ETH Zürich Foundation

Uplift

The impact of giving

№ 12

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ETH Foundation

We need to act together

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The transformation of our energy system is well underway – not least thanks to the expertise of researchers at ETH Zurich and innovative solutions from our creative start-ups. A broad mix of technological approaches are needed to achieve a successful transition, all of which must be measured against ecological and economic criteria. Due to the complexity and urgency of the challenges, going it alone isn't an option. Only with all forces of society acting together can the energy transition succeed.

Action on energy and climate issues is particularly strong among young scientists at ETH. Take Master's student Nabila Salsabila, whose inspiring story is featured in this issue; or Philipp Furler who demonstrates the strong entrepreneurial spirit ETH promotes in seeking to transfer research from lab to market as swiftly as possible. It's a fascinating read!

A powerful force in renewable energies

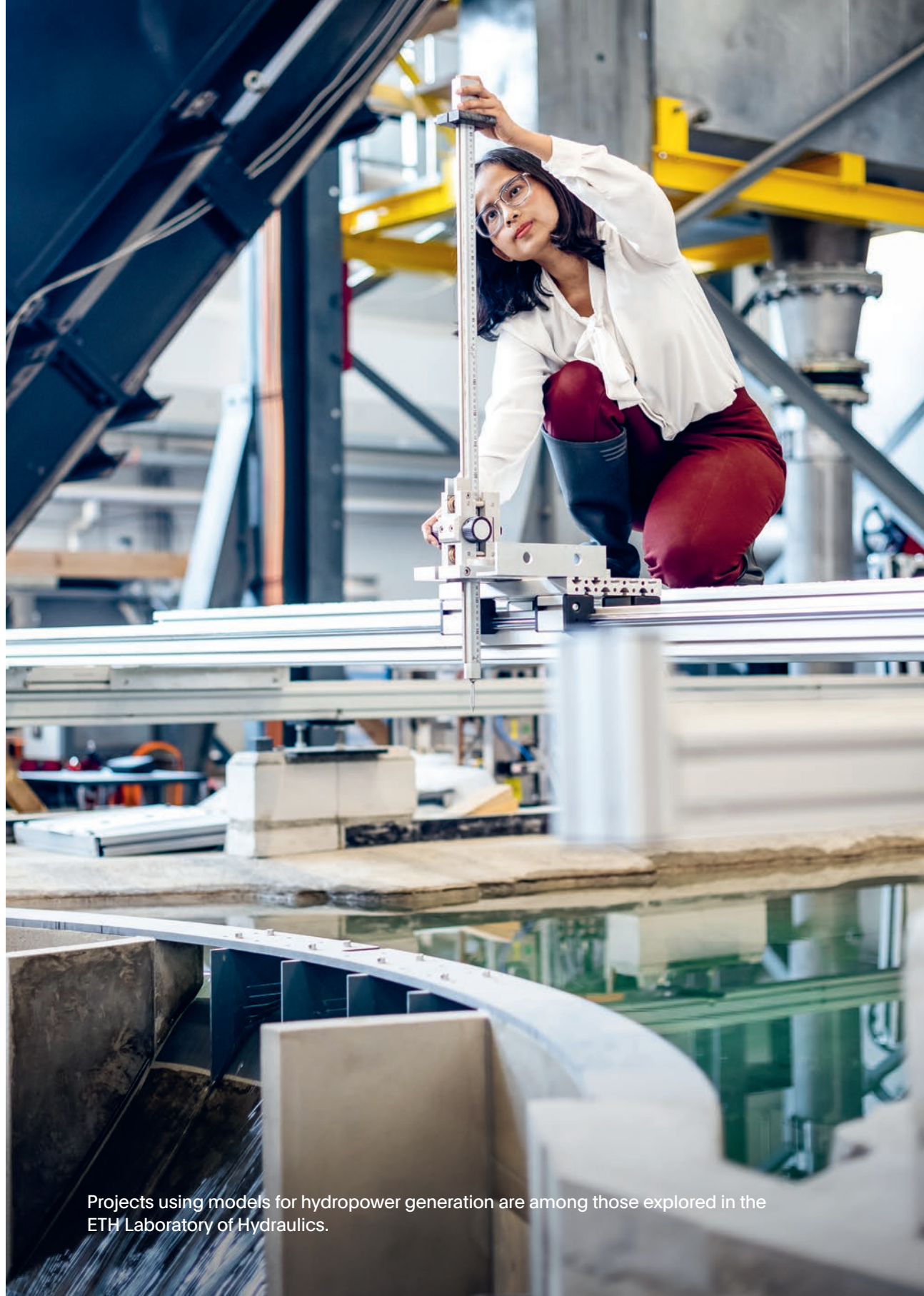
In the transition to renewable energy, Excellence Scholar Nabila Salsabila is set to play an active part. Her own energies in this area focus on the challenges facing her home country of Indonesia.

Nabila Salsabila has to think for a moment when asked who her role models are. “I admire people in leading political positions who are steering their country towards net zero as well as environmental activists like Tiza Mafira, who helped initiate a drastic reduction in single-use plastic bags in Indonesia. Inspired by different people, I want to forge my own path.” The young woman from Indonesia has a clear goal in mind: an influential position in which she can take effective action in the environmental politics of her home country. At ETH, she’s building the toolkit she needs with a Master’s degree in environmental sciences, specialising in environmental systems and policy, supported by an Excellence Scholarship.

Pushing for systemic change

For her Bachelor’s in bioprocess engineering at the University of Indonesia, Nabila Salsabila delved deep into energy, climate and sustainability-related topics. When it came to her thesis, she modelled a renewable energy system for productive usages of hybrid power generation and household-scale biogas generation, using an underdeveloped Indonesian village as a case study. Taking techno-economic, financial, political and environmental aspects into account, her analysis covered wide ground. In order to take this holistic approach a stage further, she decided to pursue a Master’s degree at ETH. Her enthusiasm was fuelled not only by the courses and the infrastructure available but also the green spin-offs that the university has generated: “Synhelion (see p. 7) and Climeworks, for example, both play an important role in the battle against climate change. And Zurich-based South Pole is at the top of the list of companies I’d like to apply to after graduating,” Nabila Salsabila says. “I’m grateful that the Excellence Scholarship allows me to study in such an inspiring environment.”

Her view of the impending energy shift is influenced by her origins. “In low- and middle-income countries, the challenges of phasing out fossil fuels and converting to renewable energies are even bigger. Many people don’t even have access to a reliable electricity supply in the first place. Social inequalities therefore push the topic of clean energy into the background,” Nabila Salsabila explains. In her opinion, a systemic change is required – and this needs to be



Projects using models for hydropower generation are among those explored in the ETH Laboratory of Hydraulics.

“I want to influence the key decisions made on energy transition and contribute to moving the needle on climate action.”
Nabila Salsabila

driven by political intervention. “Although solar panels or hydroelectric and wind power plants are expensive to build, they’re cheaper to run. Subsidies provided by the state could make renewable energy more attractive than fossil fuels.” And this could be a way of making the industry more accountable too. In the student’s view, further prerequisites for an effective energy transition include reducing bureaucratic obstacles and upgrading the electrical grid to allow for higher renewable penetration. Many of these points also apply to Switzerland and Europe, she says. But the path to transition is not as long here as it is in her home country.

A true energy nerd
There’s no question for Nabila Salsabila that her generation puts environmental issues high on the agenda and wants to find solutions. This was made clear by the 5000 young people participating in the questionnaires and dialogues she carried out as the Southeast Asia Regional Coordinator for the Global Youth Energy Outlook at Student Energy, a global youth organisation set up to empower the next generation to achieve a future where energy supply is more sustainable and fairer. Nabila Salsabila was able to vocalise her generation’s aspirations and demands in a presentation at the 2021 UN Climate Change Conference (COP26) held in Glasgow.

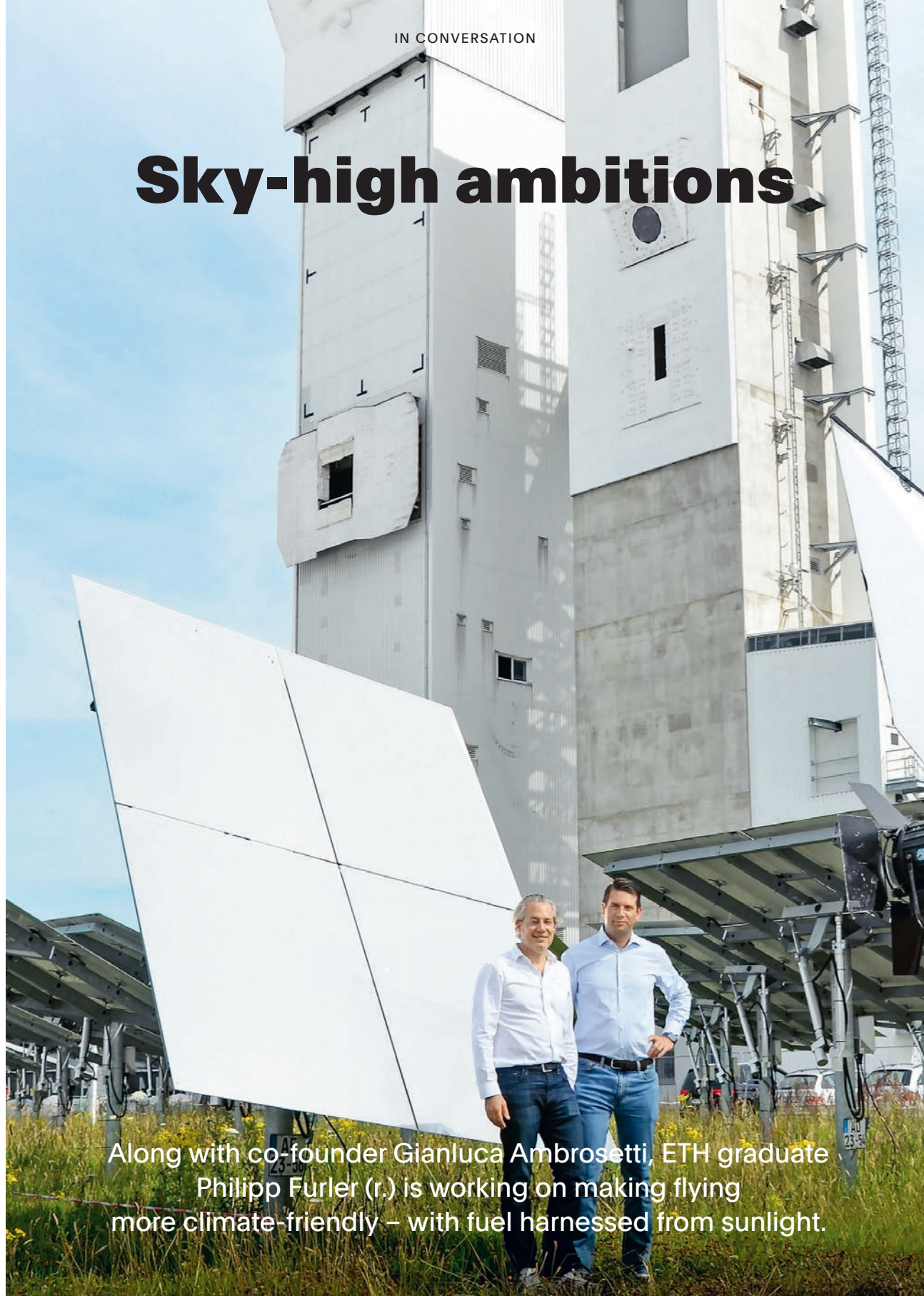
The young woman is resolute in the pursuit of her goal. For her it’s clear that the decisions taken this decade are crucial in light of what’s yet to come. She keeps on top of things with a daily to-do list and a social media timeline filled with articles and news on energy and climate topics. In addition to her studies, she’s now expanding her language skills in Indonesian and English with German and French. “My boyfriend says my biggest hobby is gaining new knowledge,” the student laughs. And adds: “He’s probably right.”

Promoting outstanding young minds

The ETH Excellence Scholarships enable ETH Zurich to win exceptional young people from Switzerland and across the world to study for a Master’s degree – an essential instrument in the international competition for the world’s greatest talent. Beneficiaries of the funding programme are those that count amongst the best two to three per cent of their year. Due to rising student numbers, the need for Excellence Scholarships has grown: the aim is to be able to award 60 Excellence Scholarships a year.

More on the programme at:
ethz-foundation.ch/en/esop

Sky-high ambitions



Along with co-founder Gianluca Ambrosetti, ETH graduate Philipp Furler (r.) is working on making flying more climate-friendly – with fuel harnessed from sunlight.

Experts say that CO_2-neutral kerosene is the only way to make air travel greener. Why such absolute terms?
PHILIPP FURLER – E-planes can be useful for journeys like crossing fjords in Scandinavia, for example. But that doesn't solve the problem with emissions, as the highest levels are generated over long distances. The best batteries we have today store a hundred times less energy than kerosene. This makes them ineffective for long-distance flights, they would be far too heavy. Then there's hydrogen, but the problem here is the little energy it has per volume. So you'd need huge tanks to store enough, which limits the range of hydrogen-powered aircraft. Global infrastructures would also have to be replaced. Given that the lifetime of an aircraft is 30 years, even if hydrogen were to work, infrastructures would have to be sustained in parallel for decades – think refuelling. This blocks any motivation on the side of airlines or aircraft manufacturers. That's why sustainably produced kerosene is currently the only sensible alternative. When it's burned, only as much CO_2 is released as was previously extracted from the air for its production.

What is Synhelion's history?
I studied under ETH professor Aldo Steinfeld and came across his research through a semester paper. In my Master's thesis we were able to show that water and CO_2 can be split with solar heat. That was the basis of my doctoral thesis, which culminated in us producing the first solar kerosene with our European partners in 2014. While subsequently working as a postdoc for Aldo, ideas for commercialising the research began to consolidate. My colleague and Synhelion's co-founder Gianluca Ambrosetti – who was then working as head of the research department of a solar company – and I both agreed: for this technology to really make a difference, we need to go down the entrepreneurial road. That's how, in 2016, Synhelion was born. A pivotal stage of the journey was the ETH Pioneer Fellowship. This enabled us to develop a prototype, a solar mini refinery, on the roof of ETH's Machine Laboratory building (see back page), which succeeded in proving the basic feasibility of our "fuel from air and sunlight" concept. I'm extremely grateful for this milestone.

ETH spin-off Climeworks originated from the same research group and is also based on an ingenious idea.
Yes, the Climeworks technology was created 10 m away from our technology, and founders Jan and Christoph are close friends of ours. We're two sides of the same coin: Climeworks' plants filter CO_2 from the atmosphere, while we process CO_2 into fuel. Aldo's vision from the beginning was to close the carbon cycle. It's his burning passion, and ours too! I consider it a huge privilege to be able to develop this technology. If I wasn't doing it as my profession, it would be my hobby!

Where does Synhelion stand today?
Much innovation has taken place since we first started. We've translated what was once an academic concept into a system that can be scaled up and operated commercially and are currently testing the technology on an industrial scale in the solar tower of the German Aerospace Center in Jülich; next year, we plan to put our first industrial pilot plant into operation in the immediate vicinity; our partnership with Swiss International Air Lines should see the first aircraft take off with Synhelion's solar fuel in its tank by 2024 at the latest; and we're aiming to open our first commercial plant in Spain in 2025. Meeting global demand for kerosene in a climate-friendly way requires plants the size of Switzerland. They need to be located in areas with plenty of sunshine and desert-like conditions. Our energy-dense fuel is then easily transported via existing distribution infrastructure.

By 2030, you're aiming to produce your solar fuel at a cost of one euro per litre and to raise production capacity to 875 million litres per year, about half of Switzerland's kerosene consumption. How realistic is that?
We don't set ourselves typical Swiss goals, we're very ambitious! We can only achieve a real impact with attractive prices, and for that we have to think big. We're in constructive dialogue with politicians and know that blending quotas for synthetic fuels are on the horizon. These quotas will create a market, and that gives us investment security. We're convinced that our scientific DNA and ability to understand systems in full depth give us the upper edge in an extremely complex and challenging energy market.

More on the Pioneer Fellowship programme: ethz-foundation.ch/en/pioneer-fellowships

Test facility in the solar tower of the German Aerospace Center: the receiver in the tower absorbs the sun's rays reflected by the field of mirrors and drives the reactor.

Pictures: © Synhelion

Aldo Steinfeld professorship

Raised in Uruguay's capital Montevideo, Aldo Steinfeld studied aeronautical engineering at the Technion in Israel and received his doctoral degree from the University of Minnesota in the USA. Since 2007 he has been Full Professor of Renewable Energy Carriers at ETH Zurich. His research focuses on advancing the thermal and chemical engineering sciences applied to solar technologies. The researcher is the author of over 350 articles in scientific journals and of 25 patents. Two spin-offs emerged from his lab: Climeworks and Synhelion, both contributing to sustainable energy utilisation.

The energy package

Research at ETH Zurich on the future design of our energy system is diverse and much of it is enabled by the support of donors. A selection of funded professorships and projects.

Domenico Giardini

The Professor of Seismology and Geodynamics is certain that economically sustainable production of geothermal energy will be possible and necessary in Switzerland in the future. In the Bedretto rock underground laboratory he researches deep geothermal energy under real conditions. He is interested in how basement rocks interact with water injections, how seismic cracks can spread through the rock and how to minimise the risk of induced seismicity associated with the extraction and storage of geothermal energy.

Funded by the Werner Siemens-Stiftung

Martin O. Saar

The Professor of Geothermal Energy and Geofluids is convinced that if modern technologies are factored in, the potential for geothermal energy is substantially higher than currently predicted. As a result, most Swiss municipalities could have their own geothermal plant and produce sustainable energy all year round.

Funded by the Werner Siemens-Stiftung

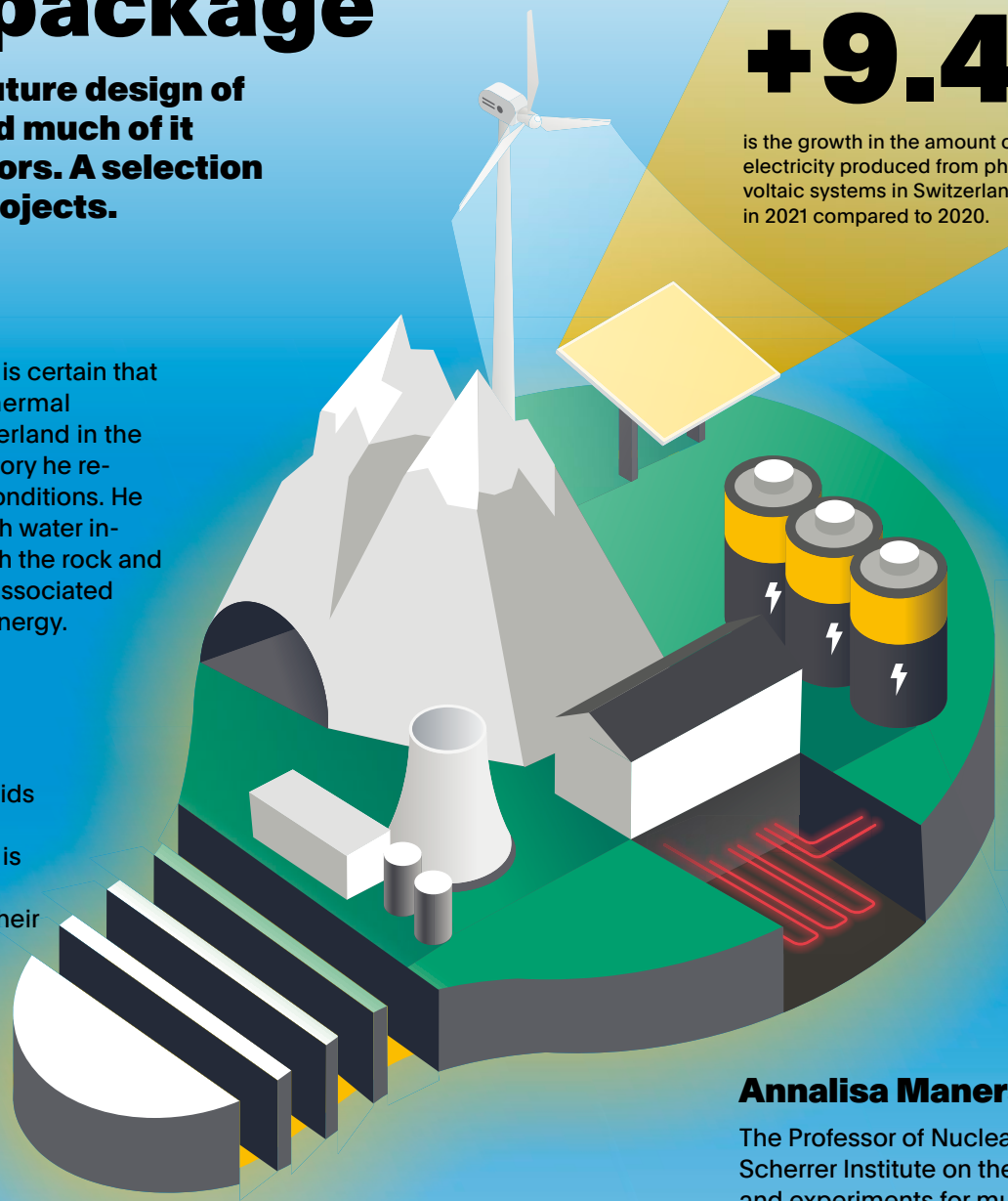
15

is the number of projects selected by Innosuisse, the Swiss Innovation Agency, as part of a flagship initiative. One of them, led by Martin O. Saar, includes an analysis of the Swiss energy system with a significant "update" on geothermal energy.

Maren Brehme

As a senior researcher in Martin Saar's research group, she and her team are investigating how geothermal energy can be used on a secure, efficient and sustainable basis. Their field, laboratory and simulation work all play their part in the quest to leverage this energy's global potential.

Funded by Energi Simulation



+9.4%

is the growth in the amount of electricity produced from photovoltaic systems in Switzerland in 2021 compared to 2020.

André Bardow

The Professor of Energy and Process Systems Engineering is conducting research on sustainable energy systems. Besides finding ways to integrate renewable energies into the Swiss energy system, he's also exploring technologies for capturing carbon dioxide from the air.

Negative emissions technologies project funded by the LIFE Climate Foundation Liechtenstein

Paul Baade

This young entrepreneur has set his sights on producing high-performance batteries at low cost with a storage solution that significantly shortens the charging time of electric cars and lowers manufacturing costs.

Funded by donors of the Pioneer Fellowship programme such as the Adrian Weiss Stiftung

+6626%

is the increase in the number of registered electric cars in Switzerland from 2011 to 2021.

Annalisa Manera

The Professor of Nuclear Systems and Multiphase Flows works both at ETH and at the Paul Scherrer Institute on the development of high-resolution measurement techniques and experiments for multiphase flows. Her professorship provides education and research to ensure the safe deployment of nuclear energy.

Funded by the Bundesamt für Energie BFE and Swissnuclear

Energy Science Center

The aim of interdisciplinary research is to use flagship projects to lead the way to an environmentally friendly, reliable, low-risk, economically viable and socially acceptable energy system.

Projects in part with ABB Schweiz, Alpiq, Axpo, BKW, CKW, EKZ, ewz, GE Power, Repower and Shell

Investing in the here and now

She didn’t learn what a stock was until after her studies at ETH. Today, Evelyne Pflugi is CEO of investment boutique The Singularity Group and promotes young entrepreneurs at her alma mater.

How does someone go from being a food scientist to CEO of a fund manager?
EVELYNE PFLUGI – Actually, I’d always wanted to work for Nestlé. At the Polymesse job fair, I was approached by several companies, including Capital Group, the world's largest asset manager at the time. It would never have occurred to me to enter the world of finance. In those days, I hardly knew what a fund or equity was. However, recruiters for a certain programme at Capital Group were explicitly looking for trainees without a financial background. Their credo was: to be a good investor, you must be willing to take risks. And a person demonstrates a willingness to take risks if they’re good at something yet still do something else. The attractive thing about their offer was that the programme would take place in Los Angeles. I really liked the idea of going to the USA, so I accepted – and learned everything there was to learn the hard way, on the job.

Today you’re an entrepreneur. What do you like about your job?
A few years ago I’d have said: the exciting bit is what we do as a company. Today my focus has shifted: as an entrepreneur, you’re constantly testing your limits. Your own limits and the limits of the system. What I find most fulfilling about my work today is getting to know myself better, my strengths and my weaknesses, and building a system around them that functions. In the meantime, I’ve discovered my greatest strength is my accuracy in spotting what others are good at and in helping them develop their talents.

What memories do you have of your university days?
I was very disciplined and competitive; I wanted to get a good degree. But I was also actually very interested in the programme’s content. I really enjoyed this sense of “being in the learning process”. Even today, I love absorbing myself in a topic. At the same time, I went out a lot, made friends for life and earned money as a nanny. What I don't miss from that time is the pressure I felt, knowing I’d have to make the leap into the working world later on. In those days, I believed my studies were basically a question of “doing a bit of research” and then “real life” would begin, where no one makes mistakes anymore. Today I know that a lot of bungling goes on at work, especially in large companies. As a student, I was unfamiliar with the working world and took it far too seriously. (Laughs.)

“I want to help turn research into applied innovation”.
Evelyne Pflugi

The ETH alumna supports future entrepreneurs such as Patrick Barton (pictured) and Aurel Neff from Caterra who are looking to bring a laser-based weeding robot to market.

You donate to ETH's Pioneer Fellowship programme – why?
I see it as an opportunity to play my part in enabling research to find practical application. Being an ETH donor allows me to support the early stages of a concept that also interests me in investment consulting: what, how and in which industries do innovations emerge and in what ways do they change the world? Much of what happens in the investment world can be described as "guessing the future". Indeed, many investment products invest in companies' research and development spending. At the other end of the spectrum, investments are made in companies that make a lot of money from their existing product and service offerings. We move in the space in between and call it applied innovation.

How do you spend your time when not managing your investment boutique?
In my professional role, I talk to an incredible number of people. In my private life, I seek tranquillity, nature, I love hiking. I don't need any additional stimulants like sports or nightlife anymore, business offers me enough adrenaline.

Pioneer Fellowship programme

The programme supports exceptionally talented researchers with ambitious entrepreneurial plans along their journey to a marketable product. A panel of experts awards 10 to 15 Pioneer Fellowships every year, which are supported by foundations, companies and over 200 private individuals. ETH Zurich is looking to expand the programme in order to offer even more young scientists funding of up to CHF 150 000, coaching, and the chance to further develop their research results for commercial application.

Find out more:
ethz-foundation.ch/en/pioneer-fellowships

Action on climate and energy

With ETH technology, the university wants to increase its impact on decarbonisation, energy security and environmental protection.

© Climeworks, Julia Dunlop

ETH spin-off Climeworks is a key player in the rapidly growing global market for the direct air capture process in which CO_2 is filtered out of the atmosphere and stored in the ground. The image shows a plant in Hinwil.

Switzerland's largest alpine solar plant on the Muttsee dam at 2500 metres.

Climate change has long been a reality, and its effects are becoming increasingly tangible: we're seeing ever more cases of temperature records being broken and extreme weather events like droughts and floods. With its ratification of the 2015 Paris Climate Agreement, Switzerland joined efforts to limit global warming to 1.5 degrees by pledging to halve greenhouse gas emissions by 2030. But Switzerland is not on track. In addition to climate change, the country is facing two other related challenges that are also partly accentuated by recent geopolitical events: the energy shortage threat, and loss of biodiversity. Determined to act, ETH has launched a variety of projects and activities, including the creation of three new professorships at the Department of Mechanical and Process Engineering (D-MAVT).

Exploiting surfaces for the energy transition

Surfaces and interfaces of different materials are omnipresent both in nature and technology, and often determine a material's functionality. As modern technologies can be used to modify these surfaces down to the atomic scale – thereby regulating the transport of energy or mass – a new professorship at D-MAVT has been set up to explore the interplay between the surface structures and function of a material, and to develop technologies to manipulate these surfaces for specific purposes. A key example of practical application lies in the capture, use and storage of CO_2.

Fueling our societies by the sun

Solar energy is the key to a sustainable society. Therefore, efficient technologies and materials are urgently required for the conversion, storage and use of solar energy. This applies not only to electricity generation, but also to the development of solar fuels, metals, fertilizers, and even cement. In view of the latter, huge progress is needed if global-scale production is to be realised on a cost-effective and sustainable basis. The department's new professorship in solar energy technology will develop new technologies – and consolidate the university's current leading position in the field.

Sustainable mechanical structures

Forming the basis for machines like aircraft or robots, mechanical structures are ubiquitous, be it in transport or construction, medicine or production. New developments – such as meta-materials – open up unprecedented opportunities for innovations, e.g. climate neutral aviation. D-MAVT's third new professorship will therefore concentrate on incorporating sustainability aspects into new mechanical structures from start to finish: from the design and manufacturing process, through to their use and recyclability. Material-specific aspects, embedded multifunctionality and optimised manufacturing processes will all play a major role in reducing CO_2 emissions and resource consumption.

Two other departments have expanded their research in the field of sustainability: a new sustainable materials and devices professorship in the Department of Materials will focus efforts on upgrading the sustainability of the materials themselves and their production. Processes are to be improved with a focus on lower resource and energy consumption and strategies for reuse developed. Composite materials are a tough nut to crack when it comes to recycling: for this reason, a new professorship in circular materials for sustainable future infrastructure at the Department of Civil, Environmental and Geomatic Engineering will work on identifying suitable additive materials with a low environmental impact and high recyclability in order to boost the development of improved building materials and infrastructures.

Find out more:
ethz-foundation.ch/en/projects

"ETH Zurich can play a vital part in helping Switzerland achieve its climate goals – thanks to outstanding teaching and research in areas such as energy, mobility and construction, and by transferring sustainable technologies and concepts to industry and society. Philanthropy and partnerships can enhance and fast-track these efforts."

Walter Gränicher
Member of the ETH Foundation Board of Trustees,
former CEO Alstom Switzerland,
President ETH Alumni Association

For her Master's in integrated building systems, Excellence Scholar Josien de Koning is working on maximising energy efficiency in buildings.

Your support

Science and technological innovations are more important than ever. We urgently need answers to the major challenges of our time, including one of the most pressing of all: the energy and climate question. Key to success are talented and imaginative minds, outstanding research and teaching, strong partners – and you. **Help us find the insights and solutions needed for energy and the climate – there's no time to lose!**

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