ETH
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Swiss Federal Institute of Technology Zurich

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PRESIDENT'S SELECTION

The Newsletter from the ETH Zurich President

www.ethz.ch

RESEARCH AND TEACHING

High-energy expertise

Photo: Amstein + Walthert AG

A model concept on ETH Zurich's Campus Science City: In summer, heat lost from buildings is stored by way of 800 earth probes in the ground to be re-used as heating in winter.

Research and teaching are key drivers to innovation in the economy. On the other hand, by providing new findings, universities such as ETH Zurich and other research institutions also contribute to solving society's challenges too. In the case of energy questions, this dual task needs particularly far-sighted answers.

ETH Zurich's research strategy focuses on energy efficiency, renewable energies and the inevitable increase in electrification. In order to systematically research basic principles in these key areas, additional professorships have been planned and partly already filled.

Three new chairs have already been established in electrical energy technology, with the aim of gaining wider knowledge on high voltage networks and energy-saving power electronics. Further appointments include two professorships for electrochemistry (in cooperation with PSI) and for innovative materials in batteries (in cooperation with Empa). In addition, two chairs for geothermal energy are being planned. Six professorships have been envisioned for sustainable construction, spread over several departments, some of whom have already started with their work. Many of the chairs have been given start-up financing from private enterprise.

Today, 47 research groups from 11 of the 16 departments work on cross-disciplinary energy projects. More than 1000 ETH students are pursuing studies in energy-related fields and will ultimately incorporate their solution-based knowledge into the economy and society.

With this manifold portfolio on the research of basic scientific and technical principles, as well as its interdisciplinary approach to teaching, ETH Zurich can make a significant contribution to overcoming the world's major energy and climate problems.

The university is also setting a commendable example by building a largely self-contained energy system on the Campus Science City using the ground to store heat lost from buildings. In addition, the new Monte Rosa hut project run by ETH students has generated a lot of interest by testing an energy management system based on predictions.

Nuclear phase out with conditions attached

In principle, a restructuring of the energy system without nuclear power by 2050 is technologically possible and economically viable. However, it will require a massive and concerted effort by the whole of society. This was the conclusion reached by ETH researchers in their recent study.

The fixed parameters applying to the modeling calculations dictate that the global climate targets (a maximum warming of 2 degrees centigrade) must be adhered to. These targets require that, among other things, this country must achieve CO_2-free building heating systems plus an efficient and partly-electrified mobility system as well as minimal CO_2 emissions in electricity generation by 2050.

Info: www.esc.ethz.ch

EDITORIAL

Devilish details

Dear reader

Fukushima shook a number of views on the energy-political ground. Despite differing opinions, the consensus prevails that to procure a safe and affordable energy supply, more research, development and education are needed.

For ETH Zurich, this call comes as no surprise, as the university has long been investing widely in teaching and research in the fields of both energy technology and energy economy.

With the necessary reduction in overall energy consumption, the demand for electricity will rise. At present, however, we cannot specify which kinds of energy conversion, linked to which societal changes, will fill the nuclear energy gap. As always, the devil is in the detail – and in the case of energy, in many details.

R. Eichler

Prof. Ralph Eichler
President of ETH Zurich

"QUOTE ... UNQUOTE"

"Astounding but true: Computers save more energy than they consume."

Prof. Friedemann Mattern, Head of the Department of Computer Science at ETH Zurich

ENERGY EXPERT

The mediator

The two year Master's program *Energy Science and Technology* at ETH Zurich brings science and technology from various disciplines together. With her Master's thesis recently completed, the environmental scientist Nina Boogen is making new plans.

Ms. Boogen, why exactly did you choose energy as your subject?
What I particularly like about the Master's program is that technical disciplines link up with those of the natural, economic and social sciences in order to address the challenges facing the energy sector together. As an environmental scientist, I see my role primarily as that of a mediator between the different fields of expertise and also towards the public.

What was the focus of your study profile?
I am particularly interested in the interfaces between two disciplines – in my case between energy technology and the economy. Added to this, many political and social aspects enter into energy economy.

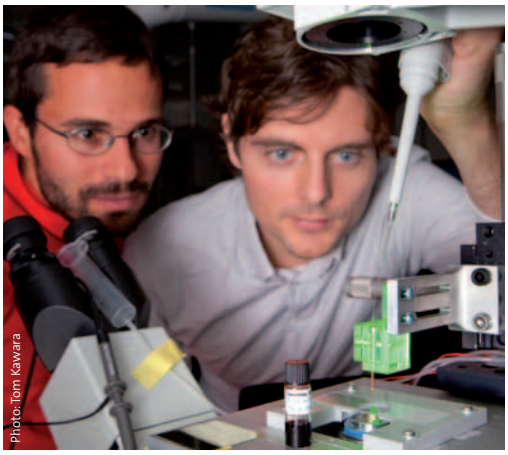
Can you give a specific example?
In my Master's thesis, I looked at apartment blocks being renovated and examined why, despite cost efficiency, often no action was taken to improve energy efficiency. The biggest obstacle proved to be lack of information – among owners as well as tenants, both unsure on the key questions: who should invest, which risks are involved and who will benefit at the end? Energy experts are needed to give clear answers.


Nina Boogen.

What highlights did you experience during your studies?
A visit to the Maggia hydropower station in Ticino made a great impact on me. The theory we students had learned in our study programs was vividly displayed to us in practice. I was also delighted to be able to present the work from my semester paper with an article in the ETH climate blog.

How do you see your future? What dreams do you have?
I don't have any specific dreams but I would definitely like to see more of the world and also work in a distant country one day. I am especially interested in energy consulting but first I will stay at ETH as a scientific assistant for six month and then my plan is to work on a farm abroad. After using my brain for so long, I would like to spend some time working with my hands.

FRESH FROM THE LAB



The doctoral students Julian Schneider and Patrick Galliker (right) filling nano ink into the printing equipment.

Nano drop by drop

A new 3-D printing process using miniscule drops could revolutionize energy and resource consumption in micro- and nanotechnology. Such is the conviction of the ETH doctoral students working on the research project. Photovoltaics would benefit too.

The demand for computer chips and sensors continues to rise. With expectations on performance mounting at the same time, ever smaller structures to the components are called for. Up till now, these micro and nano structures have generally been produced photo-lithographically in clean rooms – a process that entails huge amounts of resources and energy.

A research team led by Professor Dimos Poulikakos at the ETH Institute of Energy Technology has now developed a process which not only uses substantially less energy and material in the high-definition range but is also much more flexible.

By precisely stacking up to 100 000 nano drops per second, structures with a diameter of far less than 100 nanometers are produced (approx. one thousandth of the width of a hair). An electrical field pulls, in effect, the drops from a micropipette. They fall onto the surface to be printed and evaporate immediately.

What remains are the resulting nano particles from the desired material, which, after further drops are added, build up the desired nano structure. Thus, the technique submitted for patenting, will – in contrast to photolithography – also produce three-dimensional structures.

This method also enables thin-film photovoltaic cells to be energetically enhanced. Tiny light-scatterers made of gold are printed on the silicon, producing nano dots that can distribute sunlight throughout the cell more optimally and thus raise efficiency.

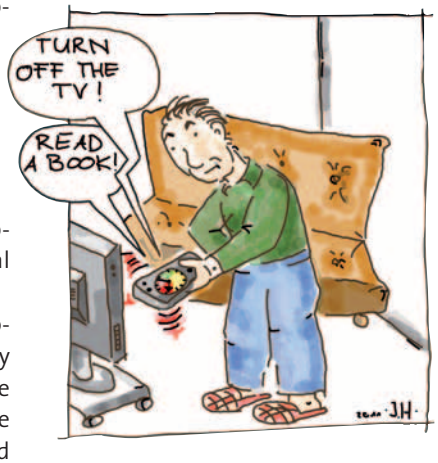
IN SHORT

Innovation from talent
In order to ensure a sustainable base for energy supply, innovative minds are needed. For this reason, ETH Zurich awards grants through the *Excellence Scholarship Programme* to students with exceptional abilities. Thanks to donations from around 800 ETH alumni, as well as companies and foundations, over 100 scholars have already been supported. Whatever these budding scientists receive today will be returned in the future to research, industry and ultimately to society as a whole.

Solar gas turbines
In his doctoral dissertation at the ETH Institute of Energy Technology, Illias Hischier developed a sunray receiver that – via a gas turbine – uses the captured energy to generate electricity at a highly efficient level. The mechanical engineer was presented with the *swisselectric research award 2011* for his achievement. By combining solar energy and fossil fuels, electricity can be produced on a constant and lower-cost basis.

Energy-eaters exposed
In most households, the energy consumed by a computer, television or washing machine is an unknown quantity, resulting in much electricity and heating in homes going wasted. With a portable monitor named the eMeter, the Bits to Energy Lab, run by ETH Zurich and the University of St. Gallen, can visually display the consumption of power-hungry appliances and thus encourage users to save energy.

FINAL WORD



The personal energy monitor has not yet achieved the motivating results intended. Challenging a neighbor to an energy-saving competition would probably be more effective.

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