New Technologies in Spain

Desalination

Spanish innovation contributes to advancing desalination to bring sustainable clean water to millions.

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Innovation in Motion

Spain is now the world's eighth-largest economy and the fastest growing in the European Union. It represents more than 2.5% of the world's total GDP and a third of all new jobs created in the Eurozone last year. Spain is fast becoming a leader in innovation and generating advanced solutions in the industries of aerospace, renewable energies, water treatment, rail, biotechnology, industrial machinery and civil engineering. Spanish firms are innovators in the field of public-works finance and management, where six of the world's top ten companies are from Spain. Where innovation thrives, so will the successful global enterprises of the 21st century.

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Canary Islands Coastline

Desalination in Spain

Spain built Europe's first desalination plant nearly 40 years ago and is the largest user of desalination technology in the Western world. Spanish companies lead the market, operating in regions including India, the Middle East, and North America. Spanish innovation contributes to advancing desalination to bring sustainable clean water to millions. This is the second in an eight-part series highlighting new technologies in Spain and is produced by Technology Review, Inc.'s custom-publishing division in partnership with the Trade Commission of Spain.

Just steps away from the Mediterranean sea along Spain's southern coast, machinery hums inside Carboneras, Europe's largest seawater desalination plant. Throughout the building, water flows through brightly colored pipes and tanks, along the way passing through layers of chemical and physical filtration before the seawater reaches the heart of the plant, the reverse-osmosis membranes that turn saltwater into fresh. This plant is the latest marker in Spain's decades of experience and research in the field of desalination. It represents the efforts of some of the top Spanish firms in the field, both in Spain and around the world.

For the past nearly 40 years, companies in Spain have built and operated desalination plants, first in the water-poor Canary Islands off the coast of Africa, then moving to fulfill water needs on the Spanish mainland and around the world. These companies, and the companies that provide a wide variety of parts for desalination plants, have grown, constantly honing and improving both cost and efficiency. Research continues in the Canary Islands for ways to couple desalination with renewable energy to provide sustainable, ecological solutions for communities in developing countries. Today, Spanish companies make up the largest percentage of competitors on the international market for the design, engineering, construction, and operation of new desalination plants around the world.

History of Desalination

The idea that pure water could be made from seawater has been tantalizing thirsty humans for hundreds, if not thousands, of years. The original premise was based on the idea that boiling or evaporating water separates the water from the salt. That theory—vaporization or distillation—was behind the technology for the first large-scale desalination plants that sprouted in desert areas in the 1950s and 1960s, primarily in the Middle East. These areas, lacking water but with plenty of fuel to burn, turned one resource, energy, into what the region craved: water. The technologies using heat, though, require vast amounts of energy.

Researchers throughout the early 1900s had been studying the idea of using a membrane to separate out salt from seawater. This is based on the osmotic nature of cell walls: certain semipermeable membranes, such as animal and plant cell walls, allow water to pass through, creating an equilibrium between a highly concentrated solution on one side of the membrane and a diluted concentration on the other.

Scientists hypothesized that with the right amount of pressure and with the correct membrane design, this natural phenomenon could be reversed through a man-made membrane. Instead of flowing from a diluted solution to a highly concentrated one, equalizing them both, the concentrate could be forced through a membrane, leaving an even higher concentrated solution of dissolved solids (in this case, salt) behind.

In the 1960s, researchers in the U.S. and Japan who developed membranes for industrial purposes soon realized that those same semipermeable man-made membranes could be used in desalination. By the 1970s, desalination-plant developers adopted reverse osmosis (RO) for use in new desalination plants.

Though more efficient than vaporization or distillation and requiring far less physical space for the same operation, these plants still demanded a high energy input. Over time, engineers developed recovery systems to take advantage of the high pressure of waste brine left after the reverse-osmosis process. This has led to precipitous drops in energy needs for the process, reducing the cost, while the cost of the membranes used in reverse-osmosis technology have also dropped about 50 percent.

At the same time, conventional sources of fresh water have proven more costly in recent years. In some areas, coastal aquifers are depleted of water before they can refill naturally, leading to the intrusion of seawater. All these factors contribute to the fact that, in some regions, desalination has become cost-competitive with traditional methods of supplying water needs.

Today, there are more than 15,000 desalination plants in the world.

Why Spain?

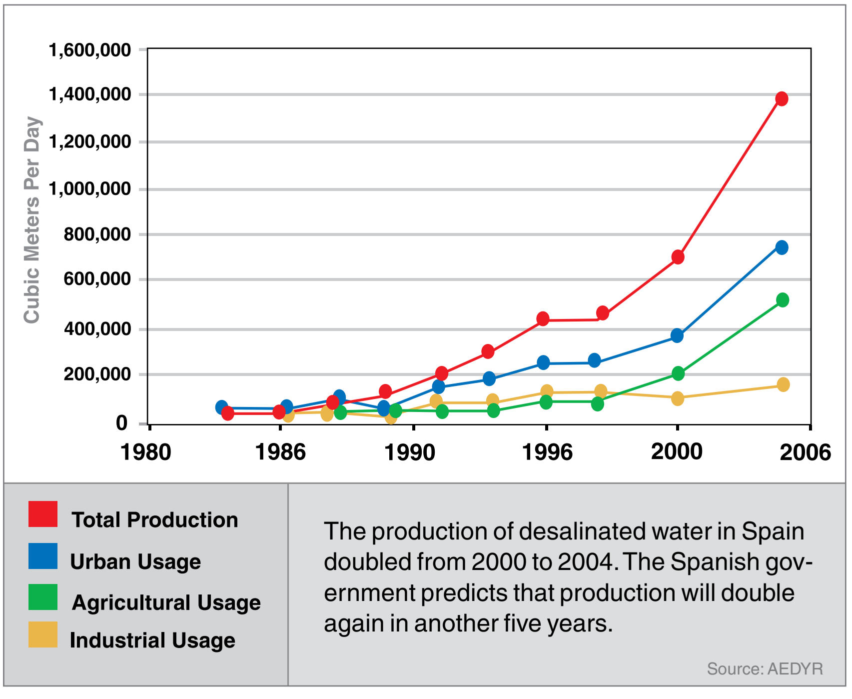
Spain provided the home for Europe's entrance into the desalination industry with the first plant installed on the island of Lanzarote in the Canary Islands in 1964. Since then, the process has expanded throughout the islands and on the Spanish mainland as well. Today, Spain is the fourth-largest user of desalination technology in the world, behind Saudi Arabia, the United Arab Emirates, and Kuwait. Spain's more than 700 plants produce approximately 1,600,000 cubic meters of water each day, or enough for about 8 million inhabitants.

The Canary Islands aren't the only dry areas of the country in need of new water sources. The coast along the Mediterranean, particularly in the south, has long suffered periods of droughts and inadequate access to water. Despite water scarcity, the sun and climate have made the southern region the agricultural breadbasket of Spain and of much of Europe, with miles of greenhouses stretching out to the horizon. At the same time, the population in these areas has grown dramatically.

Spain is already the second most visited country in the world, and tourism in Spain is on the rise. In the past decade the south of Spain has increasingly become a destination for retired northern Europeans looking to create a new home in a land with plenty of sun. The local governments have encouraged this type of development, building new homes along with the services necessary for this retired population, such as golf courses. In fact, Spain built a record-breaking 800,000 new properties in 2005, most concentrated along the southern coast; that figure is higher than the combined new properties built in France, Germany, and the U.K.

"Here we encounter the paradox: because of the climate and the long hours of sun, there's a great deal of tourism and very productive agriculture. And yet precisely because of the wonderful climate, there's little water," says Claudio Klynhout, director of communications for AcuaMed, the arm of the Spanish government in charge of the water program.

Use of Desalinated Water in Spain



The production of desalinated water in Spain doubled from 2000 to 2004. The Spanish government predicts that production will double again in another five years.

Source: AEDYR

The government has long been a supporter of desalination as a method of dealing with water scarcity. After the Spanish Civil War, Spain's economy was in desperate need of revitalization. The government saw an opportunity to boost economic activities through tourism to the sun-drenched Canary Islands, but the region lacked natural water resources, particularly on the eastern islands. In order to lay the groundwork for economic growth, the government decided to build Europe's first desalination plant in the Canaries. This original plant used the same technology as those in the Middle East, that of vaporization of water. Within a few years, though, the government switched and began using the then-novel reverse-osmosis technology for newer plants.

Recent events have conspired to continue this desalination trend within Spain. Under the past government, officials in Spain had created plans to divert the Ebro River in the water-rich north more than 480 kilometers south to supply the parched regions along the southern coast.

Based on a planned increase in water, developers had rallied behind development schemes costing billions of dollars to build vast tourism complexes between Alicante and Almeria in the south, including dozens of golf courses. But farmers and environmentalists protested that the diversion would have a serious environmental impact on the Ebro and its delta, on the farmland in the north, and along the hundreds of miles of planned pipeline.

When the new government took power in 2004, they put the expected plan on hold. Instead, they've drawn a new plan that supplies water to the south without taking it from the north. The main method involves building 20 new desalination plants all along the Mediterranean coast where needs are highest, focusing on the region in the south. The desalination plants are expected to fulfill 50 percent of the need, with reuse of treated water, increased irrigation efficiency, and other efforts supplying the rest.

"The current government thought that this new plan would be much more secure in guaranteeing water, rain or no rain, independent of the climate," says Klynhout. "In 2005 there was a drought, and there was doubt that the Ebro River would even have had enough water to supply had the planned pipeline been built."

High-pressure pumps push sea water through reverse osmosis membranes housed in narrow blue tubes. Above, desalinated water is stored in tanks to flush seawater at shutdown.

Bidding on the first six of the plants begins in the spring of 2006, with all plants intended for completion by the end of 2008. When operational, these plants will more than double Spain's desalination capacity.

Spanish Companies

The announcement of the plans to develop these new desalination plants within Spain has been a boon for desalination companies. Most also specialize in other forms of water treatment, such as wastewater treatment or water purification. But the real prize for many of these companies, the way they have been able to become significant players on the international market, has been their experience with desalination.

"We have been working for the past 30 years on all these desalination plants," says Jose Antonio Medina, president of the International Desalination Association and head of the Spanish Desalination and Reutilization Association. "That gave Spanish companies the necessary experience with both building and operating plants. At the moment Spain has the highest number of companies in the world with this level of technology and experience in desalination."

These companies include such names as Pridesa, Inima, Befesa, Cadagua, Sadyt, Infilco, Aqualia, Cobra, Grupo Seta, and IsoluxCorsan Corvian. Degremont, a French multinational company, has a strong desalination sector made up almost entirely of Spaniards.

Nearly all of these companies got their feet wet in the waters off the coast of the Canary Islands. In the portfolio that companies put forth to show their skill and experience, many point to one of the many ground-breaking plants on the Canary Islands. One plant was the first in Europe, another the first large-scale RO plant in Europe, another the first in Europe to take advantage of a new desalination membrane, still another the first to use new energy recovery systems to dramatically reduce energy needs.

"One of the early plants, it was a very complicated plant to operate," says Medina. "I worked at that plant from the beginning. It has been like the university of reverse osmosis for us."

At times today the companies are competitors when submitting bids for new plants, whether for individual stages, such as the design, or for the plant's building and operation. At times the companies work in various consortia. The Spanish government, in an effort to support a variety of Spanish companies, divided the development of the landmark Carboneras plant. Separate bids were taken for the design and engineering, construction, and operation of the plant. At the end, Inima worked out the engineering and design details. A consortium of Pridesa, Degremont, Befesa, and OHL, Inima's parent company, undertook the construction. Today, Inima operates the plant.

This experience with different aspects of plant development and management and with a wide variety of plants is the key to the companies' competitiveness, according to representatives. "Each plant is different," says Ignacio Zuñiga, international business development manager of Cadagua. "There are different conditions in different oceans. And the conditions of the intake of the plant or the level of pollution in the area, all of these affect the pretreatment of the water and the design of the entire plant."

Representatives of each company, in competing against the others in the market, point to specific company strengths. Most are backed by large construction groups or other financially secure, multinational companies that provide the needed resources and stability for investments in this sector. All have years of experience working in Spain.

Officials at Befesa, part of the Abengoa Group, say one key to their advantage has been their willingness to take a chance in newer, financially riskier markets around the word. Befesa was one of the first Spanish companies operating in Algeria and is now building the first desalination plant in India.

"This is our philosophy–when we start work in a country, we do so because we have a strategy to be working in that country," says Guillermo Bravo, CEO of Befesa. "We now have three plants in Algeria, and we plan to develop the market in India."

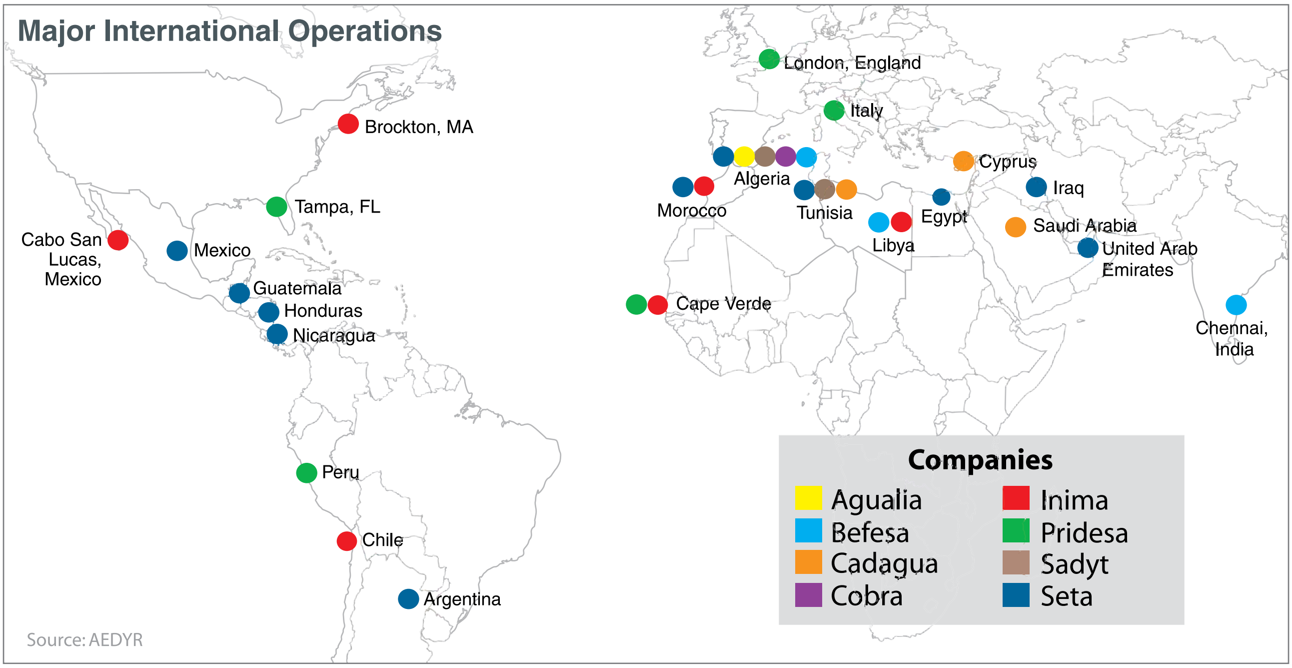
Befesa is also conducting research on the possibility of reusing desalination membranes for other purposes after replacement, thus reducing the overall cost of the facility.

Inima, which has dozens of desalination plants in Spain and around the world, points to their decades of experience, the financial backing of the international construction company OHL, and their ability to work in all aspects of water treatment.

Not only are Spanish companies building new plants, but in the U.S. one Spanish firm is attempting to fix an existing plant. The Tampa Bay Seawater Desalination Plant, the first large Ameri-

Spanish Companies at the Top of the Global Market

(View complete interactive map online.)



can seawater desalination plant, originally begun in 1999, has been inundated with problems from the beginning, due in part to challenges with construction, management, and pretreatment of the seawater. Pridesa, a Spanish company now owned by RWE Thames Water, won a contract, in partnership with American Water, to take over the plant.

Jose Maria Ortega, international commercial director of Pridesa, admits that rehabilitating an existing plant is much more challenging than building one from scratch. "We thought it was a huge opportunity to set up a good precedent for seawater desalination in the American market," says Ortega, "with ourselves as the main protagonist."

Supporting Companies

The membranes used in most Spanish desalination plants are the heart of the desalination plant. They are produced primarily by American and Japanese companies, though some institutions in Spain have begun undertaking research into membrane production. Spanish companies, however, have developed the parts to fill many of the needs in these large-scale plants around the world. The Spanish Desalination and Reutilization Association counts nearly 60 companies as members, all involved in some aspect of desalination, from producing filters and valves to the large companies that build the plants.

Along the northern coast of Spain, the land is lush and green, a visual contrast to the parched areas of the south. The cities and towns around the industrial city of Bilbao form Spain's most concentrated industrial corridor, with a large number of metal foundries and manufacturing plants.

Though this area can provide for its water needs without desalination technology, nevertheless a number of companies have specialized in meeting the needs of desalination. Desalinating seawater involves particular engineering challenges, including dealing with the high corrosivity of the water and the extremely high pressure needed to force the water through the membrane.

High-pressure plug valves await shipping at an MTS Valves warehouse in the north of Spain.

One of the companies in the north, MTS Valves, makes high-pressure valves for all sorts of mechanical needs. As the desalination industry grew, it began developing the needed valves, then specialized in the valves of the noncorrosive alloys of stainless steel called duplex and superduplex that are very expensive and difficult to cast. The fact that there are two foundries in the Bilbao region that work with this metal has proven to be a boon for local companies.

Says Jose Ignacio de la Fuente, factory manager of MTS Valves, "We have been in this market for more than 30 years. We are the European leaders in this market, supplying valves to plants around the world, to Israel, Singapore, Australia, the United Arab Emirates, and Algeria. We are in the position to guarantee a first-class product by working with our suppliers." De la Fuente says MTS Valves continues to research ways to optimize the performance of the valves, aiding in reducing the overall cost of water production.

Indar Maquinas Hidraulicas (Indar Hydraulic Machines) has also been able to take advantage of the local availability of duplex and superduplex alloys to create submersible motors and high-pressure hydraulic pumps for the intake of seawater from beach wells or intake tanks. Originally a family-owned business that began in 1940 manufacturing small motors for area companies, the company began to focus on submersible motors and pumps when desalination began in Spain in the 1960s.

As the market developed, Indar continued making pumps for other water-treatment plants while honing its desalination niche by working with these challenging alloys. Taking it one step further, Indar has now created an even more specialized niche by focusing on pumps and engines of larger diameter, suitable for the newer large desalination plants. Recent research has led the company to develop a pump and motor that saves enough energy to recoup the cost of the new pump in only one year.

"We design the systems to stay competitive, to reduce power consumption as much as possible," says Marcos Garcia, sales manager of Indar.

In desalination, a crucial factor is pretreatment, cleaning the water to the highest level possible before it reaches the reverse-osmosis membranes, the most important, expensive, and delicate part of the entire operation. The purer the water, the longer the membranes last and the more effective they remain.

Fluytec, a company based near Bilbao, creates filter systems for the second level of treatment in a desalination plant. Its filters, which look like long cylinders of wound yarn, are cased inside a cylindrical housing. To innovate and distinguish itsselve in this market, Fluytec has developed a method of building the casing out of noncorrosive fiberglass-reinforced plastic (FRP), which unlike PVC can withstand high-water pressures at much larger sizes. In the case of large-scale plants, the FRP filters must be laid out and layered by hand, a task that few companies are able to accomplish.

In addition, Fluytec has developed a new system for replacing filters in extremely large plants, mechanizing the process whereby filters are cleaned or replaced. "In the past it was done by hand. With this new system, filters will be off-duty for only a short time," says Jorge Merlo, in charge of international sales for Fluytec.

Dozens of other Spanish companies have developed expertise in niche markets in desalination, marketing their products within Spain and around the world.

Environmental Challenges

When countries or municipalities propose new desalination plants, concerns about the environmental effects often arise in terms of energy consumption and the disposal of the residual brine. For every liter of water taken from the sea, less than half becomes desalted. The remaining brine has about twice the salinity of seawater and is usually returned to the sea.

"The brine could be a problem in theory, but it usually isn't," says Medina. "You have to study how resistant the marine life is to different levels of salinity, and you have to study the conditions of the sea in that area."

The effects of the brine on the surrounding flora and fauna in the sea depend on the specific marine life in the disposal area. The usual response is to pipe the outflow far enough from sensitive species that the water quickly disperses into the surroundings. This is carefully considered in all plans for new plants, and despite extensive research, there has not been a documented case of serious deleterious effect resulting from the disposal of brine.

At the same time, companies are aware of the need to mitigate the effect of brine on the surrounding seabed. Before the development of a plant begins, careful studies are done on the sensitivity of the local marine life. Various techniques to diffuse the brine may be employed. At times, desalination plants are built close to power plants, as is the case with the Carboneras plant. The brine from Carboneras is mixed with the cooling water of the thermal power plant, diluting the brine to a percentage closer to that of the original seawater. Another option is to build a plant close to a wastewater treatment plant; many coastal treatment plants dispose of the residual freshwater directly into the sea, and the two may be mixed together.

"Many people think that desalination has sort of bad impact on the environment. This is exactly the contrary," says Corrado Sommariva, president of the European Desalination Society and divisional director of Mott Macdonald. "Because for instance one of the reasons for selecting desalination in Spain and in Australia was the preservation of some of the existing natural resources which would have been basically depleted if water transmission was implemented instead."

One of the main challenges that remains with the desalination process is the cost of the energy required to produce freshwater. Though different processes demand varying amounts of energy (desalting seawater with membranes requires the most, as it takes tremendous pressure to push the water through the membrane), it remains an issue in terms of cost and environmental issues, as nations around the world battle rising greenhouse gas emissions, such as those emitted by power stations.

In the last 30 years, the amount of energy required for desalination has fallen precipitously, and along with it the price. Decades ago it took approximately 12 kilowatt-hours of energy to produce one cubic meter of freshwater using RO technology; today it takes on average between 3 and 4 kilowatt-hours of energy. Even today, however, the cost of that energy makes up about 40 percent of the total cost to produce each cubic meter of water.

> "We design the systems to stay competitive, to reduce power consumption as much as possible," says Marcos Garcia of Indar.

"We are very close to the minimum energy for desalination," says Juan Maria Galtés, director of special projects for Inima. "There's a point where it's impossible to go any further," because of the high pressure needed to separate salt from water.

Developments in new kinds of membranes or other tweaks in plant efficiency could help engineers continue to shave off small amounts of energy, reducing both the cost and the environmental impact.

Canary Islands Renewable Energy

Researching methods to reduce energy use has long been a focus of the Canary Islands Institute of Technology (ITC), a research facility supported by the regional government of the Canary Islands. And scientists there are taking this one step further: they are investigating how to produce freshwater from saltwater without using fossil fuels at all.

"Here, we have a great deal of sun, wind, and seawater. It is an excellent place to develop systems," said Gonzalo Piernavieja, ITC energy and water director. "It is also an ideal place to simulate conditions in many developing countries."

The engineering involved in using renewable energy to power a desalination plant can be relatively simple: solar or wind generators can be hooked up to an

At the Canary Islands Institute of Technology, solar panels feed energy to a stand-alone reverse-osmosis desalination system in operation since 1998. The domes cover desalination prototypes, including workshops and labs.

existing utility grid, which then offsets the power demands of the desalination plant.

The challenge, however, in coupling desalination directly with renewable energy such as solar or wind power lies in the variability of renewable energy. The membranes used in reverse osmosis need to be kept wet, and the systems that make up a desalination plant have been developed to handle a steady stream of water. Solar energy is plentiful when the sun shines and wind power only when the wind blows.

Researchers in the Canary Islands have spent the past decade developing stand-alone small plants that could provide water for approximately 100 to 300 families, about the size of a small village in a developing country. ITC projects are also carried out in conjunction with other international research institutes or companies.

On one Canary Island test site, photovoltaic panels are hooked up to a battery, which feeds a steady supply of electricity to a small desalination plant. "But batteries aren't great because you have to replace them after, say, five or 10 years, and then you have to dispose of them as well," says Piernavieja. "It's better to develop a system that needs no batteries in the first place."

Other solutions tested at the Canary Islands site make use of wind power. In one, a small wind-energy converter powers a seawater RO plant designed to operate even with the stops and starts of wind power. In another, a small wind farm creates a small stand-alone electricity grid that then feeds electricity to the desalination plant.

The Canary island of El Hierro, which has 10,000 inhabitants, hopes to model the future of island living. ITC is involved in a project there in which eventually 100 percent of the island's energy needs will be served by renewable energy; that energy, through a grid, will also power desalination plants that supply all the island's drinking water and irrigation needs.

The ITC research group is one of only a handful focusing on developing and testing plants in which wind turbines directly power the desalination process without going through any grid.

Though all of these systems could be used in industrialized countries, the main goal of the ITC is to develop plants that could theoretically supply water to even a fraction of the billion people around the world in need of clean drinking water. "Many of these people live in areas that have abundant renewable energy resources and yet no electricity grid, and they may never be connected to a grid. This is the philosophy behind our research," says Piernavieja.

ITC research on coupling desalination with renewable energy is already being tested in the world outside the Canary Islands. The ITC has placed four small desalination plants among a population of African fishermen living within the boundaries of a national park called Banc D'Arguin in Mauritania. In 2006, the diesel-run desalination plants are being converted to run using a hybrid of wind, solar, and diesel power. Wind–solar RO plants are being installed in Morocco, and a solar plant is destined for Tunisia.

Still, these types of applications have many hurdles to overcome. Says Medina, “These types of systems need maintenance. If you install such plants in such a remote place, and if the plants break down, it could take months until someone can be sent there to fix them.”

There are applications for these types of stand-alone plants in industrialized countries as well. The ITC is in discussion with the engineering company MTorres, based in northern Spain, about combining the technology developed in the Canary Islands with the ones MTorres is developing: offshore desalination plants powered by wind. MTorres, with extensive experience in wind power, has plans to connect the two fields.

Growth of Desalination

Without a doubt, the use of desalination is rising around the world. The planned new projects in Spain expand the market for Spanish companies. In Algeria, the government, like the Spanish government in the 1960s, is currently acting on the belief that the best way to jump-start the economy is to provide water for private consumption and for industry. To fulfill those needs, Algeria is in the process of building seven large desalination plants. Of those, one will be built by Ionics, a U.S. company owned by General Electric, and one by a Spanish-Canadian consortium. The remaining five will be built entirely by Spanish companies.

Many in the field believe that the U.S., which is plagued by water supply problems in California and Texas, is another emerging market. A number of water districts in California are already in the planning stages for desalination plants along the coast, and Spanish companies are eyeing the state as a center of future business operations. A number of municipalities in Texas are investigating the option of producing potable water from desalination. Inima is already building its first plant in the U.S., a facility near Boston. If Pridesa succeeds in rehabilitating the plant in Tampa, or any other of these newer plants succeeds, it could lead to the development of others.

Mexico is installing its first large-scale desalination plant in the resort town of Los Cabos at the southern tip of Baja California, to be built and operated by Inima. India’s Chennai plant, to be built and operated by Befesa, opens the market there, while many Spanish companies are already in talks with the Chinese government about plans for desalination plants. According to Medina, Libya will soon be opening up for bids on desalination plants as well. Israel recently began operating a large RO plant, and Spanish firms are in the competition to build the second one, currently in the planning stages.

In the Middle East, most plants in the past have made use of vaporization technologies, while Spanish companies excel in energy-efficient RO plants. But many new plants in the region are now being installed with RO or hybrid technologies as the price of oil continues to rise. Spanish companies are already working in Saudia Arabia, Oman, and the United Arab Emirates and have plans to expand into this market.

While many companies around the world have years of experience in general water treatment, Spanish companies have some of the strongest backgrounds globally in the field of desalination plants. “We want to focus more on desalination,” says Jose Maria Ortega, international commercial director of Pridesa, which builds and manages a variety of water treatment and purification plants in addition to desalination. “We think that it’s probably the most significant strength of the company and the field where we feel we can differentiate ourselves compared to the rest of the companies all over the world.”

According to the United Nations Environmental Programme, hundreds of scientists around the world see water shortage as one of the top concerns in the new millennium. Spanish companies are planning to use their expertise in desalination to improve the water situation for millions of people around the world, by dipping into the nearly limitless seas.

Resources

ICEX (Spanish Institute for Foreign Trade)
www.us.spainbusiness.com

AEDYR (Spanish Desalination and Water Reuse Association)
www.aedyr.com

AMEC URBIS (Spanish Association of Urban and Environmental Equipment)
urbis.amec.es

Centro de estudios hidrográficos
(The Center for Hydrographic Studies)
cedex.es/ingles/hidrograficos/presentation.html

HISPAGUA (Spanish Water Information System)
hispagua.cedex.es

SERCOBE (Spanish National Association of Manufacturers of Capital Goods):
www.sercobe.es

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New Technologies in Spain Series

Spain is a technologically and industrially advanced country committed to innovation, research and development, both through its government and through its private sector. The country is determined to deepen and intensify its productive specialization in industries that depend on technology and innovation. The Ministry of Industry, Tourism and Commerce has launched an ambitious plan combining its available human and financial resources and setting out specific lines of action with the goal of strengthening the international outlook of the most technologically advanced companies in Spain.

As part of this initiative, *Technology Review*'s custom-publishing division has produced the New Technologies in Spain Series, which will appear as a special advertising supplement in MIT's *Technology Review* magazine. This powerful eight-part series showcases the technological development and excellence of Spanish companies in several important industries, such as wind energy, water desalination, infrastructures, high-speed rail, aerospace, industrial machinery, biotechnology and renewable energy.

Spanish firms have embraced new technologies to persevere in their continuous search for advanced solutions. To find out more, visit:
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