Interview Olaf Toedter

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Bert Beyers: Perhaps you could briefly introduce yourself?

Olaf Toedter: I work at the Karlsruhe Institute of Technology, where I manage several projects in the field of renewable fuels. The project and consortium reFuels - Rethinking Fuels and also the InnoFuels exchange and innovation platform on behalf of the Federal Ministry for Digital and Transport Affairs.

Our focus in this interview is on HVO. What does that actually mean?

It is an abbreviation and stands for hydrotreated vegetable oil. It means: hydrogenated vegetable oil, but this is no longer the case today. Used and vegetable oils, fats, residual and waste materials are used, put into a reactor with pressure and temperature and hydrogen and then chained together to form a so-called synthetic paraffin, a synthetic diesel fuel. This can be used to replace conventional fossil fuels.

And then there are reFuels and eFuels - could you perhaps bring some order into this terminology?

The term eFuels stands for electricity as the starting point; it's about electrolysis hydrogen. This is the reverse process as in

of a fuel cell. I can separate water into hydrogen and oxygen using electrolysis. I can then combine the green hydrogen with CO_2 or carbon monoxide and use it to produce a chained synthetic fuel. Then we are talking about eFuels.

And what are reFuels?

This is an artificial word, "re" stands for regenerative and "fuels" for fuels and summarises all fuels that are in the current fuel standards and that are already available today to reintroduce greenhouse gas into a closed carbon cycle. These can be eFuels, but also all bioFuels, both conventional and advanced. Advanced biofuels are also made from residual and waste materials.

How does HVO differ from conventional diesel? It differs

from fossil diesel in only two ways
Diesel fuel as we know it at the petrol station. One thing is that it has a slightly lower density, so it weighs a little less, and it also has a higher calorific value, so it burns a little better. And these two things almost cancel each other out.

In Germany, the Bundestag has now cleared the way. HVO 100 can now be sold freely at petrol stations. Why has it taken so long? And what does this step mean in practice?

German regulation is special in this respect. This is the national implementation of the European Renewable Energies Directive. In the German implementation, the fuels must be explicitly approved individually in order to be authorised at filling stations. In other countries, the solution is different. In Germany, there is a resolution by the Federal Cabinet and also the Bundestag, which called on the Cabinet. The Federal Ministry for the Environment was initially concerned that palm oil would be used as a starting point. However, this has been resolved since 1 January 2023. By this date, all European refineries will have switched to residual and waste materials as a starting point. And then

The second concern was that it is linked to the Clean Vehicles Procurement Act, which applies to local authorities and publicly procured vehicles. The Bundestag has now decided to exclude synthetic diesel fuels from fossil sources. From a scientific point of view, it is of course a shame that it has taken us so long to achieve this and that we have emitted avoidable greenhouse gases in the process.

Does HVO harm common engines?

No. Theoretically, you have a higher volume-related consumption of around two to three per cent due to the lower density. But you won't notice this in reality. It has much more to do with your right foot. So how sensitively you operate the accelerator pedal has much more influence on consumption than the density.

And what does HVO cost?

Although the number of suppliers is spread across Europe and there are many of them, this fuel is still traded in Germany at a factor times the price of diesel. This means: diesel price plus 15 to 20 cents. For this additional price, you get a CO2 reduction of around 90 per cent. Together with the technical advantages of the fuel mentioned earlier. For example, the engine runs more smoothly. You also have significantly lower particulate emissions and therefore advantages in terms of engine smoothness and fuel consumption.

Now many people are very price-sensitive when it comes to fuel prices: 15 to 20 cents more per litre is quite a lot.

That's right. Two things: one is that everyone must of course ask themselves - and this is especially true for companies - what greenhouse gas emissions are worth to them. Another point is how to deal with taxation. Today we have some tax elements on fuels that are CO2-related. In other countries, for example in Italy, they have gone there and deliberately subsidised this, omitting the corresponding taxes,

which is why fuel is currently even cheaper than fossil diesel.

You mentioned a 90 per cent reduction in CO_2. What does that mean in relation to electric vehicles?

We have well over 220 million vehicles in Europe and over 48 million vehicles in Germany. Of these 48 million, just under three per cent are battery electric vehicles. If I have to manufacture a new vehicle, I must not neglect the emissions that are produced in the process. A classic combustion engine vehicle produces six to eight tonnes of CO_2 equivalent. Depending on the battery size and chemistry, a battery-electric vehicle can easily add five to ten tonnes. So it is significant. Then there is the utilisation. If I fill up with fossil diesel today, I am taking carbon from the earth, which is then released into the atmosphere in the form of CO_2. If I have a battery-powered electric vehicle, it naturally depends on the footprint of the electricity I use to charge the vehicle. There is a wide range here: in Germany, we have everything on board, from solar cells on our own roof to night-time operation with brown coal power.

What is the potential of HVO? How much of it can be produced?

In the case of older biofuels, we had the plate-and-tank discussion because the production of biomass for fuels also displaces land that is intended for food production.
We don't have that problem here, as we produce these fuels from residual and waste materials.

And how much of these residual and waste materials are there?

There are any number of studies with correspondingly different assumptions. These studies provide for up to
40 per cent of global mobility needs that can be met in this way. This includes shipping and air transport

and everything that runs on roads and railway tracks. That's quite a lot. This could already achieve a significant reduction in greenhouse gases.

What residual and waste materials are we talking about here? We keep hearing about "chip fat", but also about tree bark or even sewage sludge.

Every restaurant has to change the fat every day. And you can imagine that quite large quantities are produced, depending on the food culture of the countries. Then there are oils from the industrial sector. Then there are animal waste products. And then, of course, there are all kinds of biogenic oils, such as those from fir trees. This is an oil that is available in considerable quantities in the Nordic countries with their large forests and is now partly used for animal production. And then there are all the biogenic residues and waste materials. We have to think about plastic waste and the like. It goes as far as algae, which is being discussed as a source material for fuels. The 40 per cent mentioned refers to the raw materials known today, while work is being done in parallel on other sources. No path can be ruled out.
Rather, we have to say: this path can help, but that path can also help. And only if we tackle everything in parallel will we be able to produce a sufficient quantity quickly enough. And that will also have an impact on costs, so that there is affordable mobility everywhere.

What is the current offer?

We have a growing supply. The market leader is the Finnish company Neste, which has plants in Rotterdam and also in Porvoo, plus two plants in Singapore and there are also several companies in the USA. In France it is TotalEnergies, in Italy the company ENI, in Spain Repsol and so on. As you can see, the list is quite long and all the plants are designed in such a way that they can fulfil the quotas that are currently taken into account in the Energy Directive and have upward potential. And that's not just the case in Europe. We are seeing significantly higher growth rates in the USA and Asia, for example. In the USA, there are some states that have a clear strategy to ban fossil diesel fuel.

And we've only just started in Germany?

Yes, we benefit from the commitment of other countries.

What about European regulation?

In Europe, there is regulation by sector. We are talking here about the Renewable Energy Directive, which is then transposed into national law. In Germany, this is the Federal Immission Control Act, with annexes. And it provides for a ramp-up of renewable energies which, in my personal opinion and also from a scientific point of view, could be more ambitious.

Where are the sticking points?

European regulation is quite complicated and national implementation is no easier. I think it's interesting what the Swedes have done: To summarise the regulation on four pages, and in a time travel that goes beyond 2030. So that potential investors also have the chance to become active. Today, we often only talk about demo plants that produce up to several 10,000 tonnes per year. But that is not enough. We need to talk about orders of magnitude of several 100,000 tonnes per year. We need to create an environment that enables the operators of such plants to develop a business model with which they can replace fossil fuels with renewable fuels over 20 years. Then almost everything would run itself. That is the crux of the matter.

And how do you get the costs down?

Several approaches. The first path is, of course, to make these issues more efficient and more tolerant of raw materials. At the same time, we also need to further develop the alternatives: by integrating and optimising the processes. This applies not only to HVO, but also to eFuels. In Germany, we have

Electricity costs in the industrial sector between 9 and 30 cents. This is not a location where we want to use energy for such processes. We have to go to locations where the electricity price is significantly below two cents. We have these locations worldwide and have to produce hydrogen there via electrolysis and import it via intermediate forms, for example in the form of methanol or ammonia. And this is done via the classic transport routes. It is perfectly possible to use today's oil tankers and import generative products that are further processed in Germany. In this way, we can achieve the corresponding offers and prices to replace fossil fuels.

What do you think the world will look like in 20 years' time, assuming everything goes well?

It is clear that the raw materials we use today are limited. The problem has been known for some time. We need to get into closed-loop processes, like the natural carbon cycle. If this understanding is there, that these circular processes are a necessity worldwide, then we will indeed replace fossil fuels, whether liquid or gaseous. We will replace them with several fuels from renewable sources with all kinds of names, which we call reFuels. And this will enable us to utilise the many technical solutions that we have today in mobility and transport. That's what will happen.

What is the situation elsewhere?

I was in Japan this year and spoke to the right people there. We also had delegations from Korea here and we spoke to colleagues in the USA. A lot of things are happening there, more than the public realises. Major investments are being made at various locations around the world and the first tankers are already running on renewable fuels. So yes, it's happening. The fuels will come. The only question is to what extent Europe will participate.

And what role do electric vehicles play in your vision?

There are applications in which a battery electric vehicle has a systemic advantage. We need to develop the technology so that it can be used in precisely these areas. In my opinion, it is important to always consider the entire life cycle, including production and recycling, and above all to think in terms of material cycles. Then this technology will also become established in some fields.