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Innovation, our tool

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Innovation is a **key** factor on the path towards a **sustainable** and more highly **developed world**, with a higher level of well-being for all. It is a **dynamic process** that is carried out by utilizing all of the resources available to the society of knowledge, science and technology. A commitment to **innovation** is tantamount to a commitment to **sustainability**.

Abengoa is a company with a strong technological base, one in which research, **development** and **innovation** (R&D+i) constitutes **the key driver behind its growth** and value creation. One of the company's principal objectives is accomplished through R&D+i: acquiring essential competencies through the generation of future options.

"Committed to innovation means committed to sustainability"

Innovation as a competitive edge

Abengoa occupies a position of international leadership in a significant number of key areas of the **"green economy"**, where the company upholds an ongoing commitment through its innovation policy and strategy to promoting sustainable use of resources and raw materials spanning their entire lifecycle. Abengoa focuses its push towards innovation on renewable energies. Sources with low environmental impact and higher energy efficiency provide the basis for driving forward and implementing these technologies. This technological development leads to a reduction in greenhouse gas emissions and less reliance on fossil energy sources.

In order to meet the challenges the company takes on, Abengoa has set up research facilities in a variety of places around the world, including, among others, Seville and Madrid in Spain; Denver and New York in the USA; Arnhem in Holland; Duisburg in Germany; and Montevideo in Uruguay.

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Abengoa also leads alliances with international partners with the aim of developing competitive proprietary technology in the field of renewable energies by adopting an **"innovation ecosystem"**, meaning a system through which to foster collaboration among universities, government agencies, public research institutes, technology centers and businesses in order to create knowledge networks. These institutions include: the aerospace center, DLR (Deutschen Zentrums für Luft- und Raumfahrt) and the Fraunhoufer ISE in Germany, the National Renewable Energy Laboratory (NREL) in the USA, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia, the Centre National de la Recherche Scientifique (CNRS) in France, the Consejo Superior de Investigaciones Científicas (CSIC) and the Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT) in Spain, in addition to highly prestigious national and international universities, such as the University of Rochester and the University of California Merced in the USA.

Key areas of activity

Abengoa has been working on **electrical power generation** based on substituting fossil fuels for **solar energy** and on developing energy storage technologies.

In the area of **biofuels**, company activities are focused on the development of technologies for producing biofuels from lignocellulosic biomass, especially bioethanol via enzymatic hydrolysis and gasification and catalytic synthesis of alcohols; in addition to obtaining high added-value bio-products.

The company also provides solutions spanning the complete **water** cycle, centered on the development of reverse osmosis desalination technology, which enables drinking water to be obtained from sea and brackish water, as well as the development of technologies for treating wastewater for subsequent regeneration to enable reuse, thereby generating new water sources wherever water is in short supply.

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Through its **marine power** business line, Abengoa participates in a variety of R&D projects via consortiums, noteworthy among which are the Cenit TEcoAgua project and the SOWFIA (Streamlining of Ocean Wave Farms Impact Assessment) project to harness wave energy.

Abengoa is likewise working on the development of new **hydrogen production systems** based on renewable sources, as well as second-generation fuel cells. The company is also involved in **CO_2 capture** and **storage programs** as a way to eliminate GHG (greenhouse gas) emissions into the atmosphere.

Managing innovation

"In 2011, we invested 90.6 M€, 31 % up on the previous year"

Innovation management at Abengoa is part of **company strategy,** formalized through a three-horizon approach in which R&D+i programs are defined with a view to developing new products, processes or services, or innovating existing products, processes or services. Conceived long-term, up to 30 years, R&D+i programs are undertaken partially over 10 years and in specific 3- or 4-year projects. These are the projects in which Abengoa's R&D+i materializes.

Abengoa's research and technological innovation projects are developed according to stage-gate model, which alternates developmental stages with critical control points in order to thereby achieve a framework for excellence and alignment with the company's strategic objectives.

With a view to R&D decision-making and activity follow-up processes, in 2010 Abengoa implemented an **indicator system** devised in accordance with the basic principle of "what cannot be measured cannot be improved", and which enables the company to assess the tangible and intangible aspects of innovation. The purpose of the system is to create a quantifiable reference framework for measurement and analysis of R&D+i at Abengoa. The company also intends to disseminate and use the system as a means of enhancing innovation management and decision-making. In 2011, Abengoa also started reporting on the investment drive indicator, enabling it to gauge the correlation between R&D investment and sales.

System of R&D indicators:

- **R&D personnel,** including all personnel directly employed in this area, as well as those who provide services directly related to R&D activities, such as directors, administrators, and office personnel.
- **Number of patents applied** for per year.
- **R&D investment,** defined as the total sum of gross annual R&D expenditure, including in-house operating and capital expenses.
- **Investment drive,** which correlates R&D investment with sales in percentage terms.

At Abengoa, most of our R&+i investment is channeled into applied research and the development of technologies that will allow us to reach our strategic objectives relating to sustainability and new products.

Investment in R&D totaled **90.6 M€** in 2011, up 31 % on the previous year and amounting to approximately 1.3 % of revenue and 12 % in annual growth from the **investment** (CAGR06-11).

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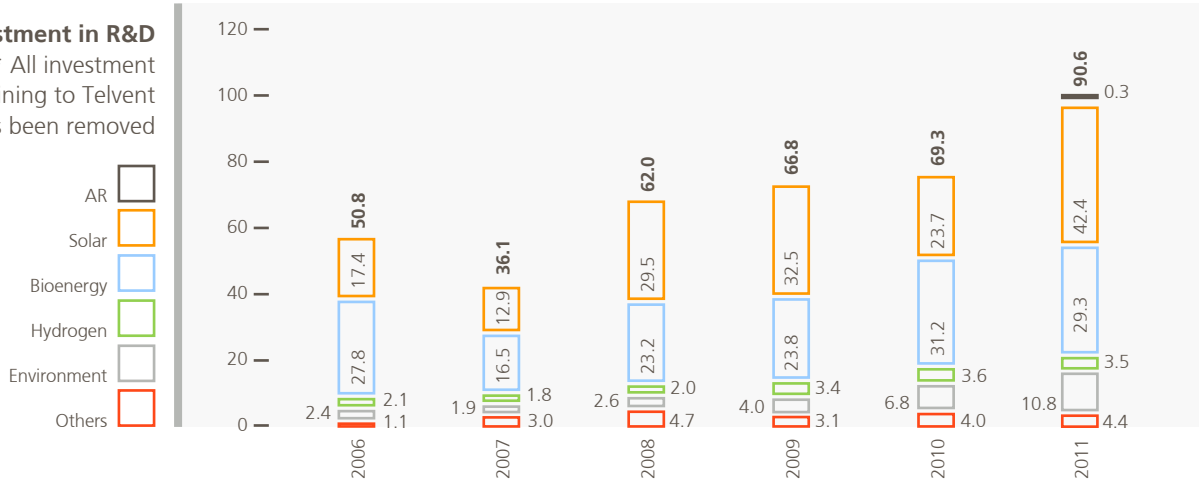
The table below shows the area distribution of R&D investment at Abengoa in recent years:

Investment in R&D
* All investment pertaining to Telvent has been removed



Due to the rise in the number of patents, in 2011 Abengoa began to implement a technological monitoring and knowledge protection system in order to ensure more efficient management of the entire patent portfolio and ascertain the state of the art of the different technologies worldwide.

The table below shows the evolution in the **number of patents** and the number of Abengoa **personnel involved in R&D** work between 2009 and 2011.

Innovation indicator system	2011	2010	Var. 11-10 (%)
Accumulated patents	190	122	56
R&D personnel	682	563	6.6
Investment drive (%)	1.31	1.40	(6)

R&D assessment

As an essential part of the range of actions **geared towards managing innovation** at Abengoa, the **R&D** assessment process is intended to help achieve the company's **strategic objectives** while at the same time **minimizing risks** linked to R&D+i project investment decisions.

In this regard, the first steps were taken in 2010 by devising a common, company-wide methodology to enable quantification of R&D+i at Abengoa, both in economic terms and in terms of value creation. In 2011, R&D was evaluated throughout the company by applying this methodology to Abengoa's R&D programs.

The overriding aim of this exercise is to provide useful information in order to enhance the quality of strategic **R&D+i** investment **decisions**, introducing qualitative and quantitative aspects, and taking into account the entire range of criteria that should affect the final decision.

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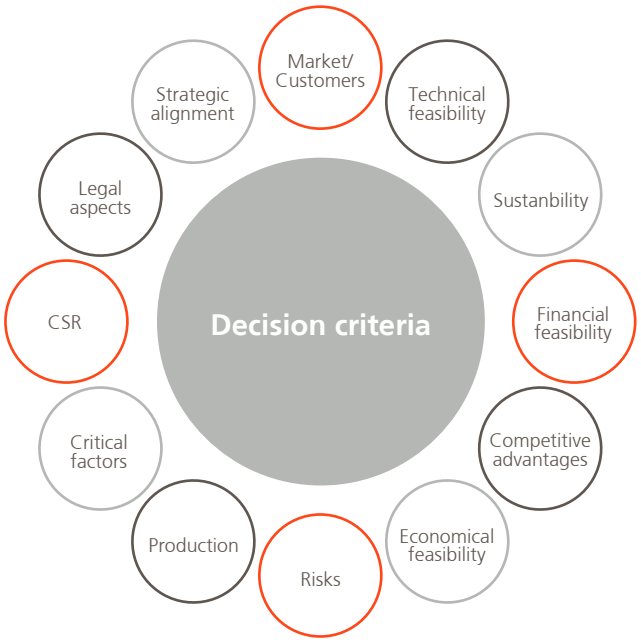

Criteria incorporated into R&D assessment

R&D assessment involves reflecting on essential issues related to company strategy: how defined programs fit in with strategy, how projects and programs are aligned, or the way in which risk is diversified. It also enables analysis of the viability of the different lines of work, with costs and returns considered globally. This allows Abengoa to identify the impact of R&D on the company's present results and on its short-, medium- and long-term projections.

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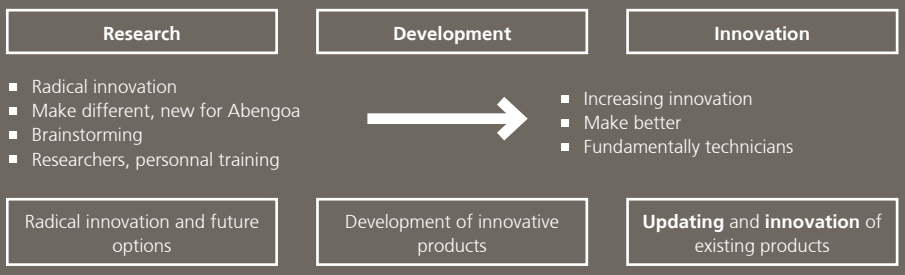
Abengoa Research

The greatest human and business advances have been the result of technological development. Leading companies that have managed to maintain their positions of leadership over the years have invariably done so on the basis of their technology.

2011 marked the creation of Abengoa Research, a new **Abengoa subsidiary devoted to R&D** and established as the core instrument in the company's focus on innovation. This focus has materialized over the years in the company's commitment to knowledge and technological and business leadership.

Abengoa Research began conducting its activity in October, embracing the vision of becoming an international point of reference in R&D, and to this end pursues the following objectives:

- **Generating knowledge** and promoting the application of this knowledge in the area of energy and sustainable development.
- Serving as the **technological base** for all of Abengoa's present and future businesses.
- Delivering **competitive edges** to the company's business areas on the basis of research and technological development.
- Providing **high-level technical support** services to the company's business units.
- Contributing to the **development of new technologies** and calculation, design and verification tools.
- Raising the scientific and **technical standard** of the company's R&D projects.
- Training **highly qualified personnel** in the scientific and technical areas related to the company's businesses.
- **Disseminating scientific and technical advances** that may be relevant for Abengoa's activity.



Abengoa Research will conduct its research activity in the following areas of knowledge:

- Functional and structural materials and nanotechnology.
- Fluid mechanics.
- Solid and structural mechanics.
- Thermal engineering.
- Process engineering.
- Biotechnology.
- Engineering and electrical networks.

To reinforce this unwavering commitment to R&D, Abengoa and the Universidad Loyola Andalucía Foundation have set up **Loyola-Abengoa Research (LAR)**, Andalusia's first joint university-corporate R&D center.

LAR, which will be located at Abengoa's Campus Palmas Altas **headquarters in Seville, is a center for research in the area of renewable energies and sustainable development,** created as a scientific and technological forum capable of proposing solutions for the future, and as a platform for training professionals dedicated to R&D+i.

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2011 milestones

- Over 1,800 hours of operation for the Eureka superheated steam plant.
- Development of:
  - **Thermal storage and heat transfer fluid (HTF) systems.**
  - **Heliostats** enabling 20 % cost reductions.
  - **Experimental plant in Cartagena where a variety of algae process configurations** and technologies will be tested.
  - **Post-treatment system for remineralization** of desalinated water through reverse osmosis, which achieves savings of 15 % over conventional systems.
  - **Wastewater treatment** system based on pressurized filtration and proprietary microfiltration membrane technology.
  - Hydrogen storage processes based on **hydrosilanes and aminoboranes**, and start-up of the borohydride-based system.
  - Portable fuel **cell-based electrical power generating** systems.
  - **Kinetic storage** devices, also referred to as inertia wheels, in different applications.

Parabolic troughs at an Abengoa solar plant

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Improvement areas

Abengoa's **commitment to innovation** necessarily implies continuous improvement. Thus, as described in previous years, R&D assessment has been conducted across the company's different sectors of activity, encompassing a **lively and dynamic process** which **feeds itself**, thereby enabling ongoing monitoring and detection of areas for technical and process-related decision-making improvement.

Future goals and challenges

Having introduced **Abengoa Research**, the greatest challenge now facing the company is its consolidation as an international reference point for cutting-edge R&D in the area of energy and the environment.

In the field of **second-generation biofuels**, Abengoa was selected to design, build and operate the US Department of Energy's (DOE) major biorefinery demonstration plant located in Hugoton, Kansas, construction of which began in September 2011.

The aim of the project is to turn approximately 300,000 t per annum of agricultural waste, such as corn stubble (stalks and husks) into approximately 100 ML of biomass ethanol per year (around 23 Mgal), using an innovative process of enzymatic hydrolysis. The plant will make the most of agricultural crop waste which would otherwise not be employed for use as a raw material input. This is estimated to cut annual gasoline consumption by more than 59 ML, which will prevent the emission into the atmosphere of over 139,000 t of CO_2.

One of the main challenges for the **solar area** is increasing its management capability through new ways to store energy, in order for solar energy to be supplied even at times where there is not enough solar radiation. Other related technological challenges include higher efficiency in converting solar energy into electrical power and cost reduction.

Objectives in the **water** segment are as follows: positioning the company as a leader in desalination; being technologically competitive in generating drinking water, urban and industrial wastewater treatment and reuse, and cementing leadership in hydro infrastructures and water resource management models and systems.

In the **aluminum waste recycling area**, R&D+i activities are aimed at improving performance in recovering raw materials and aluminum waste and optimizing operational processes and product quality, while also developing new and improved technologies contributing to sustainable development.

In the area of **one-stop industrial waste management**, the objective is to develop new technologies for adapting to the continuous changes in environmental law and the diversification towards new environmental markets, as well as the increasing number of treatable wastes, and to harness energy from these in such a way as to optimize waste processing.