



The CO₂-binding society as a goal

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Tanja Zimmermann and Martin Ackermann want to provide answers to the current climate crisis with new initiatives and ambitious goals. In this interview, Eawag Director Ackermann and Empa Director Zimmermann explain why this is primarily a water crisis, what is needed to tackle it and what can be produced from the greenhouse gas CO₂.

Finding solutions to the climate crisis and using the atmosphere as a «mine» of sorts to extract CO₂ and produce valuable materials from it – this is not a small feat. Aren't you afraid of not meeting expectations?

Martin Ackermann: First of all, a personal assessment: We are not on track. The targets for efficient climate protection, such as net zero by 2050, are a long way off at the moment, plus there is a lot of catching up to do in terms of climate adaptation, our ability to react appropriately to a changing climate. So there is still a lot to do. And we better start sooner rather than later ...

Tanja Zimmermann: Indeed, the problems are urgent. Even if we achieve net zero and master the energy transition, there is still way too much CO₂ in the atmosphere – with the corresponding consequences such as melting glaciers and increasing extreme weather situations. It is therefore extremely important to act now and do our bit. And I sense a great deal of motivation among our young researchers in particular to work on these meaningful topics. So respect for the task – absolutely; fear of not being able to offer solutions – no.

And Empa and Eawag are capable of managing this Herculean task alone?

MA: We greatly appreciate working closely with Empa – in general, but especially on the topic of climate. We want to position the joint campus as a place where intensive work is carried out on climate

solutions. In order to develop these, all available strengths must be combined, from basic research – where the two Federal Institutes of Technology are particularly strong – to the transfer of new knowledge into practical applications, be these new technologies or the scientific basis for new regulations and legislation. We complement each other perfectly within the ETH Domain.

TZ: I can only agree. It's great to be able to work together with Eawag in such an uncomplicated and efficient way. The problem is so complex, however, that we can only solve it together, i.e. with all the institutions of the ETH Domain, but also beyond, including internationally. After all, the problem does not stop at the border. We also need to involve decision-makers from industry, administration and politics at an early stage in order to generate solutions with real impact. As I said at the beginning, we are not thinking small here.



With shared initiatives, Tanja Zimmermann and Martin Ackermann want to provide answers to climate change (Photo: Marion Nitsch, Empa).

What specific contribution can research offer to solve the climate crisis?

MA: When we talk about climate research, we usually think of measurements and modeling, i.e. describing the problem. Although this is absolutely essential, we need more than that, namely solutions. We can roughly distinguish between two types of response to the climate crisis: On the one hand, climate protection or mitigation, i.e. technologies and political strategies to reduce greenhouse gas emissions and remove CO₂ from the atmosphere – as Mining the Atmosphere envisages. On the other hand, climate adaptation, to contain or minimize the harmful effects of climate change on natural and human systems, such as protection against extreme weather events. To put it bluntly: climate adaptation is about protecting yourself, i.e. looking after your own well-being. Climate protection is altruistic and has a global impact. We need both, not either-or.

So as an aquatic research institute, what is Eawag's role in all this?

MA: According to the UN, climate change is first and foremost a water crisis. It is getting warmer, yes, but this is also changing water availability and precipitation patterns. Winters are getting wetter, summers hotter and drier. And that means we face two problems at once: In wintertime, extreme amounts of water can come in the form of heavy rainfall and cause major damage, while in summer we have too little water in some places. So we have to limit the damage caused by extreme precipitation – and at the same time save some of this water for the summer. We have therefore defined climate as one of our key topics at Eawag – something that was less explicit in the past.

TZ: Incidentally, the opposite is true for sustainable energy: In future, with the expansion of photovoltaics and the like, we will have surplus energy in summer, but too little energy in winter. To compensate for this, we are trying to "materialize" energy, i.e. convert it into storable chemical energy carriers, such as hydrogen or methane using CO₂ from the atmosphere.

Which brings us to Mining the Atmosphere ...

TZ: Exactly. Our vision is to transform ourselves from a CO₂-emitting to a CO₂-binding society through the development of appropriate materials and technologies. And this is a necessity, I would like to stress that once again, because even after the energy transition, we still have to "clean up" the atmosphere from the CO₂ pollution we have caused over the last 200 years in order to prevent a further rise in temperature.

What is your rough timetable?

TZ: We are currently working on the various "pillars" of our concept: the extraction of CO₂, its chemical conversion and, finally, technologies to be able to produce value-adding materials from it in which the carbon is bound in the long term. The first projects for negative emission technologies are already underway at Empa, such as insulation materials made from biochar and types of cement that absorb CO₂ during the setting process instead of releasing it. Further initiatives are due to start next year; I myself, for instance, would like to launch a wood topic based on my research background. Initial discussions between various stakeholders are underway, and this will definitely be very exciting.

MA: We are currently working with our partner institutions in the ETH Domain to find out in which areas we can work together, for example in the field of water and climate adaptation.

What specific questions do you want to answer?

MA: Just one example: We are setting up a real-world laboratory in Bern, where we are working with authorities, residents and research partners. The aim is to adapt the neighborhood so that life will still be pleasant and safe in 15 years' time – thanks to blue-green infrastructure, the integration of water and vegetation in neighborhoods: so that people are prepared for extreme weather events and at the same time have sufficient water and cooling available in summer.

TZ: At Empa, the focus is on the development of innovative, carbon-based materials and corresponding technologies as well as on systemic approaches. To start from the end, for

example, new building materials with a negative CO₂ footprint, new manufacturing technologies to produce these – but also other raw materials, say, for the chemical industry – on an industrial scale, efficient methanation reactors and catalysts for the conversion of CO₂ and hydrogen into methane as well as new concepts to "suck" CO₂ out of the atmosphere as energy-efficiently as possible. We consider all materials and processes over their entire life cycle – which, wherever possible, is circular instead of linear.

New research initiatives also need to be financed. Where do the funds come from?

TZ: I will provide basic funding for our initiative through my Startup Grant, which I received from the ETH Board, and funds from our reserves – around five million in total. Of course, we also want to raise additional third-party funds, both from public funding agencies and from our industrial partners.

MA: As I said, we have defined the topic of climate protection and adaptation as a strategic focus and will certainly support this accordingly.

There is currently quite a lot happening in this area, such as the Coalition for Green Energy and Storage (CGES) and the Joint Initiatives of the ETH Domain. Aren't they all doing the same?

TZ: All these initiatives are important! CGES, a very large initiative of the two Federal Institutes of Technology together with PSI and Empa, is about storing sustainable energy or converting solar power, for example, into chemical energy carriers such as hydrogen, methane or methanol, so-called Power-to-X processes. The goal here is megawatt systems, i.e. large-scale implementation or upscaling of existing technologies with industrial partners, such as those developed in our mobility demonstrator move or in the PSI's ESI platform. Although there is a certain overlap with Mining the Atmosphere, we are already thinking beyond the energy transition and have our sights set on a completely new circular economic system based on CO₂-negative materials.

Why is it important for Switzerland to play a pioneering role here?

MA: There are two aspects to climate protection: The first is responsibility. As a highly innovative, wealthy country with correspondingly high CO₂ emissions, Switzerland has a greater responsibility, which it should also fulfill. The second is an economic argument: Innovations in the field of climate protection and adaptation have enormous potential and could become a huge market for Swiss industry. In the area of climate adaptation, there is an additional factor: All sectors will change as a result of climate change – agriculture, mountains, settlements. It is thus in Switzerland's own interest to prepare for and protect itself from the negative effects of climate change.

TZ: Switzerland continues to be an international leader in innovation, mainly due to the good framework conditions. We are therefore ideally positioned to develop technologies and concepts in the current initiatives and then apply and bring them to market. This will further boost the international competitiveness of Swiss industry.

Cover picture: Eawag Director Martin Ackermann and Empa Director Tanja Zimmermann
(Photo: Marion Nitsch, Empa)

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