From Molecule to Market   Coburg

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Summary

Meeting the Paris climate targets requires immediate and significant steps. To reduce GHG in mobility sector a huge variety of technical solutions is available: hydrogen fuel cells, BEV, PHEV and also various number of potential new renewable fuels. Some more molecules are under development. But what does it mean to bring a new molecule to the market and what steps are required / what risks have to be taken into account? How to deal with the uncertainties and the complexity?
How long does it take and what can be done right now and in near future to meet the climate targets?

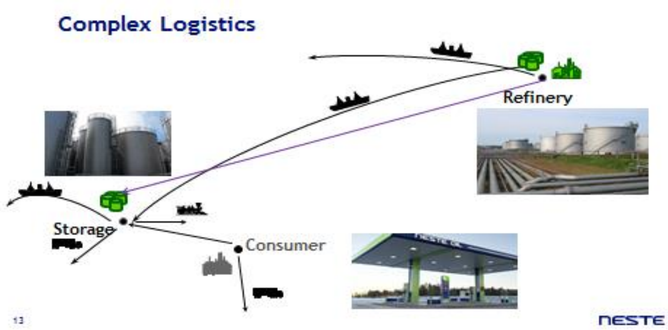
The new diesel fuel standard EN 15940 is approved. The fuel can be produced in various processes in large scale. It can be used drop in, but provides it full performance as pure paraffinic diesel – fully compatible with existing diesel engines. Potentially it supports even cleaner and more efficient new engines. Together with GTL and upgraded fossil diesel the volumes can be increased fast while sustainability growth with new installations of HVO, BTL and PTL units.

The fuel infrastructure as well as fleet infrastructure exist and can be shifted to applications like long distance transportation and aviation when city traffic and medium range traffic moves to BEV, the investments are solid if the legal conditions are clear. The renewable hydrogen infrastructure is urgently needed for grid stability as well as several chemical processes and energy carrier (E fuels; fuel cells)

1. The long way from lab to market – challenges on the way

To identify a molecule in lab suitable for combustion is one thing, to investigate all following questions like Process / EHS / Combustion Behavior / Material Compatibility / Emissions / Logistics and Handling / Cost / Standardization / Market Approach is a long term story!

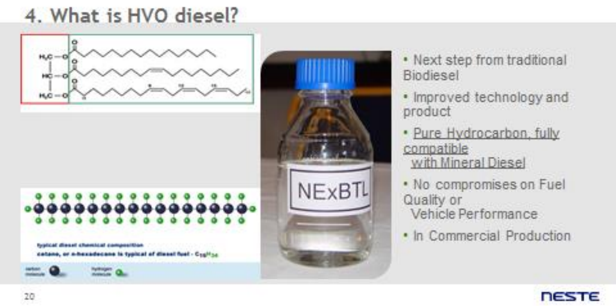
Even if the first large scale unit starts about 5 – 10 years after the first invention, it's still too small volume to justify a new single fuel standard – eventually it can become an valuable blending component. The interactions between combustion engine and fuel are typically intensive investigated at that stage. Material compatibility at all steps of fuel distribution and other logistic hurdles, interactions and risks are quite often underestimated. Logistic is a complex system with enormous investments and very specific requirements and standards– often implemented after quality issues recognized in the field.



.Density for example is important to separate different products in pipe lines or other units, phase separation or different solvency / polarity can cause problems in tanks and logistic, but also in combustion.
Foam, corrosion, aging, water separation, biodegradation are other problems, often only recognized after field experience.

2. Neste renewable Diesel Market Approach

Neste has introduced its renewable Diesel in 2006 – the development has started in the 1980ies, with the first unit of 200kt capacity in 2007 and second unit of same size in 2009. This was a very fast ramp up from lab production, the next two units of 1 mio.t capacity have been built in 2010 and 2011. Intensive testing and several fleet tests have been carried out with positive results. The Helsinki Bus test being the largest fuel test with more than 50 mio kilometers!

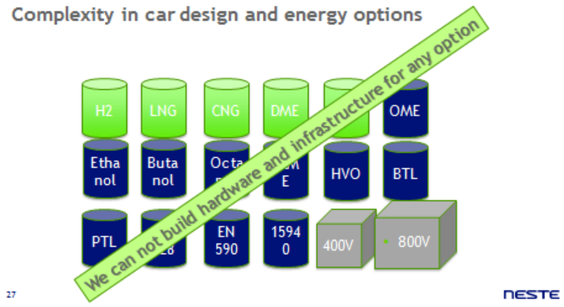


This pure paraffinic diesel can be produced from a variety of different feedstock's always with same high performance. The criteria for feedstock's are Availability, Sustainability and Cost

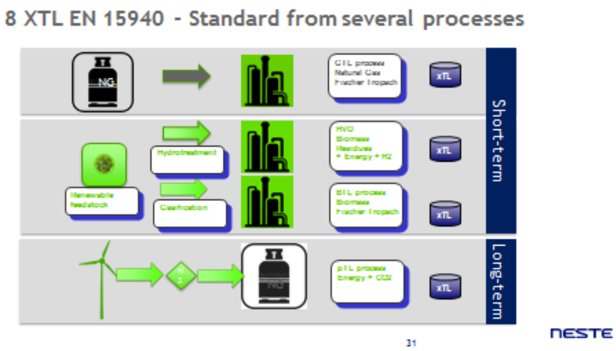
3. Why can xTL help?

Even with the ambitious upscale of Renewable diesel to 2,6 mio t these volumes do not justify a new fuel standard – use in dedicated fleets is possible, but due to strong emission requirements even this is limited. To justify new fuel standards significant volumes and availability is needed – the classic chicken egg problem pops up!

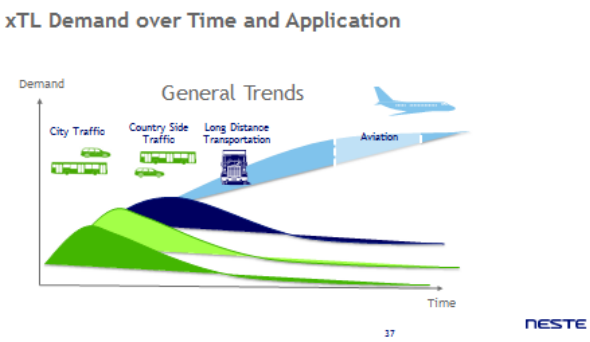
The complexity of different potential energy carriers is shown in the picture – it's very unlikely, that we are able to build infrastructure, hard ware and standards for all these different energy carriers (except dedicated fleets)



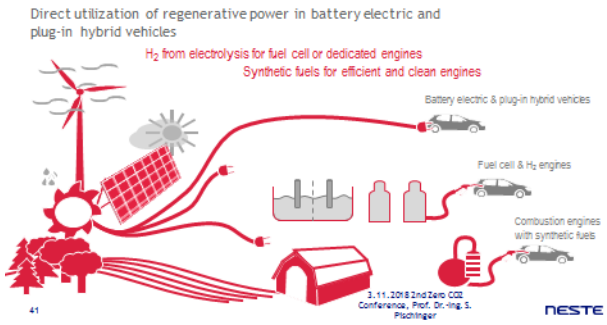
The huge benefit of EN 15940 paraffinic fuels in that respect are: They are known and widely tested / re-leased. They can be produced in many different pro-cesses in sustainable way:



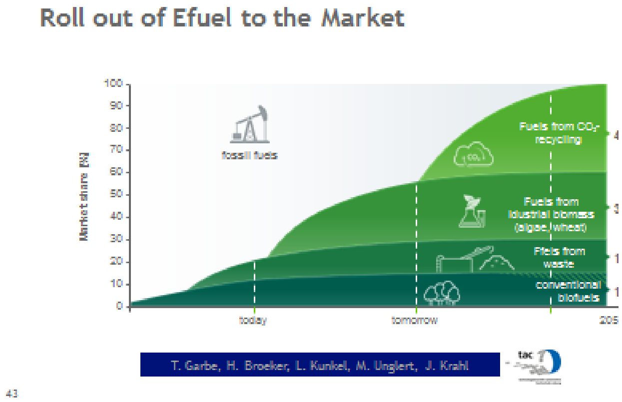
We have to accept that feedstock's like crops, waste and residues have limits, but there is still room for developments and at the end significantly increased volumes. On top of that E fuels (pTL) are promising solutions to fill the gap without concerns regarding land use. Long term road mobility might develop to-wards BEV or fuel cells, but for aviation and other long distance mobility liquid fuels as energy carrier are still needed! If we built up the capacities right now we can use them in current fleet – starting with city traffic where they bring the most benefit with regards to emis-sions, and move them step wise to other applications with the transition to E mobility in city traffic.



This allows investing in the fuel infrastructure needed for aviation already now. The financing can be borne by PC mobility fleet targets vs. penalties. Penalties do not save GHG, but renewable fuels do! The benefits for existing fleet and climate are immediately effective.
The Hydrogen infrastructure is an essential tool in all realistic GHG saving scenarios: Hydrogen is needed in grid stability as well as fuel cells, chemical processes and E fuels including HVO!



The robust investment scenario could be achieved by allowing to account RF for fleet targets - the roll out of such fuels could look like this:



4. Outlook

Arguments often stressed against E fuels are:

- Lower efficiency vs BEV in well to wheel
- Allow to stick to “old fashioned combustion engines and business models” instead of investing in new E mobility.

Basically the efficiency of E fuels is quite low, however: The energy provided by sun any year is about 100 times higher than the energy demand of all human!

The question is not efficiency itself, but cost, logistic, sustainability etc. We see already how difficult it is to build grid infrastructure. The charging infrastructure at all regions is even more demanding!

BEV provide its clear benefits in short distance traffic with start stop – here they offer clear advantages vs. any combustion engine! The diesel engine is still the most efficient thermo dynamic machine with efficiency closed to Carnot process and very useful in long distance mode!
The co-existence of BEV, Hydrogen fuel cell cars and clean combustion engines with sustainable fuels should create a competition between the systems. Our experience in economy has shown that competition is the best way to develop and speed up innovations – the target must be sustainable mobility with lowest possible emissions, but not predicting one single technology – even if that technology and related infrastructure is not really developed.

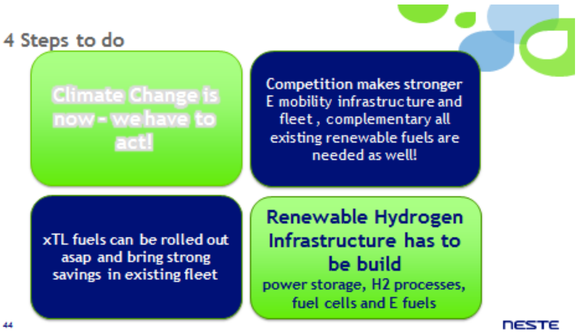
E mobility provides significant benefits – local zero emissions, low noise, high efficiency, but also bears risks and drawbacks, mainly on long distances, huge batteries are economically and ecologically doubtful – they would even increase GHG emissions within the next years – about 80% of LC GHG is implemented in Battery production, while the combustion fleet is still on the roads!

All systems should compete under clear and fair conditions! This also minimizes the risk of new technologies with their uncertainties in the market introduction!

In any case climate change is real and it is now! We have to use the tools we have available – and bio fuels are available solution for existing fleet. Replacement of fleet needs 15 years – any new technology as well to be introduced – we cannot wait 30 years!

Hydrogen Infrastructure is needed as one of the most important steps. Robust investment from demand point of view is there, we need scenarios to justify investment! GHG targets for car fleets are an option – investments are better than penalties: they do not help environment but only fiscal system!

xTL fuels are already in the market, the volumes must be significantly increased – and they can help to improve GHG and local emissions in existing fleet with immediate effect, on the longer run they must be shifted to applications like long distance transportation and aviation.



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