AUSSTELLUNG
/EXHIBITION

ENTDECKUNGEN
/DISCOVERIES
ENERGIE
/ENERGY
2010

"DISCOVERIES 2010: ENERGY"

CATALOGUE FOR THE EXHIBITION

ISLE OF MAINAU
MAY 20 – AUGUST 29, 2010

Eine Initiative des Bundesministeriums
für Bildung und Forschung

Wissenschaftsjahr 2010

Die Zukunft der Energie

PAVILIONS

01 Stiftung Lindauer Nobelpreisträgertreffen am Bodensee
/Foundation Lindau Nobelprizewinners Meetings at Lake Constance

02 Bundesministerium für Bildung und Forschung
/Federal Ministry for Education and Research

03 Deutsches Museum und Rachel Carson Center
/Deutsches Museum and Rachel Carson Center

04 solarcomplex AG

05 Universität Konstanz, Photovoltaik-Abteilung
/University of Konstanz, Photovoltaic Division

06 Karlsruher Institut für Technologie (KIT)
/Karlsruhe Institute of Technology (KIT)

07 EnBW Energie Baden-Württemberg AG

08 BASF - The Chemical Company

09 RWE AG

10 Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.
/Max Planck Society for the Advancement of Science

11 Helmholtz-Zentrum Potsdam – Deutsches GeoForschungsZentrum GFZ
/Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences

12 Max-Planck-Institut für Plasmaphysik (IPP)
/Max Planck Institute for Plasma Physics

13 US Ministerium für Energie
/US Department of Energy

14 Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.
/Fraunhofer-Gesellschaft

15 Stadtwerke Konstanz GmbH und Hochschule Konstanz /Stadtwerke Konstanz and Hochschule Konstanz, University of Applied Sciences

16 Deutsche Telekom AG

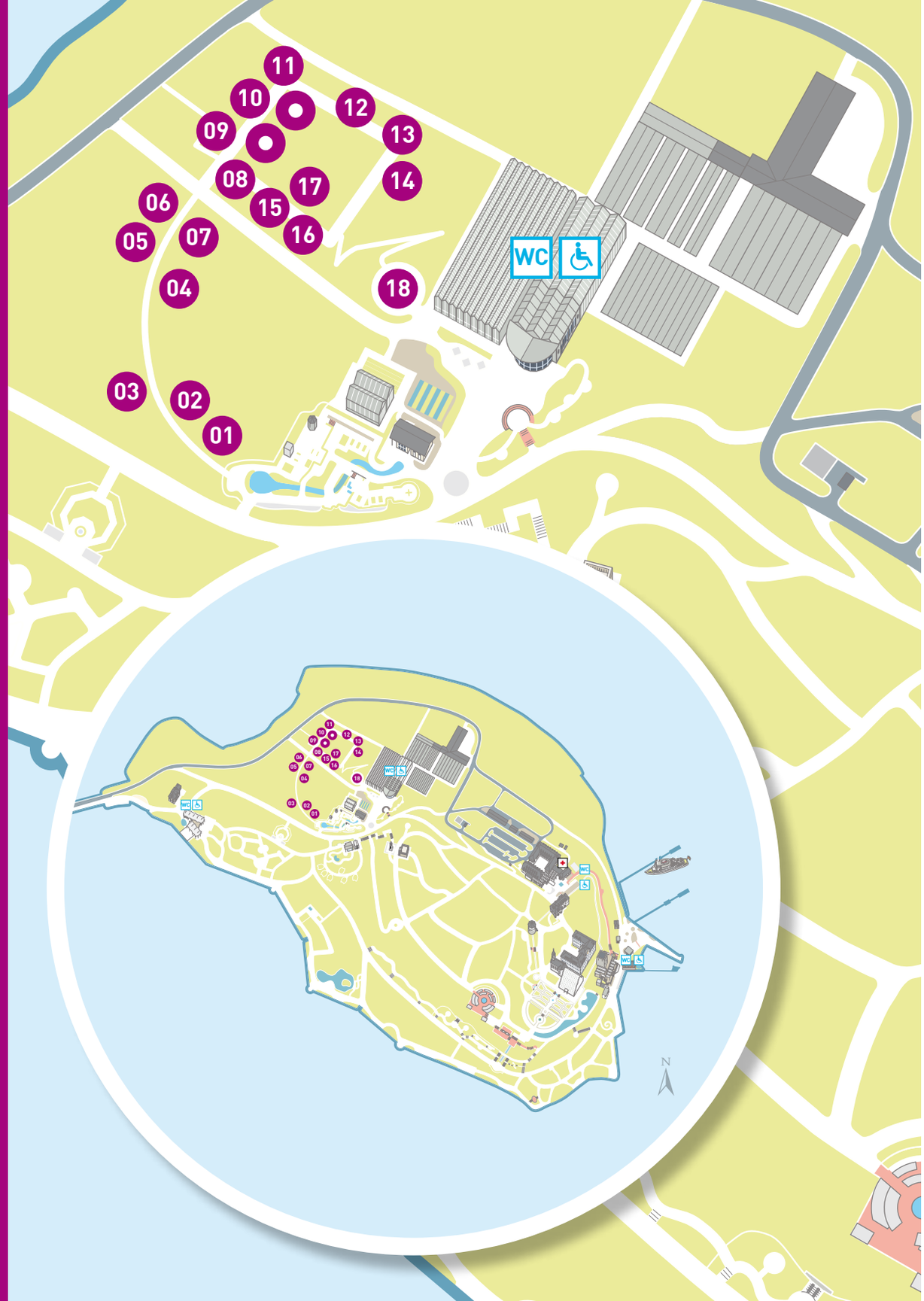
17 Dynamikum Science Center Pirmasens

18 Grüne Schule Mainau /Green School Mainau

Lounge

WC Toiletten /Restrooms

Erste Hilfe /First Aid



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ENTDECKUNGEN /DISCOVERIES ENERGIE /ENERGY 2010

ENTDECKUNGEN /DISCOVERIES

Eine Initiative des Bundesministeriums für Bildung und Forschung

Wissenschaftsjahr 2010

Die Zukunft der Energie

FORE-
WORD

COUNTESS BETTINA BERNADOTTE, PROF. DR. H.C. WOLFGANG SCHÜRER

FOREWORD

ENTDECKUNGEN /DISCOVERIES ENERGIE /ENERGY 2010

Energy is a fundamental issue for people and mankind. It is of great importance in our everyday lives and we appear to take its existence for granted. What will the energy of the future be like and what consequences will it have for our lives? With its many interactive exhibits and experiments, the "Discoveries 2010: Energy" exhibition demonstrates how science and research are working for a safe, affordable and, above all else, ecological energy supply for the coming decades. It makes fascinating topics tangible and encourages visitors to ask questions and also find out about new ways of handling energy sources with care. As you walk around the 18 futuristic-looking pavilions, you will gain insights into projects of the future and the history of energy research.

As an integral part of this Year of Science, the "Discoveries" series of exhibitions this summer will be taking place for the second time. To mark the beginning last year, it was all about the topic of water. We are delighted that with this cycle of events, research into sustainability is being brought more to life and we are honouring the memory of Count Lennart Bernadotte, who would have been 100 years old last year. As the 'spiritus rector' of the annual Nobel Laureate Meetings – which are taking place this year for the 60th time – he promoted dialogue between different generations of researchers. The relevance of science for society was equally important to Count Lennart throughout his entire life. With this "Discoveries" series of exhibitions, the Foundation Lindau Nobelprizewinners Meetings at Lake Constance, together with the Isle of Mainau, is therefore undertaking a project whose aim it is to raise awareness among visitors to Mainau of scientific issues and challenges.

With a whole series of events, Science Year 2010 – The Future of Energy shows the creativity with which scientists are working on a sustainable energy supply.
The "Discoveries" series of exhibitions is largely being funded by the Federal Ministry of Education and Research, and for this commitment for the benefit of dialogue between the general public and the science community, the Foundation and Council for the Nobel Laureate Meetings would like to thank in particular the Federal Minister, Prof. Dr. Annette Schavan, who is the patron of this project.

Curiosity is a most potent driving force. We cordially invite you to come to the Isle of Mainau and discover the future of energy. We hope that you will make lots of new discoveries as you put the exhibits to the test and be amazed by their fascinating insights, and we would be especially delighted to be able welcome you to the "Discoveries" exhibition on the Isle of Mainau again next year when the topic will be "Health Research".

Countess Bettina Bernadotte
President of the Council for the Lindau Nobel Laureate Meetings

Prof. Dr. h.c. Wolfgang Schürer
Chairman of the Board of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance

A WEL-COME

PROF. DR.
ANNETTE SCHAVAN, MdB

A WELCOME
FROM THE PATRON OF THE EXHIBITION

Life is energy. Nature can be a valuable teacher in showing us how to treat energy with a sense of responsibility and tap into new sources of energy. So the location for the "Discoveries 2010" exhibition, which is dedicated to the topic of energy, has been well chosen. The Isle of Mainau is a flourishing enviroment in which we can experience the beauty and power of nature and its vulnerability with all our senses.

The "Discoveries" exhibition is one of the highlights of the Science Year 2010, which was declared by the Federal Ministry of Education and Research and will be addressing the question of "The Future of Energy". The aim of this Science Year is to draw attention to the challenges posed by climate change and global population growth, to present the latest research methods and proposed solutions, and to promote continued social dialogue about the necessary restructuring of the supply of energy.

The "Discoveries" exhibition on the Isle of Mainau very effectively highlights a number of solutions and perspectives in view of natural sources of energy, saving energy and making efficient use of our resources. Children and young people in particular will find that there is a great deal to be discovered here with a range of fascinating hands-on exhibits.

I would like to express my gratitude to all those partners from schools and the research, science and business communities who have set up and supported this exhibition together with the Federal Ministry of Education and Research, and I wish all visitors to Mainau a relaxing and interesting time between nature and energy.

Prof. Dr. Annette Schavan, MdB
Federal Minister of Education and Research

Eine Initiative des Bundesministeriums für Bildung und Forschung

Wissenschaftsjahr 2010
Die Zukunft der Energie

DISCOVERING THE FUTURE OF ENERGY ON THE ISLE OF MAINAU

INTRODUCTION

Curiosity is a most potent driving force. New questions are always the starting point for adventurous discoveries, groundbreaking developments and exciting progress.

From 20 May until 29 August 2010, the "Discoveries 2010: Energy" exhibition will be turning Mainau into an island of discoverers and inviting visitors to dare to take a look into the future of energy. It will show how mankind will be able to cover increasing energy needs, continue to reduce energy consumption with the help of modern technology, and how energy will be transported and stored in the future. In the 18 pavilions, for example, the possibilities for development offered by regenerative energies – such as wind and solar power – will become clear. Visitors to the exhibition will also discover how car batteries are turned into savings accounts for energy – and what influence this could have on our mobility behaviour. Other partners will be presenting innovative fuels of the future in their pavilions and showing how straw and hydrogen could soon be replacing petrol and diesel.

Together with partners from the fields of science, business and politics, the "Discoveries" exhibition being staged by the Foundation Lindau Nobelprizewinners Meetings at Lake Constance aims to identify a number of possible solutions. In the next few decades, open discussion will focus increasingly on the question of a sustainable energy supply.

The theme of climate and energy in particular is of major significance for the future of mankind and its survival. "Discoveries 2010: Energy" demonstrates in a variety of interactive ways how these challenges are pushing science, research and business to make new discoveries and developments.

For school groups, the exhibition offers a separate programme with special tours and teaching units on the themes of the exhibition. For children who want to discover the future of energy by themselves or with their parents, there is a separate "Energy rallye". On the first Saturday in the months of June, July and August, special event days will be taking place on the Isle of Mainau – with experiments and lots of other hands-on attractions looking into various aspects of energy. The Isle of Mainau is also one of five event locations for the "Long Night of Science" in Constance on 17 July 2010, which is being organised together with the City of Constance, the municipal utilities, Constance University of Applied Sciences and the University of Constance.

"Discoveries 2010: Energy" is part of Science Year 2010 – The Future of Energy and is being sponsored by the Federal Ministry of Education and Research. The series of exhibitions, which began last year on the Isle of Mainau with "Discoveries 2009: Water" and will conclude in 2011 with an exhibition on the theme of health research, are being hosted by the Foundation Lindau Nobelprizewinners Meetings at Lake Constance.

20.287

20,287 wind power stations existed in Germany at the end of 2008. They create a total output of 23,894 Megawatts. This means that over the entire year a total of 40.4 Terawatt-hours of electricity can be generated, equal to 6.6% of the gross demand for electricity.

ENERGY IN FIGURES

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80 %

80 percent of the world's demand for energy is being satisfied today by fossil fuels, such as coal, petroleum and natural gas.

132 kWh

is what Germany needs per capita and per day in primary energy, for instance in oil, gas, coal, wind or hydroelectric power. Doesn't sound like a lot, but if this energy was stacked up in the form of double hamburgers, each of us would have to eat 226 fully packed hamburger buns with all the fixings every day. Enjoy your meal!

ENERGY IN FIGURES

20 Watts is what our brain needs to read or ponder something. This is equal to the energy used by a small light bulb. Perhaps this is why we occasionally experience flashes of insight.

20 W

109.000.000 t

109,000,000 tonnes of CO_2 were kept out of the atmosphere in 2008 through the use of renewable energy in Germany. Carbon dioxide emissions in Germany still amounted to 748 million tonnes in that year, however. And yet: Back in 1990, a thousand million tonnes were still being released into German air.

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2010

From where do you take the energy for research?

ENERGY FOR RESEARCH

20 %

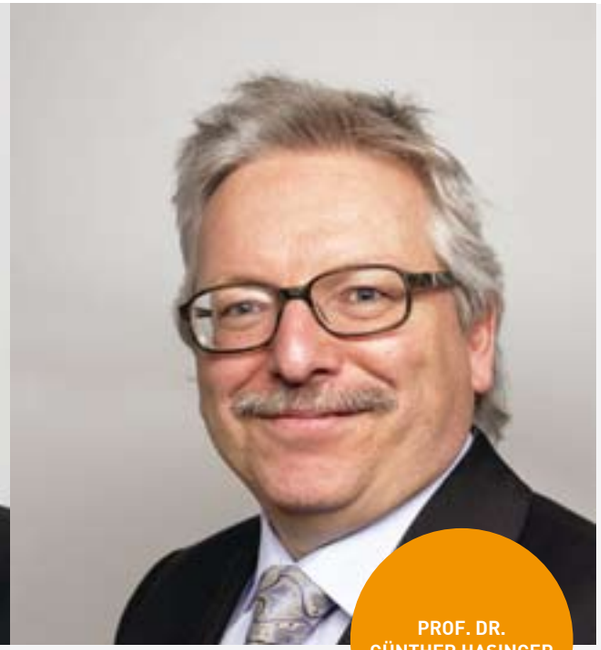
of the energy required in the EU by 2020, so goes the plan, will have to come from renewable energy sources. The EU has committed itself to this goal. In 2007, the 27 nations in the EU achieved a level of 7%. The goal of this common effort is to lower its emission of greenhouse gases by 2020 to below the level it was in 1990.

ENERGY IN FIGURES

PROF. DR. THEODOR W. HÄNSCH

"It is part of being human that we want to understand how our world works. My urge today is to accompany young people as they enter the world of science. As a mentor, I want to show them what exciting and interesting questions there are to be answered."

Prof. Dr. Theodor W. Hänsch is considered one of the most celebrated German researchers in the field of quantum optics. In 2005, he received **the Nobel Prize in Physics,** together with John L. Hall and Roy J. Glauber, for the development of laser-based precision spectroscopy, in particular for what is called the optical frequency comb technique. Because the urge to research doesn't end at retirement, Dr. Hänsch advocated for and has succeeded in continuing to research and teach at the Ludwig-Maximilians University in Munich beyond his present age of 68 years. He also continues to be Director of the Max Planck Institute of Quantum Optics in Garching, Germany. Dr. Hänsch is also a particularly strong advocate of fundamental research and of fostering talented young people in the sciences.



PROF. DR. GÜNTHER HASINGER

"For me, entering fusion research several years ago was like a refreshing leap into the deep end of a cold pool, one that spurs you on to new deeds. This potential source of future energy is my calling and my hobby."

Prof. Dr. Günther Hasinger is an impassioned garage inventor. Even in his childhood, he soldered together radios with the help of technical building kits. Later, in his musical band „Saffran", he was not only **the bassist and the fife flutist,** he was also in charge of the technical equipment. Logically enough, Dr. Hasinger therefore studied physics to become a sound engineer. But in the final analysis it was his fascination for astrophysics that made a researcher out of him once and for all. Today, Dr. Hasinger is Scientific Director at the Max Planck Institute of Plasma Physics that is devoted to **fusion research.** Modelled on solar fire, the intention here is to melt hydrogen isotopes to helium and release huge amounts of energy in the process.

DR. REGINA PALKOVITS

"Research has to be seen in terms of sport. Experiments can end like the throw of a javelin, either right on target or way out of bounds. If it doesn't work out every now and then, and as a martial artist, karate with all its highly complex series of movements is the best kind of relaxation for me."

Dr. Regina Palkovits wants to work with others to actively shape the future and make it sustainable over the long term by tapping into renewable energy resources. So it's no wonder she was already dealing in her dissertation with such topics as the biodegradability of plastics, for which she added special nano-particles to the plastics. Today at the Max Planck Institute of Coal Research she is using **catalysts** to lower energy consumption in the use of fossil resources or renewable raw materials. A further focus of her research is on renewable biomass for energy generation and as a raw material for chemicals.

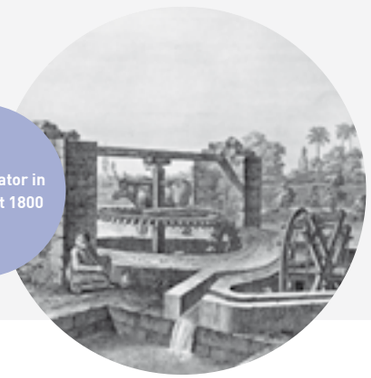
BACK TO THE FUTURE

by Beatrice Lugger

Back to the Future by Beatrice Lugger

The fascination with electricity was so strong among people in past times that they could not even imagine what sort of consequences this invention would one day have.

Human development is closely related to the development of energy resources. Which energy sources we use, and how and for what reasons we do so, will continue to affect the world we live in.
The18th Century was full of wonders in its day. For example, any gentleman who might give a kiss on the cheek to the lovely lady in the reception line at a society event might have been suddenly surprised by an "electric kiss" in return. Electrostatic machines that could generate electricity by the mechanical friction between two different materials, such as wood, glass or rubber, were quite the amusing hit in courtly salons, at bourgeois parties and yearly fairs. The fascination with the energy that clearly courses through the human body, crackles and can even be sparked off at times, was huge. Everywhere things were flashing, flickering and twitching.
The frogs' legs also twitched when Luigi Galvani, an anatomy professor in Bologna, hung them out in the open on copper hooks in 1780 to prove the existence of static electricity in the atmosphere. The frogs' muscles did not, however, react only to the oncoming thunderstorm; they also twitched when they came into chance contact with an iron grate. Galvani noted: "I actually observed rather frequent contractions, though none that depended specifically on the various states prevailing in the atmosphere or on electricity."



Bucket elevator in Egypt, about 1800

The fascination with electricity was so strong among people in past times that they could not even imagine what sort of consequences this invention would one day have.

Galvani suspected there was some sort of "animal electricity" involved. Though this turned out not to be the case, Galvani's reports gave Alessandro Volta, a physics professor at the University of Pavia, an idea. He believed that the electrical current resulted not from the frog leg itself, but from the difference between the copper and iron. Volta's experiments, measuring the current flow between different metals placed in salt solutions, led to the invention of the first electric battery, the Voltaic Pile. The cornerstone for storing and using electrical current had been laid.
The fascination with electricity was so strong among people in past times that they could not even imagine what sort of consequences this invention would one day have. Starting in the 1880s, convenient energy in a form never seen before became usable across the first electrical utility grids in Berlin, London and New York. Thomas Edison's light bulb shed a brighter light, radios in the 1930s filled the air with music, washing machines in the 1950s made daily life easier and today computers bring the whole world home to us. Electrical appliances are indispensable companions in our modern lives.
"Energy use is closely related to human life itself," says Helmuth Trischler, Director of Research at the Deutsches Museum in Munich. The oldest source of energy for people is themselves. Muscular might uses the energy that comes from nourishment – in the final analysis from the solar energy chemically stored by plants.

An enormous feat was the purposeful building of fires that brought early humans warmth, light and hot food. Wind and water power were the primary driving forces during the Middle Ages and well into the 19th Century, used in mills, pumps and hammers. An astonishingly long-lasting energy mix, Trischler stresses, "Renewable energy sources have been used throughout most of human history."

Lightbulb from Edison's time, ca. 1880

"It is important that we work more intelligently with energy, which is becoming ever more precious," Physics Nobel Laureate Theodor Hänsch demands.

However, around 80% of the world's energy needs today are met by fossil fuels: oil, coal and gas. The combustion of materials millions of years old has made humans ever more mobile and accelerated the pace of industrialisation. Supplies, however, are finite, and wasteful burning of these resources is leading to exceedingly high emissions of carbon dioxide, with all the attendant consequences for the earth's climate.

"It is important that we work more intelligently with energy, which is becoming ever more precious," Theodor Hänsch, Physics Nobel Laureate 2005, demands. First and foremost, energy conservation bears a truly great potential. The Director of the Max Planck Institute of Quantum Optics hopes that his field of research will aid indirectly in such efforts by speeding up the flow of data, thus enabling more video conferencing and a greater exchange of information online, which will help people avoid travel. "In principle, we will have to place our bets on an entire spectrum of possible alternatives, including nuclear energy as an interim solution, until we can, hopefully, exploit other forms of energy on a large scale," Hänsch feels.

Great hopes are being placed in a broad renaissance of such renewable energy sources as hydroelectric, wind and solar power. It has been a long time since wind and hydroelectric power have driven tools directly. In today's highly technical plants, electricity is generated and then fed into the public grid. Solar energy itself is used in a similar way, whether by photovoltaic means (conversion into electrical energy) or by solar thermal means (conversion into heat).
One of the most ambitious projects in this regard is named Desertec: electricity generated by the power of the Saharan sun, could supply Africa and Europe as a lasting source of energy. Solar thermal power plants covering around 20,000 square kilometres would capture sunlight in parabolic trough mirrors and use it to evaporate water which would in turn drive turbines to produce electricity. "Europe could draw around 15% of the electricity it needs from the desert by 2050," explains Robert Pitz-Paal, Deputy Director of the Institute of Technical Thermodynamics at the German Aerospace Centre (DLR), which is playing a pivotal role in developing the technology behind the vision for Desertec. The cost per kilowatt hour of solar thermal power is still much too high, admittedly, to compete with that of electricity from coal and nuclear power.

Thomas steel works, 20th century

Solarpark

But Pitz-Paal is convinced that "they will be more financially competitive within the next 15 to 20 years." But price isn't everything. The solar researchers at the DLR still have their work cut out for them: They want to increase efficiency and find out how to get the electricity to Europe without enormous waste along the way – high voltage cables that work on a DC basis instead of the usual AC could be one solution here. And they also have to find suitable storage facilities that can make energy available at night as well, when the sun doesn't shine. They are experimenting with a variety of different materials for electricity storage, including salt and sand, concrete, and chemical systems.

Jules Verne wrote as early as 1874: "Water is the coal of the future."

Perhaps hydrogen will, in the end, win the race to be the energy storage medium of the future. Great hopes have already been placed in it because the principle behind it seems so simple. Water is made to undergo fission, and the hydrogen in it stores the energy that can then, when needed, be made to combust with oxygen and create water again. It sounds both clean and feasible. Jules Verne wrote as early as 1874: "Water is the coal of the future."

However, storage in hydrogen is no simple undertaking. Larger amounts do allow themselves to be stored relatively well at extremely low temperatures or under enormous pressures. However, other storage forms will be needed if it comes to be used in the mobile sector. At the Max Planck Institute (MPI) for Coal Research and at the MPI for Metals Research, work is being done on such promising storage media as metal hydrides and metal organic frameworks (MOFs), all of which can hold a great deal of hydrogen. Hydrogen is often being used as the energy-bearing medium in fuel cells. Researchers at the MPI for Solid State Research are working to use improved materials that will make this application both more reliable and more cost-effective.

A vision for a hydrogen future already exists: cars powered by a fuel cell and an electrical engine in place of the classic internal combustion engine. But there is no mass production of them and no network of hydrogen stations across any entire area.

Holger Hanselka considers it realistic that by 2020 more than one million electric vehicles will be driving Germany's roads.

"There could also be hybrid systems made up of a battery and fuel cell, possibly still coupled to a range extender that would help the vehicle go further," says Holger Hanselka, Head Coordinator of the Research Group for System Research into Electro-mobility at the Fraunhofer Gesellschaft. The group wants to get electric cars onto the street and is betting on the know-how of the staff at its 33 different institutes to do so.

Another instance is the Institute for Chemical Technology, where Jens Noack wants to use what is called a "Redox" flow battery made up of liquid electrolytes to create a system of electrical stations "that only need a few minutes to completely recharge a vehicle." One should then be able to drive around 100 kilometres. Thanks to such innovations by the research group, and those made by many others, Hanselka thinks that it is realistic to believe "that by 2020 more than one million electric vehicles will be driving Germany's roads, and we will have the matching network of stations offering drivers a variety of opportunities."
The mix in our mobile future will also continue to include cars powered by fuels from biomass. At the Institute of Technology (KIT) in Karlsruhe, they are counting on biofuels of the second generation.
"We are exploiting biomass that is mostly dry, nothing that takes up land in competition to food production," says Nicolaus Dahmen, Project Director for "Bioliq" at KIT. Consideration is being given to residual straw and wood from agricultural and forestry activities as well as that from conservation efforts.

This biomass can be energetically densified into a special oil mixture, called BioSyncrude, at small, decentralised plants. Then kerosene, diesel or regular fuel for internal combustion engines can be made from it at one centralised plant.

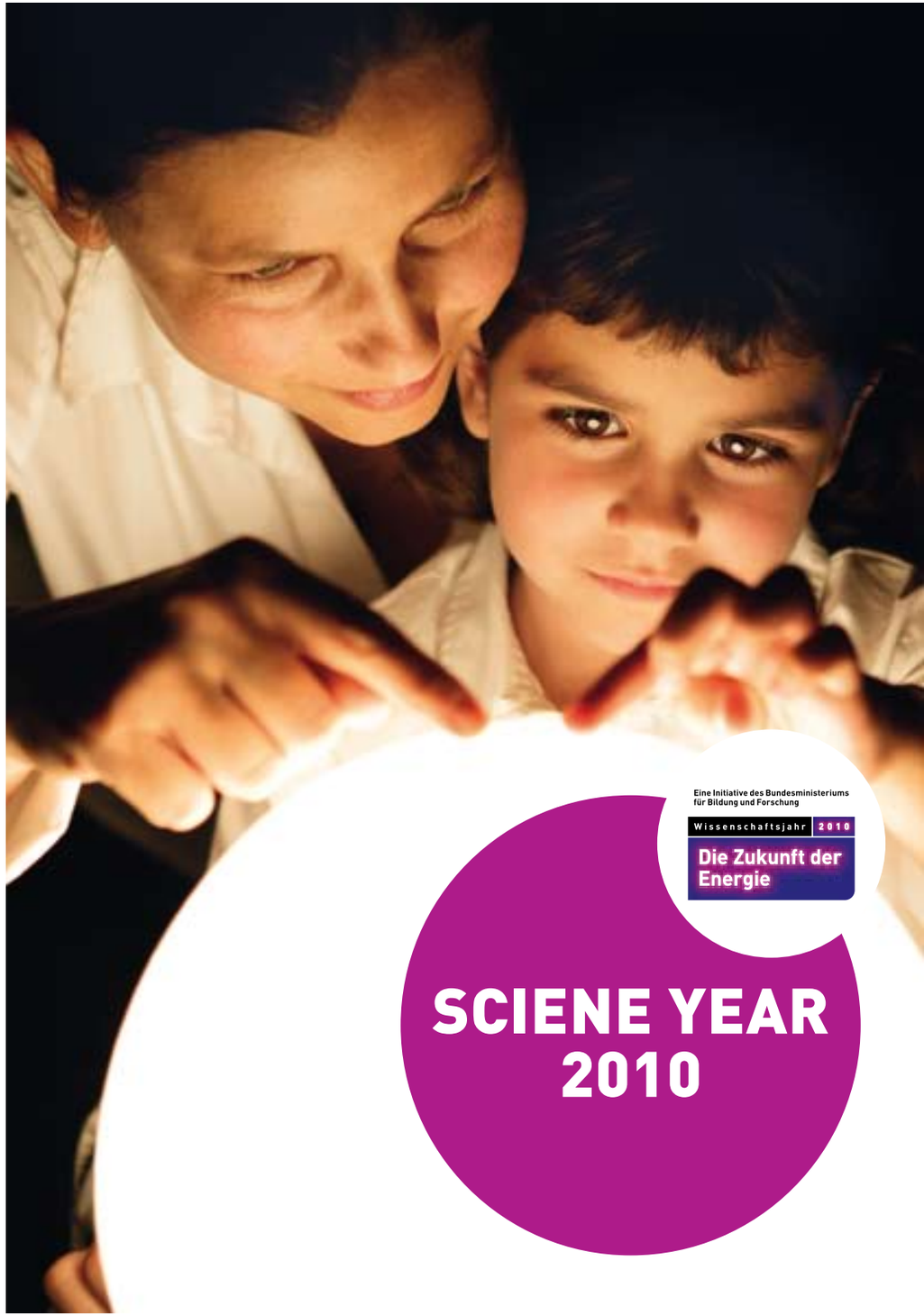
All in all, though, electricity will probably play an ever more important role. Even the geothermal heat supply is no longer only used to produce warmth, but also electricity. At the German Research Centre for Geosciences, for instance, Ernst Huenges is converting thermal energy into mechanical energy that can, in turn, be used to generate electricity – in Germany at a water temperature of 120 to 150 °C, albeit with a huge loss in energy of 90%. But that is exactly what Huenges and his team want to greatly improve upon and as he explains, "After all, this energy source is truly richly abundant."

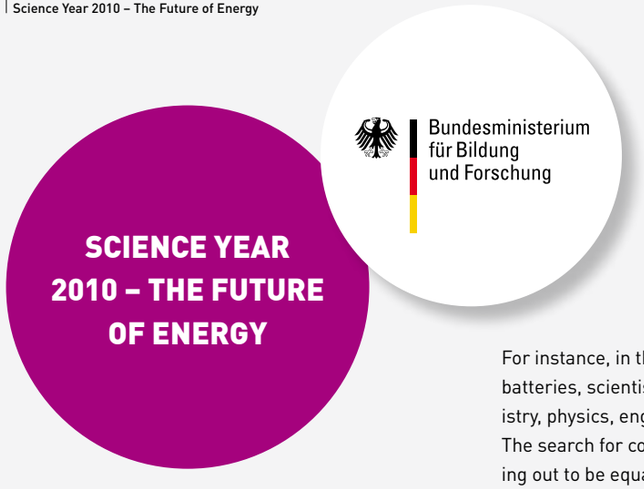
Theodor Hänsch is urging caution on many of today's programmes and warns against launching large-scale projects, for instance in solar and wind energy, all too quickly using today's technologies. He reminds us that "We must not neglect fundamental research that might, after all, lead to entirely new approaches that could in turn take us a huge step forward." Research into the basics gives young people an opportunity to shape the future perhaps a bit differently using entirely new ideas.

The peaceful use of nuclear fusion is an idea that has prodded physicists on for more than 50 years and has turned out to be a truly Herculean task.

Who knows, perhaps it will be possible to bring the sun down to earth? According to one model of the fire that powers stars, hydrogen isotopes fuse to form helium, releasing huge amounts of energy in the process. The peaceful use of nuclear fusion is an idea that has prodded physicists on for more than 50 years and has turned out to be a truly Herculean task. To fuse, atoms have to strip off their electron shells to create a plasma. On earth, researchers are employing the hydrogen isotopes deuterium and tritium because they fuse more easily than their solar original. "However, we have to heat the plasma to 200 million degrees to induce the fusion reaction," explains Günther Hasinger, Scientific Director of the Max Planck Institute of Plasma Physics. Because the ultra-thin fuel cools off immediately after each material contact, physicists have to enclose the plasma in non-contact magnetic fields.

At present, the International Experimental Reactor ITER, Latin for "the way," is being built in France with German involvement. By the mid-2020s, researchers are hoping to use it for nuclear fusion that will generate ten times the energy required to heat plasma. If they succeed, DEMO, ITER's successor, should then, starting around 2040, generate the first fusion electricity. Actual power stations could then go onto the grid in 2050. If the use of this source of energy succeeds, it would mean the discovery of an economically viable, safe and environmentally sustainable source for electricity. But the results are still open, as Theodor Hänsch points out – "though it would, of course, be a dream come true."





The global growth in energy consumption is confronting humanity with its greatest challenge since the dawn of the industrial age. On the one hand, positive economic and new technological developments will be needed, on the other it will become more important than ever to counteract climate change and its effects. So how can the world's growing demand for electricity and heat be met and our natural habitat be preserved at the same time? The answer can only lie in a safe, affordable and climate-compatible supply of energy.

Versatile and creative – energy research in Germany

This is why the Science Year Energy is being devoted to this topic. The Federal German Ministry for Education and Research, Science in Dialogue with the Helmholtz Association of German Research Centres, and also in cooperation with many other partners from research, science, business and culture, is showing a broad public how committed and also how creative energy researchers are working on innovative solutions for a sustainable energy supply at the website www.zukunft-der-energie.de.

The scope reaches from the development of new forms of storage and intelligent transmission systems to the search for new, regenerative sources of energy. It turns out that energy research can only be successful when done in interdisciplinary teamwork. A variety of different scientific disciplines have to work closely together. For instance, in the development of new rechargeable batteries, scientists are coming together from chemistry, physics, engineering and the materials sciences. The search for completely new forms of energy is turning out to be equally interdisciplinary, for example in the generation of electricity from solid and liquid biomass.

But scientists are also looking at such non-technological issues as the acceptance of new technologies. Such energy technologies as nuclear power, wind or the sequestering of carbon dioxide in empty natural gas deposits are socially controversial and under intense discussion. In such cases, it is the job of researchers to offer citizens arguments they can consider when weighing the chances and risks inherent in all these issues.

Four fields to cover during the Science Year Energy

Four topics are being planned for the 2010 Science Year – The Future of Energy as a way to depict the entire range of energy research.

- **Solutions for enhanced climate and environmental protection:** Here the focus is on how to use such fossil energy sources as coal, petroleum and natural gas in a more responsible and environmentally conscious way.

- **Issues of energy efficiency:** The intelligent use of our energy reserves is the key to lowering global energy consumption. For instance, research teams are working on energy-saving LED lamps and on intelligent, low-waste electricity grids. A more efficient use is also, by the same token, the key to taking better care of the environment and the climate.

- **Regenerative energy forms:** How can sun, wind, water, geothermal and biomass be used better? What can research learn from nature in this effort? And what will the climate-friendly energy mix of the future look like? Experts are looking for answers to these questions. If at all possible, this should be the century that will see our entire need for electricity and heat being met by the huge reservoir of renewable energy sources.

- **International cooperation:** Securing a supply of energy to all of humanity has to be the goal of international cooperation – in harmony with climate treaties to fight the threat of global warming.

The Science Year – with a new approach

For ten years now, the Science Years have been very successful in making the world of research available to everyone in Germany. In the past, the focus has been on individual disciplines or personalities, but now the 2010 Science Year is being devoted for the first time to an interdisciplinary and rather complex topic that is of decisive importance for the future of our society.

Under the motto "Driven by curiousity," young people should, above all, get inspired to interest themselves in research. After all, it is the excitement and involvement of the young generation that will build the foundation for the innovations of tomorrow. A number of events, workshops and contests, as well as fascinating worlds to explore and experience on the Internet, will be giving talented young researchers an opportunity to discover new things and get the inspiration to keep working. The exhibition "Discoveries 2010: Energy" on the Isle of Mainau will be one of the climaxes of the 2010 Science Year.

Laboratory meets school desk – the Research Fair for young talents

Thanks to a new Internet service, school classes and their teachers will, for the first time, have an opportunity in this Science Year to invite researchers directly into their classrooms or visit scientists in their labs while they work and peek over their shoulders. At the Research Fair, they can all make online appointments with each other to meet up. This feature will be available throughout Germany.

Experts from polytechnics and research departments will be displaying their careers to date or their daily work routine on the Internet. A calendar informs everyone on when they will have time for a visit. Anyone working in energy research can take part. All the information needed for those interested, for both classes and their teachers, can be found at www.zukunft-der-energie.de.

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01

Foundation Lindau Nobelprizewinners Meetings
at Lake Constance

ENERGY IN OUR DAILY LIFE

Global energy use is constantly rising, and we still have a long way to go before we can do without coal, oil and gas – the fossil fuels. Deposits are, however, limited and combustion of such fuels releases CO_2 into the air, which negatively impacts our climate. Finding solutions to the core global issue of future energy supplies is an enormous challenge for science and research.

In the exhibition "Discoveries," leading international research institutes and companies are presenting their solutions for the future supply of energy. The introductory pavilion by the Lindau Nobel Laureate Meetings gives a general overview of the issue – and asks such questions as: Which energy sources are being used today and for what? What pollutants do these sources produce? And what about my personal commitment in this field?
Here you will see why new ideas are needed and what they could look like.
So inspire yourself, find out how you can sustainably change your energy behaviour, and see how nature has inspired researchers – get ready for some fascinating discoveries, all awaiting you at this exhibition!

MEETINGS OF NOBEL LAUREATES LINDAU

Graphik © Triad Berlin

PAVILION
02

Federal Ministry for Education and Research

THE FUTURE OF ENERGY

Far-reaching changes in our climate, limited resources and a growing requirement for energy are probably the greatest challenges facing humanity in the coming decades. How can we manage to generate electricity and heat safely, economically and in an environmentally friendly manner? The Science Year 2010 is devoted to answering this question: The Future of Energy.
The Pavilion of Germany's Ministry for Education and Research (German acronym: BMBF) offers information on energy research in Germany and on events and offerings made by the Science Year that anyone can join in on. Among other venues, the "Energy Route of Museums" and the children's exhibition "Here Comes the Sun," the exhibition ship "MS Wissenschaft" ("MS Science") and the nationwide Day of Energy, 25th September, are all discussed. On the Action Saturdays, the first Saturdays of the months June, July and August, the initiative "Haus der Kleinen Forscher" ("House of Young Researchers") shows children where energy can hide and what we can do with it. As a memento of their visit to the BMBF pavilion, young and old researchers alike can have their pictures taken with prominent German energy researchers.
The pavilion is also the starting point for the "Energy Rallye" for kids aged 8 to 12.

Eine Initiative des Bundesministeriums
für Bildung und Forschung

GEFÖRDERT VOM
Bundesministerium
für Bildung
und Forschung

Wissenschaftsjahr 2010
Die Zukunft der Energie

Graphik © Triad Berlin, Illustration: Silke Meyer

PAVILION
03

Deutsches Museum and Rachel Carson Center

FULL STEAM WAS YESTERDAY

Energy is the basis of human life and the "fuel of civilization". For a long time humans used energy mostly in the form of food for themselves and their animals, biomass, wind, and water. Beginning in the 19th century non-renewable energy stores like coal - later also oil and natural gas - were used on a large-scale. This greatly increased the amount of available energy and changed the face of the world: The intense utilization of fossil fuels made the prosperity of the Western world possible, but it has also been largely responsible for environmental problems like human-induced climate change. Since the 1970s rising energy consumption has been the subject of discussion. Today, the search for alternative energy paths spans the globe.

The Deutsches Museum is one of the leading international institutions for the study of modern cultures based on science and technology. Together with the LMU Munich it took the initiative in creating the Rachel Carson Center, an Internationales Kolleg für Geisteswissenschaftliche Forschung (International Center for Research in the Humanities), that promotes the study of "nature as a cultural challenge." The joint pavilion traces the history of energy use in four phases and demonstrates both the opportunities and problems involved.

Deutsches Museum Rachel Carson Center

Photo © SZ Photo

PAVILION
04

solarcomplex AG

HEATING WITH WHAT ONE HAS

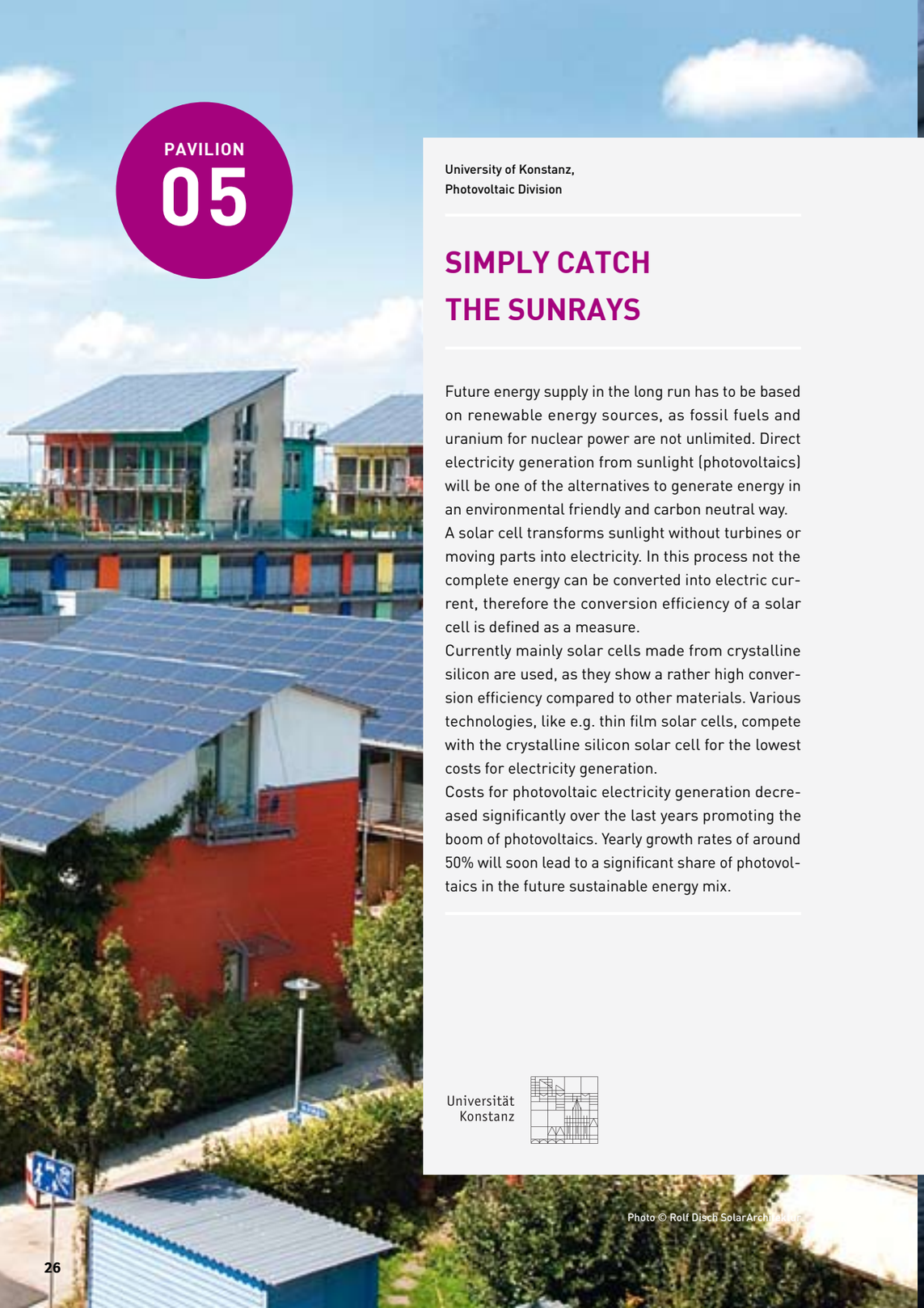
Bioenergy villages are places that supply themselves with electricity and heat to a large extent from local renewable energies. The Lake Constance region is a nationwide leader, for example in Mauenheim, Lippertsreute, Schlatt, Randegg and Lautenbach.

Electricity and heat generation from renewable energies is far less harmful to the climate and generates less global warming gases than oil, gas or charcoal combustion. Bioenergy villages are making an important contribution to the climate protection. The energy costs are not flowing off but stay locally. Energy crops and woodchips are from the region.

Heat grids are running through the streets to supply the buildings. Previous heating systems will be shut down. Biogas stations which are running on droppings, slurry and energy crops are operated to cover the basic load on electricity and heat.
In a block heating station the methane-biogas is being transferred into electricity and heat.
The biogas plant provides a constant basic load yearround where as the wood-energy is covering the peak demand during the winter half year. Other renewable energies can also be integrated in the basic concept of bioenergy villages; for example wind and hydroelectric power stations and solar power systems.

solarcomplex:

Photo © www.kuhnleknoedler.de



PAVILION
05

University of Konstanz,
Photovoltaic Division

SIMPLY CATCH THE SUNRAYS

Future energy supply in the long run has to be based on renewable energy sources, as fossil fuels and uranium for nuclear power are not unlimited. Direct electricity generation from sunlight (photovoltaics) will be one of the alternatives to generate energy in an environmental friendly and carbon neutral way.
A solar cell transforms sunlight without turbines or moving parts into electricity. In this process not the complete energy can be converted into electric current, therefore the conversion efficiency of a solar cell is defined as a measure.
Currently mainly solar cells made from crystalline silicon are used, as they show a rather high conversion efficiency compared to other materials. Various technologies, like e.g. thin film solar cells, compete with the crystalline silicon solar cell for the lowest costs for electricity generation.
Costs for photovoltaic electricity generation decreased significantly over the last years promoting the boom of photovoltaics. Yearly growth rates of around 50% will soon lead to a significant share of photovoltaics in the future sustainable energy mix.

Universität Konstanz

Photo © Rolf Disch SolarArchitekten

Karlsruhe Institute of Technology (KIT)

FUEL FROM STRAW – THE KARLSRUHE BIOLIQ® PROCESS

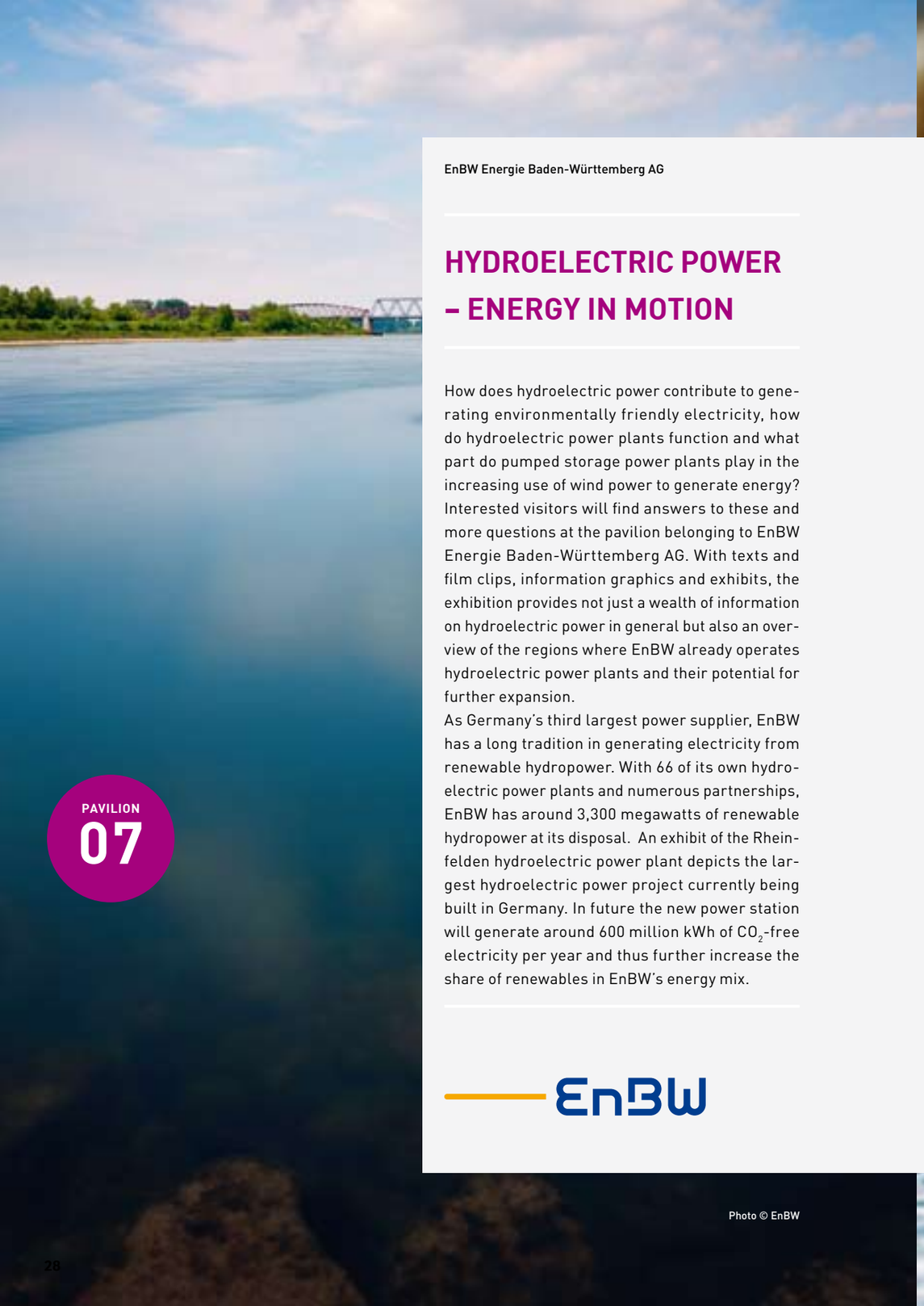
Fuel from wood, hay, or straw – how does this work? Scientists at Karlsruhe Institute of Technology (KIT) have developed a thermochemical process to produce synthetic fuel from biological residues. At the exhibition pavilion relating to the Karlsruhe bioliq process, visitors will be informed about how this works. On the touch screen, the five-stage BTL (biomass-to-liquid) production process from the straw bale to the fuel dispenser can be reproduced. The technology of the most important process step for energy concentration of the biomass is demonstrated by a plant model. The intermediate products and the final product of the five production steps will be presented in the form of samples. Figures and samples of biogenic residues will show which dry biomass materials can be used apart from wood, hay, and straw to produce BTL fuels. Children are given the opportunity to test whether they are able to identify the biological residues by viewing, touching, and hearing.

Further links:
www.bioliq.com
www.bioliq.de

PAVILION
06

Karlsruher Institut für Technologie

Photo © KIT



PAVILION
07

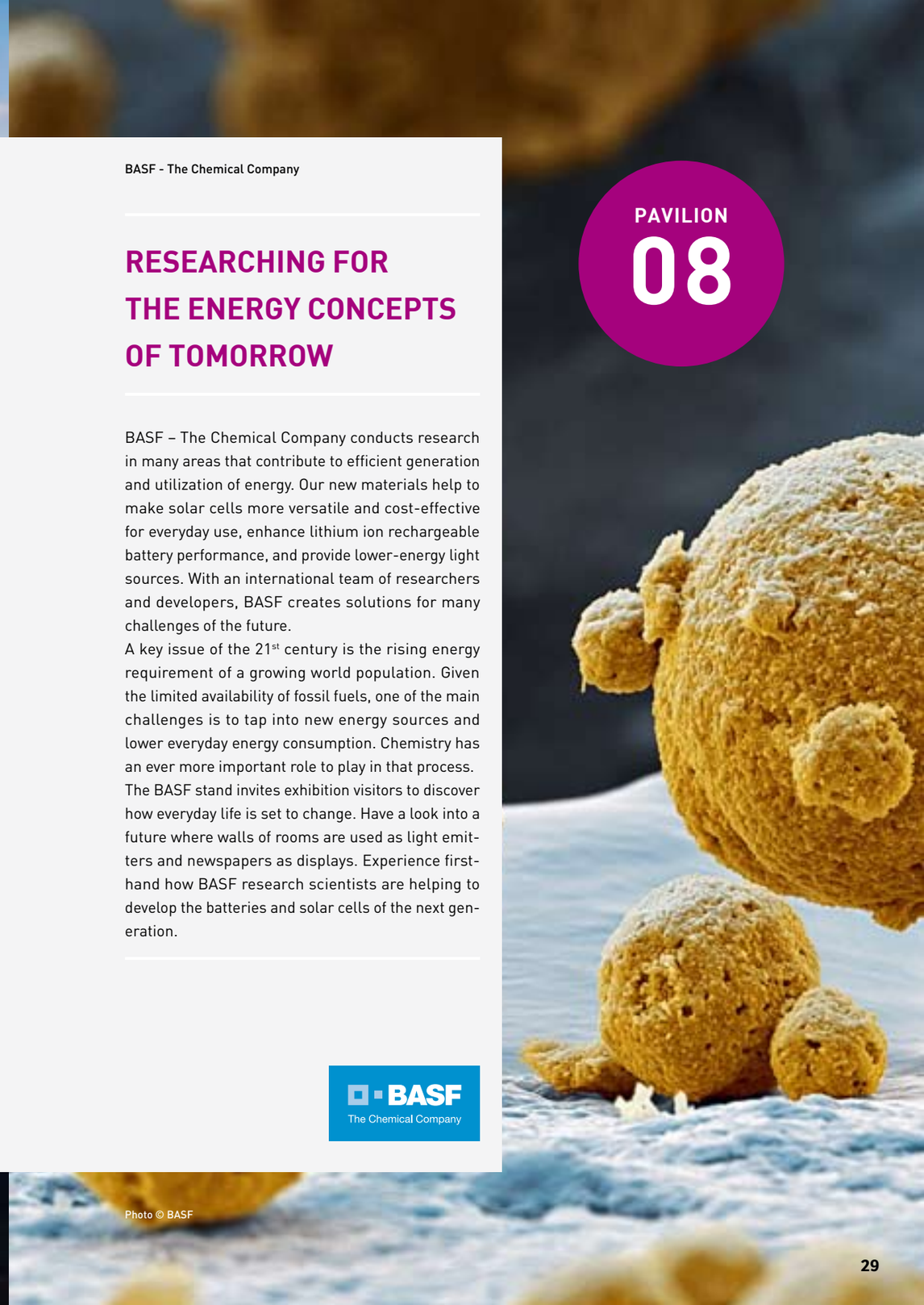
EnBW Energie Baden-Württemberg AG

HYDROELECTRIC POWER – ENERGY IN MOTION

How does hydroelectric power contribute to generating environmentally friendly electricity, how do hydroelectric power plants function and what part do pumped storage power plants play in the increasing use of wind power to generate energy? Interested visitors will find answers to these and more questions at the pavilion belonging to EnBW Energie Baden-Württemberg AG. With texts and film clips, information graphics and exhibits, the exhibition provides not just a wealth of information on hydroelectric power in general but also an overview of the regions where EnBW already operates hydroelectric power plants and their potential for further expansion.
As Germany's third largest power supplier, EnBW has a long tradition in generating electricity from renewable hydropower. With 66 of its own hydroelectric power plants and numerous partnerships, EnBW has around 3,300 megawatts of renewable hydropower at its disposal. An exhibit of the Rheinfelden hydroelectric power plant depicts the largest hydroelectric power project currently being built in Germany. In future the new power station will generate around 600 million kWh of CO_2-free electricity per year and thus further increase the share of renewables in EnBW's energy mix.

EnBW

Photo © EnBW



PAVILION
08

BASF - The Chemical Company

RESEARCHING FOR THE ENERGY CONCEPTS OF TOMORROW

BASF – The Chemical Company conducts research in many areas that contribute to efficient generation and utilization of energy. Our new materials help to make solar cells more versatile and cost-effective for everyday use, enhance lithium ion rechargeable battery performance, and provide lower-energy light sources. With an international team of researchers and developers, BASF creates solutions for many challenges of the future.
A key issue of the 21st century is the rising energy requirement of a growing world population. Given the limited availability of fossil fuels, one of the main challenges is to tap into new energy sources and lower everyday energy consumption. Chemistry has an ever more important role to play in that process.
The BASF stand invites exhibition visitors to discover how everyday life is set to change. Have a look into a future where walls of rooms are used as light emitters and newspapers as displays. Experience firsthand how BASF research scientists are helping to develop the batteries and solar cells of the next generation.

BASF
The Chemical Company

Photo © BASF

PAVILION
09

RWE AG

RWE – THE ENERGY TO LEAD WITH WIND POWER

Wind power has served the human race for many centuries. Today's windmills are high-tech facilities and are used for the generation of electricity. A single wind turbine on land can supply over 1,000 households with electricity each year. A rotor at sea can serve as many as about 5,000 households per year. Facilities with such an enormous output up to 60 miles off the coast – this would have been unthinkable a few years ago. Today RWE Innogy is building offshore wind farms that are among the biggest in the world. After all, winds on the open sea are considerably stronger and more regular than on land.
Wind power is a highly exciting topic that can be viewed from a variety of angles at the RWE Pavilion. Large-format displays are provided, illustrating how a wind farm is set up at high sea. Several short films are shown, providing interesting facts and figures about the foundations, cables and design of a wind farm. There is even a hands-on model wind farm with an opportunity to try things out for yourself. Using wind regulators, wind turbines can be run at sea, on land and on the roof of a house. So do please come and have a look at the RWE Pavilion and find out for yourself how different turbines respond to different wind forces.

VORWEG GEHEN

Photo © Guy Woodland

PAVILION
10

Max Planck Society for the Advancement of Science

SHAPING THE FUTURE WITH BASIC RESEARCH

Guaranteeing secure and sustainable energy supplies is one of the most important challenges faced by our society in the coming decades. Basic research will play a crucial role in tackling this issue, given that our energy system needs to undergo a wholesale transformation in the long term: we need to make new sources of energy accessible and extend the possibilities for storing energy, last but not least we must reduce CO_2 emissions drastically.

Hydrogen (H_2) might become an important energy carrier in the energy mix of the future. Fuel cells enable the utilization of energy stored in hydrogen as electric power – the only waste product is water. Especially with regard to cars, the combination of fuel cells and hydrogen could become an alternative to today's internal-combustion engines. Before this can become a reality, however, fuel cells need to be enhanced and suitable storage systems for hydrogen developed. Max Planck researchers are working on achieving this goal. Get to know new promising materials and find out which properties they need to have in order to bring a hydrogen energy industry forward.

MAX-PLANCK-GESELLSCHAFT

Photo © Max Planck Institute for Metals Research/Michael Hirscher

Helmholtz Centre Potsdam
GFZ German Research Centre for Geosciences

ELECTRICITY FROM THE SOCKET? ELECTRICITY FROM THE EARTH!

Electricity is indispensable for our daily lives. However, only about 18% of our electricity is generated sustainably, the rest comes from fossil fuels.
One energy source that is, in human dimensions, inexhaustible is the planet beneath our very feet. A thin crust, only about 30 kilometres thick, separates us from "fireball Earth," which has at its core temperatures of 5,000 to 6,000 °C.
The use of geothermal energy for heating purposes is a normal part of life in some parts of the world. But to use such heat to generate electricity, especially in areas with low geothermal temperatures, is still terra incognita in both technical and scientific terms. The GFZ German Research Centre for Geosciences, is putting it to the test, though, at its Geothermic Laboratory in Groß Schönebeck, northeast of Berlin.
Here, temperatures of 150 °C are found at a depth of 4.3 km, and it is proving possible to generate electricity from geothermal heat even at such a relatively low temperature. Because geothermal energy is available throughout the year and around the clock, and does not depend on either wind or weather, it is feasible to use it to cover base electrical loads and thus as a replacement for coal, gas and nuclear energy.

GFZ Helmholtz-Zentrum Potsdam

Photo © GFZ

Max Planck Institute for Plasma Physics

FUSION RESEARCH – BRINGING THE SUN'S FIRE TO EARTH

The aim of fusion research is to bring the sun's fire to earth. A power plant deriving energy from fusion of light atomic nuclei, like the sun and stars, would command an inexhaustible fuel source. Efforts are being made world-wide to harness this new, ecologically safe energy source. One has to succeed in keeping the fuel, viz. a hydrogen plasma, at ignition temperatures of over a hundred million degrees. For this purpose, it is confined in a magnetic field to prevent contact with the vessel wall.

How close has science come to its ambitious goal? Get to know the large-scale devices being operated at Garching and Greifswald. Find out more about the European programme and the crucial next step being taken jointly by international fusion research, the ITER test reactor.

And finish off by experimenting yourself with the object of fusion research, the plasma. It is to be found in fluorescent tubes, sparks, flashes of lightning and stars – a hot ionised gas in which electrons have become detached from their atomic nuclei. Try guiding the charged particles by means of magnetic fields: Can you manage to wind up the plasma?

IPP Max-Planck-Institut für Plasmaphysik

Photo © SOHO (ESA & NASA)

PAVILION 11

PAVILION 12

PAVILION
13

US Department of Energy

FINALLY GOVERNING ENERGETICALLY

The United States government science agencies such as the U.S. Department of Energy (DOE), the National Institutes of Health (NIH) and the National Science Foundation (NSF) are dedicated to enhance the quality of life through innovations in science and technology, while also protecting and cleaning up the environment. The pavilion will showcase how we are addressing the development of sufficient, sustainable energy resources through research and development. Experience our exciting exhibits and explore the vast area of energy research. The Department of Energy's overarching mission involves advancing the national, economic, and energy security of the United States and promoting scientific and technological innovation.

U.S. DEPARTMENT OF ENERGY

Photo © Envision Solar International, Inc.

Fraunhofer-Gesellschaft

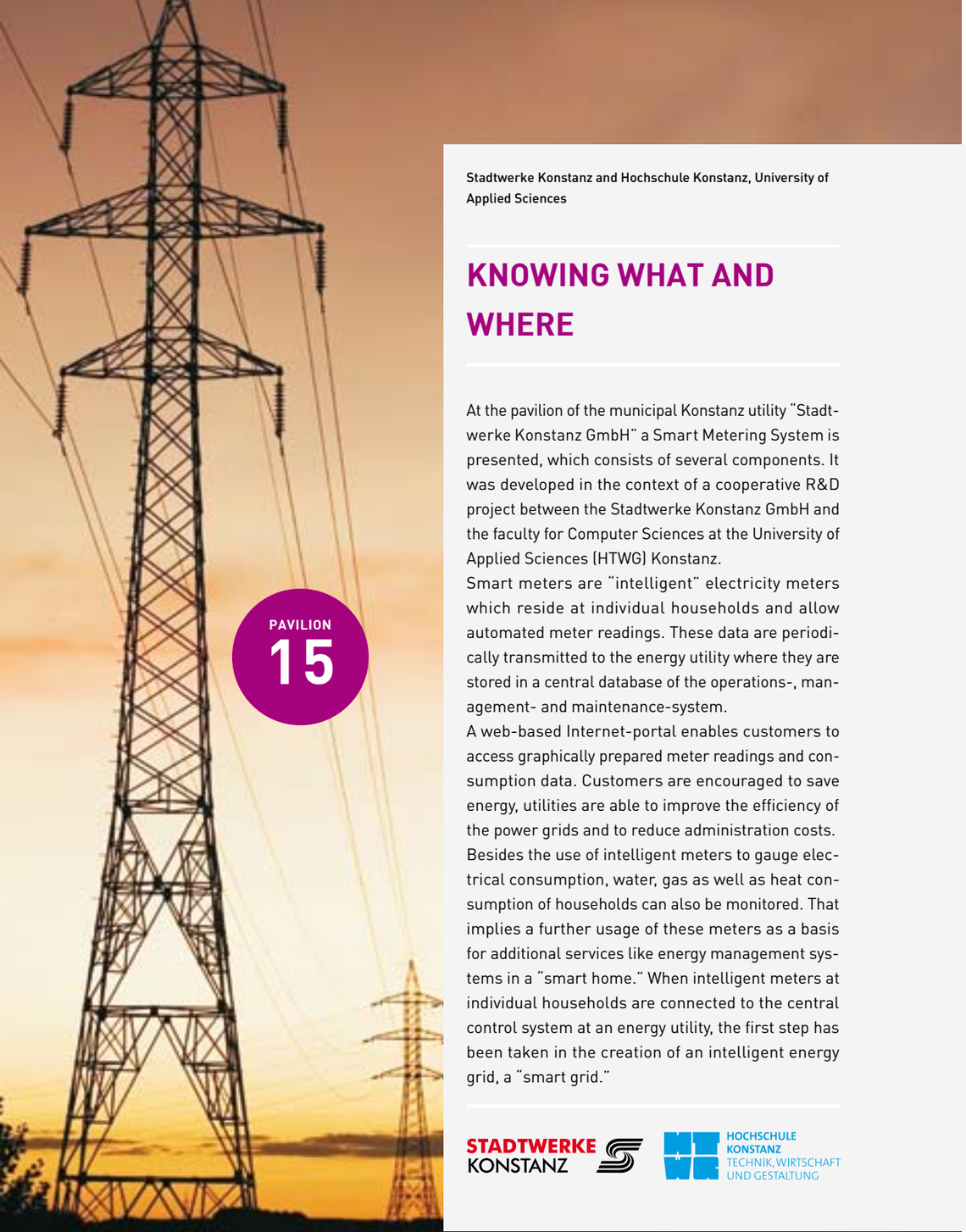
WITH RENEWED ENERGY

Wind, sun, water, biomass: an ever increasing amount of energy is being obtained from renewable sources. Today, more than 16 percent of power in Germany comes from regenerative energy. The motivation fueling the demand for renewable energy is twofold: Petroleum and natural gas inventories are gradually coming to an end - and that's causing prices to skyrocket. In addition, studies conducted by the UN show that the emission of the greenhouse gas CO_2 must be drastically reduced in order to prevent warming the earth by more than two degrees Celsius.
In the future, solar systems, wind parks and combined heat and power stations will assume the role played by oil, coal and nuclear power plants today. To ensure a constant supply of energy around the clock, not only must the producers of alternative energies be intelligently networked into the grid, but new energy storage depots must be engineered - such as redox-flow batteries, for example. These batteries can also be installed in electric vehicles. This turns the roaming individual into a mobile energy storage unit.
It is also important to use energy with greater efficiency. Buildings first and foremost offer a vast number of energy-saving opportunities. About one-third of Germany's energy requirements are needed to heat and cool residential properties and office buildings. One possibility to reduce this energy need is passive structural cooling, using phase change materials. Fraunhofer has a variety competencies to establish the technological preconditions for the energy supply of the future.

Fraunhofer

PAVILION
14

Photo © Fraunhofer



PAVILION
15

Stadtwerke Konstanz and Hochschule Konstanz, University of Applied Sciences

KNOWING WHAT AND WHERE

At the pavilion of the municipal Konstanz utility "Stadtwerke Konstanz GmbH" a Smart Metering System is presented, which consists of several components. It was developed in the context of a cooperative R&D project between the Stadtwerke Konstanz GmbH and the faculty for Computer Sciences at the University of Applied Sciences (HTWG) Konstanz.
Smart meters are "intelligent" electricity meters which reside at individual households and allow automated meter readings. These data are periodically transmitted to the energy utility where they are stored in a central database of the operations-, management- and maintenance-system.
A web-based Internet-portal enables customers to access graphically prepared meter readings and consumption data. Customers are encouraged to save energy, utilities are able to improve the efficiency of the power grids and to reduce administration costs.
Besides the use of intelligent meters to gauge electrical consumption, water, gas as well as heat consumption of households can also be monitored. That implies a further usage of these meters as a basis for additional services like energy management systems in a "smart home." When intelligent meters at individual households are connected to the central control system at an energy utility, the first step has been taken in the creation of an intelligent energy grid, a "smart grid."

STADTWERKE KONSTANZ

HOCHSCHULE KONSTANZ TECHNIK, WIRTSCHAFT UND GESTALTUNG

Photo © Stadtwerke Konstanz

PAVILION
16

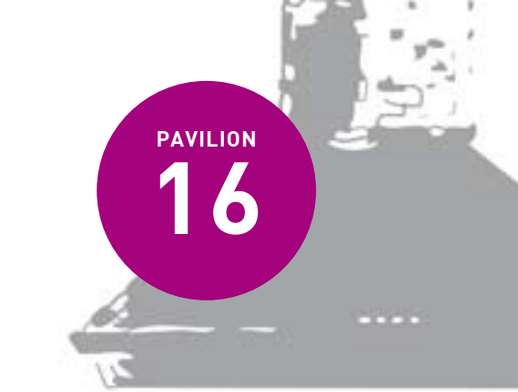
Deutsche Telekom AG

WELCOME TO THE "HOUSE OF CHANGES"

Big changes start small – and many little steps help us fulfill our responsibilities to the environment. By developing innovative products and intelligent services, Deutsche Telekom supports everyone who is committed to creating a better future. The ideas of the Telekom Laboratories, Deutsche Telekom's research institute, play a major role in this process. They create solutions that combine quality of life with energy efficiency.

The "House of Changes," Deutsche Telekom's pavilion, will be presenting the fruits of a variety of research projects for hands-on examination: subject include digital newspapers, controlling heating systems via smartphones, music downloads from the Internet and the green office. These concepts will not only help make communications easier and more convenient in future, but will also help to conserve energy. A voting system will enable visitors to choose whether they intend to use these new concepts and make a contribution to protecting the climate. Practical, everyday energy-saving tips will be presented alongside these future concepts at the "House of Changes."

After all, even the longest journey begins with a single step. More information:
www.laboratories.telekom.com/entdeckungen2010



Graphic © Triad

PAVILION
17

Photo © Axl Klein | dogtreatpix.com

Dynamikum Science Center Pirmasens

DISCOVER / EXPLORE / PARTICIPATE / UNDER-STAND

Natural sciences often seem to be difficult and boring. That this might be deceptive proves the Dynamikum in Pirmasens. It is the first and only science center in Rhineland-Palatinate. This experience museum invites visitors of every age to explore diverse phenomena from nature and technics on their own.

The guiding idea of the Dynamikum is physics and biology of movement which is in the centre of the subject areas "Get Started," "Mass in Motion," "Rotating Movement," "Moving Machines," "The Speed of Nature," "Human Force," "Moving and Thinking" and "The World´s Dance." As an out of school learning place of extraordinary kind the Dynamikum leads generations together and shows the joy contained in science.

On a fascinating choice of exhibits in the Dynamikum pavilion the visitors can become a scientist right now: gliding with a hovercraft-bicycle, feeling the gyroscopic forces, unravel a mystery XXL-cube or experience the energy transfer on a bipendular model.

DYNAMIKUM
Science Center
Pirmasens

Green School Mainau

ON THE ENERGY TRAIL

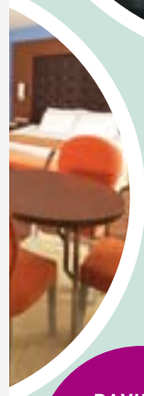
Energy is a topic people of any generation should be well-informed about. After all, only when people understand where our energy comes from and how we can conserve it can they make an active contribution towards solving the energy problems we face. Particularly among children and young people, an understanding of the present and future challenges has to be created so that they will someday be able to find long-term solutions to them. The earlier they practice, the earlier they will be perfect!

At the pavilion of the "Grüne Schule," the Green School in Mainau, the extracurricular learning site on the Mainau Island in southern Germany, children and young people can get on the trail of energy and find out what sustainability means: What does it mean to act sustainably and why does it make sense? What is a fossil fuel, what is regenerative energy and what effects does its use have on the environment? How do organisms generate energy and how much energy does a person need on average every day? All these and other topics are explained in an interactive way.

In addition to the exhibition at the pavilion, the extracurricular environmental education facility also offers, after registration, approx. 2-hour long energy projects about such topical issues as "Forms of Energy," "Energy Consumption," "Energy Production" and "Sustainability."

Grüne Schule Mainau

LENNART-BERNADOTTE-STIFTUNG

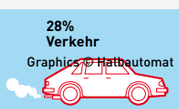


PAVILION
18

Wenn Du 8 Jahre, 7 Monate und 1 Tag lang schreist, hättest Du genug Schallenergie erzeugt, um eine Tasse Kaffee zu erhitzen.

Um 3,75 l Wasser (Temperatur 17°C) zum Sieden (100°C Wassertemperatur) zu bringen, ist ein Energieaufwand von 772 Wh erforderlich.

Nahrung ist die erste und wichtigste
Menschen: Wir brauchen die in der
Energie, um uns am Leben zu erhalt
um Arbeit verrichten zu können („L



Graphics © Hatbautomat

AIR_BORN(E): BUILDING ON AIR

Constructed using slightly compressed air controlled by pressure sensors, 18 pavilions are home to the "Discoveries" exhibition on the Isle of Mainau on Lake Constance during the summer months of 2010.

Air – or the atmosphere, rather – has no real shape per se, but instead appears at various levels of water saturation as clouds or as ground fog. When forced into a contained space, however, it exhibits a static quality. The space's outer shell combines with pressure to form an architectural symbiosis, as each component needs the other in order to become tangible. Separated by a wall just a few millimetres thick, the interior of the pressure hull forms a synthetic atmosphere that is controlled using simple technical mechanisms. The architecture hereby focuses on the creation of boundaries between a natural and an artificial weather situation. Areas of high and low pressure serve as the prerequisite for creating space.

The structural principle of the pavilions is based on a "table" of pneumatic pressure cylinders. This "table" is tightly anchored to the ground and serves as a frame into which the inner and outer shells are mounted in place. The two shells are the only components given an aesthetic appearance, and are user-definable in terms of materiality, colour, and form. The gap formed between these two thin walls is used to control the climate within the pavilion. Radiating heat from the outside heats the air between the two walls, which rises upward. The rising air pulls up the cooler layers of air near the floor, and this circulation naturally ventilates the pavilion's interior.

Solar cells help convert incoming solar radiation to electrical energy, which is then used by the pressure-sensitive sensors to either inject or extract air to and from the structure as needed. The sun and the air therefore serve as building materials in an ephemeral exhibition structure that can be erected and disassembled within a matter of hours, making it flexible for other applications. The low weight and volume of the dismounted pavilions, which fit into carrying cases, save resources needed for transport and offer diverse opportunities for reuse at other exhibitions or fairs. It provides for the creation of a gathering space whose physical structure is the embodiment of a sustainable utilization concept.

Impressions from the Opening of the exhibition on May 22nd, 2010

IMPRESSIONS FROM THE OPENING OF THE EXHIBITION

SUPPORTERS AND PARTNERS

The realisation of this exhibition is thanks in no small part to the support of our partners. The Foundation and Council would also like to extend particular thanks to the Federal Ministry of Education and Research (BMBF), which has made this exhibition possible as part of Science Year 2010 – The Future of Energy.

Supporter of the exhibition "Discoveries 2010: Energy"

Main supporter:
Federal Ministry of Education and Research

Supporters:
Mainau GmbH
Foundation Lindau Nobelprizewinners Meetings at Lake Constance

Patronage

Prof. Dr. Annette Schavan, Federal Minister of Education and Research

Organisation

Event host
Foundation Lindau Nobelprizewinners Meetings at Lake Constance

Organisers
Council for the Lindau Nobel Laureate Meetings
Foundation Lindau Nobelprizewinners Meetings at Lake Constance

ADVISORY BOARD

The Foundation's thanks go in particular to the Scientific Advisory Board and its Chairman, **Professor Bernhard Graf, Director of the Institute for Museum Research** in Berlin, who by way of his professional manner and dedication, has been a driving force behind this joint project and made it all possible.

Members of the Scientific Advisory Board

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Dr. Wolfgang Breh
Head of Coordination Office, KIT Energy Center

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Max Planck Institute for Coal Research

Prof. Dr. Helmuth Trischler
Museum Director, Research Department,
Deutsches Museum

THANKS

The Council and Foundation of the Nobel Laureate Meetings would like to express particular thanks to **Dr. Andreas Gundelwein** (Coordination), **Elisa Mussack** (Coordination) and **Christian Rapp** (Communication) for all their tremendous involvement.

Thanks also go to Mainau GmbH and its employees, our graphic designer, Andreas Mayer (Stuttgart), the architects Dirk Hebel and Tobias Klauser (Zurich), and also Ossian Vogel (Evolutions GmbH/Stockach).

This series of exhibitions would scarcely have been possible without the dedication of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance.
We would like to thank Prof. Dr. Jürgen Uhlenbusch, the longstanding Vice-President of the Council for the Lindau Nobel Laureate Meetings, for his support in planning the project.

WE WOULD ALSO LIKE TO THANK ALL THE EXHIBITORS:

BASF SE / Department of Energy, USA / Deutsches Museum München / Deutsche Telekom AG, Laboratories / Dynamikum Science Center Pirmasens / EnBW Energie Baden-Württemberg AG / Federal Ministry of Education and Research / Foundation and Council for the Lindau Nobelprizewinners Meetings in cooperation with TRIAD Berlin Projektgesellschaft mbH / Fraunhofer-Gesellschaft / GFZ German Research Centre for Geosciences / Green School Mainau / Internationale Bodenseekonferenz IBK / Karlsruhe Institute of Technology KIT / Max Planck Society / Max Planck Institute for Plasma Physics / RWE AG / solarcomplex AG / Stadtwerke Konstanz and HTWG Konstanz / University of Konstanz /

ENERGY FOR RESEARCH

PROF. DR. ROBERT PITZ-PAAL

"I fill up on energy with my family – my four kids and my wife, who always watches out for my back. By the same token, my kids are an important driving force for me and my research. I would like to sustainably secure their futures."

Prof. Dr. Robert Pitz-Paal is a nature-loving person who prefers to ride his bike the ten kilometres to work. Of course, he uses the latest, state-of-the-art technology when he does and listens to podcasts during his ride. As Deputy Institute Director and Department Head for **Solar Research** at the DLR, the German Aerospace Centre, he is creating innovations that foster active environmental protection. One of Dr. Pitz-Paal's visions is the **Desertec Initiative.** If it works out, Europe will be able to draw around 15% of its electricity needs from the desert by 2050.

PROF. DR. CAROLA GRIEHL

"The curiosity to tread on unknown worlds, which simply has to be part of any scientist, is for me completely focused on algae. They were the first organisms, after all, that brought oxygen to the earth and made our lives possible in the first place."

Prof. Dr. Carola Griehl looks forward to her holidays on the North Sea island of Amrum, not just for sea and sunshine but because her beloved **algae** live there as well. Algae of course are simply not seen as any kind of sole energy generation source for Germany. Cost-efficient technologies could, however, couple the production of high-quality products for the pharmaceutical and cosmetic industries with energy generation in the form of bio-diesel or biogas from the best kind of biomass. This is exactly what Dr. Griehl, as head of the Innovation Laboratory for Algae Biotechnology at the Anhalt Polytechnic in Germany, wants to achieve.

INFORMATION ABOUT THE EXHIBITION

"Discoveries 2010: Energy" exhibition

Opening times:
The exhibition is open daily from 10.00 to 18.00.
The park and gardens on the Isle of Mainau are open from sunrise to sunset.
Subject to change without notice.

Admission fees:
Individuals and families pay the regular admission fees for the Isle of Mainau: Adults: €15.90 / Schoolchildren and students: €8.50 / Children: (up to and including 12 years of age): free admission / Groups (from 10 people) per person: €12.90

School groups have free admission to the exhibition. This requires prior notification by phoning
+ 49 (0) 7531-303-0.

Special offers for schools

As an extra-curricular environmental education institution, the "Green School Mainau" is offering four different projects on the theme of energy as part of the exhibition: energy consumption, forms of energy, sustainability and energy production.
These are free of charge for school groups and last approximately 2 hours each. For more information, visit www.mainau-entdeckungen.de/grueneschule2010. (To make arrangements and register, please phone +49 (0) 7531-303-253.)

Teaching units dealing with the topic of energy are accessible free of charge at www.mainau-entdeckungen.de/unterricht2010. The four themes of the prepared teaching units are reflected in individual pavilions at the exhibition on the Isle of Mainau: wind power, biofuel, geothermal energy and solar energy.

Short guided tours around the exhibition are provided every hour, on the hour for school classes and groups. This requires prior notification by phoning
+49 (0) 7531 /303-253.

LEGAL NOTICES

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We would like to thank all exhibitors for their willingness to provide texts and images for their pavilions. The exhibitors are solely responsible for the contents of their pavilions.

Information about the series of exhibitions can be found at www.mainau-entdeckungen.de

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WELCOME TO THE EXHIBITION "DISCOVERIES 2010: ENERGY" ON THE ISLE OF MAINAU.

The exhibition is part of the initiative "Science Year 2010 – The Future of Energy" of the German Federal Ministry of Education and Research and is jointly organised by the Foundation Lindau Nobelprizewinners Meetings at Lake Constance and the Mainau GmbH. The exhibition series started last year with "Discoveries 2009: Water" and attracted more than 200.000 visitors. In 2011 the exhibition series will come to its conclusion.

This catalogue is published in celebration of the 60th Lindau Nobel Laureate Meeting in 2010 and the 10th anniversary of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance. From June 27th to July 2nd, 61 Nobel Laureates in physiology or medicine, physics and chemistry and more than 650 young researchers from 70 countries will convene at Lake Constance.

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