06.4 Operation and maintenance

Abengoa has an impressive portfolio of proprietary assets in the field of operation and maintenance. These range from assets under concession, where revenues are governed through long-term contracts, to technology-heavy business lines, such as biofuels.

Key financial figures	2012	2013	2014	Chg. 14-13 (%)
Revenue (€ M)	2,496	2,413	2,636	9 %
EBITDA (€ M)	303	461	602	31%
EBITDA margin (%)	12	19	23	21%

Key figures - Power transmission	2012	2013	2014	Chg. 14-13 (%)
Km constructed	1,476	1,723	2,375	38 %
Average availability factor (%)	99.4	99.8	99.5	–

Key figures - Solar	2012	2013	2014	Chg. 14-13 (%)
Plants in operation (MW)	743	1,223	1,503	23 %
Plants under construction and in pre-construction (MW)	910	640	580	(9) %
Production (GWh)	964	1,310	1,959	50 %

Key figures - Water desalination, treatment and reuse	2012	2013	2014	Chg. 14-13 (%)
Installed capacity (m^3/d)	565,000	665,000	815,000	23 %
Annual production (m^3)	107,469,355	112,379.632	123,954.585	10 %

Key figures - Cogeneration	2012	2013	2014	Var. 14-13 (%)
Installed electricity capacity (MWe)	70.6	348.4	348.8	–
Installed thermal capacity (MWt)	142.9	1,156	1,156	–
Annual electricity generated (MWh)	345,231	2,054,791	2,617,541	27 %
Annual thermal power generated (MWh)	238,703	3,204,345	4,440,381	39 %

Key figures - Bioenergy	2012	2013	2014	Var. 14-13 (%)
Installed capacity (ML)	3,175	3,175	3,175	–
Annual production (ML)	2,516	2,357	2,655	13 %
Installed electricity capacity (MWe)	1,316,500	1,643,400	1,643,400	–
Annual electricity generated (MWh)	1,548,416	1,335,384	1,579,863	18 %

Solana, with an installed capacity of 280 MW, is the world's largest parabolic trough facility.

Solar Energy

Abengoa has an installed capacity of 1,503 MW in commercial operation, with a further 360 MW under construction and 220 MW in pre-construction.

United States

Solana

In 2014, Solana celebrated its first full year of successful commercial operation. The facility offers enough clean, non-polluting energy (generating no greenhouse gases) to meet the energy demands of 70,000 homes. In just one year, it has managed to cut yearly CO_2 emissions by nearly half a million metric tons.

Its installed capacity of **280 MW** makes it the **world's largest parabolic trough plant**. The facility also boasts a six-hour molten salt thermal storage system, enabling it to generate energy both day and night to bring production in line with demand.

Mojave Solar

Located 150 km north-east of Los Angeles, close to Barstow, California, the Mojave Solar plant was brought online in 2014. This **280 MW parabolic trough plant** generates enough clean energy to power over 54,000 households, while cutting yearly CO_2 emissions by over 350,000 metric tons.

Mojave Solar, the world's second largest parabolic trough plant, was brought online in 2014

Europe

Solucar Complex

The Solucar Complex houses a number of plants that are not only commercially operational but also engaged in technology innovation. The platform features the world's first two solar power towers to have been brought online, along with **three parabolic trough plants and two photovoltaic plants**. In total, these installations provide a combined installed capacity of approximately **183 MW**. Moreover, the complex brings together numerous research, development and innovation facilities, including two pilot power tower plants, various loops for testing out parabolic trough technologies and other pilot plants testing a number of different technologies. All these structures were built and operate independently.

Thanks to the experience Abengoa has gained in the operation and maintenance of the seven commercial plants at the Solucar Complex, it has become an undisputed leader in the management of solar power plants.

Extremadura Solar Complex

2014 marked the first year of successful commercial operation of Solaben 1 and Solaben 6, two of the four 50 MW parabolic trough plants making up the Extremadura Solar Complex. All of the plants were constructed and currently operate independently. It is the **biggest solar complex in Europe** and one of the largest in the world, with 200 MW of installed capacity and enough total production to meet the power needs of roughly 105,000 homes. At the same time, it has helped cut yearly CO_2 emissions by approximately 126,000 metric tons.

Abengoa holds a stake of 70 % in Solaben 2 and Solaben 3, while the Japanese giant ITOCHU controls the remaining 30% of the two plants. In contrast, Abengoa is the full owner of Solaben 1 and Solaben 6.

1. The Solúcar Complex is a unique technology center in that it houses all types of solar technology used at commercial plants, pilot plants and R&D+i laboratories.
2. The Extremadura Complex is Europe's largest solar power platform.

Écija Solar Complex

The complex is home to **two 50 MW parabolic trough plants**: the Helioenergy 1 and Helioenergy 2 plants, both of which were constructed and operate independently and are operated jointly by Abengoa and E. ON.

The Écija Platform is operated jointly by Abengoa Solar and E.ON.

Castilla-La Mancha Solar Complex

The complex, which is nestled between the municipalities of Arenas de San Juan, Villarta de San Juan and Puerto Lápice in the province of Ciudad Real, features **two identical 50 MW parabolic trough plants**, each built and operating independently.

The Castilla-La Mancha Solar Platform features two 50 MW parabolic trough plants, each of which was built and operates independentlysedit

El Carpio Solar Complex

The complex houses **two 50 MW parabolic trough plants**, both of which were built and operate independently. Both plants are jointly owned by Abengoa and the Japanese conglomerate JGC. Abengoa, which operates both plants, holds a 74 % stake.

The Solar El Carpio Platform has helped cut annual CO_2 emissions by 62,800 tons

Photovoltaic plants

Abengoa has five commercially operating photovoltaic plants in Spain:

- Las Cabezas PV, featuring conventional photovoltaic technology and single axis tracking, is located in Las Cabezas de San Juan, Seville.
- Sevilla PV, a photovoltaic plant utilizing low-concentrating technology (1.5x-2.2x) and dual-axis trackers, is located in Sanlúcar la Mayor, Seville.
- Casaquemada PV combines concentrating and conventional photovoltaic technologies, employing a dual-axis tracking system. The facility is located in Sanlúcar la Mayor, Seville.
- Copero PV, a conventional silicon photovoltaic plant with dual-axis tracking, is located just outside Dos Hermanas, Seville.
- Linares PV, a conventional photovoltaic plant with dual-axis tracking, is located in the province of Jaén.

Africa

KaXu Solar One

KaXu Solar One, **a 100 MW parabolic trough plant with nearly three hours of thermal storage based on molten salts**, was completed towards the end of 2014. Thanks to its storage capabilities, the facility is able to generate clean energy between dusk and dawn. The project has also boosted the region's economy and social status by expanding the network of local services. Abengoa is joined by IDC and KaXu Community Trust as partners on this venture.

Construction of KaXu Solar One was completed in 2014 and the plant will begin operating commercially in early 2015

North Africa and the Middle East

Shams-1

Shams-1, the **first solar thermal plant to be built in the Middle East**, with 100 MW of installed capacity, celebrated its first year of successful operation in 2014. It generates enough clean energy to meet the power demands of 20,000 homes. Abengoa owns a 20 % stake in the plant.

Shams-1, the Middle East's first solar thermal plant, celebrated its first year of successful operation in 2014

Hassi R'Mel

Abengoa operates this 150 MW **integrated solar combined cycle power plant** out of Hassi R'Mel, Algeria. It is one of the world's first integrated solar-gas power plants. Abengoa is a pioneering figure in the construction and operation of solar power plants in the north of Africa. It shares ownership of the plant with one other partner, NEAL (New Energy Algeria).

Hassi R'Mel is one of the world's first integrated solar-gas combined cycle plants

Other sources of power generation

Uruguay

Abengoa has commenced operation of **two 100 MW wind farms** in Uruguay. The company has been awarded the operating concession of these assets for 20 years.

Photo of the Peralta wind farm. Abengoa has started up a 50 MW wind farm in Uruguay

Mexico

The company operates the **country's biggest cogeneration plant** at full capacity (300 MW), supplying electricity and steam to the Nuevo Pemex gas processing complex. The plant is currently being upgraded to generate 1,245 MW. Abengoa is to operate the asset for 20 years.

The company has also secured a contract to construct a second **924 MW combined cycle facility** and will also handle the operation and maintenance for a 25-year term.

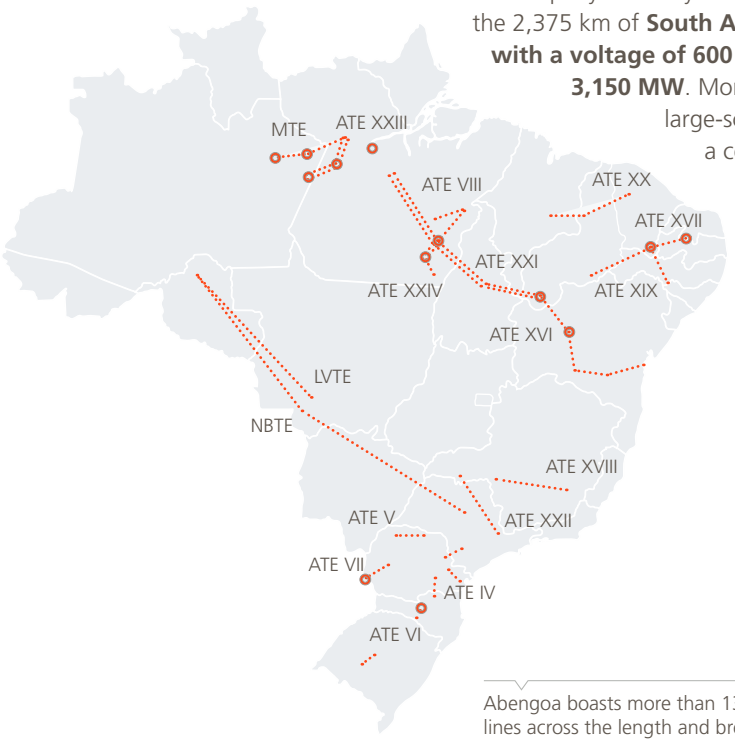
Power transmission lines

Abengoa is **one of the leading private concession holders in Latin America**, with a grand total of 12,000 km of transmission lines across Peru, Chile and, above all, Brazil.

Brazil

The Brazilian government's decision to greenlight the private venture to develop the country's massively important power transmission line network has made Abengoa **one of the main private power line concession holders** in the country.

The company currently has 1,100 km of lines in operation, plus the 2,375 km of **South America's longest direct current line, with a voltage of 600 kV and a transport capacity of 3,150 MW**. Moreover, the company is working on ten large-scale power transmission projects for a combined total of 7,200 km, with the average contract length for operation of the assets being 30 years.



Abengoa boasts more than 13,000 km of finished lines across the length and breadth of Brazil

Abengoa has brought the world's longest direct current power line online

Abengoa operates the Peru's longest power transmission line

Peru

The country has a similar regulatory set-up to Brazil and Abengoa is one of the most active companies in developing the nation's power network, where it already operates 1,500 km of transmission lines.

2014 witnessed the operational **start-up of the country's longest power transmission line**, spanning 916 km at 500 kV. The line will improve the lives of five million people, and is a further addition to the 583 km of line that the company was already operating in Peru, together with the close to 500 km of line already under construction.

Chile

Abengoa operates two power transmission lines spanning **130 km** in Chile's second region, which supply energy to the Sierra Gorda mining facility.

India

Abengoa has been awarded its **first contract** for a transmission line venture in India. The company will be tasked with the engineering, construction, start-up, and subsequent 25-year operation and maintenance of 134 km of power line. The project will improve the lives of 10 million people.

Water desalination, treatment and reuse

Africa

Skikda (Algeria)

Desalination plant that supplies drinking water to the port of Skikda, which lies on the Mediterranean coast some 80 kilometers west of Annaba, Algeria. It is the first concession-based project to have been undertaken in Algeria. The facility has an installed capacity of 100,000 m^3/day and supplies fresh water to half a million people. It has been in operation since 2009 and employs reverse osmosis technology.

The Skikda desalination plant (Algeria), with a capacity of 100,000 m^3/day, has been in operation since 2009

Honaine (Algeria)

This desalination plant takes in seawater to generate drinking water for the city of Tlemcen Honaine. The facility has an installed capacity of 200,000 m³/day and supplies fresh water to nearly one million people. It has been in operation since 2011 and employs reverse osmosis technology.

1. The Honaine desalination plant (Algeria), with a capacity of 200,000 m³/day, has been in operation since 2011

2. The Chennai desalination plant (India), with a capacity of 100,000 m³/day, has been in operation since 2010

3. The Qingdao desalination plant (China), with a capacity of 100,000 m³/day, has been in operation since 2013

1

Asia

Chennai (India)

The Chennai plant, located in the Indian state of Tamil Nadu, generates 100,000 m³/day of desalinated water to supply the city of the same name, and has been in operation since 2010. It employs reverse osmosis technology.

2

Qingdao (China)

Seawater desalination plant for both industrial processes and human consumption close to the city of Qingdao. It has an installed capacity of 100,000 m³/day and has been operational since 2013. It employs ultrafiltration technologies for pretreatment and reverse osmosis.

3

Europe

Almería (Spain)

Desalination plant that takes in seawater to generate drinking water fit for human consumption to supply the Spanish city of Almería. It has an installed capacity of 50,000 m^3/day and has been operational since 2005. It employs reverse osmosis technology.

The Almería desalination plant (Spain), with a capacity of 50,000 m^3/day, has been in operation since 2005

Cartagena (Spain)

Desalination plant operational since 2005 that converts seawater into drinking water fit for human consumption. It has an installed capacity of 65,000 m^3/day and employs reverse osmosis technology.

The Cartagena desalination plant (Spain), with a capacity of 65,000 m^3/day, has been in operation since 2005

Bioenergy

Abengoa has made significant technological advances in the field of bioenergy in 2014. Work has continued on the waste-to-biofuel project (W2B) in Salamanca (Spain) and a new plant will join the ranks of the 14 existing plants to produce cellulosic ethanol from agricultural residues on a commercial scale in the United States. Moving down to Brazil, the company is focusing on the development of second-generation ethanol from sugarcane bagasse and straw. Work is ongoing to design Abengoa's first n-butanol plant and after various years spent on technological development, we are now witnessing enzyme production on an industrial scale with proprietary technology, which will soon be market-ready.

Aerial view of the cellulosic ethanol plant Abengoa has at Hugoton (Kansas, USA)

United States

Production of cellulosic ethanol at Hugoton.

After more than ten years of research, Abengoa has brought to market second-generation ethanol, also known as cellulosic ethanol.

Abengoa's first commercial-scale cellulosic ethanol plant is located in Hugoton, Kansas. The plant will use around 300,000 tons of agricultural waste, such as corn stover and wheat straw, (approximately 15 % of the biomass can be found within 50 miles of the plant) to produce up to 25 Mgal of cellulosic ethanol and 21 MW of renewable electric power annually.

Thanks to the use of enzymes developed and patented by Abengoa, the residual biomass material is broken down into sugars, allowing for fermentation and the production of sustainable ethanol.

The biomass boiler and electric power generation system began operation and exportation of electric power to the grid in December 2013. In late 2014, the company celebrated the commissioning of the plant for the production of second-generation ethanol.

Europe

Waste-to-biofuel project

The W2B project arose as an integrated solution for the management of municipal solid waste (MSW), providing a more sustainable and efficient solution for landfills waste.

Abengoa's W2B technology is currently in its demonstration phase in Salamanca, Spain. The existing biomass plant, Biocarburantes de Castilla y León, has been modified to use municipal solid waste as feedstock. The work performed in the demonstration plant will provide proof of concept for the production of ethanol from MSW, as well as, in-depth understanding of how to design and commission a commercial-scale municipal solid waste plant.

This demonstration plant was preceded by a pilot-scale MSW pretreatment facility that was built to optimize waste pretreatment that has supported the W2B demonstration plant.

Demo plant of W2B technology at Babilafuente (Salamanca, Spain)

Catalysis: n-biobutanol

In order to diversify and add value to its first-generation plants, Abengoa continues to focus on the development of catalytic technology to produce biobutanol, a product widely used in the chemicals industry. Some main applications of butanol are the manufacturing of acrylate for coatings, paints and varnishes, as well as, the production of acetate and glycol ester. Likewise, butanol can be used as a direct solvent.

To this end Abengoa has started the construction of a butanol plant in collaboration with Biocarburantes de Castilla y León in Salamanca, Spain. The facility is now being converted to manufacture a product with a wide range of applications. This process turns n-butanol into a renewable alternative to fossil-based butanol, reducing the CO_2 footprint of final users, and allows Abengoa to enter the bioproducts market that includes higher value-added chemicals.

Pilot unit to separate and purify butanol

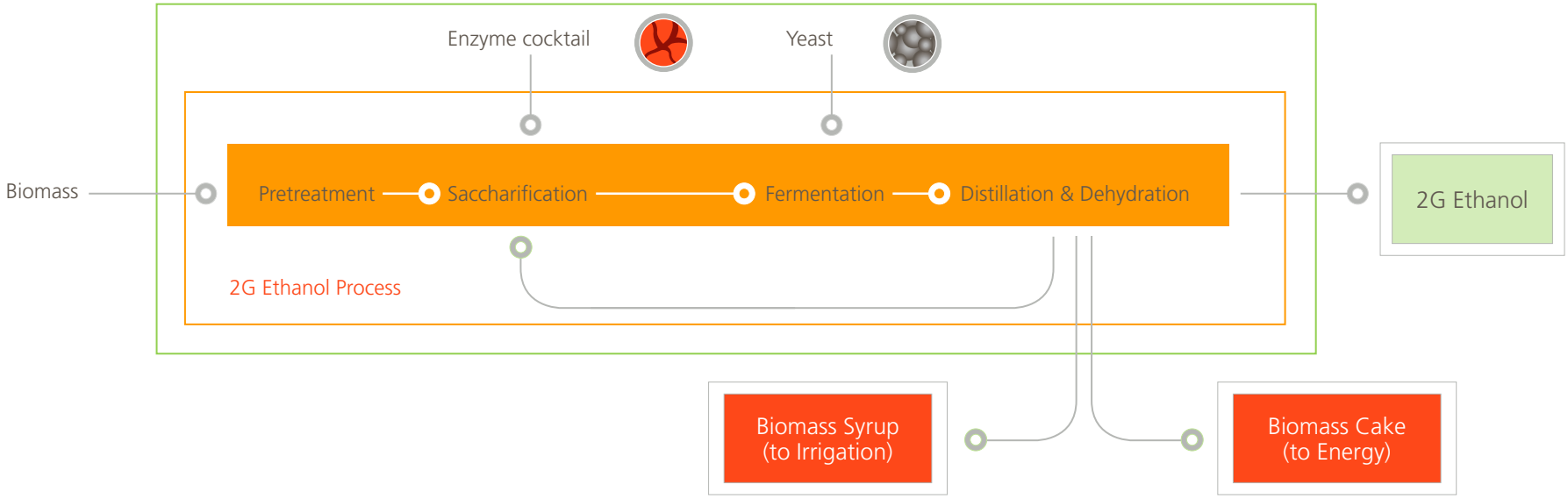
Brazil

2G Hybrid in Brazil

In Brazil, Abengoa is working to use sugarcane waste as feedstock for the production of second-generation (2G) ethanol, by integrating new production lanes into its existing facilities in Sao Luiz (Pirassununga, Sao Paulo).

This new project, which involves the installation of new second-generation ethanol lines using Abengoa's enzymatic hydrolysis technology, will add value to the existing plants. The upgraded facilities will have the capacity to process dry biomass (sugarcane bagasse or straw) resulting in the production of some 80 ML of bioethanol.

Construction at the facilities to process the new sugarcane waste feedstock into second-generation bioethanol will start in 2015. It is expected that the plant will be in full operation by 2017.



Biomass-to-2G
ethanol production process

Custom-made buildings

Mexico

In Texcoco, Abengoa runs the **Mexiquense Bicentenario Cultural Centre**, one of Mexico's most important cultural centers. The company unveiled the center in 2011 and has an operating concession for 21 years. The centre spans an impressive 35,000 m^2 and is used to stage all manner of cultural events, ranging from exhibitions, concerts and plays to courses and conferences, attracting a yearly average of 300,000 visitors.

Mexiquense cultural centre

Brazil

Abengoa is unflinchingly committed to developing hospital infrastructure across Latin America. The **hospital in the northern part of Manaus**, covering 30,000 m^2 and with the first wing already opened, marks the first public-private partnership in the Amazonas state of Brazil. Abengoa has been tasked with the construction and supply of medical equipment and the maintenance and management of the hospital's non-medical services under a 20-year concession.

Uruguay

Abengoa has been entrusted with the operation of a correctional institution in Montevideo occupying 42,000 m^2 of land and featuring 25 different buildings. The project is being developed through a public-private partnership (PPP).

Spain

Abengoa has been awarded a 30-year concession for Hospital del Tajo, in Madrid, covering 58,000 m^2, and a 40-year contract for Hospital Costa del Sol, in Malaga, spanning 56,700 m^2. The company also operates the courthouses in Olot, Cerdanyola and Santa Coloma de Gramanet in Catalonia under a 17-year contract.