

Solucar Energía is its holding company. This Business Unit's activity focuses on the design, promotion, finance attainment, construction and operation of electric energy generating plants that utilize the sun as their primary energy source. It possesses the know-how and technology required for thermoelectric solar power plants: plant receiver systems, parabolic cylinder and parabolic dish collectors, and for photovoltaic plants, with and without concentration.



With the sun...  
we produce thermoelectric  
and photovoltaic electric  
energy

Leader on the home market in  
electricity generation from solar energy,  
with a development plan for more than  
300 MW over the next few years

As a result of more than twenty years investing in solar energy research and development projects, Abengoa has established a specific business unit called Solucar to conduct its solar energy electricity generating activity.

Abengoa, through Solucar, currently occupies a privileged position in the solar energy exploitation sector as it has compatibilized, during the course of its activity in this field, the dedication to the two technologies that allow electricity generation utilizing solar energy: thermal and photovoltaic technologies. In the respect, Solucar is currently capable of designing, constructing and operating efficient and dependable solar thermal power plants with central receiver systems (tower and heliostats), and also with parabolic trough collector systems. Moreover, the company is vastly experienced in the development of photovoltaic projects, with and without concentration, that directly convert solar radiation into electricity through the use of photovoltaic cells and modules.

Within this new business unit, design, promotion, construction and operation activities are being conducted for energy production plants that utilize the sun as their primary energy source. In addition, research and development activities are being carried out on solar technologies to achieve continuous reduction of costs for general improvement of existing technologies.

During the course of 2006, the promotion and construction activities related to solar thermal and photovoltaic power plants were consolidated in Spain, while the first international projects were undertaken. In forthcoming years, we expect continuous growth in the promotion and construction activity in Spain and in the international market too, and we also expect to be able to offer more efficient in-house technologies in both solar thermal and photovoltaic fields.

Solucar is formed by several companies:

- Solúcar Energía: It promotes, constructs and operates, in Spain, electric energy production plants that utilize the sun as their primary energy source.



- Solúcar PV: Its activity focuses on the promotion, construction and operation of solar photovoltaic power plants in Spain.
- Solúcar R&D: A company dedicated to the design, research and development of new thermal and photovoltaic technologies.
- Solúcar Inc: A recently constituted company responsible for developing the solar business in the United States.
- Solúcar Solar: It concentrates the resources dedicated to the development of new businesses.





### Promotion in Spain (Solúcar Energía and Solúcar PV)

In Spain, Solucar operates with two clearly differentiated solar technologies, as in the case of solar photovoltaic energy and solar thermal energy, and possesses an extensive MW output portfolio in both technologies.

Solucar's main activities are dedicated to the promotion of projects and the obtaining of permits up to financial closure stage, the construction of plants with supervision of the turnkey contracted works and operation of plants in production.

Over the next eight years, plans are for a Solar Platform is to be constructed in the vicinity of Sanlúcar la Mayor (Seville). This complex of solar thermal and photovoltaic facilities will eventually exceed 300 MW output. The company is thereby putting its trust in the potential of solar energy for electricity production purposes, while also contributing to sustainable development and conservation of the environment and natural resources.

The most important references in 2006 are those related to the construction, and start-up of the first commercial solar thermal power plant in Europe, PS10; the commencement of the construction of PS20; and the advance in Solnova 1 and Solnova

3 promotion operations. The last two are 50 MW parabolic trough power plants on which construction is scheduled to commence in 2007. Also of note is the signing of an agreement with Sepides and the IDEA for the joint development a 20 MW plant in Almacen. As regards photovoltaic energy, several facilities have been, or are being, constructed in the south of Spain. In addition, Solucar continues to work on the development of new sites for new solar thermal and photovoltaic power plants that will expand its project portfolio.

### Solar thermal technology projects PS10 Power Plant

On June 28, 2004, the foundation stone laying ceremony for the PS10 power plant took place and work continued throughout 2005 on the construction and assembly of the different components. The site of the solar facilities is within the property of the Sanlúcar la Mayor solar platform, in the province of Seville (Spain). During 2006, construction of the PS10 plant was completed and the testing stage thereof commenced towards year-end.

The 11.0 MW rated, PS10 plant, has been designed to supply approximately 6,000 homes under the Special Regime for electricity production, and it will also prevent the emission of 18,000 tons of CO<sub>2</sub> per year.



PS10 comprises a large field of heliostats, mobile mirrors that reflect and concentrate solar radiation onto a receiver on top of a 115 m tower. Each one of the 120 m<sup>2</sup> reflective area heliostats reflects a cavity of approximately 200 m<sup>2</sup> of water cooled energy exchange surface area onto the receiver; the thermal energy required to produce steam. This is forwarded to the turbine where it expands to generate, by means of the corresponding connection to an alternator, the electricity.

Following several years of Research and Development by Abengoa, this project represents the launching of the technology known as tower and heliostat field employed for electric exploitation of the renewable solar resource. The main contribution by the PS10 project to the development of this technology is the fact that it is the first solar thermal power plant in the world that will produce electricity in a stable and commercial manner.

This project has become a reality thanks to the collaboration received from public and private institutions including, among others, Ciemat, the IDEA, and the University of Seville.

### PS20 Power Plant

Once all the necessary permits had been obtained, work commenced during the second half of 2006 on the construction of the PS20 power plant. This plant is the second with tower and heliostat field technology to be included in the Sanlúcar la Mayor Solar Platform, and will have twice the PS10 output.

The solar radiation capturing area comprises more than 1,000 two-axis sun tracking heliostats, each of 120 square meters. This field of heliostats will concentrate solar radiation onto the receiver on top of a tower approximately 165 meters high.

The plant's electricity production capacity will enable energy supply to approximately 12,000 homes and will prevent the emission of a million tons of CO<sub>2</sub> over its 25-year useful life. This project represents continuity in the launching of tower and heliostat field projects, following the experience gained



from the PS10 project. In fact, PS20 represents a second generation of this technology with important improvements to critical elements such as the receiver, which will enable progression to more efficient tower technology plants in the future.

### Solnova One and Three Power Plants

Early in 2007, work will commence on the construction of the 50 MW rated Solnova One solar thermal power plant that will utilize parabolic trough collector technology. It will comprise a large field of collectors, designed by Solucar, that reflect and concentrate the solar radiation they receive onto an axis in which the heat-carrying fluid circulates.

The steam produced is then forwarded to the turbine where it expands, by means of the corresponding connection to an alternator, to generate electric energy. In addition, the plant will have a thermal storage system that will contribute stability for energy production.

Construction is scheduled to begin early in the second half of 2007 on the Solnova Three power plant, of the same technical characteristics as Solnova One. Both plants will form part of the Sanlúcar la Mayor Solar Platform.



### Almaden 20 Power Plant

During the second half of 2006, the company Almaden Solar was jointly constituted with Sepides, a subsidiary of the SEPI Group responsible for business development, and the IDEA, the Ministry of Industry's Institute for Energy Diversification and Saving.

The Almaden Solar project contemplates the development of a 20 MW tower technology solar thermal power plant in the municipal district of Almaden. The power plant, with a configuration very similar to the PS20 plant already under construction in Seville, will consist of a field of more than 1,000 heliostats that will enable concentration of the solar radiation received onto a receiver located on the upper part of a 155 meter tower.

The construction and operation of this plant will contribute greatly to strengthening industrial development and employment in the area, as estimates are for the creation of 250 to 300 local jobs per year associated with the manufacturing and construction stage, and a further 25 jobs for operation and maintenance of the plant over its 25-year useful life. This will contribute to the industrialization of an area that is in search of initiatives to activate its development.

The entry into operation of this plant will contribute to the generation of clean electricity to supply a total of 12,000 homes while also preventing the annual emission of 35,100 tons of CO<sub>2</sub>.

### Solar photovoltaic technology projects Sevilla PV

Solucar has constructed, together with the IDEA which holds a 20% stake, the first commercial photovoltaic power plant, with concentration, in Europe. Early in 2006, works were completed on the engineering, connection of the project's most important supplies, photovoltaic modules, inverters, mirrors and trackers and field assembly of all the equipment, up to connection to the grid. The plant was brought into operation in July 2006.



The 1.2 MW Sevilla PV solar photovoltaic power plant utilizes low concentration (1.5X and 2.2X) and two-axis sun tracking concepts. It will produce electricity and prevent emission into the atmosphere of 1,800 tons of CO<sub>2</sub> per year, which means it will have prevented the emission of 45,000 tons of CO<sub>2</sub> at the end of its useful life, estimated to be 25 years. With the data collected, electricity production from this plant at the end of December 2006 had successfully met production estimates.

The Sevilla PV power plant has 154 tracking devices, each with an opening of 100 m<sup>2</sup>, that combine in almost equal parts the capturing area of photovoltaic modules and mirrors. The facility is included in the Sanlucar la Mayor Solar Platform complex.



### Other photovoltaic projects

During 2006 and 2007 work has been and will continue to be carried out on the construction, together with Emasesa, the city of Seville water management company, of several photovoltaic plants (Copero). Moreover, in 2007, work will commence on the construction of several plants at the Sanlúcar Solar Platform complex and in other locations in the south of Spain.

### International Promotion

In 2006, Solúcar began to develop its first activities outside Spain and, to-date these have resulted in two projects:

- The setting up of a small team in the United States responsible for developing the Solar business. With the objective of achieving rapid implantation, several people with a long history in the American solar thermal market have joined Solúcar and the business of the company IST dedicated to the design and installation of parabolic trough collector systems to supply steam to industries and large buildings was acquired. This system can also be used to provide solar origin air-conditioning.
- Solúcar will participate in the construction and operation of the first combined gas-solar power plant that Abengoa will construct in Algeria.

### R&D&I Activities (Solúcar R&D)

Throughout 2006, the development of R&D&I projects under way continued and new lines of technological research and development were launched. In addition, the execution of a series of demonstration and experimentation construction projects was undertaken.

#### Demonstration and Experimentation Projects

##### Parabolic trough demonstration facility:

During 2006 and early 2007 work has continued on the construction of a demonstration facility for parabolic trough collectors that utilize oil as their thermal fluid. This facility will serve for the conducting of a series of projects focused on improving Solúcar's parabolic trough collector technology.



#### Installation of 7 Stirling Dishes (Azna collar TH):

In 2006 and 2007, seven in-house design Stirling Dishes are being installed at the Sanlúcar Solar Platform complex. These 7 dishes will serve to prove the efficiency and durability of different designs and components.

#### Solar Thermal Concentration R&D&I Projects

**E-2:** Design and testing of a new parabolic trough collector that is more efficient than that currently in use.

**Medcal:** Systems to Improve the Precision of Sun Targeting, and Increase Efficiency in Solar Power Plants.

**Almería Solar GDV:** A 5 MW Parabolic Trough Collector Plant with Direct Steam Generation, in Almería.

#### Photovoltaic R&D&I Projects

**Fresnel PV-5x:** Development of the Medium Concentration Photovoltaic Concept at Values between 5X and 10X.

**CAC-30x:** Development of a Controlled Atmosphere Photovoltaic Concentrator of around 30X.

**Hicon PV:** Development of a High Concentration Photovoltaic Concentrator (1,000X).

