Editorial

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Advances in biorefinery research

<https://doi.org/10.1515/hf-2018-0287>

Today's global society is based on the use of fossil resources, primarily oil, natural gas and coal. The entire chemical industry – and thus all dependent industries – rely on fossil energy and material carriers. It is important not only to think about fossil fuels – as is often done in the media. Of course, oil and natural gas are used to produce fuel oil, fuel gas, gasoline, diesel and kerosene. More importantly (and often forgotten) are all the materials and substances that are naturally available to us in everyday life: plastics of all kinds, colors, chemicals, packaging or pharmaceuticals. Many of these everyday necessities have undergone various processing steps and chemical transformations, and behind some of them is even the complexity of entire industries. Ultimately, however, as diverse as they may be, they all come from the same fossil resources.

Two of today's global and future problems followed directly from the exploitation and utilization of these fossil fuels: climate change and the environmental problem. The burning of fossil fuels generates carbon dioxide (CO_2). This process can to a certain extent be counterbalanced by photosynthesis, quasi the natural “back-reaction” of combustion processes: atmospheric CO_2 and water are converted into glucose and oxygen, and ultimately new organic matter, by using solar energy. However, the increasing amounts of released carbon dioxide can no longer be compensated for, which leads to an overall increase in the CO_2 content in the atmosphere with the known negative climatic effects. The environmental problem is also a direct consequence of the processing of fossil resources, namely the occurrence of side reactions and waste products along the production lines and the low recyclability of many products with high environmental persistence. Fossil resources are therefore the foundation of today's global production – the current world economy and high-tech society are based on their use – but their overutilization also puts us in grave danger.

It is an undisputable scientific fact that one day the fossil resources will be used up. While the exact timing cannot be accurately predicted – neither the exact amount of fossil resources nor the evolution of their consumption is well known – the arrival of this event is beyond doubt.

If the global society does not want to fall back into a rudimentary state of preindustrial development, it must be able at that time to completely replace fossil resources in their entirety and in all applications – and the only option to do this are renewable resources. This is not just about producing energy and fuels based on other fuels, but rather the entire production lines, material fluxes, and processes of the chemical industry and its downstream industries must be re-composed on the basis of the new starting materials. All the materials, basic and fine chemicals, plastics, paints and pharmaceuticals as products of the petroleum-based industry, which today are naturally part of our lives, must then be produced on the basis of renewable raw materials. This is such a fundamental process of change at all levels of society and economy that it is often compared to such fundamental revolutions as the transition of hunters and gatherers to sedentariness or the transitions from Stone Age to Bronze Age and Iron Age. While the use of renewable raw materials is already starting today and will increase more and more in the future, the train of thought is today rarely completed in its entirety: fossil resources are definitely finite, and even if the time when they are being used up is not fixed, at the latest by that time the whole global chemistry will have to be based on renewable resources, or the consequences for human development would be catastrophic.

It is the natural scientist's, and especially the chemist's privilege to anticipate these future developments, to analyze and to prepare for them on a factual basis. Thus, worldwide, and especially in research, a focus on renewable resources is noticeable, but on a large scale, i.e. when replacing fossil resources on an industrial scale, this does not yet seem to be on full swing. All refineries of the future will be complex biorefineries. Even today we have walked already a good share of the way toward this goal. Let us just take all the developments in pulping and lignin utilization as an example for the transition of low-grade biorefineries, which use only one component of wood or other natural starting materials, to complex biorefineries that try to make use of those renewable resources as completely as possible.

This special issue in *Holzforschung* dedicated to “Advances in biorefinery research” will reflect current

scientific endeavors in the biorefinery field and mirror its complexity and wide scope. It is hoped that the aspects of biorefinery research presented here are instructive and informative. In sum, the contributed articles show how challenging and sometimes tedious, but first of all highly rewarding and educational, the

work with renewable resources towards future biorefineries can be.

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