tower to generate steam and power a turbine paired to an electrical generator connected to the electricity grid.

The plant generates enough clean energy to meet the needs of 5,500 households while cutting yearly CO₂ emissions by 6,700 t. The plant also boasts an energy storage system of nearly one hour in duration, enabling it to manage sporadic cloudy spells without having to shut down and then restart the plant. It is the world's first solar power plant to incorporate a power storage system.

In June 2007, the plant successfully underwent its first operational testing and continued to operate successfully in 2008 and 2009. Ever since its start-up, PS10 has borne witness to the viability of power tower technology, while acting as a learning tool to improve future plants built with the same technology.

PS20

This plant has benefitted from the extensive experience of Abengoa Solar in constructing and operating this type of plant and incorporates numerous design improvements, making it more efficient than PS10. These enhancements include a more efficient receiver and numerous improvements to the control and operation systems and the thermal energy storage system. The plant was constructed by Abener, the Abengoa group company that specializes in "turn-key" contracts.

With 20 MW of capacity, the PS20 plant supplies 10,000 households and slashes yearly CO₂ emissions by 12,100 t. The Solúcar Platform's second power tower plant incorporates 1,255 heliostats designed by Abengoa Solar. Each heliostat measures 120 m² and reflects the solar radiation it receives onto a receptor located on the 165-m high tower, thereby enabling the plant to produce the steam required to generate electricity in the turbine.



Sevilla PV

The world's first commercial plant to feature low-concentration photovoltaic technology. With a capacity of 1.2 MW, the plant is located at the Solúcar Platform in Sanlúcar la Mayor, Spain.

Sevilla PV has 154 solar trackers on a plot of land spanning 30 acres.

The plant is able to generate 2.1 GWh of clean energy per year, enough to supply approximately 650 households and curb yearly CO₂ emissions by 1,800 t.



Copero PV

This plant is effectively a series of ten photovoltaic installations with a combined capacity of 1 MW, all located on the site of Emasesa's Wastewater Treatment Plant (WWTP) at the El Copero site, within the municipal district of Dos Hermanas (Seville). Emasesa and Abengoa Solar are each 50 % owners of the plant.

Las Cabezas PV

5.7 MW photovoltaic plant with one-axis trackers located in an area of high solar radiation in the province of Seville.

Casaquemada PV

A 1.9 MW plant employing two-axis photovoltaic tracking technology situated at the Solúcar Platform. It includes a 100 kW high-concentration installation with latest generation technology.



Linares PV

1.9 MW photovoltaic plant with two-axis trackers located in Jaén.

Plant Construction

Abengoa Solar currently has seven plants under construction with a total capacity of 450 MW.

Solnova 1, Solnova 3 and Solnova 4 plants at the Solúcar Platform

During 2009, Abengoa Solar made further progress in constructing the first three parabolic trough plants at the Solúcar Platform (Seville): Solnova 1, Solnova 3 and Solnova 4, each with 50 MW of capacity. The construction companies for all three plants are Abener and Teyma.

The chosen technology concentrates solar radiation through high precision curved mirrors onto a heat absorbing tube containing a fluid that is heated to high temperatures. The fluid allows the plant to generate steam, which is then sent to a turbine generator, where it is used to produce energy.

Each plant boasts 54,000 m of collectors. One collector has 6 m of aperture and a surface area of close to 150 m². Each plant takes up an area spanning 300 acres and is able to generate enough energy to supply roughly 26,000 households, while cutting yearly CO₂ emissions by roughly 31,000 t.

Solnova 1 is currently going through its start up following completion of the construction work.

Significant progress has been made on the construction of Solnova 3 and Solnova 4, which will begin operating during 2010.



Helioenergy 1 and 2 plants at the Écija Platform

50 MW concentrating solar power plants with parabolic trough technology under construction within the municipal district of Écija (Seville).

When the plants are brought into operation, each will be able to supply approximately 26,000 households while curbing yearly CO₂ emissions by 31,000 t.

To construct and operate both plants, Abengoa Solar forged an alliance with E.ON Climate and Renewables, which will invest approximately €550 M in the two plants. start-up is scheduled for 2011 and 2012 respectively.

Solabén 3 at the Extremadura Platform

50 MW concentrating solar power plant with parabolic trough technology under construction within the municipal district of Logrosán (Extremadura).

The World's First Integrated Solar Combined Cycle Solar Plant in Algeria

During 2009, Abengoa Solar continued work on the parabolic trough plant at Hassi-Rímel. The Industrial Engineering and Construction business unit, Abengoa Solar and Neal (New Energy Algerie) are all involved in this particular project.

The project includes the design, construction and operation of a 150 MW hybrid combined cycle plant, 20 MW of which will be provided by a solar field of over 180,000 m² of reflective area.

Development of Solar Power Plants

Abengoa Solar has hundreds of MW under development around the world.

Development in Spain

Over recent years, Abengoa Solar has channeled much of its time and resources into developing solar power plants in Spain. As a result, it currently has a portfolio of roughly 1,000 MW in different stages of development, 350 MW of which have already been filed with the "power register" (registro de potencia) of the Spanish Ministry of Industry, Tourism and Trade, therefore, have all the licenses required to commence construction.

Ciudad Real Platform (100 MW)

Abengoa Solar has two 50 MW concentrating solar power plants in the province of Ciudad Real (Castilla-La Mancha), both equipped with parabolic trough technology. Both projects are duly included in the Spanish power registry and Abengoa Solar plans to begin construction in 2010.

When they are brought into service, each plant will be able to supply approximately 26,000 households, while curbing yearly CO₂ emissions by 31,000 t.

Córdoba Platform (100 MW)

The Córdoba Platform includes two 50 MW concentrating solar power plants utilizing parabolic trough technology. Abengoa Solar hopes to begin construction during 2010, as both are already filed with the Spanish power registry.

Extremadura Platform (150 MW) + 50 MW

Four concentrating solar power plants are under development in the province of Cáceres and have already been recorded with the Spanish power registry, allowing the company to begin construction work in 2010 and 2011. We are beginning the construction of the first plant.

The other 650 MW under development are at different stages of completion, and encompass both concentrating solar power and photovoltaic technologies. Most of these remaining plants will be built following the introduction of the new regulatory framework in 2012.

Development in the United States

Abengoa Solar has an 80-person team working out of the four company offices located in the United States, where the company has been developing projects since 2006.

Solana - 250 MW

Concentrating solar power plant under development in Arizona, with parabolic trough technology, 280 MW (gross) and 250 MW (net) of capacity and thermal storage.

Abengoa Solar signed a power purchase agreement in 2008 with Arizona Public Service (APS), Arizona's largest electric utility.

When it begins operation, Solana will be capable of supplying energy to 70,000 households while preventing the emission of roughly 400,000 t of CO₂.



Mojave Solar - 250 MW

250 MW (net) concentrating solar power plant equipped with parabolic trough technology under development in California.

Abengoa Solar signed a power purchase agreement in 2009 with the electric utility, Pacific Gas & Electric Company (PG&E).

When it is brought on line, Mojave Solar will be able to supply energy to 90,000 households, while cutting yearly greenhouse gas emissions (GHG) by 431,000 t.



Industrial Projects

Abengoa Solar develops, designs and constructs small and large-scale customized installations.



Industrial solar thermal installations employ parabolic trough technology, which not only produces electricity but is also ideal for generating thermal energy (heat and steam) for industrial processes. The main advantage that this technology offers is that it can be adapted to different needs, while also helping to cut CO₂ emissions, given that industry is one of the primary sources of these gases.

Following are two industrial solar thermal installation projects performed by Abengoa Solar during 2009:

- The industrial solar thermal installation integrated into a coal power plant owned by Xcel Energy (Colorado). The project, which will begin construction in 2010 at the Cameo coal power plant (Colorado), will demonstrate that the heat produced by a solar power installation can actually enhance the efficiency of a conventional power plant while reducing its CO₂ emissions.
- The industrial solar thermal installation under development for the U.S. (DOE) in Arizona. The purpose of the facility, which was brought into operation in January 2009, is to produce additional heat to replace coal-generated heat. This is then used to treat the water contaminated by an old uranium processing plant.

International Development

Outside Spain and the United States, Abengoa Solar has teams able to offer the best possible energy solution to every need in those markets it considers attractive due to their high levels of solar radiation and regulatory control. Abengoa Solar currently has a number of projects under development in various countries and regions, including North Africa, the Middle East, India, China and Australia.



Development of New Technologies

For Abengoa Solar, developing and making improvements to new solar technologies is a priority. The company's overriding objective is to offer technologies capable of generating clean energy at prices that prove competitive with fossil fuels, after considering the cost of their emissions. To make this a reality, Abengoa Solar has rolled out an ambitious research and development plan and channels its activities through a team of over 80 people belonging to the company Abengoa Solar New Technologies, with research centers in Seville, Madrid and Denver (Colorado). The Abengoa Solar team is involved in the two key technologies: high-temperature concentrating solar power and photovoltaic.

During 2009, Abengoa Solar continued to grow and hone its abilities in the main areas of research, while forging collaborations and alliances with leading universities and institutes worldwide (Ciemat, Centro de Investigaciones Energéticas, Medio Ambientales y Tecnológicas, in Spain, NREL, National Renewable Energy Laboratory, in the U.S., DLR, Deutschland für Luft-und Raumfahrt and Franhoufer in Germany and Cnrs Centre national de la recherche scientifique, in France) and constructing pilot facilities to test new technologies under real operating conditions. During 2009, Abengoa Solar conducted various R&D projects with the backing of the U.S. Department of Energy, while also continuing work on a project within the seventh framework program of the European Union and on the ConSOLI+Da project against the backdrop of the Cenit (Consortios Estratégicos Nacionales en Investigación Técnica) programs in Spain. These projects will allow Abengoa Solar to enhance its knowledge of new technologies and make improvements to existing technology.

Abengoa Solar's approach to R&D involves four stages:

- Stage 1, the project is defined and preliminary research work conducted.
- Stage 2, the solution is analyzed and modeled from a theoretical standpoint.
- Stage 3, a prototype or demonstration plant is constructed.
- Stage 4, the demonstration system is analyzed and validated before moving on to the commercial stage.

Our teams of researchers focus on five priorities:

- Improving existing parabolic trough technology by developing new collectors, using new fluids and improving site operations.
- Developing new solar power tower technologies.
- Developing new energy storage technologies.
- Developing and testing concentrating photovoltaic technologies.
- Developing certain thin-film photovoltaic technologies.



Abengoa Solar currently has various pilot plants in operation at the Solúcar Platform:

- Parabolic trough pilot plant in service since 2007, which was used in 2009 to test various improvements to the control and operating systems of the commercial plants. The facility has enabled the company to optimize the technology being used at the Solnova 1 and 3 plants and to be used in future plants, and to pinpoint possible improvements to the optics and components, including structures, supports, mirrors, ball joints, flexible joints and tubing. The company has also been designing, testing and validating new parabolic trough collectors, including the ASTRØ collector in Spain, allowing for significant reductions in costs and manufacture time, simplifying transportation, and facilitating and reducing on-site assembly costs. Meanwhile, in the United States, Abengoa Solar has been developing new collector designs in collaboration with National Renewable Energy Laboratory (NREL).

- Parabolic trough plant that uses water instead of oil as its fluid. Construction was completed and the plant was started up and tested during 2009. This new technology enable the company to cut construction costs and increase system efficiency in comparison to the oil-based technology in current use.
- Second generation superheated steam power tower. Construction was completed toward the beginning of 2009 and testing has continued since then on the initial receiver and superheated steam. The power tower, which benefits from the knowledge acquired from PS10 and PS20, will enable Abengoa Solar to test its second generation of power towers, which generate superheated steam and are set to become significantly more efficient when the technology becomes commercial.
- Demonstration Stirling dish facility, with which Abengoa Solar expects to acquire direct knowledge in designing, constructing and operating this kind of technology with a view to assessing its future potential. The Stirling dishes have the advantage of their modularity and the fact that they can be used for distributed generation, as no turbine is required. The downside is that their associated costs are currently much higher than those of other technologies.
- Thermal storage plant with molten salt technology in operation, underwent testing in 2009 to test various technological improvements. Storage is key to increasing the availability of concentrating solar power. High-temperature concentrating solar power enjoys a considerable advantage over other renewables in that it is manageable, either via hybridization with other energy sources or through the use of storage systems.

In the field of photovoltaics, Abengoa Solar also has a number of installations incorporating new technologies at the Solúcar Platform:

- High concentration photovoltaic demonstration installations. Photovoltaic technology is a highly efficient means of meeting certain generation needs. It is therefore crucial for Abengoa Solar to develop efficient photovoltaic technologies, and for this reason the company is continuing work on numerous concentration systems.
- Photovoltaic laboratory, where Abengoa Solar measures, characterizes and analyzes modules of all the different technologies under real operating conditions with and without solar tracking. The purpose of this project is to create an experimental tool with which to analyze the energy production costs of different technologies and configurations, prevent and troubleshoot problems over the life of the photovoltaic systems and pinpoint the optimum technology and configuration for different types of installations. The photovoltaic laboratory has the facilities and equipment required to measure and characterize photovoltaic devices and systems.

2009 proved to be a critical year in which Abengoa Solar underscored its commitment to R&D in solar energy by bolstering its human teams, capacities, collaborations and alliances. 2010 will also be a key year in which the company intends to make further progress in its new priorities to guarantee a future of clean and efficient solar energy.

Supply of Key Components

Ensuring a reliable supply of high-quality key components is essential for Abengoa Solar. This often takes the form of framework supply agreements through which the company is able to showcase its sharp purchasing skills, while at other times the company actually manufactures the key components itself, either at its own facilities or with partners.

For power tower plants, Abengoa Solar designs its own heliostats and manufactures them at proprietary or third-party facilities. As for the receivers, it collaborates with specialist companies to manufacture the designs required for each of its plants.

For parabolic trough solar power plants, Abengoa Solar designs its collectors, which are manufactured by its subsidiary companies. They are then assembled at the assembly facilities located on site at the plants.

The parabolic trough mirrors are manufactured by the company Rioglass Solar, with which Abengoa Solar signed a commercial agreement for the supply of this key component, the quality of which far outstrips that of other mirrors available on the market. This has effectively led to lower assembly costs and fewer breakages on site.

On a final note, in 2009, Abengoa Solar was able to secure a large part of its future receiver tubing needs for its projects in Spain.