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## PRESSING AHEAD

The circular economy in a general sense and the biobased economy in particular will eventually become an economic reality. But the question is: how fast will this transition happen? As Rein Willems (ex-CEO of Shell Netherlands) argues in the interview in this edition, the developments in 'green chemistry' are proving to be ponderous and slow. This can be blamed partly on the damnable oil prices – we know that by now – and partly on a government which invests predominantly in pre-competitive R&D. Unfortunately this does not apply to actual industrial activities, that is, a biorefinery which converts biomass on a large scale into semi-finished products which can then feed the downstream.

The same applies to the circular economy. This has become a household concept, at least among those who have an above-average interest in economy and the environment. According to Jan Jonker, Professor of Corporate Sustainability at the Radboud University in Nijmegen, the name recognition is at odds with the economic reality. Many companies simply have no idea what the circular economy means and how they can earn money with circular concepts in an as yet linear economy.

The professor sees an active role for the public sector, also in view of the national government's high ambitions. To start with, from 2018 the Dutch government needs to start investing cumulatively in the further development of a circular economy. In practical terms this means one billion euros in 2018, two billion in 2019, four billion in 2020, etc.

But money is not enough, says Jonker. Just as in the biobased economy, laws and legislation will have to be amended so that circular business models are also legal. Jonker advocates 50 'pilot zones' where laws and legislation are relaxed. These circular experimental gardens are where the circular 'seeds' can then be sown. These can be businesses, but also citizens who often develop circular concepts in organised form. The power of simply doing it: it shouldn't be underestimated, according to Jonker. Before you know it, the theme becomes the domain of theorists and consultants. Not that fundamental insights are not necessary, but often people learn best by actually doing things.

Apart from committed citizens, the circular economy also needs committed consumers. Far too often 'we' still go for cheap products which have a relatively short lifespan. On the other hand, businesses should not be naive either. Will a consumer be willing to pay more for a product based on recycled plastic than on virgin plastics? Whatever the case, the market factor is crucial. The push factor is essential to get the circular economy moving, but the pull factor will trigger the breakthrough in the end.

## END OF SUGAR QUOTE SPURS INNOVATION

**The EU quota system for sugar production will end by October 1 of this year. Production will rise, prices will fluctuate but above all: there will be lots of new chances to make much more use of the sugar beet as a whole.**



That was the centrale message of the presentation of Frank van Noord, director of Research & Development at Suiker Unie. Van Noord spoke at the Carbohydrate Competence Center (CCC) Open Day which took place in May.

The European market for sugar production has been very predictable for many years: fixed quota for food production, almost no exports possible but excess production could be sold as raw material to the chemical industry.

As from October, all this will change. 'The production quota will be gone, and we are allowed to produce for the world market. This creates a

much more dynamic situation. We are already putting the final touches on adaptations to our three factories to prepare for increased production this fall.'

### Shift

On top of that, there's an increasing interest in using sugar or beet pulp as an alternative for raw materials that are traditionally produced by the petrochemical industry. Alcohols or polymers for plastics can all be made from sugar beets. 'At Suiker Unie, we have been making sugar for over a hundred years. But now, there is a shift towards biorefinery: getting maximum value from the beets.'

New knowledge and insights are needed to create maximum value from the beets. That's where the CCC is a very valuable partner, says Van Noord. 'Collaboration with academics helps us to look at carbohydrates in new ways. We really need this to keep ahead in the new, much more dynamic sugar beet market.'

## AMIBM WINS RALF RAUE AWARD

**At the BIOMEDICA summit in Eindhoven AMIBM (Aachen-Maastricht Institute for Biobased Materials) was awarded the Ralf Raue Innovation Award for Life Sciences 2017.**

According to the jury 'AMIBM (Aachen Maastricht Institute for Biobased Materials) follows the spirit of Ralf Raue with regard to bringing people, knowledge and infrastructure of the EU-region together on the social relevant topic of biomedical engineering. By training young people into excellent professionals for academia and industry and stimulating the collaboration between academia and industry by building-up a sustainable cross-border institute located in the industrial environment of the Brightlands Chemelot Campus.'

As a much appreciated board member of BIOMEDICA, Dr. Ralf Raue previously dedicated much of his time to stimulate cross-border innovation between Euregional partners.

## Global Bioenergies inaugurates bio-isobutene demo plant

**Global Bioenergies, a publicly-listed renewable chemical company at Euronext stock exchange, inaugurated in May its new bio-isobutene demonstration plant in Leuna (Germany).**

Global Bioenergies claims to be the only company currently producing sugar-based isobutene, a chemical building block that can be converted into fuel, plastics, organic glass, elastomers, etc.

Gevo was once previously working with Lanxess to convert bio-isobutanol to isobutene but Global Bioenergies' one-step process seems to be more economical. The advantage of gaseous isobutene over isobutanol is that it could be easily recovered from the fermenter with minimal separation energy input, and that the low aqueous solubility of isobutene minimizes product toxicity to the microorganisms.

Global Bioenergies started the 100 tpa demo production of bio-based isobutene last year in December. The Company initially focused its efforts on the production of isobutene. With the demo plant now ongoing, Global Bioenergies is now preparing its first full-scale plant through a joint venture with Cristal Union, named IBN-One.



## TU DELFT JOINS KLM'S BIOFUEL PROGRAMME

**Over the coming two years, the staff at Delft University of Technology will take flights using sustainable biofuel. Today, the university signed an agreement to participate in KLM's Corporate Biofuel Programme.**

Through the Corporate BioFuel Programme, the Dutch airline hopes to promote the market for sustainable biofuels in the aim to reduce carbon dioxide emissions. By participating in the Corporate BioFuel Programme (CBP) the university wants to contribute actively to the introduction of more environmentally friendly jet fuel. With this partnership, the university can reduce CO<sub>2</sub> emissions among its staff's business travel by about 10% per flight.

Other partners in the Corporate BioFuel Programme include ABN AMRO, Accenture, FrieslandCampina, the City of Amsterdam, PGGM and the Schiphol Group. KLM only purchases biofuels made from raw materials that have no negative environmental impact on biodiversity or food production. Sustainable biofuels are purchased through SkyNRG.

## Shell: advanced biofuels production in EU

**Shell aims to produce advanced biofuels at a (semi-)industrial scale at the beginning of the next decennium. These facilities are most likely to be planned in Europe and Canada, as it stands now.**

Andrew Murfin (general manager Advanced Biofuels, Shell) stated this at the World Bio Markets conference which was held in Amsterdam from the 27th until the 29th of March. 'At the moment, we are between TRL5 and TRL 7. Not where we want to be, but the next three to four years we aim to be at TRL9.'

As for the location of the advanced biofuel plants, Murfin said: 'Both the EU and Canada have policies in place which create room for advanced biofuels (via mandates, ed.). However, mandates do not guarantee price levels.'

## 23<sup>RD</sup> - 27<sup>TH</sup> OF JULY

### **Bio World Congress on Industrial Biotechnology, Montréal, (Canada)**

The 2017 BIO World Congress on Industrial Biotechnology returns to Montreal. The congress provides a unique forum for business executives, government officials, academic researchers and industry leaders to share the latest advances in renewable chemicals, synthetic biology, enzymes, food ingredients, biofuels and more.

Meet and network with 1,000 global business leaders, investors and policy makers, attend education all week that covers the latest in industrial biotech including synthetic biology, advanced biofuels, biobased materials plus two new tracks on flavors, fragrances and food ingredients, as well as agricultural crop technologies and biomass supply. Experience and learn about the latest in technology and innovation in the Exhibit Hall and throughout the event.

## 9<sup>TH</sup> - 11<sup>TH</sup> OF OCTOBER

### **EFIB 2017, Brussels, Belgium**

EuropaBio and Smithers Rapra are proud to announce dates and venue for 10th edition of the globally renowned European Forum for Industrial Biotechnology and the Bioeconomy.

This year's event is setup to surpass the success of the 2016 edition, which attracted 650 biobased professionals to Glasgow for three jam-packed days of business critical presentations, enlightening workshops, a showcase theatre, PitchFest and one of the largest bioeconomy exhibitions in Europe.

EFIB 2017 will not only deliver a high-level agenda of decision makers from global biotechnology leaders, SMEs and consumer goods companies, but will also provide an increasingly productive networking environment, with all delegates receiving unlimited access to our exclusive 1-to-1 partnering tool.

## 17<sup>TH</sup> - 18<sup>TH</sup> OF OCTOBER

### **Biofuels International 2017, Edinburgh**

Biofuels will continue to play a crucial role in the fuel supply chain with current and new producers looking to improve their processes and search for new markets, whether that be aviation, marine or vehicle biofuels.

The 10th anniversary edition of the leading Biofuels International conference & expo, for the first time held in partnership with Bioenergy Insight conference & expo, will focus on the latest developments in biofuels policy, international biofuels trading, sustainability, solutions for first generation producers, progress in advanced biofuels and information on feedstock pricing and trends. It's a must attend industry event with many great networking opportunities.

With over 200 attendees over 2 days of high level presentations and discussions it is an excellent opportunity to engage with the market and to highlight your company's products and services.

## Call for participation BIO-HarT

**Currently partners in Biorizon's BIO-HARt project are looking for companies with an interest in biobased aromatics that would like to receive samples to test them in their own applications and share the results with us.**

In time, the consortium will be able to provide samples of sugars, lignin, furans, alkylphenols, mono-, di- and tri-acids, functionalised phenols and other aromatic compounds. 'This is a unique opportunity to share your specific wishes with us regarding the characteristics of the samples (functionality, reactivity, ..) in order to discuss how we could cooperate and both benefit from the results. In collaboration with the industry, applications will be developed based on these test samples', according to BIO-HarT.

In the cross-border BIO-HARt-project (Biorizon Innovation and Upscaling of Renewable Aromatics Technology) ten partners are working on the scaling up of technology for the production of aromatics from biomass. By the end of 2018 this must result in functioning bench scale demonstrators that can produce samples for the industry on a kilogram scale. Besides that, the processes for the production of bio-aromatics will be optimized further.

In BIO-HARt, project coordinator and co-initiator of Biorizon, TNO, works together with VITO, Avantium, Chemelot InSciTe, University of Antwerp, KU Leuven, Bio Base Europe Pilot Plant, Technical University Eindhoven, Maas-tricht University and DSM ChemTech Center.



## AVANTIUM, LEGO, AMYRIS TO SPEAK AT EFIB 2017

**Chief Executive Officer of Avantium, Tom van Aken, is one of the speakers that's confirmed for the European Forum for Industrial Biotechnology and the Bioeconomy 2017 (EFIB2017). Also Nelleke van der Puij, VP Materials at Lego Group and John Melo, President and CEO of Amyris, will speak at the EFIB 2017.**

Besides the aforementioned speakers, the three day event, which will take from the 9<sup>th</sup> until the 11<sup>th</sup> of October in Brussels, is jam-packed with enlightening workshops, a showcase theatre, PitchFest and one of the largest bioeconomy exhibitions in Europe. It will also provide an increasingly productive networking environment, with all delegates receiving unlimited access to the exclusive 1-to-1 partnering tool.

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**The future of the Dutch chemical industry lies in optimising the bottom line and making it more sustainable, partly by optimising existing processes and partly by using more renewable raw materials, according to Rein Willems. The second pillar, however, is not strong yet. 'The developments are proceeding laboriously and certainly not as fast as desired.'**

Text Lucien Joppen Image Casper Rila

**R**ein Willems, former head of Shell Netherlands, has been closely involved in the strategic plans drawn up for the port of Rotterdam and the Eems Delta. The course of action for both chemical clusters is based on a two-track approach: increased sustainability/cost reduction for existing processes and investment in activities in the area of renewable raw materials. One of the results of this in the northeast of the Netherlands was Chemport Europe which opened in April.

**Rotterdam and the Eems Delta need to prepare ahead for a more sustainable chemical industry. Is this transition proceeding according to plan?**

'Good progress is being made in the northeast of the Netherlands, in Delfzijl (part of Chemport Europe, editor's note) to be precise. That applies especially to the way the businesses share the costs of utilities. This in turn has resulted in cost savings, some of which are used to invest in new activity. A good example is a biorefinery which AkzoNobel, Avantium, Chemport Europe, RWE and Staatsbosbeheer (public organisation in forestry, editor's note) want to build. Setting up infrastructure for steam based on biomass is another initiative. This enabled AkzoNobel, in collaboration with Eneco, to straightaway make one tenth of its power consumption green in the Netherlands. Timewise, the plans for the port of Rotterdam are slightly behind those for the Eems Delta. Initiatives for more sustainable processes have been implemented, such as Shell's supply of residual heat to 16,000 households. By putting things like heat, energy and CO<sub>2</sub> to better use, businesses can lower their process costs and reduce their CO<sub>2</sub> footprint: a win-win situation. The biobased chemicals situation in Rotterdam is slightly more difficult. About 14 new players are aiming at chemicals

**Reinier (Rein) Willems** (Geleen, 26 August 1945) has an extensive CV in the chemical sector and national politics. From 12 June 2007 to 7 June 2011 he was a member of the Senate of the States General. From 2003 to 1 September 2007 Willems was President of Shell Nederland. Willems studied chemical technology at the Delft University of Technology. In 1970 he started working for the Royal Shell Group, where he held various positions in the Netherlands and abroad. Willems is a member of the executive board of VNO-NCW and delegated supervisory director of Gasunie. The Dutch government under Rutte designated Willems as a figurehead of the Top sector Chemistry.

based on renewable raw materials. But the problem is that these relatively small companies stay small, because there is a lack of scale. We are waiting for a large-scale biorefinery which will then feed the downstream processing companies with semi-finished products.'

**Why has that biorefinery not been built yet?**

'Currently there is not a good business case for this kind of facility as yet. The low oil prices are largely to blame. There are simply no parties willing to invest 200 to 300 million euros in a biorefinery right now. This will only be possible if governments assume part of the risk. There is very little enthusiasm, either from the government or from private investors. A few years ago I urged the Ministry of Economic Affairs to participate in the construction of a biorefinery. We are now three years down the track and the silence is deafening! Perhaps Invest-NL, established at the start of this year with a budget of 2.5 billion euros, can provide a solution. Are there prospects of

such a plant in the medium term? I know that Biobased Delta has made considerable progress with the Redefinery project, but also that no decision has been made yet.'

**Apparently these biorefineries are possible in the US, Brazil and Malaysia**

'Yes, but only because the governments there contribute financially. The business case for such plants is not really different to here in Europe. It's just that here "we" are wary of investing in industrial production. The emphasis is on pre-competitive R&D projects. That is a good thing in itself, but we do have to prevent this R&D from being turned into industrial production outside of the European Union. If the activity is shifted more and more to outside the EU borders, the expertise will also disappear more and more to other continents. That would be a terrible shame, certainly for the Netherlands which has an excellent worldwide reputation in the field of petrochemicals, chemicals and biotechnology.'

**Are the Netherlands – and the EU in a wider context – on the right track in any case with their R&D programmes in innovative and more sustainable chemical and manufacturing industry?**

'I still support the Dutch innovation policy as implemented with the nine Top sectors. "We" have the potential in all those sectors to play a part on the world stage. The point is that we must not become slack. Other countries and continents are investing substantially more in scientific research and R&D, luring our talented researchers away to universities and research institutes overseas. Ben Feringa, who won the Nobel Prize for Chemistry last year, had every reason to appeal to the government for more money and resources for fundamental research.'

**Shouldn't the business sector feel challenged as well? Scientific/fundamental knowledge is essential for radical innovations. And it is the businesses which form the link between fundamental research and the market.**

'Certainly we should challenge businesses on this point. The past years have been anything but easy for the chemical and manufacturing industries. When the focus is on rationali- >>



## BBI JU ON TRACK FOR 2020

The European strategy "Innovating for Sustainable Growth: A Bioeconomy for Europe (2012)" calls for a bioeconomy as a key element for smart and green growth in Europe. To make this happen the European Commission (EC) and the Biobased Industries Consortium (BIC) joined forces in the Bio-Based Industries Joint Undertaking (BBI JU).

The aim is to keep investments in Europe and to deploy and create new markets for sustainable bio-based products. Derisking this emerging but fragmented industrial sector, together with supporting the high costs for demonstration and deployment activities, were key drivers for this public-private intervention.

Now that the mid-term review of the Bioeconomy Strategy is ongoing, what has the BBI JU realized? Since 2014, BBI JU has substantially contributed to building the European bio-based economy sector.

Well, after the first three years, already 65 projects - including 20 demos and 6 flagships are running with a total of 729 participants from 30 countries for a total grant of € 414 million public funding and € 2.15 billion of private contribution announced by beneficiaries. More than a third of current beneficiaries are SMEs. Furthermore, BIC's annual survey shows that its members in general had 2 billion euro's worth of investments in the European bio-economy in the pipeline end of 2014, and this increased to 4.7 billion beginning of 2017.

The expected outputs by 2020 (from projects launched so far) are well above expectations, e.g. 82 new or optimized bio-based value chains, 46 new bio-based chemical building blocks based on biomass from European origin, 106 new bio-based materials such as breakthrough chemicals, fuels, fertilizers, fibers, plastics, bioactive ingredients and proteins, and 47 new bio-based consumer products based on bio-based chemicals.

One of the strategic pillars of the BBI JU is to create and accelerate market uptake of bio-based products. Bio-based industries are increasingly engaging with brand owners in projects. This direct involvement is key to develop new applications for bio-based products that are appreciated by consumers.

These facts and figures describing the impact of the BBI JU after only 3 years of operating cannot be neglected during the mid-term evaluation of the EU Bioeconomy Strategy, and during the preparation of the next Framework Programme (FP9). Creating jobs and growth, and making the industry more sustainable are key for our society!

**Dirk Carrez**

Executive director Biobased Industries Consortium

sation, investments in new business are affected adversely. DSM implemented its policy consistently. Shell is now much more active in the area of renewable energy, as witnessed by the ambitions in advanced biofuels.'

**Back to the government. In view of the broadly supported commitment arising from the Paris Climate Agreement, governments could tilt the playing field more towards energy as well as chemicals from renewable raw materials. That would also 'soften' the effect of a lower oil price.**

'In the Netherlands and also worldwide there is broad consensus about climate change and the role of CO<sub>2</sub> reduction in minimising its effects on people and the environment. Some parties do go too far in the sense that they want to lay down the law for businesses or want targets which are not economically feasible. The business community wants to reduce its CO<sub>2</sub> footprint as well, but in a way that allows it to remain competitive. Putting a price on CO<sub>2</sub> and trading in it has turned out to be ineffective. I expect changes in this to happen in Europe in the short term, partly by removing free rights from the market. That is something that will have to happen. CO<sub>2</sub> currently costs five to six dollars per tonne; it will have to be at least 40 dollars to have any kind of effect. Besides a higher tax on carbon, I see market forces as an effective lever to limit CO<sub>2</sub> emissions. Large brand owners, for example in the automotive or food sectors, want to reduce their CO<sub>2</sub> emissions. This has a ripple effect through the supply chains which supply these companies. Investors are looking more and more at the "ecological performance" of businesses. One wake-up call is the initiative of the Financial Stability Board to draw up accounting standards for the evaluation of the climate actions (editor's note: CO<sub>2</sub> emissions) of businesses so that investors can compare these efforts. My expectation is that this measure will be highly effective.'

**How important do you think fossil raw materials are in the medium term? It looks like the oil price will remain relatively low for the time being.**

'Their importance will decrease, but slowly. Fossil currently accounts for 80 percent of the volume of fuel and raw materials. According to various parties (editor's note: IEA, BP, Shell, ExxonMobil), that will be around 60 percent in 30 years' time. The fossil sources will shift more, with the more polluting raw materials such as coal and diesel being exchanged for gas or advanced biofuels. The price of oil will not exceed 60 dollars for the time being. That ceiling has come about due to shale gas exploitation. At lower prices shale gas is not profitable, but it enters the picture when prices are around 60 dollars, which makes the supply grow and dampens any price rises. Let's not forget that the global demand for energy is still increasing, by 1 to 1.5 percent per year. To meet this demand we still need fossil energy for the time being.' ●



Maasvlakte 2: a site of more than 80 hectares for businesses which are active in innovative chemicals based on renewable raw materials.

# CHEMELOT INSCITE: SUCCESSES AND VALIDATION

**Chemelot InSciTe was launched at the start of 2015. The public-private joint venture has been active for two years now. High time to haul in the nets and inspect the catch. The initial results are positive. Currently significant work is ongoing on the validation of the economic feasibility.**

Text Lucien Joppen

**C**hemelot InSciTe (Chemelot Institute for Science & Technology) was set up by the Technical University of Eindhoven, Maastricht University, Academic Hospital Maastricht and DSM with support from the Province of Limburg. Contrary to the many virtual joint ventures, it has an actual physical infrastructure with laboratories, pilot facilities, offices and suchlike. They are located at the Brightlands Chemelot Campus in the southeast of the Netherlands. It also has a link with education, so that students can be trained to become 'biobased' or 'circular' professionals. 'InSciTe Biobased is about more sustainable materials and processes which link in seamlessly with the circular economy', according to Bart van As, business developer at InSciTe. 'To that aim we need biobased materials and more effective and/or milder processes. At InSciTe we are focusing on two tracks: biomedical materials and biobased building blocks.'

## SECOND-GENERATION BIOMASS

For the latter track, InSciTe is aiming at the biobased building blocks which serve as a platform for derivatives for chemistry and materials. These building blocks are based on second-generation biomass, thereby avoiding the food-versus-fuel or food-versus-materials discussion. The processes to expose this biomass do require more energy and the yields are not always high enough for a solid business case. What is more, combinations of technologies are often required which are not present

At the end of 2017, another InSciTe project in the biobased chemicals track will be completed: LA2AA. This project focuses on a more sustainable production route for adipic acid. It is based on biobased levulinic acid, which reduces the CO<sub>2</sub> footprint and creates fewer residual products. The process was scaled up successfully from the laboratory to the MPP plant. The project will possibly be continued by a private party.

under the same roof. That is why InSciTe addresses the need for groups of companies to investigate these technologies and scale them up in a pilot project setting. It is then up to the private parties to bring processes and/or products to the market.

## LIGNIN CRUDE OIL

Michael Boot (Eindhoven University of Technology) is working very hard on the latter. At InSciTe, he is the project leader of Lignin RICHES. This project is based on a thermocatalytic process developed in the group of Professor Emiel Hensen (Eindhoven University of Technology), to convert lignin into so-called lignin crude oil (LCO).

'It involves lignin which arises as a by-product from the production of second-generation bioethanol. This raw material is currently used mainly as a source of energy for the biorefinery process. Once converted into LCO, the value of the lignin increases by a factor of four. This is

because lignin can be replaced quite simply by relatively cheap natural gas. On the other hand, LCO offers an alternative to the much more expensive high-sulphur fuel oil which the shipping sector currently uses for bunkering. To keep the cost price of LCO under control, refining will not go any further than is done for tar sand oil. This makes the oil just fluid enough to flow through a pipe and burn in a ship's engine. We will have to optimise our process for this purpose: that means lower process temperatures and a lower concentration of catalysts.'

## PILOT PRODUCTION MID-2018

Van As believes that biobased fuel oil has a good chance of succeeding. After all, shipping is a particularly polluting sector due to the use of high-sulphur (3 to 5 percent) fuel oil. More sustainable alternatives such as electrification are not present. 'In the short to medium term, low-sulphur, biobased fuels like LCO are the only option to make shipping more sustainable.' Before Michael's LCO can reach the market, various things will still have to happen. The pilot production is scheduled to take place from mid-2018 in the Multipurpose Pilot Plant (MPP) at Brightlands Chemelot Campus, where Boot will test on a 100 kg scale. 'By the end of next year I want to be able to produce one barrel of LCO a day: that's around 160 litres. These volumes are essential to attract the interest of industrial partners.' ●

*This article was created in collaboration with Source B.*

# PROPER RISK MANAGEMENT NEEDED

**There are funding gaps that hamper the development of circular/biobased projects in the EU. Private investors for now are reticent to invest, mainly due to perceived risks. Measures should be taken to manage these risks in a proper fashion.**

Text Lucien Joppen Image Shutterstock

In May 2017, the European Investment Bank (EIB) published a study, performed by Ernst&Young. The report, devised in close collaboration with the Bio-based Industries Consortium and its members, aims to collect information on the access-to-finance conditions for larger investment projects in the domain of biobased and the blue economy.

Furthermore, the study also explores the need and potential for public risk-sharing instruments as well as policy actions (EU and on a member state level, ed.) that would be able to attract funding from the investment community. First of all, what is the current situation in terms of capital investment? As for the public sector, the EU is investing 3,8 billion euro into the bio-economy in the period 2014-2020. The EU also participates with roughly 1 billion euro in the Bio-Based Industries Consortium: an investment that is matched by at least 2,7 billion euro of private investments.

## RISK FACTORS

However, these funds for now seem to be insufficient for biobased and blue economy projects to 'move' across the TRL-time line. 'Ernst&Young surveyed more than 20 biobased industries investment projects, some of them running

under the BBI-flag', Dirk Carrez (Biobased Industries Consortium) says. 'Roughly eight of ten respondents mention difficulties in accessing finance from private investors. These parties identify a number of risk factors, such as market demand, technology and EU/national regulation. The first risk-factor is identified as the major one: most biobased markets are not fully developed yet and have to compete with mature sectors.'

The report also mentions issues in getting sufficient public funding, especially in the commercialisation phase. Procedures are complicated, lengthy and the sums are relatively low, compared to the private funding needed. Therefore, the catalytic effect of public funding is low, which in turn turns private investors away. Carrez: 'The result is that industrial-scale (TRL9) projects are being halted, which in turn slows down the transition process towards a European bio-economy.'

## FUTURE GROWTH POTENTIAL

The report also includes feedback from so-called financial market participants (FMP's). These parties - some of them are investing into the bio-economy - confirm that they view regulation, market and technology-related risks as

being very high. Furthermore, they state that sometimes there is information asymmetry and insufficient understanding of the sector and related risk assessment.

'Interestingly enough, these investors are not turned away entirely by the aforementioned risk factors', Carrez says. 'As said before, some already are investing and they state that they see its future growth potential in terms of turn over and profit. It is the sustainable and innovative drive of the sector that appeals to these investors. Some of these investors identify early mover advantages, which signals the urgency to invest now and not apply a 'waitandsee'-approach.'

## SIMPLER PROCEDURES

In short, there is not so much lack of public funding in general, but more a lack of funding in the upscaling and commercialisation stage of biobased industry related projects. This is also the stage in which private investments have to step up. If not matched properly with public funding and sufficient insights (information asymmetry, ed.), private investors are not willing to draw their wallets. The report mentions a number of public financial instruments that could partially de-risk private investments, such as loans, guarantees or equity investments. These instru-



ments also should have more favourable conditions such as simpler procedures and lower interest rates. The establishment of investment platforms, bundling together various public and private investors, is seen by a majority of FMP's as a way to mitigate risks across the value chain. As for the information asymmetry, most FMP's advocate the development of information exchange platforms that would provide market and technology insights for investors.

## EFFECTIVE, STABLE AND SUPPORTIVE FRAMEWORK

The report concludes with four key recommendations to address the existing funding gaps in the biobased and blue economy. First of all, the establishment of an effective, stable and supportive regulatory framework at

the EU level. Policy actions should demonstrate a long-term commitment to support the development of more sustainable alternatives to fossil fuels. This should not be limited to energy but extended towards chemicals and/or materials. These actions should be directed at creating price and volume stability as well as the availability of sufficient feedstocks. The report identifies many routes, for example harmonisation of labelling standards, setting targets for biomass use in materials/chemicals or procurement programmes.

## MEETING POINT

Second, to raise awareness within the industry of specific funding tools from the EIB which are already in place: InnovFin and the European Fund for Strategic Investments (EFSI). These funds, though not specifically targeted at the

bio-economy, could match other funding instruments such as grants from the BBI JU. The establishment of a EU-wide information platform could help creating awareness regarding these funding options as well as provide insights to investors.

Third, the development of a new EU risk sharing financial instrument, potentially in the form of a thematic investment platform which would be able to attract private investors.

Last but not least, the creation of a EU-wide information platform that would provide insights to all stakeholders regarding market, technology and public investment opportunities (f.e. InnovFin, EFSI). Carrez: 'Such as meeting point could help promoters and investors find partners and create business partnership that are needed to bring the bio-economy forward.' ●

# FOCUS ON BIOBASED CHEMICALS AND MATERIALS

Ghent is the birthplace of bioenergy production in Belgium. No less than 90% of all biofuels in Flanders are produced here. The renewed cluster Flanders Biobased Valley (FBBV) will provide a further boost to biobased chemicals and materials. In addition to this, FBBV wants to become the premier cluster organisation representing the biobased economy in Flanders.

Text Lucien Joppen Image FBBV



Ghent is traditionally an area where large agro bulk streams enter the country', according to Sofie Dobbelaere, managing director of Flanders Biobased Valley (FBBV). 'This contrasts with the port of Antwerp which concentrates more on petrochemicals and container transport and storage. Ghent – especially the University – has also built up significant expertise in the field of biotechnology. So it is no coincidence that Ghent Bio-Energy Valley was established in 2006. This was in large part due to Wim Soetaert (Ghent University). His inspiration and the cooperation between private and public partners enabled Ghent to attract a large share of the development and production of biofuels here over the years.'

## BIOREFINERY CLUSTER

Currently in Ghent roughly 350 KTon biodiesel, 170 KTon bio-ethanol and 250 MW electricity are produced on the basis of biomass every year. A biorefinery cluster has arisen at the Rodenhuisziedok with two producers of biofuels, Cargill (supplier and pre-processor of rapeseed) and two storage companies. Dobbelaere: 'We have acquired a lot of experience in setting up this kind of biorefinery cluster. It was easier for us as a neutral party to bring the parties together.' In the meantime, the plants are running at full speed and have been able to push up production several times. Full attention is now being paid to second or third generation streams, according to Dobbelaere. 'One interesting route is gas fermentation. This process converts carbon monoxide and hydrogen into ethanol by means of fermentation.

ArcelorMittal is currently building a large-scale plant to convert one tenth of the gas emissions from its factory in Ghent into ethanol.'

## GROWTH OF BIOBASED CHEMICALS

Since its establishment in 2005, FBBV has expanded into a major cluster organisation which supports and promotes the development of the biobased economy in Flanders. Just as the cluster was the birthplace of the biofuel industry in Flanders, it now also wants to be the driving force behind the further development of the biobased economy in Flanders. In contrast to energy/fuels, particularly strongly regulated markets, there are still significant growth opportunities for biobased chemicals and materials, in the eyes of FBBV. According to Soetaert, half of all chemicals will be produced from biomass by 2050. The oxygen molecules in particu-

lar set biomass apart from fossil raw materials. Because these molecules are already present naturally in the biomass, these functional groups do not have to be added, which simplifies the production process and makes it less expensive.

## CONNECTION WITH CHEMISTRY

The question is: which role do the parties under the FBBV umbrella see set out in the route from biomass to chemistry? 'We have defined a number of strategic domains for ourselves,' explains Dobbelaere. One of them involves the upstream section. 'This is the part of the route where biomass, preferably residual streams, is converted into sugars through pretreatment. The Bio Base Europe Pilot Plant is one of the places where a great deal of expertise has been acquired over the years in the technological and economic

evaluation of the different routes. These sugars can then be converted into chemicals through fermentation or chemical conversion. In that context we work together closely with organisations such as Catalisti, which has the objective of boosting innovation in the Flemish chemical and plastics sector. Another strategic domain is the conversion of waste gas into chemicals via syngas fermentation, which is a biobased process.'

## FACE OF FLANDERS

FBBV will also present itself more as the turning and linking point for Flemish businesses and public organisations which are active in the biobased economy; this also explains the name change. 'We were associated too much with Ghent,' according to Dobbelaere. 'This broadening was necessary so we would no longer be

regarded as a purely regional initiative, but as a Flemish cluster which wants to support the biobased economy in the whole of Flanders. We want to create a support base and contact point in Flanders for the development of the biobased economy. On the one hand we want this platform to supply businesses with the essential knowledge and contacts, and on the other hand we also want to make the government aware that the biobased economy offers huge potential for Flanders and accordingly deserves the necessary support. We believe there is a need for this kind of cluster, so that it is clear for businesses or other organisations where they can turn to for questions about everything that has to do with biobased. That is not so obvious right now. With bio-energy we saw that a joint approach works. We are now continuing along that line.' ●

# AMPLE OPPORTUNITIES AND CHALLENGES

Slowly but surely, natural fibres are finding their way into widely varying markets such as construction, infrastructure, automotive and packaging. The heterogeneous character of natural fibres still presents challenges in the manufacture of homogenous end products.

Text Lucien Joppen Images NAC, Unipak



The Natural Fibre Application Centre in Raamsdonkveer.

Incorporating natural fibres in end products is no easy task', according to Leon Joore (Millvision). 'That is why a separate natural fibre cluster has been set up in the Biobased Delta (public-private cluster in the South West of the Netherlands) which concentrates on the whole supply chain: from plant to customer. This is because every process step has consequences for the next step and in the end the application in which fibres – often combined with other materials – are used.' An important part of the natural fibre cluster is the Natural Fibre Application Centre (NAC), which houses laboratory and pilot equipment for testing whether applications do what they are supposed to do. The NAC originally targeted wood (paper) and agricultural (residual) fibres for paper, cardboard and composites. Now the NAC also includes other fibres such as hemp, flax, miscanthus, bamboo and sorghum.

## BOSKALIS

A material in itself is not yet an application or a market. These include packaging, construction and infrastructure, paper/cardboard, ornamental gardening and automotive. Over the years, various applications have been developed at the NAC which are now being tested in the field. A number of projects in the infrastructure sector have reached the regional and national media. Boskalis, active in infrastructural projects, was recently awarded the contract to widen a certain section of the Tractaatweg road in Zeeland. The province of Zeeland, the client, challenged the company to come up with biobased solutions. Thus the anchoring system and the geotextile are (partly) based on biopolymers. The N18 road near Lichtenvoorde (province of Gelderland) is likewise a good example of biobased in infrastructure, with the use of wood fibres in concrete and sound barriers.

## ZEELAND LEADS THE WAY

Esther Stapper, colleague of Joore at the NAC, suggests that (regional) governments have a major part to play in infrastructure – and construction – by facilitating these kinds of projects. 'We need these showcases to show other parties that it really works. Some provinces, such as Zeeland, are leading the way in this respect. It is important that the other provinces follow suit. Market parties will have to make it clear what biobased is, to make this process easier. The NEN standard is a minimum 30 percent (biobased) of the volume. At least as important are sustainability parameters, such as an LCA

(including CO<sub>2</sub> footprint) and the end-of-life: can you recycle the material? If so, into what kinds of products?' Stapper believes that governments also need to take the necessary steps when it comes to sustainable purchasing. In practice it often goes wrong, because price is the most important factor, or because buyers are not familiar with the material. Good news in this area is the Responsible Procurement Manifesto 2016-2020 which various provinces, municipalities and water boards have signed. Key points in the Manifesto are combating climate change and environmental pressure.

## DIFFERENT PRETREATMENT METHODS

At the NAC different methods of pretreatment are tested in practice, such as shredding, milling, fractionating, cleaning, condensing, drying and pelleting. That is just the start of the process. The fibres then have to be exposed (mechanically or chemically). 'These technologies are present, on laboratory and pilot project scale,' according to Joore.

The NAC is the only place in the Benelux countries with a pilot paper machine (50 kg/hour) which can process wet pulp. The dry pulp can be processed in a compounding plant. 'When we produce for a few hours, that gives us sufficient data to calculate a business case. There is also enough material for applications so that end customers can perform their tests.'

## CONCRETE CLUSTER

According to Joore, governments can also play a more active part in the phase preceding the pilot project, namely in the area of applications. 'Public funds mainly go to research, which leaves a gap in the intermediate phase. As a result, few (partly) biobased products enter the market. That explains my plea for a focus on application research in which SME businesses will be linked together. The market demand will be the

guiding factor: what do end customers want exactly and to what extent can natural fibres play a part in that?

A good example of this kind of practical market demand comes from Concrete Valley, a large production facility in Bergen op Zoom. Since 2012, this location has been the home base for a range of innovative companies in the concrete industry. Currently three companies are operating in the Valley: mbX, microbeton and Waco. At mbX, specific concrete products are produced for ornamental and constructional elements. The director of Concrete Valley, Pieter Nap: 'We stand out mainly because of our distinctive shapes. We have developed a specific flexible mould for them, which allows us to produce these elements. For instance, we produced the double curved elements for the public transport terminal in the city of Arnhem.'

## WEIGHT REDUCTION

Microbeton makes elements like balconies and façade components. Nap: 'We want to make these elements as light as possible, but they must have the same functional properties. Microbeton reduces the load factor of the façade and can often be installed on existing structures without too many adjustments, using our patented chute system. Currently we supply these elements with a polystyrene core. That reduces the weight by 60 percent. We are investigating whether we can replace the polystyrene with even lighter biobased materials. We are collaborating with Waco, together with NNRGY BV and the Technical University of Eindhoven, to see whether we can use miscanthus fibres: on the one hand as reinforcement, and on the other as an alternative for sand. It will probably work for ornamental elements, such as frame elements for windows, which do not have to bear as much weight.'

## HURDLES

Bioplastics such as PLA or bio-PET or PE are no strangers in packaging materials any more. Natural fibres have since tentatively made their appearance, for instance in the Rondeel egg cartons which are based on a mix of potato starch and grass fibres.

Unipak from Steenberg in West Brabant is also looking for natural fibre applications for its range. The packaging company targets the food sector especially: a high volume market in which every cent counts. 'The bulk of our range is based on PP and PET. They are proven materials which are very cost-competitive and >>



The production of lighter concrete elements is an interesting market, in which natural fibres can play a part.

The great variety of natural fibres means that a wide range of applications is possible. But that also creates challenges in the application process, according to Florent Gauvin from the Technical University Eindhoven. 'Natural fibres themselves are also composites, and consist of different layers, so that they differ morphologically from each other. That means that their mechanical properties also differ, even in similar natural fibres. Natural fibres are hydrophilic, so they absorb moisture faster and they swell. And that is at the expense of their properties.'

According to Gauvin, there are options for pretreating natural fibres, for instance with epoxy resin or with CaOH<sub>2</sub> (slaked lime), so that they are less sensitive to moisture ingress and/or differences in functional properties.

also quite easily recycled. This is because they are mono-materials: the recycling becomes more complicated and more expensive if a product is made from several materials,' according to packaging consultant Eddie Clarijs.

The above materials, however, are not compostable. That is why Unipak is investigating whether it can extrude foils which are based partly on natural fibres and partly on potato starch. These foils could be used for fresh products and the packaging could go along in the compost stream. The first tests have shown that it is possible, but also that there are still a few hurdles to be taken. For instance, the foil is not transparent, sometimes it has holes, and the fibres can become stuck in the extruder. Clarijs:

'The fibres should not be too long or too stiff. That is an important lesson.'

### HORTICULTURAL APPLICATIONS

Bato Plastics from Zevenbergen in North Brabant produces plastic products for horticulture. These products are predominantly of fossil origin and not decomposable. The company also has some products in its range which are based on compostable plastics, including pots, clipper, wire tensioners and cluster supports. These have end-of-life advantages compared with the fossil-based plastics, because they can be disposed of along with the plant matter (stalks, leaves, etc.). The fossil-based equivalents have to be removed and disposed of, result-

ing in extra costs, especially labour costs.

Gert-Jan Spierings, director of Bato: 'We are working together with Rodenburg Biopolymers and Millvision to use natural fibres from paprika cultivation for the above bioplastics. Of course there are challenges: the longer production time, the stability and homogeneity of the material and the odour which is released in the injection moulding. But the use of natural fibres also has its benefits. The larger the content of natural fibres, the faster the composting process in the ground. To sum up, we definitely see a future for this kind of application in our range.' ●

*This article was created in collaboration with Biobased Delta.*



## The new chemical industry is coming off the ground

The Northern Netherlands offers fertile soil for the chemical industry of the future. We are at the cutting edge in the transition to biobased chemical industry based on renewable resources like **potatoes, sugar beets, grain varieties, and grass and wood**. New products are being developed at the interface of agribusiness and chemical industry. These products meet the wish of producers and consumers to live and work responsibly. That's how we create a world of opportunities for the Northern Netherlands.

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## MASTERS IN SUSTAINABLE POLYMER ENGINEERING

**The industry is searching for processes and products that are more sustainable. The same applies to plastics. Green PAC has responded to this development by offering a Masters degree in polymer engineering.**

In the Netherlands, Windesheim and Stenden universities of applied sciences, which are associated with Green PAC, have developed the Masters for chemical technologists or engineers who are working in polymer chemistry. The Masters programme, starting in September 2017, will have two parts: the industrial applications of biopolymers at Stenden and the process of processing sustainable polymers (biopolymers and recycled polymers), the craft of Windesheim.

'It is not a purely theoretical Master programme,' says Rudy Folkersma. 'The participants also acquire practical experience in the Plastics laboratories at various locations. They can put this experience to use in positions where they are involved in the design of new plastic blends and the effects of these materials on the product and the production process.'

The Masters in polymer engineering is a two-year programme (two semesters, 40 weeks, study load 20 hours a week). The programme starts in September 2017. Participants conclude the Masters with a research project within their own organisation. ●

More information:  
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# MARKET WITH PROSPECTS

Compostable disposables in food service still form a relatively small market, but certainly one with prospects for the future. Out-of-home consumption is rising again, and market parties are looking for more sustainable alternatives to standard materials such as PE and PP.

Text Lucien Joppen Images Biodore, Shutterstock



**T**he European market for (industrially compostable) 'biodegradable food service disposables' in 2015 amounted to no less than one billion US dollars (converted to 2017 currency: 900 million euros). According to Persistence Market Research (PMR) which supplied this data, this market will grow in Europe with a CAGR of 5.5 percent, resulting in a turnover in 2022 of approximately 1.4 billion dollars.

The above market is segmented into plates, trays/containers, cutlery, cups/dishes and the so-called clam shells (editor's note: container with the lid attached to the container and which can flip shut).

The largest segment as regards turnover is concerned is formed by the cups/dishes, with a share of 33.7 percent. PMR expects that this segment will dominate the biodegradable disposable market (BDM) in the coming five years.

## PAPER IS DOMINANT MATERIAL

When you look at the raw materials used for BDM materials, what is striking is that paper is by far the largest segment. PMR did not provide any details when asked for current data. It does expect that paper will achieve a turnover in 2022 of 1.2 billion dollars (of the total of 1.4 billion). Wood/leafy products and bioplastics account for the rest of the market. PMR predicts growth mainly in the last segment, driven by developments in PLA, PHA and potato starch-based plastics, among other things.

PMR sees the expected growth of the BDM market through a heightened consumer awareness of more sustainable plastics with a more environmentally friendly end-of-life scenario (editor's note: more on this later).

## ACTIVE APPROACH IN ITALY

The research agency also observes that food service providers are increasingly making their

business more sustainable. Thus McDonald's has exchanged foam packaging for cardboard, which moreover is made from 70 percent recycled material. Finally, the laws and regulations in some countries cater to the purpose of compostable plastics/materials. For instance Italy, a country with a long coastline, hopes to combat plastic pollution in and around the Mediterranean and Adriatic seas by taxing fossil plastics and giving preference to compostable plastics. It remains to be seen whether this measure will be successful in combating litter and the plastic soup problem. These plastics still have to be collected and then composted. Worse still, consumers might be more inclined to throw away compostable plastics, on the assumption that the composting is a natural process and not an industrial one.

## LARGER AND WIDER RANGE

The growth – especially that of biobased polymers and plastics – is also driven by the larger and wider range. For example, Natureworks has launched the necessary innovations in the PLA segment and consequently broadened the application area considerably. Product parameters such as heat resistance, flexibility and stability are still necessary for many food service applications. A bowl should not bend under a certain load, for example, or become softer because of hot food like soup. According to Natureworks, their High Heat Technology guarantees that PLA for disposable applications like plates, cups and cutlery is a good (and especially more sustainable) alternative for PP and PE.

## ICE-CREAM CONTAINERS

Synbra and its sister company Synprodo are another player which has developed polymers for compostable disposables. The company created BioFoam, a 100 percent biobased and com-

postable alternative for EPS, which it has put on the market.

Director Jan Noordegraaf: 'EPS is used in food service and retail for things like ice-cream containers. This is quite a considerable market in a country like Italy, home of gelato. EPS has the largest part, but the share of BioFoam (editor's note: E-PLA) is growing. The attractive legislation for disposables in Italy and also in France is the main thing which is making the market come round already. Another growth factor, albeit smaller, is the growth of biological food. Some of our customers in this market, for example in Germany, prefer biodegradable materials. As indicated earlier, these products will not reduce litter. Only draconian penalties, as in Singapore, have any effect. These kinds of products do generally have a much lower carbon footprint.'

## COMPLETE RANGES

Bioplastics have now conquered a permanent position on the disposables market. There are even complete ranges available. Thus Van der Windt, part of the Pacombi Group, launched Biodore last year. The brand offers a total of more than 150 items which are based on various raw materials, such as cardboard, (C)PLA, starch and natural fibres. 'We work with different producers around the world,' says Huib Burggraaf, biobased packaging specialist with the company. 'All our products are certified, for instance via the FSC quality mark or Vincotte for the compostability. We supply to retail, food service and other distributors. We have been on the market for a good year now and the turnover has grown 50 percent. Granted, anything that is small grows fast, but we are growing faster than expected.'

## FESTIVAL MARKET OPPORTUNITIES

Burggraaf believes that the growth is >>

mainly to be found in the food service market. The emergence of higher-quality concepts, like Bram Ladage (higher end fast food chain), have made businesses in this market more open to more attractive and more sustainable presentation. 'Appearance is also important. It does make quite a difference whether you present a dish on a pressed palm leaf or a PE dish,' according to Burggraaf. He also sees growth opportunities in festival catering. Every year the numerous (summer) festivals in the Netherlands attract more than 23 million visitors. 'The organisers often try to outdo each other in sustainability. One part of that is keeping the CO2 footprint as low as possible. They can achieve that partly by using biobased disposables.' Burggraaf does admit that Biodore still makes up only a fraction of the total turnover in disposables. In view of the embryonic state of the market, that is hardly surprising. 'The bulk still comes from fossil origins. But we also have a range here called Bright which performs better in terms of the environment (editor's note: 19 impact factors) than conventional materials. It's one way we can also upgrade the mid-market.'

### PRICE PREMIUMS

The Biodore range consists of compostable as well as non-compostable materials. Van der Windt informs its customers which products can and cannot be composted. The Rotterdam company Bio Futura carries exclusively compostable disposables. 'We only use starch-based plastics, sometimes in combination with PLA,' according to director Wouter Moekotte. 'We also carry disposables produced on the basis of sugarcane fibre, palm leaves and cardboard. Recently we made an exception: a screw cap made from bio-PE for a bottle which is otherwise made entirely from PLA. We needed a harder material for this application. Of course, we will encourage the separate collection of the bottles and caps among the users.' Similar to Van der Windt, Bio Futura sources its biobased disposables from all over the world. The producers are often the same as the 'fossil' counterparts. But the pricing shows the essential difference. 'The price premiums we charge through to our customers vary from 20 to 50 percent. For natural fibre products this is between 20 and 30 percent. For that they get a more sustainable and in some cases better product as well, because it has a better appearance or better properties, for example, higher oxygen barrier.'

### FOCUS ON PRICE

The above price differences and the lack of clear national laws and regulations especially are

keeping biobased disposables in the niche and out of the mainstream. Marcea van Doorn, sustainability category manager at Bunzl, an international supplier of disposables: 'Most customers, that is, the large catering businesses, focus on price because their clients in the business community and institutional sector count every cent. There is some space, especially in the added value concepts such as Marqt and smaller businesses. But that is not where the large volumes are to be found yet. I do see that the larger players in the catering market are switching increasingly to more sustainable disposables, for

example by replacing plastics with cardboard.' Van Doorn suggests that the returns logistics is also an obstacle for the customer. After all, the compostable products still have to be transported to a processing plant. That is a real issue. There are organisations, especially hospitals, which want to make some of the medical materials compostable and then convert them into energy. If they also make their food-related disposables compostable, they increase the efficiency of their biogas plants. If this trend continues, it will mean another new and larger market for 'biobased disposables.' ●



On-the-go consumption is increasing and likewise the growth opportunities for disposables.

## OUT-OF-HOME CONSUMPTION RISING

After years of standstill and sometimes decline in turnover, the out-of-home consumption in the Netherlands seems to have resumed an upward trend. Total food consumption in 2016 rose by 2.1 percent to almost 55 billion euros. Out-of-home grew even faster, by 2.7 percent, and is good for one third of the total food turnover (source: Food Service Institute Netherlands/FSIN). Out-of-home/on-the-go consumption is expected to continue to grow, partly due to the efforts of supermarket chains to cater to this. The Plus chain recently opened its first Briljant 2.0 supermarket which includes several catering service elements.

FSIN sees a polarisation looming ahead for certain out-of-home markets, with aggressive price concepts and formulas aiming at higher positioning in terms of supply and price. In the latter case, consumers are prepared to spend more for a product of higher quality (often fresh), with emotional aspects also playing a part. This can be sustainability for example, such as the sourcing of the food or the packaging.

# GELDERLAND: FIRST ZERO WASTE PROVINCE IN THE NETHERLANDS

Gelderland has set the standards high. It aims to be the first zero waste province in the Netherlands and slash the quantity of waste in 2030 by 50 percent. It is focusing mainly on input: fewer raw materials and more renewable raw materials. That is why biobased is an integral part of the circular agenda of the province.

Text Lucien Joppen Image Provincie Gelderland

Willem Huntink, Circular Economy programme manager for the province of Gelderland, was closely involved in drawing up the agenda. 'The circular economy is unavoidable. Raw materials are becoming increasingly scarce. Throwing away or incinerating these raw materials will indeed become less attractive, from an economic and ecological viewpoint. That is why the province has set its sights on a zero waste future.'

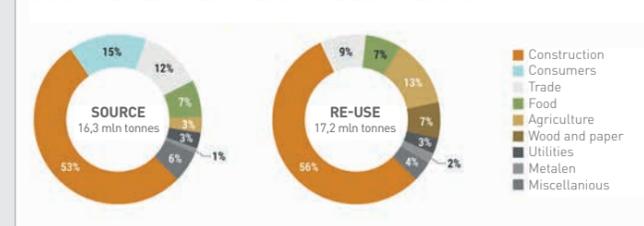
Huntink believes that the key to this endeavour lies in the first instance on the input side. If the industry and the inhabitants use fewer raw materials, there will also be less waste. 'Industry in Gelderland uses 44.7 million tonnes of raw materials and other materials on an annual basis. Fossil fuels (oil, gas) take up half of this, followed at a great distance by minerals (14 percent) and chemicals (9 percent). The industry uses a total of 1 million tonnes of waste as raw material. This volume can be bigger and it must grow, through the stimulation of reuse and the development of alternative raw materials, via regional chains among other things.'

### PROCUREMENT POLICY

This transition will not happen automatically; Huntink acknowledges that. And that is why the province is acting as a booster. 'To start with, we have to set a good example. We are doing that

already in various areas, including circular procurement. Similar to biobased procurement, local governments will have to prepare their organisations for the growth in circular concepts. The parties involved in a procurement process – administrators, buyers and clients – must have a shared understanding. Relevant questions include: what are the province's circular objectives and can they be translated into

### SOURCES EN RE-USE OF SIDESTREAMS



In Gelderland, the building sector causes the most waste. On the other hand, this sector is responsible for more than half of the reuse of residual streams.

Source: Metabolic

practical guidelines for buyers? What instruments are required so that buyers have hard procurement criteria at their disposal which they can use to account for their decisions? How can you weigh circular parameters such as material use (including LCA) against other criteria like price? In brief, together with public and private parties, we are working very hard to create the conditions for a circular procurement policy for the public sector.'

### AUPING

Apart from the demand side, the supply side will have to grow as well. Huntink argues that the business community is not yet working with circular business models on a large scale. 'Apparently they do not feel any necessity yet and they earn their money doing what they have been doing for years. We have to start by raising awareness. The province shoulders its responsibilities in this respect by organising meetings for the SME where fellow entrepreneurs can talk about their circular successes. Several businesses have since taken steps, like Auping which leases mattresses, or the producer Van de Bosch from Almelo which produces lighter, stronger and more sustainable concrete by mixing in natural fibres.'

Biobased raw materials – materials and energy – form an integral part of the circular agenda in Gelderland. Thus various businesses (clusters) are actively using natural fibres for textile, biocomposites (packaging) or applications in paper/cardboard. 'The other routes are manure valorisation, especially aiming at nutrients, and the transition to vegetable proteins. These are the three focus areas for which we see the best market opportunities and biggest impact on the environment.' ●

This article was created in collaboration with BIC-ON.

# SCALING UP: FROM CUSTOMER TO PLANT

The decision has been made. On 30 March, the construction of the Bio Treat Center at Brightlands Campus Greenport Venlo was launched. This will be the first centre in the Netherlands where the business community, in conjunction with knowledge and research institutes, will scale up its technologies in the area of biomass value creation.

Text Lucien Joppen Image Brightlands Campus Greenport Venlo



**P**retreatment is an essential step to prepare the often recalcitrant biomass for the downstream processing stage. Certain components have to be exposed in a way that ensures satisfactory quality and volume for making a business case. Currently this technology is still seldom used in the pretreatment phase. That is why the BTC has been set up with companies which have varied processes. What is more, the BTC prefers to set up projects which involve the entire value chain: from end customer to the supplier of the raw material. The demand of the customer is leading: let's say from customer to plant.

## TOGETHER UNDER ONE ROOF

The link with the agricultural and horticultural sector is obvious. This sector is well represented in the southeastern region of the Netherlands (East Brabant, North Limburg), with businesses which want to look beyond the prevailing revenue models. 'The demand and need for a centre where applied research is carried out into the pretreatment of various forms of biomass, especially from horticulture, is huge,' according to Patrick Lemmens, Biobased Economy Business Developer at Brightlands Campus Greenport Venlo

and involved in Source B. 'All that was missing was a physical location where these parties could find each other. With the BTC we can bring these parties together under the one roof and provide them with facilities (equipment, manpower) so that they can make swift progress in this phase. One thing is clear in any case: the core of the BTC is formed by businesses which are working on concrete business cases. The intention is to deliver activity, not beautiful reports.'

## HALF-OPEN INNOVATION

Well, that activity is certainly there now. Five companies have already registered with the BTC: NewFoss, Hofmans (biomass logistics and processing), Grassa!, Eco-Makelaar and Ingenia. Of course the BTC is open to other companies. Lemmens labels the BTC a 'half-open innovation location': innovating together with a low wall in between. One of the participants is a well-known player in the Dutch bio economy: NewFoss Biobased products & techniques from Uden. The company has built up a reputation with its process for refining grass and breaking it down into fibres and other components such as protein.

## REFINING STEVIA

One of the activities of NewFoss at the BTC will be researching the refining of stevia. 'This plant, which supplies sweetening, is currently cultivated mainly in China and South America,' according to Geert van Boekel. 'The problem is that it is not always cultivated in a sustainable way. Furthermore, the liquorice-like taste of stevia often stops it from being used in applications in food such as soft drinks. On the basis of our understanding of grass refining, we have found a way to refine stevia so that the after-taste does not occur. We can perform this trick on a laboratory scale. We want to scale this up at the BTC to a 1,000 kg scale. Together with Wageningen UR and Maastricht University we are also examining other active components in the plant, including for the pharmaceutical industry. If the scaling up is successful, we would prefer to cooperate with local suppliers. The stevia plant can flourish in this climate. And it does not necessarily have to grow in glasshouses.'

## BIO BITUMEN

Another 'old friend', the engineering and consultancy firm Ingenia, will work at the BTC on scaling up its process to make bio bitumen for asphalt from different types of biomass. The

company has already made a product on laboratory scale by heating biomass at 300 degrees at a pressure of 200 bar. According to Ingenia director Ronald Verberne, the product has the same quality as fossil-based bitumen. It is just the price which will present a challenge. Several road builders have in any case expressed their interest, says Verberne. 'We just still need a few years to scale up and carry out tests with our bio bitumen. The great thing about the BTC is that we are going to investigate how we can pre-dry the biomass, together with another BTC partner, engineering factory Hofmans. The moisture content of the input determines the final quality to a large extent.'

## PRODUCTION LINE FOR HEMPCRETE BLOCKS

Richard de la Roy, owner/founder of Eco-Makelaar, develops and supplies sustainable/biobased materials to the building industry. 'At the BTC I am going to investigate a number of interesting processes. For instance, I am working on a system that will enable hempcrete blocks to be used as load-bearing elements. Apart from investigating the right composition of the blocks, we have to design a production line so we can make these blocks at current market

The **Bio Treat Center** is part of the Brightlands Campus Greenport Venlo. Everything at this campus revolves around the theme of healthy food. Innovators from the business community, science and education collaborate on innovations in healthy food, cultivation and growing, alternative raw materials and food sources. For instance, alternative crops are considered, including those based on LED and non-food applications based on biomass. The BTC is an exponent of these. The campus in Venlo is connected directly with the Brightlands 'sisters' in Heerlen (Smart Services), Geleen (Chemelot) and Maastricht (Maastricht University).

prices. That is what we are going to do at the BTC. Another project is putting a biobased bitumen coating on hemp wood, so that it can be used as a sustainable alternative filler in roof pitches.

## GRASSA

Grassa! focuses on possible routes for refining

grass and other crops via a small-scale biorefinery – in a mobile plant – in order to become a supplier of biorefinery products. 'We consider the BTC as our R&D facility in the south,' says director Martijn Wagener. 'Thanks to that, we can transfer some of our equipment in nearby Panningen to Venlo.' At the BTC, Grassa will work together with the Feed Design Lab in Wanssum, North Limburg. 'We are going to see how we can use the grass protein, the fibres and the juice as feed for poultry, pigs and cattle.' This requires different fractions: for instance, grass protein can be used in a wet form as pig feed, but not as feed for the other animals. Another project Grassa! will work on at the BTC is refining water plants. Some varieties have grown enormously over the past few years and create extra work for the water authorities. 'Our process also works with these plants. The art is in beating the existing value creation route, which is composting. We also have to find a use for the biorefinery products which parties want to pay for. Currently these rampant water plants are nothing but a cost item.' ●

*This article was created in collaboration with Source B.*



PYROLYSIS TESTING GROUND IN SOUTHERN NETHERLANDS

# THE SEARCH FOR WINNING COMBINATIONS

**'At the Pyrolysis Testing ground in Moerdijk, we want to test value chains on the basis of pyrolysis technology. In the coming four years it should ultimately become clear which business cases have market potential.'**

Text Lucien Joppen Image Haven Moerdijk

These are the words of Raimo Van der Linden (REWIN), responsible for the business development of the Moerdijk Pyrolysis testing ground. Various parties have joined forces in this project (see the full list in the box). 'We have the raw material suppliers on board, the providers of the technology – companies that have developed pyrolysis technology, end customers – and the companies that buy pyroly-

sis products, and knowledge and research institutions. Half of the investment in the project is provided by private parties, while the rest comes from the European Regional Development Fund within the framework of the Operational Programme South Netherlands ERDF 2014-2020. The project also receives financial support through a contribution from the government and co-financing from the Province of North Brabant,' according to Van der Linden.

## NOT 'ONE SIZE FITS ALL'

According to Rob Plattel (PNO Consultants), project leader at the Testing ground, pyrolysis is a promising technology for converting a large variety of residual streams into fuels, chemicals and – by extension – materials. 'It is a proven technology, but it still needs to be optimised for the different input streams and products (oil, gas, carbon) which come from the process.'

Four pyrolysis companies are working in the project, each concentrating on their own technology. Pyrolysis is not one-size-fits-all, according to Plattel. Different configurations are possible for pyrolysing biomass and non-organic materials.

The four technology companies are Nettenergy, Teknow Systems, Charcotec and Waste4ME. Nettenergy has a mobile plant it uses to produce oil as well as wood vinegar, gas and biochar. Teknow pyrolyses (contaminated) plastics into oil and gas. Charcotec converts clean biomass – wood (pallets) and turf – into biochar. And finally, Waste4ME converts contaminated waste into gas and oil.

## WINNING COMBINATIONS

The companies mentioned above will bring their technologies to pilot scale (between 25 and 200 kg/day) to further optimise the process on the basis of different feedstock combinations. All in all, there are more than enough options, according to Van der Linden. 'We are at the start of the process. So I am not going to make any predictions about winning combinations. The companies will discover these themselves in the coming years.' In doing this, the companies receive assistance and expertise from the knowledge institutes. The Centre of Expertise BioBased Economy of the Avans University of Applied Sciences, for example, will carry out analyses and LCA studies on samples and provide internships for students who will work at the physical locations at the Moerdijk port and industrial estate.

## COMMON DENOMINATORS

Plattel stresses that the above companies will not only concentrate on their technology, but also work together on the important common denominators which apply to all businesses, such as emission standards, product specifications or ensuring that pyrolysed products enjoy wider acceptance. The status of these raw materials is not the same in every country, which can delay or expedite the market introduction.

Together with suppliers of biomass and end customers, the technology companies will also set up value chains. This is about winning com-

binations which should bring technology and economy together. And that too is a matter of scale: to what extent are the volumes which are demanded in line with the supply?

## FOCUS ON THE MARKET

The customers in the project will first have to test the semi-finished products and end products. Large volumes will be required for this purpose, for example to run diesel engines on pyrolysed bunker oil or convert pyrolysis oil further into chemicals.

Plattel: 'These pathways will first have to be examined on a pilot project scale before further scaling up can take place: technology development with a focus on the market. If you leave out the latter, there is a good chance you will run into a dead end. That is why the input and feedback of customers is of crucial importance.'

The last question is: what will happen after the summer of 2020 when the period of the Moerdijk Pyrolysis testing ground ends? 'I don't consider it as an end date,' says Raimo Van der Linden. 'It is more like the moment for a follow-up when certain technology market combinations are scaled up further. It would be nice if we could keep this activity in the port of Moerdijk or somewhere else in the region.' ●

## MOERDIJK PORT AUTHORITY

The Moerdijk Pyrolysis Testing ground currently has 14 participants from the public and private sectors: the Moerdijk Port Authority, REWIN, Avans, B.N.M. Holding, SABIC, Goodfuels, Teknow Systems BV, Nettenergy, Nimaro Ageno, Charcotec, Waste4ME, DSM, Delphy and the Technical University Eindhoven.

The physical location will be at the Moerdijk port and industrial estate. The Moerdijk Port Authority has made part of the former Tetra Pak location available for the project. 'Our location is ideal for such an initiative,' according to Manon Baartmans, commercial manager at the Port Authority. 'In Moerdijk we already have the necessary experience in the processing of residual substances, including pyrolysis. The logistics factor is important for rendering biobased processes economically viable, which makes it necessary to deliver (larger) volumes by water. That is possible through our port or via the hinterland where the agrofood sector serves as a potential supplier of biomass.'

# CONDITION FOR TRANSITION TO A BIOBASED ECONOMY

Cooperation in a powerful network is crucial to ensure the efficient growth of biobased R&D and product development and to achieving a strong market position. 'We cannot classify it on a provincial or national level any more; we also have to look at developments across the border,' believes Professor Emmo Meijer.

Text Kelly van Bragt Image Source B



Scaling up as the necessary link between lab and commercial scale.

**F**igurehead of the Dutch province of Limburg in the field of Biobased Economy, Meijer plays an active part in the Source B consortium. This platform unites several important parties in Limburg (Brightlands Campus Greenport Venlo, Brightlands Chemelot Campus, Maastricht University and the Province of Limburg) to coordinate biobased projects with each other and facilitate developments.

Since April 2017, Meijer has also been the figurehead of the Top Sector Chemistry, which means he is able to promote the interests of the south in The Hague. 'Developments in the biobased economy are proceeding very fast, on national and international levels. We must link up with that,' says Meijer. The Source B consortium has a large network, especially in the Euroregion. Maintaining these contacts and making use of them at the right times will translate opportunities more easily into real partnerships.

## INDUSTRIAL THRESHOLD

Europe boasts a wealth of knowledge and expertise in biobased, usually organised around the same themes in the biobased economy. But putting biobased products on a large, international market is a high-risk undertaking which requires substantial investment. Granted, there are already companies such as Reverdia and GFBiochemicals which are producing for the market. But it will be some years before we can really speak of a commercial biobased sector, according to Meijer.

'So we shouldn't want to go too fast with biobased either. The current developments in this field are only one of the transitions in the entire range of the circular economy, on a European scale as well. It is better for us to start on a small scale and go through all the scaling-up steps. That minimises the risks, for production as well as market. Matters will have to be arranged step by step, and then we can proceed with scaling up to a commercial level.'

## SCALING UP

'There are interesting initiatives arising in Limburg,' says Meijer. For example, an innovation facility for de-centralised biorefining, the Bio-Treat Center (BTC) will be built in Greenport Venlo. If certain routes are successful, scaling up to larger pilot plants will be possible, if necessary at Chemelot InSciTe at the Brightlands Chemelot Campus. One good example of

## TRIPLE F: FOOD FROM FOOD

Triple F is a cross-border collaboration project of Interreg Flanders-the Netherlands. Partners such as Brainport development, Flanders' FOOD, Brightlabs and other parties in the regions North Brabant, Limburg and Flanders are cooperating to stimulate, support and accelerate innovations in the agro and food industry. The ambition: finding high-quality applications for sidestream products from the food chain and producing food in a more sustainable way. 'Triple F links available components from sidestreams with demands from the market. Besides the existing partners, other companies can come in to have their ideas examined. The role of Source B is particularly that of joining parties and helping realise the link between different sectors,' says Patrick Lemmens, Alternative Raw Materials Business Developer at Brightlands Campus Greenport Venlo. Triple F is currently in the start-up phase and projects can be submitted from 1 June 2017. More information is available at [www.foodfromfood.eu](http://www.foodfromfood.eu).

scaling up is Avantium, which has a pilot plant at the Chemelot Campus. They went through the entire preliminary process of scaling up for the development of biopolymers for bottles and other applications and are now at the stage where this can be established on a large scale.

According to Meijer, it is particularly important to link up with partners which have complementary infrastructure, knowledge and expertise. Practical examples of existing international collaborations are Triple F (see box) and AMIBM, a cross-border research institute with major partners Maastricht University, RWTH Aachen University and Fraunhofer IME.

## NATIONAL POLICY VERSUS EUROPEAN POLICY

How difficult is it to set up projects in cross-border joint ventures? Meijer: 'Scientists collaborate in any case, also across borders. But many public initiatives in R&D taken in the Netherlands are determined for the most part by the national policy. Source B is not bound to existing frameworks and can determine itself which developments in the Provinces of Zeeland, North Brabant and Limburg will be stimulated and which European programmes we join.' Meijer stresses that policy clearly differs between the countries in Europe. Thus Germany invests hugely in knowledge and innovation. In Flanders there is a more specific focus on the approach to biobased research programmes. The Netherlands is somewhere in between the two. According to Meijer, in the Netherlands we work too often with a short-term horizon: 'The field is relatively young and everyone is still busy

finding their way around. In the biobased economy you have to plan for the long term. You are talking quite easily about 10 to 15 years, and that does not happen enough at all in the Netherlands.'

## SWING

Another stumbling block is formed by the national laws and regulations. Potentially interesting raw materials are typified as 'waste', for example, and because of that they cannot be processed further. One example is residual streams which have been contaminated with agricultural pesticides, whereas there is enough knowledge to clean up these streams and make them fit for use again. 'We have to work more towards a European legislation which will accelerate biobased product development,' is Meijer's opinion. We are slowly seeing a swing from a national to a European policy, according to Meijer. 'International funding programmes like Horizon 2020 put the focus on social challenges. Previously things were not organised like this in the Top Sector Chemistry and the other top sectors, but that is changing now. 'The international programmes mean that the European landscape is having some influence on the Dutch policy. Internationalisation, in the areas of cooperation, policy, laws and legislation, does seem to be an essential condition for a transition from a chemical industry to a biobased economy.'

*This article was created in collaboration with Source B.*

# AMIBM: NEW BIOPOLYMERS IN THE PIPELINE

It is anything but easy to get new polymers on the market. Technology, market and sustainability all throw up challenges. This became clear from the presentations held during the second AMIBM symposium in the middle of May. Good staying power is essential.

Text Lucien Joppen Image AMIBM

The new Center Court location at Brightlands Chemelot Campus in Geleen welcomed a gathering of representatives from academia, the business community and government, who had come together to discuss the above challenges.

Yvonne van der Meer (Maastricht University) kicked off the meeting. Van der Meer (see picture), who will focus on sustainability in AMIBM, emphasised that this aspect is essential for a market breakthrough of biobased polymers and products.

'If that is not the case, an important USP drops out. Granted, biobased products generally mean lower CO<sub>2</sub> emissions and require less fossil energy sources during production. But there are also downsides, such as possible consequences for food prices, and land and water use. We must take these factors into consideration in a model which unites economic, ecological and social factors. The aim is to end up with a specified standard that will have international support.'

According to Van der Meer, quantifying sustainability still faces the necessary challenges. This is partly due to missing or incomplete data and because certain factors such as biodiversity are extremely difficult to measure.

## GALX

There are more than enough technological challenges, as numerous presentations at Brightlands Chemelot showed. One example is (partly) biobased polyamides which are derived from derivatives of galactaric acid (a by-product of sugar beet production). The structure of these monomers can improve the thermal properties of polyamides so that other applications

come into the picture. However, the monomers are not very stable at high temperatures. The polymerisation fortunately proceeds smoothly at moderate temperatures. Ongoing research taking place under the AMIBM flag now shows that a type of monomer (GalX) can be used in amorphous polyamides which remain stable at temperatures exceeding 300 degrees Celsius. That means they can be processed further in plastic materials.

## COSUN: DERIVATIVES PAY

The above research is taking place under the name Beets 2 Polymers, a consortium which includes a supplier (Cosun), an end user (Philips) and a number of knowledge institutes such as Astron, Maastricht University and the University of Groningen.

According to Alex Benschop, business development manager at Cosun Biobased, the biggest challenge is connecting business development with scientific research. 'It is a long and winding road,' according to Benschop, paraphrasing a song of The Beatles.

The parent company of Suiker Unie nevertheless does see potential in derivatives from the sugar beet and pulp. The group of companies is focusing on four growth domains, says Benschop: vegetable proteins, healthy food, functional biopolymers and chemical building blocks. 'Some of these chemicals already occur naturally in the beet, such as galacturonic acid which we can process via the beet pulp into a powder with a purity level of 99.5 percent.' This galacturonic acid can in turn be converted into galactaric acid (and then GalX) in a catalytic process with high selectivity.

## LONG DEVELOPMENT TIME

Cosun is now planning a demo plant of approximately 100 tonnes galacturonic acid per year, more than enough for pilot production. The company also wants to scale up the production of galactaric acid, but that is where it stops for Cosun. That is why the group is looking for partners which will take over the baton and convert the galactaric acid into GalX and then process it in a polyamide. This material will enable the parties further in the chain, such as the compounders and end users, to test whether these materials meet the specifications. To put it briefly: it is a matter of perseverance.

Jan Ravenstijn confirmed this in his presentation on the evolution of (new) polymers. Ravenstijn, with a long track record in polymer chemistry, claimed that it took between 15 and 20 years to develop a new polymer.

## THERE GOES ANOTHER BILLION

'It is a multidisciplinary, time-consuming and expensive activity,' according to Ravenstijn. 'You can "lose" a billion euros just like that. It is important that all parties have realistic ambitions. You can set hard deadlines, but in (research) practice, it is not so simple. That applies even more so to the market. With a price premium of 100 percent, you won't make it. Premiums which fluctuate between 25 and 50 percent are acceptable, depending on the polymer. Coca-Cola is now willing to pay this kind of premium for its Plant Bottle, but does want to end up at lower price levels in the long term if the market volume – in this case, that of FDCA/PEF – grows.'

In conclusion, Ravenstijn emphasised the importance of cooperation in the value chain, an aspect which is also expressed in the AMIBM projects. 'What sometimes still gets forgotten is that all the links in the chain have to benefit from it. Do not rely on laws and regulations either. These can change at any moment. Rather, work on the basis of the material itself and its advantages compared with customary materials.'

This article was created in collaboration with Source B.



## COLUMN

### BIOECONOMY AND REALITY

The bioeconomy has been hyped, applauded, ridiculed and rejected over the last decade. One thing is sure, it cannot be ignored and it is an absolute must in a 'clean' circular economy.

Meanwhile, the first-of-a-kind lignocellulosic plants are solving their technical challenges and biobased packaging materials and bottles are entering the market. The bioeconomy grows, maybe slower than some have anticipated, but it grows steadily. And so do other renewable technology solutions.

The bioeconomy is not alone in a steady 'greening' trend. It is searching for its actual role in an economic reality. Some concepts will flourish, others will wither and die. In my new role in the Bernal Institute at the University of Limerick in Ireland, I encourage the blending of biobased solutions into a bigger pool of functional materials and processes. We have to experiment to establish what the solutions are and that has to be done at a relevant scale. The investment of hundreds of millions in technology development and innovation programs (such as BE-Basic), should now be followed by real-world investments of billions. That is one part of reality. Another reality is that the fossil sector has suffered - and still is suffering - major drops in value and revenue. Organisations, such as institutional investors, or entire countries (like my new 'home' Ireland) have an active and radical fossil investment strategy. Billions and billions of public and private capital are searching for 'new homes'.

Interestingly enough, the actual dependence on fossil resources for instance for mobility has hardly changed on a global scale. Some sectors, such as aviation and marine transport, have started their own initiatives to anticipate this large scale transformation process. At sustained low fossil prices (which seem also to be a reality) and with increasing costs of new fossil explorations, it may actually be the fossil sector seeking (public) support to continue operating its petrochemical infrastructure for our mobility, energy and materials.

We have to face both realities that are developing at vastly different rates. Therefore, we have to step up investments in the renewables space, including in the bioeconomy. It is good to reflect on the pro's and cons of specific directions, but in this large scale transition there is very limited time, see the rate of global warming. There is a growing body of facts and knowledge of how the bioeconomy can blend into the new economic reality. It is being scrutinised and debated, but we better focus fast on win-win situations, as we need all options. At any rate, the bioeconomy is becoming part of our reality.

Luuk van der Wielen

Director and Professor of Biosystems Engineering and Design, Bernal Institute, University of Limerick



# NEED FOR POLYMERISATION PILOT PLANTS

While the polymerisation of biobased monomers is an important step in making (partly) biobased plastics, resins and coatings, there are currently no pilot facilities for this process in the Netherlands. Industry, regional bodies and research institutes all see a clear need to realize such facilities in the near future. Two new initiatives in the Netherlands are aimed at realising an open access pilot plant for polymerisation.

Text Lucien Joppen Image Wageningen UR



The catalyst for both initiatives is the Biobased Performance Materials research programme, coordinated by Wageningen Food & Biobased Research. The programme facilitates fundamental and applied research into new biobased materials that can compete with their fossil counterparts and is sponsored by the Dutch government's top sector Chemistry. 'When the end market is not sufficiently in sight, a dedicated polymerisation pilot plant is often too costly and risky for individual companies,' says Christiaan Bolck (see picture), director of the BPM programme. 'This is why the BPM programme aims to scale up the production of new polymers with open access pilot initiatives that can result in unique properties and/or application possibilities. Due to the economic opportunities for upscaling – and potential spin-off – it would be best if such a pilot is linked to a suitable industrial infrastructure.'

## BIOBASED DELTA

Both the Chemport region in the North of the Netherlands and the Biobased Delta region in the South West of the Netherlands have a good starting position in this regard for different reasons. This is why the regions have joined forces with BPM to establish world-class shared facilities. The first pilot facility, planned in Etten-Leur, is focused on ring-opening

polymerisation of biobased monomers. Jan Noordegraaf (general director at Synbra Technology): 'The realization of this pilot, adjacent to the Synbra premises, enables the development of new copolymers which can convert new biobased monomers into polymers in an infrastructure that we have always wanted to achieve with the parties in the Biobased Delta.' Five larger and ten smaller companies have already indicated a desire to make use of the pilot.

## CHEMPORT EUROPE

The second pilot facility is planned in Emmen, at the Sustainable Polymer Innovation Campus (SPIC). 'The SPIC innovation cluster already has all the required hardware, and enables us to easily make the link to applications, such as multifilament yarns or monofilaments for 3D printing,' says Gerard Nijhoving (managing director of Senbis, a company that carries out applied research in the field of polymers). 'Emmen (Chemport Europe) has already realized lots of research into polycondensation to improve the performance of polyester and polyamide yarns. We have received many questions over recent years regarding biopolymers, in particular, as they often have a polyester-like structure. As upscaling these can be difficult we are initiating a polycondensation pilot facility with a capacity of 50 to 100 kg a day.'

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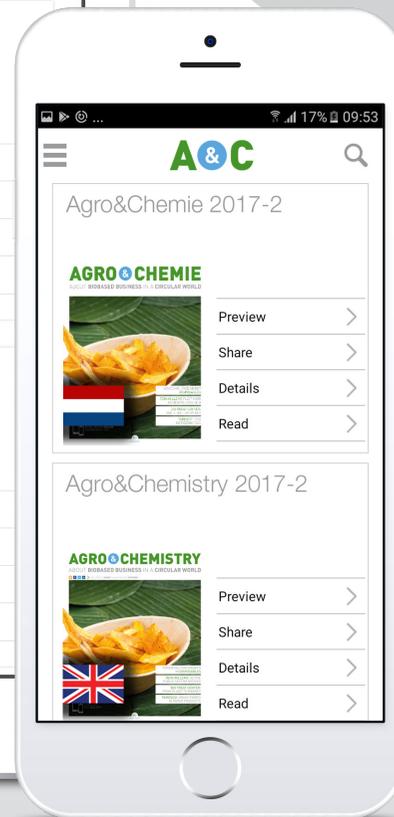
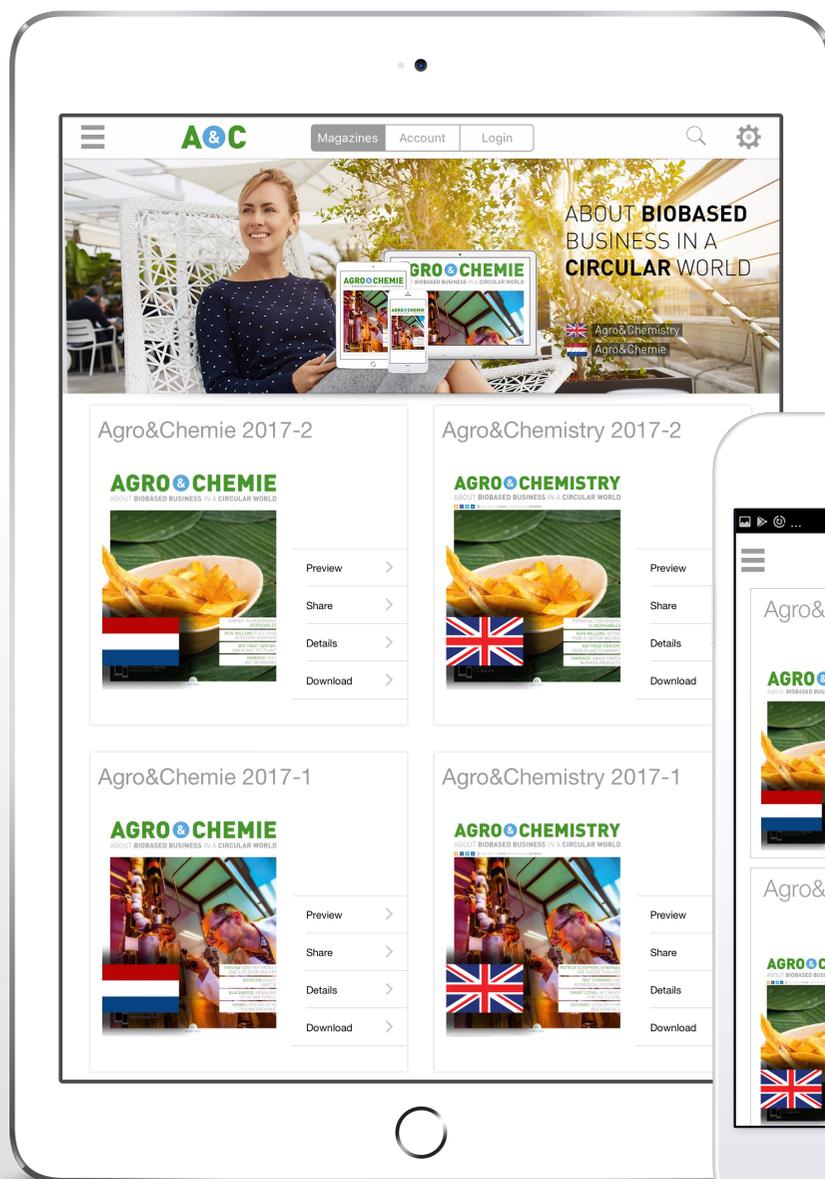
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