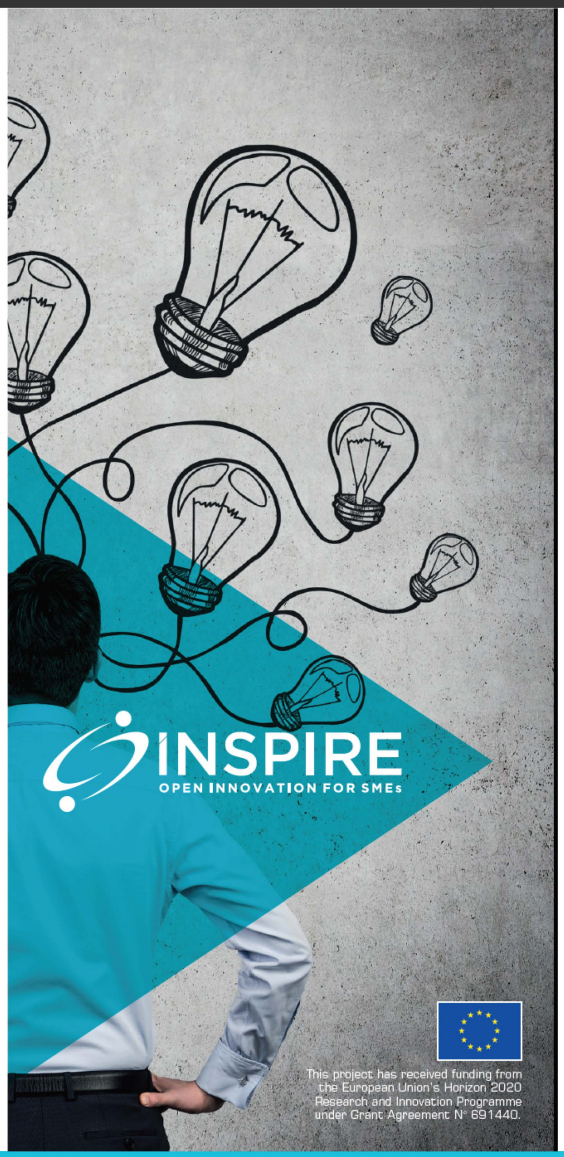

ARCHIMEDESOLARENERGY

Italy, www.archimedesolarenergy.it

From a public procurement assignment to a mutual knowledge exchange, this case relates a successful collaboration between a Public Research Organization and an SME in Italy

Executive Summary

Archimede Solar Energy is a start-up company spun out from an Italian industrial group for the purpose of commercializing knowledge developed by a major Italian Research Center (ENEA), which was financed by two international investors. From its origins in a large company, it is in practice an SME which faces the same issues as other SME counterparts. Thanks to its manufacturing/industrial expertise and its cooperation with a consortium of selected Italian suppliers, Archimede was able to prove the technical feasibility of a technology patented by ENEA while engaging in a fruitful and long-lasting collaboration. By exploiting this valuable and mutually beneficial collaboration as well as its know-how/IP portfolio (exclusive licensing agreements and proprietary patents for production processes) and its network, Archimede Solar Energy has managed to become within a few years the world leader in the production of solar receiver tubes for thermodynamic power plants with parabolic trough collectors.

CASE N°: SE18

SECTOR: RENEWABLE ENERGY

TECH INTENSITY: HIGH-TECH

LIFE CYCLE STAGE: SCALE UP

INNOVATION VECTORS: PRODUCT, PROCESS

01 PARTNERS: PSR, OTHER SME

KEYWORDS: Thermodynamic energy plants, licensing-In new technologies, partnership with a consortium of suppliers, disruptive innovation, solar receiver tubes

- BACKGROUND FRAMEWORK
- INNOVATION CHALLENGE & MARKET OPPORTUNITIES
- OI TRAJECTORY
- BUSINESS IMPACT
- LESSONS LEARNED

archimede solarenergy

BACKGROUND

This case describes a strong collaboration between an Italian research centre, ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) and an industrial group (Angelantoni) which led to the creation of a new company to take charge of "transforming" the applied research results into an industrial product ready for the market.

Italian players (both industry and research) have played a key role since interest has risen in solutions for energy production and efficiency with low environmental impact. In particular, Carlo Rubbia, President of ENEA and Nobel Prize winner, has focused efforts on improving the efficiency of solar receiver tubes by developing and patenting a new method which uses molten salts for heat transfer and storage, instead of oil. To demonstrate the technical feasibility of this new patented technology, ENEA launched a public procurement tender for building a prototype of the sputtering machine, and one of the companies in the Angelantoni Group, specialized in this field, won the assignment. From then on collaboration between the Angelatoni Group and ENEA grew stronger and closer.

Archimede Solar Energy (ASE) was born. After this first achievement, which demonstrated proof of concept, ASE planned to scale up to high-volume industrial production by building a bigger plant with the necessary investments. During the fund-raising phase, it was contacted by a large industrial player with a specific interest in the solar energy sector. However, due to a lack of alignment with their strategic roadmap, the parent group finally decided to purchase the investor's shares.

New investors -a technology player and a Saudi Arabian holding (well connected to potential markets) -came on board and the company continued to develop its product package. In 2013 ASE inaugurated a demo plant, the most innovative solar plant in the world with thermal storage, and positioned itself as the leading player in the thermodynamic power plant field. Currently, the company is offering consultancy and engineering services for the construction of solar thermodynamic plants and has also enlarged its product portfolio.

Innovation is embedded in the company's vision and values. To maintain its technological leadership, the company has put in place a focused innovation strategy which concentrates on continuous product development and on the search for new methods to improve the production process.

INNOVATION CHALLENGE & MARKET OPPORTUNITIES

Established in 1932, the Angelantoni Group has been pursuing strategic collaborations with relevant research institutes and universities and creating dedicated subsidiaries to fulfil its mission of becoming a worldwide technological leader in the biomedical, testing, and clean technologies sectors, with a specific focus on the solar energy sector.

As soon as the renewable energy sector started to expand, Italy took a leading position with the Angelantoni Group playing a central role by stimulating the creation of an integrated supply chain. Thanks to their highly diversified skills and experience - and in order to continue to enhance its market presence -Angelantoni implemented in the early 2000's a diversification strategy which consisted of looking for promising cutting-edge technologies to develop new products/ solutions for their pre-identified markets, including solar energy.

The decision to apply through one of the companies in its network to the ENEA call for tender was also motivated by the opportunity of starting a collaboration with the second largest research centre in Italy, and to "have a look" into a novel concept that seemed to have the potential to disrupt the market and open up new opportunities. When the technical feasibility of the new method was proved via a first pilot, the group realized that it needed to "spin out" this new venture.

As said, the group was interested in entering the solar energy market with new low environmental impact solutions, in line with the group's values. Given the strong interest in mitigating climate change, the renewable energy sector seemed to offer good potential, and when policymakers introduced a string of legislation, it started to attract new players (by 2007, renewables accounted for about 8 % of total energy consumption in the EU). The focus on environmental concerns raised the need to develop new solutions for the renewable energy field in order to reduce impact on the environment and improve energy efficiency.

ENEA's technology matched exactly these requirements and offered significant potential for acquiring relevant market share in a context where, at that time, few players were active (3 manufacturers in total) with promising opportunities mainly in Southern Europe, North Africa and the Middle East.

OPEN INNOVATION TRAJECTORY

Concept development

The receivers, which are currently produced and commercialized by ASE, with the contribution of ENEA, are designed to operate at high temperatures {up to 580° C) with different types of heat transfer fluid used for the big solar thermodynamic plants. Concentrating Solar Power (CSP) systems produce electricity using steam to drive a turbine similar to conventional power stations. However, CSPs convert energy from solar radiation into high-temperature heat using hundreds of mirrors. Currently, operating parabolic trough (concentrator and receiver) plants use a synthetic oil as a heat transfer fluid (benzene) that cannot reach temperatures above 400°C without affecting performance and which have environmental side effects.

To overcome this obstacle, the ENEA research team developed a new solution based on molten salts (a non-polluting, non-flammable natural raw material), thereby producing an alternative fluid technology which can reach up to 550° C and offers high performance in terms of energy efficiency, while reducing environmental impact and improving turbine and plant performance.

This first concept was validated thanks to the support of the Angelantoni Group which developed a sputtering machine and subsequently helped to fine-tune its performance. From then on, ENEA and the Angelantoni network began collaborating more closely for their mutual benefit: ENEA transferred its technology and scientific know how (also training the technical team of the company) and ASE contributed its industrial skills and market aptitude.

The development process, IPR and competition strategy

After the prototype system was built, the two organizations worked together for another two years (ENEA providing the skills in advanced materials and technical-related issues and Angelantoni on how to optimize the machine and set up a production process) until they obtained an optimized solution with clear added-value for the market.

Due to the complexity of the manufacturing process, other Italian suppliers were involved in the development phase and other patented technologies were used to obtain an industrial product. Since its inception, ASE bought the prototype systems from ENEA and started to work on designing the industrial process. After the injection of fresh financial resources from investors, the board of management decided to move towards high quality mass production. At this stage ENEA continued to play a key role since the most vulnerable phase in the production process was the thin film deposition.

To further optimize this process, they applied to another project - ELIOS-Lab - which was working on the development of a solar thermal laboratory to improve the efficiency of the solar receiver tubes (the consortium also included other research centres). After an intense joint innovation activity (a small team from ASE was hosted at ENEA's premises to acquire the skills necessary for running the process), ENEA was awarded a worldwide patent covering the thin film deposition mechanism (which was then licensed to ASE).

The collaboration is still on-going; in fact, the latest development in this R&D partnership is the creation of a new medium-temperature receiver specifically designed for the application using oil (traditional sector), which has a clear competitive advantage over the current offer. This also opens up the possibility for ASE to address other plant concepts. In 2011, ASE completed the construction of one of the most innovative and flexible manufacturing plants. With a nominal capacity of 250MW equivalent, scalable up to S00MW, the ASE plant is one of the largest of its kind in the world.

The collaboration between ENEA and Angelantoni/ASE led to a new worldwide patent owned by the research centre and licensed exclusively to ASE. However, the thin film deposition is not the only critical technical step in the process. ASE also has another licensing-in agreement with an external laboratory to use a technology for making an anti-reflective coating on the glass jacket.

To further improve both process and product quality, the company has also developed its own new technologies. ASE owns different international patents, such as one related to an innovative strong glass-metal joint and another one for packaging. Although the product concept has remained almost identical to the initial one, the production process was substantially improved during the development phase, thanks to the synergy between the technical know-how of the engaged research centres and the industrial know-how of ASE and the related supply chain.

Thanks to the know-how developed during this long-standing collaboration, ASE is now able to offer a high-performing product to the market, based on a novel process and with a positive impact in terms of cost reduction and environment/climate change.

The solar receiver tubes offer added value in terms of:

- higher efficiency in the thermodynamic conversion;
- 2/3 reduction in the volume of the storage tanks (-30% in storage costs);
- elimination of the heat exchanger.

The USP can be summed up as follows: "high quality standards of manufacturing solar receivers ensuring highest optical and thermal performance and stability, while guaranteeing the maximum efficiency of the operating plant".

Driven by the diversification strategy of the Angelatoni Group, ASE is now pursuing a path to differentiate and further improve its offer (molten salt, oil solar and superheated steam solar receiver tubes) to acquire market share either in the new plants segment or in the renovation of those based on more traditional concepts.

Commercialization and follow-up

Scaling up implies moving from a small-scale industrial plant to mass production, with the appropriate investments. One of the main issues for this phase has been to raise the necessary financial resources, acquired initially from an industrial player who became a minority shareholder. Due to a disagreement about the strategic focus, Angelantoni purchased the investor's shares and in the following years new investors entered into the capital:

- Chiyoda Corporation, the largest engineering, procurement and construction contractor of industrial plants such as petroleum, petrochemical and chemical;
- FAL Holdings, headquartered in Riyadh, a multinational company operating in various fields which could open up new markets for the company.

To complete its expansion process in the field of concentrated solar power technology (CSP) and to set up the industrial process, the company has had to focus on further improving the production process. In fact, in addition to ENEA's licence for the tube coating with a multilayer thin film, ASE is using another technology which was developed by another external laboratory and protected by a proprietary patent covering an innovative strong glass-metal joint.

According to recent studies, 87% of CSP projects are located in Spain and the USA, while other countries have begun investing in these plants since 2012 (e.g. China has registered rapid growth in this sector). To enter new markets, ASE's board of management decided to strengthen strategic partnerships such as:

- the cooperation agreement signed with Chiyoda Corporation, before becoming their shareholder, in order to explore joint business opportunities for concentrated solar power plant projects in the Middle East and North Africa;
- the collaboration with the other investor, FAL holding, which is acting as a gatekeeper for the Saudi market, one of the most promising emerging markets where companies are waiting for upcoming tenders (9.5 GW plants expected by 2030).

Apart from strategic alliances for exploring joint opportunities, the company's key marketing action consists of promoting the technology and its added value among potential customers/ decision makers by regularly attending sector events and technology conferences in key target countries. Awareness- raising campaigns are also intended to inform contracting authorities of the benefits of the ASE offer which one day could be included in the terms of reference of future tenders.

A sales team monitors the procurement tenders and puts together the appropriate consortium/ partnership, which also includes exploiting the ASE supply chain. (When bidding for tenders to build production plants, the company found it crucial to team up with a pre-selected group of reliable suppliers.)

Another channel is through membership of sectoral associations which can also facilitate the creation offavourable conditions for opening up future markets.

After the industrial plant was ready, the company continued to:

- enlarge its product portfolio with solar receiver tubes based on alternative fluid technology;
- collaborate with ENEA to monitor the coating and solve specific technical issues.

BUSINESS IMPACT

Thanks to this open collaborative project, a new solution was developed (involving new skills) to address new market opportunities. In addition, the collaboration with ENEA enhanced the technical skills of the ASE team, while the experience of working with their industrial partners has been an important training opportunity for middle management, especially in terms of building a sales network and addressing communication issues thoroughly.

The team raised its awareness of the importance of interacting successfully with strategic partners, especially with multinational bodies. One key lesson is that in bringing a complex disruptive innovation to market it is necessary to form strategic alliances with strong reliable partners (technological, commercial, industrial) and that in the first proof of concept phase public research centres are good partners since they are not concerned about competition issues.

Archimede's joint collaboration resulted in their gaining 100% of the molten salt solar receiver tube market and 50% of the CSP oil receiver tube market in the European Union.

LESSONS LEARNED

This is an interesting case since it covers a long-standing R&D collaboration between a leading research centre and an industrial player:

- from proving the concept up to the technology demonstrator, initial market research and IP protection
- to knowledge spill-over, in this case:
  - moving from the demonstration to industrialization phase (through licensing), and
  - spinning out the new business (corporate start-up vs academic spin-off vs joint venture).

This case also demonstrates that:

- strong R&D collaboration generates not only new IP/knowledge but also a fruitful cross-fertilization between teams with a research and business experience/ approach; each side complements the other from a cultural point of view, thereby leading to the development of a successful new product;
- high-tech players are very keen to strengthen open innovation partnerships in particular with:
  - public research entities (not concerned about competition) to prove a new concept/develop a new product;
  - with industrial players when approaching a mass market (high volume);
- when dealing with a public/ semi-public market for large plants, it is fundamental to have a good supply chain and a local presence to build up a strong consortium and to be in a good position for bidding;
- a spin-out from an industrial player has a strong management background, a stronger aptitude towards open innovation collaboration and easier access to strategic partners.

Main lessons learned:

1. Licensing-in agreements can play a key role for developing new disruptive solutions.
2. Public research centres and universities are generally seen as preferred partners by industrial players for joint research/ innovation activities.
3. A close collaboration between academic and business teams also generates interesting cross-fertilization effects.
4. In the high-tech area, interacting with industrial players requires strong skills and an in-depth knowledge of the market.
5. Negotiations with investors can be demanding and are not always satisfactory if agreement is not reached on the strategic road-map.
6. Collaborate with a supply chain of reliable partners with a strong local presence when the main sales channel is through public procurement.