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### Alternative Feedstocks

In this issue of the green indicator we will have a closer look at the world of alternative feedstocks for the biodiesel industry. We will review potential sources of residual fatty acids and triglycerides that could potentially influence the biodiesel production in the future. In the same article, the current state of the art in *Jatropha* cultivation will be reviewed.

In the cat scan of this issue we will revisit the important topic of heteroatom removal from different hydrocarbon feedstocks. The discussion ponders the potential of this type of catalysis with the advent of renewable feedstocks in the fuel and chemicals production infrastructure.

In this issue there will also be an answer to the questions on tax incentives, this time from Helena Tillborg at Clean Tech Inn Sweden.

/ Christian Hulteberg

### The Answer

**Is there a need for tax-incentives on biochemicals as well as biofuels?**

given by **Helena Tillborg**, at *Cleantech Inn Sweden*

Any serious tax-incentive approach to fossil based products will have to take into account the fact that on an unregulated market fossils do not bear their full cost to society. Climate change is the most obvious symptom of this market failure. While renewables often get criticized for their dependence on subsidies, very few voices are raised against the several times higher subsidies that support fossil fuels globally and the insufficient level of taxes to accommodate for the full cost to society. In short, if fossil based products receive higher subsidies and lower tax, than their renewable peers, the playing field is not level.

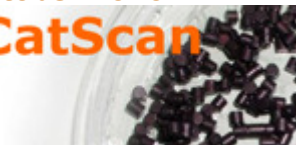
Biofuels and biochemicals hold the promise to replace petrochemicals in a wide array of contexts, driving the change towards a sustainable society. But without leveling the unbalance in subsidies and letting the alternatives compete in the market on equal terms, the rate of change will be slow and costly.

Tax incentives have proven to be an efficient measure for policy makers to drive change. For example tradable green certificates have already shown significant success in supporting increased investments in wind and bio energy power production.

It is in the best interest of society to facilitate the shift from petrochemicals and fossil fuels to biochemicals and biofuels. Tax incentives or other subsidies that level the unbalance in the market are important measures to support a fast and smooth transition towards a sustainable society.

**Green Indicator #7,  
October 2010**

### CatScan



### HDO Revisited

The removal of hetero-atoms is performed today in the refinery context where the oxygen and sulphur content of the feed is reacted with hydrogen to form water or hydrogen sulphide. Similarly, this operation is performed in the production of diesel fuel from tri-glycerides where the ester bonds are (simply expressed) removed using hydrogen. However, there is another feedstock discussed that would require significant catalyst development work if implemented.



By heating wood in an inert environment it is possible to create an oil-fraction which is traditionally known as pyrolysis oil. This oil is a mixture of different types of organic compounds such as acids, alcohols and aliphatic hydrocarbons. This mixture also contains both oxygen and sulphur, but compared to traditional hydrogen deoxidation feedstock the oxygen content is much higher. This along with the fact that the feedstock has a lower boiling

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As the margins in the traditional biodiesel business are ever shrinking with high feedstock prices and the existing subsidies are shaky at best, there is a great interest in alternative feedstocks for this industry. The first and already implemented alternative feedstock is the used cooking oil that has been used in minor quantities for quite a while. The major problem here is handling the free fatty acid content in the feedstock, which requires additional process equipment.

As an alternative there has been a lot of discussion regarding the use of jatropha oil, a non-food competitive oil, but there seems to be little of non available oil at the moment; this despite initiatives in several countries ranging from India to China and Hawaii. This is explained by the fact that the crop is perennial with yields starting to increase after 3-4 years. Another plausible reason is that the initial harvests get better payment for the seeds when sold to other farmers starting up their plantations than producing oil from them.



Where can one then find low-cost feedstock that is available today? One suggestion is the use of palm oil fatty acid distillate, a by-product generated in the fatty acid stripping and deodorization of palm oil. This feedstock is used for industrial fatty acid production and for use in power plants and industrial boilers. The availability is rather good with 700 000 tons produced in Malaysia in 2010 and the split between the fatty acid distillate and palm oil has been a minimum of \$200/ton and above \$600/ton over the last two years; making it a readily available alternative feedstock, potentially bearing the additional processing equipment required.

Another potential feedstock is the light fraction of the tall-oil, a paper and pulp side-product. This light fraction is rich in fatty acids, but also contains rosin acids and other organic compounds that may be problematic. Another potential show-stopper is the sulphur content that has to be dealt with somehow. Perhaps the best solution to integrate this stream into the fuel mix would be integration into an oil refinery where removal of hetero-atoms can be performed.

diverse (e.g. containing both hydrophilic and hydrophobic molecules) require additional work on this catalyst system. Another issue is the non-stability of the feedstock, compounds will be reacting in the mixture and thus change it over time adding complexity to the treatment of the stream.

There is also another type of contaminants present, with higher amounts of alkaline and alkaline earth metals present. These contaminants are however dependent on how the pyrolysis unit is operated and the amount of char that is included in the oil. With this said, there is no guarantee that this feedstock ever makes it into a refinery, but if it does, this will have to be preceded with an effort on the catalyst in this unit operation.

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