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Quo vadis Biofuels

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FRONTIER VIEW

The background: Changing mobility in times of climate change

Worldwide, there is growing concern that climate change is accelerating. Calls to reduce greenhouse gas emissions quickly and significantly are becoming louder and louder. The transport sector is one of the world's largest producers of greenhouse gas emissions. In contrast to the other sectors of an economic system, such as the energy sector or industry, measures to reduce these emissions have so far had little success. Although the specific fuel consumption of modern vehicles with combustion engines has decreased in recent years, this reduction has been largely offset by a growing number of vehicles and increased mileage.

At first glance, the solution to this problem appears simple and straightforward: replacing the internal combustion engine with new drive technologies such as the electric drive or fuel cells. However, a look into reality shows that such a fundamental system change is much more complex than it initially seems

On the one hand, there is the enormous number of vehicles on our roads worldwide - in 2015 this number amounted to around 1.3 billion vehicles, and it is growing steadily [1]. Of course, the vast majority of these vehicles use internal combustion engines - in 2017, the global inventory of electric vehicles was only 3.2 million, with the majority of these vehicles being found in China [2]. Assuming an average lifetime of the vehicles of at least 15 years, it is clear that the replacement of the entire stock

will take until well into the next decade, even if a worldwide ban on the sale or re-registration of vehicles with combustion engines were immediately imposed.

Such bans are being discussed in various countries. However, it must be taken into account that such a switch to electro mobility is not possible in all areas of road traffic without difficulties. Particularly in the area of road freight transport, a sector that is growing very rapidly, there are still numerous open technical questions as to how the diesel engine can be replaced by an electric drive.

It should also be noted that an accelerated expansion of electro mobility also places high demands on the necessary infrastructure. At this point just one of the problems should be mentioned: A growing share of electric vehicles inevitably leads to an increase in electricity demand. Especially in countries where a reliable supply of electricity is already difficult today, a rapid increase in the number of electric vehicles would lead to further bottlenecks in terms of grid stability and reliability of supply. Finally, it must also be mentioned that the high CO₂ savings demanded by electro mobility can only be achieved if the electricity that is needed for this purpose comes predominantly from renewable sources.

This brief outline of the problem area shows how complex the interrelationships in our transport system are.

Are there other ways of reducing greenhouse gas emissions in the transport sector as quickly as possible and thus supporting the long-term restructuring of a national transport system?

Yes, biofuels represent an interesting and important option here. The use of advanced biofuels can significantly reduce greenhouse gas emissions. Furthermore, these fuels can be integrated quite easily into existing supply structures (existing network of filling stations) and their direct use in diesel or petrol engines is widely unproblematic.

If we look back some 15 years, there was a certain euphoria about the use of biofuels, at least in Europe at that time. It almost seemed as if biogenic fuels could solve all the problems of the transport sector. Unfortunately, reality very quickly showed the limits of these expectations. Finally the discussion about the extent to which it is justifiable and permissible at all to use agricultural products not as food, but to produce fuels from them, led to growing concern among political decision-makers. Added to this was the - justified - concern that increased demand for biofuels in the industrialised countries could lead to a growing import of the raw materials required for this purpose from developing and emerging countries. The example of palm oil showed that this concern was not unfounded.

As a result, there was a rapid paradigm shift away from biofuels and towards electromobility. This was accompanied by considerable financial cuts in the area of research and development of modern technologies for the production of synthetic biofuels, and many promising research projects had to be stopped. Biogenic fuels were increasingly pushed into a small niche, and only comparatively small quantities (e.g. in Europe biodiesel with a 7% addition to diesel) were added to conventional fuels.

So have biofuels been a mistake? Certainly not. On the contrary - particularly in view of the challenges facing climate-friendly, low-CO₂

mobility in the future, the future prospects for biogenic fuels are improving significantly. In future, however, the existing, well-known fuels of the so-called 1st generation (i.e. biodiesel from oil-containing plants or bioethanol from sugar-containing raw materials) will be replaced by 2nd and 3rd generation biofuels. With these options, which are mainly produced by chemical synthesis processes, it is possible to use not only certain plant ingredients (such as oil or sugar) but the entire organic mass. This makes it viable to use organic residual and waste materials, which today represent a growing problem in many countries. If we leave the area of "biomass" here, these processes can also be used to convert plastic waste into valuable fuels. In view of the constantly growing quantities of plastic waste worldwide, this offers a very interesting perspective outside the classic biomass sector. The biofuels of the so-called 3-generation go one step further. They rely on the conversion of algae into liquid fuels. This could open up a very large biomass potential worldwide, which can be found outside the typical sectors of agriculture and forestry. However, there are still many technical questions to be solved before these raw materials can be used.

But it is not only science that is showing growing interest in biofuels again. The automotive industry also sees synthetic fuels as an important component in climate-friendly mobility [3]. Another factor contributing to this insight is that the above-mentioned system change towards electromobility will take a longer period of time and that the combustion engine will continue to play an important role in the transport sector worldwide in the coming decades. Figures show that by 2030 the powertrains produced worldwide will be divided into three large blocks [4]. A

distribution of 30 % purely combustion engine driven (incl. micro-hybrid), 40 % hybrid and 30 % purely electric drive trains is predicted. This means that 70% of all drives produced have a combustion engine (purely combustion-engine and hybrid) and again 70% of all drives are electrified (hybrid and battery electric). However, the regional distribution differs greatly in some cases. In Europe and China in particular, electromobility is driven by strict regulations on CO₂ emissions. In South America, by contrast, internal combustion engines will still be used almost exclusively in 2030.

Is the production and use of synthetic biofuels even realistic?

The production of synthetic fuels is certainly technically much more complex than the comparatively simple production of biodiesel or bioethanol. Depending on the production process, fuel synthesis requires a process chain that starts with the production of a synthesis gas. This gas is then purified and treated in several process steps. The advantage is that important process parameters such as pressure, temperature and catalyst can be varied in this process chain, so that different products from the same process can be produced from different feedstocks. These processes thus offer a high degree of flexibility to adapt to changing supply or demand conditions. Examples for such processes are the Fischer-Tropsch synthesis, the synthesis to dimethyl ether, DME, to methanol or to methane. From today's point of view, these interesting advantages are offset by the following disadvantages: on the one hand, these processes still need to be further developed in order to actually be used on an industrial scale, and on the other hand, the

product prices are still significantly higher than for the known fossil fuels. However, this disadvantage is likely to be put into perspective in the near future when CO₂ taxes or similar levies are increasingly imposed on fossil fuels, as is increasingly being discussed internationally.

A brief conclusion

Especially in view of the broad raw material base, which ranges from the typical biogenic residues of agriculture and forestry to biogenic waste, the further development of synthetic biofuels is extremely interesting from a scientific point of view but also from the perspective of climate protection. It is therefore to be hoped that the currently noticeably growing interest in these synthetic biofuels on the part of the automobile industry, but also the mineral oil industry, will provide new impetus and new momentum for the necessary technology development. Then biofuels will indeed look to a promising future and can help us to meet the worldwide requirements of low CO₂ mobility in the coming years.

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