

03. Management of capitals

03.2. Industrial capital

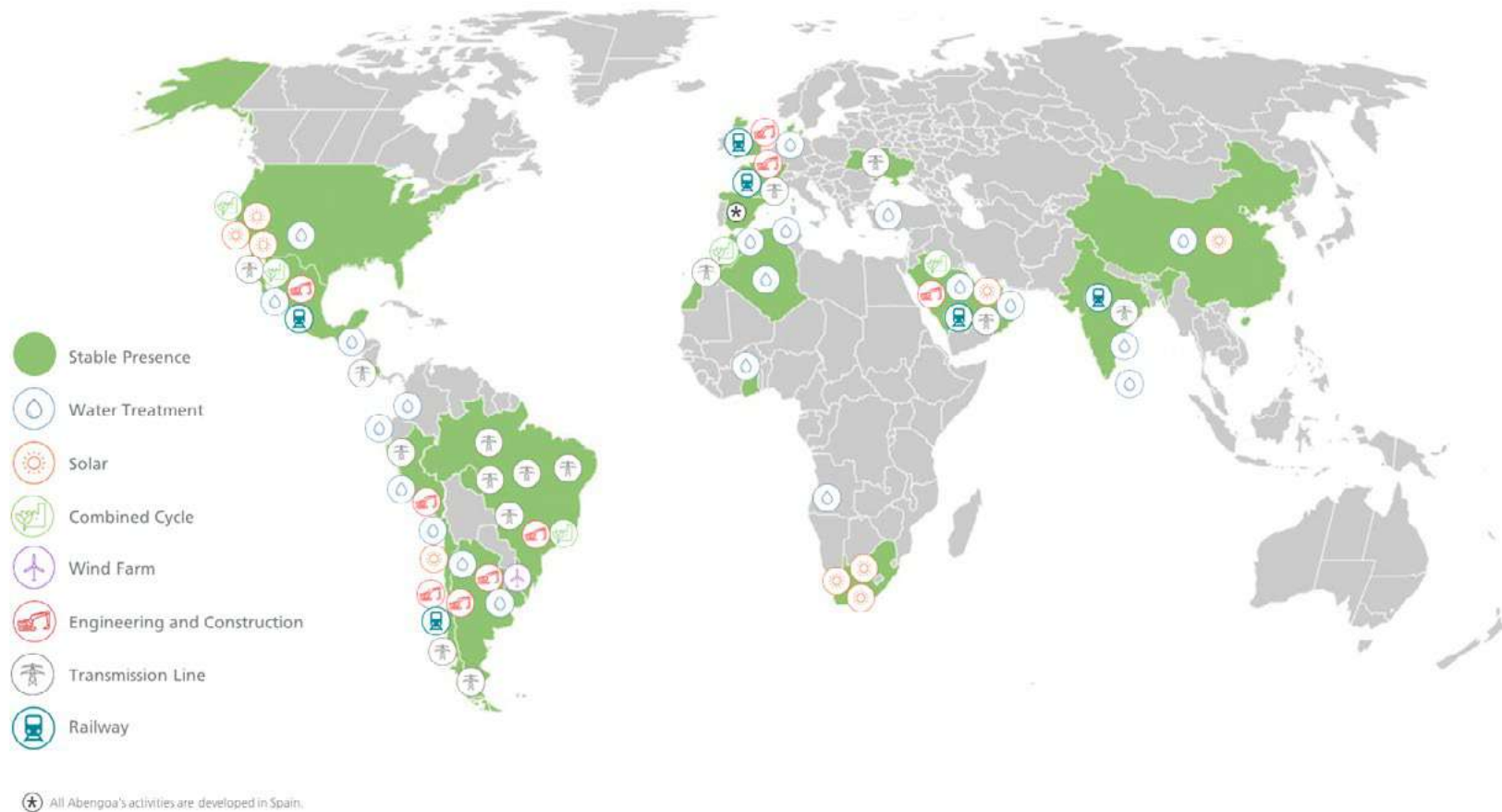


Projects in which the company works

Abengoa's engineering and construction activity is organised according to **verticals (businesses)** and **regions**.

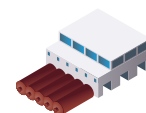
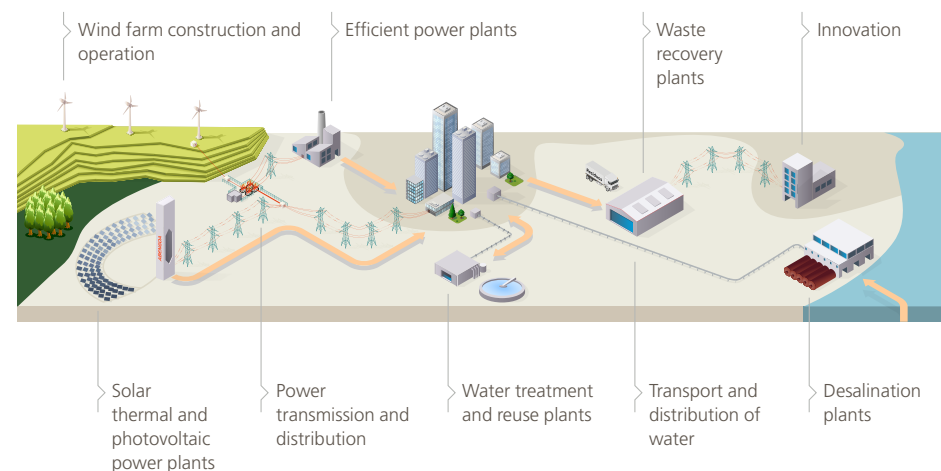
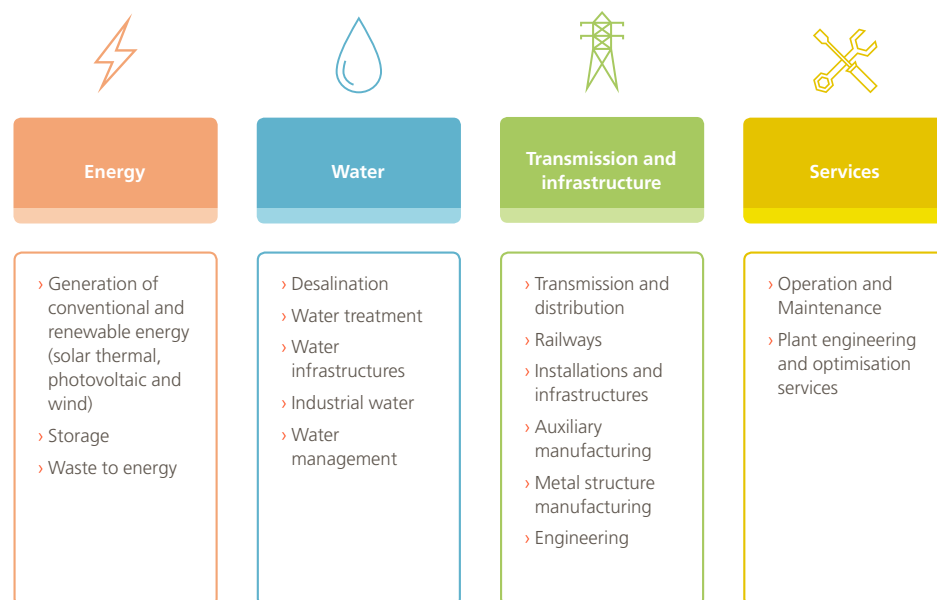
From the point of view of its businesses, Abengoa's activities are grouped in the following **areas**: energy, water, transmission and infrastructure and services.

As regards its **regions**, Abengoa has established a series of strategic countries and geographical locations, which are defined in its viability plan. These areas are: South America (Argentina, Brazil, Chile, Peru and Uruguay), North America (United States and Mexico), Europe (Belgium, Denmark, France and the United Kingdom), Africa (Algeria, Ghana, Kenya, Morocco and South Africa) and the Middle East (Saudi Arabia, United Arab Emirates, Oman and Qatar). The company concentrates its efforts on searching for new business opportunities in these regions, while operating and maintaining its assets.

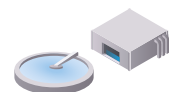


Projects by area of activity

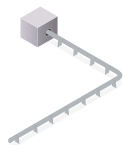
Abengoa is specialized in the development of turnkey projects for third parties in four key areas: energy, water, transmission and infrastructure and services, and it has capabilities which cover engineering, procurement, construction and start up.



1. **Desalination:** Abengoa is an international benchmark and leader in the global desalination plant rankings. During 2018, the company was awarded with a contract for a desalination plant in Saudi Arabia, which will have a capacity to produce 600,000 m³ of water per day and supply water to three million inhabitants. It also completed the financial closure of the desalination plant being built in Morocco, the largest plant designed and built for the combined use of drinking and irrigation water. In addition, it continued with the construction of the Shuaibah desalination plant in Saudi Arabia, the Salalah plant in Oman and the Susa plant in Tunisia.



2. **Water treatment:** with a global capacity to produce 2.2 million m³/day of drinking water and treating over 1.5 million m³/day of wastewater, Abengoa has a vast experience in water treatment, water purification, treatment and reuse of municipal wastewater. In 2018, Abengoa was awarded a contract for the design, construction, operation and maintenance of two wastewater treatment plants and their corresponding sanitation networks in India over a ten-year period.



3. **Water infrastructures:** Abengoa has over 75 years of experience in the construction of water infrastructures for public and private institutions, such as pumping stations (over 40 stations) and large water supply pipes for regulation and transport infrastructures (over 1,100 km). It distributes water to over four million inhabitants, has executed or upgraded structures for the irrigation of over 500,000 hectares and has installed more than 400 MW in over 40 hydroelectric power plant construction, improvement and upgrade projects. In 2018, the company signed a contract for the execution of the infrastructures associated with the Salalah desalination plant and received the Provisional Acceptance for a wastewater channelling project in India.



4. **Industrial water:** Abengoa specialises in providing state-of-the-art technological solutions associated with process water, reuse, wastewater and zero liquid discharge (ZLD). In this area, it has rolled out projects in different industrial sectors, exceeding 500,000 m³/day of treated water throughout its over 25 years of experience. In 2018, it started the commercial operation for the expansion of the plant executed by Abengoa for the production of demineralised water at the Norte Durango combined cycle power plant in Mexico.



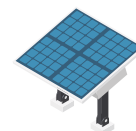
5. **Solar thermal power plants:** Abengoa is a leader in the development, construction and operation of solar thermal power plants across the world, with a global installed capacity that exceeds 2.3 GW, representing approximately 34 % of the global installed capacity. In 2018, the company executed a 110 MW project with tower technology in Chile at the solar field with parabolic trough collectors of the Mohammed bin Rashid Al Maktoum Solar Park in Dubai, and provided the technology for a 50 MW tower project in China.



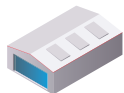
6. **Conventional generation:** In conventional generation plants, where it already accumulates an installed power of over 9 GW, Abengoa uses single and combined cycles, systems for the conversion of simple to combined cycles, motor and cogeneration power plants.



7. **Wind farm construction and operation:** Abengoa has participated in projects associated with the wind power sector since 1985. It has accumulated experience in over 480 MW across the world over these past 33 years. We offer services for the entire project life cycle, from the study of the resource, optimisation and selection of turbines, to detailed engineering, logistics, construction and operation of the wind farm.



8. **Photovoltaic power plants:** Abengoa designs, builds and operates power plants, optimising their design according to the characteristics of the land, using high, low or zero concentration panels, as well as thin-film panels. Currently, Abengoa has built over 400 MW. The photovoltaic power plant of the Cerro Dominador 100 MW solar power complex was commissioned in Chile in 2018, with the first 62 MW starting operation in 2017.



9. **Waste to energy and biomass:** Abengoa specialises in the design and integration of smart solutions, building and operating innovative facilities to transform any type of waste and biomass into energy, generating renewable and sustainable energy in the form of heat, cold, electricity or fuel. In 2018, the company continued with the construction works of the first plant that will produce fuel for the aviation industry from municipal solid waste in the United States.



10. **Storage and technology hybridisation:** Abengoa specialises in providing manageability and stability solutions for energy generated from renewable sources through the hybridisation of technologies and storage systems. The current commercial operating capacity of this thermal energy storage systems using molten salts exceeds 6,000 MWht and more than 4,000 MWht are under construction.



11. **Power transmission and distribution:** Abengoa has over 75 years of experience in industrial engineering, construction and maintenance of infrastructures for the energy, industry, environment, transport and communications sectors. In the last 15 years, it has built more than 27,000 km of transmission lines and 330 substations.



12. **R&D and innovation:** technological development continues to be Abengoa's main competitive advantage in high value-added projects. The company develops R&D and innovation projects that improve the features of its current products and services, and help the company acquire new skills. Abengoa has been granted with 342 patents since 2008.

Thanks to its track record, experience and knowledge acquired over more than 75 years, **Abengoa has managed to strengthen its position as a leader of the global EPC** (Engineering, Procurement and Construction) market, being awarded new projects and successfully completing other projects in progress. Below are the main milestones achieved by the company in 2018, by area of activity.

Energy



Abengoa has a vast experience, with over 12.8 GW of conventional and renewable energy plants installed and under construction.

Abengoa has a vast experience in the electricity generation sector, thanks to the development of single-cycle, combined-cycle and cogeneration technologies, wind farms, solar thermal plants, photovoltaic plants and biomass plants, exceeding 12.8 GW installed and under construction as a whole.

Such experience has allowed the company to achieve a high design and hybridisation capacity of solar technologies and also conventional generation techniques, to offer the optimum solution to its clients.

Abengoa has an impressive portfolio of thermal energy storage systems using molten salts. Its current commercial operating capacity exceeds 6,000 MWh, with a salt inventory of over 200,000 tons and more than 4,000 MWh under construction. Abengoa also designs and builds energy storage plants with batteries and offers the Smart Solar Plant (SSP) solution, based on the combination of three complementary and synergistic technologies: photovoltaic power panels, concentrated solar power with standard Rankine cycles and the above-mentioned energy storage systems that use molten salts and batteries.

Aware of the need to eliminate and turn the waste generated by human activity into energy using a sustainable approach, Abengoa specialises in designing and integrating technological solutions in this sector, building and operating innovative installations and facilities for transforming any type of waste and biomass into energy, as well as generating renewable and sustainable energy in the form of heat, cold, electricity or fuel. It designs projects that transform raw materials into bioenergy or biofuel, according to the type of waste and/or biomass (municipal waste, wood, agriculture, livestock farming, agri-food waste, industrial, etc.).



A3T efficient cogeneration plant.

Abengoa develops turnkey projects in all of these sectors, which include the entire value chain, from development, engineering, purchasing and construction to the commissioning of the installation, in addition to its operation and maintenance.

Conventional generation

In the case of conventional generation plants, where it already accumulates an installed power of over 9 GW, Abengoa uses single and combined cycles, systems for the conversion of simple to combined cycles, motor and cogeneration power plants.



A3T is an efficient cogeneration plant that produces electricity and steam in Mexico.

In 2018, Abengoa continued to make progress in the construction of the A3T 220 MW efficient cogeneration plant located next to the Nuevo Pemex gas processing complex in Mexico, which started to operate by the end of the year. In addition, the construction of the transmission system associated to this project concluded this year, achieving the power delivery to the grid.

Solar power

Abengoa develops solar power plants with solar thermal and photovoltaic technologies and is the current leader in the development of solar thermal plants across the world, with a global installed capacity that exceeds 2.3 GW, representing approximately 34% of the global installed capacity.

Power-tower solar thermal technology allows the production of electricity with the concentration of solar power, captured by a heliostat field, onto a collector installed on the top of the tower. Abengoa is a pioneer in the construction of tower plants for commercial operation, with more than 80 MW in operation and 110 MW under construction.

Solar power is captured using parabolic troughs (STEP), designed with a solar thermal collector that heats a heat transfer fluid, from which its heat is transferred and used in a conventional thermal cycle. Abengoa has over 1.6 GW in operation and 650 MW under construction in the plants using this technology, positioning the company as a benchmark of the solar thermal power sector.



Abengoa develops innovative energy storage solutions in solar thermal plants.

In its constant search for new sustainable alternatives for the generation of energy, Abengoa is currently developing solutions to the heat or steam requirements in industry, with the use of solar thermal trough technologies that feature built-in thermal storage systems, allowing such systems to supply industrial heat in the absence of sunlight. In this area, Abengoa has a portfolio with important references across the world, especially, in Latin America and the United States.

As a result of its leading position in this sector, in 2018 Abengoa signed a collaboration agreement with the Chinese bank ICBC (Industrial and Commercial Bank of China Limited), Shanghai Electric Group Co. Ltd., one of the most important equipment manufacturing conglomerates in China, and with ACWA Power, leading Saudi Arabian company in the development, investment, ownership and operation of cogeneration and desalinated water plants, for the development of future energy projects.

In addition, the goals of this agreement included the identification of joint business opportunities, as well as the establishment of long-term strategic partnerships with ICBC, as the agent funding the operation, ACWA Power, as the developer, Shanghai Electric, as the contractor, and Abengoa, as the technology provider.

In 2018, the consortium became the successful bidder of the Fourth Phase of the Mohammed bin Rashid Al Maktoum Solar Park project, the largest solar complex in the world, owned by DEWA (Dubai Electricity and Water Authority), which is currently being built in Dubai. Abengoa participates as a technology partner and is responsible for building and commissioning a solar field of 3x200 MW parabolic troughs, with 12 hours of storage in molten salts (more information on [page 51](#)).



Cerro Dominador (Chile) is the first complex that combines solar thermal and photovoltaic power across the continent.

Abengoa has consolidated its leadership in this sector in 2018 thanks to the construction of a 110 MW solar thermal plant, in collaboration with Acciona, for EIG Global Energy Partners in Chile. This plant uses the tower technology and will have a thermal storage capacity of 17.5 hours using molten salts, in addition to the 100 MW photovoltaic plant built by Abengoa and in operation since 2018, creating Cerro Dominador, a renewable energy complex with a total capacity of 210 MW and the first to combine both technologies in the continent.

In **China**, Abengoa also expanded its technical assistance services at the LuNeng Haixi 50 MW power-tower solar thermal plant, located in Qinghai, in which it has provided its technology and engineering development services.

Another important milestone achieved during 2018 consolidating the company's presence in South Africa, where it has been operating since 2009, was the inauguration of Xina Solar One, the third solar thermal plant built by the company in this country, with 100 MW of power. The plant uses the parabolic trough collector technology and supplies clean, sustainable and manageable energy to 95,000 South African households. It also features a thermal energy storage system with molten salts, which is capable of accumulating the energy required for supplying an additional 5.5 hours, helping cater to the electricity demand in peak periods during the evenings. (More information on [page 53](#)).

Innovation is the base of Abengoa's activities and has allowed the company to become the **technology leader** in different sectors, such as the solar thermal sector. As a result, Abengoa received a series of awards during 2018 in this area, such as the **CSP Globalization Contribution** award, by the largest and most important international event of the Chinese solar thermal industry held every year, CSP Plaza 2018. The award was given to Abengoa for its contribution and participation in the main global CSP markets and promotes the development of global solar thermal projects.

The company also received the Antoni Caparrós Award to the best technology transfer project for its project entitled "Transfer to a leading technology development multinational company is possible. A case study of the energy sector", given by the Economic and Social Council of Fundació Bosch y Gimpera, University of Barcelona.



Waad Al Shamal, the largest hybrid solar-gas power plant in the world, built by Abengoa.

The works for the construction of Waad Al Shamal plant, the largest hybrid solar-gas power plant in the world, carried out by Abengoa in Saudi Arabia continued in 2018. It will feature a 1,390 MW combined cycle power plant and a 50 MW parabolic trough field, reaching a total production of 1,440 MW of energy.

Abengoa designs and builds photovoltaic power plants, optimising their design according to the characteristics of the land, using high, low or zero concentration panels, as well as thin-film panels. Currently, Abengoa has built over 400 MW.

Similarly, the photovoltaic power plant of the Cerro Dominador 100 MW solar power complex was commissioned in Chile in 2018.

Waste to energy and biomass



Fulcrum, the first biofuel plant for aviation that uses Municipal Solid Waste in the United States.

Among the main solutions for the protection of the environment within a context of sustainability and durability, we need to eliminate the waste generated by human activity and to reduce the use of fossil fuels in order to help reduce the greenhouse effect. A possible solution is the recovery of energy from waste and biomass.

In 2018, Abengoa continued with the construction works of the first plant that will produce fuel for the aviation industry from municipal solid waste in the United States. The plant will have a capacity to produce 10 million gallons of jet fuel per year, to be used in the aviation sector. (More information on [page 50](#)).

Water



Abengoa builds large-scale desalination plants to provide sustainable solutions to the comprehensive water cycle.

Through its Water vertical, Abengoa offers sustainable solutions for the comprehensive water cycle, covering from scarcity of water resources, with large-scale desalination and purification plants and water infrastructures, to the protection of the environment, with the construction of urban and industrial wastewater treatment plants. Its scope of action includes the entire value chain of turnkey or EPC projects, from the marketing, design and basic and detailed engineering phases to construction and commissioning.

Desalination



Abengoa builds the Salalah desalination plant (Oman) in a consortium with Fisia Italimpianti.

Abengoa is an international benchmark and global leader in the desalination sector, having designed and built more than 30 of the largest plants in Spain, Africa, Latin America, Asia and the Middle East for the production of drinking and industrial water from seawater or brackish water, through advanced membrane processes. Currently, it has a global capacity to produce 3.7 million m³/day of desalinated water, out of which 2.2 million m³ are currently under construction.

In 2018, Abengoa received the Desalination Company of the Year Award from Global Water Intelligence, a magazine specialising in the water sector, after being awarded important contracts in Tunisia, Oman, Morocco and Saudi Arabia.

In addition, Abengoa became the successful bidder in a consortium with the companies SIDEM, Veolia Group and SepcoIII, for the construction of the largest reverse osmosis desalination plant in Saudi Arabia, in the city of Rabigh, approximately 150 km to the north of Jeddah. The project is part of a programme of the Saudi Arabian's government to promote private participation in the country's water sector. The consortium will be responsible for the engineering, supply, construction and commissioning of this desalination plant for ACWA Power, which will act as the project promoter, developer and owner. The Rabigh plant has a capacity of 600,000 m³/day and it will guarantee the supply of drinking water for the cities of Mecca, Jeddah and Mastorah, catering to the needs of three million people.



Abengoa builds the largest desalination plant for the combined production of drinking and irrigation water in Agadir (Morocco).

During 2018, Abengoa also completed the financial closing process of the desalination plant being built in the region of Agadir, Morocco, which is the largest plant designed and built for the combined use of drinking and irrigation water. The plant will have a capacity to produce 275,000 m³/day, with the possibility to be expanded to up to 450,000 m³/day. This is a unique project created by combining two projects. On the one hand, the 50 % increase in the plant's drinking water production capacity developed by Abengoa for a total capacity of 150,000 m³/day and, on the other hand, an additional production of 125,000 m³/day of water for irrigation, as well as the construction of the corresponding irrigation network for a total surface of 13,600 hectares. Abengoa is responsible for both the design of the engineering and construction processes, and for the operation and maintenance of this plant over a 27-year period.

The importance of the financial closure of this project lies in the complexity of closing the two project finance processes in parallel, with two different clients and a joint scheme. Abengoa's leadership and experience in this type of projects has been vital.

In 2019, Abengoa has continued reaping the rewards in the desalination field, with the awarding of important projects in United Arab Emirates, such as the biggest reverse osmosis desalination plant in the world, located in Taweelah and a desalination plant for the industrial complex of Emirates Global Aluminium (more information in [page 51](#)).



The reverse osmosis desalination plant built by Abengoa in the Shuaibah III complex has operated for over three million hours with no occupational accidents requiring sick leave.

Another important milestone was the start of permeated water production at the reverse osmosis desalination plant of the Shuaibah III complex, which is currently being executed in collaboration with Fisia for ACWA Power in Saudi Arabia. The plant has a capacity of 250,000 m³/day and it will guarantee the stable and quality supply of water for Mecca, Jeddah, Taif and Al-Baha. In addition, by the end of 2018, it had been in operation for over three million hours with no occupational accidents requiring sick leave and it is expected to start commercial operation by May 2019.

Abengoa has also made progress in the construction of the Susa desalination plant being built in Tunisia, in collaboration with the Tunisian company Engineering Procurement & Project Management (EPPM), which will have a daily capacity of 50,000 m³, and the Salalah desalination plant in Oman, in a consortium with Fisia Italmimpianti, which will be capable of producing close to 114,000 m³/day.



In 2018, Abengoa received the final acceptance of the Barka desalination plant (Oman).

Finally, Abengoa received the final acceptance of the desalination plant executed in Barka (Oman) with a 45,000 m³/day capacity of desalinated water.

Water treatment



Abengoa builds plants that reuse municipal wastewater.

With a global capacity to produce 2.2 million m³/day of drinking water and treating 1.5 million m³/day of wastewater, Abengoa has a vast experience in water treatment, drinking water purification, treatment and reuse of municipal wastewater using physical-chemical and biological processes, including treatments for the digestion and recovery of waste.

In 2018, Abengoa was awarded a contract for the design, construction, operation and maintenance of two wastewater treatment plants and their corresponding sanitation networks in Nasrullaganj and Maheshwar over a ten-year period. These cities are located in the state of Madhya Pradesh, central India. Both projects are funded by the World Bank through the Madhya Pradesh Urban Development Project, developed by the state-run Madhya Pradesh Urban Development Company, aimed at improving the coverage of the key urban services of this state, in this case, the collection, transport and treatment of wastewater.

The Nasrullaganj project includes a sewage network with a length of approximately 53 km and a diameter of up to 700 mm, as well as a treatment plant with a sequencing batch reactor (SBR), with a capacity to treat 4,200 m³/day of wastewater.

Moreover, approximately 30 km of the sewage network are being built in Maheshwar, also with a maximum diameter of 700 mm and, in this case, the plant will have the capacity to treat close to 5,000 m³/day of wastewater.

Thanks to these projects, the sanitation system will be improved, covering a population of close to 55,000 inhabitants, reducing untreated wastewater discharges into natural rivers and streams.

Water infrastructures



Abengoa has over 1,100 km of large water supply pipes in its portfolio.

Abengoa has over 75 years of experience in the execution of water infrastructures for public and private institutions. In particular, it has executed more than 40 pumping stations and more than 1,100 km of large water supply pipes for regulation and transport infrastructures, distributing water to over four million inhabitants, has executed or upgraded structures for the irrigation of over 500,000 hectares and has more than 400 MW installed in more than 40 hydroelectric power plant construction, improvement and upgrade projects.



Abengoa distributes water to over four million inhabitants across the world.

In this area, Abengoa has signed the contract for the execution of the drinking water infrastructures associated with the Salalah desalination plant in 2018. The project is being executed in Oman and includes a 90,000 m³ tank and a pipe connected to the existing tank.

Likewise, the company received the provisional acceptance for the wastewater pipe project in Roorkee (State of Uttarakhand, India), which collects the waste from a city of over 300,000 inhabitants.

Industrial water



Abengoa has already exceeded 500,000 m³/day of treated water throughout its 25 years of experience. Norte Durango combined cycle plant.

Abengoa specialises in providing state-of-the-art technological solutions to the public and private sectors, associated with process water, reuse, wastewater and zero liquid discharge (ZLD). In this sense it has developed projects in different industrial sectors, such as power generation, steel production, paper and pulp industry, leachate, oil and gas, petrochemical, pharmaceutical, mining and food, among others, having treated more than 500,000 m³/day of water throughout its 25 years of experience.

In 2018, it started the commercial operation for the expansion of the demineralised water production plant executed by Abengoa in the Norte Durango combined-cycle plant, with a treatment capacity of 1,000 m³/day, and which uses cutting-edge desalination technologies, using CCRO (Closed Circuit Reverse Osmosis) and CDI (Capacitive De-Ionization) modules.

Abengoa will face major challenges during 2019 in the water sector, such as the execution of some of the key projects in its portfolio, as well as the new plant contracts for all lines of activity, consolidating its leadership of the international desalination market and maintaining its position as an international benchmark in the construction of water infrastructures and treatment plants. To achieve this, it has a solid, highly-committed and qualified team of experts with a proven track record in EPC and O&M, as well as specialised and competitive know-how, aimed at meeting and exceeding our clients' needs.

Transmission and infrastructures



Commissioning of the Faya-Shamka HVL in the United Arab Emirates.

Abengoa has over 75 years of experience in the Transmission and Infrastructure (T&I) vertical sector, including engineering, construction, industrial and infrastructure maintenance in the energy, industry, environment, transport and communications sectors, covering the development of power transmission and distribution lines, railway electrification, installations and infrastructures for all types of plants and buildings, as well as auxiliary electric and electronic component and metal structure manufacturing.

Transmission and distribution



Work in HV power lines in France.

In **Spain**, Abengoa continues with the electromechanical assembly work of the GIS (Gas Insulated Switchgear) substation in Jares (Las Palmas) and the remodelling work on a section of the Belesar-Mesón 200 kV line (Galicia).

In **France**, the company is executing HV power line and substation construction, modification and disassembly works for the French public operator, responsible for managing the country's transmission systems. In addition, a new framework contract for HV power lines was signed in 2018 for a further three years, covering the 2018-2020 period, which started in 2003.



Construction of a 765-kV line with a length of 187 km in Ukraine.

Progress is being made in the construction of a 187 km long 765 kV line in **Ukraine**.

In **Morocco**, the company is making progress in the development of the 400 kV transmission lines in Oujda and 225 kV transmission lines in the Ouarzazate area. It has also completed the construction work of the 60 kV substations in Melloussa and Sefrou for the country's electricity system operator.

In the **United Arab Emirates**, the Faya-Shamkha power transmission line built by Abengoa was successfully commissioned.

And in **Oman**, Abengoa received the final acceptance of the 132/33 kV Al Dreez substation. The company has also completed the construction of the Sinaw 132/33 kV GIS substation for the electric utility in Oman and is currently executing another substation in Samad with the same characteristics.



132/33kV GIS Substation in Oman.

Railways



Mecca-Medina High-Speed Line

In **Spain**, the following can be highlighted:

- › New four-year maintenance contract awarded for the Antequera-Granada high-speed line overhead contact line.
- › Progress in the construction of the project for the installation and maintenance of the protection, safety and telecommunications systems, as well as the overhead contact line and substation installation work for the Spanish Railway Infrastructure Administrator.



Power supply installations of the Barcelona Metro.

- › The construction works of the MV power supply substations and ring of Line 9 and Line 10 of the Barcelona metro are still being executed.
- › The electrification works of the Madrid-Levante high-speed line are currently being executed.
- › Progress is being made on the maintenance work of the following high-speed lines: Madrid-Barcelona-French Border; Madrid-Alicante; Madrid-Córdoba-Seville-Málaga; Zaragoza – Tardienta; Madrid-Toledo and Madrid-Valladolid.



Overhead contact line work in the United Kingdom.

In the **United Kingdom**, the engineering and installation tasks are still being carried out on different railway lines near London.

In **France**, different overhead contact line and substation projects have been completed and the contract for the continuation of these services was renewed with the French rail operator.



Mecca-Medina AVE Station.

In **Saudi Arabia**, the Mecca-Medina high-speed line is in the final construction phase and commercial routes are already operating. The maintenance phase of the line was started in parallel to these activities.

Installations and infrastructures



Electromechanical installations in a shopping centre in Seville.

In **Spain**:

- › Abengoa continues to execute the electromechanical installations of the Lagoh shopping centre and family leisure centre (Seville).



Mechanical assembly work for the new campus of the Loyola Andalucía University.

- › The company is executing a mechanical installation project for the new university campus of the Loyola Andalucía University being built in Dos Hermanas (Seville).



Remodelling of the communication and control systems of Seville station (Madrid Metro).

- › The remodelling work of the communication and control systems of Sevilla station (Madrid Metro) has already started.

- › The installation work of the MV distribution substations is being carried out at the Torrecárdenas shopping centre in Almería.
- › The power system and lighting installation project of the new School of Nursing in San Juan de Dios, Seville, has already been completed.
- › The low voltage installations of the aircraft factories in Puerto Real (Cadiz) and Tablada (Seville) are being adapted to comply with the regulations.
- › The voice and data installation work corresponding to maintenance and opening of logistics centres and stores of one of the largest supermarket chains in Europe are maintained.
- › Progress is being achieved on the electrical and instrumentation maintenance work carried out at the Almaraz power plant.
- › Work for the deployment of the mobile telephony, radio and fibre-optic networks, installation of telecommunications structures and installation of GSM-R systems is also being carried out.

In **Chile**, Abengoa continues with the execution of the electrical buildings for the Cerro Dominador solar power platform.

In **Belgium**, the company is executing a project for the development of the mechanical facilities of the new University Hospital Centre building in Liège.

In **Denmark**, the company is currently working in the project of the electromechanical installations of the new 56,000 m² hospital complex in Herlev.



Abengoa is developing the International Thermonuclear Experimental Reactor (ITER) in France.

In **France**, the company is executing the construction work of a project for the ITER (International Thermonuclear Experimental Reactor), installing seven bays of two 400/22 kV substations.

In **Morocco**, it continues to make progress on the low and medium-voltage electrification work of three mobile telephony repeater stations, as well as on the deployment of the GSM network across the country and for all telecommunication operators currently operating in Morocco.



Installation of the tower for the deployment of the fibre-optic network in Navarra.

Auxiliary electric and electronic manufacturing

During 2018, Abengoa has achieved important milestones associated with auxiliary manufacturing:

- › Manufacturing and integration of urban traffic control regulation equipment in Spain and Peru.
- › Manufacturing control assemblies to update access control systems for various railway operators.
- › Manufacturing monitors and updating the command and control consoles for the frigates of the Spanish Navy.
- › Manufacturing the power distribution boxes for the armoured defence vehicles of the United Kingdom.
- › Manufacturing prototypes and pre-series units of power converters for the European Organization for Nuclear Research (CERN) in Switzerland.
- › Manufacturing level III boxes and inclinometers to control the position of the heliostats at Cerro Dominador solar thermal plant (Chile).



Manufacturing power converters.

Metal structure manufacturing



Towers for the 220 kV line in Cañuelo-Pinar del Rey.

In Spain:

- › The construction work on the towers of the Cañuelo-Pinar del Rey 220 kV line (Cadiz) and Alhama-El Palmar 132 kV line (Murcia) has been completed.
- › The company continues to manufacture the 220 kV towers and supports for the substation of the Picón I, II and III photovoltaic power plants (Ciudad Real).

In **Mauritania**, the company has supervised the design, tests and manufacturing processes of the towers for the Aleg-Boghé 90 kV line.

In **Sweden**, towers have been manufactured for the Kraktorpet-Nylandsbergen and Nylandsbergen-Nysater 130 kV lines.

In **Chile**, the support structures of the Cóndores-Parinacota, Candelaria Puente Negro and Melipulli-Puerto Montt substations have been manufactured, in addition to the heliostats for the Cerro Dominador power-tower solar thermal plant.



Tests conducted at the HV tower of Abengoa's Testing Station.

Engineering



Design of the overhead contact line for the Saudi Arabia AVE line.

We have achieved the following milestones in 2018:

- › Completion of the Monforte del Cid-Murcia high-speed line project work (Spain).
- › Start of the overhead contact line maintenance project of the Antequera-Granada high-speed line (Spain).

- › Support for the construction and design of the electrical installations of singular buildings, Lagoh shopping centre and family leisure centre, Loyola University and Switching and Transformer Substation of San Juan de Dios, in Seville (Spain).
- › In the United Kingdom, the company participated in the design of the railway systems of GRIPs 4 and 5 of the UPS C2C Renewal project, in GRIP 6 of the GEML British railway project, in GRIP 3 of the British rail project between Southcote Jn and Basingstoke, and in GRIP 5 for the design of Swindon station (UK) and the Cocklebury Siding.
- › The RAMS design and study work for lines 3 and 6 of the Santiago de Chile Metro was also completed.
- › Abengoa was the successful bidder of the engineering work for a substation of the French railway operator in Paris.
- › We have continued to prepare the testing & commissioning documentation for two substations in Cadarache (France).
- › The company started with the design work on the airport branch connecting the main roads to the King Abdullah International Airport, as part of the High-Speed Line Project in Saudi Arabia between Mecca and Medina.



Rail gate, aimed at upgrading the electric rail systems in England.

Services

The scope of Abengoa's Services vertical covers the comprehensive predictive, preventive and corrective operation and maintenance (O&M) activities in the energy transmission, water and power generation (renewable and conventional) sectors. Its main aim is to improve management capacity and increase production and efficiency levels.



50MW Parabolic through thermal plant located in India.

Abengoa has a vast experience of almost 20 years, during which it has participated in all project stages, from development, conceptualisation, funding and construction to final operation. It is worth highlighting its global leadership in the solar thermal O&M field (1,648 MW), hybrid solar-gas power plants (Integrated Solar Combine Cycle - ISCC), combined cycles and desalination plants, as one of the companies with the highest number of m³ currently being operated.

Abengoa's O&M services are adapted to the requirements of each technology, its clients and the specific requirements of each project. Thanks to its vast experience in these sectors of activity, it is capable of offering alternatives that share project operating risks, balancing the offer with the risk profile required in each project and by each client.

In addition to conventional O&M services, Abengoa offers the following specific services:

- › Predictive techniques, such as thermal imaging, ultrasounds, vibration and electric quality, data analysis and treatment in a single platform and generation of technical asset health reports that result in the minimisation of O&M costs and the maximisation of the useful life of equipment.
- › Plant O&M Engineering.
- › Optimisation of installation management efficacy.
- › Optimisation of O&M and plant performance contracts.

During 2018, the company started to provide the following services at the 220 MW A3T efficient cogeneration plant in Mexico:

- › **Predictive:** implementation of off-line predictive maintenance with vibration, thermal imaging and ultrasound techniques.
- › **Implementation of the CMMS:** Computerised Maintenance Management System, IBM ® Maximo ® Enterprise Asset Management.
- › **Implementation of the PI:** service involving the definition and collection of data from a distributed control system at the plant, storage, analysis and use of such data. In addition, this service includes the development and implementation of a production control model for the plant.

Moreover, the 50 MWe solar thermal plant with parabolic troughs in Nagalapuram, state of Andhra Pradesh (India), was optimised. The work was undertaken for Megha Engineering & Infrastructures Limited. This service is the result of Abengoa's internationalisation efforts and the search for new clients.

The O&M practices of the Cerro Dominador photovoltaic plant commissioned in 2017 were consolidated. Since then, the plant has successfully met all production goals agreed with the client.

Likewise, the vertical has provided support to O&M activities of the plants built by Abengoa in South Africa, transmitting the know-how acquired by its service personnel.



The Services vertical is aimed at driving the company to become the leading technology provider of solar thermal plants.

During 2018, Abengoa faced the following challenges in the plants it currently operates and maintains:

- › Planned downtime: major inspections were conducted in different plants, achieving excellent results. Pressure tests were carried out in steam generators and solar field loops. Likewise, two technical interruptions were required in two specific plants.
- › Solar field optimisation work in different Asian plants.

One of the main challenges for 2019 in Abengoa's Services vertical is to consolidate the company as the leading technology provider of solar thermal plants. The purpose is to consolidate the provision of services to third parties in the solar thermal power market, both for projects currently being developed and for existing plants.

Likewise, the company will continue to provide support to the plants that are currently being built (Cerro Dominador CSP and DEWA IV); the implementation services of specific O&M services will be completed at the A3T efficient cogeneration plant. One of the goals will be the acquisition of new contracts, market expansion in all regions and continuing with the optimisation of plant efficiency and availability for all plants in Spain and abroad.

Projects by region

During 2018, Abengoa mainly operated in the following regions.

Argentina



Abengoa has continued with the work in the 25 de Mayo transformer station during 2018.

In 2018, Abengoa celebrated 50 years of operations in Argentina. Established in 1968, Abengoa's Argentinian subsidiary started its activities designing and installing industrial plants. However, today, it is a benchmark in the transmission and distribution sector, with over 1,500 km of lines and over 25 substations built. Some the works executed during this period include flagship projects throughout the country, such as the 345 KV Extra-HV line (EHV) at an altitude of over 4,000 metres, crossing Los Andes, between Salta and Antofagasta (Chile), or the EHV with a length of 175 km for the interconnection of Gran Mendoza – San Juan, among many other projects.

As regards 2018, the country's economic crisis and financial turmoil led to cancelling the tender projects for the main works on the 500 kV lines and stations, to be announced in the future under better conditions. However, the company has continued to work and execute projects, completing some of them, including the following main achievements, allowing Abengoa to position itself as a local benchmark in high and extra-high voltage projects:

- › Completion of the 132 kV HV power line for the Aluar wind farm in Puerto Madryn (Chubut), south of the country.
- › Progress on the execution of the 25 de Mayo 500 kV transformer station.
- › Progress on the execution of the Altiplano 345 kV GIS switching station at an altitude of 4,000 metres above sea level.



Images of the work in the Altiplano switching station.

Likewise, the company was awarded with and started the activities associated with the contract for the expansion of the 132 kV substation in the Villa María thermal power plant, owned by MSU Energy, a power generation company, located in Cordoba, central region of the country. In particular, Abengoa is responsible for providing the labour, part of the materials and equipment required for the expansion, with the construction of a switching yard, including the civil works,

installation of equipment, connections and assistance during commissioning and start-up.

Abengoa's main challenge for 2019 in Argentina is to remain as a leader in its sector, accompanying the country in its changes, participating in the most important projects, acting as a benchmark in the electrical power transmission sector and following the right path to become a leader in infrastructure and water projects.



The company completed the 132 kV HV power line for the Aluar wind farm.

Brazil



The company is responsible for managing the public-private participation of the Zona Norte Hospital of Manaus.

Abengoa has been operating in the country for over 20 years, focusing its activity on the electrical transmission and infrastructures sectors.

In 2018, Abengoa Brazil successfully sold its transmission lines in operation and continued with its transmission asset operation and maintenance activities (over 3,200 km of lines and 20 substations), in addition to managing the public-private participation in the Zona Norte Hospital of Manaus (with a capacity for 350 patients). In addition, it continued to provide its machinery rental services to build new transmission lines.

Brazil continues to be an attractive market, since the Brazilian economy will continue with its process of economic recovery in the coming years and a more positive macroeconomic scenario is expected. In addition, the infrastructure sector and, in particular, the transmission sector continue to attract investments and offer relevant business opportunities.



Abengoa is responsible for the O&M of over 3,000 km of transmission lines in Brazil.

In addition to guaranteeing the continuity of the operation and maintenance and machinery rental activities, Abengoa Brazil's goals for 2019 include completing its current restructuring process and increasing the volume of construction contracts, so the company can become a benchmark in the transmission sector again.

Chile



Repowering the Maitencillo Caserones transmission line.

Abengoa has been present for over 30 years in Chile, in which it has a vast experience in the development of projects in transmission lines and electrical infrastructures, having built over 1,800 km of power lines and 50 substations.

The company completed the following projects during 2018:

- › Supply of the electricity system for Lines 3 and 6 of the Santiago de Chile Metro. It is currently providing its operation and maintenance services.
- › Expansion of three 110 kV HV electrical substations in the region of Valparaíso for Chilquinta Energía S.A.
- › Engineering, supply, construction, assembly, tests and commissioning of the Puente Negro 220 kV substation in San Fernando for Colbún S.A.
- › Construction and commissioning of three HV and MV power lines (220 kV, 220 kV and 23 kV) in Antofagasta for Minera Centinela.
- › Development of the electromechanical assembly work on the main fan (V55) of the El Teniente mine for Corporación Nacional del Cobre de Chile (Codelco). The

project scope included the civil works and structural, mechanical and electrical work.



Image of the area in one of the substations built for Chilquinta, in the region of Valparaíso.

In addition to the above, other projects are still in progress and expected to be completed after 2018:

- › Replacement of the 110 and 13 kV conductor in Rancagua for Codelco in El Teniente mine.
- › Construction of a transmission line in Caserones for Transelec.

- › Construction of a 220 kV HV line with a length of 87 km for Enel Generación in the Seventh Region of El Maule, at an approximate altitude of 2,000 metres above sea level and at a distance of 150 km from the closest town (Talca). This line will connect the Hydro Los Cóndores power plant to Ancoa substation.
- › Construction of substations and a switching station with three 220 kV lines in Malleco for Transelec.

Abengoa's goals for 2019 in Chile include work on two technologies that the company has not used until now: construction of the technical building hosting an Extremely Large Telescope (ELT) at the Paranal Observatory of the ESO (European Southern Observatory); and the electromechanical assembly work in a gas treatment system to reduce the emission level at the Chuquicamata Concentrates Foundry, allowing our client, Corporación Nacional del Cobre de Chile (Codelco) to comply with the country's environmental regulations, proof of our commitment to implement technologies that allow sustainable development and the protection of the environment.



Work carried out at the Chuquicamata Concentrates Foundry for Codelco.

United States



Work of the Fulcrum Sierra BioFuels project.

During 2018, the company continued to make progress in the **Fulcrum Sierra BioFuels project**. This biofuel plant, the first in its class, is expected to process approximately 175,000 tons of raw materials from municipal solid waste, producing 11 million gallons of renewable synthetic crude oil (Syncrude) per year. In particular, Abengoa completed the basic engineering work last year, started detailed engineering, completed most project acquisitions and started the civil works and mechanical work.

In October, after two years of planning and 28 months of construction work, Abengoa inaugurated the **Keck Centre for Science and Engineering of Chapman University** through its subsidiary, Abacus - a company working in project management and construction in the United States. As the benchmark programme, project and construction manager of Chapman University for almost two decades, Abacus has completed over 100 projects, including many different building refurbishment work and new construction projects.



In 2018, Abengoa inaugurated the Keck Centre for Science and Engineering of Chapman University.

In particular, Abengoa provided project management and construction services for this innovative cutting-edge learning/training facility. The building has a gross floor area of 27,000 m² and it includes a laboratory building with a gross floor area of 13,000 m², a second underground floor and a car park with a gross floor area of over 14,000 m².

Moreover, Abengoa continues to maintain and operate two of the largest solar power projects in North America: the **Solana and Mojave solar thermal plants**, both owned by Atlantica Yield.

The highest annual production rates were achieved in Solana since the start of its commercial operation, ~ 776 GWh. In addition, monthly production records were achieved in January, February, May, July and September. The safety improvements contributed to completing the year with 717 days with no injuries requiring sick leave (Lost Time Injuries), which is proof of the actions and attitude of Solana's team and Abengoa's support.

In addition, the safety levels at **Mojave Solar** were also improved, reaching 381 days with no injuries requiring sick leave (Lost Time Incidents) in 2018. In addition, it achieved a very important milestone on 12 October after the plant passed the Guaranteed Energy Production Period.

Mexico



Work on the transmission line associated with the Norte III combined cycle plant.

Abengoa has been operating in Mexico since 1981 and its presence has been consolidated over time to become a leader of the energy and environment sectors, working on an on-going basis for the Federal Electricity Commission (CFE) and Petróleos Mexicanos (Pemex), in addition to private clients. Its main business lines are: transmission and distribution, generation of conventional and renewable energy, building and electromechanical and water installations (desalination plants, water treatment and water infrastructures).

Despite the levels of uncertainty in the energy sector, Mexico continues to be an important region for Abengoa for the experience accumulated in this country and in relation to the existing electricity requirements. The company expects to create a new portfolio for 2019, mainly with privately-run companies, with the aim of re-launching the company in the country and meeting the requirements of its Feasibility Plan. Likewise, Abengoa Mexico trusts that it will end the bankruptcy proceedings filed on 23 November 2018 and reach a restructuring agreement with its creditors.

One of the highlights of the activity dashboard prepared by the company in 2018 includes the reactivation of the work on the 230 kV transmission line, with a length of 21.1 km, associated with the **Norte III** combined cycle plant for CFE.

The completion progress was 96 % by the end of the year and the project was completed in March 2019.



Image of the work at the A3T efficient cogeneration plant

Likewise, the works at the **A3T 220 MW efficient cogeneration plant** continued, closing the year with a 99% progress. The associated transmission system was completed and the plant is currently in operation and delivering power to the grid.

In 2019, the company expects to start the development of the **A4T plant**, a 680 MW combined cycle plant, as well as to complete the divestment procedure of the A3T and the long-term financing for the plant. Finally, a positive agreement is expected to be reached in the Zapotillo project after issuing a waiver without liability in 2017.

Middle East



Abengoa is building the largest solar power complex in the world in Dubai.

The Middle East is a strategic region for Abengoa and so it operates in countries such as Saudi Arabia, Kuwait, United Arab Emirates, Oman, Qatar, Bahrain and Egypt.

At the beginning of last year, Abengoa became the successful bidder in a consortium with SIDEM, Veolia Group and SepcoIII to build a **reverse osmosis desalination plant in Rabigh**, with a capacity for 600,000 m³/day, which would become the largest plant using this technology built in the country until now. The desalinated water will be supplied to the state-run company Saudi Water Partnership Company (SWPC). (More information on [page 38](#)).

Moreover, the company was selected by Shanghai Electric Group Co. Ltd. in May as its technology partner for the construction of a solar thermal plant in Dubai. In particular, Abengoa will be responsible for developing the solar thermal power technology and for building a solar field with 3 x 200 MW parabolic troughs, storing 12 hours of energy in molten salts, for the largest solar power complex in the world, the **Mohammed bin Rashid Al Maktoum Solar Park**, owned by DEWA (Dubai Electricity and Water Authority). Abengoa's work will focus on phase IV of the complex, developed by DEWA in collaboration with ACWA Power.



Abengoa continues to work on the desalination plant in Salalah, Oman.

These new contracts strengthen Abengoa's position in the region, in which it has a vast portfolio that includes recently awarded projects, such as the Salalah desalination plant in Oman or the Shuaibah III plant in Saudi Arabia. In addition, Abengoa is currently participating in the construction of the **largest hybrid solar-gas power plant in the world, Waad Al-Shamal**, also in Saudi Arabia.

In fact, the company has already been selected in 2019 to work in the largest reverse osmosis desalination plant in the world, located in the Taweelah power generation and water treatment complex, 45 km to the north of Abu Dhabi (United Arab Emirates). With a treatment capacity of 909,000 m³/day, it will guarantee the supply of water for the city of Abu Dhabi throughout the entire year and it will be the first large-scale desalination plant in the country that combines the production of drinking water and the generation of clean energy, thanks to the installation of a solar photovoltaic field that will generate over 40 MWp.

Likewise, Abengoa recently became the successful bidder for the construction of another project in the United Arab Emirates: a reverse osmosis sea water desalination plant at the industrial complex of the largest premium aluminium producer in the world, Emirates Global Aluminium (EGA), located in Jebel Ali. In particular, Abengoa will be responsible for the engineering, supply of mechanical equipment and instrumentation and control, as well as the supervision of the commissioning process of a desalination plant that will produce over 41.000 m³/day of drinking water and water for industrial use.

Peru



Abengoa was awarded different works of the Shougang mining project in the region of Ica.

Abengoa has been operating in Peru for over 25 years and it specialises in providing comprehensive solutions to its clients, focusing on civil works, water and electromechanical projects, adding value to all of its stakeholders with its management model, focusing on safety, corporate social responsibility and its contribution to sustainable development.

Likewise, the company offers its asset management, supervision, operation and maintenance services for the electrical power transmission systems of public and private clients.

One of the last year's major milestones was the financial restructuring process of the company in this country, signing a new long-term financing agreement worth 30 MUSD, allowing the company to pay the existing debt and receive additional liquidity for the development of its current and future projects in Peru.



One of last year's milestones in Peru was the new contract for the electrical distribution project, part of the Santa Justa mining project.

In addition, the following achievements can be highlighted:

- › Renewal of the triple certification: Safety and Hygiene OSHAS 18001:2007, Environmental ISO14001:2015 and Quality ISO 9001:2015.
- › Provisional Acceptance (PA) of the project for the expansion and improvement of the drinking water and sewerage systems of the Esquema Independencia Unificada y Ermitaño system, region of Lima, which will serve 100,000 inhabitants.
- › First mining operation maintenance contract awarded, covering the electrical system and instrumentation of the new Shougang Hierro Peru concentration plant, representing the successful reactivation of the MV and LV distribution projects for the mining sector.
- › Two 22.9 kV distribution line contracts for the Minas Justa and Shahuindo mining projects, including the completion works of the Pampa Honda substation, located in the regions of Ica and Cajamarca, respectively.



Abengoa is completing a 220 kV substation in the Department of Cajamarca.

- › Contract awarded for the engineering, procurement and construction of the Quebrada Honda 2 substation and the 13.8 kV regulation substations, owned by Southern Copper Corporation, in the region of Moquegua.
- › Contract awarded for the design of the electricity transmission system of the 138 kV/ 69 kV Arondaya substation for the Southern Copper Corporation.
- › Contract awarded for the electrical installations of the main building, HPGR, milling, magnetic separation, flotation and strip of the mining project owned by Shougang Hierro Peru, region of Ica.

Abengoa's goals for 2019 include recovery of the market share in Peru and ensuring its active participation in mining, energy and public infrastructure projects.

South Africa

Abengoa began its operations in South Africa in 2009. Over this period, it has been responsible for the development of three of the country's most important solar thermal projects, as part of the South African government's "Renewable Energy Independent Power Producer Programme" (REIPPP), including the country's first solar thermal plant, **Kaxu Solar One**, and the first power-tower solar thermal plant, **Khi Solar One**.



Representatives of Abengoa, IDC and PIC during the opening speeches of the official inauguration of Xina Solar One.

In particular, Abengoa and its South African partners, Industrial Development Corporation (IDC) and Public Investment Corporation (PIC), were honoured to participate in the official inauguration of Xina Solar One in 2018, the last of the three solar thermal projects developed by Abengoa in South Africa. With the parabolic trough technology, a power capacity of 100 MW and 5.5 hours of thermal energy storage in molten salts, the plant started its commercial operation in August last year.

The inauguration was held in May and it was a very important event, chaired by the Minister of Energy and heralded by the South African Government for its importance.



Tweet of the South African Minister for Energy, announcing his arrival at the official inauguration event of Xina Solar One.

Likewise, Abengoa has continued with the operation and maintenance of the three plants during 2018, which have a joint installed power of 250 MW and use two different technologies: parabolic trough (two, 100 MW each) and tower (one, 50 MW).

The yield of all three was optimised throughout the year, with December 2018 being the month with the highest absolute production volume for each plant since the start of their operations.

Moreover, Kaxu Solar One, the plant using parabolic trough technology with a power capacity of 100 MW and capacity for the thermal storage of energy for 2.5 hours in molten salts, passed the guaranteed production test in October. This is a vital commitment associated with the EPC construction contract of the plant, which will also require the correct performance of the operator during the warranty period to pass the tests successfully.

Likewise, Xina Solar One passed its corresponding guaranteed production test in November. In addition, in this case, it was achieved in record time, after the start of commercial operation of the plant in August 2017.

On the other hand, Abengoa received an important award in May at the Industry Awards of the African Utility Week. Xina Solar One received an award in the category of +10 MW renewable energy projects connected to the grid, competing in the final phase against two photovoltaic power plants from Uganda. The eighteenth African Utility Week was held in 2018 and the event's award-giving ceremony was attended by more than 800 professionals of the African continent's energy and water sector.



Javier Payán (left), CFO of Abengoa South Africa, receiving the award given to Xina Solar One at the 2018 African Utility Week.

All of the above was achieved thanks to the excellent performance of the Health and Safety areas, in response to Abengoa's strategic commitment in this area. There were only two incidents requiring sick leave of one of Abengoa's employees or subcontractors in all three plants during 2018, a very relevant result if we take into account the number of hours worked.

The protection of the environment has also been one of the pillars of Abengoa's activities in South Africa during 2018, in accordance with its corporate strategy and with the commitments acquired in projects adhering to the REIPPP.



Flamingos at the evaporation pond of Khi Solar One.

Uruguay



Antel Arena is a multi-functional complex with a gross built surface of 40,500 m² and with the capacity for 10,000 seats.

Abengoa is present in Uruguay through its subsidiary Abengoa Teyma. The company has been working in the fields of engineering, construction and industrial services since 1980, as well as in areas associated with the forestry and waste management sectors, among others.

One of the main milestones achieved by the company in 2018 was the successful restructuring of Abengoa's debt in this country, after signing a new long-term financing agreement for the acquisition of all existing debt, as well as providing the company with new local liquidity, which will allow it to operate under higher levels of flexibility for the development of its current and future projects in Uruguay.

It is also worth highlighting the completion of the works at the Antel Arena multi-purpose complex in Montevideo. The building was officially inaugurated in November in an event with music and art and attended by Dr Tabaré Vázquez, President of the Republic, and other important figures of the central and municipal government.

The execution of the works represented an important milestone, not only because the arena is one of the largest in the world and because it overcame important construction and technology challenges, but also because it managed to build a flagship space in Uruguay.

In particular, Abengoa's scope in the project included all civil works on the building, the reinforced concrete structure, roof, masonry, inner finishing work and sanitation installations, among other tasks.

Moreover, Abengoa signed a contract for the development of the executive project and construction of the sanitary landfill for a 30,000-ton capacity and the operation service for up to 12,500 tons of municipal solid waste of Fray Bentos, Río Negro Department.

With this contract, signed with Intendencia de Río Negro on 28 August 2018, the final waste disposal concept is changed from an open-sky dump site to a sanitary landfill, an engineering solution that minimises the environmental impact, resulting in a higher quality of life for the region's inhabitants.



Recreation of the Capurro Fishing Port project developed by Abengoa in Uruguay.

Other achievements of 2018 include:

- › The activities of the **rail restoration project** continued, achieving much progress in the works after installing more than 100 km of the tracks, for a total of 280 km out of the 327 km to restore, having laid approximately 130,000 sleepers and over 170,000 m³ of ballast. Moreover, additional progress was achieved in the reinforcement tasks of 46 railway bridges.
- › The development phase of the **Capurro Fishing Port executive project** was completed, making progress towards the final stage to receive the environmental authorisation. This project involves the construction of approximately 700 metres of wharfs for industrial fishing vessels, filler of a backfill area of 3.3 hectares, dredging

the corresponding dock and its final layout using the geo-container technology.

- › At the close of 2018, the progress was of approximately 25 % in the installation of **sanitation networks** and of 50 % in the replacement of the drinking water lines of the Sanitation project for Zone B3 of Ciudad de la Costa. The works included the installation of approximately 40 km of sanitation networks and the replacement of 32 km of drinking water lines, in addition to the replacement of the paved areas of the project.

The company will face important challenges in 2019. Regarding execution, the works in Capurro Fishing Port are currently starting, and will be executed over a 30-month period. It has also started the Fray Bentos sanitary landfill works, because of their environmental importance. Moreover,

in reference to new contracts, the company's expected turnover levels must be maintained to guarantee a diversified and profitable project portfolio.

Finally, and equally important, Abengoa must continue with the on-going improvement of its occupational health and safety indicators, which consolidates its leading position in different sectors, among other things.



Abengoa is responsible for the restoration work on 327 km of railway lines.



Innovation

ID1, ID2, ID3_4

Technological development continues to be Abengoa's main competitive advantage in high value-added projects. The company executes technology development and commercial projects that improve the performance features of its current products and services, in addition to the acquisition of new skills.



Technology development continues to be one of the main competitive advantages of Abengoa.

Main figures	2018	2017	2016
Investment in R&D and innovation (thousands of €)	1,420	621	4,762
Personnel	19	25	232
Total number of patents granted since 2008	342	395	294

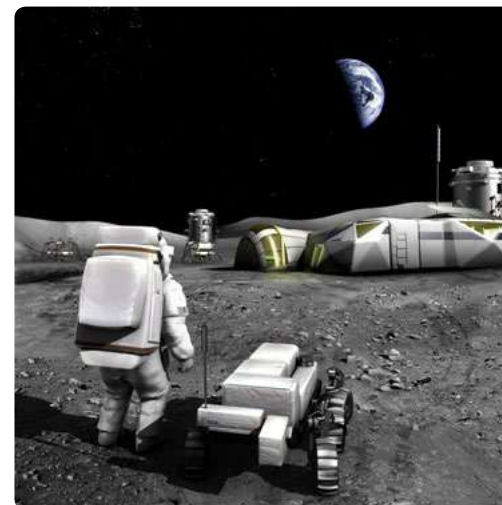
Abengoa focuses on these activities in three main sectors: aerospace, electrical power systems and hydrogen.

- › **Aerospace:** during 2018, Abengoa played an active role in the development of the future Ariane 6 and VEGA-C European launchers for Airbus DS and AVIO, two of the leading European aerospace contractors, who will receive the testing systems that will be used for the qualification of the control and power distribution units of these launching systems.

In addition, Abengoa was awarded the two first contracts for a new line of development of the European Space Agency (ESA). Known as In-Site Resources Utilization, it involves using natural resources from other planets and satellites (such as the moon) to create an environment that is suitable for life. This line of development includes the generation and

storage of energy or the production of H₂O, O₂, H₂, etc., creating important synergies with the activities of other lines of business and allowing Abengoa to become a pioneering company in space in the activities in which it already is a leader on Earth.

Likewise, Abengoa continued with the development of defence products during 2018, a line in which it has already shown its commitment, by improving and certifying its power distribution unit for land vehicles.



Abengoa has had an active role in the development of projects in the aerospace sector. Copyright: ESA

- › **Electrical power systems:** Abengoa works in innovative energy control and storage technologies to improve the levels of safety, quality and flexibility of the electrical system, allowing a greater integration and improved management of renewable energies.
- I. **Storage systems:** analysis, development and integration of energy storage technologies, mainly electrochemical, such as Ion-Lithium, Flow and NaS batteries and supercapacitors, and the analysis of new technologies, such as Zinc-Air, Ion-Lithium variations, Magnesium-Air, etc.
- II. **Control solutions:** development of new algorithms and strategies to control energy assets, mainly storage and renewable energies. In this line, Abengoa is developing Abengoa Energy Management System (AEMS), a proprietary control platform, which offers many different services with a high economic impact, guaranteeing compliance with the strictest technical interconnection requirements.

The main milestone achieved in 2018 was the design and start of assembly of the demo unit for which Abengoa is responsible in the Flexitranstore project (GA No. 774407), funded by H2020. This demo unit will have a storage capacity of 1MW/2MWh. It is being installed in Seville and it will be transferred to Cyprus during 2019, where it will be connected to an electrical substation, offering a power management service to the local distributor.



Abengoa is responsible for the assembly work on the demo unit of the Flexitranstore project

During 2018, Abengoa was awarded a new project, E-Magic (GA No. 824066), as part of the H2020 call for proposals, which will start during the first months of 2019; the company will face the challenge of developing magnesium batteries for their use in energy storage applications as an alternative to Ion-Lithium batteries. The use of batteries provides advantages in terms of density of energy, price and safety.

- › **Hydrogen:** Abengoa is also developing hydrogen and fuel cell technologies. The main technology focuses on the design and development of solutions for the production of hydrogen and its use as a fuel that can produce energy in fuel cells. Main work areas:

- I. hydrogen plants with electrolysis and hydrocarbon and alcohol reforming;
- II. power plants that use fuel cells;
- III. hydrogen service stations used to refuel vehicles;
- IV. hydrogen energy storage plants, using a combination of production, storage and electricity generation technologies, and
- V. special projects (adaptation of the hydrogen technologies and fuel cells for the defence and aerospace sectors).



Hydrogen service station

The Grasshopper project (GA No. 779430) was launched during 2018, a project funded by H2020. The expected result of this project is the design of a flexible, modular and low-cost electricity generation system that uses MW-scale fuel cells. The design will be validated with the design, construction and operation of a small-scale demo system (100 kW). Abengoa has worked in the design of this modular and cost-effective system, which will be installed in Delfzijl (Netherlands) after the validation process carried out in Seville during 2019.

The Hydrosol-beyond project (GA No. 826379) will start in 2019, which is mainly aimed at the production of hydrogen with the use of concentrated solar power.

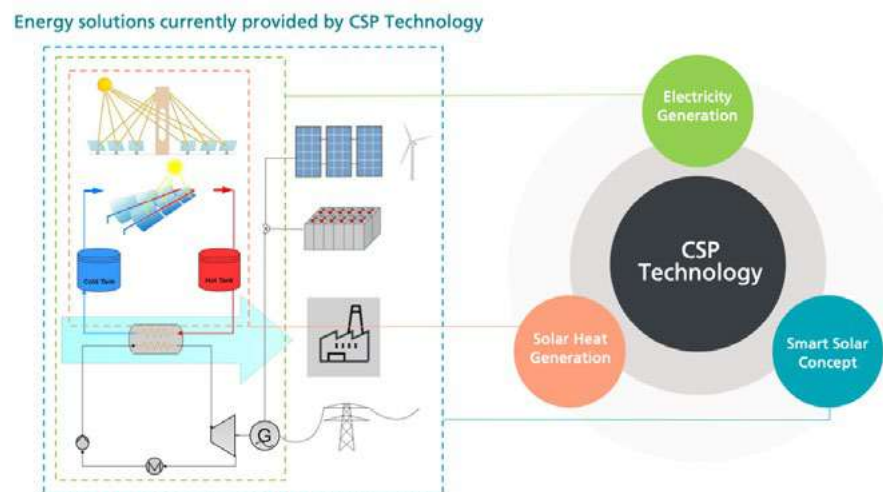
Main lines of technological development

R&D and innovation in the solar thermal area

Abengoa continues to prioritise on the innovation of its products to maintain its global leadership position in the solar thermal sector.

Abengoa's portfolio of technology solutions provide a response to cater to the maximum manageability requirements of energy demand. Thanks to the know-how accumulated since its establishment, Abengoa has designed and promoted a new generation of renewable energy plants in which the low cost of photovoltaic power (PV) and the manageability of solar thermal power (CSP) with thermal storage (TES) are all present in a single facility. These are solar plants

with hybrid technology or Smart Solar Plants, which have been developed and optimised by Abengoa during this last period and which is expected to achieve a big reduction in the cost of energy, thanks to the on-going progress achieved in R&D&I, one of the company's main priorities.



Graph SSP ES

The company has incorporated new hybrid manageable solutions into its portfolio, which allow the decarbonisation of conventional thermal power plants. Moreover, Abengoa is committed to developing new solar thermal power applications in the process heat production field, designing solutions that are adapted to the needs of strategic sectors, such as mining and the chemical and petrochemical industries.

The optimisation of the cost and accuracy has been and will continue to be a priority development. Progress has been made on the optimisation of the wind loads used to design solar field components. The activities focusing on tracking control and monitoring will continue to be a priority, in addition to the study of other critical systems, such as the corrosion of materials and degradation of heat storage and transmission fluids in advanced solar thermal plants. Regarding the work undertaken during 2018, the following can be highlighted:

› **Design of a new production model.**

- I. Abengoa has created a model for photovoltaic power plants that corrects errors and adds new functions to the main commercial software used in the sector. The production model can be used to dimension the systems that make up the installation and calculate the production rates that can be guaranteed with high levels of accuracy, reducing the risk for Abengoa. In addition, this will allow the integration of Abengoa's traditional production models to the tower and parabolic trough technologies (saturated steam, overheated steam and molten salts), with the PV model to study and optimise hybrid technology plants.
- II. In addition, another hot pressurised water, saturated steam and overheated steam generation model for industrial applications has been designed. The production model can be used to dimension the systems in the installation and calculate the production rates that can be guaranteed with different CCP types.
- III. Integration of emerging energy storage technologies into Abengoa's production models: electric batteries and electric molten salt heating systems. This will allow new plant configurations to be studied, one of the current demands of the solar power sector.

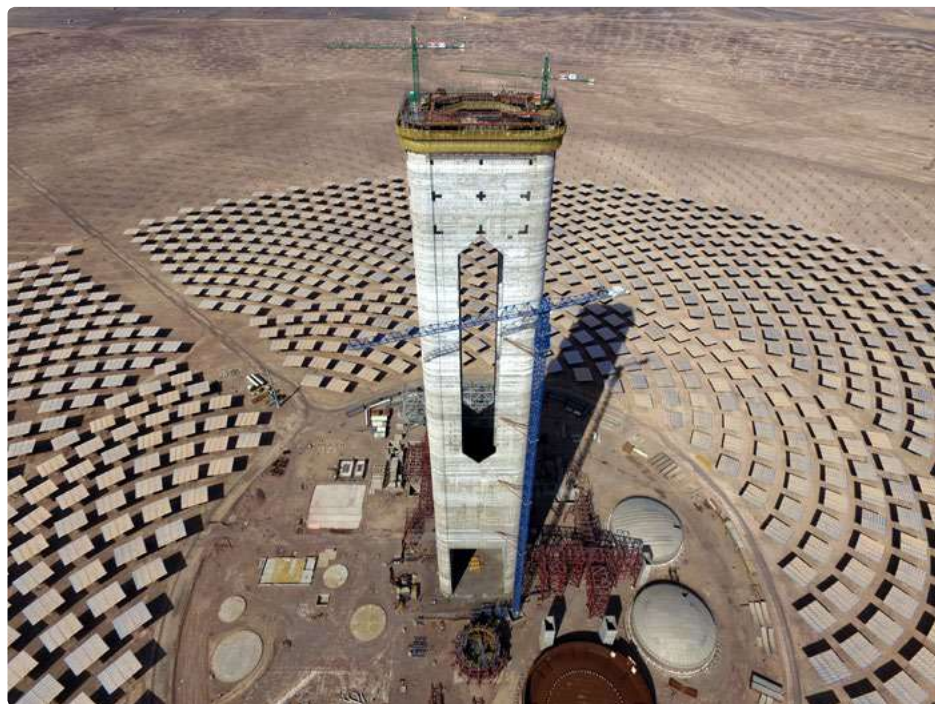
› **New software for the optimised design of components.**

- I. Optimised implementation of heliostats with a variable size and geometry (polygon and circle), maximising their performance while minimising the land used for such systems.
- II. Calculation of the yield of solar fields with variable geometry heliostats (polygon and circle), based on Ray Tracing techniques, which provide highly reliable results.

› **New tools for the optimisation of the start-up and tracking operations.**

- I. Optimisation of the molten salt solar collector pre-heating process, integrating the readings of IR cameras, the control algorithm of the heliostat field, flowchart map simulations and surface tube temperature simulations. This technology has been developed for the commissioning of the solar receivers of the Luneng Haixi (China) and Cerro Dominador (Chile) projects.
- II. Tracking system optimisation. Azimuth and elevation positioning system, with new high-accuracy sensors on both axes, with the optimisation of their installation on the heliostat structure.

› **Study and validation of the dynamic behaviour mechanisms of molten salts** in the receiver and storage tanks, as required to optimise the design of these key components and guarantee their durability and reliability throughout the project.



Cerro Dominador, 110 MW plant, under construction.

Likewise, Abengoa fosters the creation of international partnerships and focuses on new high-temperature technology developments, highlighting the solarisation of industrial processes, with its main milestones achieved in 2018 including its participation in the Solpart and Sun-to-Liquid projects.

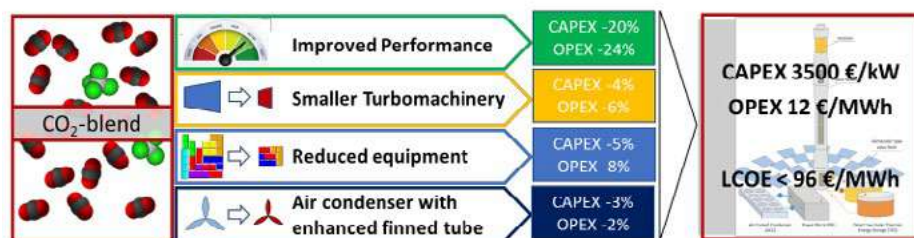
- › **Solpart:** project funded by the European Union as part of the H2020 call for proposals, aimed at developing a pilot-scale project for a high-temperature (950 °C) 24h/day solar process suitable to treat the particles of industries with a high consumption of energy, such as the cement and limestone production industries. The project aims to supply all or part of the thermal energy required for the calcination of CaCO_3 and the construction of a pilot plant was recently started for the validation of the fluidised receiver in which the calcination process will be carried out.



Pilot plant of the "Sun to Liquid" project in operation, located at IMDEA's facilities.

- › **Sun-to-Liquid:** project funded by the European Union as part of the H2020 call for proposals, aimed at designing and building a pilot plant for the validation of solar kerosene production for the aviation industry. The pilot plant located at IMDEA's facilities was completed and commissioned in 2018. It will be used for the first validation of the entire production chain, from sunlight, H_2O and CO_2 to liquid hydrocarbon fuels.

Abengoa continues to work on the development of new super-critical cycles, with the purpose of seeking for power cycles with a higher yield that can reduce the cost of CSP energy. The main milestone achieved in 2018 in this area was the award of the EU's Scarabeus project as part of the H2020 programme. The aim of this project is to develop and implement a super-critical and high-efficiency CO_2 cycle in concentration plants. The project budget is € 4,950,266.25 and nine partners will participate in the project (four universities and five companies).



In 2018, Abengoa was awarded the Scarabeus project.

In 2019, it will continue to provide its technological support for the development of commercial plants during the design, construction and operation phases. Different work groups specialising in the most critical systems of each technology are available to provide technical support during the design, procurement and manufacturing of the main units.

Finally, Abengoa continues to promote the creation of a network of strategic collaborators from different national and international universities and research centres, developing specific projects and medium- and long-term collaboration agreements, which will allow researchers to collaborate in different locations and transfer knowledge.

R&D and innovation in the rail industry



Abengoa continues to work in rail innovation projects, such as Broken Track, a project that involves the detection of rail breakage.

In 2018, Abengoa continued to participate in the following rail innovation projects:

- › **The Railway Innovation Hub:** Abengoa is the Vice President of this cluster of rail companies based in Malaga, aimed at becoming a national and international benchmark in railway innovation.
- › **Broken Track project:** real-time rail breakage detection system created by Abengoa.
- › **Development of the BIM (Building Information Modelling) tool for railway environments:** used for the creation of a tool that can adapt the layout of overhead contact lines and substations automatically.
- › **Alis Project:** we are still in the marketing stage of this comprehensive railway electrification system simulation tool.