

# ENERGY INNOVATION

It has one of the smallest populations in the world, but Iceland is the giant of green energy production and expertise.



[www.landsbanki.is/english](http://www.landsbanki.is/english)



# Renewables paradise

Iceland is keen to export its wealth of green energy solutions across the planet.

One of the few countries not feeling the brunt of today's oil prices and boasting one of the world's most pristine environments is Iceland. This small nation leads globally in renewables usage, with the entirety of its energy needs now met by harnessing geothermal and hydroelectric power. Thanks to abundant hot springs and water resources, and a population

of only 314,000, Iceland quickly advanced from economic stagnation to become one of the world's richest nations per capita, moving to the top of the United Nations Human Development Index.

Currently, 72% of Iceland's total energy use is tied to geothermal power sources, supplanting hydropower as the energy of choice. "We are arguably the most sophisticated users of geothermal energy globally," says Minister of Industry Össur Skarphéðinsson. "We invest heavily in developing new technology, and are pioneering a breakthrough technology, 'Deep Drilling,' which multiplies the energy you would receive from a field three- or four-fold."

Iceland's economy, under Minister of Finance Árni Mathiesen, has seen GDP per head increase to U.S. \$40,000, while growth stabilized at 2.7% in 2007. The government has been pushing for energy-intensive industries to locate to Iceland and take advantage of renewable energies to reduce emissions in the country of origin; aluminium giant ALCOA is a recent arrival. The governmental Invest in Iceland Agency is also luring finance and high-tech companies, with the promise of cheap renewable energy as well as preferential tax advantages compared to the E.U.

Private industry is also devoted to renewables development, and one of the most active voices is Landsbanki. "We have been the bank for the energy sector, energy companies, and power intensive companies in Iceland, and have a specialized team in lending to renewable energy developments," says CEO Halldór Kristjánsson. The bank has already established an extensive network of securities companies around Europe, covering 40 companies just in the renewable energy sector, and always retaining local management.

Last year, Landsbanki founded HydroKraft Invest, an investment company dedicated solely to financing foreign energy projects. Its partnership with Iceland's largest hydropower company, Landsvirkjun, will see joint investments

## New School of Thought on Sustainability

With the world's energy demand predicted to grow by 50% through 2030, the need to harness sustainable energy sources is more vital than ever. Iceland, which already uses renewable energies for 70% of its needs, is a hotbed of up-to-date scientific and technical know-how, and, as such, a hub for tomorrow's energy solutions providers.

With this in mind, Reykjavík Energy—the world's leading geothermal energy company—has set up the Reykjavík Energy Graduate School of Sustainable Systems (REYST), in collaboration with Reykjavík University and the University of Iceland. Opened in December 2007, REYST is an interdisciplinary school in higher education for engineers and scientists that focuses on global environmental protection and sustainable use of energy resources.

Its objective? To create new generations of experts in management, design, and research in sustainable energy use. Hjörleifur Kvaran, CEO of Reykjavík Energy, says: "We want the emphasis to be on practicality, innovation, and interdisciplinary thinking. The unique expertise of each of REYST's founding partners forms an excellent platform for the school to build on."

### Reykjavik Energy

Baejarhalsi 1, 110 Reykjavik Iceland, Reykjavik, Iceland  
Tel: +354 516 6000 Fax: +354 516 6709  
or@or.is www.or.is





**UNITED NATIONS  
UNIVERSITY**

**Geothermal  
Training Programme**  
Grensasvegur 9,  
Reykjavik 108, Iceland  
Tel: +354 569 6000  
Fax: +354 568 8896  
ibf@os.is  
www.os.is/unugtp



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N1's new building.



Graduates of the UNU-GTP in 2007 from 14 developing countries.

overseas. Landsbanki, with hugely successful and expanding banking and financial services worldwide, including some of the U.K. and Ireland's biggest stockbroker firms, is also among a group of 153 international companies committed to speeding up action on climate change.

As vehicles cause ever greater greenhouse gas emissions, Iceland has pledged to be the first country to use only renewable fuels. All private automobiles, fishing boats, and public transportation will eventually run on hydrogen fuel. Energy company Skeljungur opened Europe's first hydrogen retail filling station near Reykjavik in 2003. Public buses and some cars now run on hydrogen fuel, and Skeljungur, formally part of Shell, is currently working on applying the technology to ships.

N1, which recently bought out Esso in Iceland, has 120 sales points



Reykjavik University's new campus, a perfect synergy of architecture, science, and technology.

countrywide and is also heavily involved in renewables innovation. Together with SORPA, NSA, and Reykjavik Energy, N1 founded Metan Ltd., which develops methane fuel derived from waste. "It is a fantastic way to recycle our garbage, and we will be investing more than U.S. \$1 million in new Metan stations within Reykjavik," says CEO Hermann Gudmundsson, adding that, by the year-end, 200-300 vehicles powered by methane will be on the roads.

Metan has stimulated the methane market by building a refinery to process it and introducing larger hybrid vehicles to utilize the fuel. Additionally, N1 has initiated the distribution of biodiesel as another renewable vehicle fuel.

Iceland also heavily invests in educational programs developing renewables. The United Nations University's Geothermal Training Program, owned by Iceland's energy authority, has, since 1978, been a center

of excellence in geothermal research and development, and assists developing countries with geothermal capacity building. Since UNU-GTP's inception, 380 geothermal professionals from 41 countries have graduated and, starting this year, the former MSc graduates can, for the first time, enrol as PhD students. Reykjavik University has jointly set up REYST energy school. It plans to take advantage of Iceland's reputation for sustainability to offer courses in harnessing energy technology and the exploration and management of renewable energy overseas. The RU is also building one of Europe's best campuses at 40,000 m<sup>2</sup>, creating a truly international university in Iceland. ■

REYKJAVÍK UNIVERSITY  
HÁSKÓLINN Í REYKJAVÍK

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Invest in Iceland Agency

[www.invest.is](http://www.invest.is)

Dalvegur 10-14,  
IS-201 Kopavogur,  
ICELAND  
Tel: +354 440 1000  
Fax: +354 440 1010  
n1@n1.is

[www.n1.is](http://www.n1.is)

# Spain

When it comes to the green agenda, Spain is a hotbed of activity.

Thanks to political will, a favorable climate and largely mountainous terrain, Spain has forged ahead to become a world leader in renewable energies both at home and for export. Spanish energy producers were early investors in renewables, and the government has also provided favorable tariff incentives guaranteeing generators that all the energy they produce will be sold. The country is the world's second largest producer of wind power after Germany, with 27% of total electricity supply, or 8,375 megawatts, now generated by turbines—more than the proportion produced by any other single energy source.

Spanish companies are also global leaders in biofuel and solar power, which is experiencing exponential growth, and not just because of a sunny climate. The government recently passed legislation requiring every new or recently renovated building to use solar power. One of Spain's biggest solar success stories is Siliken, which, after just seven years in operation, has a 24% market share of Spain's photovoltaic module production. It had a turnover of €52 million in 2006, a 220% growth rate in two years. "The most important reason for our success would have to be our relationship with our suppliers, who we treat as both clients and partners," says



**Carlos Navarro**  
Founder, CEO  
and DG, Siliken



**Gonzalo Navarro**  
Co-Founder  
Siliken



**Alfredo Puche**  
Co-Founder  
Siliken

CEO and DG Carlos Navarro. "Another key strength is that our production lines include machines developed by ourselves, giving us independence, as well as allowing us to plan our growth capacity in this competitive market."

Now Siliken, which has installed more than 70MW of photovoltaic energy and has three factories in Spain, has embarked on a program of both national and international expansion. This year, a U.S. base will open in San Diego, California, an ideal location for solar uptake, and facilities in Italy, Germany and France will follow. Siliken is looking for local partners with each set-up, and is also seeking to diversify into other renewable energy sources and produce its own raw materials in the form of silicon.



*"It has been calculated that if 0,71% of the European land mass was covered with PV modules, this would meet Europe's entire electricity consumption."\**

*Let's make the most of  
renewable energies.*

*Future generations will be grateful to us.*



\*Report "Solar Generation IV" of EPIA (European Photovoltaic Industry Association)

#### SILIKEN S.A.

C/ Massamagrell, 40. Pol. Ind. L'Horteta, Rafelbunyol, Valencia, Spain  
Tel: +34 902 41 22 33 • Fax: +34 961 41 12 41 • info@siliken.com • www.siliken.com

# Center of Excellence

Spain's National Renewable Energy Center is a melting pot for energy solutions.

The National Renewable Energy Center (CENER) is a technological center specializing in renewable energy applied research, development, and promotion. It is highly qualified and has both national and international prestige. It is headed by general manager Juan Ormazábal.

CENER commenced operations in 2002 with the sponsorship of the Government of Navarra, the Ministry of Education and Science, and the Center for Energy, Environmental, and Technological Research, all of which, along with the Ministry of Industry, Tourism, & Trade, are members of its board. It currently provides services and performs research initiatives in six areas in the field of energy: wind,



**Juan Ormazábal**  
General Manager  
CENER

solar thermal, photovoltaic solar, biomass, bioclimatic architecture, and the network integration of renewable energies.

CENER is equipped with a cutting-edge technological infrastructure and Europe's most modern laboratories and installations. It has a staff of 200 highly-qualified professionals who have made CENER a reference both within and beyond Spain. It provides professional services to a large group of institutions and organizations

linked to the energy business, as well as Spanish autonomous governments and European and Latin American government bodies.

CENER's headquarters are located in the City of Innovation (Sarriguren, Navarra) and equipped with the very latest technological installations. Additional installations and offices are located in Sangüesa, Navarra, and Madrid.

## How do we work?

CENER focuses its work on three interrelated axes:

- Technology generation through R&D and innovation projects and the creation, acquisition, and diffusion of scientific and technical knowledge for the industrial sector.
- Provision of services and technical support to companies and public institutions collaborating in the creation and start up of the technical, managerial, and legal framework required to commence operations.
- Technical and financial reports and viability assessments.

R&D projects cover the entire process of power generation from natural resources, including: determination of renewable resources; development of performance technology; technological risk assessment; economic viability assessment; verification and standards; systems equipment development.

These efforts are carried out with a double objective: to stimulate the level of competitiveness of companies in the renewable

energy sector, meeting all of their R&D needs while simultaneously promoting the technological and commercial development of renewable energies.

## Customer orientation

Permanent contact with customers enables us to evaluate their individual and collective needs, and gives us the necessary insight to continuously improve our products and services and provide the best possible service. CENER is committed to results and ensures customer satisfaction by: confidentiality and ethical commitment; rigor and technical precision; high standards of quality; flexibility and agility; innovation; independence; proactivity; loyalty, trust, and respect for people.

## Quality

Our mission is to assure the maximum quality of service, efficiency, and research. To achieve this, CENER carries out:

- Under ISO 17.025 ENAC, testing in wind energy, photovoltaics, and solar thermal.
- Total quality management-EFQM.
- MEASNET accreditation in wind energy.

## Our people

The people who work at CENER are our main asset and the key to our success. We have a multi-disciplinary technical team of more than 200 professionals and experts qualified in the use of natural resources, together with young research professionals who are newcomers to the labor market.



**Jerónimo Camacho Perea, Strategic Development & Business General Manager**

## A unique wind turbine test laboratory

CENER operates the Wind Turbine Test Laboratory, the only one of its kind in the world, located on 30.000m<sup>2</sup> at the Rocafort Industrial Complex in Sangüesa. The installations have warehouses where structural tests are performed on blades of up to 90m in length (the longest produced presently for land wind farms are 45m, and 61m for sea wind farms) and power train tests for machines of up to 5Mw. Along with these tests, the laboratory allows provision of the following services:

- Manufacturing processes and materials laboratory (Study of the performance of new materials and their applicability to the land and sea wind farm industry.)
- Wind tunnel. (Measurement of aerodynamic performance of new generations of blades.)
- Field test. (Complete machines in any part of the world under IEC standards.)
- Own research farm. (Six positions for machines of up to 5 MW.)



CENER — At the cutting edge of renewable energies.

## CENER's areas of activity

### 1. Wind Energy

By collaborating with other agencies in the wind sector, the Wind Energy Department has gained experience, knowledge, and a global outlook, enabling it to offer highly competitive, high value-added services both at home and abroad. It provides services to all agents operating in the sector, including investors, manufacturers, certification boards, and financial institutions, users, associations, and administrative bodies.

#### Areas of activity include:

- Wind resource evaluation and wind farm design.
- Power generation forecasts.
- On-site trials of wind turbines accredited by ENAC MEASNET.
- Design tool development and production.
- Installation tests (Experimental Wind Farm, Mechanical and Rotor Blade Tests) and Predictive Maintenance.
- Wind turbine and component design.
- Wind turbine certification (by agreement with the DNV).
- Wind turbine performance monitoring.

### 2. Photovoltaic (PV) Solar Energy

This department provides value-added services and solutions to meet the specific demands of the growing PV industry. Its services are required by component manufacturers, installers and other partners involved in PV electrical energy production.

#### Main research and service areas include:

- Design, evaluation, and operation methods for complete PV systems .
- PV module testing laboratory for: Crystalline silicon terrestrial PV modules; design qualification, and type approval. (IEC 61215: 05); electrical safety.
- PV solar material and cell characterization.
- PV solar cell production processes characterization.

### 3. High, Medium Temperature Solar Thermal Energy

The Renewable Energy Integration Department provides high value-added services to the solar thermal energy industry through its solar collectors laboratory and R&D in the area of medium and low temperature collectors.

#### Areas of activity include:

- Solar Collector Laboratory.
- R&D in low, medium and high temperature solar thermal energy.

- Design and development of solar collectors.
- Testing collectors according to standards.

### 4. Biomass Energy

This department provides high value-added services to private industry, biomass plant owners, and investors, public entities, local administrations and regional authorities. The department's activities cover the entire agricultural and forest biomass exploitation chain, as well as waste assessment, from resource evaluation to power generation technology. It includes research into alternative energy cultivation, harvesting technology, supply logistics, liquid biofuel production technology, combustion technology, and biomass gasification.

#### Its research and services cover the following areas:

- Assessment of the usable biomass potential and the logistics required in a given area
- energy cultivation
- combustion and gasification
- 2nd Generation of biofuels, bioethanol and biodiesel
- lifecycle analysis
- microalgae cultivation system

### 5. Bioclimatic Architecture

This department provides specialist technical support in the area of energy conservation in buildings, the application of bioclimatic strategies (both in buildings and on an urban scale), and the integration of renewable energy in architecture.

**Areas of activity include:** R&D projects on innovative building solutions • energy certification of buildings • standards and technical aspects of energy conservation and the integration of renewable energy in buildings • energy assessment of buildings and building projects • CENER's label of environmental quality in buildings • integration of collectors in buildings • integration of solar thermal energy in industrial and residential heating and cooling systems

### 6. Renewable Energies Grid Integration

This department was designed as a support unit for all of CENER's other areas, and also to render services to customers and provides competitive, high-value-added services, both at national and international levels.

#### Its research and services cover the following areas:

- Integration of renewable energy into the grid system.
- Protection against and prevention of lightning strokes.
- Hydrogen production from renewable energy sources.
- Power electronics. ■