customer magazine

issue no. 2

ambitions

Efficient Systems
Mathias Häussler and his team have an award-winning solar house solution.
Page 8

Future Prospects
Ralph Eichler, President of the Federal Institute of Technology Zurich, on energy, research and business synergies.
Page 10

Fresh Opinions
Energy inspires special reactions from young people around the world.
Page 24

Great Adventures
With his newest project Bertrand Piccard is striving to circle the globe in a solar airplane.
Page 28

Energy

Capturing the Forces of Nature

Investments into renewable energy: Around the world, Sika protects wind turbines from top to bottom.

Sika®

Sika Sarnafil membranes are part of a flexible solar panel array system. In Fulda, Germany, 3900 m^2 of photovoltaic solar panels are producing 187.7 kWp.

intro

Manfredo Belohuby provides Enercon, a leading turbine manufacturer, with know-how and products that it needs to build the largest wind farm in Latin America. Our article about this key technology appears on page 14 of this issue.

Dear Readers,

Energy is essential for life. Since prehistoric times, when man used bonfires to keep warm at night or to cook food, energy has been the force behind human evolution. In its various forms, energy now moves vehicles, machines and even the rockets that will take us to new frontiers in space.

Paradoxically, the use of fossil fuels like coal and oil, while it has allowed for an unimaginable development, endangers the very existence of humanity, given the limited supply of these fuels.

Today, modern man is faced with unbridled energy consumption, on the one hand, and a shortage of energy resources, on the other. This situation has resulted in a relentless search for alternative renewable sources that reduce our dependency on fossil fuels.

In this context, the exploitation of wind energy becomes increasingly interesting as it is a clean and abundantly available alternative. Alongside other alternatives, such as nuclear, hydro, solar and geothermal energy, wind power is becoming more prevalent around the world. Wind farms are now a common sight in many countries, where they provide cities and industries with electricity.

Sika is proud to participate in large projects to generate wind power in the world with its technological contribution, developing chemical products that meet the needs of state-of-the-art wind farms – even under harsh conditions like in offshore regions. And this is only one example where Sika products contribute to a sustainable energy use.

Wind power is also important because of the current downturn in the automobile industry, as Ernst Bärtschi, Sika's CEO, points out. "Many of the technologies we use in the automobile sector can be used for the industrial production of windows and the construction of wind turbines. As a result, Sika will not have to change its business strategy. We will continue to strive for better market penetration in both areas in the future."

Enjoy reading!

Manfredo Belohuby, Manager Marketing & Products for Business Unit Concrete, Sika Brasil

ambitions issue no. 2
ambitions is Sika's international customer magazine.
It appears twice a year in English (circulation: 6600 copies).

Project lead: Silvia Schärer, Kathrin Müller, Sika Services AG, Zurich

Editor's address: Sika Services AG, Corporate Marketing, Tüffenwies 16, CH-8048 Zurich, Switzerland; e-mail: ambitions.magazine@ch.sika.com

Concept: Andreas Turner (editing and production), Beni Spirig (design), Infel AG, Zurich, Switzerland

Printing:
Abächerli Druck AG, Sarnen, Switzerland

Contributors to this issue:
Dieter Bauer, Jens Berger, Manfredo Belohuby, Gustav Bracher, Stephen Burke, Kajsa Byfors, Peter D'Antonio, Luis Gutierrez, Mark Harris, Francisco Jimenez, Jeannette Kaufmann, Don Kirk, Angela Koller, Hanna Kronenberger, Paul Magera, Horst Peters, Jane Rüegg, Silvia Schärer, Andreas Turner, Rainer Weihofen.

renewable

Solar power
Photosynthesis turned the Earth's initially toxic environment into the life-giving atmosphere we know today.

Tapping the Sun's Energy

Our **Sun** is a single star among a multitude of brighter, larger and more powerful stars. But its proximity to Earth makes it uniquely suited to support life as we know it.

The Sun means well by the Earth. Mercury and Venus? Too near, too hot. Jupiter, Saturn, Uranus, Neptune? Too far away, and too cold. Mars? Perhaps, at some ancient time, but robots are still searching for signs of life. But the Earth is perfect. With just the right size and distance from the Sun, the Earth was able to create something as improbable as the human race from a desolate, gaseous collection of chemical elements some 4.6 billion years ago.

Humans thrive under the Sun. It warms them, feeds them, and helps them advance their technologies. The Sun's energy makes photosynthesis possible – the most important biochemical process on Earth and basis for plant life and life in general. And it's very old. Tiny fossils, similar to bacteria, might have been capable of photosynthesis as early as 3.5 and 4 billion years ago. During the photosynthesis process, plant cells use sunlight to make glucose and oxygen from carbon dioxide and water. In this way, the Earth's ancient toxic air became the life-giving atmosphere we know today.

The Sun is a gigantic fusion reactor where nuclei fuse to produce energy that keeps the fusion process going, but also radiates into space. The latter arrives on Earth in the form of electromagnetic rays, which we call Sun energy. At the fringes of our atmosphere, the Sun produces an average of 1367 watts of energy per square meter. Particles in the atmosphere, such as ice crystals, dust, or fluid airborne particles, reflect or directly absorb part of the Sun's radiation and transform it into warmth. The rest generates between 800 and 1000 watts per square meter of energy when it reaches the ground, depending on the latitude, altitude, and weather. The Sun's radiation is converted to warmth and keeps photosynthesis going. In total, the Sun provides 10,000 times the entire primary energy requirements of Earth.

Normally, the vast majority of this huge amount of energy is reflected back to space in the form of heat radiation. This doesn't happen when the Earth's climate is favorable to the formation of coal, oil or natural gas. That was the case during the Carboniferous Period, or about 300 million years ago. At that time it was very warm, very humid, and conditions were perfect for plant growth. Some of the dead plants sank into swamps where – deprived of oxygen for decomposition – they became turf. Later, these swamps were covered by ocean sediments that put pressure on the turf and increased temperature transforming it into lignite. Depending on the geological conditions, more layers of sediment created more pressure, transforming lignite into black coal and, eventually, anthracite. In this way, the Sun's energy was stored deep under the Earth.

Oil and natural gas also originate from plants. However, in this case, it was sea organisms such as algae that died and settled to the bottom of the oceans, where they were covered by sediments and deprived of oxygen. Enormous pressure and high temperatures transformed the long water-insoluble, hydrocarbon chains into short, gaseous and fluid

The Sun's radiating energy is the source of wind and weather.

renewable

hydrocarbon chains. Today, the chemical industry uses this process in so-called crackers.

Coal, oil and natural gas. For ages, humans have made extensive use of the Sun's energy in the form of fossil fuels. Today, oil consumption has increased to about 30 billion barrels a year. And about 4.5 billion tons of coal and 2500 billion cubic meters of natural gas are consumed as well. Fossil storage has two serious drawbacks, however: It cannot be replenished – at least not in a time scale humans can consider – and carbon, stored in it, changes to carbon dioxide, a greenhouse gas, when it is burned. This makes the search for different methods to use Sun's energy directly one of the most important tasks of science and industry.

The guiding principles of a sustainable development – to which Sika feels committed – pays deference to the needs of today's generation without endangering the ability of future generations to fulfill their needs. This is the overall standard that Sika management and employees place upon their work. In this respect, the relationship between economic, ecological and social aspects is becoming increasingly close.

The idea of using renewable energy is anything but new. Windmills and watermills have used the Sun's energy for centuries, capturing circulating winds and water that result from sun-induced evaporation and changes to air pressure. Hydroelectric plants and wind turbines are modern examples of this medieval technology. Today, these energy sources supply a growing amount of electricity to entire regions and industry with increasing efficiency thanks to modern building processes and new materials.

Solar collectors use the Sun's radiating energy even more directly, producing warmth for heating and steam to generate electricity by bundling energy in units on the roofs of houses and larger power plant configurations. The most efficient direct use of Sun's energy, however, comes from solar cells made of silicon, which convert sunlight directly into electricity. Silicon is made of sand. And sand is almost as plentiful as the energy supplied by our solar system's central star.

Wind power and solar energy are becoming increasingly important for the generation of electricity. Sika supplies the manufactures of wind turbines and solar modules with adhesives that are perfectly designed for the extreme operating conditions of their facilities. The adhesives used for wind turbine rotor blades, for example, can withstand strong mechanical force, while adhesives for solar modules can bear up against exceedingly high temperatures.

And, who knows, one day it might be possible to ignite the fire of the Sun on Earth. The world's largest industrial fusion reactor is now under construction and should provide electricity in a few years from now. Just one gram of hydrogen fused to helium would generate about the same amount of energy as the combustion of eight tons of oil or eleven tons of coal.

Rainer Weihofen

"The search for methods to use Sun's energy directly is one of the most important tasks of science and industry."

All forms of life and technology depend on the Sun.

self-sufficient

The Champion of Energy-Efficient Building

College and university students from around the world compete in the **Solar Decathlon,** an international contest to design, build and operate the world's best solar-powered house. The current champion, TU Darmstadt, uses insulated windows bonded with Sika adhesives.

Efficient solution: "Our bonded windows have been a part of an award-winning solar house," says Mathias Häussler.

A unique ritual takes place every two years within walking distance of the White House in Washington D.C.: A small village is built at the National Mall by teams of solar technology researchers and building designers who gather for a three-week contest to construct and operate the most attractive, energy-efficient solar-powered house. Sponsored by U.S. Department of Energy and the National Renewable Energy Laboratory (NREL), the Solar Decathlon tests the skills of its contestants in ten disciplines, including market viability, appliances, hot water, lighting and energy balance.

TU Darmstadt, a leading German technical university, won the contest with a 70 m^2 house that produced more solar energy than it used. All teams had to run a stove, washing machine and 435-liter refrigerator for a week and use reserve energy to power an electric car, which was monitored for mileage it could travel.

"Generally our goal was to build in energy saving into the design," says Isabel Schäfer, a project manager from the TU Darmstadt. "It may be more of a European approach, but we wanted to create a house from floor plan to the building shell that would save as much energy as possible even before adding active solar systems."

The TU Darmstadt team succeeded in building a "passive" house, which does not exceed energy consumption limits with high insulation that would make it possible to live in a European climate all the year round without outside electricity. "We wanted to achieve a passive-house standard that would comply with the European norm," said Schäfer.

Insulated windows were a key success factor. "Adhesives were essential to achieving high insulation performance with little profile," said Mathias Häussler, Sales and Product Manager of the window Energate, made by the window manufacturer Ludwig Häussler GmbH.

To achieve a high window insulation, Häussler used Sika adhesives for large window surfaces, including two 2.5 x 1.2 meter French balcony windows. "We were not worried about the large surface. Even with the mounting we had more than enough leeway to hold 130 kg or about four square meters with triple glazing."

The TU Darmstadt project used floor-to-ceiling windows on the north and south sides allowing for generous daylight (quadruple glazing north, triple glazing south, insulated frames). Shutters and windows can be operated manually, extending or limiting the living space, according to daytime, seasonal, and user demands.

Heating and cooling systems. Correct construction significantly reduces the effects of both heat flow and air leakage. Sika adhesives are widely used in the manufacture of insulated windows that enable these remarkable energy savings.

The Standards of Eco Living

Passive House is a standard for energy efficiency in buildings. It generally applies to buildings that require little energy for heating or cooling, not exceeding 15 kWh/m^2 per year. Total energy consumption may not exceed 42 kWh/m^2 and the primary energy for heating, hot water and electricity may not exceed 120 kWh/m^2.

Minergie House – A Swiss standard for new and remodeled low-energy consumption buildings. The label Minergie may be used only for buildings, services and components that meet Minergie standards, meaning high-grade, air-tight buildings that enclose and continuously renew air in a building using energy-efficient ventilation systems. This standard requires that a new single-family home does not exceed 42 kWh/m^2. A refurbishment project may not exceed 80 kWh/m^2.

Zero-Energy House is a standard for buildings with zero net energy consumption over a typical year. This may apply to cost, energy, or carbon emissions. The onsite renewable energy source generates the same amount of energy the house uses. This may also include the energy used to transport energy to the building.

Energy-Plus House – This standard applies to a building that produces more energy from renewable energy sources than it gets from external sources. A combination of micro-generation technology and low-energy building techniques such as passive solar building design, insulation and site placement is used, as well as energy-efficient appliances and fixtures.

Concrete – Heat and Comfort

Concrete can do much more than support weight and provide a uniform surface to cover an area. Concrete is the almost perfect heat accumulator and ensures a consistent moisture balance. Developed further, concrete can become a damper hull that adds optimum cost performance – also in terms of energy – to its growing reputation as the ideal building material.

Sika adhesives are used for an aesthetic appeal and for energy-efficient building.

progress

House of the Future
ETH Zurich is developing a technology that could drastically reduce the CO_2 emissions from heaters and air conditioners. Using heat pumps a model building is being built with interlaced pipes for the outside shell that use water from 200 meters under the earth to cool the building in summer and keep it warm in winter.

Climate Systems Modeling Center
The newly established "Center for Climate Systems Modeling" (C2SM) with strong participation of ETH Zurich will foster climate research, refine and exploit a hierarchy of climate and climate-related models, conduct analysis of climate data sets, and prepare for the use of the next generations of high-performance computers.

Monte Rosa Hut
Supported by Sika, ETH Zurich is setting new standards in Alpine building technology at the Monte Rosa Hut in Switzerland, where cutting-edge design, energy management and solar technology are combined to achieve unmatched energy performance 2883 meters above sea level.

"Prosperity Is Still Possible with Less Energy Consumption"

Innovative technology should be the first line of defense against climate change: Ralph Eichler, President of the Swiss Federal Institute of Technology Zurich (ETH Zurich), talks about research and business synergies, as well as the prospects of a future with low carbon emissions.

Mr. Eichler, is the economic crisis bad for the earth's climate? Economic crises have positive and negative effects on the climate. An economic downturn means fewer goods are transported and fewer people travel. In turn, that means fewer flights and trips over land and water. As a consequence, there is a drop in emissions that is good for the climate. On the other hand, changes to the energy infrastructure, with the goal of achieving more sustainable energy production, will cost money initially. And we need to make considerable investments in infrastructure before we can achieve any long-term savings effects. Right now is a difficult time to do that. That is the reason that countries are launching business stimulus programs; energy-sensitive infrastructures need to be steered in the right direction.

There have always been periods of dramatic climate change in the history of the earth. What is the basis for certainty that humans are the cause of global warming? Analysis of core samples from the Antarctic have proven conclusively that climate change has never before taken place as rapidly as it has now done since the beginning of industrialization. And the greenhouse gas CO_2 is the main cause for it. Several reports by the United Nations Intergovernmental Panel on Climate Change, IPCC, have led to wide agreement that humans are responsible for climate change.

The new ETH Zurich energy strategy calls for a "one ton CO_2 society". Does that mean that you have departed from the idea of a "2000-watt society"? The focus is different. Both slogans are metaphors for a reduction of material flow, and both concepts are actually too simple. The reality is much more complex. I am an advocate of an 'energy trilogy' of society, economy and science and I am continually amazed at how complex these interdependencies are. We have to reduce gases that affect the climate. To prevent the climate from warming more than a tolerable 1.5 degrees Celsius, we must reduce the annual per capita CO_2 ton consumption – and we must do it in a stable world population of at most 10 billion people.

How could that be applied to the world's current population? To achieve a reduction of one ton of CO_2 per capita, a country like Switzerland would have to reduce its emissions to one-ninth of its current level. In general, we could achieve this goal by using fossil fuels only for heavy transports via trucks, ships and aircrafts. Everything else such as private transport overland, and electricity production and heating would have to be achieved without CO_2 emissions.

The ETH Zurich Center for Climate Research takes data from the past and compares it to current data in order to achieve an exact climate model for the future. How do you use your findings? Climate change

Ralph Eichler was born on New Year's Eve in 1947 and grew up in Basel, Switzerland. He studied physics at the ETH Zurich and received his doctorate at the former Swiss Institute for Nuclear Research (SIN). After doing research in the U.S. and Germany, the natural scientist was elected associate professor at ETH Zurich in 1983, where he has been a full professor for Experimental Physics at the Institute of Particle Physics since 1993.
In 2002, Ralph Eichler was elected Director of the Paul Scherrer Institute in Villigen, Switzerland. He became President of ETH Zurich on September 1, 2007.

Sustainability in all of the three core areas of the university – education, research and implementation – is of great concern to Eichler. "To bring the vision of sustainability to life, we need the right approach, but also efficient technologies that produce little waste and the means to recycle waste into high-quality products," says Eichler. Well thought-out solutions involve more than simple energy savings. "I am proud that our Campus Science City is a model community for sustainability," said the ETH President. "To achieve this goal, we are using the technologies available today in a consequent manner."

Photos: Sebastian Derungs, ETH Zurich

progress

Plug-in Hybrid
Plug-in hybrid cars could play a central role in the traffic systems of the future. Propelled mostly by electricity, these vehicles would take their energy from a network of electrical outlets.

A Million Revs a Minute
Increasingly small electronic devices ask for high-revolution drills. ETH researchers have developed a drive system with a million revolutions a minute – four times faster than anything currently used in the industry.

Fuel Cells from Solar Energy
The solar-thermal production of hydrogen (H_2) from water (H_2O) holds great potential. Among other things hydrogen can be used to power fuel cells. The research focus is on the development of high-temperature solar-chemical reactors.

Citius
ETH Zurich is helping the Swiss Bobsled Association (SBSV) to develop superior bobsleds for the Olympic Games 2010 in Vancouver. The Citius project is sponsored by Sika and other companies.

is not something that Switzerland alone can influence directly and decisively. However, that should not hinder us from nevertheless working towards a policy of climate protection in our country. As an institute of technology, ETH Zurich is focused on conducting high-level research, and thus brings our industry in a position to sell our specialized climate-friendly technology around the world.

Will we need more electricity in the future to ensure that our level of prosperity doesn't fall when we stop using energy generated by fossil fuels? It is quite possible to continue to ensure our prosperity while using lower energy consumption. Electricity's share of our total energy consumption will increase, but this could also mean that we will be producing the very same amount of electricity as today, but simply cutting back on other energy production.

Are there any generally valid solutions for a sensible climate policy? Every country is different and, as a result, should have a custom-tailored energy mix. Electricity can be produced in different ways: photovoltaic, wind power and nuclear, coal, natural gas, hydroelectric and biomass. In the Sahara, for example, lots of energy can be produced with photovoltaics, but not so in Scandinavia. In Switzerland there is an abundance of hydroelectric power, in contrast to northern Germany where this is not so due to a flat geography. Coastlines offer a lot of wind and nuclear energy gives a possibility for those countries without other options. Many expect a renaissance of coal use in this century. China, India, Canada and the U.S. have a lot of coal reserves. However, coal should only be used, technologically and economically, if we succeed in extracting and storing the CO_2 it produces.

"ETH Zurich is focused on conducting high-level research, bringing our industry in a position to sell our specialized climate-friendly technology around the world."

Do we already have the technological requirements needed to reduce the climate-damaging emissions from vehicular traffic to an acceptable level? Gasoline has an energy content per kilogram that is nearly unbeatably high. Meanwhile, a modern battery offers only one percent of energy density compared to gasoline. Should you want to drive a battery-driven vehicle 400 kilometers, you would need a battery that weighs one ton. The comparable gasoline tank, including content, would weigh only 80 kilograms. That means there is no emission-free drive propulsion for aircraft, ships and trucks in sight. For private transport, particularly in emerging markets, it is urgently necessary that we develop inexpensive hybrid drive propulsion. With respect to passenger cars, we do not yet know if the fuel cell, or plug-in electro drive will ultimately succeed.

Global shipping has been identified as the largest source of air pollutants. Ship engines burn heavy fuel oil – the least expensive of all fossil fuels – and on the open sea there is no emissions regulation. So we have to develop diesel engines that cleanly burn heavy fuel oil. Swiss industrial companies produce large diesel motors and turbochargers, and ETH Zurich and the Paul Scherrer Institute (PSI) conduct research into environmentally friendly ship diesel motors. This should give our industry a competitive advantage.

What is the ETH Zurich vision for cities of the future? As in the past, today's cities are primarily places where people work. They sleep elsewhere. It would be better if things were more balanced. We, therefore, support mixed zone projects, where high tech goes hand in hand with living space. And suddenly people don't have to commute as much.

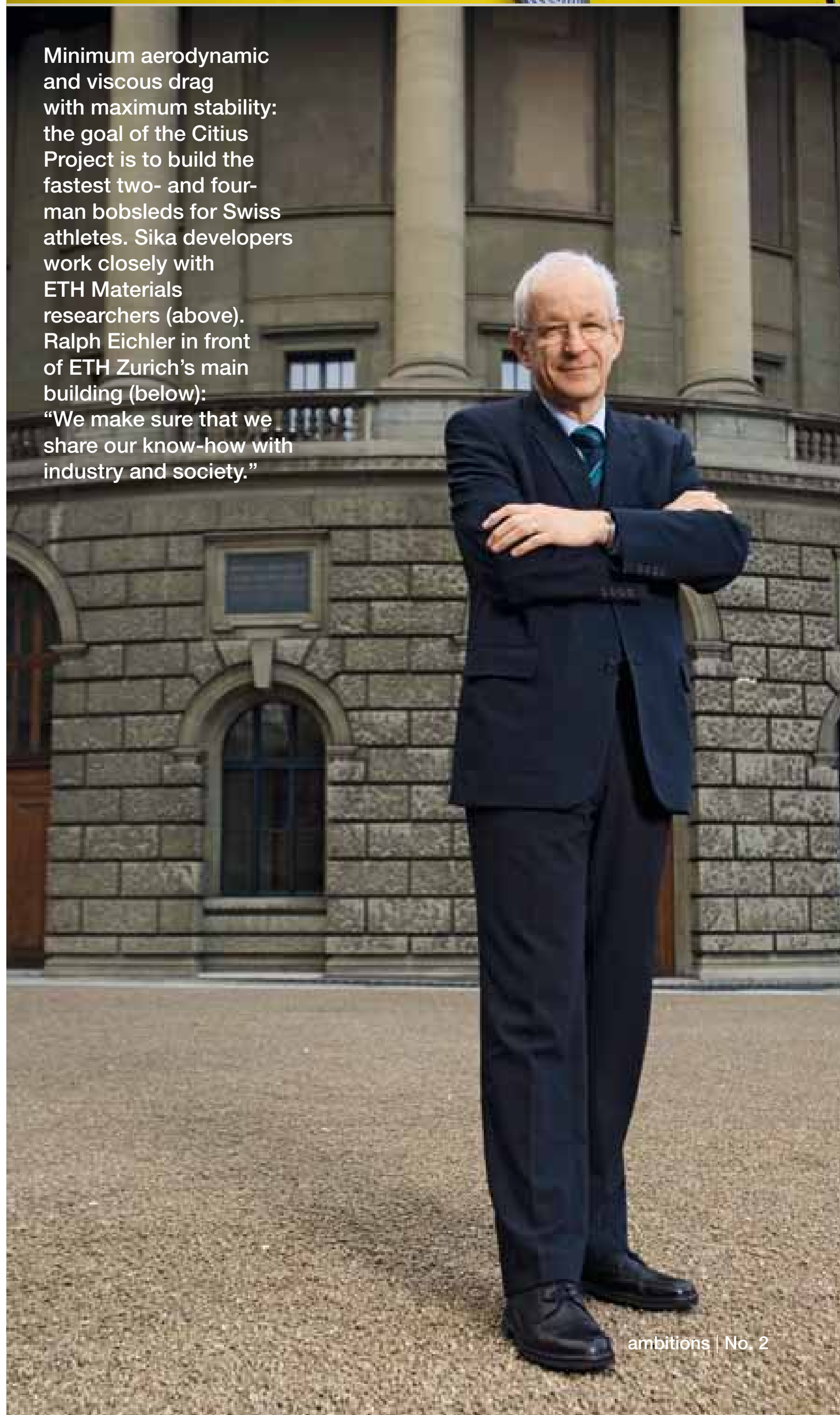
What about technology for buildings? With respect to buildings, here too you have to begin with solar and geothermal energy in the cooler temperature latitudes. It is entirely possible today to design a zero-energy house that does not consume additional energy from outside and does not produce CO_2 emissions. Things get more complicated when it comes to renovating existing buildings. Even there, though, enormous potential to improve energy efficiency exists.

How important is collaboration between research in academia and business and industry? ETH Zurich has three main tasks: first of all, we work to provide excellent training for engineers and scientists. Secondly, we engage in basic research and thirdly, we make sure that this know-how is transferred to society. The latter is carried out not only by the students we educate, but also through cooperation with business. It is very important that industry is integrated into the development of prototypes of technical products from the very beginning, and we do this. Companies know exactly what the market needs and wants.

What are your expectations of the high Alpine ETH Zurich showcase project, the Monte Rosa Hut? This building project, located nearly 3000 meters above sea level, should prove that construction can be done under extreme weather conditions, while at the same time reducing CO_2 levels and conserving resources. We want to try out certain ideas, and combine excellent architecture with sustainability and the most advanced technology. Projects of this kind which focus on the intelligent handling of energy have a symbolic radiant power, and they are perceived by the public accordingly – even though the effect on the climate in this particular instance may be modest.

Energy consumption by the earth is only a tiny portion of the sun's solarization. At the same time, direct use of the sun is the most expensive of all energy forms. Will this paradox ever be solved? Wind and water power also depend on the sun. That means that we use a lot of solar energy, at least indirectly. Storage is the main problem for all forms of renewable energy. You need energy at night, but the sun shines only during the day. In addition to photovoltaics, there is an urgent need for energy-efficient batteries. That is why there is intensive research underway in this area all over the world, including at ETH Zurich.

Interview: Andreas Turner



Minimum aerodynamic and viscous drag with maximum stability: the goal of the Citius Project is to build the fastest two- and four-man bobsleds for Swiss athletes. Sika developers work closely with ETH Materials researchers (above). Ralph Eichler in front of ETH Zurich's main building (below): "We make sure that we share our know-how with industry and society."

generate

Rock-Anchored
Rock anchor foundations are more costly to build, but they offer considerable advantages for strong-wind sites on rocky ground like in the Enercon project in Bessakerfjellet and Valsneset, Norway.

Bonded to Last
SikaCor® and Sika Permacor® provide a long-term corrosion protection for external and internal surfaces of steel towers. SikaFast adhesive products are used to bond parts on the blades at Enercon.

Enercon France
Villesèque-des-Corbières is one of six new Enercon wind farm projects in France. Type E-70 turbines have a hub height of 57 meters.

Enercon Germany
Inland wind turbine towers like these in Peterswalde near Uecker-Randow, Mecklenburg-Vorpommern, are built of precast concrete segments. The bonding is executed at the jobsite with a special Sika®-WEA epoxy type adhesive.

Harnessing Wind Power

Around the world, Sika protects **wind turbines** from top to bottom, helping guard long-term investments into renewable energy.

Under a cloudy blue sky in a pasture not far from the Brazilian coastline, 75 giant wind turbines are spinning in the sea wind. Each propeller spans 70 meters and sits on top of a 98-meter mast.

This is the Osório Wind Farm, the largest group of wind turbines in Latin America, and among the largest in the world. With a total capacity of 150 MW, Osório produces enough electricity to power a city of 650,000 inhabitants and reduces CO_2 emissions by an amount equivalent to 148,000 tons per year.

Like Osório, most wind farms are located in areas where they can take advantage of relatively constant winds: a location which also subjects them to corrosion through salt air, humidity, and UV radiation from the sun.

To avoid this problem on its precast concrete towers, the manufacturer, Enercon, turned to Sika to get a complete coat-

From the beginning humans have been using wind energy to propel sailboats. In our time, wind power represents an important part of the current clean revolution in the energy sector.

The largest wind turbines in Latin America are located in Brazil: Wind Farm Osório, Rio Grande do Sul.

generate

Belgian Offshore Wind Farm
C-Power and Sika are involved in one of Europe's largest offshore wind energy projects. Located off Zeebrugge in Belgian waters, this wind farm will ultimately have 60 wind turbines with a maximum capacity of 300 MW.

Nordex Germany
Rotor blades materially determine the output of a wind power system. Nordex Control units for wind turbines ensure maximum yield.

Giant of the Sea
A 5-MW megawatt wind turbine by Repower Systems being built for the Beatrice project. Its place of operation is the open sea in the Moray Firth, East Scotland.

Reliability
Monitor systems measure several parameters of wind generator operation: GE Infrastructure 3.6-MW wind turbine in Spain.

"Belgium will get eventually one third of its total renewable energy from wind power. The Thornton Bank Offshore Wind Farm alone will supply 600,000 people with totally clean electricity."

ing system to assure long term protection against the harsh environment conditions. For this application Sika supplied the products Antisol® EP, Sikadur® PF and Sika®Uretano successfully. Sika also helped with adhesives, providing epoxy segment bonding adhesive Sikadur® 31SBA, and with Sika Grout® AC and Intraplast NN for basement regularization and post-tensioning. Elements from the precast plants of Enercon-Europe meanwhile are bonded with the tailormade types of Sikadur® WEA for three temperature requirements.

In case of steel towers, used in several projects worldwide, proven in decades of service life lasting corrosion protection in immersed service, SikaCor® and Sika Permacor® provide a long-term corrosion protection for external and internal surfaces as well as machine parts of wind turbines (onshore and offshore). The products are tested and approved by leading wind turbine manufacturers.

Wind, wave and weather. Wind turbines have to operate across a wide range of wind speeds that can reach up to gale force winds of 90 km/h (56 mph). Near-shore turbine installations, like Osório, make use of relatively constant winds that are produced by differences in heat of land and sea each day. Offshore wind networks, often located ten kilometers or more from land, are effective primarily because the average wind speed at that location is considerably higher. Most offshore wind farms have turbines with a capacity of up to 3.6 MW, but they are slowly making way for larger 5-MW turbines that are expected to become the "standard" in the coming years.

In Belgium, one of the world's most ambitious offshore projects, a farm of sixty 5-MW wind turbines managed by C-Power, is under construction ca. 30 km from the coastline.

When completed in 2011, each wind turbine will rest on top of a 184-meter tower that is anchored to an enormous concrete cone-shaped foundation 26 meters underwater. At a greater depth and farther from shore than other wind farms, these foundations – each weighing 3000 tons – require special concrete that was refined at the Dutch laboratory of ENCI and supplied by Inter Beton (subsidiary of Heidelberg Cement Group). Based on polycarboxylether (Sika Viscocrete® 1020X) and air entrainer (Sika® LPSA-94), concrete designers came up with a new generation of superplasticizers for this job. They did so with impressive results. Last year, six of the Thornton Wind Farm turbines were linked to the Belgian power grid. Eventually, the country will get one third of its total renewable energy this way – enough to supply 600,000 people and reduce CO_2 emissions by an amount equivalent to 450,000 tons per year.

Innovation sets the pace. In the last ten years, wind turbine innovation has fueled industry growth, helping boost global capacity by 32%. The use of composite materials has reduced blade weight, while new drive train systems (Enercon has models with direct drives to generators) reduce loads and increase reliability. Sika also plays a key role in this development and will continue to spearhead research and development into products for the construction and protection of onshore and offshore wind turbines around the world.

9TH C

The History of Windmills

Down through the ages, mankind has used the natural and renewable power of the wind for windmills. A windmill is a machine that uses sails or blades to harness the kinetic energy of wind and convert it to mechanical energy to grind grain and corn, saw timber, and draw up water for irrigation and water supply.

The first practical windmill dates from 9th-century found in Persia and was likely a vertical shaft with six to twelve sails. Windmills of this type were used throughout much of the Islamic world, and introduced to Europe through Islamic Spain. In China, a similar type of vertical shaft windmill with rectangular blades was used in the 13th century.

A different design was introduced in northern France in the 12th century that became the standard for Europe. A horizontal shaft was mounted to an upright body or buck that could be rotated to face the direction of the wind.

By the end of the 13th century, windmills mostly were made of brick with a timber cap that rotated rather than the body of the mill. This made it possible to build windmills that were much taller, allowing sails to be larger, making it possible to work even in low winds.

A small auxiliary set of sails, called a fantail, at the rear of the cap helped keep the sails facing the direction of the wind. With the industrial revolution, windmills became less important as a primary industrial energy force and were largely replaced by steam and the internal combustion engines. They did experience a brief heyday during and after World War II due to the lack of fuel, electricity and other means to run machines. In Holland, about 10,000 windmills were in operation by the end of the 19th century. Today, there are about 1000. In the U.S., where windmills were used on farms in the Midwest to pump water, there were about six million windmills by the end of the 19th century of which only 15,000 remain.

The modern generation of windmills, more properly called wind turbines, are used to generate electricity. The largest turbines can generate up to 6 MW of power.

By the Middle Ages horizontal-axle windmills were used in Northwestern Europe to grind flour. Many Dutch windmills still exist.

biopolis

Green at the Top

From Singapore to Chicago, Berlin to Santiago – city planners, architects and engineers are turning to **green roof systems** to curb air pollution, decrease energy expenses and reduce storm runoff.

Newcastle, U.K.
A living and breathing green roof is the crowning glory of a new building which now houses childcare as well as health and family support services.

High above Chicago's busy financial district, a rooftop island of greenery stands out among its neighbor buildings. Covered with grasses and plants, the Chicago City Hall is a haven, especially on a hot day when the temperatures on the black asphalt of neighbors roofs soar.

"You can feel the difference in summer," said Kevin Laberge of the City of Chicago's Department of Environment. "One roof is big, empty and unused while the other is providing a habitat for wildlife, reducing temperatures and retaining storm water." Chicago's City Hall has a green roof, a planted rooftop with system of waterproofing, insulation, and a layer of growth medium used to conserve energy and to contribute to a more healthy environment.

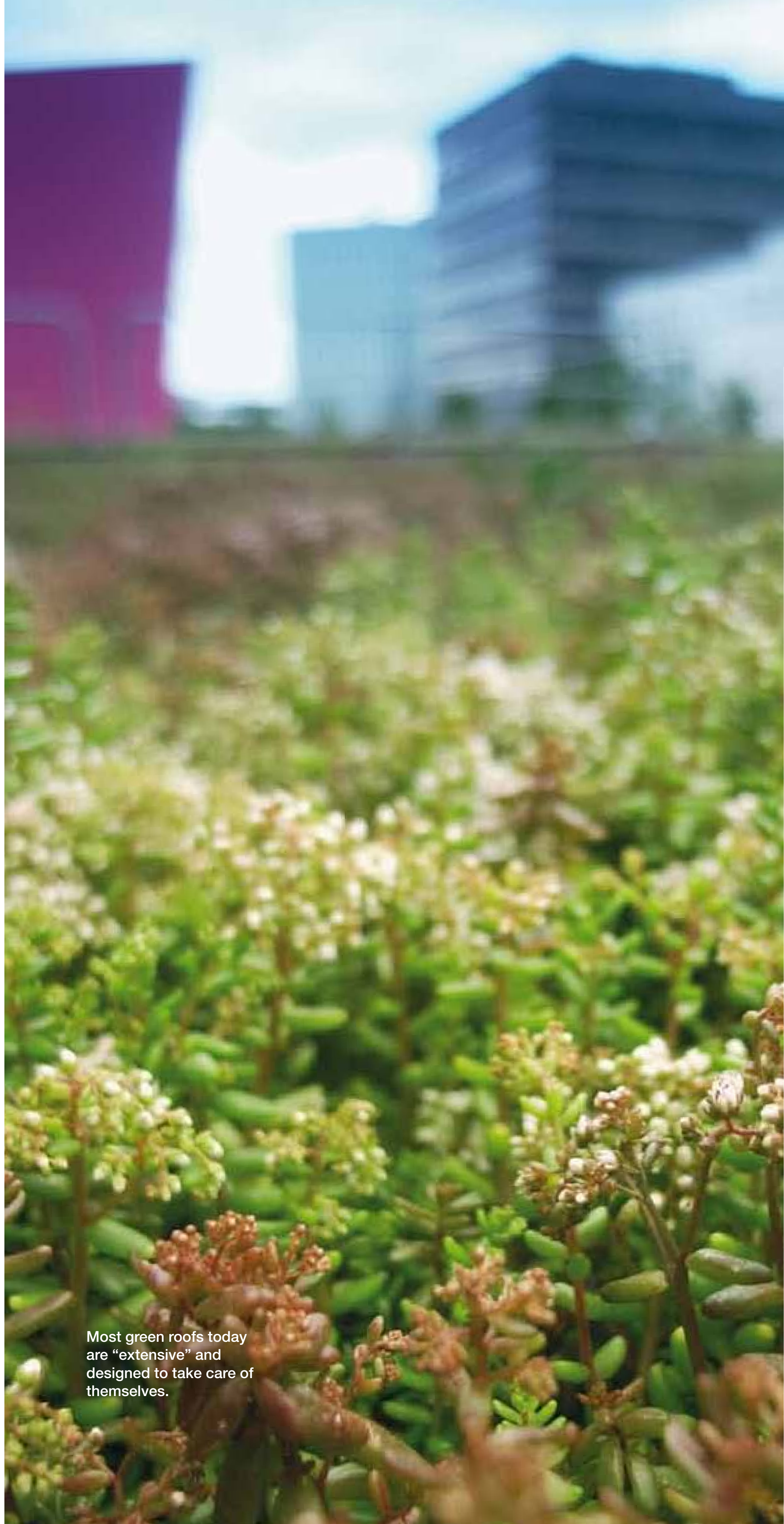
More city planners, architects and engineers around the world are turning to green roof technology because it makes environmental and economic sense. Most notably, in Chicago, it saves the city almost $10,000 annually in energy costs. During summer and winter months, the roof exhibits superior insulation properties, requiring as much as 30% less from City Hall's heating and air-conditioning systems over the last four years.

Additionally, the green roof reduces storm water runoff by absorbing as much as 75% of the rainwater that falls on it, lightening the load of Chicago's sewer system. Improved air quality and a reduction in noise pollution by as much as 40 decibels as compared to a traditional flat roof are also typical to green roofs like the City Hall's.

Finally, planted roofs extend their own life by moderating temperature swings that can lead to additional wear and tear on an exposed roof in a climate like Chicago's. Where the average life expectancy of an exposed roof may be 20 years, green roofs can be expected to last considerably longer.

A global trend. Particularly in big cities, the transformation of heat-absorbing roofs into green islands is advancing, fuelled by incentives, including tax relief, but also the availability of effective green roof technologies. In New York, Chicago, Toronto and Seattle, city planners have embraced green roof technology as a viable, effective means to create green spaces in urban environments. Even the U.S. Green Building Council considers green roofs to be part of its criteria for excellence in Leadership in Energy and Environmental Design (LEED) evaluations.

In Asia, governments in Japan, South Korea and China encourage roof greening in an effort to improve urban environments. In Singapore, the futuristic green roof on the Nanyang Technical University as well as the Fusionopolis, a skyscraper with roof gardens to reduce solar heat gain, have won numerous awards for design. From the "Meydan" shopping center in Istanbul, Turkey, to the FiftyTwoDegrees office building in Nijmegen, Netherlands, and Novalisstrasse penthouses in Berlin, Germany, creativity in green roof design knows no bounds. For decades, Europe has led green roof research and development. Germany is widely considered to have started



Most green roofs today are "extensive" and designed to take care of themselves.

How to Build a Green Roof

The design of a green roof depends on client requirements, both in terms of cost and aesthetics, but also climate and weather-related factors.

In Santiago de Chile, Sika builds for a Mediterranean climate in which most rainfall occurs in the winter months followed by a very dry season. "The actual building process is a team effort that closely involves the customer," says Juan Francisco Jiménez, General Manager, Sika Chile. Typically the process has these basic steps:
- Evaluation of the supporting structure
- Waterproofing with the most efficient system for the climate
- Thermal insulation if necessary
- Plant selection by a specialist with consideration of maintenance requirements

A semi-extensive green roof would typically have cultivation depths of about six inches with different kinds of plants, including flowers, ground-creeping plants and shrubs, which would cost a client on average about $75 per m^2.
A layer of insulation, a separation layer, waterproofing membrane, such as Sarnafil® F610-12, a drainage composite, such as Sika® Drenaje 32, growth medium and vegetation would follow.
Extensive green roofs have a narrower range of herbs, grasses, mosses and drought-tolerant succulents such as sedum, which are known for their tolerance for extreme conditions.
"Chile's varied geography and climate zones (warm in the north, temperate/moderate in central and cold in the south region) strongly influence green roof design," says Jiménez. "Our task is to provide architects with the technical assistance they need to work in different climates and find new ways to enhance and oxygenate our cities."

biopolis

Unrolling Plant Stripes
The sedum plants that populate green roofs are commonly found in mountain ranges and grow easily on stone.

Photo: Edmund Maurer

Environment First
Rogner Bad Blumau in Styria, Austria, was designed by artist Friedrich Hundertwasser and is an exclusive hot spring resort in a very natural landscape. Its green roofs are a timely reminder of the commitment to conservation and tackling climate change.

Short Wood Primary School, U.K.
Achieving a high quality, attractive and sustainable environment, SarnaVert plug and hydroplant green roof were used on Short Wood Primary School, Telford, U.K.

Tesco Clapham, U.K.
A supermarket green roof solution with an eye-catching design.

Chile
A growing interest in green roof solutions animated Sika Chile to experiment with a wide variety of solutions.

Holy Trinity C of E School, London, UK
Public schools are among the growing number of city buildings in the U.K. with green roofs.

Metal Roof Solution
1 Vegetation
2 Growth medium
3 Drainage composite
4 Roof repellency
5 High-quality waterproofing
6 Metal deck

London Zoo, U.K.
The design is based on principals developed in Switzerland and adapted for a London environment.

the trend in 1960, and today has the broadest penetration worldwide. About 10% of all German roofs are "green."

Steven Peck, founder and president of the Toronto-based industry association Green Roofs for Healthy Cities (GRHC), believes European research into lightweight, low-maintenance green roof systems has been the key factor that has "opened up thousands of miles of roofscapes that had been unavailable to any sort of greenery." For more than eight years, the GRHC has collaborated with Sika Sarnafil, a leader in green roof construction in the U.S., promoting the benefits of vegetative roof covers, providing design expertise, to increase awareness in the industry about the technology.

"A green roof design depends on many factors, including the choice of plants, climate and building structure. Designers are challenged to develop their own solutions."

Gary Whittemore, Product Manager, Sika Sarnafil USA

Better ideas, better results. Sika Sarnafil is in a good position to impart knowledge about green roofs in the U.S., having worked on projects like the $1.5 million and 38,800 sq. feet Chicago City Hall green roof. When the project began, a bitumen built-up roofing system with a gravel surface was in place but to complete the green roof, the contractor group Bennett & Brosseau needed an odor-free waterproofing system that would work with future landscaping.

"We needed a manufacturer who had experience with green roofs before," said Jim Brosseau. "And we needed a system that wasn't dependent on asphalt. Sika Sarnafil understood that." Extruded polystyrene insulation was installed over the City Hall's concrete roof deck with separator sheet, additional insulation and a Sarnafil® G474 type roofing membrane. Then a filter fabric, growth medium, some concrete pavers and an erosion blanket were fitted to keep soil in place. Finally, over 20,000 plants of over 100 species were planted.

"This roof was the ideal situation for the Sika® Sarnafil® Loose-Laid System," said George Patterson, project manager with Bennett & Brosseau. "A green roof design depends on many factors, including the choice of plants, climate and building structure," explains Gary Whittemore, Sika Sarnafil product manager in the U.S. "Since there is no design standard for green roof systems, designers are challenged to develop their own designs."

Other design options can include a robust, self-adhering membrane or a loose-laid roof assembly with rigid insulation material. And, when other waterproofing systems are not practical, a grid system can compartmentalize the system into smaller areas, effectively limiting the amount of vegetated cover to be removed if a problem develops.

Since 1978, Sika Sarnafil has been a pioneer in green roof construction around the world. In North America, recent examples include the U.S. Postal Service building in New York, the Howard Hughes Medical Institute Ashland, Virginia, the Notebaert Nature Museum Chicago, the Children's Museum Boston, Ford Automotive Corporate Headquarters, Irvine, California, the Wal-Mart experimental store, Chicago, and the Federal Reserve Bank in Charlotte, North Carolina.

In the U.S. as elsewhere green roof system popularity is growing and Sika Sarnafil is growing with it.

The green roof of Chicago's City Hall.

ambience

A New Playhouse Energizes Copenhagen

The Royal Danish Playhouse in Copenhagen, which opened in 2008, is Denmark's new national stage for the dramatic arts. And, thanks to its scenic location right on the waterfront, an oak footbridge and spectacular architecture, the building is energizing more than theatergoers.

Designed by Danish architects Lundgaard & Tranberg, the 20,000-square-meter building is about half the size of the Royal Danish Theater's opera house across the harbor, but its aura has made it Copenhagen's biggest attraction on the waterfront. "A distinguished blend of aesthetics and practicality add to the excitement," says Artistic Director Emmet Feigenberg. "The location is beautiful at the waterfront and, as the first theater built in Copenhagen in the last hundred years, the playhouse is an exceptional and unique focus on our art form."

The dark relief-patterned cladding on the interior and exterior walls is crafted from ceramic tiles, which were kilned using English fireclay. A stage tower exterior is clad with copper, which fits well into the Copenhagen skyline of domes and spires. The glass-enclosed top level for administration offices, the canteen and other areas lights up at night, signaling to the city the building is in use.

In the airy, eight-meter-high foyer, where the wide stairs lead to the balcony and upper levels, the playhouse takes on a sculptured appearance. One of the most striking aspects of the building is the foyer floor of blond wood, which, like other elements, produces a special building magic. "The openness, the light and view combine with the intimate and condensed atmosphere of the auditorium to give the building a special aura," says Feigenberg. The Royal Danish Playhouse was built to create the ultimate theater experience with more intimate auditoriums for 650 and 200 people, plus a smaller Studio Stage for 100. The larger auditorium is more formal looking with dark veneer paneling and chairs covers in china red velour, while the smaller stage has the appearance of a workshop or experimental theater.

"The wooden foyer produces a special magic of the building."

To create the particular beauty of the playhouse's hardwood floor, Sika helped flooring contractor, Paketmestrene A/S, supplying a special bonding agent with a unique damp-proof primer that was applied to the concrete. Humidity at the Copenhagen waterfront is particularly high and the elastic wood floor adhesive SikaBond®-T52 FC was a valuable ingredient in playing a perfect, durable and moisture-resistant floor.

Overall Sika products and equipment were used to lay 3500 square meters of hardwood parquet flooring in the foyer, but also the stairs and the suspended balconies, and have also been fitted with bonded oak parquet from Woodfloor. The architects chose this method to make the floor more usable and hard-wearing.

The result is a great place to work, says leading actress Helle Fagralid. "First and foremost it is the playhouse's atmosphere which inspires me. The stage is both warm and intimate, like a cave, a perfect place for storytelling. The open areas, the stones and the soft wooden floor – together with the self-effacing décor – bring a sense of peace to the place. It is a privilege to work in such a beautiful house."

Photos: Asger Carlsen

Sky, sea, authentic materials and a peaceful environment inspire Danish actress Helle Fagralid (photo above) to further improve in her demanding task. Artistic Director Emmet Feigenberg says, "This building has a very special aura."

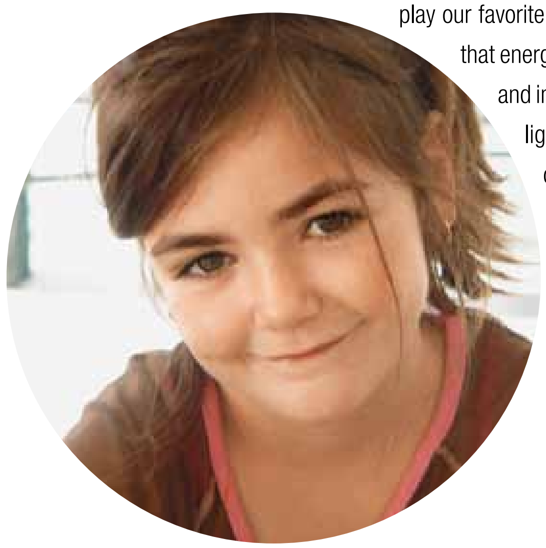
answers

“What Is Energy?”

From a little girl’s smile right up to nuclear fusion, energy is the spark of change. For this issue of ambitions we turn to a **special group of energy experts**. We asked children on five continents to answer the question: What is energy?

We use energy every day, sometimes even without noticing. Everything we do is related to energy, walking in the streets, cooking our favorite dish or even sending astronauts into space – energy is there and gives us the power to do it all. Energy enables us to light our homes or play our favorite songs on the stereo. We know that energy comes from different sources and in different forms – such as heat, light, mechanical, electrical, chemical, and nuclear power.

Moreover we can distinguish between stored energy as for example the energy in the food we eat and the kinetic energy that we release from our body stores when we work or play. But as we all know, “energy” is much more than that. The scientific declaration doesn’t explain everything and expressions like “the positive energy of a person” will always be interpreted individually. We asked children all over the world to tell us what they understand by the word “energy.” The answers are sometimes startling, others just really impressing.



Manon Logette, 8 years, Le Plessis Trevise, France
“Energy gives you power. It is the force behind fire and lighting. I have seen windmills on the side of the road that produce energy from wind.”

Aída Herrera, 9 years, Querétaro, Mexico
“Energy is used to run a car, take a shower, and gives life to plants and animals. When you want to do something in the kitchen and need heat or something, you can get it with energy.”

Carlos Daniel Morales Delgado, 10 years, Querétaro, Mexico
“Energy recharges batteries and it moves and heats water, that’s all!”

Florencia Ampuero, 8 years, Santiago City, Chile
“Energy is like a ray with a lot of power. If we didn’t have sunlight, we wouldn’t have water.”

Tatiana Carreño Rojas, 8 years, Santiago City, Chile
“Energy is something that allows us to move and do things. The sun gives us energy during the day, and electricity gives us energy at night. There is bad energy, like the energy used to make bombs that kill people. And there is good energy, like the energy coming from the sun. You can do a lot of things with electricity. I can watch television and listen to music.”

Daniela Gutiérrez Gallo, 10 years, Santiago City, Chile
“There are different kinds of energy: Body energy is the one energy that keeps us active and alive. Solar energy is another energy that gives us light and warmth. Electric energy is needed to make computers, telephones, lamps and other things work.”

Ryoto Fujita, 10 years, Kanagawa, Japan
“If we use limited resources uncarefully, our future will be gloomy.”

Saúl Alegría, 10 years, Querétaro, Mexico
“Energy is a force that helps us a lot. It gives us light and makes floodlights work. Everything would be very dark without it.”

Thai Minh Tuoc, 7 years, Ho Chi Minh City, Vietnam
“Energy is something that makes people stronger.”

Maximilan Vlad, 9 years, Constanta, Romania
“Energy is force and power, something that fills up your body and keeps you fit, strong and smart.”

Lauren Weber, 8 years, Novi, Michigan, USA
“What I know about energy is that it is a source of change for all matter. It comes from the sun and from the earth.”

Cosmin Agapie, 10 years, Brasov, Romania
“What I understand by energy is the force that gives me the power or the strength I need. Sports produces energy.”

Liu Xiao, 8 years, Suzhou, China
“Energy can bring power and warmth for me. It is just like sun in the winter. Solar energy is good.”

Karim Ezzine, 9 years, Casablanca, Morocco
“Energy is the force that makes the world grow.”

Gloria Cárdenas, 8 years, Querétaro, Mexico
“To irrigate plants.”

The Fremri-Kárahnjúkar mountains bear the site of Iceland's largest-ever industrial development: a 690-megawatt hydropower plant.

The Heartbeat of Clean Energy

The Kárahnjúkar Hydropower Project is Iceland's ticket to economic diversity through **renewable and emission-free energy.**

An ice-cold morning in the Fremri-Kárahnjúkar mountains. Shift workers are walking into an access tunnel that leads to the underground Kárahnjúkar Hydropower station. Deep within the main cavern water from surrounding reservoirs and rivers thunders through six turbines, generating 690 megawatts of power for a new aluminum smelting plant built by Alcoa in the town of Reyðarfjörður. This is the beating heart of Iceland's largest-ever industrial development: a € 1.1 billion five-year-building hydropower plant that required 70 km of tunneling and the construction of five dams – one of the largest concrete-faced rock-filled dams in the world.

The project won praise in Iceland for setting an exceptionally high standard of safety, but also the countries highest environmental award, the Conch, for its policy of generating no waste to landfill, and not discharging wastewater into the neighboring fjord. Due to diversification and availability of clean energy from hydro- and geothermal power plants Iceland has become an important country for the production of aluminum with a planned production capacity of 1.5 million tons in 2010.

Aluminum is produced by an electrolytic process from bauxite as basic raw material. Electric power represents about 20% to 40% of the cost of producing aluminum. Smelters tend to be situated at harbors (most of the bauxite is coming from Australia) and where electric power is inexpensive.

For Iceland, the Kárahnjúkar Hydropower Project is a ticket to economic diversity through renewable and emission-free energy – a step toward a unique future as forerunner of renewable energy for power-intensive industries.

Sika solutions. As workers pass by the gray-rock arch leading to the power station, they can see what is left of conduits for shotcrete, a special concrete used to coat tunnel walls and keep rocks in place. During excavation and construction, shotcrete helped civil engineers solve some of the project's most serious challenges, including water seepage, frost and the long-distance distribution. Enhanced by admixtures, shotcrete was pumped hundreds of meters into the mountain, where it could be sprayed onto rock to stop water inflows and secure the wall.

Under harsh Icelandic conditions shotcrete admixtures like SikaViscoCrete®-SC305 were used to keep shotcrete pumpable. "And Sika admixtures like accelerators made this mixture stick to the wall, which it wouldn't do otherwise," explains Sika engineer Gustav Bracher. Sika admixtures were put to the ultimate test during the five-year project. Not only did engineers and workers have to deal with excessive seeping water, there was also a large expanse of rock that required steel fiber-reinforced shotcrete, ground injections, foam and still rib support behind the cutter heads of the giant TBM drills.

"It was good that we participated actively in prequalification phases and introduced the ductility test of steel fiber-reinforced concrete," said Bracher. "A guarantee of no logistics problems for the client was also important at such a remote site." To keep its promise, Sika flew in raw material from the U.S. and set up production of liquid accelerators at two sites. As the project proceeded, the contractor produced more than 200,000 m³ of shotcrete with 6000 tons of alkali-free accelerator and 8000 tons of Sika®Fiber steel fibers.

Alcoa Aluminum Smelting. Sika was also the partner of the prime U.S. contractor for the smelter, Bechtel, which competed the facility in 2007 despite the challenges of the harsh northern climate. Sika supplied all the admixtures for the 170,000 m³ of concrete, but also the epoxy flooring projects, which according to Bracher, "demonstrated the full range of products in a key project."

Don Kirk

Concrete work, harsh conditions: Sika admixtures were put to the ultimate test.

adventure

Around the World in a Solar Airplane

Solar cells on the wing surface keep the plane aloft.

The Piccards – Three Generations of Swiss Adventurers, Explorers and Scientists

Auguste – Conqueror of the Stratosphere (1884–1962). In 1931, Auguste, a Professor of Physics in Zurich and Brussels, climbed into a pressurized cabin that was attached to a balloon that carried him 15,781 meters into the stratosphere. He is the first human to see the curvature of the earth with his own eyes.

Jacques – Conqueror of the Oceans. In 1960, the oceanographer reached a record depth of 10,961 meters in the bathyscaphe "Trieste." He explored the deepest point of the world's oceans. He died in 2008 at the age of 86.

Bertrand – Conqueror of the Skies (born 1958). Psychiatrist, scientist and adventurer. Bertrand and Brian Jones made a non-stop flight around the world in a balloon in 1999 (19 days, 21 hours and 55 minutes). It is the longest balloon flight in duration, but also in distance.

Energy and its management are the make-or-break factors in a first-ever attempt to fly a **solar airplane** night and day around the world.

Bertrand Piccard made history in 1999 with the first non-stop flight around the world in a balloon. Now the Swiss explorer hopes to become the first man to circle the globe in a solar airplane.

The "Solar Impulse" project, which Piccard initiated in 2003 with his partner, Swiss engineer André Borschberg, is a unique energy challenge: an airplane capable of taking off on its own and remaining in flight day and night without fuel, propelled solely by solar energy collected on its wings composed of 200 square meters of solar cells. But how do you succeed when present-day technologies and performances of photovoltaic cells can supply only an average of 28 watts – the equivalent of an electric light bulb? Piccard, Borschberg and their 60-people team have had to develop a totally new type of airplane of disproportionate dimensions (61 meters wingspan) and very light weight (1500 kg) which can fly sufficiently slowly (cruise speed 70 km/h) to operate off the available energy.

"The revolutionary concept behind 'Solar Impulse' goes beyond existing knowledge about materials, energy management and the man-machine interfaces," admits Piccard. "The inordinate wingspan for its weight and the aerodynamics are unlike anything the world has seen." From the solar collectors to the propellers, "Solar Impulse" is all about optimizing the links in the propulsion chain. During the day, the aircraft's solar panels have to generate enough energy to fly, gain altitude and recharge batteries for flight at night. Only about eight hours of "usable" light is available each day, which means that energy efficiency has to be as high as possible. Bertrand Piccard and André Borschberg pushed development of ultra-thin silicon photovoltaic cells with soldered connections on the back to ensure that the front side gets as much sun energy as possible. Those special cells were successfully tested recently at an altitude of 3580 meters in the Swiss Alps. Engineers were able to get 50% more energy than conventional solar cells provide. Overall 22% of the sunlight was converted to electrical energy. In addition those cells withstood high temperature changes and storm winds of up to 250 km/h. Engineers are also using cutting-edge technologies to build the plane and stimulating scientific research in the field of composite structures – so-called intelligent light materials – as a means of producing and storing energy. The results will be used in various industries. With five times less weight in proportion to its size than today's most advanced sailplane, "Solar Impulse" places totally new demands on design, material and construction methods. Through the use of highly developed digital models Piccard and his team have been able to greatly expand stability limits and, in cooperation with their partners such as Solvay, Omega and Deutsche Bank, developed a new construction process that permits a design that requires much less material.

For Piccard, the airplane's pure and futuristic design is a symbol of the situation on earth. "If we make the wrong decisions and don't minimize the use of energy, the plane won't stay in flight at night long enough to have the sun come up. In the same way, our generation can't afford to abuse the resources, otherwise it will crash before it can pass its inheritance to the next generation."

"Solar Impulse" wants to show the potential of renewable energy and promote its public use: "We want to create amazement," says Piccard. "Solar Impulse' should send a message: It is now time to develop new technologies, that lower energy consumption. Society is not ready to lower its standard of living. For that reason we must generally promote the development of more efficient products and alternative energy sources." Sections of the aircraft are now being assembled so that, if possible, the HB-SIA, first prototype of the "Solar Impulse," will be ready by end of June. This first aircraft has a mission: demonstrate the feasibility of a night flight only propelled by solar energy. The first night flights should take place next summer. After that Piccard and Borschberg will build a second airplane probably even bigger, fly over North America, the Atlantic and ultimately around the world.

A non-stop flight? Piccard says "no." "Even if we could prove that it's possible to fly non-stop, we would still have to consider the human factor. A single pilot could hardly stand the cramped conditions for more than five days without stop. We could consider it once we have the technology that allows for two pilots on board." Even with stops the project is daunting: Piccard, who calls himself an "entrepreneur with pioneering spirit," admits "Solar Impulse" is not a normal undertaking. "The team is challenged every day to find solutions to questions that have never been answered. There are no certainties about this mission. But ultimately this project is a way of telling the public: risk something, be pioneers of your lives."

Andreas Turner

Creating solar technology amazement: Bertrand Piccard.

Photos: Solar Impulse

bonding

Photo: istockphoto

How Energy Is Triggered by Special Chemistry

There are a lot of chemicals racing around the brain and body when people are in love. Researchers are gradually learning more and more about the roles they play and the effects they have on our emotion and behavior.

"High dopamine and noradrenalin level leads to intense energy."

For months, Barbara, a young woman of 24 years, felt weak. She would have preferred to curl up under a blanket and just sleep. Now she feels her spirits return and with them her interest in men. It's springtime. By April – at the latest – melatonin, the cuddle hormone, is displaced by endorphin, the body's own biochemical that creates a sense of happiness – an effect well known to top athletes. Behavioral scientists and endocologists (specialists for hormones and biochemical messengers to nerves) agree: Springtime stirs up our hormones.

And, in fact, when Sebastian, a 27-year old, suddenly shows interest in the woman with red shoes, it's (also) because of hormones testosterone and estrogen, which are love's true producers, beginning with flirting. It's like a "propaganda war" that produces adrenaline, a hormone that is also generated in battle and at times of danger. That's exactly what Sebastian needs now, because a lot is at stake and he must react quickly. He eyes Barbara and she acts as if she doesn't notice. But at the same time she is also analyzing him to see if he fits her partner criteria. Both decide if the other is attractive within a matter of seconds. Once this is done, it sets an unconscious chain reaction in motion. Their feelings surge. Barbara attempts to draw more attention to herself. She musses her hair, slumps down and crosses her legs, which signals that he can advance without danger. And he doesn't miss the opportunity. He asks about her newspaper and moves his chair in her direction. They share first information in a trivial conversation. The looks that they share become more intense and because they like each other an entirely new phenomenon takes place: They begin to move in sync. They reach for their glasses at the same time and Sebastian crosses his legs. They no longer notice their surroundings. Chemistry is in the driver's seat. Attractants, like pheromones, emanate from their axillary glands. Should Sebastian be genetically compatible to Barbara, she will "scent" it. She does and agrees to have a glass of wine with him.

When Sebastian gets up he feels elated. There are signals that indicate to him that Barbara is the right one. From a biochemical perspective, he is made to believe there is no better partner for him. Due to the affect of hormones on the brain, researchers believe love – no matter how romantic – has only one purpose: reproduction.

The evening was a success. For that reason Barbara has a hard time concentrating on her work. She can hardly control her feelings and has lost her appetite. Her brain produces dopamine and noradrenalin in large amounts, which inebriates, excites and possesses, but also blinds. Scientists have discovered that love actually cripples parts of the brain as is indicated by a reduction of serotonin.

Regardless of love's intoxication and sentimentalism: We are not slaves of our hormones. We can suppress our feelings and divert our energy to other things. But those who fall in love should enjoy it, because love's hormones will become inactive once again.

Andreas Turner

Love's True Producers

How hormones interact to influence our emotions.

Falling in love Higher dopamin- and noradrenalin levels and low serotonin.

Dopamine is thought to be the "pleasure chemical." It acts to elevate spirits, leads to increased attention and goal-oriented behavior and arises a feeling of bliss. Norepinephrine is similar to adrenaline and produces the racing heart and excitement. Together these two chemicals cause elation, intense energy, sleeplessness, craving, loss of appetite and focused attention.

Pheromones tell us if we are on the "right scent" while endorphin produces elation and inhibits pain. Serotonin is the balancing hormone. Too little serotonin indicates compulsive behavior. The serotonin level of people in love is as low as that of those who are mentally disordered.

Desire hormone: testosterone. Testosterone affects desire and can increase the production of dopamine. Men with an abundance of testosterone marry less often, are more likely to be unfaithful and divorce sooner.

Bonding hormone: oxytocin, vasopressin.

The production of oxytocin runs through the body when touching and also strengthens the bonding of mother and child, during breast-feeding, for example. Vasopressin on the other hand triggers father instincts in men.