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In which fields of energy research are German scientists, universities, and research facilities making the most progress?

First, one has to mention the more conventional energy technologies, which we should not neglect since they will be around for decades to come. German science and industry is strong in turbine and power plant technology, both with respect to engineering and materials science. Increasing the working temperature of power plants is a highly important measure for improving energy efficiency. In the renewables field, German scientists and German industry are strong in wind energy. They are also strong and highly visible in organic photovoltaics, and more generally, organic electronics research. Biomass conversion, by different routes, is also a focus of many current research activities, and German scientists have made major contributions to this field. Catalysis as a cross-sectional activity required for many different energy technologies has always been and still is strong in Germany as well. Battery research was relatively weak over the last decades, but has now gained substantial momentum. Moreover, outside of the natural sciences, there are additional important activities, such as energy systems analysis, energy law, and energy economics, all of which need to develop new approaches for the implementation of energy systems relying increasingly on renewable energies.

Please describe your research on hydrogen storage materials and catalysts for alternative fuels.

Hydrogen storage research was very important over the last 15 years in my group. Our target was the development of hydrogen storage materials for mobile applications to be used in connection with fuel-cell-powered cars. However, I am now much less optimistic than I was ten years ago that a suitable hydrogen storage material for mobile applications can be developed. Therefore, the work on hydrides – this is the hydrogen storage material that we have been working on – is continuing, but is now primarily focused on its use as a heat storage material. The uptake and release of hydrogen is accompanied with strong thermal effects, and thus this reaction can be used to store heat at different temperature levels and to release it again when it is required.

With respect to alternative fuels, we are pursuing a rather broad range of approaches. On the one hand, we try to synthesize so-called oligomethyleneethers from synthesis gas obtained from biomass, which could be a replacement for diesel fuel. We also study the direct mechanocatalytic conversion first of wood to a water-soluble raw material, then, in subsequent steps, further via other catalytic routes to

fuel molecules, such as dimethylfurane. Finally, we are working on direct catalytic routes to convert natural gas to a transportable liquid fuel. Several of the independent group leaders in the department are also working on renewable energies, such as novel types of dye-sensitized solar cells, photocatalytic water splitting, and biomass conversion pathways. We are thus carrying out a broad range of activities, which are centered on addressing the question of alternative energy carriers.

What is the general sentiment of the German public with respect to the "Energiewende" debate?

In general, there is still strong support for the Energiewende, in spite of the effect of feed-in tariffs on electricity prices. However, the costs of the Energiewende are becoming a major issue. There is currently discussion about how to restructure the feed-in tariff system in order to avoid over subsidizing renewable energies, and this may alleviate the problem to some extent. In addition, Germany - as probably most societies in the world - suffers from the NIMBY (Not In My Backyard) phenomenon, which makes it more difficult to install power lines, wind parks, and the like.

What are some reasons why Germany has become a global leader in environmental protection and renewable energy?

I think there is a combination of different factors that contribute. Germany is a densely populated, highly developed, highly industrialized, and fairly rich country with a long cultural heritage. This combination favors environmental protection and energies, which are more sustainable than fossil fuels. If population density is high, the impact of environmentally unsound production routes are rapidly felt. Environmental protection is an issue that is typically further down the list of priorities when it comes to meeting human needs. Food, clothing, and housing are higher up on the list, and thus, environmental protection only becomes an issue after the more immediate needs are met for the vast majority of the population (i.e. a country needs to be rather developed). It is also advantageous to have a strong industrial base which could support the domestic technology needs concerning environmental protection. In the short-run, this is typically more expensive and is therefore why the richer countries can more easily afford it. Finally, a long cultural heritage tends to favor conservative values in the best sense of the word. It is thus a combination of many effects. Similar conditions certainly hold true for countries other than Germany, but these countries typically have also implemented comparable measures.

In your opinion, what will be the most significant changes in Germany's energy infrastructure over the next decade?

Over the next decade, the changes will not be dramatic, but rather more gradual in nature. We will see the phase-out of nuclear energy, but it is important to note that there are many countries that do not rely on nuclear energy at all. We will also

have more intermittent energy due to solar and wind energy, but again, over the next ten years this will not completely change the energy system. Grid extension is necessary and will happen, and we will see more and more new efficiency technologies being implemented. The most visible changes may actually happen in the non-technical part of the energy system – in other words - market and legal conditions may be strongly adapted to a more renewable energy infrastructure.