07

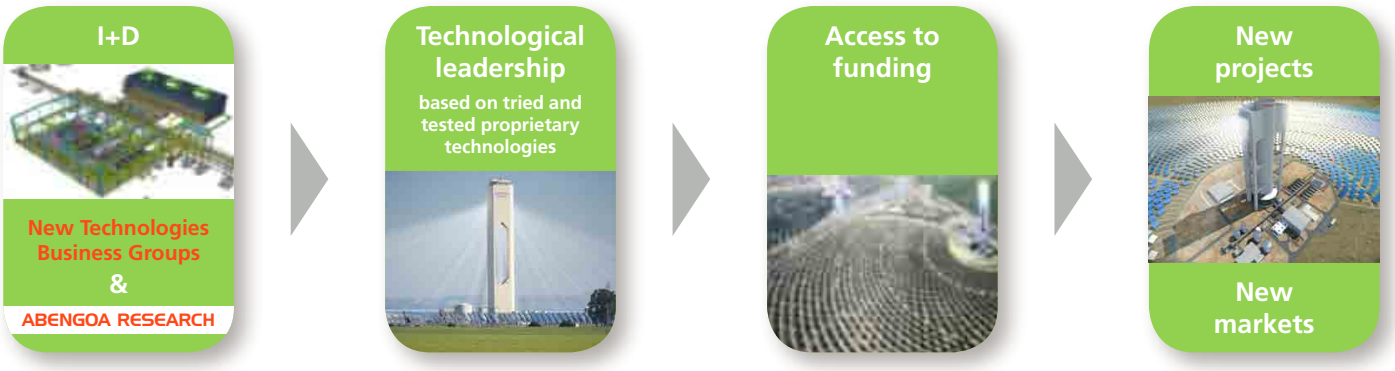
Abengoa and innovation

Key figures	2012	2011	2010	Chg. 12-11 (%)
Patents applied for (cumulative)	203	153	113	33 %
Number of doctorate holders	50	36	22	39 %

R&D+i as a growth driver

R&D drives Abengoa forward towards technological leadership

Abengoa has set itself up as a technological company and, as such, research, development and innovation (R&D+i) is what drives it forward as the company relies on proven and tested proprietary technology to penetrate new markets and regions. At Abengoa, technological leadership is what affords the company its competitive edge. It is also highly valued by lenders and is one of the key factors that investors look for.

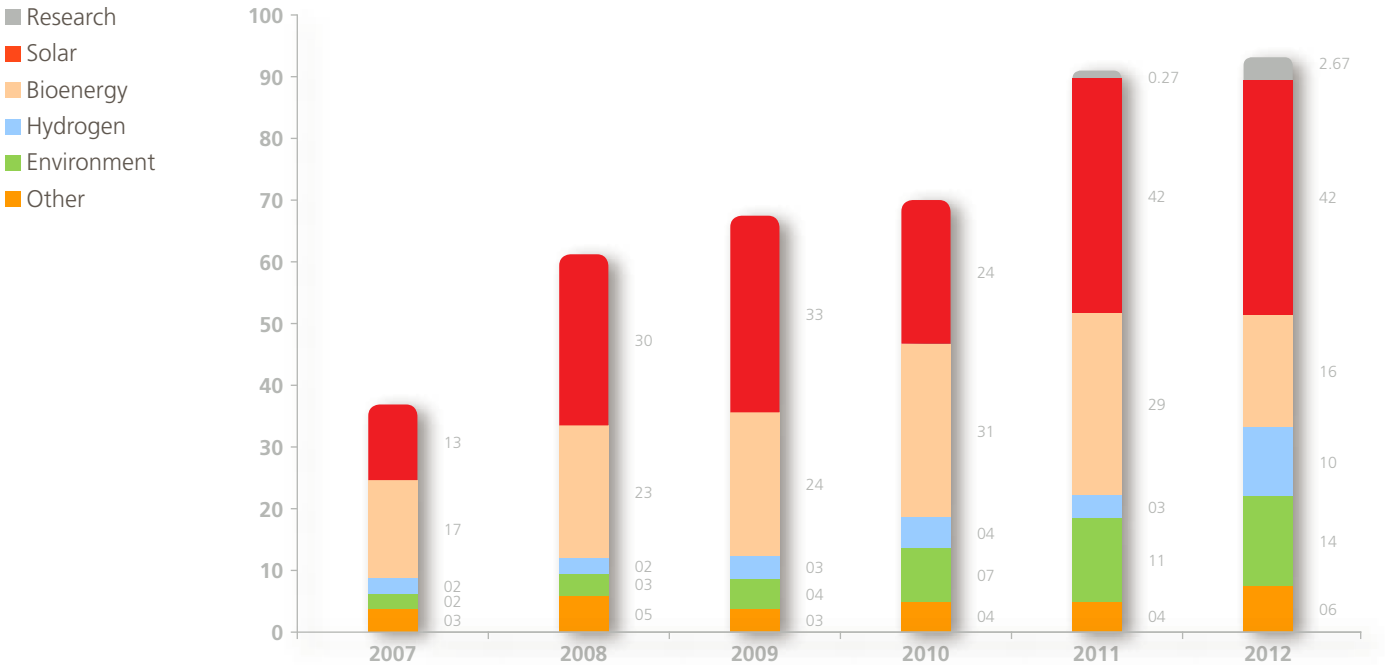


R&D+i investment in 2012 amounted to €91,3 M, marking a 0.6 % year-on-year increase, accounting for approximately 1.2 % of revenue and placing annual growth in investment at 20.7 %. This figure does not factor in investment in innovation, which, though not readily quantifiable, is a key element of Abengoa's strategy.

Most of the company's investment in R&D+i is channeled into developing technology within the energy and environment business lines. This has enabled us to create new value-added products and processes while improving upon existing ones.

The table below shows how Abengoa's investment in R&D has evolved over recent years by sector.

Abengoa remains committed to R&D+i, ramping up its investment year after year



R&D+i management at Abengoa mirrors the global strategy of the company as a whole and of each business unit and has three aims: new products, new processes and improvements to existing assets through R&D+i programs.

The R&D+i projects undertaken by Abengoa are continuously reviewed and updated through an efficient management system, which employs systematic company-wide tools with which all members of the company are fully familiar. The main tools used by Abengoa include R&D+i assessment, the Stage-Gate process, and the creation of a patents office and technological surveillance within the company. This all helps to improve decision-making processes by creating a pipeline of performing projects and ensuring that resources are swiftly earmarked to the most attractive projects.

Abengoa Research

Abengoa Research, created in February 2011, is engaged in technological research and development activities within the fields of energy and sustainable development. This research center, a forerunner in private research in Spain, is intended as a top-rank science and technology center, valorizing our accumulated knowledge by developing existing and future real applications. By engaging in R&D, Abengoa Research seeks to expand upon existing knowledge while generating new approaches, rooted in our scientific knowledge of the state of the art and the multidisciplinary skill sets of our human team.

The company's specific objectives are akin to those of a research center but are tailored to Abengoa's strategy and geared towards the present and future business needs and interests of the company. This includes generating and exploiting patents and other intellectual and industrial property and conducting studies, preparing reports and performing scientific-technical projects.

Projects to date have focused on the areas of research in which Abengoa is currently interested: solar power, bioenergy, water, waste, hydrogen, ocean energy, and so on. The center has also been working on an Abengoa-specific strategic technology agenda for the coming years in relation to the areas described above.

This agenda includes seven programs and 26 lines of research, under which the company has already rolled out a number of specific research projects, which are continuously reviewed to bring them in line with Abengoa's changing needs.

Technological agenda
Abengoa Research

Physico-chemical engineering

- Production of carbon-based added value materials and lignin recovery
- Biofuel production

Biotechnology and microorganisms

- Synthetic biology in the design of microbial cell factories
- Bioremediation
- Production of biofuels from microorganisms

Ocean and atmospheric engineering

- Aerodynamics and aeroelasticity
- Fluid, structure and soil interaction in ocean engineering
- Pollution analysis and contamination control

Thermophysical problems and systems

- HTF and TES solutions
- Transport phenomena in complex fluids
- Advanced Solar Energy Systems
- Hydrogen storage and CO_2 capture

Technological agenda
Abengoa Research

Structural materials and systems	Functional materials and smart systems	Electrical engineering
▪ Damage Tolerance Design and Structural Health Monitoring ▪ Surface protective coatings and corrosion ▪ Self healing materials ▪ Virtual materials design and characterization	▪ Smart surfaces ▪ Materials for membranes and porous systems ▪ Nanostructured thin films ▪ Smart fluids ▪ Conducting polymers	▪ Distributed power systems ▪ Electrical energy storage ▪ Power electronics based power processing ▪ Smart grids ▪ Sensing and control of complex systems. Sensor networks ▪ Thermoelectricity

Abengoa Research has been tasked with working alongside the different Abengoa companies engaged in R&D+i, providing basic research solutions, helping to disseminate research findings throughout the international scientific community and developing disruptive technologies likely to have a major impact in the future. Through this invaluable work, Abengoa Research aims to ensure continued growth for the company while helping it cement its position of international leadership.

R&D+i projects in 2012

Included below is a brief description of the main R&D projects undertaken by Abengoa companies over the course of 2012:

Waste to Biofuel

The aim of this project is to provide a one-stop solution to one of the greatest problems of the twenty-first century, namely the increase in municipal solid waste. To achieve this, Abengoa combines various different treatments, including hydrolysis and fermentation of organic material to produce ethanol, depolymerization of common plastic to produce diesel and recycling of materials for subsequent reuse.

Zinc recovery

By applying a reducing agent (hydrogen or syngas) to the waste generated during the Waelz recycling process, the company is able to reduce the amount of toxic waste generated by the process while increasing the yield of zinc recovered from steel dust.

Solugas

Abengoa is working on the third generation of solar thermal power tower technology, which will be able to compete with combined cycle gas turbine plants. A demonstration plant featuring hybrid solar-gas power technology has already been operating since May 2012.

Pilot Solugas plant located at the Solúcar Platform, the world's largest solar R&D+i center

CRS Molten Salts

Abengoa's aim with this project is to demonstrate the viability and efficiency of generating super-heated steam by passing molten salts through a steam generator. The demonstration plant has been in operation since May 2012.

Biofuel reforming for hydrogen production

One the techniques used to obtain renewable hydrogen is biofuel reforming, whereby biofuel molecules are broken down by mixing biofuel with water steam or oxygen, or a mixture of both, in the presence of a catalyst and at a high temperature, in turn generated by combusting part of the biofuel or another waste.

Remineralization

During the desalination process, remineralization is commonly used to make water produced through reverse osmosis technology drinkable and to ensure the quality of the end product.

Ocean energy

Ocean waves and currents provide a source of renewable energy from which we can generate electrical power. Abengoa is strategically involved in the development of this technology, which has considerable future potential.

Energy storage

Energy storage can herald major improvements to the global energy system and can be deployed from initial generation through to final consumption, embracing the entire distribution and control system.

Butanol

Butanol has an energy content similar to that of gasoline and is one of the areas in which Abengoa is currently working within the field of biofuels. It has the advantage that the same infrastructures as those for conventional fuels can be used, thus eliminating the need for new plants and processes to bring it to the market.