

ENERGIZING SPAIN

As part of an energy-hungry planet searching for clean sources, Spain stands as one of the most active players in the global push towards energetic diversification and efficiency.

In the past two decades, the country's energy landscape has changed radically, giving rise to a globally competitive renewable energy sector.

Behind these changes is the reality that Spain is one of the fastest-growing major industrialized economies, yet it imports 99% of the oil and natural gas that it uses.

Powering ahead

Meeting growing energy demands while reducing carbon emissions is a complicated juggling act.

Spain's domestic energy demands are expected to increase at 3.7% per annum up to 2011, a fact being faced with firm determination by the Spanish government as it works to reduce the country's reliance on imported hydrocarbons.

The solution to keeping the lights on in the fifth-largest electricity market of the European Union—without ending the ongoing moratorium on nuclear power—is both modern and traditional: building natural gas-burning, high-efficiency, combined-cycle plants, and significantly increasing the country's wind-power. In the home of the errant Don Quixote, it is only fitting that windmills should again dot the landscapes of La Mancha and elsewhere, with a capacity of over 10,000 Megawatts (MW), making Spain the second-largest wind energy producer in the world, in between Germany's 16,000 MW and the 6,500 MW generated in the U.S.

Solar power also plays an important role in the renewable energy panorama, with Spanish companies leading solar-cell production worldwide for over ten years. Spain's PV electricity



Ignasi Nieto
Secretary General
of Energy

production ranks second in the E.U., and current building codes are making solar panels a standard feature in new constructions, which will save tons of carbon emissions in coming years.

The growth and consolidation of renewable energy sources has been made possible by the ongoing work of the regulatory National Energy Commission (CNE) and the Spanish Ministry of Industry, Tourism and Commerce.

María Teresa Costa Campí, President of the CNE, defines the complex nature of the sector: "Reaching sustainability, a competitive environment and a secure energy supply in the E.U. requires a multilateral policy. We must find a global solution to a global problem," she says. With this in mind, the CNE is looking to grow its international presence, especially in Latin America and Europe. It forms part of the Council of European Energy Regulators and the European Regulators Group for Electricity and Gas.

At home, Costa says the sector is functioning "magnificently well." Ignasi Nieto Magaldi, the Secretary General of Energy, points to the deep liberalization that is taking place in the country's energy sector. "The markets have been liberalized and we are in a profound new period in the sector," he says.



Control Center at Red Eléctrica de España (REE).

"There is a free market in energy, as long as it doesn't abuse our consumers. This is our principle objective at the Ministry, the defense of our consumers and citizens. We want to be able to guarantee the supply of energy to the country."

The Ministry's roadmap for the 2008 to 2012 timeframe contemplates increasing public resources for energetic efficiency, with subsidies of €400 million per annum for renewable sources. "Promoting renewable energies is an absolute priority for us as a reference country in this sector. We are second in the world for installed wind farms, which currently provides 9% of our total electrical production," says Nieto. "Our objective is to achieve an energy mix in Spain to include 12% from renewable sources by 2010."



María Teresa Costa
President, CNE

"There is a free market in energy as long as it does not abuse our customers."

Energetic connectivity with neighboring countries is also high on the Ministry's agenda. Spain's energy sector is relatively isolated from the larger European market due to poor connections with France. The push to improve these ties is being furthered by the ongoing work to establish a single Iberian Peninsula energy market between Spain and Portugal for gas and electricity.

Meanwhile, the Ministry's efforts have begun paying off in terms of increased efficiency. "In 2006, the country consumed less energy in absolute value compared to the previous year, while our gross domestic product increased by 4%. It was a great accomplishment for our Action Plan of 2005 to 2008," says Nieto.

The challenges of a united infrastructure between the European Union's member states is picked up by the head of Spain's leading petroleum company. Antonio Brufau, chairman and CEO of Repsol YPF, says: "This is not a country issue, but a regional issue. It revolves around the E.U. being united on the technical issues of energy rather than the political issue, on a united infrastructure and of independence from the few powerful suppliers."

Meanwhile, Madrid-based CEPSA is rapidly moving toward becoming a leading regional player, and continues to embark on exploration projects with other energy players around the world. Dominique de Riberolles, executive director and senior vice-president of CEPSA says: "We are optimizing the synergies between refining and basic chemical operations to drive organic growth internationally."

The secret's in the mix

Endesa is another energy powerhouse, and the leading name in Spanish electricity production. In 2006, Endesa had a total installed capacity of 47,000 MW, generating more than 186,000 Gigawatt hours, almost half of which was generated outside of Spain. This ranks the company as number one in Spain, Greece and Latin America; number three in Italy and France, with a significant presence in Portugal, Germany, Morocco and Poland.

Meanwhile, five Latin American countries—Chile, Argentina, Peru, Colombia and Brazil—provide 12 million clients, putting Endesa ahead in the entire subcontinent with a 10% market share.

For Rafael Miranda Robredo, CEO of Endesa, president of the Club Español de la Energía (Enerclub) and president of Eurelectric, the company's ongoing investments in the sector reflect the priority given to guaranteeing the supply. "In the past two years, we have invested more than U.S.\$5 billion in Spain and Portugal, which represents 51% of the investments made by the rest of companies combined. Our investment plan for 2007 to 2009 will total U.S.\$6.7 billion more for this region.

Endesa has bet strongly on renewable energies and other zero-emission technologies and is present in the renewable energy and cogeneration sector in Spain through Endesa Cogeneración y Renovables, with a market share of 20% and 1,124 MW generated from renewable energy sources.

"By 2009, almost U.S.\$2 billion will be invested to achieve a total capacity in renewables of 4,100 MW from a mix of wind energy, minihydraulic plants, waste and biomass transformation facilities and cogeneration power," Miranda says.



Rafael Miranda
CEO of Endesa,
President of Club
Español de la Energía
and President
of Eurelectric

THE CLEANEST ENERGY IS THE ENERGY YOU DON'T CONSUME. AND IT'S THE CHEAPEST, TOO.

At UNION FENOSA, we can advise you so you consume only the energy you need. In this way, you will save both energy and money. Ask about our Energy Plan Gas and more, and we'll make you a personalised offer so you can save on your bills.

SIGN UP FOR THE **ENERGY PLAN** **gas** and more 901 380 220

www.unionfenosa.es

 **UNION FENOSA**
A little help for a better world

Indeed, the growing preoccupation with environmental issues means directives are being issued on a national and world level to find more sustainable and less damaging alternatives to fossil fuels. Making optimum use of energy, particularly in environmentally friendly bio-fuels such as biodiesel and bioethanol, is one of the European Union's prime concerns. As such, it is calling on member countries to be using 5.75% of biofuels by the year 2010, and at least 10% by 2020.

With this in mind, Infinita Renovables (IR)—a new start-up dedicated to biofuel production—is looking to make a significant impact on the European landscape, and exceed the E.U. directives. An affiliate of the Isolux Corsán group, Spain's seventh largest construction, engineering and services company, IR plans to start producing from June 2008 at its two plants in Castellón (Valencia), and Ferrol (Galicia.)

An alternative to oil

With an initial investment of €300 million, the company has a production capacity of 900,000 metric tonnes per year, and hopes to exceed a €700,000 million turnover by 2009. Thinking big is the only option, according to IR's CEO Rafael Lorenzo Fernández. "From the outset, we knew that if we wanted to survive in this market, we needed a very ambitious project. We are starting with biodiesel, and in that sector, you are



Rafael Lorenzo, CEO
Infinita Renovables

competing with the four biggest oil companies—which collectively own 90% of the market.

"Biodiesel, in its purest form, is a biodegradable, biocombustible, non-toxic, and non-polluting substitute to the diesel we use today, so this will certainly be a global market. It is a truly interesting sector, with many, many interesting opportunities."

Lorenzo will draw from his experience in the telecommunications start-up Communitel, sold to Tele2 in 2005, to weather the challenges of a growth sector. He says: "We are used to market waves, rotations and fluctuations. This is a relatively young sector, with a positive regulatory framework still in the pipeline. The environment is very similar to that of telecommunications in that there are a few powerful players controlling most of the market."

With a global reach in mind, the company has strategically positioned its plants next to two ports, and will be working with the CLH (Compañía Logística de Hidrocarburos) Group and its logistics chain to distribute the products effectively.

"We believe that because of the dimensions of the players we are working with, and the growth opportunities offered by the sector, and because we strive for quality, we will become leaders in this market," Lorenzo says, confidently.

IR will have the capacity to provide 45% of the biodiesel in Spain by 2010. "However, this does not mean that all our production will go to the Spanish market," Lorenzo says. "We are thinking global, and exporting is an important part of our strategy." Indeed, once production starts rolling, IR hopes to

have accrued some 50% of the total biodiesel production in Germany, Italy, Portugal, France and the U.K.

Spain has already made good progress with the modifications needed to use biofuels when they enter the market. "The major advantage with biodiesel is that it can be mixed with traditional diesel in whatever proportion, without harming vehicle engines," Lorenzo points out.

A high-quality product will be essential, he stresses. "In the diesel market in Spain, no one questions the quality of the product—everybody expects it to be good," Lorenzo says. "It must be the same with biodiesel. A good quality, stable product will ensure a continuous supply for our customers."

Technology is an important part of the equation. Although IR is currently working with the first generation of biofuels, a second generation is already in development. "The industry is going to really start moving in 2008-2009," says Lorenzo. "There are many advances still waiting to be discovered."

To produce the biodiesel, IR will use vegetable oils from soya, sunflowers, rape, and sustainable palm trees, and as much as possible will come from Spain. It will not use oil derived from animals, or recycled oil, to ensure a quality product. The vegetable oil is mixed with methanol, which converts into biodiesel. IR has selected a process developed by Desmet Ballestra, the world leader in biodiesel engineering, which is flexible in the oils it uses, while maximizing the efficiency of the process and guaranteeing quality.

"The technology is absolutely fantastic," says Lorenzo. "Let me give you an example. The conversion process produces glycerol as a waste product, which is commonly used in pharmaceutical preparations. We are therefore working with one of the world's leading glycerol companies who will buy our glycerol to make new products. This is a great example of the sector's growth opportunities."

IR's own growth strategy will begin internally, in the development of projects to produce the agricultural supplies needed for their production plants in Latin America and Africa. Lorenzo says: "The agricultural sector is very limited in this

"From the outset, we wanted a very ambitious project."

country. In essence, we want to ensure we will always be able to get a constant supply of inputs. We are working towards reaching 20-30% of the necessary total inputs coming from our own suppliers, as damage limitation against demand quantity or price problems.

"We are also thinking about entering into downstream production with our own line of products and distribution lines, but this is at an extremely early stage. In terms of diversification, we will be looking at setting up a bioethanol project in Central America. In Colombia, for example, they are growing bio-plants in zones that used to grow cocoa-plants. For these countries, bio-plant cultivation will be an amazing opportunity."

As Lorenzo points out, while the new technologies may not

completely solve the world's pollution problems, the technology available now will go a long way to alleviate them.

Back to the source

Before electricity, before fossil fuels and even before fire, there was a shared energy source for the whole planet—the sun. And despite the growing energy demands of modern humankind, the sun continues to shine down 2,000 times more energy than we consume as a species and more of it is being transformed directly into electricity with unheard-of efficiency by pioneering companies like T-Solar Global, located in Galicia, Spain.

The harnessing of solar radiation with photovoltaic solar panels—the human version of photosynthesis—is the cleanest of all renewable sources, but a lack of cost-efficient technology has slowed down its widespread application. This is the hurdle T-Solar is set to clear when it begins production of panels made with the thin-film silicon layer technology developed and supplied by U.S. semiconductor leader Applied Materials.

The start-up T-Solar project, first initiated in 2006, took off when the Isolux Corsán group decided to make it part of its construction, engineering and service portfolio. Isolux Corsán has a 50.1% interest in the company, the Xunta de Galicia—the regional public administration—holds 29%, Caixanova bank 5%, and the remaining 15.99% is held by the development group. With a total investment of €75 million, when the new factory becomes operational in 2008 the initial nominal capacity of the production will be of 40 MW per year, in the form of more than 7.5 million square feet of next-generation modular photovoltaic solar panels.

According to T-Solar Global CEO, Juan Laso Rodríguez, the company's first strategy is to supply the growing demand in markets that are actively promoting the use of solar energy. "At the start of the millennium, Japan and Germany saw acceleration in this sector. In the domestic Spanish market, this acceleration took place in 2004, when the government applied a regulatory framework to favor renewable energy sources," explains Laso.

"Our first step then is to capitalize on these growing markets with the thin-film silicon layer technology supplied by Applied Materials—with their fantastic support to complement it—which will allow us to deliver advantages to our clients in the form of lower costs and higher efficiency of our solar panels. This way we will grow at a faster pace than that of the global market."

While a U.S.\$10 billion global solar energy market can hardly be called new, Laso believes it is immature and still being shaped. "The sector is still quite young if we consider where it should be in terms of the technology it is producing," he argues. "At the moment, there are many solar projects evolving all over the world that still don't have a very clear focus. For example, there is a shortfall in terms of standardization in the industry. To alleviate this is one of our goals—eventually, all of these shortfalls will have to be overcome if we are to succeed as an industry in the long run."

The list of advantages solar panels offer over other energy

sources, renewable and otherwise, is very compelling except in one key detail: the price. This is the factor that T-Solar is set to turn into a competitive edge.

"Solar energy has many advantages in comparison to other forms of renewable energies. It is direct energy, meaning it converts directly into usable electric energy from the sunlight in one step," Laso says. "It is clean and does not produce any emissions or radioactivity, and it is easy to maintain, as there are no moving parts and the processes are stable. It is also easy to integrate using different modules and the electricity can be saved for later use through networks.

"These characteristics are the unique advantages that make the resource so attractive. The biggest handicap to the sector right now is that it is still very expensive with respect to other forms of electricity. This is relative, of course, when you take into consideration the savings in environmental impact and the cost of global warming. In direct economic terms, however, if you compare the price of a barrel of oil and an equal amount of energy produced from solar panels, the solar panels are still much more expensive. But we believe there is huge potential in reducing these costs," he says.

T-Solar's cost-reducing edge comes from the technology developed by Applied Materials, similar to that used in flat-screen TVs, in which the silicon layer is grown directly on the glass instead of being applied in slices. This allows for large,

"Solar energy has many advantages over other forms."

flexible panels to be produced that are cheaper, more efficient and require 50 times less silicon to produce than the traditional crystal panels. Translated into cost-efficiency, the thin-film panels are 2.5 times cheaper per watt, meaning the total investment for solar installations is reduced by 10%, while output capacity rises a full 25%.

"Some analysts predict that in ten years the cost of producing solar energy will be parallel to what we currently pay for our home energy needs. This will allow individual consumers to get their electricity from their local power companies or from personal solar energy panels. In Spain, where we have a lot of land and sun, there is great potential for solar energy development. Hydroelectricity has reached a ceiling and wind power will slow down in the future. Biomass is a limited resource, and other energies are still at an experimental stage," says Laso. "That is why I believe solar energy will comprise 5% of the 20% requirement in renewable sources set by the E.U. for 2020. This translates into roughly 10,000 MW. There are some people in the industry that want to reach twice that amount."

Backed by superior technology and clear objectives, the next generation of photovoltaic panels from T-Solar are ready to meet future energy needs. The sun is the limit.



Juan Laso
CEO, T-Solar Global

Bright sparks

Both new and traditional energy providers are coming up with hi-tech alternatives to fossil fuels.

The UNION FENOSA Group, one of Spain's main energy companies, operates in the generation, distribution and commercialization of electricity and natural gas. It is an integrated energy company, well positioned in the domestic market (Spain) and with operations in another 12 countries. It participates all around the world with a total installed capacity of about 13,900 MW, which implies an attributable power of 10,289 MW. It provides services to 8.7 million gas and electricity customers, to whom it bills 81.386 billion kWh.

The company is present in every link of the value chain in energy: from production and supply of primary energies (upstream) to the direct trading with customers, both industries and households (downstream), that permits added value from the capture of margins in the various businesses, activities and countries, where over 12,000 professionals work.

Company chairman, Pedro López Jiménez, knows exactly how to define the company's vision. "UNION FENOSA is an integrated energy company with an international dimension. We are very well positioned in the market and hold a solid base to support our current platform for growth," says López Jiménez.

The renewable energies sector grew by 43% in 2006.

In fact, one of UNION FENOSA's major advantages is the strength and stability lent by its principal shareholder, the ACS Group, one of the top three infrastructure, construction and industrial services in the world.

Getting BIGGER

In November 2006, the UNION FENOSA Group, based in Madrid, launched a new business plan with the objective of doubling its net profits by 2011. "The company has the goal of reaching €4 in earnings per share within the 2007 to 2011 period," says López Jiménez. "To realize this, we have



Bio Fuel Systems: Preparing tomorrow's energy needs today.

developed a strategic business plan called BIGGER, which stands for "Business Investments, Growth x 2, Efficiency and Returns." We have started an expansion drive on the basis of our existing integrated energy operations, our expertise and opportunities to develop infrastructure capacity and our international experience."

UNION FENOSA has developed a culture of strategic alliances that will add weight to its planned expansion. "Our affiliates include three of the world's top energy companies—ENI, ENEL and TOTAL," López Jiménez says, "and nationally, companies such as CEPSA and INDRA. All these will strengthen our business opportunities in this new expansion phase."

With an investment capacity of €9 billion without resorting to shareholders, the BIGGER plan calls for an important growth of the group's industrial assets. The generation of power will rise from 10,300 megawatts (MW) to over 16,000 MW by 2011.

The gas business will increase the supply capacity by 51% until reaching 8 bcm. And renewable energies will have a strong drive that will allow the company to strengthen its generation mix. Another significant aspect of the new plan is the firm intent to guarantee the stability of supplies and prices of fuels needed for the generation of electricity. This strategy, successfully applied in the gas business, will also be developed in the



Pedro López Jiménez
Chairman
Unión Fenosa

BFS
Bio Fuel Systems, S.L.

Energy of the future

Inexhaustible - Clean - Ecological

www.biopetroleo.com

business of coal, the first stage of which includes the acquisition of mining operations, with special interest in the so-called "sustainable coal" (through new carbon capture and storage—CCS—technologies). UNION FENOSA's ambitious expansion plan will bring many countries a step closer to a reliable and sustainable energy supply.

In the meantime, Schneider Electric is committed to providing more efficient electrical systems that use less energy.

Such initiatives are welcomed by José Manuel Entrecañales, president of pioneering business group Acciona, who says: "Technological diversity is an indispensable tool for meeting our future energy demands. Our current dependency on fossil fuels, and our environmental impact problems makes us more imaginative. Renewable energies of all types are occupying a more relevant space in our energy mix."

The figures speak for themselves. According to industry sources, renewable energies set a new record in 2006, reaching U.S.\$100 billion in financial transactions, of which U.S.\$71 billion were in new investments, a 43% increase over the previous year. Meanwhile, industry profits grew by 36% to U.S.\$55 billion between 2005 and 2006, and are predicted to reach more than U.S.\$220 billion a year by 2016. Solar and wind power are to power the growth together with biofuels, and E.U. companies are already hard at work in the world's most competitive and dynamic markets, investing heavily in R&D and

supplying technology for an energetically plentiful future.

One of these companies is Spanish wind-energy powerhouse Gamesa, ranked second worldwide in wind turbine supply and wind farm operation, with 10,000 MW installed in 22 countries and a market share of 15.6%. Gamesa's design and development facilities for wind turbines offer 29 assembly facilities with integral production capacity of blades, root joints, gearboxes, generators, converters and towers. Marketing and maintenance is undertaken on a global basis, opening new plants and negotiating strategic partnerships with local suppliers in the world's largest markets, including the U.S., China and Europe. In fact, 12 of the 15 largest utilities on the planet are Gamesa clients.

Gamesa chairman and CEO, Guillermo Ulacia Amaiz predicts: "By 2011, the weight of India, China, Brazil, Mexico and Poland will account for over 25% of our total wind power installed base." The company philosophy of "Think Global, Act Local" is moving toward a decisive participation in the growth of clean energies worldwide. Ulacia adds: "We have a motto here at Gamesa that says: "Our clients do not buy products, but solutions to their needs." Different marketing techniques that



José Luis Manzano,
CEO, ISOFOTÓN

ENERGY

EXPOZARAGOZA

ENDESA

EXPO ZARAGOZA 2008

WE SUPPORT EXPOZARAGOZA 2008
with all our energy

Endesa

we apply in Gamesa are directed towards demonstrating to our clients that we are competent in offering products and services that are technologically advanced, that we contribute to the efficiency in obtaining sustainable technological solutions, and that we are capable of satisfying their energy needs in the best possible quality, price, and time frameworks."

Another Spanish company that is strongly contributing to global spread of renewable energies—solar in this case—is Isofotón (www.isofoton.com). Specializing both in photovoltaic and thermal technologies, Isofotón was founded in 1981 as a university project in Málaga, and has been developing its technological know-how for over 25 years. In its new factory opened in 2006, cutting-edge solar technology is manufactured

"One can always buy new technology, but it becomes obsolete faster and faster."

for clients in over 60 countries, including subsidiaries in China, the U.S., Ecuador, Italy, Morocco and the Dominican Republic, and a project office in Senegal.

"One can always buy technology with enough money, but the technology becomes obsolete faster and faster. That is why you need constant investment in R&D to stay competitive," says Isofotón CEO José Luis Manzano. As the company's 2006 report attests, Isofotón is growing at double-figure rates in turnover, profit, cash flow and investment.

In the spirit of the company's mission statement, Isofotón also invests in tangible social responsibility with its Rural Electrification project, installing solar systems for homes, hospitals, schools and community centers. Ten thousand systems have been installed in Senegal, 17,000 in Bolivia and 34,500 in Morocco. A contribution to the quality of life, technology and progress that reaches where it is most needed.

Fossil fuel no more

As its name suggests, the Latin "stone oil", or petroleum, is a fossil fuel. But the truth is that, despite the name, petroleum does not always have to be of fossil nature, and can in fact be produced by live, renewable sources on a commercial scale. This is what Bio Fuel Systems' patented technology is set to prove, with the creation of the world's first bio-petroleum production plant in Alicante, Spain.

Spanish company Bio Fuel Systems was born in 2006 from a

project developed by scientists and engineers in collaboration with the universities of Alicante and Valencia. The company is led by president and CEO Bernard Stroiazzo-Mougin, who is also the creator of bio-petroleum and holder of numerous patents on the production process.

"Bio Fuel Systems has developed an energy converter process, based on three elements: solar energy, photosynthesis and electromagnetic fields. Our process allows us to produce bio-petroleum, which is similar to regular petroleum, while actually reducing CO2 emissions," explains Stroiazzo-Mougin.

The key component of this innovative technology is one of nature's simplest creations: phytoplankton, or single-cell algae. This organism offers various advantages in the production of biofuel: it is far more plentiful than agricultural foodstuffs used for biodiesel and bioethanol, it is readily available and can be turned into energy within eight hours. More importantly, the algae consumes excess carbon dioxide, purifies residual waters and generates by-products rich in vitamins and other useful compounds.

The resulting bio-petroleum, which can substitute regular petroleum directly without mixing, arises from the company's Integral Energy Transfer System technology. This technology will, Stroiazzo-Mougin explains, produce massive amounts of biopetroleum at a competitive price. He says: "The price of the biofuel obtained has been calculated at €0.35 per liter before tax. As regards productivity, this system could produce 400 times more oil than any other source of biofuel. Soya, for example, produces 50 cubic meters per square kilometer per year, rape seed produces 100 to 140 cubic meters, mustard yields 130 and palm oil 610 cubic meters. Algae, on the other hand, produces 10,000-20,000 cubic meters of biofuel per square kilometer per year.

"Many believe that one of the biggest barriers in the renewable sector is that it is too expensive to compete on a high level at the moment. Our opinion is very different. We hope that by 2010 we will be able to maintain a price level of €0.25 per liter, which is €40 per barrel.

"We believe that bio-petroleum will be able to outdate the existing energy sources that we have today," says Stroiazzo-Mougin. "It will be the most ecological, efficient and cheap source of energy the world has experienced so far."

All said, it's an optimistic picture, which shows that despite the challenges, Spain's energy companies are powering ahead with new solutions to keep the lights on for generations ahead. ■

