Interview with Claus Felby, Professor in Wood and Biomass Technology, Faculty of Life Science, Copenhagen University - 01.07.2010.

Charlotte: How do you see the future development of the aviation biofuel industry as a whole? EU directive does not include air ... what is your vision for aviation biofuel is developed to a commercial level?

Claus: There are two visions there’s are cynical and then the idealist. The cynic says that there is part of the aviation industry who will fight like the devil and very aggressively against any type of regulation and CO2 taxes, and at some point they will hit the wall that could be e.g. extremely high fuel prices, or that the direction turns so bad, that a powerful regulation more or less closes half of their business. And sometimes I think that this could happen. But among them there are some who have prepared themselves to meet the adjustments and will be able to better survive this transition that can be very fast and very fiercely. The idealist has an idea that we want this and it is possible to do this because the technological, biological and mechanical-wise, it can very well be done, it requires only an investment, but it's a huge investment in the infrastructure and yes it costs, approx. $ 100 billion on a worldwide scale and the industry cannot do this alone, it requires a public partnership. On a pure technological and research based view, we can do this, it's not easy but we can, but it costs money. There's no free lunch, and here is a very expensive lunch, which you at some point have to eat, otherwise you die of hunger. So when will it happen? That’s the question, but it will happen.

Charlotte: What is the time frame?

Claus: Where we will hit the actual problem is when we reach the peak oil, when the Saudis no longer have the ability to regulate on how much oil to pump up because the resources are empty, and this will happen. But whether it happens in 1-5-10-20 years? Time will show. The second opportunity is that the politicians come together and agree that they want to do this, basta! And here the Chinese / Asians could very well be the ones that will become the movers on this, because they are very limited on resources. I find it hard to believe that the western world's politicians will be able to come together on such decisions, and the fact they will not do it, will mean, that at some point we will be forced to eat dog-food with a tiny bit of salt on the tip because they do not do it. Perhaps this is a development that takes 50 to 100 years determined on the fact that things will keep running. But the EU and the U.S are about to disconnect ourselves from the green wave, because every time someone wants to take a penny from anyone, then there’s an outrage, and our culture are built on political lobbyists which are characterized by irrational point of views, here the Chinese ex. Are much more rational in their decision-making. The results is that our decision making is just a lot slower, and it will end in the fact that the geology evolves much faster than us and we will simply fall behind. And that’s the reality, I don’t think we can do it, we have to get very far out before we can turn the boat.

Charlotte: So what you believe is that we need a common political agreement?

Claus: Well from our side, but then how mobilized should it be? Even though the
industry itself has said we must do something here, then nothing is really happening!

Charlotte: What is your perception of what the EU has done for the biofuel area?

Claus: If we just take a look at sustainable biofuels, one of the things that has happened, is that lobbyism has successfully been able to document palm oil plants as forest, and the most unsustainable biofuel one can produce is palm oil, but they succeeded, and the result of this is a speed up of further deforestation in south-east Asia has been allowed. It’s worth absolutely nothing. What was supposed to have been done was to protect against further CO2 emissions and you ended up with the opposite. But basically in reality it is not a problem with wheat and maize, there are so many factors affecting this, but destroying the ecosystem from this production is not one of the problems, where it real problem is the next 5-20 years, is on palm oil and rainforest destruction. And it doesn’t solve the problem it only gives a small break and a fake message, since we think it’s all good, when in reality it’s really bad!

Charlotte: But didn’t Malaysia just complain to the WTO because the new sustainability criteria have characterized palm oil as unsustainable?

Claus: Palm oil will be included in the production, it is a part of the game, in practice, you can export palm oil just as crazy you want, because it's documented as forest, which means that there hasn’t been any deforestation involved in the process! CO2 reduction is high, it looks good, and because we have not taken deforestation in into the equation, they say there has been no deforestation, in order to avoid the actual way too high CO2 emission. It is confusing, and especially to someone like me who possess this kind of knowledge, and can keep track of how stakeholders pass by all the regulations very elegantly. And we have not really done a damn thing about the problem, or maybe a little, but it has definitely not been removed.

Charlotte: What do you think it takes before biofuel becomes commercialized and up scaled?

Claus: It is up running today, it's coming, just look at Inbicon in Kalundborg, but biofuel is more expensive than traditional fuel, and always will be, so far, biofuel will not be much cheaper but at some point fossil fuel will become very expensive and what it takes is simply a proper framework in order to state that we need this to work. And here aviation is of course a little bit different, because it is not regulated in the same manner as other transport industries, it's very difficult to regulate because the plane can just fly somewhere else and avoid the regulations, and the consequence hereof is competitive distortions and that’s why it is so difficult for them, what is needed is an international agreement on a set of criteria for the CO2 emissions from aircraft, in order to reduce, and it would of course then push the development, but it must be internationally, which means on global scale and global agreements are really hard to manage, but aviation is of course well aware of where the shoe pinches and they are doing it, but again it is the framework around, which is politically controlled. Also it’s the markets, and the markets for fuel is not a pure market, it's a politically regulated market, but the regulation needs to be revised in order to create this development, it is the market that can manage it here, and if you can beat the market into the right position so it develops in the right direction,
then it's a fantastic driver, but you'll have to punch it properly, otherwise we will just do what we did yesterday, but a little smarter.

With such huge changes in the technological infrastructure as we are looking at here, needs something else, like a big war or a global crisis, one of the two things needs to be done before something happens. So a global resource crisis or an economic crisis for that matter, a climate crisis, but a climate crisis would probably not even be able to solve it, because the climate crisis would not hit us to begin with, it would be in the third World and not ours. We would not be affected in the same way. But a resource crisis, it would certainly be able to move it and especially with oil prices of $140-200 per Barrel. Or political instability, if the gas taps suddenly are closed or if the Saudis closes their oil exports, this would indeed boost it.

An ex. if the U.S. drove European cars wouldn’t have to import oil, they would be self-sufficient, and it is a very easy solution, it is on the shelf, it just has to be done. It would not entail any change in quality of life or lifestyle other than they would drive in a smaller car. And when you can not even implement this which is so easy, how can we ever carry out the big things, think of what effect it would have on the American society if they did not have to import oil. It is irrational, it's emotionally irrational and certainly the only thing, which can override this, is a crisis.

**Charlotte:** How do you think SAS can use biofuels in their strategic development?

**Claus:** What SAS has to do is to work on the politicians, the technology is there, their challenge is the need for global regulation, because if there’s only a regulation in Denmark or in the EU, they could end up with a competitive challenge in a way where it becomes very expensive for EU companies to fly compared to the rest of the world's airlines, this will indeed cost them and that would not work. On one level, when you enter you can gain an advantage in terms of image and probably some sort of political support that can help capitalize in the beginning. The where you can really move the development, is the need for a global regulation. And the level now, is that they are trying to figure out the possibilities etc… but what they also need to do is to send some very clear signals on the political level, because politicians like solutions, they have to tell that this can be done also economically efficiently. And the technology is here, but what is required is the politicians to take some actions. It is a big thing, but we know how to do it etc... Politicians like to have solutions presented. But a whole other thing that could affect SAS is that people could reduce their travel, and honestly why do people really need to go to Thailand on holiday in the winter? Basically the business of SAS is build on a lifestyle that is so tremendously unsustainable, that the development hereof also is unsustainable. I think this development is going to stop at some point, partly because it becomes more expensive to fly due to rising fuel price, or regulation could make it obsolete! Also the short trips I really think could be reduced enormously, especially with better development of the Internet of IP telephony, and this development is coming! It is here but it has not really implemented yet, but we will see in the next 10 years. Trouble times are ahead and it is not linear growth.

**Charlotte:** Where do you see the opportunities for Scandinavian aviation to upscale the biofuel production?
Claus: It’s not only a question of having the technological equipment ready, what they do need to do is to make sure to create an infrastructure, so they can be ready to implement the biofuels when they come. Because if no one is really ready to buy the biofuels, you will not have any investors that are ready to invest in the production and the development hereof. And most of the investment is on the aviation side, is the aviation industry ready for this and can they show they are ready; the engines etc… are ready for the fuel. Then you will see a development, and this is a step the airline industry must take this step, this is so important. One could also imagine a crisis scenario, where the airline companies that have created a proper infrastructure that is ready for the fuel, will survive contrary to the ones that have not prepared themselves properly, they will die, very fast. This is a possibility. But I also think that it is very important that the industry comes together with alliances etc… Scandinavia is too small on their own, they need to enter a cluster. They have to create the drive for this development themselves, and then turn to the politicians, if they are not able to do that then at some point in the future, they will have a huge problem and then the industry would probably suffer big time. And the low cost company’s will probably be the first ones to die, if the technology develops so that the small business trips will be eliminated then they will not be able to survive. Or the small unnecessary weekend trips for the youth would probably be eliminated.

But it is really vital that they make sure to create a pull, and I think they are doing it, but are they doing it enough? What I don’t think they are doing and at least SAS is not capable of doing, is to finance all of the technology development etc… but if no one pulls or push the train, it will not move!

Charlotte: SAS has gotten an offer from SOLENA group where the fuel is based on community waste and in the long perspective, algae,…

Claus: But they need to stay away from the algae, there is so many technological and biological problems with the algae’s. You can produce them on a laboratory level, but when you start calculating etc… it’s not viable, it would be somewhat around $400 pr. gallon and if you look at the necessity of up scaling, it’s unrealistic. For ethanol you talk about up scaling to level 4, for algae were talking about level 1 billion, before there is a real production, and basically there is a biological hindrance in the algae production. This could probably be solved but it is not SAS’ job to move towards algae as the solution, it’s much better for them to wait the situation in this case; they should defiantly not touch the algae’s.

Charlotte: What biomass would you think would be the most feasible solution for aviation?

Claus: Well the sugar fermentation solution, another solution is Jatropha, where the grains are produced on marginal land, not agricultural land, but this solution could be effective. Then you have the Halophytos, which haven’t really been examinated properly. And 10-50 years in the future you have the algae. But on the short term they need to stay from the algae.

For the Camelina plant it is also oil. And you need approximately 4 times as much solar energy to produce this, as you need to produce sugar, this means that the amount of crop
will also be 4 times bigger. So the limitation of this lies in the area of land available for biofuel production, which is very limited. So this solution would very quickly collide with agricultural production. The solution is to use all the residual waste of agriculture and forest production that is already available, here you won’t need any extra land or fertilizer etc… you just make the system much more effective.

On the long-term what can become sustainable, in a world where we expect 9 billion people in the future, is to use the systems that we already have, not to create new systems. And this is much more clever, the farmer is already on the crops harvesting, he just needs to carry a bit more back from there.

**Charlotte:** What about the efficiency of ethanol vs. oil?

**Claus:** Well ethanol is only a middle stage of the fuel production; via synthesis-technology you can create jet fuel, which is actually more efficient than oil. There are so many biological opportunities for this technology and it is coming, but it is a really big project.

**Charlotte:** In which sector do you think the producers wants to place their efforts?

**Claus:** Well it is very easy to just apply it to the gasoline today, but I think when the electric car is developed properly, the efforts will be put on aviation shipping etc… and chemical production. But if you reach a technological level where the energy efficiency in general is higher for aircrafts and shipping, then it is very likely that the fuel will be produced for this sector. If the grains on the field can produce the double amount of today, you would be able to supply 50% fuel for the world aviation and shipping. There are some obvious solutions and recommendations on using the system that already exists. And then maybe later in the stage we will perhaps the algae’s. But today algae are at the same level as when we first found out what agriculture was.

**Charlotte:** So do you think those involved with algae today are able to produce what they claim they can?

**Claus:** Yes I think so, but it is so damn expensive, there’s no commercialized airline company can pay for it, only the US military air force.

**Charlotte:** What are the External environmental issues? (land use and change of land use, utilization of the biomasses, etc...)

**Claus:** When we talk about oil plants they are not optimal solutions, it is very good on the laboratory level but not on the commercialized level. But LUC is a very complex thing. I read an article in may 2007/08, where an American investigation in this claimed that the destruction of forest had resulted in13 billion HA extra LUC, 5 times DK, this was based on economical models, this was later recalculated based on facts and not models, to 0-1 billion HA, it is still a good thing to keep an eye on land use. But the indirect LUC is much more difficult to handle, I know that some reports will come in the near future. But SAS needs to very aware of the fact that there are many solutions that produces fodder as a by-product which means that the grain use will become much more
efficient. And they must ID the criteria and technologies that have this potential. But we don’t have all this information about algae as we do on optimizing the existing systems.

Land use is very important and they must keep a proper focus on it so they are aware that they do not choose a solution that turns out to be unsustainable, also political, because this will set them back. They have to examine the processes and opportunities fully and then present to the politicians and show them how the problem can be solved.

Charlotte: Is there any NGOs that work actively against biofuels?

Claus: Oh yes, Greenpeace, Friends of the Earth etc… you name it. It’s the new black to them! Actually I’m very shocked about the NGOs because what their missions is catastrophes, the bigger the more dangerous the more scary, the more revenue. Because this generates publicity, exposure, new members. Solutions, they don’t consider, because they don’t gain anything from it, they are not interested in solutions. I recently participated in a debate with Greenpeace and they were creating scary scenarios, when I asked them if they had actually looked at the numbers, they weren’t interested in the results. And the politicians know that, so they don’t take anything they say for granted. I agree there exist some very bad ways of producing biofuel, but by placing everything into the same bucket does not do any good, it’s not really a helpful way to look at it.

Charlotte: What about the risk of public negative exposure when you enter the biofuel industry? Ex. Palm oil

Claus: The funny thing about palm oil is that you normally use this for food and cosmetics, so ask the consumers: do you have lotions? Have you eaten a bag of chips lately? How does it feel to apply a peace of the Indonesian rainforest to your skin every morning? So when you actually start looking into it and taking the things apart, there’s a big arrow pointing towards yourself and your own way of consuming! In reality it is a big self betrayal, we run of to the church to light a candle and convince our selves we’re so good, when in fact we’re not at all and after we will go and make a new sin!

Charlotte: What are the Economical issues?

Claus: I think the aviation industry is doing the right thing and moving towards the right direction, but they cannot move it by themselves they need the political backup.

Charlotte: Biofuel vs. bioethanol?

Claus: Ethanol can be applied in a jet engine, but it’s not that relevant, you need proper jet drop-in fuels. And this is a development that’s a fact, it will come, the aviation industry does not have to worry about that in any way. Within the next 5-10 years, but it is not algae as biomasses, it’s sugar.

Charlotte: Dan Riise’s project, would this be interesting to SAS?

Claus: Well yes because it’s sugar. And you can make huge amounts of fuel on this; the sugar roes can make just as much fuel as sugar canes. And the area needed to produce it is not as big as you would expect.
Charlotte: How do you think a supply chain on biofuels could look like for SAS?

Claus: It would be build by small units compared to the big ones controlling the fossil fuel market. And also it is be limited by the amount of fuel you can produce, so smaller units globally placed, maybe 1,500 factory’s, then you have some central refinery of the fuel and after it will enter a supply-chain, similar to the one we have today, so you would relatively be able to use the same supply-chain as we have today. And again it is important to be ready for when the biofuels will arrive. SAS could end up in a situation where they have developed something that’s damn clever, but then it suddenly doesn’t comply with the regulatory, then you have to go and change everything you just build up. The biofuel will end up in the aviation and the shipping industry, because it’s the same technology as for land transportation, the critical part is to build the infrastructure and the supply-chain, and this takes a lot of investment, and an investment that is too big for the aviation industry to carry alone.