AGRO & CHEMISTRY

ABOUT BUSINESS IN THE **BIOBASED** ECONOMY

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LEGO, FRONT RUNNER IN BIOBASED

CLEVER PLA-COMPOSITES

BIC AND VANGUARD JOIN FORCES

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EDITORIAL

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FIGHTING EACH OTHER NOT REALLY A VIABLE OPTION

The column of Marcel Lubben, CEO of Reverdia, which is published in this edition, appeals very much to me. Lubben, a man who regularly writes about the biobased economy and related affairs, deals on a daily basis with the challenges this transition pose. He is, given his expertise and writing skills, someone whose articles or blogs I like to read. In his latest blog he deals with the issue which I would to like describe as: fighting for the bear's skin before the animal has been shot (this is a Dutch saying, mind the example).
Companies therefore shouldn't deal with IP-issues in an early stage, but try to develop new business in the biobased economy. Companies who strive for a monopoly, are most likely not to succeed because the market does not like monopolists. The motto therefore should be: build a market first and compete later. The latter passage is not Lubben's credo, to be exact, but it is my interpretation.
Cooperation is key, but also the drive of the entrepreneurs. In the interview with Kirsten Steinbusch (Delft Advanced Renewables) her drive clearly shone through. Drive, which should not be confused with blind faith. Steinbusch is too pragmatic for this. However, (internal) drive is just as important for a company's success as the 'cold' numbers. Cooperation, building new value chains, drive, personal commitment. These aspects for me add colour to the biobased economy. More than often the tone of voice is business like: volumes, price levels et cetera. How many times you hear that business cases are not viable yet. It tends to take the winds of out someone's sails although the biobased/circular economy is unevitable eventually.

Kirsten and Marcel - and of course there are many more! - are people who encourage me that we will succeed in making our society sustainable. That we won't leave an earth which is sick and exhausted, to our children and grand children but a vibrant, energetic planet. A definite turning point has not happened yet. Trust, faith, drive and a cooperative spirit are needed to make that turn. We have to, there's no other way.

BREXIT BLOW FOR EUROPEAN R&D

Britain's decision to leave the EU will have an impact on the development of the bio-economy in terms of international R&D-programs. Overall, the transition towards a European bio-economy will not be hindered.

Adrian Higson (NNFCC) expresses his discontent with the decision to leave. 'The Union provided a strong mechanism for the transnational cooperation required to solve today's global challenges including climate change and food security. We would like to reaffirm our belief that the development of the bio-economy is central to solving these challenges.'
Higson furthermore states that NNFCC will press the UK Government to take an active role in the European development of the bioeconomy and support the transnational collaboration required for technical innovation, value chain creation and market development.

Special blow

Christian Patermann, former DG Research and still actively involved in the bio-economy, is equally disappointed with the Brexit and its implications for international cooperation in the field of R&D: 'Brexit is not only a loss for Europe, it is a special blow to cooperation in European science, research and innovation. With respect to the bio-economy in Europe, Britain's official standpoint was not that clear. Contrary to a growing number of EU and non EU-States, UK had not started to work on a national strategy or action plan on the bio-economy. There were however isolated bioeconomical developments in the area of fuels, agroecology, food and combatting animal diseases, based on the usual strengths and competences of British science. This is different in Scotland, for example with its road map on biorefining or the Master-program offered by the University of Glasgow.'

Short term no impact

Dirk Carrez, executive director of the Biobased Industries Consortium, does not expect – on a short term – any impact for UK-based companies and universities on their possible participation in BBI Joint Undertaking and Horizon2020-calls. 'The negotiations to realize the Brexit will take several years, and will probably become concrete as of 2019. On the longer term – and that will be part of the negotiations – the UK could become, just like Switzerland, Iceland or Norway, a so-called "Associated Country". Legal entities from Associated Countries can participate under the same conditions as legal entities from the Member States. Association to Horizon 2020 (and BBI JU) takes place through the conclusion of an International Agreement.'

Bioenergy can support food security

Bioenergy development and food security can be simultaneously improved, contrary to the popular belief that biofuels displace food crops, according to a report released by an international, multidisciplinary team of experts from 10 institutions.

"Reconciling Food Security and Bioenergy: Priorities for Action" identifies science-based steps to ensure that biofuels, food crops and natural resources can be managed sustainably together. The report, published in the journal Global Change Biology – Bioenergy, was coordinated by the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL).
The recommendations include increasing production of "flex-crops" that can provide fuel, food and other services, working with local populations to assure benefits target the right people, diversifying crops, land cover, and product markets to increase resilience against external forces.
'It is a mistake to ignore local costs and benefits of biofuels based on generalized assertions or global models. Reliable information about the actual local effects is essential, but has been lacking in food-biofuel-climate debates', said lead author Keith Kline of ORNL's Climate Change Science Institute. 'Local contexts and priorities must be considered when evaluating sustainability', said Patricia Osseweijer of Delft University of Technology, co-author of this publication.

BioSTEP must create public awareness

The biobased economy in Europe is above all the domain of governments, businesses and research institutes (the so-called triple helix). The general public knows next to nothing about it. The BioSTEP project should change this..

BioSTEP is supported by an international consortium from five countries: Germany, Italy, Bulgaria, the United Kingdom and the Netherlands. According to researcher Greet Overbeek, involved with BioSTEP from the LEI Institute at Wageningen UR, it is imperative for the public to get to know the biobased economy, as a way of boosting social urgency and understanding.
Overbeek believes that organisations in the rest of Europe can use the approach of Biobased Delta in Southwest Netherlands as an example. Biobased Delta uses events to introduce SMEs and consumers to biobased products and production methods in a positive way.

Fuels via pyrolysis on the market in 2018

In a project funded by TKI-BBE (editor's note: top consortium knowledge and innovation biobased economy), BTG Biomass Technology Group is developing a process for making pyrolysis oil suitable for use in transport fuels such as petrol, diesel and kerosene.

Pyrolysis oil is made by heating biomass to high temperatures in anaerobic conditions. This liquid is used for the production of green electricity and heat. Until now the oil could not be used very well as a transport fuel, but when the oxygen is removed, it can be mixed with petrol, diesel and kerosene. The Dutch BTG Biomass Technology Group (BTG) is developing a technique for this, in conjunction with catalyst manufacturer Johnson Matthey and the University of Groningen.
Robbie Venderbosch, project leader at BTG: 'We can develop a completely green transport fuel, with the right combination of catalysts and processing conditions. Currently the catalyst has to be replaced after one thousand hours, and that is not long enough. In this TKI project we are aiming at a process and an application in which the catalysts remain active for a longer period of time.'

AGENDA

MONDAY, THE 22ND OF AUGUST
9th Brasil Agrochemshow, Sao Paulo (Brazil)

The most important agrichemical trade fair in Latin America, with speakers from MAPA, ANVISA, IBAMA, CCPIT, ARYSTA, Rothmann Sperling Padovan Duarte Advogados, AllierBrasil.

More info: http://www.agrochemshow.com

SUNDAY, THE 28TH OF AUGUST
International Biobased Economy Student Symbiosum (IBBESS), Wageningen (Netherlands)

Looking for a Green Career? Are you interested in: networking to companies/ experts, potential job opportunities, developing consulting skills or inspiration? Then climb on board of the first International Biobased Economy Student SymbioSUM and find out what our green future has to offer for you!

More info: http://www.wageningenur.nl/en/activity/IBBESS-Conference.htm

MONDAY, THE 12TH OF SEPTEMBER
MOOC, Introduction biobased economy

On September 12th 2016 the Centre of Expertise Biobased Economy (Coe-BBE) will start with its free MOOC Biobased Economy Introduction. The MOOC BBE focuses on green chemistry, technology and environmental science.

More info: https://www.coebbe.nl/project/mooc

THURSDAY, THE 22ND OF SEPTEMBER
3DPRINTEU, Emmen (the Netherlands)

3DprintEU is the event on 3D-printing and scanning in the north of the Netherlands. With exhibitors, presentations and work shops. With input from Green PAC iLab, Health Innovation Park and the Polymer Science Park

More info: http://www.greenpac.eu/nl/3dprinteu/

THURSDAY, THE 22ND OF SEPTEMBER
Innovation on all fronts, Gent (Belgium)

Focus on opportunities for Dutch and Flemish sme's for EU-subsidies (f.e. Interreg) regarding innovation projects in the biobased economy. Companies that are interested, can qualify for subsidy grants varying from 10.000 to 200.000 euro. At the meeting Interreg-personnel will be present to answer questions from the industry.

NEWS

Biobased FDCA ecologically safe

Are biobased chemicals just as safe as the substances they are meant to replace? The ecological risk assessment of biochemicals is still in its infancy. Researchers at the VU University Amsterdam have taken a major step forward in this respect.

Researchers Chen, Van Straalen and Roelofs investigated the synthesis of 2.5-furandicarboxylic acid (FDCA). This is a substance that can be made from lignocellulose through enzymatic catalysis. A possible risk is caused by an intermediary substance, 5-hydroxymethylfurfural (HMF), which is formed during the synthesis of FDCA. HMF induces a large number of biotransformation enzymes in the organism, an indication of conversion to a reactive intermediary product. HMF fortunately has a very short half-life: it is quickly broken down by micro-organisms in the soil. This is shown by the fact that the reactivity of HMF can only be measured in sterilised soils. The researchers conclude that the production of FDCA from plant waste poses no extra risk to the environment in comparison with the current production of PET from petroleum.

DUPONT HAS HIGH EXPECTATIONS OF PTF

DuPont sees a market in new polymers especially, in order to keep out of the price discussion. 'If we can realise improved functionalities, the price is less of an issue,' according to Ernst Poppe, business development manager with the American chemical giant.

Poppe was speaking at the 5th BPM Symposium, held in mid-June in Wageningen, the Netherlands. DuPont has set up a joint venture together with ADM to scale up a new polymer: PTF (polytrimethylene furandicarboxylate).
PTF is made up of two biobased 'ingredients': FDME (derivative of FDCA) and bio-PDO. The two companies announced earlier this year that PTF will be produced in a plant with an annual capacity of 60 tonnes. The barrier properties of PTF are extremely well, according to Poppe. He sees a market in beverage and food packaging in particular, with a longer shelf life. The joint venture thus moves closer to PEF (Avantium). Poppe: 'As far as yield and operating costs are concerned, we have a very competitive product that furthermore is 100 per cent biobased.'

VNCI: SUSTAINABLE GROWTH

The Dutch chemical sector is world class, both on a academic and economic level. However, its position on the global stage is under pressure. In other parts of the world energy and feedstock costs are lower. For the longer term, the outlook remains positive with an emphasis on sustainable chemistry.

Tekst Lucien Joppen **Beeld** VNCI

This is the vision of the VNCI (the national association of the Dutch chemical industry). For the next 15 years the chemical sector will have to transform considerably. It has to re-ivent itself, so to speak. VNCI-director Colette Alma: 'We have established a route towards 2030, which should lead both to higher production volumes and to value growth through higher-value products. This growth has to be achieved in a sustainable manner. World wide there are significant challenges which need to be adressed, such as climate change or the scarcity of production means. The chemical sector is playing a pivotal role in this matter because it supplies to all other production sectors.'

KEY ROLE

This key role, according to Alma, has been translated by the VNCI into an ambitious plan to reduce the environmental footprint of the chemical sector and of the products this sector supplies. 'There are different domains where we want to make a difference: CO_2-reduction, efficiency in dealing with raw materials, biomass as an alternative feedstock and waste for feedstocks. The reduction of CO_2-emissions should be 40 per cent in 2030 (including effcets on the entire supply chain, compared to data from 2005, ed.). Efficiency in raw materials can be realised by increased recycling. The use of biomass definitely offers opportunities for our sector. Our main ports transfer tonnes of biomass on a daily basis and the Netherlands is a major producer of sugar beets and potatoes which can be used for material and/or chemical purposes. Waste-to-chemical also is an interesting domain given the enormous volumes and relatively low feedstock costs.'

TARGETS FOR 2030

The goals the VNCI has set for the use of biomass and recycled feedstocks are quite high: in 2030 15 per cent of all feedstocks should be biobased. At the moment this percentage hovers between 5 and 6 per cent. 'We expect that the share of recycled feedstocks will be 10 per cent, which implies that fossil feedstocks will take up 75 per cent.'
The question is if the transition towards a biobased/circular economy is going fast enough to reach to above targets. Alma says it is too early for a balanced judgment. However, she is concerned about the current growth rate. 'It is not so much a matter of R&D, but more of a lack of industrial activities, for example a biorefinery situated in a industrial complex. We need significant investments and momentarily these are scarce because of the relative low oil price and the uncertain economic climate. In the long run, the outlook for the biobased economy will improve as fossil feedstock prices will continue to be volatile.'

START-UP WITH IMPACT

Even before she studied Environmental Sciences at Wageningen UR, Kirsten Steinbusch wanted to work in the business sector, preferably for a multinational, so she could achieve the greatest possible social impact. Luckily, she says, she ended up at a start-up. Now she is running her second start-up: Delft Advanced Biorenewables.

Tekst Lucien Joppen **Beeld** Dick Teske

While studying for her doctorate between 2005 and 2009, Steinbusch came into contact with a fermentation process. Based on anaerobic bacteria, it converts organic waste into high-grade chemical raw materials. The technology eventually resulted in Steinbusch's first start-up, Waste2Chemical.

Kirsten, you really wanted to join a company as large as Shell, and it ended up being a start-up.

'Yes, but in hindsight this was the better choice. I actually thought there was a role for me in R&D at a large company that wanted to make the transition from the traditional (petro)chemical industry to different, more environmentally friendly process technologies. But there was a good chance that I would have ended up on the sideline. At the time, in 2009, I was given the opportunity to purchase a patented technology that I had discovered myself, for a good price. I took on a business partner, Niels van Stralen, and together we started Waste2Chemical. It was and still is a promising process with competitive yields. The financial risks for us were not that large either: we were still in an early phase of the R&D-stage and obtained capital injections from various funds. The technology has since been scaled up to a pilot plant, and a demo factory is planned.'

You no longer work at Waste2Chemical, now operating as Chaincraft.

'That's right, Niels and I each went our own way in 2014, on good terms. At the time I simply wanted to apply for jobs but very soon I had a call from Luuk van der Wielen (Delft University of Technology, BE-Basic) who was also involved in Waste2Chemical. He asked me to set up a company focusing on a promising separation technology for the fermentation of oils. It was a process that worked on laboratory scale. So it had to be scaled up further and alignment with the market had to be found. For the latter activity especially I had already obtained the necessary experience at Waste2Chemical.'

'THE MARKET IS AIMED (...) MORE AT DEVELOPING MICRO-ORGANISMS. THAT IS WHAT THESE COMPANIES EARN THEIR MONEY WITH.'

What does the technology involve?

'It is better if I start with the background. When you produce oils using micro-organisms, you often get an emulsion, like a kind of mayonnaise. You have to extract the oils from this with a high level of purity. The industry usually requires several steps to achieve that: several centrifuge rounds, a temperature swing, the addition of chemicals and a final filtration step. This all entails considerable additional costs, so that some business cases are sent back to the drawing board, certainly those for relatively low-grade end products such as biofuels. Well, the research group of Dr Maria Cuellar at the Delft University of Technology developed a patented process for separating the oil in the reactor already, making savings of 20 to 40 percent possible. This step can also be performed outside the reactor, so that producers do not immediately have to acquire a new reactor. The separation step is preferably performed as fast as possible because the emulsion is less stable then. The more stable the emulsion becomes, the more energy it will cost to centrifuge the oils out of it.'

What phase is the technology development currently in?

'The process works on laboratory scale (editor's note: one hundred litres) and we have already done simulations for one hundred and one thousand litres. This year we are going to scale up to a prototype with volumes of one hundred litres and in 2017 we will have an eight-thousand litre tank at the BioProcessFacility in Delft. Efficiency-wise we are at 86 percent, which puts us close to the 90/91 percent that the industry works with. We have already had discussions with various national and international parties in the fermentation business so that the technology can be geared to what the industry wants as much as possible. As I said earlier, our technology is highly suited to the more low-grade end products such as biofuels or aromatic and flavouring substances for the food industry. The first sector mainly needs cheaper process technology to be able to get close to fossil fuels or bio ethanol at all. The sector has become smarter thanks to the Amyris-debacle in which the production costs of biofuels ended up being higher by a factor of 8 and the market value evaporated. The food sector is chiefly interested in alternative raw material streams so that companies can reduce their dependence on one particular stream. A good example is Isobionics, a company in the Netherlands which produces valencene and nootkatone via fermentation; these substances can be used as flavours in soft drinks. This method delivers an end product that is purer than the standard method (extraction) which also happens to be more detrimental to the environment. The level of purity of oil-bearing components is also an issue for halal products.'

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COLUMN

BIO-BASED ECONOMY, NO PLACE FOR IP BATTLES

In my previous post I called for an equal playing field for bio-based players vis-a-vis fossil-based incumbents. In short: (i) stop subsidizing fossil-based fuels and chemicals and (ii) put a price on carbon. Essentially, two of the most important conditions that our emerging biobased industry needs to move from niche to mainstream.

What we certainly don't need, is biobased players fighting each other over IP. At this moment in time where oil dropped below $30/barrel, we need all of our energy to develop meaningful products with customer benefits that go beyond green. We need to demonstrate together with our customers and partners that biobased products are meaningful innovations and that our renewable value chains will reduce overall system costs even in a "$30/barrel world".

In that environment, it is important to team up. Team up with biomass suppliers, biopolymer companies, compounders and brand owners. Co-develop but also co-commercialize. Changing value chains from fossil-based to biobased is a tremendous effort and requires multiple competencies that no company has all in-house.

But this goes further than collaboration through the value chain. This is also about working with industry peers. For our industry to thrive, multiple strong players are needed. Customers don't want to find themselves depending on one or two (emerging) companies. They want to have security of supply and always want to have a choice.

It is in this spirit of working towards a common goal that Reverdia signed a deal with BioAmber. Both companies are active in bio-succinic acid. Both companies use a yeast-based fermentation manufacturing technology. And yet Reverdia agreed to provide a non-assert agreement to BioAmber on certain intellectual property conditions of Reverdia's Biosuccinium™ technology.

On top of that, the non-assert agreement provides comfort to both BioAmber and Reverdia to continue the implementation of their respective businesses using their own unique, proprietary yeast-based technologies.

I am firm believer in open innovation. In my time at DSM I have practiced this approach in many different ways, for example by licensing out the PER.C6® cell line for the manufacture of therapeutic proteins together with biotech company Crucell.

At Reverdia, we will continue practicing open innovation throughout the value chain because we believe the bio-based economy needs collaborators. Not companies that hold each other hostage over IP.

Marcel Lubben
CEO Reverdia

What does the DAB business model look like? Are you going to design and build the reactors yourselves, or will you extract value from the acquired expertise in one-on-one procedures with third parties?

'DAB is a technology company, not a reactor builder. There are not that many reactor builders anyway. Often companies develop and build them in-house or contract the work out to welding businesses. Every micro-organism, or rather every strain, has its own processing conditions which require a tailored approach. We have the knowledge in the field of fermentation and the patented separation method to develop the optimum solution with each individual customer.'

You stated that you are already holding discussions with national and international parties. How definite is the demand of these companies for your technology?

'The interest is there, even though, as I said, the technology has not been scaled up yet for commercial operation. We expect this to happen in 2018/2019. The market is aimed primarily at developing micro-organisms. That is what these companies earn their money with. Optimising processing conditions is therefore not top-of-mind, certainly not for the more high-grade end products. So it is up to us to get this into people's heads, especially with producers which concentrate on relatively low-grade end products. In the long term, however, our technology will be able to prove its value for high-grade products as well, definitely once they develop into more mature markets.' ●

Kirsten Steinbusch: 'Idealistic motives are important internally, for retaining the focus and persistence. The cost price is leading when it comes to the market. You must always keep your feel for the market.'

TOY SECTOR MORE SUSTAINABLE

LEGO ONE OF THE FRONTRUNNERS

BIOBASED ABS

Until 1963 Lego produced its world famous blocks from cellulose acetate. After that, ABS came into the picture, a more stable plastic which has been in use for more than 50 years. It also illustrates that the bar is set high for any plastic (blend) that would replace ABS.
One option is an alternative plastic blend, the other a biobased copy of ABS. There are several initiatives which target biobased butadiene, for example ENI and Novamont of Lanzatech/Invista. The route towards biobased biobenzene is being explored by Anellotech and several companies and knowledge institutes are investigating biobased drop-in's, for example glutamic acid, for acrylonitrile.

Slowly but surely, more and more (partly) biobased toys are being launched on the market. For the younger ones (age zero to six) health is an important factor. Also companies, with Lego as one of the frontrunners, are looking more into circular concepts with a special focus on renewable feedstocks.

Text Lucien Joppen **Images** Shutterstock, Lego, Geobra Brandstätter

Last year, Lego announced it will spend at least 135 million euro's for research directed at renewable materials for its toys and packaging. The Danish toy giant, with a turn over of 4,8 billion euro's (2015), is one of the biggest players in the sector, which turns over 160 billion per year (source: Euromonitor, 2015). The above decision of Lego is mainly fuelled by environmental concerns. 'It is our ambition to use100 per cent sustainable materials in 2030', CEO Jørgen Vig Knudstorp has said. 'We have already taken steps in the field of renewable energy (wind farms to power production, ed.) and FSC-certified packaging materials. Now it is time to focus on the materials for our products.'

PERFECT FIT

Currently, Lego produces its base material, the world famous Lego-blocks, from ABS (Acrylonitrile Butadiene Styrene). Each year, the company manufactures roughly 20 billion pieces. ABS is 100 per cent fossil, but the material has its advantages. Lego tolerates only minimal deviations (up until 0,002 millimetre), which ensures a seamless fit with the other blocks. This is not only the case with "modern" blocks, but also with the older ones, up until the "generation" of 1958.
ABS also has relative high creep resistance, making it less susceptible to deformation as a result of pulling and/or bending. ABS is relatively light-weight, but hard and with a high impact-resistance. Last but no least, ABS is relatively cheap.
'Out Lego-blocks are made of the highest quality plastics', a spokesman says to Agro&Chemistry. 'The functional properties and lifespan are good. However, there's a downside: the material is fossil-based and therefore based on scarce feedstocks. We believe we can perform better with renewable materials that have a lower environmental footprint.'

RECYCLING NO OPTION

The question is: which types of renewable plastics are in Lego's sight? For the time being, the company does not want to disclose anything. What's clear is that Lego, in conjunction with the World Wildlife Fund, has determined criteria based on which it can determine the "sustainability factor" of each material.
'We are at the beginning of our journey', the spokesman for Lego says. 'There are several challenges: the materials have to be more sustainable and should be comparable in terms of functionalities and user safety.'
It remains to be seen whether Lego will end up with a 100 per cent renewable solution. 'We will look into several blends in which bioplastics/polymers can come into play.'
In an article. published in Wired (2015), it appears that Lego has already tested with an "impact-modified" PLA. In this test, the material initially resembled ABS very closely. However, after a number of weeks the material started to deform, the author of the article states. In short, it won't be an easy fix, hence Lego's timeline (2030).
Recycling (of fossil plastics) is not an option for Lego - or any manufacturer for that matter - because of strict regulation in this sector. Reuse, however, is definitely an option: there are several websites where consumers are able to buy and sell second-hand Lego-materials.

BIOSERIE: MADE OF PLANTS

Lego mostly is interested in the environmental aspects of its (future) materials. There are also companies that position their products as "child-friendly" alternatives for fossil plastics, more specific certain additives such as plasticizers.
One of these companies is Bioserie which launched the first generation "Made of Plants" for toddlers. Bioserie, with its head office in Hong Kong, has put in three years of R&D into the concept, which is based on Ingeo (NatureWork) and a "proprietary blend of biobased components".
According to Bioserie, its toys do not contain any potential toxic elements which can be present in fossil-based toys. 'Most of the toys for babies and toddlers are based on fossil plastics', Stephanie Trau, one of the founders of Bioserie, says. 'It is for parents very difficult to assess whether these toys contain harmful components such as heavy metals, phthalates or Bisfenol A. The information on the packaging often is inadequate or too technical for the

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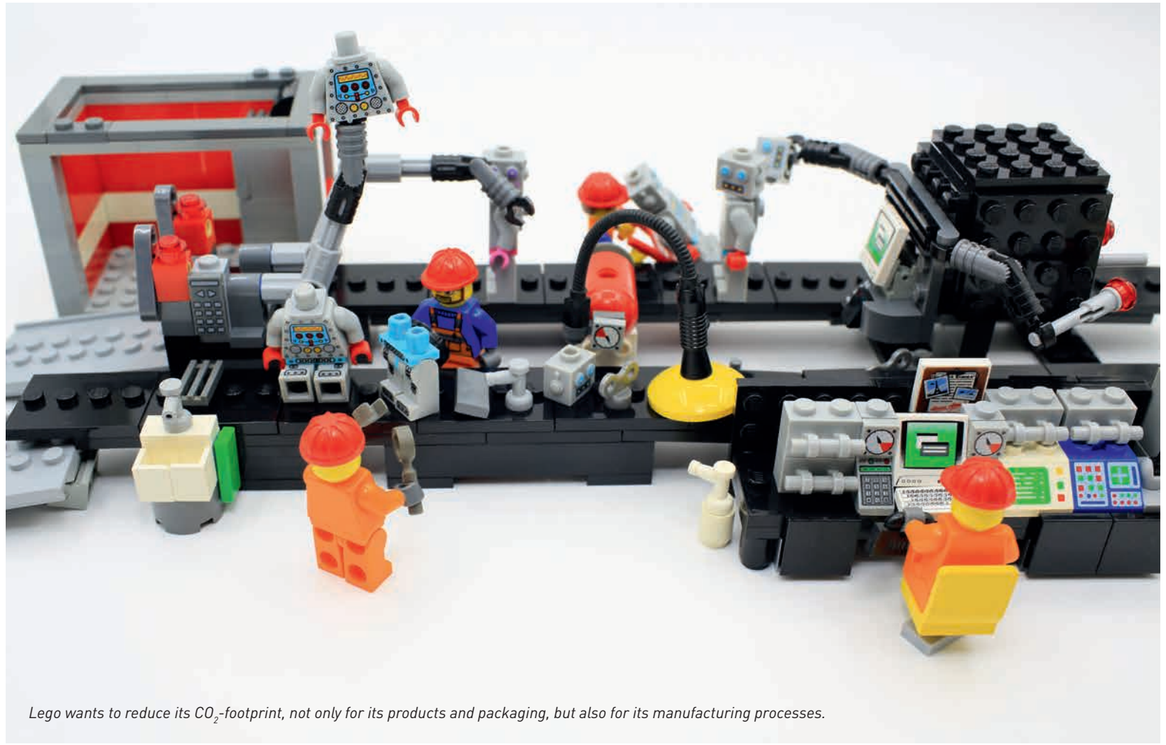
ECODESIGN

The choice of materials is an important element in Lego's journey to 2030. Most of its parts are based on ABS. There are also other materials which are in use, such as metals. For example, the chassis of Duplo has metal axes. These have been omitted by an alternative design which allows the wheels to be clicked directly into the chassis. This design not only lowers production costs, Lego says, it also lowers the overall impact on the environment.



Lego wants to reduce its CO_2-footprint, not only for its products and packaging, but also for its manufacturing processes.

average consumer. With our products consumers will get the guarantee that these components will not be present.'

SUPERTOYS

As mentioned before, Lego still has to figure out which materials it will use. Italeri, the Italian manufacturer of model cars, planes, tanks et cetera, already made a choice. Together with Bio-on, it will use a PHA-blend for certain models. In the so-called Minerv PHA Supertoys Project both companies want to develop "environmental-friendly" models with the same functionalities (esthetics et cetera) as current products. From the Supertoys-project, two types of PHA-blend should emerge: a type R (rigid, strong) and a type F (soft, flexible). At the end of 2017 these plastics are scheduled to enter the market.

'Our models are very difficult to produce', Marco Astorri, CEO of Italeri says. 'Tolerance levels are minimal but if we succeed, other items in the toy sector will be suitable for these kind of materials.' ●

'WE BELIEVE WE CAN DO BETTER: RENEWABLE FEEDSTOCKS AND A SMALLER ENVIRONMENTAL FOOTPRINT'

PLAYMOBIL PANDA

Geobra Brandstätter, the manufacturer of Playmobil, is still experimenting with plastics based on renewable feedstocks, a spokesman for the German family-business says. Geobra already has put its toe into the water by designing a biobased Panda-shaped key ring for the German division of the World Wildlife Fund. 'It will be very difficult to replace all fossil-based plastics with renewable materials in our Playmobil-portfolio. This has to do with the required functionalities.'

DSM STARTS PILOT WITH BIOBASED LEVULINIC ACID

GREEN POLYAMIDES A STEP CLOSER

At Chemelot InSciTe, an international research and knowledge institute for biobased and biomedical materials, DSM is on the right track with its development of a green synthesis route to produce adipic acid from levulinic acid. This is an important raw material for nylon yarns and heat-resistant plastics. Now that it works on laboratory scale, a pilot with continuous production will follow. Once its success has been demonstrated, the way to large-scale production will be opened.

Text Vincent Hentzepeter **Image** InSciTe

The production of Adipic Acid (AA) from Levulinic Acid (LA) offers a biobased alternative to the traditional route based on ring carbon compounds such as benzene and cyclohexane. The levulinic acid raw material is obtained from (residual) streams containing cellulose. The 'LA2AA' project is coordinated by Michèle Janssen (DSM). 'Wood chips are an example, as long as they have C6 chains, but we are not concerned with that process. The GFBiochemicals company here at Brightlands Campus is concentrating on that. Our research starts with the levulinic acid. It is actually much easier to produce it from biomass than from fossil raw materials, and with high yields as well.'

POTENT GREENHOUSE GAS

One of the elements required for the classic synthesis of adipic acid from derivatives of fossil fuels is nitric acid. The reaction product that arises, nitrous oxide or laughing gas, is the main reason for developing a biobased alternative, explains project leader Janssen. 'One of the biggest advantages of this new route, compared with the current one, is that no N_2O - a potent greenhouse gas - is formed. That is a potent greenhouse gas. The process also requires a lot of energy, which results in extra CO_2 emissions. Our new route looks to be much better as far as environmental impact goes. What's more, it could turn out to be cheaper than the traditional route too.'

FOUR-STEP ROUTE

The LA2AA project started in 2010. 'Together with a large number of experts in the chemical and biocatalytic fields we devised a route on paper. We tried to estimate the extent to which the individual steps in that route are proven or whether breakthroughs still have to be forced. We drew up a ranking that helped us determine the most promising route for testing this on laboratory scale. The size of those production quantities can be counted in grams.'

A four-step route was developed for the synthesis process from levulinic acid. 'Following a hydrogenation reaction we convert it into gamma-valeroactone; this is a cyclic compound. Then we do a ring-opening reaction on this molecule to obtain methyl pentanoate. We convert that into dimethyl adipate, which in turn is converted into adipic acid. The interesting thing about this route is that these intermediary molecules also have applications in their own right. Gamma-valeroactone is a solvent, but it can also be a monomer. This route can conceivably branch out into all kinds of directions that deliver valuable products.'

SCALING UP

The chemical conversions are catalytic. The challenge is to end up with an efficient process that has as few by-products as possible. The results on laboratory scale are promising: 'The catalytic agents are giving us good activity and selectivity. That means few by-products. And that is positive, both in economic and environmental terms.'

Now the time has come to scale up the batch-wise laboratory production to continuous production in a pilot system. This is always an exciting phase, says Janssen, because only then does it become evident whether the process can actually work in practice. 'Although all four steps of this process have been proven on laboratory scale, we still don't know whether the catalytic agents will be sufficiently stable in a continuous process. We will have to run long durability tests to see whether we obtain enough purity. With this kind of process small quantities of impurities can arise that can whip up through recycling and deactivate the catalytic agents. That in turn creates side reactions. These are problems that we have investigated very thoroughly, but in the end the pilot has to prove that we can recycle in an economically viable way. We can only draw in external partners to commercialise the process further once this has been proven.'

Adipic acid is the basis for the synthesis of sewing threads for the textile industry (polyamides). DSM uses it to produce Stanyl, an impact-proof, heat-resistant synthetic material for automotive parts.

IMPURITIES

A dedicated demonstration plant will be designed and built for this phase. With an annual production of between 3 and 10 kiloton of adipic acid, the product will really have to find a place on the market. 'For the customer it is important that the biobased adipic acid offers the same quality, just as pure and preferably cheaper than our current product.' Impurities, however minimal, are inherent in a chemical process. The biobased adipic acid will in any case contain different impurities to those in the classic synthesised product. 'The question is how that will affect nylons or applications under the bonnet in the long run - the engineering plastics we are aiming at.'

INDUSTRIAL SCALE AROUND 2026

The global production of adipic acid is currently around 3,000 kiloton per year. Obviously much more research and many more experiments are needed before a biobased process can achieve those kinds of quantities. 'The test with the continuous process in the new pilot plant has been planned to run until mid-2017. So in a little more than twelve months you could start thinking about the next step: a demo plant. It would have to be designed and built specifically for this purpose, and that will take another five years. Once that has all proven successful, you can scale up to a real, industrial scale. I'm talking about at least 10 years from now. Once the biobased product is just as good and at least as cheap, that could have a huge impact on the market.'

Isn't Janssen afraid that rival companies are ahead of DSM? 'Other chemical companies are certainly carrying out activities as well. I've seen patents go by with different routes. We have to wait and see which route will be the winning one. Possibly several routes can exist alongside each other because they are all efficient and end up with approximately the same price tag.' ●

This article has been written in cooperation with Source B.

VALUE CREATION IN THE PRIMARY SECTOR

MARKET DEMAND HEATS UP

How can agricultural entrepreneurs increase and safeguard their value in biobased supply chains? It is not easy, but certainly not impossible either. Demand from the market is essential to set up these kinds of supply chains. The good news for the primary sector is that this demand is slowly but surely building up.

Text Lucien Joppen **Image** Shutterstock

This is asserted by Patrick Lemmens, who has been intensively involved in establishing value chains in the biobased domain in the Netherlands for more than five years. As project leader at the Greenport Venlo Innovation Centre (editor's note: the precursor of Brightlands Campus Greenport Venlo), he has supervised and/or initiated the necessary projects in which various partners from the primary sector were - and still are - involved: interesting projects, such as the valorisation of spent mushroom compost or extracts from blueberries.

In many cases, however, the route to market has still not been found. Lemmens believes that this is mainly a matter of time. 'Most project participants initially thought they would have a product ready for the market within two years. That turned out to be aiming too high. An average R&D process for a large company also takes around five to seven years. So you cannot expect that groups of SMEs will operate faster. After all, the project partners depend on each other's speed. Some simply can and do work faster than others.'

TURNING POINT

Another hurdle was that final customers were less interested in main and/or side streams from agriculture. Lemmens now speaks of a turning point: producers from different fields of application are increasingly seeking alternative sources for their raw materials and/or semi-finished products and end up at the agricultural and food sectors that way.

'A good example is the paper industry, in which certain producers develop and produce high-quality papers that are partly based on plant fibres. The necessary things are happening in the use for plant components as well, for instance for cosmetics and nutraceuticals. Specific backward reasoning from the applications leads to possible alternative semi-finished products and corresponding processes and raw materials.'

That's good news, but it does not mean that the primary sector will immediately draw in profit from this development. 'The farmers are on top of this themselves,' according to Lemmens. 'If they portray themselves as suppliers, they end up in a situation identical to that with their primary products. Exchangeability is something you need to avoid. Otherwise you are evaluated purely on price.'

NAIVE

Lemmens asserts that participating in projects in which the primary sector and end customers work together on marketable concepts does not guarantee that these parties will eventually do business with each other. Lemmens: 'You would expect that the parties concerned end up with strong ties because they work together so closely, and that this would make the relationships at the negotiation table friendlier. That is simply very naive. Sometimes parties already drop out earlier, during the project, so that there is not even a prospect of a marketable concept. The knowledge and expertise provided by the primary sector, for example about cultivating and processing biomass, gains no extra value or 'overflows' to the cooperation partners. It is essential to build up expertise on biomass, for example about breeding, cultivation and pretreatment, but it is also important to make clear agreements in advance. This applies to matters such as knowledge and IP, but also to marketing. I often pose the 'what if' question. Suppose there is a prospect of a product-market combination: which parties do you involve in the introduction and how do you approach the market? Parties from the primary sector often have no eye for this yet. It is also a matter of experience; it requires a different mindset. Businesses in agrifood also have to consider supplementary business models in addition to their daily business.'

FORWARD INTEGRATION

Besides the knowledge about biomass, say the domain of the primary sector, farmers can also realise their (added) value by forward integration, according to Lemmens. 'There are definitely opportunities in small-scale biorefinery or pretreatment/reprocessing into useful semi-finished products. Obviously these activities need to be performed in an organised way, for example by a cooperative or a third party, in which farmers can possibly participate. Using the knowledge and expertise accumulated in this phase, parties from the primary sector can set themselves apart on the market: from exchangeable to indispensable.'

One of the projects that arose under the umbrella of the Brightlands Campus Greenport Venlo is Paprikansen (opportunities with capsicum, editor's note) which focuses on the use of certain components in food and pharmaceuticals. The project has now reached the stage where the possibility of translating the knowledge about components into new products based on capsicum is being investigated.

LUCRATIVE

Anton Winkelmolen (Arvalis) has been involved with Paprikansen from the very start. Because the project has now come closer to the market, he is not able to provide details. Capsicum farm Litjens from Meterik in the province of North Limburg is one of the parties involved in the project. Winkelmolen believes new value creation of the farm product are interesting for the grower, because this can provide lucrative extra income in times of overabundance when the capsicum prices drop. 'It is crucial to find the right partners with the right knowledge; we have continually focused on this in our search. We have spent a lot of time on it, with the result that things don't always proceed as fast as might be hoped. In practice you can come up with a tight (time) plan, but you always encounter crossroads where it might be more interesting to take a different (roundabout) path. That happened with Paprikansen as well.'

CHICKENS AND EGGS

Winkelmolen argues that the challenge of setting up a new value chain lies mainly in finding a good cooperation model with partners. In the very beginning it is too early to make detailed agreements. The market is still very far away and the project can go in all directions. 'It doesn't help if you already start bickering about dividing up the chickens when you haven't even seen any eggs, let alone made sure they have hatched,' according to Winkelmolen. 'However, once the investments and interests become larger, both parties will have to put things down in writing.' That applies to matters such as cash, hours and intellectual property. The last issue is difficult and costly for smaller parties. There are cheaper alternatives, such as specification in dossiers (editor's note: customary in the pharmaceutical sector). The quality control is important, but the essence of the value that the primary sector can build up, lies in the knowledge and expertise in growing certain biomass according to certain specifications and - possibly - reprocess it into useful semi-finished products for market parties. That is what they should put their energy into.' ●

This article has been written in cooperation with Source B.

OUTSIDE THE COMFORT ZONE

Academics who move to the business sector and the other way round: a far-reaching decision that requires the necessary adjustments. But the people who have chosen to do this can recommend it to everyone.

Text Lucien Joppen **Images** Pierre Gielen, Jonathan Vos

Sanjay Rastogi switched from the university to the private sector in 2008. 'A few years previously I had moved to Loughborough University where I continued the work I had been doing at Eindhoven University of Technology. This concerned the "unravelled" synthesis of ultra-high molecular weight polyethylene (UHMPE), a study that was supported by the Dutch Polymer Institute. At the time I was mainly interested in the fundamental aspects of this process. There were also interesting functionalities of the material that the business sector could use. I was already collaborating with the company Teijin Aramid on that pathway, examining how UHMPE could be processed into a tape with a high strength modulus. It was the strongest "man-made" tape with applications in lightweight products such as bulletproof vests or helmets. The advantage with respect to Dyneema was that it could be produced without solvents, making it more environmentally friendly (and cheaper). The tapes are now produced in a "solid-state processing plant" in Emmen in the Northeast of the Netherlands.'

PIONEERING RESEARCH

Stefaan de Wildeman made a similar step, except that he swapped the business sector for the research laboratory. He left DSM behind him in 2013 after an eleven-year career with the multinational company. 'I made this switch so I could lay a fundamental basis for the development of biobased building blocks. It is pioneering research in which our team is concentrating in the first instance on the conversion of sugar derivatives into new polymers. For this kind of research you have to distance yourself from day-to-day affairs such as the price of oil and short-term or shorter-term strategies. It's about that point on the horizon, how you get there and preserving your own belief in that horizon. That applies not only to the research, but also to the teaching and supervising of young academic talent. The generation who will be in charge in the coming decades.'

Stefaan de Wildeman: 'It's about that point on the horizon. That applies not only to the research, but also to the teaching and supervising of young academic talent.'

Sanjay Rastogi. He is now back in the academic world. In 2013 he set to work at Maastricht University to establish a research group in 'polymer science & technology' in the Biobased Materials department, with an emphasis on the circular economy.

RULES OF THE BUSINESS SECTOR

Rastogi has never regretted his transition. His move to Teijin gave him an accelerated introduction to the rules of the business sector, partly through an MBA. 'Recognising and articulating a specific "market pull" is the added value that businesses can bring. Timing and decision-making are critical success factors. If you make mistakes here, it doesn't matter how good your product is: it really won't succeed. It is important to have salespeople who are well versed in the technology. That is why I regularly have contact with these colleagues.'

Both Rastogi and De Wildeman can recommend jumping the fence, although the latter advises that this decision not be taken too lightly. 'It should not be taken lightly. 'It is a serious step: you would leave your comfort zone for an uncertain future in fundamental research. Once again, it can produce trailblazing innovations, but there is absolutely no guarantee of that.'

PERSONAL GROWTH

Rastogi likewise would not hesitate to encourage colleagues who are considering a change. 'Especially if they want to transform their concepts into marketable products. This step is anything but easy, but if it is successful it will bring the satisfaction of climbing that mountain together with a multidisciplinary team and planting the flag on top. It also requires personal skills of the (fundamental) researcher, skills that are possibly less fostered in academic circles. Cooperating in teams requires you to listen to each other's arguments and weigh them up carefully. That is not always that easy for specialists who are used to operating more as soloists. You need flexibility, respect and joviality to get teams to function. In brief, a switch also demands a certain degree of personal development and growth.'

VISION AND LEADERSHIP

Europe is often labelled as excelling in fundamental research but finding it more difficult to get to the market. Perhaps a more dynamic work climate, in which people switch from scientific study (and research) to the business sector (and vice versa) more regularly, can ensure that 'we' in Europe also become better in realising innovation.

De Wildeman: 'What we lack here in Europe, is a more explicit "can do" mentality and entrepreneurial spirit. More importantly, vision and leadership are missing in a sector that is currently far from stable, even chaotic. In short, these are fundamental matters you cannot solve with increased "traffic" between the business sector and fundamental research. Transforming innovation into marketable products and/or services is important, but it is definitely not the only aspect. What is involved is a sustainable world which we want to leave behind for our children. This carries a moral obligation. I believe that it is senseless to compete purely on price. This only results in the destruction of value. We have to restore the connection with the products we use. Issues such as working conditions and environmental taxes then also enter the picture.'

Rastogi also acknowledges the European deficit in this area. 'It is about a cultural change whereby we should work more with close-knit teams whose team leaders have strong communication skills. It wouldn't be a bad thing if experts jumped the fence more regularly.' ●

This article has been written in cooperation with Source B.

COLUMN

BRINGING INNOVATION TO THE INDUSTRY

Fundamental research is hugely important to improve our understanding of the potential of plant molecules and develop innovative, efficient conversion routes. This also means combining knowledge from different disciplines in a smart way and using existing technologies for new objectives.

However, innovations can only be realised if the business sector recognises the opportunities of the biobased economy, includes biobased ambitions in its strategies, works across sectoral boundaries and forms new value chains, and is supported with appropriate policy to develop and implement the concepts.

That is what the European Biobased Industries Consortium (BIC) is for. This is a growing group of already more than 70 companies in Europe that, together with the European Commission, have set up, designed and implemented the 'JTI for Biobased Industries'.

The 'JTI' (Joint Technology Initiative) concept was conceived to expand the innovative power of Europe. It is intended to increase the involvement of the European business sector in the European research infrastructure, and vice versa: industry-driven research that will increase the implementation of innovations for the European economy.

The same holds for the biobased economy. New innovative biobased value chains, based on European biomass and European technologies, implemented in Europe. The first call will have been launched on the 9th of July, with topics drawn up by the joint industrial BIC-members. These topics solve specific technological problems in new value chains; value chains with tangible impact, with new processes and products that can improve the profitability of their businesses. Innovations which match their ambitions, and in which the industry accordingly co-invests significantly.

And this is where the major challenge can be found. A great deal of interesting and relevant research still takes place outside of the field of vision of the industry. How can we make sure that this part of the research world finds the business sector and can inspire and feed it with new ideas? How can we make sure that the industry identifies promising research results in good time and takes them on for demonstration?

The biobased economy is only possible if we know how to find each other: with fundamental research as well as demand-driven research, and with entrepreneurship as well as a policy of encouragement.

Annita Westenbroek

Programme Coordinator of the Biobased Industries Consortium (BIC). She is also director of the Dutch Biorefinery Cluster, and innovation manager of the Koninklijke VNP, Royal Netherlands Paper and Board Association.

EUROPEAN PROJECT BIO4SELF

CLEVER COMPOSITE MATERIALS FROM PLA

The aim of the recently established Horizon 2020 BIO4SELF project is to develop and produce self-reinforced polymer composites (SRPCs) for high-end applications. The project participants expect that the new, ultra-strong biobased composite materials will compete with traditional polymers, due to their mechanical, functional and durable properties.

Text Richard Bezemer **Images** Shutterstock, AMIBM

The recyclability of parts is becoming an increasingly important issue in car design. This applies for example to reinforcement of the body panel between the bonnet and the front windscreen. It is crucial in assuring the safety of pedestrians in the event of an accident, and must therefore satisfy very specific mechanical requirements. The Spanish tier 1 producer Maier currently produces this part from a combination of polypropylene and fibreglass.

'You can use PLA as raw material for the petrochemical PP as well as the fibreglass. This biobased version supplies a huge advantage when it comes down to durability, while its mechanical and functional properties are at least equal to those of composites based on PP. What's more, it is a monomaterial, which makes it much easier to recycle,' states Guy Buyle, coordinator of BIO4SELF, which was established on 1 March 2016.

HOME APPLIANCES

BIO4SELF builds further on existing expertise in SRPCs, including that of one of the initiators and coordinator Centexbel, the Belgian research centre for textile and plastics, where Guy Buyle works as European project manager. 'Besides making new blends and their characterisation, together with end users we want to end up with real applications in this project. One of those parties is Maier, which already has a real application in mind for the PLA composite materials: they can serve as a stiff and shock-absorbing material >>

Promising markets for PLA composites: automotive and home appliances.

AMIBM AND PARTNERS

A major role is set aside in the BIO4SELF project for the international research institute Aachen-Maastricht Institute for Biobased Materials (AMIBM), set up at the end of last year at the Brightlands Chemelot Campus. This joint venture between Maastricht University, RWTH Aachen University and Fraunhofer IME has a research programme aimed at the sustainable and efficient production of biobased materials and their innovative application in medical and technical applications. Of the €6.7 million subsidy awarded to BIO4SELF, almost €1.2 million is destined for the partners Maastricht University and RWTH Aachen of the AMIBM.

Because businesses from the entire value chain are involved with the partners in the BIO4SELF project, the expertise of AMIBM employees can also be put to use directly in practice. For instance, there are companies that engage in extrusion, twining, spinning, injection moulding and thermoforming, all separate processes that need to be optimised for the biobased composite materials. 'The advantage of this chain-wide cooperation is that when there is a success, a production chain is immediately ready for large-scale products, and we can have a significant impact on the market with large end customers such as Maier and Arcelik,' says Guy Buyle.

IKEA

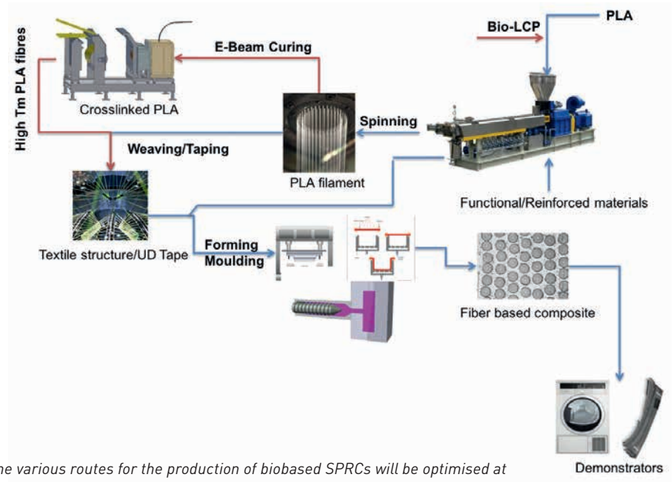
Dietmar Auhl, lecturer in the 'biobased materials' research group and project leader at AMIBM for BIO4SELF, explains how AMIBM wants to add value to the Horizon 2020 project. 'We have a great deal of experience in polymer research, materials and process design. Our multidisciplinary team covers the entire value chain starting from biobased materials, and can contribute fundamental expertise to every phase. The selection of the PLA raw material and ideas about existing grades or variations are crucial steps you need to take before you can make a start on processing and product design. We improve practical research with (simulation) models, which enables us to design materials, processes and products even more efficiently.'

It is highly likely that in the coming five years it will not be possible to compete with the classic SRPCs on the basis of the raw material prices, unless the current low prices of oil and raw materials derived from oil change fast. 'But you have to consider that SRPCs are not used much at all yet anyway, that the concept has not been fully developed yet, not for the classic polymers either. By achieving that further development in this project for biobased SRPCs, we can develop excellent alternatives for conventional solutions, based on mechanical and functional properties', argues Guy Buyle.

On the basis of the deliverables from BIO4SELF alone, he estimates that in three or four years there will be a market of 35 kton/year for PLA-based SRPCs. 'But it can be a lot more than that, if I just go by the interest of the now five companies that have joined the Innovation Support Group, for example because they are interested in testing materials. When you know that IKEA is one of the parties showing interest, the impact of biobased SRPCs could become quite a lot bigger.' ●

for certain vehicle parts. Another example is the Turkish home appliance manufacturer Arcelik. They have specified a number of components, but will determine the actual applications at a later stage, depending on the properties we can obtain with the composite materials,' according to Buyle. This will also depend on the temperature to which the new components can be exposed. For PLA that has been limited thus far to around 50 °C. 'One of the aims is to improve that specification. We also want to create more generic products, which can be put to a wider range of applications than just with the partners in the programme. We want to show what you can do with 100 percent biobased materials and we want to urge businesses to use them.'

An important condition of the large-scale production of the PLA-based SRPCs is that the polymers can be processed with the existing production equipment. 'The concept of material reinforcement is clear, but we have to see how that performs in the value chain and optimise it even more, for example by adapting process parameters,' according to Guy Buyle.



The various routes for the production of biobased SPRCs will be optimised at BIO4SELF.

PLAYING WITH CHAINS AND FIBRES

The production of self-reinforced PLA boils down to combining two different PLA polymer fibre types. The matrix requires one PLA with a relatively low strength and melting temperature, while the other polymer, like PLA, has to have great strength and high melting temperature. When you combine the two starting substances, at a particular pressure and particular temperature, the polymer with the low melting temperature will melt and form the matrix, while the other one remains intact and adds strength to the material.

The properties of the final composites are determined by different factors. For instance, you can vary the ratio between the two polymers (blends) and vary the length of the chains. Buyle: 'In this project we will also attempt to create even stronger materials by combining PLA with biobased LCP (Liquid Crystalline Polymer).

In addition, special additives can add all kinds of extra properties. As far as that goes, at BIO4SELF the focus is on three 'smart' functionalities: self-healing, cleaning and sensing. With self-healing, microcapsules are added to the polymer, which can cause a repairing polymer reaction. Cleaning involves the breakdown of certain components under the influence of light (UV) so that they can be rinsed off the material, along with the contamination on it. For sensing, conductive nanoparticles are added to the mix, which allows the material to be incorporated in an electrical circuit where it can detect interruptions, for instance. BIO4SELF also aims to use biobased materials for these additives as much as possible.'

This article has been written in cooperation with Source B.
More information: www.bio4self.eu

COLUMN

BIOMASS: RAW MATERIAL FIRST, ONLY THEN ENERGY

We have been living in an economy of abundance for years. Waste has decreased in value more and more, so it is incinerated. Even food surpluses are destroyed.

A counter movement simply had to materialise. One international climate conference after the other brought us closer to understanding that the earth cannot sustain this and that humankind must change course.

The knowledge we have now, puts a radical change within reach. We have the knowledge, the technology, the money and the will to raise the value of biomass sustainably in clusters and chains of large and small businesses.

And yet something is not right. Countless national and international reports show how important it is to make the best possible use of biomass for the transition to a biobased circular economy. Via cascading first the highest possible value must be obtained from biomass, and only then should the low-grade applications be tackled, ending with biomass for energy.

Practical experience shows, however, that biomass falls prey mainly to firing and co-firing in power stations. That is inefficient use of biomass. The limited financial and political support for industrial production from biomass is in stark contrast to the EU Renewable Energy Directive and other national incentive policy for biomass for energy. It is high time that the government restored the equilibrium to this uneven playing field.

A second problem is that Europe seems to be gearing definitively towards large-scale import of biomass from other continents. In doing so, it chooses not to increase production of its own biomass and high-grade applications. Fortunately, the Biobased Industries Initiative in which various companies and the European Commission work together, does concentrate specifically on the valorisation of European biomass. This stimulates the development of knowledge for new technological innovations, time after time. That is where the opportunities are to be found so that the well-developed agricultural and forestry sectors in Europe can also benefit from the sustainable Biobased Economy. This gives huge impulses to the vitality of the country and employment.

Agnes van Ardenne
Board Member Biobased Industries Consortium

BIC AND VANGUARD JOIN FORCES:

MORE ALIGNMENT BETWEEN INTERNATIONAL AND REGIONAL DEVELOPMENT

The Bio-based Industries Consortium (BIC) and the Vanguard Initiative have signed a Memorandum of Understanding (MoU) to establish a better interregional cooperation in the bioeconomy. 'It is about better access to funding, alignment in R&D-programs and creating awareness throughout the EU.'

Text Lucien Joppen **Image** BIC

At the signing of the MoU on 21 June, Dirk Carrez, Executive Director of BIC, said: 'BIC will work together with the regions in the Vanguard Initiative to exchange information and explore synergies between BBI's work programs and Vanguard pilot projects on the bioeconomy. Our collaboration will identify opportunities for joint demonstration, accelerating the development and uptake of biobased products, strengthening regional development and creating jobs. At the same time, I encourage European regions to explore different financing options, such as regional development funds, to help them bring to market innovative renewable products.'

VANGUARD: FIVE THEMES

The Vanguard Initiative, established in 2014, is centered around five themes. The relevant theme for the MoU is the bio-economy. 'With an industry driven bottom-up process, based on the regions' Smart Specialisation Strategies, we have identified a number of relevant topics that are of interest to the regions involved', Bart Verschoor says. Verschoor is one of the coordinators of the Bioeconomy-track within Vanguard. 'At the moment we have defined seven bio-economy-related themes, for example bio-aromatics, lignin refining or aviation biofuels. Some of these themes are interconnected. The aim is to establish (inter)regional value chains, say from demo to pilot scale. We are talking about TRL5 and higher; fundamental research is not our cup of tea.'

According to Carrez, there is a certain thematic overlap of both BIC and Vanguard which needs to be further explored and mapped out. 'Lignin valorisation and bio-aromatics are good examples of interesting innovation-domains. I can imagine that regions can attract and support BBI-demo and flagship projects, for example with regional funding or by locating, transporting and pretreating local biomass streams. And vice-versa BIC and the BBI-JU can support regional initiatives.'

AWARENESS

Setting up (inter)national and local value chains in the European bio-economy is what both BIC and Vanguard are aiming for. Carrez states that Europe needs integrated biobased value chains if it aspires to become the world's leading bioeconomy. 'Achieving this goal depends on bringing regional stakeholders together to pool resources, combine complementary assets and share best practices', he says. 'We need to bring these developments into rural Europe, boosting new growth through entrepreneurial innovation and industrial renewal. This not only accounts for the 'usual suspects', say the established clusters in Northwest- and Southern Europe, but also in Central and Eastern Europe. That would be a missed opportunity, given the significant volume of biomass in these regions. In general, more EU regions need to start thinking about the opportunities they have concerning their feedstock such as municipal waste, agricultural crops or forestry, waste from food industry. Many are still not aware of these possibilities.'

FOCUS ON RENEWABLES

As mentioned before, funding is an important condition to bring biobased value chains to market. Verschoor: 'BIC and the Bioeconomy Pilot will work together as equal partners on both improving access and strengthen synergies between different financing instruments (e.g. European and regional), based on mutual interest and in line with the common goal to create a more favourable investment environment for biobased industries in Europe.'

Finally, Carrez emphasizes the importance to include renewable feedstocks into the concept of the circular economy. 'The circular economy is not only about fossil-based economy but also about renewable resources. As BIC we are very happy to see at least the Council putting the accent on the role of the bioeconomy in the circular economy.' ●

'WE NEED TO BRING THESE DEVELOPMENTS INTO RURAL EUROPE, BOOSTING NEW GROWTH THROUGH ENTREPRENEURIAL INNOVATION AND INDUSTRIAL RENEWAL.'

GIVING IN OR GIVING UP?

NEDERVANILLE

'Nedervanille' is a public-private cooperation in which growers, Wageningen UR, University of Applied Sciences Leiden and other partners have been working together since 2014 on biological vanilla from Dutch glasshouse horticulture. Vanilla is of course well known as a spice for the food industry. The plant also contains the component 'vanillin', which is active as a medicine against conditions like thrush and athlete's foot. Vanilla stems from the vanilla orchid, which is endemic to areas with a hot climate, like Africa and Mexico. Although glasshouse horticulture is more expensive than growing in open soil, it offers the producer of plant components many advantages that can even up the differences in investment. Crops like the vanilla plant can be cultivated in Dutch greenhouses, regardless of the external climate conditions and without expensive transport costs. The quality and purity of the plant components can be guaranteed. Moreover, production in greenhouses is guaranteed, and sometimes it is possible to harvest several times a year. The crop is also cleaner because no pesticides are used. Eric Poot: 'We are encountering all kinds of interesting challenges in growing a new plant like vanilla under glass. In nature, the plant is pollinated by the melipona bee, which leads a solitary life. This bee cannot survive in greenhouses. We are now working to find the best possible alternative from nature or using technology.'

The value and huge biodiversity of plant components have been known from over centuries. And yet processing new components for high-end commercial applications in the pharmaceutical, food and cosmetic industries has been a slow business thus far. Where are the obstacles and how can they be removed?

Text Kelly van Bragt **Image** Shutterstock, Kenniscentrum Plantenstoffen, Greenport Westland-Oostland

The past few years have seen structural research performed on plant components from Dutch horticulture and agriculture for high-end applications in the food, pharmaceutical and cosmetic industries. How far have we got? 'Experiments currently underway concentrate particularly on drop-in products to replace chemical building blocks and improve the quality and quantity of plant components by optimising cultivation,' says Jolanda Heistek, programme manager at Greenport Westland-Oostland. Leon Mur, director of the Dutch Centre of Expertise for Plant Compounds (Kenniscentrum Plantenstoffen), also sees opportunities in the development of new, innovative molecules. 'The Dutch Centre of Expertise for Plant Compounds is directed especially towards new bioactive ingredients; molecules with a specific effect such as antibiotics, anti-wrinkle effects for cosmetic applications or crop protection against pests.'

ABUNDANCE

There are thousands of components in plants. 'And we certainly have more than enough plants in the Netherlands,' says Heistek. 'There is an abundance of knowledge as well as enough greenhouses.' Nor is the market the problem, believes Mur: 'More and more often the consumer wants natural ingredients and fewer preservatives. The big companies are responding to this. Moreover, nature can supply substances that cannot be produced from oil. These are of particular interest to the industry. It is a unique position for the agricultural sector to make use of.' Plant components can also offer 'green' alternatives for chemical raw materials. 'For instance, biobased substances with antimicrobial activity can be added to food, and this can greatly reduce the amount of added salt and sugar,' says Heistek. 'The components in a plant can reinforce each other in some cases. That is why they have greater effect in a plant extract than an isolated or synthetically produced substance,' adds Eric Poot, team leader at Wageningen UR Greenhouse Horticulture.

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LONG LEAD TIME

Experts from the sector believe there are currently good opportunities for the Dutch horticulture and agriculture to create added value from plant components and strengthen the Dutch economy. But specific applications have yet to appear. What is still holding up the development?

Poot: 'The pharmaceutical industry in particular, but also food and crop protection products require significant investments and these projects have a long lead time. This is because many tests have to be carried out before they satisfy all laws and regulations.' That does not come as a surprise, according to Marlon Pijpelink, project manager at Biobased Economy, Impuls Zeeland, the provincial investment agency. 'It also took the traditional oil-based industry decades of development to get to where they are now.'

RUSTHOEVE

'The processing industry does not possess enough knowledge about what plant components can mean,' states Heistek. It could therefore be a valuable exercise for the horticultural and agricultural sector to present potentially interesting crops to customers. One example is the Biobased Innovation Garden Rusthoeve project in the province of Zeeland, which mainly targets agricultural crops from the Biobased Delta with possible new potential (e.g. oil-bearing grain for fatty acids/fine chemicals, other crops for biocides, colouring and flavouring, building materials, etc).

'By growing the crops in a garden at the De Rusthoeve test farm, we can gain experience in the cultivation of new crops and inspire parties for these possibilities. One of the ways is by holding "inspiration sessions", where we help different parties connect,' says Pijpelink. Wageningen UR also acts as an idea box. Poot: 'In the Greenhouse Pharmacy programme we optimise the cultivation of a selection of plants with high potential in our greenhouses and present them to horticulturalists and market parties. We will develop the plant that attracts the most interest into a business case.'

ACCELERATING DEVELOPMENT

Besides showcasing interesting crops, Poot believes there are other ways for the horticultural sector to speed up the development of plant components. 'The sector and the State have currently entered into a Green Deal, to get green crop protection products on the market faster. The horticultural sector can influence itself on these kinds of deals itself.' Mur thinks that the

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agricultural sector itself must invest if it wants to take up its own position and create value. According to Poot the opportunities are currently to be found in serving niche markets with new high-end applications for plant components.
Heistek agrees. 'We are going through a transitional phase right now. It is very important to take decisions now and show breakthroughs. In the Biobased programme of Greenport Westland-Oostland, together with Greenport Aalsmeer and the Centre of Expertise for Plant Compounds, we have chosen seven business cases that we will put on the market.'

SCALING UP

There are still some hurdles to be taken to scale up the extraction process. 'A lengthy process of laboratory tests, pilots and demos needs to be completed before a plant component can be used in larger applications. We also need large equipment for a few business cases. That means large investments,' says Pijpelink. 'These investments will only be made if people are very certain that everything works. The risks are currently still too large.'
Heistek also understands that entrepreneurs or horticulturalists cannot take on all the risks on their own: 'Cooperation means sharing risks. Initiatives like Greenport Westland-Oostland have to support that cooperation.' Scaling up also creates a number of logistical issues. You can only store biomass for a short period. And in the context of sustainability it is not sensible to transport plant material long distances. 'That only makes everything more expensive,' says Mur.

DIFFERENT LANGUAGE

Heistek believes that business development is the most important step now in order to make the transition from knowledge to the market. Mur emphasises: 'If we want to succeed, the entire value chain has to be organised from start to finish.' According to Pijpelink, this is not an easy task either: 'Parties from the different sectors often don't speak each other's language, they don't have a clear picture of the process, they don't assess the risks and that's why they drop out.'
Heistek: 'If we succeed in bringing the processing industry and the horticultural sector together, we can make considerable headway. Market parties have shown interest in all our projects and the scientific proof of the feasibility of the projects is there. A last requirement is that entrepreneurs are closely involved in the projects, on the production and the market sides.' Pijpelink: 'Impuls Zeeland also emphatically encourages the selling parties and the supply side, and the entire supply chain in between, to become involved in the development of new products, so that it goes further than just development and a market is actually created.'

NO GOLDEN BULLET

'It just takes a lot of time,' thinks Mur. 'But we now have an extract library with raw and cleaned extracts from around 1,200 plants grown on a commercial basis. Of course, it is no golden bullet, but we do have something tangible in our hands that connects the horticultural sector and industry. Other parties also concur with this. The extract library generates funds for research and creates knowledge for valorisation. The innovations that arise in turn create new business. That is the current impact of the library, on a national but also international level. Currently we are working with companies like L'Oréal to see how they can use the extract library for screening, for instance for anti-ageing compounds or skin-whitening substances.'
It is all becoming increasingly more tangible, so that a breakthrough will definitely be made, asserts Heistek. 'A number of the current projects, like Nedervanille (see box), are now at the turning point and almost ready to go to market.' A little more patience, that is the drift of the above experts: the market-mature products are on their way. ●

This article has been written in cooperation with Biobased Delta.

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