



News Review

Issue Fifty-Eight

January 2017

Each month we review the latest news and select key announcements and commentary from across the biobased chemicals and materials sector.



Contents

Contents.....	2
Foreword.....	3
Policy	4
Markets.....	4
Research & Development.....	6
Polymers	8
Chemicals	11
Consumer Products.....	15
Patents.....	16
Events.....	17
Price Information.....	18

Foreword

Welcome to this month's edition of the NNFCC Biobased Products Market Review.

With 2017 now upon us, we can look forward to what this year will bring in the ever developing Biobased products sector. Before we leave 2016 to the realms of yesteryear however, we report in this month's review on some exciting developments which took place late last year with Mazda introducing their Roadster RF model built using a bio-based engineering plastic. As we all know cars are made up of a number different materials including glass, metal, plastics and a sometimes-sizable organic portion that resides in the foot rest following Friday night's fish and chips (the case in my car at least...). Regarding plastics specifically, one type that is commonly used to build exterior automotive parts is acrylonitrile butadiene styrene (ABS), a thermoplastic polymer which is the same substance used to make Lego blocks. While this polymer has several properties apropos for car parts, such as being lightweight and very durable, its fundamental properties mean that a coating is required to achieve a smoothened coloured surface. This coating carries with it an associated cost as well as the potential release of volatile organic compounds (VOCs) to the atmosphere. The ABS polymer also derives from fossil feedstocks which carries with it a host of concerns regarding sustainability. The Roadster RF is built using Mitsubishi Chemical's DURABIO™ biopolycarbonate made mainly from plant-derived isosorbide. A key benefit of DURABIO™ that makes it an excellent material for use in car manufacturing is its ease of colouring. As a transparent polymer, extremely vivid colours can be produced simply by mixing the polymer with a pigment to create glossy, rich hue surfaces eliminating the need for an external coating. There's also no compromise on quality as DURABIO's properties also include hardness, durability and scratch resistance. With all of this in mind, it looks like DURABIO™ could be in the fast lane for use by other car manufacturers and any other companies who have the need for sturdy, coloured plastics and the desire to employ sustainable practises.

Green Biologics Inc. also deserves a mention in this month's foreword as the company at the end of last year announced its 100% biobased n-butanol and acetone had received certification under the USDA BioPreferred Programme. This programme appears regularly in the NNFCC biobased market reviews, and is designed to assist in the development and expansion of markets for bio-based products, with products requiring a minimum of 34% biobased content for accreditation. At the end of 2016, Green Biologics, Ltd. also started its first commercial first shipments of biobased n-butanol and acetone from its production facilities in the United States. Sean Sutcliffe, the Chief Executive of Green Biologics, called the shipments a 'critical milestone' and the stated the company are "looking forward to working with existing and new collaborators to bring a wide range of sustainable, environmentally-friendly products to shelves."

Read on for the latest market news

Policy

CEPI Stakeholder's discussion paper on "2050 Roadmap to a low carbon bioeconomy"

The European forest fibre and paper industry envisions itself at the forefront of a climate-friendly bioeconomy in which renewable raw materials are replacing fossil resources and are "kept in the loop", contributing to a better environment and quality of life.

The pathways to this destination - reducing greenhouse gas emissions while creating added-value - were first outlined in 2011 in CEPI's landmark "2050 Roadmap to a low carbon bioeconomy". Building upon an expert review of the identified pathways and recent developments, this paper explores the investment agenda that the roadmap implies for industry. It also underscores that this unprecedented industry transformation will be "made in Europe" if policies, both at EU and national levels, and financing conditions are best aligned to make it happen. This paper will serve as a platform to consult stakeholders on the pathways and conditions industry has identified to lead the transition towards a low-carbon and resource-efficient bioeconomy.

Click [here](#) for more information.

New Norwegian national strategy on the bioeconomy launched

The Research Council of Norway will play a key role in implementing the cross-sectoral strategy

that forms the basis for national investment in the bioeconomy.

Ten ministries have played a part in designing the Government's newly launched strategy on the bioeconomy. The strategy attaches great importance to cooperation across sectors, industries and subject areas, and highlights the importance of research. The Research Council, the Industrial Development Corporation of Norway (SIVA) and Innovation Norway are each in charge of specific tasks as part of the overall effort to translate the strategy into action.

The strategy has been given the title Kjente ressurser – uante muligheter [Known resources – unheralded opportunities]. The foreword of the document emphasises that a national bioeconomy initiative must promote increased value creation and employment and lead to reduced greenhouse gas emissions and more efficient, sustainable utilisation of renewable biological resources. The strategy places new demands on the government research and innovation system and its users.

Click [here](#) for more information.

Markets

Global Industry Insight: Bio Alcohol Market Size, Share, Development, Growth and Demand Forecast to 2020

The bio alcohol market is growing due to increase in scarcity of non-renewable resources and rise in crude oil prices. Bio alcohol production process to reduce the carbon footprint is becoming an opportunity for the bio alcohol market to grow at a considerable rate in the coming years. Rise in demands of bio fuels from emerging regions have

also opened up opportunities for the bio alcohol market to grow in the coming years.

Bio alcohol has various advantages over fossil fuels with regard to sulphur, nitrogen oxide, particles, hydrocarbon, ground ozone and carbon monoxide. The only increase in emissions in contrast with fossil fuels is formaldehyde and acetaldehyde that do not have any impact on the surroundings. Ethanol gases have less atmospheric reactivity and results in reduced oxidant (ozone) formation. With the increased use of ethanol such as benzene and butadiene, gene toxic substances will reduce immensely in the atmosphere. Many cancer cases that occur due to air pollution are mainly caused by cars and it will reduce by using ethanol, because ethanol and methanol gives out advanced steam pressure after getting mixed in petrol. Steam pressure remains unchanged even after changing the composition of ethanol and methanol in petrol.

The bio alcohol market can be categorized on the basis of type as bio butanol, bio BDO, bio ethanol and bio methanol. On the basis of applications, the bio alcohol market can be further categorized as infrastructure, transportation and medical. Transportation industry leads the bio alcohols market in 2014.

Germany has been the largest consumer and producer of bio alcohols in 2014. One of the major factors for the growth of bio alcohols market in Germany is the severe government regulations regarding sustainable and greener environment. However, the shortage in availability of bio based raw materials is posing a major challenge for the bio alcohols market in Germany.

Click [here](#) for more information.

Global Bio-based Propylene Glycol (Bio-PDO) Market Outlook 2016-2021

1,3-Propanediol (PDO) is the organic compound with the formula $\text{CH}_2(\text{CH}_2\text{OH})_2$. This three-carbon diol is a colourless viscous liquid that is miscible with water. It is mainly used as a building block in the production of polymers such as polytrimethylene terephthalate. 1,3-Propanediol can be formulated into a variety of industrial products including composites, adhesives, laminates, coatings, mouldings, aliphatic polyesters, copolyesters. It is also a solvent and used as an antifreeze and in wood paint.

1,3-Propanediol may be chemically synthesized by the hydration of acrolein, or by the hydroformylation of ethylene oxide to afford 3-hydroxypropionaldehyde. The aldehyde is hydrogenated to give 1,3-propanediol. Moreover, the bioconversion of glycerol to 1,3-propanediol is existent in certain bacteria.

Two other routes involve bioprocessing by certain micro-organisms, including conversion from corn syrup effected by a genetically modified strain of E. coli by DuPont Tate & Lyle BioProducts. An estimated 120,000 tons were produced in 2007. According to DuPont, this Bio-PDO process uses 40% less energy than conventional processes.

Bio-PDO can also be converted from glycerol (a by-product of biodiesel production) using Clostridium diolis bacteria and Enterobacteriaceae.

This report provides detailed analysis of worldwide markets for Bio-based Propylene Glycol (Bio-PDO) from 2011-2015 and provides extensive market forecasts 2016-2021 by region/country and subsectors. It covers the key technological and market trends in the Bio-based Propylene Glycol (Bio-PDO) market and further lays out an analysis of the factors influencing the supply/demand for Bio-based Propylene Glycol (Bio-PDO), and the opportunities/challenges faced by industry participants. It also acts as an essential

tool to companies active across the value chain and to the new entrants by enabling them to capitalize the opportunities and develop business strategies.

Click [here](#) for more information.

Research & Development

Validation and regulatory acceptance of bio-based approaches to assure feedstock, water & product quality in a bio-based economy

Chemical analytical techniques and animal experiments are widely used and well-grounded in regulatory frameworks for safety evaluation of chemicals, products, waste streams and the environment. Although successful in the past to identify and solve problems related to highly persistent and toxic chemicals, these methods are not sufficient for current safety issues that need rapid evaluation of large numbers of chemicals, and assessment of their combined toxicity in mixtures. This is particularly relevant in a bio-based economy in which evaluation of complex mixtures of relatively non-toxic chemicals in e.g. feedstocks, residues and bio-based products is the most relevant safety issue to consider. Bio-based approaches, and particularly modern effect based bioassays show great promise to be used to compliment and partly replace animal experiments and chemical analytical methods in safety assessment. Their speed, high capacity and the possibility to assess effects of mixtures provide unique properties not equalled by conventional methods. By using these advantages safety testing can be modernized and obvious gaps can be

filled. To further integrate bio-analysis in safety testing, regulatory acceptance is an important step, which requires validation and the establishment of realistic trigger values. Unfortunately, the process of integration of these novel tools in current regulations and guidelines is slow. In the past decade, however, important progress has been made which paves the way for better acceptance and application of these novel analytical tools. Here, validation strategies for formal validation of effect-based bio-analytical methods are described, exemplified by their experience with effect-based CALUX bioassays. In addition, as a final, but essential step towards full application establishment of effect-based trigger values and inclusion in regulatory frameworks for risk assessment is described. These approaches can be used as a guidance for promoting regulatory acceptance and application of additional effect-based bio-based assays to assure safety in a bio-based economy.

Click [here](#) for more information.

DEINOVE Validates Key Milestone 3 of Its DEINOCHEM Program and Receives €0.8 Million from ADEME

DEINOVE, has announced that it has validated the 3rd key milestone of its DEINOCHEM program, dedicated to the bio-based production of carotenoids and financed by ADEME (the French Environment and Energy Management Agency) under the "Investissements d'Avenir" (Investments for the Future) program.

This new key milestone validates the technical progress made in developing the carotenoid production process. The target thresholds for productivity and yield have been reached using optimized *Deinococcus* strains at the laboratory scale.

The Company's ambition is to market its first batches of the target compounds in 2018, and last

November it announced that it had selected Processium, an expert in industrial process engineering, to work with on these developments.

The DEINOCHEM program targets the production of carotenoids: compounds that are naturally found in many living beings and widely used in industry for their colouring and antioxidant properties. The worldwide carotenoid market is expected to reach \$1.8 billion by 2019. In 2013, Europe was the largest market, followed by North America. Applications for these molecules are becoming increasingly diversified in human and animal food, as well as in cosmetics and healthcare. The largest share of production comes from petroleum derivatives, but natural molecules are generating the strongest growth, notably due to consumer demand. Today, there are several production techniques such as extraction from tomatoes (lycopene) or paprika (capsanthin) and bioproduction from algae (astaxanthin) or microorganisms (beta-carotene). The supply of bio-based solutions is nonetheless limited due to their high production costs.

DEINOVE's objective is to provide industrials with a competitive, bio-based alternative by developing a carotenoid biotechnological production process and offering significant advantages in terms of supply stability and quality, natural resource conservation and costs.

Click [here](#) for more information.

A methodological review on bio-lubricants from vegetable oil based resources

Finiteness of global crude oil reserve, rising crude oil prices, and issues related to environment seems to be a reality check for the problems of emerging generations. Present article focuses on lubricating oils as well as lubricating greases developed from vegetable oil. Vegetable oil based lubricants are an attractive alternative to

conventional petrol based lubricants due to number of their physical properties including renewability, biodegradability, high lubricity and high flash points. Still they have not yet replaced petrol based lubricants due to their inappropriate chemical structure, which lags them behind at various odd conditions during applications. The challenges in this field are to improve certain characteristics of vegetable oils without impairing their excellent tribological and environmentally relevant properties. Chemical modification of vegetable oils overcomes the structural problems related to vegetable oils which in turn makes them fit for the application of lubricant. In this review article, they have reviewed the available literature and recently published data related to development of bio-lubricants by chemical modifications of vegetable oils.

Click [here](#) for more information.

A trade-off between carbon and water impacts in bio-based box production chains in Thailand: A case study of PS, PLAS, PLAS/starch, and PBS

Currently, bio-based plastics are considered the most promising and environmentally friendly alternative to replace petroleum-based plastics to reduce their environmental impacts. The aim of this research work is to assess and compare the life cycle impact of three types of bio-based boxes (namely, polylactic acid from sugarcane, polylactic acid from sugarcane-starch blends and polybutylene succinate from sugarcane and corn) and petroleum-based boxes of polystyrene. The locations of the plantation stage are focused in 4 provinces, namely, Kanchanaburi, Sakaeo, Prachinburi, and Chonburi provinces, in Thailand. The total impact using the external environmental cost (unit: THB equivalent) is performed at two impact categories: carbon footprint and fresh water consumption. The results from this study indicate that polybutylene succinate reveals the

lowest water footprint at 0.38 m³ H₂O of all the bio-based boxes and presents the second lowest water deprivation at 0.008 m³ H₂O equivalent and the lowest carbon footprint at -0.06 kg CO₂ equivalent. The lowest water footprints for all bio-based boxes production chains are found in Kanchanaburi and Chonburi provinces because the highest sugarcane and corn yield were observed, respectively, whereas, the minimum of water deprivation for all bio-based boxes production chains are clearly observed in Sakaeo province because of the lowest amount of chemicals used during plantation stage. The total impact on CF decreased by 26–69% for the production of bio-based boxes because CO₂ absorption from the photosynthetic reactions during the plantation stages were included. In conclusion, for bio-based boxes, the polybutylene succinate box showed the lowest total externality cost of 0.046 THB equivalent on production chain in Sakaeo province. This externality accounts for 64–74% of total cost for freshwater consumption but only accounts for 26–36% of total cost for CF. These results are beneficial to supporting the development for establishing bio-plastics industry in aspects of water used and CF. Therefore, the effective strategies for preparing a sufficient supply of irrigation system or efficient water management and appropriate performance from agrochemicals used for supporting the feedstocks production to bio-plastics industry production chains should be proposed.

Click [here](#) for more information.

Polymers

Evonik ramps up production capacity for biomaterials

Evonik is expanding its production facilities in Birmingham (Alabama, USA) and Darmstadt

(Germany), aiming to solidify its leadership in the bioresorbable polymer market. This will create additional capacity for the production of biodegradable polymers marketed globally under the brand names RESOMER® and RESOMER® SELECT. These poly-lactic-glycolic-acid (PLGA) copolymers are primarily used to manufacture bioresorbable medical devices and controlled-release formulations for parenteral drug delivery.

The expansion will involve construction of a new building adjacent to Evonik's existing facility in Birmingham. Besides greater production capacity, the project will also result in new production clean rooms and a laboratory for polymer contract research projects. Commissioning is slated for late 2018.

The expanded plant in Birmingham is the second investment to serve the growing market demand after the inauguration of the new manufacturing site in Darmstadt two years ago. The Darmstadt unit capacity will also be increased with the opening of a new production line.

Moreover, Evonik will open an applied technology laboratory in Darmstadt at the end of the year to support its customers in the medical device field. Its first facility of this kind was completed in 2015 in Shanghai (China). At these laboratories, customers receive prompt support for product development and training in the use of Evonik products.

Click [here](#) for more information.

Lenzing invests in new TENCEL® fibre plant in the USA

The Lenzing Group aims to increase the share of speciality fibres as a percentage of revenue to 50 percent by 2020. Following the previously announced expansion plans for Lenzing, Heiligenkreuz (Austria) and Grimsby (Great Britain), in December the Supervisory Board of

Lenzing AG approved the investment for a TENCEL® fibre plant in the USA. Lenzing now plans to construct a state-of-the-art plant with a production capacity of 90,000 tons per year at its site in Mobile, Alabama. The new facility will be the largest TENCEL® fibre plant in the world, it will set a new milestone in the history of lyocell fibres. The investment volume will total USD 293 mn (EUR 275 mn). The new plant will utilize the latest technological standards and is scheduled to start in the first quarter of 2019. The Lenzing Group currently has a worldwide production capacity of 222,000 tons per year of TENCEL® fibres. The new plant in Mobile plus the already announced debottlenecking projects at the other TENCEL® fibre sites will increase the total TENCEL® fibre capacity by more than 50 percent by 2019. The decision to build this plant in the US was supported by the good infrastructure at their Mobile site and attractive energy costs.

Click [here](#) for more information.

SDK to Terminate Production and Sale of Biodegradable Plastic

Showa Denko (SDK) has decided to terminate production and sale of the biodegradable polyester resin Bionolle™, which is used as material for various products including shopping bags and agricultural mulch film. SDK terminated production of Bionolle™ by the end of December 2016, and will cease sale of it by the end of December 2017.

SDK pioneered biodegradable plastic in Japan, and started to sell it in 1993. Recently, SDK has striven to cultivate the market for compound products to form shopping bags, in response to the tightening of environmental regulations in Europe and China on shopping bags made from conventional plastics. This time, however, SDK concluded that it is difficult for the company to continue production and sale of biodegradable plastic, since there has been no sign of

improvement in the harsh market environment for biodegradable plastics, due to the delay in permeation of environmental regulations on plastic shopping bags, and a fall in market prices of biodegradable plastics.

Click [here](#) for more information.

HEXPOL TPE creates more possibilities to be green

Thermoplastic Elastomer (TPE) compounding group HEXPOL TPE has added new compounds to their Dryflex Green family of biobased TPEs, creating more opportunities for sustainability.

Dryflex Green is a family of thermoplastic elastomer compounds based on raw materials from renewable resources such as plant and vegetable crops. Raw materials can be produced from various renewable sources, these include products and by-products from agricultural that are rich in carbohydrates, especially saccharides such as grain, sugar beet and sugar cane.

HEXPOL TPE has developed several new customisation options for the Dryflex TPE compounds. The hardness range has been expanded to include 20 Shore A to 50 Shore D, with amounts of renewable biocontent to over 90% (ASTM D 6866-12), depending on the hardness.

The biobased content in the Dryflex Green compounds can derive from various raw materials such as polymers, fillers, plasticizers or additives. For applications wanting a look even closer to nature, HEXPOL TPE has additionally developed compounds using organic fillers and natural fibres from plants, crops or trees, including cork. Cork is a natural product which comes from the bark of the cork oak tree. The removal of the bark does not harm the trees and the bark is only harvested after the first 20 years of growth. The removal stimulates a steady regeneration of the bark. Each

cork tree provides on average 16 harvests over its 150-200 year lifespan.

Dryflex Green TPE compounds can be processed using standard thermoplastic processing methods, including injection moulding and extrusion. Typical applications include; soft-touch grips and handles, tools and hardware, sports equipment and packaging.

Click [here](#) for more information.

Bio-on announces new multi-license maxi agreement for revolutionary PHAs bioplastic

Bio-on has announced it has signed a new multi-license contract worth 55 million Euro with a major multinational company and leader in its sector. The goal of Bio-on's new client is, within the next 3 years, to replace conventional plastic with biodegradable biopolymers made from agro-industrial waste using Bio-on's revolutionary PHAs bioplastic. Thus transforming waste into raw material, using a new plastic with a positive impact on people and the planet.

The plan envisages the construction of a series of PHAs bioplastic production plants for an overall output of 100,000 tonnes per year. The individual plants will have a potential of between 10,000 and 30,000 tonnes per year and will be built in Europe and Asia according to a three-year schedule, which will meet the needs of Bio-on's multinational client to produce its own PHAs biopolymer. Thanks to this agreement, the company will from 2020 be able to replace a large part of the conventional plastic now used in its products with an innovative, 100% natural and biodegradable material.

The PHAs bioplastics (polyhydroxyalkanoates) developed by Bio-on are made from renewable plant sources with no competition with food supply chains. They guarantee the same thermo-

mechanical properties as conventional plastics with the advantage of being 100% eco-sustainable and naturally biodegradable at ambient temperature.

Based on the agreement announced in December, the PHAs bioplastic to be produced with the technology licensed out by Bio-on will be made from co-products of the sugar industry and the production of starch and its derivatives. All the bioplastic produced at the new plants, 100 thousand tonnes per year, will be used by the multinational exclusively within its own production cycle to create finished products ready for sale. In other cases, Bio-on licenses allow for the bioplastic to be put on the market and sold to custom moulders.

Click [here](#) for more information.

Reduced CO₂ emissions and increased sustainability in plastics production: Commercial debut for PLAneo® technology from thyssenkrupp

To reduce dependency on petroleum-based plastics thyssenkrupp has developed its own manufacturing process for the bioplastic polylactide (PLA). Now the company is building the first commercial plant based on its patented PLAneo® technology in Changchun, China. The customer is COFCO Corporation, a leading supplier of agri-products offering a wide range of foodstuffs and services. Once completed, the new plant will produce around 10,000 tons of PLA per year. Commissioning is scheduled for the first quarter of 2018.

Polylactide (PLA) is a 100% bio-based and compostable plastic which is suitable among other things for processing into packaging materials, films and engineering plastics and can therefore replace conventional oil-based polymers in many areas. The raw material for PLA production is lactic

acid, which is produced from renewable resources such as sugar, starch or cellulose. Polylactide is thus both bio-based and bio-degradable.

In developing the PLAneo® technology, Uhde Inventa-Fischer, a subsidiary of thyssenkrupp Industrial Solutions, profited from expertise gained from the construction of more than 400 polymerization plants and extensive experience in the scale-up of new technologies. PLAneo® technology converts lactic acid into PLA in a particularly efficient and resource-friendly way. Another advantage is its transferability to large-scale plants with capacities of up to 300 tons per day (100,000 t/year). Thanks to its great flexibility the process allows the production of tailored PLA types with different degrees of crystallinity and viscosity for a multitude of applications.

Click [here](#) for more information.

Chemicals

Green Biologics Receives USDA Certification



Green Biologics

Green Biologics, Inc., the U.S. subsidiary of Green Biologics Ltd., a U.K. industrial biotechnology and renewable chemicals company, announced that its high purity bio-based n-butanol and acetone have received official certification under the USDA BioPreferred® program. The products are now certified as 100 percent bio-based and are marketed under the BioPure™ brand.

The BioPreferred program is a USDA-led initiative designed to assist in the development and expansion of markets for bio-based products. Created by the 2002 Farm Bill and expanded as part of the 2014 Farm Bill, BioPreferred is transforming the marketplace for bio-based goods through mandatory purchasing requirements for Federal agencies and contractors, as well as voluntary product certification and labelling.

Products using the USDA Certified Biobased Product label are guaranteed to contain a USDA-verified amount of renewable biological ingredients, enabling consumers to make informed and sustainably-minded purchasing decisions.

Green Biologics, a member of the American Chemistry Council (ACC), is in the early start-up of its first commercial production facility for BioPure™ renewable n-butanol and acetone in Little Falls, Minnesota, and aims to be in commercial production by late 2016.

Click [here](#) for more information.

Amyris Partners with Queensland to Create the leading Industrial Biotechnology Hub in Southeast Asia

Amyris, Inc., the industrial bioscience company, and the Government of Queensland, Australia have announced a partnership to create a southeast hub of sustainable ingredients production for the rapidly-growing personal care sector in Asia, while supporting Queensland's local economy and sugarcane industry. The partnership aims to develop a new production plant with support from local partners. The plant will produce Amyris's high-value personal care and nutraceutical actives, as well as farnesene-derivative products.

Globally, key trends are driving expansion in the market for sustainable ingredients that are natural and plant-derived rather than animal derived, and that are efficient and pure, yet offer high-performing characteristics. With economic expansion and growing consumer demand for high quality skin care and nutraceutical products in Asian countries this market is one of the fastest-growing markets in the world for Amyris products and technology.

Amyris ingredients are naturally derived from sustainable sources and are delivering disruptive performance to its partner companies and to their consumers. Many of these companies are based in Asian countries and have significant current and projected growth.

Amyris and the Government of Queensland are actively working on this program to facilitate pathways for the development of a commercial plant and production. Through this alignment of each parties' common goals, clear lines have been established and first industrial production of product at the new production facility is expected to occur in 2020.

Amyris & NIKKOL Group Create Leading Cosmetics Ingredient Joint Venture

In other news, Amyris has announced it has signed a definitive agreement to establish a cosmetic ingredients joint venture with NIKKOL GROUP, a leading Japanese cosmetic speciality chemical provider. NIKKOL is purchasing 50% of the Amyris Neossance business for up to \$20 million in total. Amyris will receive \$10 million of the purchase price upfront and the remaining \$10 million is structured as an earn out over the first three years of the joint venture operation.

NIKKOL has been a long-term distributor of Amyris's cosmetic ingredients in the Japanese market and a key partner of Amyris in helping grow the business. As a world leader in personal

care ingredients segment, it is anticipated that NIKKOL's participation in the joint venture will support even greater sales growth while further establishing a market leadership position.

Click [here](#) for more information.

AVALON Industries takes over all bio-based chemistry activities from AVA-CO₂

AVALON Industries AG, the new entity of Swiss-based company AVA-CO₂ Schweiz AG, is taking over all bio-based chemistry activities from AVA-CO₂ with immediate effect. In order to fully focus on biochemistry, AVA-CO₂ has also decided to sell its Hydrothermal Carbonisation (HTC) technology to the globally active International Power Invest AG, a holding company investing in renewable energy projects. From now on, AVA-CO₂ will act as a holding company.

In response to rapid application developments relating to bio-based chemical 5-Hydroxymethylfurfural (5-HMF) and following increased 5-HMF demand from value chain partners, AVALON Industries was created to take advantage of new market opportunities and to prepare for future large scale production. A subsidiary of AVA-CO₂, AVALON Industries is taking over all operational activities from AVA-CO₂ and will focus on the global implementation of the Hydrothermal Processing (HTP) technology for the industrial-scale production of 5-HMF. This technology was successfully developed and patented by AVA-CO₂ over the last seven years.

International Power Invest AG, a holding company active in renewable energy projects, has acquired AVA-CO₂'s HTC-0 industrial scale demonstration plant and all relevant HTC Intellectual Property rights. Among other renewable energy projects, IPI has also invested in the "Innovationspark Vorpommern" located in Relzow, Germany and

plans to continue the development and international roll-out of the HTC technology.

Large-scale commercialisation of 5-HMF would have applications such as 2,5-Furandicarboxylic acid (FDCA), Polyethylene Furanoate (PEF) as well as non-toxic, bio-based resins and adhesives.

Click [here](#) for more information.

TÜV gives clearance to start operations in the Leuna Demo Plant

Global Bioenergies has announced they have received the official permit to commence operations at the Leuna Demo Plant from TÜV, the main state certification agency in Germany. This clearance was obtained for the fermentation area after a complete audit, specially focused towards safety and environmental issues.

A team of 12 operators was recently recruited and trained by the Fraunhofer Institute, who are in charge of operating the Demo Plant on a 24/7 basis.

Click [here](#) for more information.



Global Bioenergies plans to acquire Dutch start-up Syngip B.V.

Global Bioenergies has also signed a contribution agreement with the shareholders of Syngip B.V. to transfer all Syngip shares to Global Bioenergies S.A. The transaction's completion remains subject to the fulfilment of several suspensive conditions including approval by the shareholders of Global Bioenergies.

Syngip is a 3rd generation industrial biotech start-up created in 2014 in the Netherlands. It has developed a process to convert gaseous carbon sources such as CO₂, CO, and industrial emissions such as syngas, into various valuable chemical compounds. To this end, the company has identified a specific micro-organism capable of growing using these gaseous carbon sources as its sole feedstock, and has developed genetic tools to allow the implementation of artificial metabolic pathways into it. Its recent work has been directed to the implementation of metabolic pathways leading to light olefins, major petrochemical molecules, which include isobutene.

Global Bioenergies has set the diversification of feedstocks usable in its isobutene process as its new R&D frontier. CO₂, CO and syngas cause global warming, but represent an abundant and cheap source of carbon. Syngip's acquisition would greatly accelerate the development of a 3rd generation isobutene process based on the use of such resources, an aim that has been part of Global Bioenergies' strategy for several years. All Syngip employees would be dedicated, as part of the Global Bioenergies group, to developing such a process.

Click [here](#) for more information.

Chevron Makes Equity Investment in Novvi and its High-Performance Renewable Base Oil Technology

Chevron Products Company, a division of Chevron U.S.A. Inc., and Novvi LLC have announced that Chevron has made an equity investment into Novvi LLC (a joint venture of Amyris, Inc., Cosan S.A., and American Refining Group (ARG)). Terms of the transaction were not disclosed.

Novvi's products and technology are recognized by the global lubricant market to deliver sustainable, high-performance solutions in a range of lubricant applications. Since launching

first commercial production in 2014, Novvi has been steadily increasing base oil manufacturing to keep up with robust and growing demand for a variety of applications.

Chevron is a leading manufacturer of premium base oils and one of the world's largest suppliers of finished lubricants. Chevron has one the world's largest base oil manufacturing platforms through its own refining network and its base oil licensing technology position.

In addition to an equity investment, Chevron and Novvi plan to work together to introduce new base oils and lubricants to the industry in key areas.

Click [here](#) for more information.

BioAmber and CJ CheilJedang Plan JV for Succinic Acid Production in Asia

BioAmber Inc. has signed a non-binding letter of intent with South Korean-based CJ CheilJedang Corporation (CJCJ). Under the terms of the agreement, BioAmber and CJCJ plan to establish a joint venture in China to produce up to 36,000 metric tons of bio-succinic acid annually and commercialize the output in Asia. This can be achieved rapidly, cost effectively and with limited capital investment by retrofitting an existing CJCJ fermentation facility with BioAmber's succinic acid technology. CJCJ would incur all capital costs required to retrofit their fermentation facility, including the capital needed during plant commissioning and startup, and production would begin in Q1 2018. If market demand were to subsequently exceed production capacity, the joint venture could expand production through debottlenecking and/or additional investment. The partners would also have a mutual right-of-first-refusal to retrofit additional CJCJ fermentation facilities globally.

The proposed joint venture is subject to certain conditions, including technical and commercial due diligence, with the definitive agreements expected to be signed by July 2017. As part of the letter of intent, BioAmber will be selling CJCJ bio-succinic acid manufactured at its Sarnia, Ontario plant, so that CJCJ can undertake market development in China and South Korea in the first half of 2017.

Click [here](#) for more information.

Amyris Signs Multi-Year Collaboration Extension with Kuraray



Amyris, Inc., the industrial bioscience company, announced that it has executed with its long-time partner Kuraray Co. a multi-year extension to their collaboration agreement for the use of Amyris's Biofene® branded β -Farnesene in liquid farnesene rubber ("LFR") and farnesene-based elastomer applications. This collaboration, which originally began in 2011, features increased farnesene supply to Kuraray and joint marketing of products to industry and end-customers.

Amyris's sugar cane-derived Biofene forms the basis for a wide range of products varying from speciality products such as cosmetics, perfumes, detergents and industrial lubricants, to transportation fuels such as diesel and jet fuel. As a tailor made pure hydrocarbon it provides numerous advantages when compared to petroleum-based oils and chemicals and is renewable, contributing to a sustainable future.

Kuraray's recent technological successes with rubber containing farnesene includes an enhanced synthetic additive for tire manufacturers. Its novel

LFR and other farnesene- containing rubber materials add substantial grip and cornering capability to tires, particularly in cold, snow and ice conditions. In addition, its hydrogenated styrenic-farnesene copolymer ("HSFC") has demonstrated superior shock absorption in products ranging from footwear to speciality construction materials.

Click [here](#) for more information.

Green Biologics Begins Customer Shipments at First Commercial Plant

Green Biologics, Ltd., a UK industrial biotechnology and renewable speciality chemicals company, announced the start of commercial shipments of bio-based n-butanol and acetone from its manufacturing facility in Little Falls, Minnesota.

Over the past year, Green Biologics has built a robust pipeline of domestic and export customers combined with multiple partnerships to bring its products to downstream markets. These include distribution agreements with Acme Hardesty, Nexeo Solutions, and Caldic as well as a strategic partnership with HOC Industries, a custom blender, packager and distributor of consumer and government products. The company is collaborating with other industry leaders in a range of speciality markets and applications where performance and sustainability drive value.

Offered as a high-performance, high purity, fully-sustainable alternative to conventional petrochemical-based commodities, Green Biologics' speciality chemicals aim to drive value in customer applications and downstream markets ranging from speciality coatings, pharmaceuticals, cosmetics, personal care and consumer products. Both butanol and acetone products carry the brand name BioPure™ and have received USDA BioPreferred® status. As a member of the American Chemistry Council (ACC), Green

Biologics' commercial facility is actively working towards meeting Responsible Care® standards.

Through its own manufacturing efforts and collaborations with industry partners, Green Biologics offers a wide portfolio of 100 percent bio-based products in addition to n-butanol and acetone, including high purity 100 percent bio-based isopropyl alcohol and a range of speciality esters of n-butanol, isopropanol and other bio-based alcohols.

Click [here](#) for more information.

Consumer Products

EcoHelmet wins James Dyson Award 2016

Bike share programs are used by millions of people around the world. But bike share users rarely wear helmets – a potentially fatal decision. According to the Bicycle Helmet Safety Institute, more than 800 cyclists were killed on US roads in 2015.

Isis Shiffer, a recent graduate from the Pratt Institute of Design in New York City, set out to address this problem. Her solution: EcoHelmet, a folding, recyclable helmet for bike share users.

EcoHelmet uses a unique honeycomb configuration to protect the head from impact, and folds flat when not in use. A biodegradable coating makes it resistant to rain for up to three hours. The lightweight, durable design of EcoHelmet empowers cyclists to ride safely and confidently.

The cell structure of EcoHelmet distributes any impact evenly around the head as effectively as a traditional polystyrene helmet. Due to the radial nature of the cells, it will protect the user from a blow coming from any direction. The simplicity of EcoHelmet's construction, coupled with its inexpensive materials, will keep the manufacturing costs low – meaning they can be sold for \$5 at bike share stations.

Click [here](#) for more information.

Mitsubishi Chemical's DURABIO™ Bio-based Engineering Plastic

Mitsubishi Chemical Corporation (MCC) have announced that Mazda Corporation has adopted MCC's DURABIO™ bio-based engineering plastic for the exterior design parts of Mazda's Roadster RF, which was introduced on December 22, 2016. DURABIO™, developed by MCC, is a bio-based engineering plastic made from plant-derived isosorbide. It features excellent performance, offering higher resistance to impact, heat, and weather than conventional engineering plastics. Additional benefits include ease of colouring – DURABIO™ can be simply mixed with pigment to create glossy, highly reflective, and rich hue surfaces – as well its hardness, enhancing durability and scratch resistance. These advantages eliminate the need for a coating process, thereby reducing emissions of volatile organic compounds (VOCs) from paints. MCC and Mazda jointly developed a new grade of DURABIO™ that can be used for exterior design parts without coating. The new grade has been used for interior and exterior design parts of Mazda's CX-9, Axela, and Demio since 2015, when it was first adopted for the Roadster launched in the same year. The Roadster RF is the fifth model to use DURABIO™, and the new grade will be adopted for more models. MCC will accelerate research and development of DURABIO™, with the goal of expanding applications for car interior

design parts, of course, but also expansion of its use in exterior design parts, contributing to environment-friendly car production.

Click [here](#) for more information.

Patents

Polymer compositions based on a bio-sourced polyarylene ether sulfone

Polyether sulfones (PES) are thermoplastic polymers comprising -aryl-SO₂-aryl- moieties, which are typically manufactured by polycondensation reaction of a bis-(halodiphenyl) sulfone with a diphenol. PES are used for a variety of industrial applications, including, but not limited to, the manufacture of articles for medical applications and for automotive applications and the manufacture of flame retardant compositions. Among the requirements of articles made from PES, especially medical articles, are transparency, high strength and stiffness and there is a continuing need for new polymer materials satisfying such requirements. Furthermore, in the polymer industry, there is a continuing need to provide environmentally friendly materials.

Solvay Speciality Polymers USA, LLC.

EPO Patent Application EP 3088/442 A1

Click [here](#) for more information.

Processes to prepare elongated 2-ketoacids and c6-c10 compounds therefrom via genetic modifications to microbial metabolic pathways

Modification of metabolic pathways includes genetically engineering at least one enzyme involved in elongating 2-ketoacids during leucine biosynthesis, and preferably at least isopropylmalate dehydrogenase or synthase (LeuB or LeuA in *E. coli*), to include at least such non-native enzyme, enzyme complex, or combination thereof to convert 2-ketobutyrate or 2-ketoisovalerate to a C7-C11 2-ketoacid, wherein the production of such is at a higher efficiency than if a purely native pathway is followed. The C7-C11 2-ketoacid may then be converted, via a native or genetically engineered thiamin dependent decarboxylase, to form a C6-C10 aldehyde having one less carbon than the C7-C11 2-ketoacid being converted. In some embodiments the C6-C10 aldehyde may then be converted via additional native or genetically engineered enzymes to form other C6-C10 products, including alcohols, carboxylic acids, and alkanes. This genetic engineering offers the opportunity for commercial scale of in vivo biosynthetic processes that may be more cost-efficient than non-biobased approaches to produce the same products.

Click [here](#) for more information.

Events

Biobased Live, May 31st - June 1st, 2017, Amsterdam Science Park, Amsterdam, the Netherlands.



The 2nd annual meeting of our European community offers an interactive and intimate environment to make bio-based innovations a key part of future sustainable strategies. Bringing together the CEOs, senior R&D, Process Heads, and BD Heads, with the sustainable professionals brand marketing specialists and end users, we create a unique platform to do business and create practical takeaways to ensure long-term success.

13th International Conference on Renewable Resources and Biorefineries, 7-9th June 2017, Wrocław, Poland



Delegates from university, industry, governmental and non-governmental organizations and venture capital providers will present their views on industrial biotechnology, sustainable (green) chemistry and agricultural policy related to the use of renewable raw materials for non-food applications and energy supply.

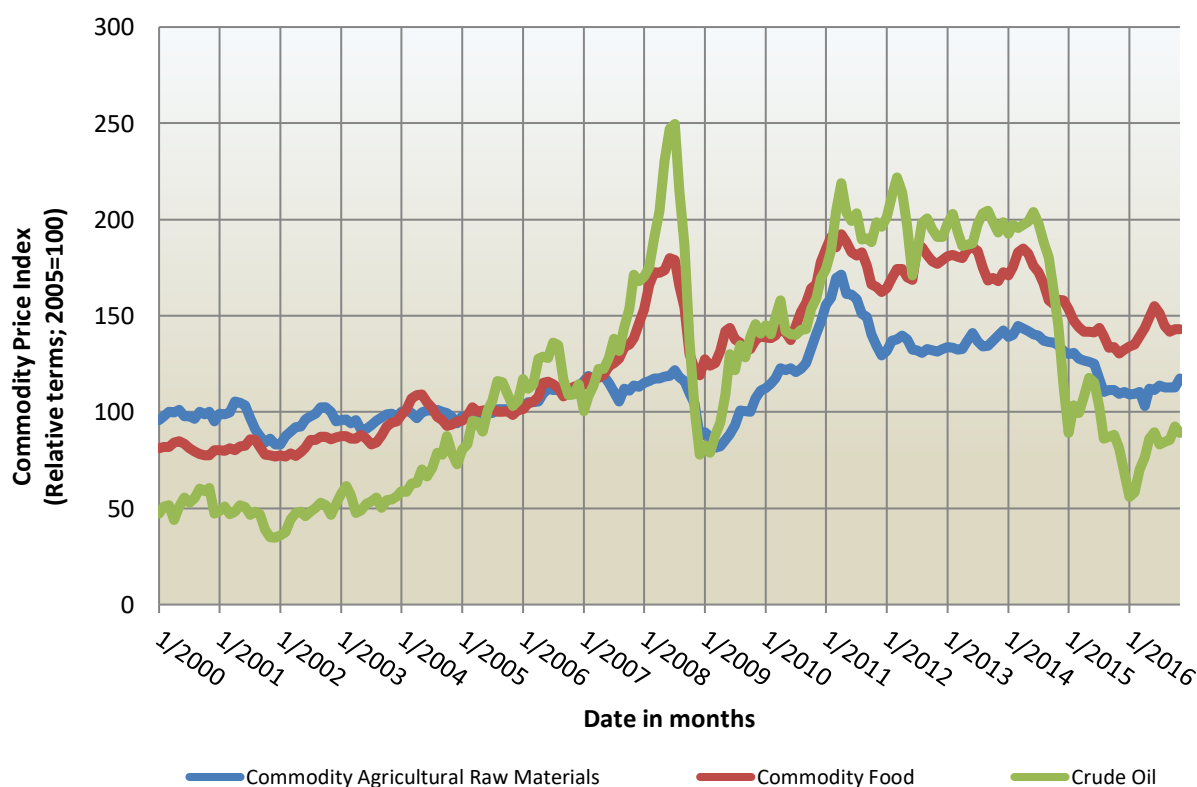
Price Information

Spot Prices of feedstocks as of today and five years ago, and percentile price change. Arrows indicate rise (↑), constant (–) or fall (↓) from previous month.

Item	Price, US\$ (Dec 11)	Price, US\$ (Dec 16)	% Price Change
Crude oil (petroleum, barrel)	104.26	45.28 (↓)	-57
Maize (corn, metric ton)	258.44	151.30 (↓)	-41
Sugar (pound)	0.2342	0.2087 (↓)	-11
Rapeseed oil (metric ton)	1,244.43	896.35 (↓)	-28
Soybean oil (metric ton)	1,103.04	772.41 (↑)	-30
Ethanol (gallon)	2.49	1.70 (↑)	-32

For details on indexes please see www.indexmundi.com/commodities; Ethanol prices from Govt of Nebraska at www.neo.ne.gov/.

Raw materials 15-year Price Indices



For details on the nature of these commodities please see www.indexmundi.com/commodities

Credits and Disclaimer

NNFCC Market Review is edited by Robert Horton for NNFCC members. Feedback is welcome. The Review has been compiled in good faith and NNFCC does not accept responsibility for any inaccuracies or the products or services shown.



NNFCC
Biocentre, York Science Park
Innovation Way
Heslington, York
YO10 5DG

Phone: +44 (0)1904 435182
Fax: +44 (0)1904 435345
Email: enquiries@nnfcc.co.uk
Web: www.nnfcc.co.uk
Twitter: @NNFCC