Bioeconomy BW

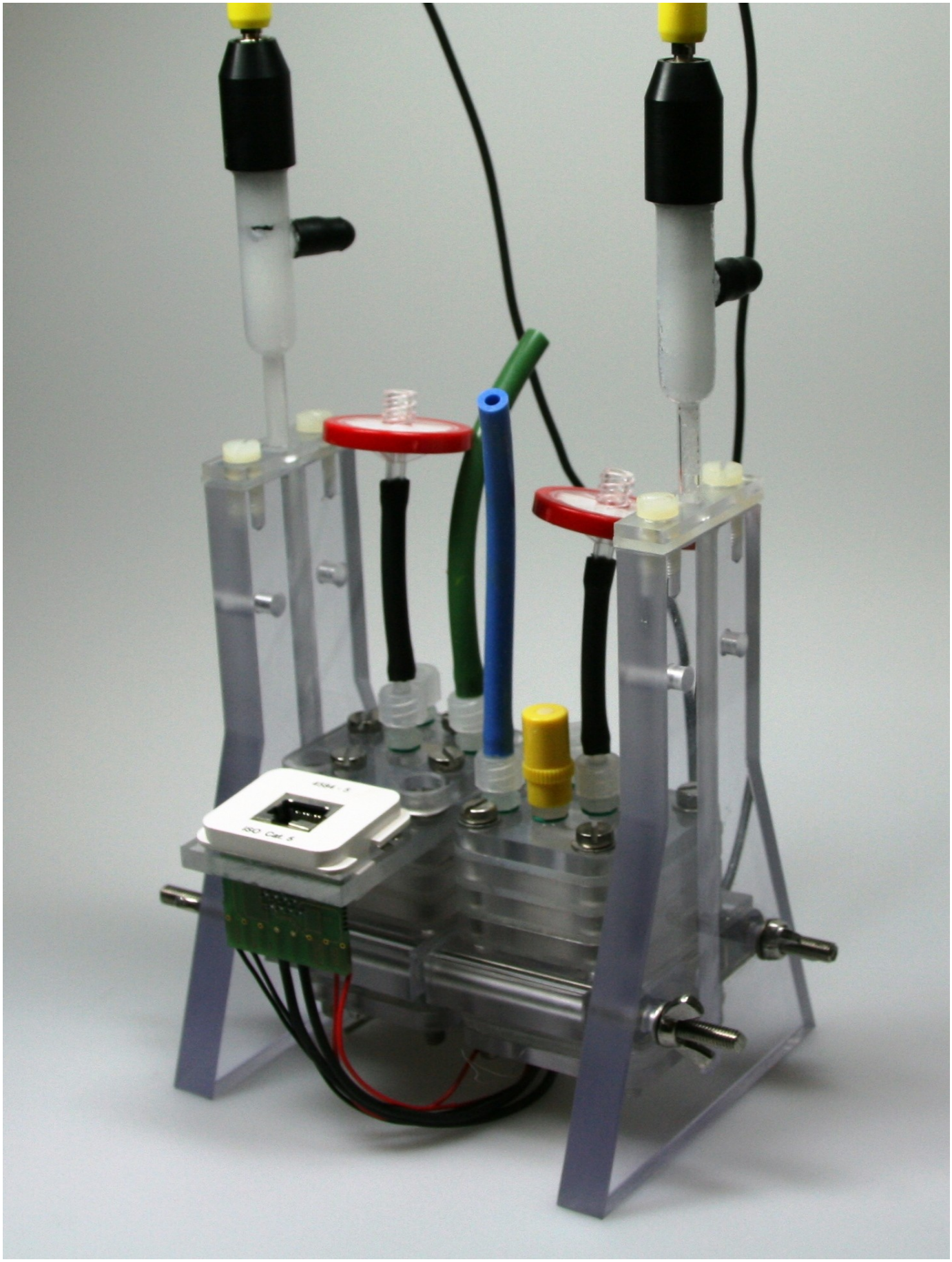
Energy generation from waste

We are all very aware of what happens when we dispose of waste, whether it is industry waste, private household waste or CO2. We also know that cost-effectiveness is still given priority over sustainability. As more and more waste is dumped, it is increasingly entering the groundwater, soil and atmosphere. The ideal solution would enable us to kill two birds with one stone if we could somehow combine the problems related to increasing environmental contamination and anthropogenic global warming with the problem of finite resources. What would be more natural than that? Waste is a sustainable source of energy. How can this source be tapped?

Germany is heavily dependent on imported fossil energy: up to 97 per cent of all mineral oil, 83 per cent of gas and around 61 per cent of stone coal is imported. Both German and European energy and environment policies are aimed at using waste as renewable source of energy. The twin objectives are to create power from waste and reduce the amount of waste and CO2 produced. In Germany, (according to official statistics from the German Environment Agency) around 380 million t of waste were produced in 2008, of which 24 million t were converted into energy. The German Environment Agency plans to increase the use of waste for energy production. The life sciences are likely to play a pivotal role in this plan.

Small organisms with great capabilities

Modern waste disposal can be used to generate energy in the form of heat and power using the cogeneration of heat and power by burning bulky goods or biological waste. Energy can also be extracted from organic compounds using chemical or biotechnological methods. However, innovative methods must be efficient. For example, organic waste could be processed in sewage plants or waste dumps, as is the case of a plant operated by the Heidelberg Association for Sewage Treatment (Abwasserzweckverband, AZV) where microorganisms are used in a two-stage high-performance process to ferment organic waste developed by the Fraunhofer IGB in Stuttgart. This method reduces the quantity of waste at the same time as releasing biogas that can be used for energy generation.



Bacterial fuel cell
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Another example is bacterial fuel cells that can directly produce power from organic compounds. So-called exoelectrogenic microorganisms that use specialised enzymes and membrane proteins are

able to degrade carbon compounds to produce energy. This process leads to the release of electrons that are transported to the outside across the cell membrane. These electrons can be directly fed into an electric system using special electrodes. Algal biotechnology is specifically directed at using the waste product CO2: Algae and plants are both able to turn CO2 into biomass by way of photosynthesis, and scientists are able to genetically modify the algae quite easily. In a pilot facility close to the city of Aachen, algae are grown in the waste gas stream of a coal power station operated by RWE. The algae convert the emitted CO2 into carbon compounds that can be used for the production of materials and energy.

Setting the course for the future

Politicians attach great importance to the energy production potential of the waste industry and are making efforts to promote this by putting favourable conditions in place. One key piece of legislation is the "Renewable Energies Law" which came into effect in its amended form on 1st January 2009. The Law was created to promote and develop the generation of regenerative energy in Germany and it guarantees the feeding of energy generated from renewable resources into the existing energy network as well as establishing a compensation scheme that requires the operators of power supply systems to pay a specified sum to the producers of electricity from renewable sources. The sum includes a basic amount that is graded according to electrical performance classes and bonuses that reward producers for the use of waste for the generation of energy, amongst other things.

TREA Breisgau located in the Breisgau industrial estate is an example of a plant in which waste is burned for the generation of power.

In addition to legal incentives, the legislators are also trying to create stimuli for research, one example of which is the "Bioenergy - breaking new ground" idea competition launched as part of the BioEnergy 2021 funding initiative of the German Ministry of Education and Research (BMBF). This

competition calls on young researchers to submit applications detailing new scientific ideas and concepts. A team of scientists from Freiburg was awarded a prize in 2010 for its research on bacterial fuel cells. Finding a way to exploit the potential of energy produced from waste is a huge challenge for research and technology. Scientists still need to considerably improve the efficiency of methods in order to increase the proportion of energy produced from waste materials. And this requires the participation of scientists from all disciplines: materials researchers, microsystems engineers, biologists, chemists, physicists and others. Of course, waste will not be expected to become the only source of energy in the future. Politicians and scientists agree that the generation of energy depends on a balanced mixture of resources. Waste as energy source has a decisive advantage over agriculturally produced biomass: Energetically interesting crops such as rape or short-rotation plantations require cultivation areas that are in direct competition with the production of food, whereas waste does not. In fact, the opposite is true - the combustion of waste frees up land, so killing two birds with one stone.

Dossier

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