D1.2 – REPORT ON BEST PRACTICES AND SWITCH TO BIO-BASED CASE STUDIES

FOR THE AGRICULTURE, FOOD, FORESTRY AND CHEMICAL SECTORS

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This document is the BIOSWITCH project Report On Best Practices And Switch To Bio-Based Case Studies (contract no. 887727) corresponding to D1.2 (M8) led by BTG. This document describes the results of Task 1.2 and presents a series of case studies for the key cluster sectors (agriculture, food, forestry and chemical sectors) as good practices to inspire brand owners and support their transition to bio-based products.

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ACRONYMS AND ABBREVIATIONS

1.1

ACRONYM	FULL NAME
B2B	Business-to-business
BBI JU	Bio-based Industries Joint Undertaking
BI	Bio-based Industry
BIC	Bio-based Industries Consortium
BO	Brand Owners
BTG	B.T.G. Biomass Technology Group BV
CLIC	CLIC Innovation Oy
CS	Case study
CTA	Corporación Tecnológica de Andalucía
DoA	Description of Action
EC	European Commission
FBC	Food & Bio Cluster Denmark
FF	Flanders' FOOD
GDPR	General Data Protection Regulation
ITT	Institute of Technology Tralee
PE	Poly-ethylene
SIE	Sustainable Innovations Europe SL
WP	Work Package

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1 INTRODUCTION

Objective of BIOSWITCH

The main aim of the BIOSWITCH project is to bring Europe to the forefront of the bio-based economy, encouraging and supporting brand owners to switching to bio-based approaches by following a holistic, systemic approach built on two pillars:

- A framework where brand owners are placed as the centre of the public administration-bio-based industry-consumers triangle through a set of events and communication actions that will allow shaping solutions to mitigate their perceived risks; and
- The BIOSWITCH toolbox as the ultimate instrument that will assist them in the bio-based transition journey.

Objective of Work Package 1

The aim of WP1 (Framework development and mapping and analysis exercise) is to set up the brand owners' networks and to involve public administration, consumers and bio-based industries in the BIOSWITCH framework:

- To analyse brand owners needs and perceived risks when switching to bio-based
- To gather best practices and case-studies so they can inspire brand owners
- To identify motivations and incentives as well as bio-based products consumer acceptance drivers
- To promote a co-creation exercise (via a design thinking approach) between brand owners, public administration and consumers where all previous information can be analysed and discussed, and efficient solutions to mitigate perceived risks can be developed.

Objective of Task 1.3

In Task 1.3 BIOSWITCH partners will undertake the identification of relevant best practice cases and opportunities for companies to "switch-to-bio-based". The scoping exercise will form a basis for the development of one of the BIOSWITCH tools and for engagement with industry and clusters on specific opportunity areas. Building on the results of the previous task (*T1.2 European and regional analysis of the needs, risks and motivations of brand owners switching to bio-based approaches*), Task 1.3 will build up industry-relevant case studies for the key cluster sectors (agriculture, food, forestry and chemical sectors) as good practices to support the transition to bio-based products.

Task results will be documented in the current report, Deliverable 1.2 - Report on Switch-to Bio-based Case Studies for the Agriculture, Food, Forestry and Chemical Sectors. The task results will also be presented at the project workshop in early 2021, incorporated in one of the BIOSWITCH communication tools (a video) in WP2, and included in WP3 and WP4 activities.

Introduction to Deliverable 1.2

After providing an introduction (in the current Chapter 1), the methodology adopted for the research task is presented in Chapter 2, followed by an overview of research results in Chapter 3. Findings of a cross-analysis of the case studies are presented in Chapter 4. Some data sources for further reading are provided in Chapter 5.

Appendixes include present the Case study development guideline, the Form of consent, a sample of a formally edited factsheet and the full set of "raw" unedited factsheets.

2 METHODOLOGY

The wok associated with the identification of case studies (CS) and the assessment of best practices and opportunities for brand owners to "switch-to-bio-based" covered the following:

a) Identification and selection of case study candidates
b) Development and refinement of case study content
c) Formal editing of case studies
d) Cross-analysis of case studies to assess best practices
e) Dissemination and promotion of results

Almost all consortium partners were involved in the work. Under the coordination of task leader BTG, the six partners CLIC Innovation (Finland), Food & Bio Cluster (Denmark), Flanders' FOOD (Belgium), Fundación Corporación Tecnológica de Andalucía CTA (Spain), Institute of Technology, Tralee (Ireland) and BTG Biomass Technology Group (Netherlands) developed and lead a case study each. In the process task leader BTG supported the five other CS leaders, by answering their questions, helping them select suitable CS candidates, providing background information and CS examples, and giving general guidance. Finally, partner Sustainable Innovations (SIE) was charged with the formal editing of the case studies.

Selection of case study candidates

The aim of the first sub-task was to make sure to include a variety of case studies, in terms of company size, the company's bio-based experience, the bio-based (product) innovation and the benefits of the bio-based innovation. In addition, each of the four sectors of primary focus within BIOSWITCH (Agriculture, Food, Forestry and Chemicals) should be covered.

To obtain a balanced mix of case studies, each of the six case study leaders first drew up a short list of several CS candidates from their respective networks. In a joint meeting in September 2020, they discussed all CS candidates, and selected for each of them the Top 2 or Top 3 candidates (preferred choice plus one or two back-up options) offering the best perspective to yield an interesting case study.

Development of case study content

At the September 2020 meeting the six CS leaders also discussed and agreed internally on the CS development approach that had been prepared and suggested by task leader BTG. The final version of the CS development guideline is attached (**Appendix 1**).

Next CS leaders interviewed representatives of the candidate case study companies to secure their participation. In two cases none of the originally selected CS candidates were retained. For these cases new CS candidates were identified and secured, making sure to maintain the balanced mix.

After securing and formalizing[1] the engagement of the CS companies, a case study was compiled. Information for the case study was collected though targeted interviews with a case study company representative, and supplemented with information gathered online.

Task leader BTG reviewed (one or more) draft versions of each of the case studies, after which CS leaders produced the final draft case study content. When deemed complete, the final draft was shared with the case study company for their final approval. After receiving that approval, the final draft case study was sent to project partner Sustainable Innovations (SIE) for formal editing.

Formal editing of case studies

Graphical designers at Sustainable Innovations (SIE) reworked the appearance of each factsheet to render a visually attractive document, reflecting the project's brand image. The first factsheet that SIE edited in this manner is attached (**Appendix 3**). Formal editing of the other five factsheets is ongoing and remains to be completed at the time of writing (mid-December 2020). Therefore, their unedited "raw" versions are attached instead (**Appendix 4**).

Cross-case study analysis

As soon as draft version of all case studies were available, task leader BTG started with their cross-analysis, with a view to assess best practices. In particular, the cross-analysis zoomed in on (a) brands' motivations, (b) bio-based product innovations, (c) barriers and challenges encountered, and (d) lessons learned and take home messages. The results of the cross-analysis are discussed in the next two chapters.

Dissemination and promotion of results

For maximum exposure and outreach, it was agreed with communication partner SIE that completed individual case studies as well as the associated research findings would be promoted in several ways:

- CS factsheets will be integrated in the BIOSWITCH Toolbox and in the project website
- CS factsheets will be promoted through the periodic electronic newsletter.
- CS factsheets will be advertised in the BIOSWITCH social media
- Case studies will be presented in a dedicated CS webinar, to be held in January 2021
- Case studies will be promoted in a dedicated communication tool (video)

Promotion on the BIOSWITCH twitter channel started just before the 2020 Christmas holidays with two announcements. Firstly, that the fist (formally edited) factsheet was released, and secondly, that the case study webinar would be held on 27 January 2021. Implementation of all other mentioned promotional activities is foreseen after the submission of the current document.

[1] All case study companies were requested to sign a Letter of Consent to confirm their readiness to participate. The Content From is attached (Appendix 2).

3 RESULTS

By the due date of the current deliverable (31.12.2020), two main results following from the research task were duly completed[2]:

- A series of six Case Studies was elaborated. These CS are (or will become) available and will be promoted as stand-alone documents. Drafts versions are incorporated in Appendix 4).
- A short introduction on the collection of case studies is presented below.
- A cross-analysis of these Case Studies describing best practices was elaborated. The results of this analysis are presented (below and) in the next chapter.

Case study companies

The six case studies cover companies (also referred to as: "brand owners") of various ages and sizes. The smallest and youngest one (Bioco) is less than 5 years old, and has just 2 staff members (and no R&D department of its own). The oldest one (StoraEnso) is more than 700 years old, employing close to 26,000 people, and continuously innovating to valorise renewable forest resources. The brand owners are headquartered in six different European countries. Each of the economic sectors addressed in BIOSWITCH (agriculture, food, forestry and chemical sectors) is covered in one or two case studies. The case study companies are introduced in the current document in order of ascending company size.

Although the case study companies are widely different in age, size, market strength etc., they have values in common such as a focus on sustainability and innovation. Although it was not used as a selection criterion at all, during the cross-assessment it appeared that all case studies brands/ products have gained prizes at award competitions in recent years (either for the renewable material use, the product design, the company orientation on sustainability/innovation/entrepreneurship).

Key characteristics of the case study companies are presented in Table 1.

Company	Main products	BIOSWITCH sector(s)	HQ	Established	No. of staff
Bioco	Craft coffee	Food	BE	2016	Just 2
Dantoy	Games and toys	Chemistry	DK	Early 1960's	About 50
Naty	Baby care products	Forestry	SW	1995	Few hundred
Vaude	Outdoor clothing	Chemistry	DE	1974	About 500
Alhóndiga La Unión	Vegetables & fruit	Agriculture, Food	ES	1993	750 – 1000
Stora Enso	Paper, packaging, wooden construction, biomaterials	Forestry	FIN	1289	Some 26,000

[2] Future results include the implementation of a dedicated Case study webinar (scheduled for 27 January 2021) and the development of a promotional video (scheduled for February 2021).

Table 1. Companies (brand owners) covered in the series of case studies

Products and applications

The case studies cover a wide range of bio-based products and packaging, from fast moving consumer products and disposable packaging to toys and outdoor clothing intended for long-term use. Some are made using drop-in bio-based chemicals[3] whereas others apply dedicated bio-based chemicals and materials. Some are used on the body (nappies, outdoor clothing) and/or meant for use by children (toys, nappies).

In terms of benefits, all of them avoid the use of fossil feedstock (largely or completely) and were developed to offer superior environmental performance compared to the product that they substitute. The bio-based products meant for long time use (toys, clothing) are recyclable; the bio-based products and/or packaging materials that are single-use are biodegradable (industrially compostable or home compostable). Depending on the application, the bio-based innovations offer further benefits that range widely: functionally performant, appealing design, creating new shapes and styles, increase efficiency of packaging, etc.

Key characteristics of the bio-based products covered in the case studies are presented in Table 2.

Company	Bio-based innovation/s	(Other) benefit/s	BB share (%)
Bioco	Coffee packaging (pouches; capsules)	Industrially compostable, Appealing design	Almost 100%
Dantoy	Toys	Recyclable	Almost 100%
Naty	Baby diapers	Home compostable	More than 50%
Vaude	Clothing components	Recyclable, High performance	Various (>25%)
Alhóndiga La Unión	Vegetable netting and packaging	Industrially compostable	Almost 100%
StoraEnso	Single-use food bowls	Industrially compostable; New shapes and styles, increased efficiency of packaging	Almost 100%

Table 2. Bio-based products covered in the series of case studies

[3] Bio-based drop-in chemicals are bio-based versions of existing petrochemicals which have established markets. They are chemically identical to existing fossil-based chemicals. The term drop-in is usually used in relation to commodity chemicals and polymers with large production volumes.).

Bio-based transition journeys in brief

The scope of each case study is described below in a nutshell. (Full descriptions are presented in Appendix 4).

Bioco, is an organic, artisan coffee roasting company from Belgium, established in 2016. The company looked for packaging that would make it stand out at the retailer's shelves. Incited by consumer push, it dropped its original packaging solution, and made a radical shift, adopting a packaging solution that is both bio-based and industrially compostable in 2017. As early mover Bioco has been a true pioneer, not just in Belgium but also in the whole of Europe, to apply bio-based packaging innovation for its full range of coffee products.

The Danish producer of toys and games, dantoy, has a clear target of constantly raising the sustainability levels of toys and games that are high-quality and long-lasting, and produced with minimized negative impact on environment and climate. In 2016 dantoy launched the I´m Green product line, a new series of bio-based plastic toys for pre-school children made of sugar cane derived poly-ethylene (PE). The packaging of these toys is also based on renewable sources. Market uptake of the bio-based toys has exceeded dantoy´s expectations.

Eco by Naty is a brand of disposable baby diaper and other eco-friendly products. While bio-based materials have been central to the Naty brand since the start in the nineties, the product range has increased to include a wider variety of bio-based products. Currently Naty has the highest share of bio-based components (>50%) in nappy brands. The full range of Naty products are partially or fully bio-based, and 8 out of 10 product lines are compostable, eco-friendly products.

Vaude is a German sports equipment brand making functional and innovative clothing and other articles to enjoy the outdoors. For its Green Shape Core Collection, launched in 2018, nature serves as model, taskmaster, and source of inspiration. About 90% of the diverse textile materials used in this product collection are made using bio-based, recycled or purely natural materials. For Vaude, using innovative bio-based materials helps to reduce its collective impact while also improving technical attributes to drive very high performing materials.

Alhondiga La Unión is an exporter of fruit and vegetables, committed to sustainability and engaged in the fight for a clean and waste-free world. Alhóndiga La Unión seeks to develop circular approaches, including the valorisation of its own horticultural waste. The company has pioneered development of various bio-based materials and ingredients, including materials for bio-based packaging. Under a newly establish brand, WeCarePack, the company is promoting its industrial compostable bio-based packaging material.

Stora Enso is a provider of renewable solutions in packaging, biomaterials, wooden constructions and paper on global markets. It has been part of the forest-based bio-economy since its establishment in the 13th century. Collaborating since 2019 with the HS Manufacturing Group, Stora Enso adopted patented barrier technology for formed fiber production, and in 2020 introduced single-use food bowls made of renewable moulded wood fiber, as a substitute for the common plastic version, with the Swedish company Tingstad acting as launching customer.

All case studies can be considered "showcases" demonstrating a successful shift from the use of fossil resources to renewable and bio-based resources. One of the smaller brands has largely completed the journey. But the majority of brand owners, including early movers that have initiated the transition years ago, still have some road to travel, as they face more challenging (technical and market) barriers to increase the bio-based share of their products, or are expanding the range of products being made bio-based.

Key characteristics of the bio-based transition journeys are presented in Table 3.

Company	Type of transition	Start of this BB journey	Stage of this BB transition journey	Goals for the future
Bioco	Replace all existing coffee packaging	2017	Journey is basically completed	Longer term option: kraft-material based coffee pouches
Dantoy	Replace type of plastic used	2016	A share of toys sold is now bio-based	Increase portfolio share; Source feedstock locally
Naty	Reduce use of fossil resources	1995	Ever more products are bio-based	Increase BB content; Expand product range
Vaude	Reduce use of fossil resources	Ca. 2018	Ever more products are bio-based	Increase BB content; Expand product range
Alhóndiga La Unión	Valorise own biomass residues	Ca. 2015	Early stage of the journey	Expand product range and improve anti-bacteria features
StoraEnso	Commercialise innovations	2019	For this product: early stage. For company as a whole: Bio-based *Champions league* player	More products & markets; New business model

Figure 3. Bio-based transition journeys covered in the series of case studies

4 DISCUSSION AND CONCLUSIONS

The previous chapter illustrated the highly different nature of the companies covered in the case studies, and introduced their bio-based innovations and bio-based transition journeys. This chapter will assess if despite these large differences they share common motivations, encountered similar barriers and challenges, or have similar messages to share.

A cross-analysis was made of the six case studies to elaborate such "best practices".

Brands' motivations

For all brand owners **sustainability is a main driver**, if not part of their brand ethos and DNA. Usually, brands do not only consider the (environmental, social and economic) sustainability of a line of products, but also of the products' packaging. Many of the bio-based products covered in the case studies carry an environmental-friendly label (such as EU-Ecolabel or Nordic Swan) or other certified labels (e.g. for bio-based content, or for biodegradability).

It stands out that several brand owners made radical choices, indicating explicitly that they want to **break away from doing business as usual and are pioneering high–quality bio-based solutions instead.** For Naty this was the reason to start the company in the mid-nineties. Nappy producer Naty was founded because its CEO was unable to find a viable alternative to conventional plastic diapers. For its Green Shape core collection of outdoor clothing, Vaude opted out of the race for higher, faster, farther, optimising product design instead. Initially incited by a push of their consumers Bioco made a radical shift towards packaging that is 100% bio-based and industrial compostable. Dantoy also decided to fully do away with using plastic (netting) for packaging "I'm green" products, applying recycled cardboard instead.

Few if any of the customers and consumers of the products covered in the case studies that make conscious product choices explicitly ask for bio-based products. They express their needs and expectations in various other terms instead. They ask for products that are high-quality and long-lasting, produced with minimized negative impact on environment and climate (dantoy); free of chemicals and contributing to healthy living (Naty); and ensuring a sense of well-being and comfort (Vaude). When it comes to packaging, the situation is likewise. Eco-friendly customers of Stora Enso in the hospitality sector want to reduce the use of plastic for packaging, e.g., takeaway food companies that consider alternatives to plastic food containers. Or they demand eco-friendly alternatives for food packaging, as is the case for Alhóndiga La Unión. **In short, shifting to bio-based products and packaging is more a means to an end, and not a goal by itself.**

Bio-based product innovations

Collaborative research: None of the brands developed their bio-based solution all by themselves. The smallest companies do not have relevant in-house R&D facilities and relied on innovative solutions available on the market. Bioco searched and found a supplier of an innovative single-serve coffee packaging solution that is industrially compostable but also very functionally performant. Dantoy identified a supplier of bio-based plastic granulates that are chemically identical to the fossil-

based plastic granulates they already use. The medium and larger sized brands operate their own R&D facilities. They developed bio-based solutions in close collaboration with their suppliers (and with customers, in the case of B2B markets) for one or multiple product lines. Naty sells a range of bio-based baby care products, including compostable diapers and plant-based wipes, collaborating with e.g. PLA-supplier NatureWorks. Working in close collaboration with suppliers from the chemical industry, including Evonik, Vaude developed innovative bio-based materials including biopolymers and biocomposites that it uses in its Green Shape outdoor clothing products. For Alhóndiga La Unión leadership of, and participation in, two collaborative research projects that investigated *inter alia* bio-based packaging solutions helped them develop new technologies to valorise their horticultural waste. Last but not least for Stora Enso, "the renewable materials company", R&D on forest-based packaging solutions is the key of the company's existence. Nonetheless they also collaborate closely with external parties, e.g. technology supplier HS Manufacturing Group from which they adopted their patented barrier technology.

Innovation design objectives: any bio-based solution should meet two rather different objectives. On the hand it needs to be ensured that the product is very functionally performant. On the other hand it should be made sure that one or more of the following is achieved: (a) reduce or even avoid the use of fossil feedstock (b) ensure that at the end of its use the product is industrially compostable (biodegradable in well-determined conditions). Bioco and Vaude explicitly mentioned, but it will equally apply for all other brands, that finding a bio-based solution that meets both objectives is a true quest. Stora Enso observed that the unique properties of plastics are hard to compete with. E.g. to ensure longer shelf-life oxygen barriers are required, for which currently plastic coatings are used.

Biomass feedstock: A wide range of different types of biomass feedstocks find its way in the bio-based products that the brands manufacture. This includes sugarcane bagasse (e.g. used for children toys and in coffee capsules), wood cellulose (e.g. used in diapers and in TENCEL® fiber lining), castor beans (used in trims such as zippers, buckles and hooks and in clothing fibers), recycled coffee grounds (used for waterproof clothing membranes), and horticultural residues (used to make films and mesh for the packaging of fruit and vegetable products). The two largest brands (Stora Enso, Alhóndiga La Unión) searched to develop higher value applications for their existing resources (forests supplies and horticultural waste streams respectively). The other companies covered in the case studies depend on external suppliers of bio-based chemicals and materials.

Biomass shares achieved: the current share of bio-based materials in consumer products sold by the brands ranges from around 25% to 100%. Bioco reaches 100% bio-based share for its compostable coffee capsules. For their coffee pouches trade-offs had to be made, as 100% bio-based pouches would not guarantee airtightness, leading to shorter shelf life and thus to an assumed bigger global ecological footprint (Bioco). Toy supplier Dantoy reaches almost 100% bio-based share; to colour their toys a small amount of non-bio-based material is currently used. However, the bio-based share by itself is hardly an indicator of the efforts and resources already spent and the actual achievements made switching to bio-based. With established technologies and processes materials such as hard plastics, metals, foams for shoe soles etc. are very hard to produce more environmentally friendly from bio-based than from conventional feedstock (Vaude).

International acknowledgement: Each of the bio-based innovations covered in the case studies is a winner, and has gained an award in one of the following categories: entrepreneurship, innovation, product design, sustainability, or bio-based materials. The bio-based and compostable coffee capsule that Bioco sells were originally developed by Dutch coffee roasters Koffiebranderij Peeze and Dutch technology service provider Advanced Technology Innovations (ATI) for which they won the Food Valley Award for most innovation product in 2015[4]. In 2020 dantoy was a silver award winner of the Play for Change Awards 2020 in the Environmental Sustainability category[5]. Also in 2020, Naty won the 'Best Eco Nappy' award, issued by the German daily Süddeutsche Zeitung[6]. Vaude was a gold winner at the IF Design Award 2018 in the sustainable design category[7]. The bio-plastic netting that Alhóndiga La Unión helped develop won the bronze award at the Bio-based Material of the year competition at the 2018 ICBM[8]. The research project it was part of won the Accelera award for Best Innovation and Entrepreneurship Project at the 2019 IFEMA Fruit Attraction fair[9]. And as a recognition of the innovation-oriented corporate culture and the leadership that Stora Enso shows in the implementation of new sustainable bio-renewable processes it received the 2020 Forest Products Innovation Award from the Biorenewable Deployment Consortium (BDC)[10].

Barriers and challenges encountered

When competing with "traditional" brands and products, sold in established markets, the challenges of being a pioneering innovator that is doing things radically different can be substantial. Production process, raw material, marketing and consumers can all be challenges and barriers that have to be overcome (Naty). Deploying innovative technologies, applying renewable raw materials (that are often more expensive than virgin fossil feedstock) and operating at a relatively small scale leading to smaller efficiency often results in higher production costs than those in established industries that have the benefit from decades of process optimisation incur. And if a brand can or will not accept a lower costs margin, this leads to higher sales prices. Marketing is key to inform customers about the benefits of the product and why it is worth to pay more for it.

No matter if your bio-based innovation is radically different (Naty) or marginally different (dantoy), maybe the main challenge is the **consumer**. The consumer is both the success and the barrier to switching to bio-based approaches. For Naty, who entered the market with their bio-based diapers as early as the late nineties, the first major challenge was that nobody had understood what they had done, and as a result customer demand was not there at first. Marketing was key to promote the bio-based product and to increase market reach. Over a period of two decades, Naty built a base of loyal customers buying-in to its ethos of sustainability. For dantoy, an established high-quality toy brand, the challenge was very different. They started selling plastic toys made from drop-in bio-based

[4] https://peeze.nl/peeze-wint-food-valley-award/
[5] https://playforchangeawards.eu/news/toy-industries-of-europe-announces-winners-of-play-for-change-awards
[6] https://www.naty.com/nl/en/best-disposable-diaper.html
[7] http://www.mountainblog.eu/vaude-green-shape-core-collection-receives-if-design-award-in-gold-sustainable-design-award-winning
[8] https://www.plastech.biz/en/news/Innovation-Award-Bio-based-Material-of-the-Year-2018-12474
[9] https://brandfor.com/en/wecarepack/
[10] https://www.storaenso.com/en/newsroom/news/2020/10/stora-enso-honoured-with-bdc-forest-products-innovation-award

plastics in spring 2018. Consumer demand was larger than expected, exceeding their production capacity (which is limited due to a lack of guaranteed bio-plastic feedstock supply).

Anno 2020 more and more consumers expect products they buy to be sustainable, for example in the higher-end outdoor clothing sector. But, rather surprisingly, to date only few people question the sustainability of using fossil-based materials (Vaude).

Modest leverage power: Except for Stora Enso, all brands covered in the case studies have less than 1,000 permanent employees. This makes them relatively small actors in comparison to the global brands that operate in the same industry. As Vaude notes, their modest size, in comparison to market giants as Nike and Adidas, wages them limited power to enforce changes at the level of their suppliers from the chemical industry.

For Stora Enso, the story is rather different. To commercialise their PureFiber™ formed wood fiber packaging products they are even changing their business model, taking one or two steps closer to consumers in the supply chain: while barrier-coated paperboard goes to packaging producers, formed fiber products go to packaging distributors or even directly to large brand owners using packages.

Uncertainty about feedstock supply: A reliant feedstock supply is critical for any commercial operation. Typically, companies do not want to depend too much on a single supplier. For dantoy the stable supply of bio-based plastic granulates in right amounts and satisfactory quality is essential for its reputation. Actually, how the availability of (affordable) granulates will develop sets the pace of the company's switch to bio-based over the coming years.

Higher production costs: dantoy states that the price of bio-based plastic granulates is substantially higher than the price of traditionally used plastic granulates. Bioco observes that using bio-based packaging for its coffee they will never get as much financial return (per product) as when they would stick with conventional packaging. Vaude reports that not only the prices of renewable/recycled feedstock or less harmful chemical components are higher than those of virgin fossil feedstock. They also need to factor in costs linked to sustainability certification.

Stora Enso, highly confident about the potential of renewable material solutions, considers that "the only challenge that may seem unattainable for fiber products is to beat the low price of plastics", as plastic products benefit from decades of process optimisation.

Unfortunately, the recent drop in the price of mineral oil has exuberated the financial challenge.

Lack of economic incentives: Currently there are few economic incentives supporting a (further) switch to bio-based[11]. Implementing fiscal measures, such as the carbon tax on fossil resources that is being considered under the European Green Deal, could improve the price competitiveness of bio-based products (Vaude).

[11] In deliverable D1.3, due early 2021, BIOSWITCH will assess types and availability of various incentives supporting a switch to bio-based.

Lack of willingness to pay: Carus et al. (2014) report that consumers are willing to pay 0-25% higher prices for bio-based products, depending on the product group[12]. For a product like outdoor clothing, this willingness-to-pay is marginal at best: "*In real life we do not experience much GreenPremium effect*".

Lessons learnt and conclusions

The brands covered in the six case studies succeeded to overcome (most of) the barriers and challenges mentioned above. And they keep actively searching to further increase the bio-based share of their products and product lines. What are the lessons that can be drawn from these "best practice" success stories?

1. Bio-based materials are a way to reduce a product's and therewith a brand's and company's impact on climate change and use of resources while also improving technical attributes. Brand owners scientifically substantiate this through various sustainability assessment methods[13], including e.g. life cycle assessment.
2. Traditional thinking that a sustainable product delivers lower performance might become obsolete.
3. Incompatibility with existing processes is a practical barrier. If new production machinery has to be bought initiating the shift to bio-based can be (come too) costly.
4. For a small company, being the first mover adopting a bio-based innovation can offer advantages, especially in terms of strategic decision making, supplier collaboration and pricing strategy. However, it is not easy to be the first bio-based innovator in the industry.
5. To succeed developing and deploying innovative bio-based products at commercial scale collaboration within the supply chain, upstream (with suppliers), downstream (with customers), with technology suppliers and even across and beyond value chains is needed.
6. Until major players in the industry demand bio-based materials in their manufacturing and make major investment, systems and technologies will not change.

[12] These so-called "Green premiums" are paid along the value chain, often already at an intermediate stage, and are not always passed on to the end consumers. GreenPremium are defined as: "*The additional price a market actor is willing to pay for the additional emotional performance and/or the strategic performance of the intermediate or end product the buyer expects to get when choosing the bio-based alternative compared to the price of the conventional counter-part with the same technical performance*." See Carus, M., Eder, A., Beckmann, J. 2014a: nova paper #3: "GreenPremium prices along the value chain of bio- based products". Hürth 2014. http://bio-based.eu/nova-papers/#GreenPremium

[13] « «Screening » life cycle assessments and other sustainability assessment tools will be tested and demonstrated in Task 2.3 of the BIOSWITCH project.

7. It is suggested to engage with key players in the innovation eco-system to create a cooperation environment in which knowledge and experience can be exchanged, and to find out where bio-based approaches will benefit you the most.
8. By gaining experience in the bio-based transition journey, companies can be more aligned with what is expected from them under upcoming EC (sustainable packaging) legislation[14].
9. The bio-based transition journey can support company staff in opening their minds to developing new products and working methods.
10. Bio-based materials are a chance to create a ripple effect throughout the industry.
11. As for any product innovation it is key to listen to and understand customers and consumers. Brand owners can take advantage of the growing trend among, and awareness of, consumers for sustainable products, offering opportunities for bio-based innovations. However, the road ahead can be long and windy.
12. An open mind-set, an entrepreneurial spirit and true motivation are key. It is important to be consistent and not give up, stay focused, be patient, and aware of the problems and new opportunities. If your motives are green washing, you will not come very far.

And last but not least: the brands covered in the six case studies are proof that, despite many barriers and challenges, a transition to bio-based is possible. The broad mix of cases is evidence that possibilities and opportunities to make such transition are everywhere.

[14] The European Directive 94/62/EC on packaging and packaging waste, last amended in 2018, requires EU countries to take measures encouraging the increase in the share of reusable packaging put on the market and of systems to reuse packaging in an environmentally sound manner without compromising food safety or the safety of consumers. The target is to achieve that by the end of 2025, at least 65 weight% and by the end of 2030 at least 70 weight% of all packaging waste is recycled. See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al21207

5 FURTHER READING

Many more examples of companies, ranging from small ones, including start-ups, to multinational and even truly global ones, that manufacture and/or supply branded bio-based products and materials for B2B and B2C markets can be identified. Examples can be found in trade journals, newsletters, and web blogs.

A number of **catalogues, databases and platforms** that specialize in collecting, documenting and showcasing bio-based products substituting for fossil-based products are worth special mentioning. Some of the most interesting ones are listed here.

Bio-based product catalogues

Under the title Bio Art Gallery, the BIOVOICES project with support of the BIOBRIDGES project published a catalogue presenting 60 artistic pictures that associate commonly known feedstock (tomatoes, coffee, apples, oranges, etc.) with their surprising bio-based applications.

A journey to the bioeconomy future! with a suitcase filled with great products presents the content of a suitcase, fully packed with bio-based products. Items that look and feel like the products we have been using for years, except that they are slightly different: they don't harm the environment.

Worth a special mentioning is the promotional video "A Bio-Based Day", recently produced by the BIOBRIDGES project, that follows a young lady during her bio-based day, from the wake up to the goodnight, discovering how bio-based products can substitute fossil-based ones in every day's lives.

Searchable bio-based product databases[15]

Product databases can help you to get an idea of the wide variety of bio-based products already available. There are many databases that present green products and materials that also include bio-based products. But there are also some that exclusively cover bio-based (end) products.

Originally designed in Open-Bio project, and incorporated in the InnProBio project, the InnProBio product database presents various bio-based products sorted by application area, product type and Common Procurement Vocabulary code. Products include for example office supplies, gardening equipment, lubricants or plastics plates and cutlery. In the database, users find information about the bio-based content of products, sustainability, functionality and end-of-life aspects, such as biodegradability. Claims are supported by references to standards, technical sheets and labels.

The project "Nachwachsende Rohstoffe im Einkauf", led by Fachagentur Nachwachsende Rohstoffe e.V. (FNR), generated a range of materials, mainly targeting public procurers in Germany, including a website featuring a product database with more than 600 products (and their suppliers) in six broad product categories.

[15] Based on: Where to find bio-based products? A guide to the most interesting databases of bio-based products. http://www.allthings.bio/find-bio-based-products/

In the Netherlands various databases (with highly different coverage of product characteristics) were established in the last few years. Among the most interesting ones are:

- the Bio-based Collection, initiated by the Centre of Expertise Bio-based Economy - CoE BBE, Centrum voor Innovatief Vakmanschap – CIV and Biobased Delta;
- the Knowledge Bank Bio-based Construction of the Stichting Agrodome;
- the bio-based product database newly established by Agro & Chemie.

Although not a European source, worth mentioning is the BioPreferred® Program, for its elaborate bio-based product catalogues. The US Department of Agriculture (USDA) BioPreferred® Program promotes federal purchase and use of bio-based products, which have a specified amount of bio-based content, including plant, animal, or marine resources. In its online catalogue USDA designates the minimum content of bio-based materials used in products.

The US member organization Plant Based Products Council (PBPC) represents business large and small that are working to guide the global economy toward more sustainable and responsible consumer products and packaging through greater use of plant-based materials. PBFC is committed to encouraging the adoption of renewable biomass products. To help achieve this goal, they have assembled a searchable database of plant-based products across a wide range of categories.

APPENDIX 1:

GUIDELINES FOR CASE STUDY DEVELOPMENT

BIOSWITCH

Encouraging Brand Owners to Switch-to-Bio-Based in highly innovative ecosystems

Guidance to authors for developing **industry-relevant best practice cases studies** of Brand Owners switching from fossil- to-bio-based

BIOSWITCH Task 1.3

Enschede (NL), October 2020

AVAILABLE DOCUMENTATION

Documentation developed for the current assignment includes:

1. The current Guidance document (this document)
2. Notice of consent on the data from interviews and questionnaires regarding best practice case studies
3. Excel sheet prioritising candidate case studies

INSTRUCTIONS FOR CASE STUDY DEVELOPERS

Summary of the assignment

A series of industry-relevant best practice cases studies of Brand Owners switching from fossil- to-bio-based will be developed.

In total **6 case studies** will be developed: one each by the four BIOSWITCH Cluster Partners (ABP, CTA, CLIC, FBC-DK), one by ITT, and one by BTG. Herein after we refer to them as case study developers.

Scope

Regarding the switch-to-bio-based all of the following options are considered within scope:

- Bio-based packaging replacing fossil-based packaging
- Fully bio-based packaging replacing partly-based packaging (e.g. Tetra Rex®)
- Bio-based product replacing fossil-based product
- Fully bio-based product replacing partly-based product (e.g. replacing the resin in a composite)
- Bio-based product replacing (less sustainable) bio-based product
- Biomass Balance approach (as advocated by e.g. BASF)

The use of biomass exclusively for energy generation is not considered within scope.

Identifying and interacting with Brand Owners

Brand Owners may be large or small, and operate internationally or locally. They may serve one or more of the following markets: business-to-business (B2B), business-to-consumers (B2C), business-to-public procurers (B2P). They may or may not be active in any of the four BIOSWITCH sectors (chemical, forest-based, food and agro). They may have reached very different levels of transition from fossil-to-bio-based, from anywhere of making the very first steps on that pathway to having made a full switch. They may already produce bio-based products, and/or may make use of the biomass-balance method, and/or use bio-based packaging, or none of these (when they are still at the orientation stage).

For the case study we focus on Brand Owners that made more than just the first steps transiting from fossil-to-bio-based, and that have or can make a significant impact. That impact may relate to the specific product group, the brand as a whole, the company itself, the economic sector it operates in or even for society at larger. Associative keywords: first mover, iconic product, achieving higher bio-based share (than market average), reputable firm with strong market presence, multinational firm with broad presence across the EU, switch to bio-based is part of wider drive to company's sustainability, brand owners is actively exploiting multiple transition options (bio-based products, bio-based packaging, biomass-balance method, etc.)

To **identify** suitable Brand Owners for the case studies, it is recommended that the **Case Study Developers** first approach their member organisations (for ITT and BTG: approach their business relations) to pre-select tentative case study subjects, and to asses (a) compliance: did they start a real transition, (b) relevance: whether the transition has or can make a significant impact (c) gauge their interest to be the focus of a case study. If there is insufficient interest among their member organisations (for ITT/BTG: among their business relations) the Case Study Developers should widen their search span.

Should the need arise, Case Study Developers can consult one or more of the following additional data sources to identify leads/candidates (Brand Owners) for case studies

- (Mapping results of) other EU projects, in particular those funded by BBI JU, including
    - Biobridges, https://www.biobridges-project.eu
    - LIFT factsheets, https://www.lift-bbi.eu/
    - BioCannDo article: Where to find bio-based products? A guide to the most interesting databases of bio-based products, http://www.allthings.bio/find-bio-based-products/
    - InnProBio's Bio-Based Products Database And Supporting Tools For Public Procurement, https://www.biobasedconsultancy.com/
- Trade journals (e.g. Bio-based World)
- Targeted inquiries
- Smart search on Internet (in case of any remaining gaps)

It is considered desirable that each of the four BIOSWITCH sectors (chemical, forest-based, food and agro) is covered in (at least) one case study. At request, task leader BTG can help brainstorm and/or make suggestions finding (potentially) interesting cases. Note that experience leans that developing a case study will be easier if the Brand Owner is already known to the Case Study Developer.

When approaching case study candidates, it is helpful to present some arguments why Brand Owners should become the focus of a case study ("what's in there for them"). These arguments can be sector or region-specific. More general arguments include:

- International/European exposure (and free marketing) by serving as a showcase of a Brand Owners that has made an impactful transiting from fossil-to-bio-based
- Knowledge transfer: learning about additional opportunities (modalities) to transit from fossil-to-bio-based (if relevant), learning about the experience of other Brand Owners (best practice case studies)
- Coaching/mentoring: get support to help make/prepare additional transition (if relevant)
- Co-creation: help shaping the content of the BIOSWITCH toolbox
- Networking with like-minded brand owners in the same economic sector/region/country as well as beyond

Implementing the case study

To ensure that case study are similar in length and detail, the case study descriptions shall follow as much as practical possible a standard format. Guidance on the topics and issues that could be covered in the case study is provided in Annex A of the current Appendix.

There is no prescribed method or format to gather relevant data and information from Brand Owners, trade association, Internet, literature etc. on which the case study can be based.

Suitable resources may include the following: news items / articles (online, in trade journals, etc.), conference proceedings, formal literature and as a minimum (one or several) interviews with representatives of Brand Owners (conducted face-to-face or otherwise).

For attractive reading, the use of direct quotes from representatives of Brand Owners representatives is encouraged.

Interviews can be conducted and recorded in any preferred language. It is recommended to make a voice recording of each interview, to help ensure that all information provided can be captured. It is recommended to elaborate an interview report for own use (there is no need or requirement to prepare or share interview reports with BIOSWITCH partners).

It is necessary to inform (prospective) case study subjects and reach agreement prior to conducting the interview on organisational issues and practicalities e.g. (a) that the interview is recorded, and what is done with the recording, (b) other relevant issues/restrictions.

Planning

It is recommended that all six case study developers (ABP, CTA, CLIC, FBC-DK, ITT and BTG) make a planning for implementing their respective case studies.

Activities to be covered in the planning may include:

- Pre-identifying (ideally multiple) candidate Brand Owners (companies) and company staff that could be the focus of a case study
- Determine their relevance and their interest to be the scope of a case study
- Present proposed brand owners and products to a joint T1.3 meeting (this could be scheduled in the first half of September e.g. on Friday 4 September 2020 in the afternoon), and agree on a final selection of brand owners and products to be covered in the 6 respective case studies

For <u>each of the case studies:</u>

- Engage with selected brand owner to collect information and quotes that can be used
- Develop the case study (several iterations)
- Finalise the case study and ensure/arrange its official formatting (by BIOSWITCH partner SIE)
- Preparing a short memo (synthesis report) summarising key insights from the case study exercise

ADDENDUM: ADDITIONAL INFORMATION

Case study selection criteria

From earlier discussions we have a basic understanding what is in/out of scope. We also appreciate that examples of bio-based packaging may be easiest to find, however, there is agreement that we aim to have a broad scope/coverage of case studies. Having said that, generally speaking:

- Replacing ingredients is preferable above replacing packaging
- Case studies with high replication potential are preferable
- Companies that can benefit most from showcasing and exposure are preferred

No stringent criteria will apply. As any selection of case studies will also depend on a range of practical considerations, such as: your personal preference, the business contacts you already have, if you can identify a good resource person at the candidate company, if they have an interesting story to tell, if they are interested/willing to collaborate with BIOSWITCH, if it helps you to make any cross-links with your other work, et cetera.

Length of case studies

Indicative length of the plain style text would be 3-4 pages. With formal editing the length is likely to increase somewhat, or even quite a bit. As no hardcopies are foreseen the actual page length is not a real problem (and there is no need to have an even number of pages).

The case studies will not be fully harmonized. They don't have to follow the exact format and don't have to have the exact same length.

Refined time table for preparing case studies

The edited case studies are to be completed before the end of 2020 (M7). SIE will take care of their visual editing. SIE needs about 20 working days for the six case studies combined. Taking into consideration that there are several holidays in Spain in December (there are a couple of bank holidays in early December in Spain, and then the Christmas period) the final unedited content for the case studies should be ready by 20 November the latest. This leads to the following updated timetable:

Final selection of case study partner	Friday 23 October 2020
Elaborate first draft of unedited case study	Friday 6 November 2020
Elaborate final draft of unedited case study	Friday 20 November 2020

Unfortunately there is little flexibility in this time table. The second **project video** (due in M9 = Feb 2021) will revolve around the success cases, and SIE need at least 10 weeks to develop it (if it is done in the same animated format as the first BIOSWITCH video).

Case study promotion

The case studies will be promoted in a number of ways:

- Through the second project video
- Separate "news" items in social media format

ANNEX A: TOPICS & ISSUES THAT COULD BE COVERED IN THE BIOSWITCH CASE STUDY

Theme / Category	*Question / Guidance*
BACKGROUND OF THE BRAND OWNER	Please inform about **your company** (names, date established, (short history), size, location, your products/applications, type of customers (B2B or B2C), regions and/or countries where you operate, and about **your brand/s** (names, applications)
MOTIVATION OF BRAND OWNER	What and who made you decide to make a first step in the transition / part conversion / full conversion from fossil-based to bio-based (supplier, customers, research partner, adviser, other)? Can you identify **main drivers** behind transitioning/converting to bio-based? Does **your company/brand** pay systematic attention to Corporate Social Responsibility and if yes, how? Was there any multiplier/ambassador involved?
SHIFT MADE & **PROCESS ADOPTED &** **TIME AND RESOURCES NEEDED**	What **changes** were made? New product (group), change in composition/formulation of product (group), change of product packaging. What **biomass ingredients** are used? Who supplies the biomass ingredients and how? How are they used in products/packaging? How did you change your assembly line / product formulation et cetera? What **process** was followed to implement these changes? What initiated them? What hurdles had to be overcome? When was the change implemented? How much (calendar) **time** was needed from 1st idea to implementing the shift to bio-based? How many manpower resources?
RESULTS (TO DATE & **FURTHER PLANS**	What **results** were made and/or impacts gained? Examples: Reduced ecological footprint (per unit of product). Improved product functionality. Use of locally available resources. Growth in sales and/or revenues. Growth in customer satisfaction, positive impact on customer's image of the brand, more attractive brand to work for, etc. Were these results in line with what was **expected/predicted**? What about any negative side effects? Any potential and any concrete **plans** to make further shifts from fossil-based to bio-based (or other renewable) ingredients?
IMPACT: WHY <u>THIS</u> SHIFT?	For **what reason** did you select this product/packaging to start the transition? Did you consider impact, in relation to the specific product group, the brand as a whole, the company itself, the economic sector it operates in or even for society at larger. *Associative keywords: first mover, iconic product, high visibility, achieving higher bio-based share (than market average), reputable firm with strong market presence, multinational operating across EU, switch to bio-based is part of wider drive to company's sustainability, brand owners is actively exploiting multiple transition options (bio-based products, bio-based packaging, biomass-balance method, etc.)*
LESSONS LEARNED	This can be a mixed bag of tips and tricks: • What makes this an industry-relevant **best practice** case study? • **Dos and don'ts.** Suggestions and recommendations. Practical tips and tricks. E.g. Where to start (e.g. low hanging fruit), what to avoid, where to look for further info (online &offline), etc.

	• **Lessons learned.** What worked well? What did not work so well? What unexpected barriers had to be overcome? What would you do different (or in another order) next time? • Further **take home messages.** • Et cetera
CONTACT PERSON	Name & affiliation of the key recourse person/s (for example the person/s quoted in the case study)
QUOTES	Any statements form the contact persons that can be quoted
FURTHER INFO	References (relevant literature for further reading)

APPENDIX 2:

NOTICE OF CONSENT

NOTICE OF CONSENT ON THE DATA FROM INTERVIEWS AND QUESTIONNAIRES

The **BIOSWITCH** project has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement no. 887727. **BIOSWITCH** aims to bring Europe to the forefront of the bio-based economy by encouraging and supporting brand owners from different sectors to switch to bio-based approaches.

The project is coordinated by CLIC Innovation, which is responsible for the lawfulness of the processing of personal data in connection with the BIOSWITCH related research.

Ethical procedures for an EU H2020 project require that interviewees agree to be interviewed and are informed of how the data and information from their interview will be stored and used. The signing of the consent form is necessary to ensure that the interviewee understands the purpose of the involvement and that the conditions of the participation are understood.

DATA PROCESSING METHODS

The interview may be recorded and it will be logged as a written file, notes can also be taken. The confidentiality of the data provided can be individually agreed upon. The data and information that has been agreed to be kept confidential will not be reported. The interview material will be stored on project Microsoft Teams site, which is CLIC's secure and password protected closed server system

This project has received funding from the Bio Based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 887727.

that is operated according to CLIC's data management procedures. Members of the project team can only access the data, any recordings and notes will be deleted when the project is finished or at any time by the request of the interviewee.

DATA PRIVACY PROTECTION AND CONFIDENTIALITY

Various BIOSWITCH consortium partners are involved in the study and the data collection conducted in connection to the project. The BIOSWITCH consortium collects and processes, for example, the following information: the name and general details of the entity, interviewee, and the interviewee's observations and views on e.g. bio-based products and bioeconomy stated in the questionnaires and interviews. All data and individual comments are anonymized in public reports by not associating the comments with the individual without their explicit consent. The anonymized data and information gathered will only be used for the purposes of the BIOSWITCH project, e.g. in its publications like project deliverables, academic papers, policy papers, news articles, website, or presentations. If agreed, the name of the interviewee/entity can be recorded in the list of sources for public reports.

VOLUNTARINESS, HANDLING OF PERSONAL DATA AND OTHER RIGHTS OF THE SUBJECT

Participation in this study and the disclosure of personal data/data requested in the investigation is voluntary and participation will not be paid for. The subject may at any time during and after the interview without giving any reason and without any penalty;

1) refuse to participate in the interview,
2) refuse recording of the interview or parts of it,
3) decline answering any questions,
4) end the interview at any point,
5) suspend his / her participation, or
6) withdraw his / her consent to participate

The processing of personal data is based on the consent of the person. The subject may revoke his / her consent to the processing of personal data by notifying the responsible person who held the interview or the project coordinator that consent has been withdrawn. Information on the possible withdrawal will be handled discreetly and will not be published in any way.

The subject has the right to ask for access to their own personal data, as well as the right to request rectification or erasure or restriction of the data. The subject may oppose the processing of the personal data, which he / she has provided to the interviewer.

CONTACT INFORMATION FOR PERSON IN CHARGE

In the case of any questions or requests about the study and/or data protection, the subject can contact the person who is responsible for the interview:

Interviewer FIRST NAME LAST NAME

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TITLE, ORGANISATION
E-MAIL
PHONE NUMBER

Coordinator of the BIOSWITCH project/ representative of the personal data register:

Anna Tenhunen
Project Coordinator, CLIC Innovation
anna.tenhunen@clicinnovation.fi
+358404868713

By signing this form of consent, I confirm my participation in the research described in this document, agree voluntarily to be interviewed and give my voluntary consent to the processing of personal and or other data.

Place and date

_____

Name and signature

_____

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APPENDIX 3:

SAMPLE OF EDITED FACTSHEET

FOR ILLUSTRATION PURPOSE ONLY. PROVIDED IN LOW RESOLUTION

The full range of edited factsheets will be finalised in December 2020-January 2021. Once completed, they will all be accessible here in the Documents section at the project website.

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BIOSWITCH

ENVIRONMENTALLY-FRIENDLY CLOTHING BASED ON BIO-BASED AND OTHER RENEWABLE MATERIALS

THE GOOD PRACTICE CASE STUDY VAUDE SPORT GMBH & CO. KG

Author: John Vos, BTG Biomass Technology Group BV
Contributor: René Bethmann, VAUDE Sport GmbH & Co. KG

Abstract

This case study describes the transition journey and experience of German outdoor outfitter VAUDE, and the role renewable raw materials, including bio-based materials, play in its consumer product innovations. Sustainability is a core value of the company that has the ambition to become the greenest outdoor outfitter in Europe. This ambition is reflected in the launch of its trend-setting Green Shape Core Collection in 2018: a collection of clothes, shoes and backpacks made from innovative materials that are functional and environmentally friendly. Throughout the product development phase, nature served as model, taskmaster, and as an inexhaustible source of inspiration. About 90 % of the diverse textile materials used in the production processes are bio-based, recycled or purely natural materials. For VAUDE, using innovative bio-based materials helps to reduce its collective impact while also improving technical attributes to drive very high performing materials. The VAUDE experience can serve as a showcase and, considering the strong involvement of the outdoor sports industry in sustainability, offers a chance to create a ripple effect throughout other industries.

This project has received funding from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 887727.

BIOSWITCH

PARTNERS

CTA

Food & Bio Cluster Denmark

INSTITUTE OF TECHNOLOGY TRALEE
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Sustainable INNOVATIONS

CLIC

VTT

btg biomass technology group

FF FLANDERS' FOOD

This project has received funding from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 887727.

Company background

VAUDE is a German sports equipment brand making functional and innovative clothing and other articles like bags, rucksack, tents, etc. to enjoy the outdoors. The family-owned company, founded in 1974, employs about 500 people at its company headquarters near the southern German town of Tettnang. VAUDE operates internationally and generates annual sales of around €100 million.

VAUDE stands for environmentally-friendly products made from fair manufacturing. It has a willingness to invest time in innovation and has a clear ambition to remain a sustainability pioneer. Antje von Dewitz, who followed up her father as CEO in 2009, wants to make VAUDE the greenest outdoor outfitter in Europe.

A pioneer and industry leader on sustainability

When it comes to ecological product development "Practice what you preach" applies to VAUDE for decades. In 1994 it introduced Ecolog, a recycling system for polyester clothing, in 2001 it was the first outdoor company to be awarded the Bluesign ecolabel and since 2012 the head office has been fully CO_2 neutral.[1]

VAUDE participates in a number of sustainability initiatives in the clothing sector: Fair Wear Foundation, Greenpeace Detox and Bündnis für nachhaltige Textilien. It has received a number of awards and accolades for its products and role with regard to sustainability.

EFFECTIVE project interviewer: VAUDE is a true pioneer for sustainability in the outdoor clothing and sports industry. Why is this part of your DNA?

René Bethmann (Innovation Manager Materials and Manufacturing): "As an Outdoor Outfitter which supports users to enjoy nature, our aim is to make our impact on nature and the environment as small as possible. We take responsibility in everything we do for our employees, our partners, the environment which is surrounding us and our products. We design with a focus on minimal material consumption, we try to avoid waste and design products that are timeless, durable and repairable. Thus, as a company that acts sustainably, we align ourselves with long-term, future oriented, ecological, social and economic goals. We use or develop the most sustainable materials available to us, optimizing processing even in the most inconspicuous places to make products we can be proud of. Products that convey our enthusiasm and guarantee our end customers the perfect experience."[2]

[1] Outdoormerk Vaude, koploper in duurzaamheid, 5 April 2018, https://farout.be/2018/04/05/outdoor-merk-vaude-duurzaamheid/

[2] H2020 project EFFECTIVE, spring 2020 newsletter, https://www.effective-project.eu/f/docs/DOWNLOAD/EFFECTIVE---Spring-Newsletter---A-biobased-economy-for-the-post-virus-world.pdf

This project has received funding from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 887727.

It has been innovative in terms of creating a circular approach for its prominent **Green Shape** product line where emphasis is laid on quality materials, design and reparability to ensure longlife[3].

What sustainability means in VAUDE products: the Green Shape label

In 2009 VAUDE began to steadily steer product development toward sustainability and the next year it introduced the Green Shape label. Green Shape identifies environmentally friendly products made from sustainable yet functional materials. They are manufactured under fair working conditions along the entire supply chain. Green Shape has become very well established in the outdoor market.

Green Shape has gone through several stages of development. Initially, the Green Shape criteria included only the materials used. Nowadays the Green Shape criteria apply to the entire product lifecycle, from design, through all the materials used, production sites, use and care of the product, to possible recycling and/or environmentally friendly disposal.

Each year more Green Shape items are added to the VAUDE product range. In the apparel collection the company has been increasingly successful in finding environmentally friendly materials from responsible suppliers. Over 95% of VAUDE's apparel is Green Shape. For other products -especially with tents, backpacks and footwear- great challenges are faced. Materials such as hard plastics, metals, foams for shoe soles etc. are a fairly hard nut to crack from an ecological point of view[4].

Figure 1 : Green Shape infographic[5]

[3]Alexis FIGEAC, Centre for Sustainable Consumption and Production (CSCP). VAUDE: A Circular Business Model Innovation Journey. R2piproject Deliverable 5.2, www.r2piproject.eu/wp-content/uploads/2017/12/D5.2-Vaude-Case-Report.pdf

[4]https://csr-report.vaude.com/gri-en/product/greenshape-concept.php

[5]https://csr-report.vaude.com/gri-en/product/greenshape-concept.php

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Green Shape Core Collection

With the Green Shape Core Collection, launched in 2018, VAUDE offers a thoroughly sustainable set of outdoor apparel and gear. VAUDE developed innovative materials for the collection that are functional and environmentally friendly and also offer solutions to global problems such as those caused by microplastics. The collection includes 19 products: apparel, shoes and backpacks. Throughout the product development phase, nature served as model, taskmaster, and as an inexhaustible source of inspiration. About 90 % of the diverse textile materials used in the production processes are bio-based, recycled or purely natural materials. The Green Shape Core Collection is a clear testimony of what motivates VAUDE as a brand and an unwavering expression of what the company imagines the future of sustainable outdoor gear to be[6][7].

> The development of the trend-setting Green Shape Core Collection focused on various aspects of sustainability. Mario Schlegel (Head of Design) describes the special design approach:
> "The Green Shape Core Collection breaks with convention in terms of concept and organisation. Instead of aiming for weight optimisation, higher waterproof values, and other high performance parameters, the collection has opted out of the race for higher, faster, farther. We have not only optimised the product design and fit of the individual items to ensure a sense of well-being and comfort for a diversity of activities, we have also focused on making the collection combinable. How can they be intelligently layered for even more flexibility? Colours and materials play a smaller role so that a very limited outdoor collection can be truly versatile and used for any activity."[8]

Clear ambition to increase the share of renewable raw materials

VAUDE uses petroleum-based synthetic materials such as polyester, polyamide or polyurethane for many of its products. To use less fossil resources and to avoid adding more plastic to the planet it has set itself the goal of increasing the share of renewable raw materials used in its products, including bio-based polymers and materials, responsible natural fibers and a variety of recycled materials. Renewable resources can be natural plant fibers such as organic cotton, hemp or kapok. Animal-based raw materials such as down, merino wool or leather can also be an alternative to synthetic materials. Fibers from cellulose are also suitable, such as fibers from wood[10].

The company has set concrete objectives for its ambition that "by 2024, at least 90 % of all VAUDE products will have a renewable (bio-based) or recycled material content of greater than 50 %." [11]

[6]http://www.mountainblog.eu/vaude-green-shape-core-collection-receives-if-design-award-in-gold-sustainable-design-award-winning

[7]https://www.vaude.com/media/pdf/53/1c/78/2018_05_VAUDE-wins-the-GreenTec-Award-2018_en.pdf

[8]https://www.vaude.com/en-GB/Green-Shape-Core-Collection

[9]https://www.effective-project.eu/Partners/VAUDE_1/

[10]VAUDE 2019 CSR report (Aug 2020), https://csr-report.vaude.com/gri-en/product/bioplastics.php

[11]H2020 project EFFECTIVE, https://www.effective-project.eu/f/docs/DOWNLOAD/EFFECTIVE---Spring-Newsletter---A-biobased-economy-for-the-post-virus-world.pdf

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Figure 2: Green Shape Core Collection[32]

EFFECTIVE Interviewer: Where do you see the potential of bio-based materials for your products?
René Bethmann (Innovation Manager Materials and Manufacturing): "Up to now, most functional fabrics are based on fossil fuels. But, fossil resources are finite. Therefore, synthetic materials made from renewable raw materials must become a part of the solution. We have set ourselves the goal of increasing the amount of renewable raw materials we use. In this way, we can use less fossil resources and diminish our carbon footprint. Bio-based materials are a way for us to reduce our collective impact while also improving technical attributes to drive very high performing materials. Traditional thinking that a sustainable product delivers lower performance might become obsolete. Recycling is just the end perspective of a product or material. We need to start at the beginning of material's life to close the loop entirely and finally lower our dependency on fossil resources, which not only create environmental sustainability, bio-based materials are also a chance to create a ripple effect throughout other industries, the aim being that virgin fossil-based products should eventually be withdrawn from any raw material portfolio."[33]

[32] http://www.mountainblog.eu/wp-content/uploads/2018/03/GreenShapeCoreCollection_W1819_Produktuebersicht.jpg

[33] H2020 project EFFECTIVE, spring 2020 newsletter, https://csr-report.vaude.com/gri-en/product/bioplastics.php

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Examples of switching from fossil to innovative bio-based materials

Working in close collaboration with partners in the value chain, in particular suppliers from the chemical industry, VAUDE has introduced innovative bio-based materials including biopolymers and biocomposites in its Green Shape products. Here are a few examples[14,15]:

- VAUDE uses polymer materials derived from the oil of castor beans to produce trims (such as zippers, buckles and hooks) and high-performance fibers (for clothing). Castor oil is a unique natural material that is obtained from the Ricinus Communis plant, which grows in tropical regions. It is grown in relatively poor soil conditions, and its production does not compete with the food-chain. For developing the buckles of its new bag and backpack collection, VAUDE uses bio-polyamides supplied by Evonik[16]

- In VAUDE's Ceplex Green membrane, used for waterproofing, up to 25% of conventional polyurethane (PU) is replaced by s.Café®. The bio-PU is obtained from recycled coffee grounds which are converted into a polyol. Bio-PU is a drop-in chemical offering the same performance as its conventional fossil counterpart.

- Bio-based thermoplastic polyurethane (TPU) is used in the heel counter and toe cap to waterproof one of VAUDE trekking boot models. The bio-TPU is made using two building block biochemicals: succinic acid and 1,3-propanediol. The bio-TPU, a joint development of Covestro and Reverdia, has a bio-based content of about 64%.

- Another innovation highlight is the newly developed fleece material in which TENCEL® is used on the inner surface. The TENCEL® fibre is made from 100% wood cellulose, a renewable raw material that has excellent functional properties. And the best thing about it: microparticles that enter the global water cycle during the washing process can biodegrade completely in seawater.

Challenges shifting to bio-based

As mentioned above, VAUDE has the ambition that by 2024, at least 90 % of all VAUDE products will have a renewable (bio-based) or recycled material content of greater than 50%. The company is spending a lot of time and resources on realising these targets. But achieving them is no panacea. What are the main challenges for the company to realise its ambition? The BIOSWITCH project interviewed VAUDE's innovation manager René Bethmann on this topic[17].

"To increase the renewable or recycled content whilst remaining price competitive is a major challenge", he mentions. "In terms of sales price we have little room to manoeuvre. As a brand you are stuck in a specific price range. VAUDE operates at the mid-price level, and there is a natural maximum to the sales

[14] https://www.vaude.com/en-NL/Equipment/Eco-Fair/Sustainable-Materials/Biobased-plastic

[15] René Bethmann (2019), VAUDE, presented at: Bioplastics and Biocomposites Innovative Building Blocks of the Emerging Bioeconomy, 14 February 2019, Rotorua, New Zealand, https://www.scionresearch.com/__data/assets/pdf_file/0008/65816/Bio2AN-Vaude.pdf

[16] https://corporate.evonik.com/en/evonik-showcases-sustainable-material-solutions-for-the-sports-industry-117644.html

[17] Telephone interview with VAUDE Innovation Manager René Bethmann, 13 October 2020

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price that our consumers consider acceptable. A jacket selling at 250 euro will stay unsold if it is priced 15% higher. In real life we do not experience much of a GreenPremium effect[18].

Our production costs are rising, for various reasons and in many ways. It is not just the higher prices of renewable/recycled feedstock or less harmful chemical components compared to virgin fossil feedstock. It also concerns costs linked to the certification process. The costs of labour in production countries are increasing too.

We work with several large chemical industries but compared to some of the other outfitters in the outdoor sports industry are a relatively small player. Our power to convince our suppliers to adjust their chemical product portfolio is limited. Our modest scale limits the accessibility and availability of new biomaterials such as bioplastics and biocomposites to us and drives up their costs.

Currently there are few economic incentives supporting a (further) switch to bio-based. We hope that fiscal measures that are to be implemented under the European Green Deal, like the carbon tax on fossil resources, will lead to a monetary award for our sustainable practices.

Only few people question the (un-)sustainability of using fossil-based materials. And since the onset of the Covid-19 pandemic prices for fossil oil dropped dramatically. Making it difficult for us making large progress towards achieving our 2024 ambition right now."

Lessons learned and take-home messages

VAUDE is a fully family-owned company that has sustainability as part of its DNA and long-term, future-oriented ecological, social and economic goals.

Have set themselves an explicit goal of increasing the share of renewable raw materials used.

Its collection of 19 core products, for the development of which nature served as model, taskmaster, and source of inspiration, ensures a sense of well-being and comfort for a diversity of outdoor activities.

Already succeeded using bio-based, recycled or purely natural materials for about 90% of the diverse textile materials used in the collection of 19 core products, with the ambition to achieve a renewable (bio-based) or recycled material content of >50% for almost all (at least 90%) VAUDE products in 2024.

[18]The term GreenPremium prices is defined by nova-Institute as: "The additional price a market actor is willing to pay for the additional emotional performance and/or the strategic performance of the intermediate or end product the buyer expects to get when choosing the bio-based alternative compared to the price of the conventional counterpart with the same technical performance." See e.g. See Carus, M., Eder, A., Beckmann, J. 2014a: nova paper #3: "GreenPremium prices along the value chain of bio- based products". Hurth 2014. http://bio-based.eu/nova-papers/#GreenPremium

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Bio-based materials are a way to reduce the company's collective impact while also improving technical attributes to drive very high performing materials.

Bio-based materials are also a chance to create a ripple effect throughout other industries.

Increasing cost prices, modest company size, lack of monetary reward for sustainable performance and lack of incentives are important barriers to keep up momentum in the ongoing transition from fossil to bio-based.

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APPENDIX 4:

SET OF 6 (UNEDITED) FACTSHEETS

Company	Bio-based innovations	BIOSWITCH sector/s	Case study author(s)
Bioco	Coffee packaging (pouches; capsules)	Food	Emma Sidgwick Flanders' FOOD
Dantoy	Toys	Chemistry	Thorkild Frandsen Food & Bio Cluster Denmark
Naty	Baby diapers	Forestry	Emily Marsh Institute of Technology, Tralee
Vaude	Clothing components	Chemistry	John Vos, BTG Biomass Technology Group BV
La Unión	Vegetable netting	Agriculture, Food	Marta Macías Aragonés Corporación Tecnológica de Andalucía
Stora Enso	Single-use food bowls	Forestry	Anna Tenhunen, Teija Laitinen, Marianna Salin CLIC Innovation

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BIOSWITCH

Encouraging Brand Owners to Switch-to-Bio-Based in highly innovative ecosystems

CASE STUDY X: **BIOCO BVBA**

Emma Sidgwick

Flanders' FOOD

Abstract

This case study describes the transition journey of Bioco, an organic, artisan coffee roasting company from Belgium. For Dieter and Jo, co-owners of Bioco, it goes without saying that the sustainability of their product – ensuing from its production and processing – must have a counterpart in its packaging. Initially incited by consumer push, Bioco made a radical shift towards bio-based packaging, packaging produced from biomass, to decrease dependence on finite fossil carbon resources. Moreover, their coffee capsules are not only bio-based but also industrially compostable. Indeed, throughout their transition journey, Bioco has always strongly considered actual or expected end-of-life management processes in Belgium. Hence its company slogan: *"Bioco leaves nothing but a great taste"*. In Belgium but also at European level, Bioco has been a true pioneer: only very recently bigger players such as Lavazza are going the same route. For Bioco to be a first mover its smaller scale has come as an advantage, especially in terms of strategic decision making, supplier collaboration and pricing strategy.

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Company background

Bioco is a small Belgian coffee-burning company established in 2016 honouring the craft of roasting coffee. They refuse turning to industrial fast-roasting methods but swear by allowing the beans to roast slowly. This ensures for an optimal aroma, wherein the essential oils of the coffee bean are stored within the bean.

While Bioco distributes to a couple of bigger retail channels in Belgium, the company has only two employees – Dieter and Jo – on the payroll. However, it is precisely this smaller company scale, which has enabled them to set their rather idiosyncratic course in the global field of sustainability.

More precisely, Bioco has been a first mover in two areas. Firstly, Bioco is the sole 100% organic coffee-burning company in the Benelux. Secondly, they are a pioneer in Belgium when it comes to their packaging choices. Most notably, they currently use 100% bio-based and compostable coffee capsules with guaranteed functional performance.

Consumer concerns kick-started Bioco's transition journey to more sustainable packaging

Dieter and Jo are both intrinsically motivated to weave their company strategy around the more sustainable sourcing and cultivation of coffee beans, the craft roasting process, and fossil-free and more ecological packaging solutions. Yes indeed, they connect entrepreneurial mindset with aspirations to a fairer and better world.

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Adopting bio-based packaging solutions, however, has been a true 'transition journey' initially incited by consumer push. Amid the chaos of starting a new company, Bioco initially opted for packaging that visually differentiated the company from their "168 potential competitors" on the supermarket shelves. Thus, they initially sold their coffees in paper tubes with aluminium coating and metal lids.

While certainly eye catching, the critical consumer base of the organic market did not fail to raise their concerns. These concerns have become the start of a thoroughly researched transition journey towards more sustainable packaging options.

Bioco's radical shift towards bio-based packaging

> **Jo Temmerman (Co-Owner Bioco):** *"Fossil-based plastic remains a huge problem if you know that globally around 350 million tonnes are produced annually. It is time to shift not only to more sustainable products but also to more sustainable packaging. For us it is critical that after drinking our coffee, it is only its taste that remains."*

Bioco has evidently no R&D department, but Dieter and Jo plunged into extant research on sustainable packaging options and combined such with actual 'field work': they consulted suppliers, the Public Waste Agency of Flanders (OVAM) and different inter-municipal waste collection bodies (the so-called 'intercommunales') to understand actual end-of-life management processes.

This journey resulted in the uptake of a coffee pouch that for 89% consists of bio-based, renewable materials – mainly cellulose and sugarcane biomass residues – and coffee capsules that are 100% bio-based *and* compostable.

For the coffee pouches trade-offs had to be made. Most notably, fully bio-based and compostable pouches would – at least at the time of decision taking – not guarantee airtightness, which would lead to shorter shelf life, and thus to an assumed bigger global ecological footprint, given the energy-intensity of coffee production.

For the coffee capsules, this problem did not pose, given the sturdy material required for coffee capsules provides sufficient thickness to guarantee airtightness.

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Figure 1: Bioco's 89% bio-based coffee pouches

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Figure **2**: Bioco's 100% bio-based and compostable coffee capsules

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100% bio-based and compostable coffee capsules with a 'green ring' as visual cue

> **Jo De Temmerman (Co-Owner Bioco):** *"We started looking for a coffee capsule, which is industrially compostable but also very functionally performant. To find the combination of both is a true quest. But if the capsule would not work as it is supposed to, or if the coffee would taste bad, people would buy your coffee only once.*

The coffee capsule in 2017 adopted by Bioco consists of PLA-material without GMOs (some of their customers ask for GMO-free certificates). The capsule stands out because of two features.

First, supplier Bio4Pack offers a capsule that is fully bio-based and compostable without compromising the quality of the coffee. Essential in that sense is to prevent coffee oxidation. Bio4Pack developed a patented technology for the membrane that seals the capsule. Making this membrane both bio-based compostable and air-tight is indeed the major challenge. The membrane developed by Bio4Pack combines cellulose and PLA in a specific weave structure. Cellulose in itself is porous and hence not airtight. PLA in itself would be too sturdy to enable perforation of the capsule. Additionally, an airtight capsule ensures that you can repackage in ecologic materials and do not have to take recourse to plastic or aluminium repackaging.

Figure 3: Coffee capsule from Bio4Pack with patented technology for the membrane that seals the capsule

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Second, in the design of the capsules not only technological innovations but also eventual, individual consumer waste sorting practices were considered. Given correct waste sorting, collection and end-of life management is a critical component in the sustainability impact of the product, a green ring was added as a visual cue to signal industrial compostability and thus steer adequate waste sorting behaviour.

The innovative bio-based coffee capsule

The innovative bio-based and industrially compostable Nespresso-compatible coffee capsule is the result of close collaboration of Bio4Pack, specialist in the field of sustainable packaging, and Advanced Technology Innovations (ATI), a product innovator. Working with Koffiebranderij Peeze as launching customer in the Netherlands, the partners developed a sustainable alternative for Nespresso-type aluminium-based capsules. The plant-based single serve coffee capsule is manufactured from bio-based material (sugar) and is compostable after use in municipal waste streams.

In 2015 the product was launched and in the same year the innovation was awarded the Dutch Food Valley Award. In 2016 the innovation was a finalist in the Packaging Innovation Contest De Gouden Noot, one of the world's most competitive packaging innovation contests

Since 2015, the innovative product has been picked up by the rapidly growing market for coffee capsules. Bioco adopted them in 2017 whereas the Italian espresso giant Lavazza started using the capsules in the UK in 2019, at the same time announcing plans to replace its entire range of home use capsules with new eco-friendly ones.

The importance of being a small player in becoming a first mover

Bioco's radical choice for more sustainable packaging is intrinsically motivated, but also strategic: as a small player you must take a clear position to poach on bigger players' territory.

But equally in terms of executing the uptake of bio-based pouches and coffee capsules, being small has its advantages. First, for bigger companies, supply of bio-based packaging may be a big question mark. And indeed, also Bioco must place orders way in advance because of feedstock issues, but as Dieter explains, "As a large company you cannot work with a delivery time of 12 weeks, but for us this does not pose a problem. We produce smaller volumes and can make sure to have sufficient packaging products in stock."

Also, the impact of bio-based packaging on total cost price is huge – it accounts for approximately 10%. Nonetheless Bioco does not pass on this cost to consumers but partly allocates it as marketing cost, partly takes a lower margin. Again, within a larger company a choice that bold may not pass that easily.

Key take-away messages from Bioco and the future of the coffee capsule

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Bioco has just one, major 'learning lesson' from its transition journey: if your motives are green washing, you will not come very far. Choosing for bio-based packaging is still an investment – "you will never get as much financial return compared to when sticking with conventional plastics". Nonetheless, Bioco considers it the only right choice in the longer run. Indeed, since their switch they have not had a single complaint from their growing customer base.

Coffee capsules are here to stay. According to research by Halo, a British producer of compostable coffee capsules, every minute about 39,000 of these capsules are made worldwide, while up to 29,000 are dumped in landfill sites. Compostable coffee capsules do not only tally with actual industrial waste stream management and individual consumer behaviour – e.g. recycling still requires each capsule to be emptied first, thus imposing a hassle barrier – they can also be turned into a value-added product at the end of their life cycle, with the recirculation of nutrient-rich compost.[1]

Further resources

https://kanaalz.knack.be/nieuws/start-up-komt-met-afbreekbare-koffiecapsules/video-normal-860047.html

https://www.madeinvlaamsbrabant.be/nieuws/koffiebranderij-bioco-lanceert-ecologische-buidel/

https://www.biojournaal.nl/article/7029673/bio-koffie-nu-in-ecologische-pouch/

https://www.gezondverstandig.be/het-verhaal-van-een-liefdeskind-van-twee-koffieliefhebbers-met-een-passie-voor-duurzaamheid/

https://news.bio-based.eu/lavazza-launches-compostable-coffee-capsules/

https://www.wired.co.uk/article/coffee-pods-nespresso-recycling

https://nlintheusa.com/food-valley-award-2015-finalists-announced/

https://www.en.nvc.nl/finalists-de-gouden-noot-2016/

https://www.worldfoodinnovations.com/innovation/biobased-compostable-single-serve-coffee-capsules

https://www.theguardian.com/environment/2019/nov/04/better-latte-than-never-compostable-coffee-pods-go-on-sale

[1] Kooduvalli, K. et all. (2020) Life Cycle Assessment of Compostable Coffee Pods: A US University Based Case Study, in: *Scientific Reports* 10

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BIOSWITCH

Encouraging Brand Owners to Switch-to-Bio-Based in highly innovative ecosystems

CASE STUDY 5: **DANTOY A/S**

Thorkild Frandsen

Food & Bio Cluster Denmark

Abstract

The Danish producer of toys and games, dantoy, has a clear target of constantly raising the sustainability levels of its products. As part of that journey dantoy has launched a new series of bio-based plastic toys for pre-school children made of sugar cane grown under environmentally friendly conditions and transported in a sustainable way. Not only the biobased product itself but also the packaging it comes in is based on renewable sources. The market uptake of the "I´m Green"-line has exceeded dantoy´s expectations and therefore the company plans to increase its share of bio-based products. The biggest challenge right now is to secure enough amounts of bio-based plastic granulates for this expansion. The dantoy case is demonstrating a successful shift from use of fossil resources to renewable and bio-based resources.

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Company background

Dantoy is a Danish company with approximately 50 employees specialized in production of games and toys for indoor and outdoor use. The company has more than 50 years' experience in designing and manufacturing quality products for use in private homes, nurseries and educational institutions. All products of dantoy can be easily cleaned with a disinfectant solution, washed by hand with water and soap or put in a dishwashing machine. The toys can also be used with food as all roleplay products are approved for contact with food and microwave safe[1].

Unlike many other companies in the toy industry dantoy maintains its production in Europe instead of outsourcing to other continents. Its products are sold in more than 50 countries around the world and 75-80% of its revenues relates to export sales[2].

A front-runner in sustainable toys

For dantoy it is very important to deliver high quality and long-lasting toys, which are produced with minimized negative impact on environment and climate. Dantoy is certified according to the environmental standard ISO 14001 and more than 90% of its products qualifies for the Nordic Swan eco-label. Dantoy works systematically to implement the United Nations sustainability development goals in the company.

Dantoy aims to reduce its impact on climate. Different initiatives have been implemented so that today the production process in the factory is CO_2-neutral. However, the feedstock used for production of plastic toys is contributing to CO_2-emissions since it is mainly based on fossil resources.

The dantoy bioplastic line

In 2016 dantoy initiated development of a new series of toys for pre-school children made of bio-based plastic. This decision was a natural next step in the journey towards even higher standards when it comes to sustainable products from dantoy.

Two years later, in spring 2018, the first bio-based products were ready for the shops and the sale began. Key elements of toys in dantoy's "I´m green"-line are:

- Minimum 90% biobased material (sugar cane)
- The sugar cane is cultivated in controlled, pesticide-free plantations in Brazil
- Same product durability
- 100% recyclable (single-material)
- Recycled cardboard with almost no plastic is used for packaging

[1] https://dantoy.dk/en/
[2] https://plast.dk/2018/03/dantoy-investerer-i-udvikling-af-produkter-i-bio-plast/

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- The bio-based plastic line qualifies for the Nordic Swan eco-label

The products in the "I´m green"-line are characterised by a lower climate impact than traditionally used plastic based on fossil resources. For each kg manufactured bio-based plastic, 3.09 kg of CO_2 are removed from the atmosphere[3].

"Green Bean" is another product line recently introduced by dantoy. All products from the Green Bean series are made from dantoy's own surplus waste materials. This recycling process creates shades of colour in the toys and no two pieces are the same.

Figure 1. Examples of products from dantoy´s « I´m green »-line.

Bio-based packaging based on recycled resources

During the development of the "I´m green"-line dantoy also looked at the packaging used for the new products. To improve sustainability in all aspects of its "I´m green"-line dantoy decided to use 100% recycled carton and no plastic netting or plastic film.

[3] https://dantoy.dk/wp-content/uploads/2019/01/BIOnewspaper_EN-1.pdf

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Figure 2. Packaging used for the « I´m green »line based on 100% recycled carton.

Experiences from the "I´m green"-line

The products in the new "I'm green"-line have been received very well by the customers and the sales have exceeded the expectations dantoy had before launching the bio-line.

The "I´m green"-line has also been acknowledged by the international toy industry. In 2020 dantoy received a silver medal in the sustainability category of the Play for Change Awards, which is organised by The Toys Industries of Europe[4].

[4] https://playforchangeawards.eu/winners/

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Figure 3. Justication for the silver price to dantoy in the Play for Change Awards 2020.

Challenges shifting to bio-based

One of the challenges of shifting to bio-based plastic granulates is that the price is substantially higher than the traditionally used plastic granulates.

What is more critical, however, is uncertainty about the supply of bio-based plastic granulates. For dantoy it is essential to have a stable supply of its raw materials in right amounts and satisfactory quality. As one of the first movers dantoy has faced challenges getting access to enough amounts because the bio-based plastic production capacity is too low to satisfy the increasing demand. A possible consequence of this bottleneck situation is that dantoy can be forced to postpone the expansion of biobased products in its portfolio.

Ideally, the "I´m green"-line was 100% bio-based and dantoy is very close to this target. However, it is a challenge to find bio-based components to be used for the right colours and this explains why a small percentage of the material in the toys are based on fossil resources.

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Figure 4. The dantoy bio life cycle.

Lessons learned and take-home messages

The plastic used for the "I´m green"-line is polyethylene (PE). It was crucial for dantoy to identify bio-based plastic granulates with the same functional properties and chemical composition[5] as the plastic granulates used for dantoy´s other products. That would allow the bio-based plastic granulates to be used in the existing production line in the factory. If new machines should have been bought to establish a new biobased production line parallel to the existing fossil resource-based production line it would have been too costly to launch the new series of bio-based toys.

[5] Bio-based drop-in chemicals are bio-based versions of existing petrochemicals which have established markets. They are chemically identical to existing fossil-based chemicals. The term drop-in is usually used in relation to commodity chemicals and polymers with large production volumes.

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Next steps

Dantoy would like to increase the share of its products made of bio-based plastic over the coming years. How fast this transition can be, depends on how the supply of bio-based plastic granulates will develop. According to the CEO of dantoy it is not unrealistic that by 2030 all dantoy products are based on bioplastic.

Even though dantoy is happy with the plastic granulates made out of sugar cane it might be interesting to find a feedstock which can be produced more locally. That could for instance be wheat straw processed in a biorefinery to produce sugars for plastic.

Quotations

Marck Matthiasen, CEO of dantoy:

"We cannot compromise quality. It is crucial that the bio-based products will have at least the same strength and durability as fossil-based plastic products. Otherwise, we undermine the dantoy-brand."

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BIOSWITCH

Encouraging Brand Owners to Switch to Bio-Based in highly innovative ecosystems

CASE STUDY: ECO BY NATY

Institute of Technology, Tralee

Abstract

Eco by Naty is a Swedish company that was a first mover in creating an alternative to fossil-based disposable baby diaper products. This case study will present the story of Naty as a success case to support the switch to bio-based products. Naty has developed a line of products made from plant-based resources, including a compostable nappy made from certified wood pulp and other natural biodegradable materials. Eco by Naty is the market leader in eco-friendly nappies and their innovative technology has created a high quality compostable product made from natural renewable resources, delivering a brand of sustainable performance.

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Company background and philosophy

1.1 Origin Story of Naty

Naty is a family-run company founded in 1994 by Marlene Sandberg and is now a multinational enterprise spanning 35 countries worldwide. Eco by Naty is a brand selling a range of bio-based baby care products, including compostable diapers and plant-based wipes. Naty was created to develop a baby diaper/nappy product that was healthy and sustainable. Naty's CEO and founder Marlene Sandberg became aware of the environmental issues with conventional fossil-based disposable nappies after reading an article on their negative effect on the Swedish environment, and as a busy mother of two young children and unable to find a viable alternative, developed Naty[1]. Concerned about the direct effect of toxic chemicals in conventional plastic diapers on children's skin and thinking about the next generation, Marlene developed a prototype eco diaper, spending 5 years in the 1990s developing the eco-friendly diaper product further and launching the brand.

Founder Marlene Sandberg - from lawyer to an ecological entrepreneur

Naty was founded in 1994 and after 5 years of research, the first eco-friendly diaper was on the shelves in Sweden[2]. Marlene did her own testing, sourcing of materials and producers, and tested prototypes on her own child. The origin of Naty came from a personal determination to combat the impact of traditional nappies on environment and climate (fossil resource use, mountains of waste) by developing a viable bio-ba`sed alternative.

1.2 Motivations of Brand Owner

"To radically change the way the market works to protect the planet through enabling a person to make conscious choices and empowering people to change society"[3].

The founder Marlene was a strong believer that we could not continue on the path of ecological destruction and has been on the forefront of sustainable innovation on the 26 year journey since company creation. The main driving factor for innovation was upset about the plastic in the industry and the need for an ecological solution. Strong environmental principles have driven product development for Naty since the beginning.

The Naty brand was motivated by developing a lifestyle concept for healthier living for people and the planet. All Naty products are made of renewable and compostable materials. They have as high a performance as fossil-based material products.

[1] Naty Website Naty - About Us
[2] Naty Blog Post Naty Blog Post - Origin Story
[3] Sustainability Report by Naty 2018 Naty Sustainability Report

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Wide range of bio-based care products

Over the years, Naty has expanded its product range from nappy products to a full range of wipes, feminine hygiene products, nappy disposable bags, skincare, clothing and changing bags, all bio-based:

- ⇨ In 1998, launch of first eco-friendly disposable diaper in Sweden
- ⇨ In the years to follow the diaper range was expanded and a range a biodegradable wipes
- ⇨ In 2005, launch of Femcare range of feminine hygiene products
- ⇨ Naty launched toiletries in 2009
- ⇨ A clothing range is launched in 2010
- ⇨ And more recently a diaper bag and potty

Figure 1. A sample range of Eco by Naty products

Beyond developing new bio-based product lines, Naty had steadily increased the renewable raw material share in existing products, as is illustrated below.

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Showcase: diaper products and packaging

As mentioned above, Naty is targeting to switch from partly bio-based to fully bio-based products and packaging in a number of product ranges. The achievements made with regard to eco-friendly diapers are highlighted here.

Disposable diapers were the first product Naty developed, and these have been on the market since 1998. Rather than basing so much of the diaper on oil based plastic as other brands do, Naty nappies use bio-based and plant-based plastic wherever possible. Their renewable material content is being increased step-by-step. In the mid 2010's Naty's diapers were 51% renewable, the successor generation launched in 2017 reached 70% bio-based share, and Naty aims the next generation of diapers to be fully 100% renewable[4]. With more than 50% bio-based content Naty is the market leader in environmentally-friendly care products for children in Europe and Australia with regard to renewable material content.

The absorbent core of the Naty nappy is made from 100% FSC certified wood pulp, the natural fibres are breathable and super absorbent. For the diaper range the corn feedstock was replaced with sugar cane based material due to consumer feedback that the corn-based material was too rough on the babies' skin. Innovation is key to Naty and a new generation of product was developed. The core remained the super absorbent FSC certified wood pulp polymers and the tabs are also from renewable material. Bioplastic is the material used for the waterproof coating on the outer layer. The conventional fossil-based oil plastic layer was replaced with a plant-based plastics of corn starch and cellulose fibres. The absorbing layer of Naty nappies also consists of biodegradable cellulose fluff pulp. The next generation of diapers are produced with a bioplastic outer layer from renewable agricultural sources of sugar cane feedstocks. The leakage barrier is 80% bio-based and Naty are working on 100% plant-based for future nappy products.

As with all Naty products, nappies are packages sustainably. On average, the packaging for Naty products is 77% made from renewable materials that are recyclable[5] and the aim is to reach 80-100% share of bio-based materials in all packaging. Naty avoided 400 tons of fossil-based plastic by using renewable plant-based plastics which equals 2,000 tons of CO_2 emissions avoided (Triodos, 2019).

[4] Triodos Investment Management https://www.triodos-im.com/articles/2016/how-naty-radically-changes-the-rules-of-the-diaper-market

[5] Triodos Investment Management (2019) https://www.triodos-im.com/articles/projects/naty-2019

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Environmental certifications

Transparency in its supply chain has always been key to Naty. The sourcing of its renewable raw materials, and the end-of-life performance (home compostable) of its products, is certified by independent organisations, as shown in the table below. All Naty product lines have the OK Biobased Certification by Vinçotte (now TUV Austria)

	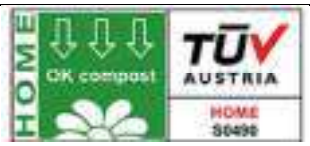		
OK biobased TÜV Austria (certifies bio-based share. Four stars: more than 80%)	**OK compost TÜV Austria (certifies biodegradability in an industrial composting plant)**	**Certifies at least 95% plant-based ingredients, and at least 10% content originating from organic farming**	**Certifies that content is sourced from forests that are managed environmentally & socially responsible**
Diaper products Eco Diapering Pants Wet wipe range Plant-based Potty Potty Liners Feminine hygiene product range Skincare range	Diaper product range Diaper disposable bags Wet wipe range	Wet wipe range Skin care range	Diaper products

Figure 2: Environmental certificates carried by various Naty products

Recently, Naty won the 2020 'Best Eco Nappy' award, issued by the leading German newspaper Süddeutsche Zeitung[6].

These certificates and the award are important for customer satisfaction and trust in the biodegradable and compostable products. Marlene and Naty are proud of the transparency of the materials in their products and the third-party certification gives recognition to there ecological performance.

[6] See https://www.naty.com/gb/en/best-disposable-diaper.html or https://www.sueddeutsche.de/stil/oeko-windeln-test-1.4757387

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Impact of Switching to Bio-Based Products

Absorbent hygiene products (nappies, feminine hygiene products and wipes) has 8,500,000 tons of this type of waste incinerated or landfilled in Europe each year, accounting for 3-4% of the total municipal solid waste[7]. Naty full range of nappies, feminine hygiene products and wipes are partially or fully bio-based, and 8 out of 10 product lines are compostable. Naty considers the waste management for the consumer, with all nappy products being fully compostable at home and does not require industrial composting.

Naty products take into consideration the full life-cycle of their products, with commitments to sustainable manufacturing, packaging, distribution and disposal. Naty conducts business in a socially and economically sustainable way as well as environmentally sustainable. Naty pays full corporation tax in Sweden, full due diligence to the full supply chain, no ingredients are tested on animals, requires protected workers' rights, no child labour and their manufacturers in all 14 countries follow all laws and regulations required[8]. Distribution and transportation takes into account the lower carbon emitting transport modes of sea and land freight, preferring this over air freight which is avoided completely where possible.

The consumers of Naty products are engaged with the brand ethos of sustainability, and chose this brand as it is free of chemicals and oil-based plastics.

[7] Embraced BBI JU project public summary

[8] https://www.naty.com/on/demandware.static/-/Library-Sites-NatySharedLibrary/default/dwedf17704/pdf/sustainability_report_2018.pdf

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Challenges

The main challenge identified for Naty was the consumers - they are both the success and the barrier to switching to bio-based approaches. Naty was an early mover to bio-based materials and the customer demand was not there at first. However, Marlene was a strong believer in delivering an ecological plant-based product as a viable alternative to the fossil-based diaper products. Marlene Sandberg highlighted that "marketing consumers and industry has been a barrier", and that the first major challenge was that nobody had understood what they had done. To overcome this challenge Naty has a marketing budget to promote the sustainable products they develop and increase market reach.

Marlene Sandberg - "not easy to be the first innovator in the industry"

Production, raw material, marketing and consumers have all been challenges and barriers that Naty have overcome. Changing existing manufacturing caused problems with efficiency, cost and waste. An increase in product cost is required as the same level as the big fossil-based plastic brands can not be reached, there is an increased cost for improved efficiency and waste. Naty is producing the most expensive product in its industry but this has been overcome by customer loyalty and a consumer bases that has a by-in to the Naty ethos of ecological performance, the demand for bio-based product and the need for a home compostable product.

Challenges around existing manufacturing processes continue until major players in the industry demand bio-based materials in manufacturing and until then major investment in changing system and technology will not be made[9].

Planning for the Future

Today Eco by Naty is the leading green nappy company in the world. We have reached this far due to the constant drive for excellence and determination to make a real change. We are at the edge of eco development and determined to stay so in the future.

Over the years we have invested millions of dollars in new, ground-breaking technology. Instead of locking our developments with patents, we leave them free for other companies to adopt if they would like to do so. This has happened many times over the years. We don't mind that, we salute it!

The more good solutions there are on the market, the better.

- Marlene Sandberg. Founder & CEO

[9] Triodos Organic Growth Fund https://www.triodos-im.com/articles/2016/how-naty-radically-changes-the-rules-of-the-diaper-market

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For the future, Naty wants to achieve 100% bio-based materials in all the product range. Naty plans to keep improving the current product lines and start research on developing new product lines. With a continued strong focus on research and development, Naty strives to achieve further innovation in sustainable performance products. A growing awareness of consumers for sustainable products is the future for bio-based products. Naty will continue to innovate in the ecological market and hopes that interest in natural bio-based products continues to grow.

"Seeing the difference, we're making on a daily basis helps drive me forward. Wanting to make a better world, and a better future for my sons. Seeing the harm that we were doing to our environment by being so careless whether we are aware of it or not, was hard to accept. All this is a daily reminder why I started Naty and why we keep innovating and moving forward. That's where my spark came from and keeps coming from!" – Marlene Sandberg[10]

Take Home Messages

"It's important to be consistence and not give up" – Marlene Sandberg

The founder of Naty, Marlene Sandberg, highlights the importance for others switching to bio-based approaches to be consistent and to never give up. To be successful in switching from fossil-based materials and processes to bio-based approaches you need to stay focused and to be patient. There are special conditions for each sector, some more complicated that others, but Marlene stress the need for other industries to keep open and aware of the problems and new opportunities. "Each company needs to set their own vision and understand what their aim is in the long term and move that direction" (Marlene Sandberg). Marlene had a clear vision for Naty, to create a fossil-free product that is biodegradable and compostable. That the consumer products should be compostable and should be able to compost at home, not just industrial composting.

Marlene's final take home message to other brand owners is to believe in the future systems and find where bio-based approaches will benefit them the most. To have an idea and a vision and to move before the slow political system. There is increased awareness among consumers and brand owners can take advantage of the growing trend among consumers for bio-based products.

[10] https://www.naty.com/us/en/naty%27s-origin-story.html

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BIOSWITCH

Encouraging Brand Owners to Switch-to-Bio-Based in highly innovative ecosystems

CASE STUDY 1: **VAUDE SPORT GMBH & CO. KG**

John Vos

BTG Biomass Technology Group

Abstract

This case study sketches the sustainability journey and experience of German outdoor outfitter VAUDE, and the role renewable raw materials, including bio-based materials, play in its consumer product innovations. For its Green Shape Core Collection nature serves as model, taskmaster, and source of inspiration. About 90% of the diverse textile materials used in this product collection are made using bio-based, recycled or purely natural materials. For VAUDE, using innovative bio-based materials helps to reduce its collective impact while also improving technical attributes to drive very high performing materials. The VAUDE experience can serve as a showcase and, considering the strong involvement of the outdoor sports industry in sustainability, offers a chance to create a ripple effect throughout other industries.

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Company background

VAUDE is a German sports equipment brand making functional and innovative clothing and other articles like bags, rucksack, tents, etc. to enjoy the outdoors. The family-owned company, founded in 1974, employs about 500 people at its company headquarters near the southern German town of Tettnang. VAUDE operates internationally and generates annual sales of around €100 million.

VAUDE stands for environmentally-friendly products made from fair manufacturing. It has a willingness to invest time in innovation and has a clear ambition to remain a sustainability pioneer. Antje von Dewitz, who followed up her father as CEO in 2009, wants to make VAUDE the greenest outdoor outfitter in Europe.

A pioneer and industry leader on sustainability

When it comes to ecological product development "*Practice what you preach*" applies to VAUDE for decades. In 1994 it introduced Ecolog, a recycling system for polyester clothing, in 2001 it was the first outdoor company to be awarded the Bluesign ecolabel and since 2012 the head office has been fully CO_2 neutral[1].

VAUDE participates in a number of sustainability initiatives in the clothing sector: Fair Wear Foundation, Greenpeace Detox and Bündnis für nachhaltige Textilien. It has received a number of awards and accolades for its products and role with regard to sustainability. It has been innovative in terms of creating a circular approach for its prominent **Green Shape** product line where emphasis is laid on quality materials, design and reparability to ensure longlife[2].

EFFECTIVE project interviewer: VAUDE is a true pioneer for sustainability in the outdoor clothing and sports industry. Why is this part of your DNA?

René Bethmann (Innovation Manager Materials and Manufacturing): *"As an Outdoor Outfitter which supports users to enjoy nature, our aim is to make our impact on nature and the environment as small as possible. We take responsibility in everything we do for our employees, our partners, the environment which is surrounding us and our products. We design with a focus on minimal material consumption, we try to avoid waste and design products that are timeless, durable and repairable. Thus, as a company that acts sustainably, we align ourselves with long-term, future oriented, ecological, social and economic goals. We use or develop the most sustainable materials available to us, optimizing processing even in the most inconspicuous places to make products we can be proud of. Products that convey our enthusiasm and guarantee our end customers the perfect experience."*

[1] Outdoormerk Vaude, koploper in duurzaamheid, 5 April 2018, https://farout.be/2018/04/05/outdoormerk-vaude-duurzaamheid/

[2] Alexis FIGEAC, Centre for Sustainable Consumption and Production (CSCP). VAUDE: A Circular Business Model Innovation Journey. R2piproject Deliverable 5.2, www.r2piproject.eu/wp-content/uploads/2017/12/D5.2-Vaude-Case-Report.pdf

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What sustainability means in VAUDE products: the Green Shape label

In 2009 VAUDE began to steadily steer product development toward sustainability and the next year it introduced the Green Shape label. Green Shape identifies environmentally friendly products made from sustainable yet functional materials. They are manufactured under fair working conditions along the entire supply chain. Green Shape has become very well established in the outdoor market.

Green Shape has gone through several stages of development. Initially, the Green Shape criteria included only the materials used. Nowadays the Green Shape criteria apply to the entire product lifecycle, from design, through all the materials used, production sites, use and care of the product, to possible recycling and/or environmentally friendly disposal.

Each year more Green Shape items are added to the VAUDE product range. In the apparel collection the company has been increasingly successful in finding environmentally friendly materials from responsible suppliers. Over 95% of VAUDE's apparel is Green Shape. For other products -especially with tents, backpacks and footwear- great challenges are faced. Materials such as hard plastics, metals, foams for shoe soles etc. are a fairly hard nut to crack from an ecological point of view[3].

Figure **X**: Green Shape infographic[4]

[3] https://csr-report.vaude.com/gri-en/product/greenshape-concept.php.
[4] https://csr-report.vaude.com/gri-en/product/greenshape-concept.php

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Green Shape Core Collection

With the Green Shape Core Collection, launched in 2018, VAUDE offers a thoroughly sustainable set of outdoor apparel and gear. VAUDE developed innovative materials for the collection that are functional and environmentally friendly and also offer solutions to global problems such as those caused by microplastics. The collection includes 19 products: apparel, shoes and backpacks. Throughout the product development phase, nature served as model, taskmaster, and as an inexhaustible source of inspiration. About 90 % of the diverse textile materials used in the production processes are bio-based, recycled or purely natural materials. The Green Shape Core Collection is a clear testimony of what motivates VAUDE as a brand and an unwavering expression of what the company imagines the future of sustainable outdoor gear to be[5] [6] [7].

The development of the trend-setting Green Shape Core Collection focused on various aspects of sustainability. **Mario Schlegel (Head of Design)** describes the special design approach:

"The Green Shape Core Collection breaks with convention in terms of concept and organisation. Instead of aiming for weight optimisation, higher waterproof values, and other high performance parameters, the collection has opted out of the race for higher, faster, farther. We have not only optimised the product design and fit of the individual items to ensure a sense of well-being and comfort for a diversity of activities, we have also focused on making the collection combinable. How can they be intelligently layered for even more flexibility? Colours and materials play a smaller role so that a very limited outdoor collection can be truly versatile and used for any activity."

Clear ambition to increase the share of renewable raw materials

VAUDE uses petroleum-based synthetic materials such as polyester, polyamide or polyurethane for many of its products. To use less fossil resources and to avoid adding more plastic to the planet it has set itself the goal of increasing the share of renewable raw materials used in its products, including bio-based polymers and materials, responsible natural fibers and a variety of recycled materials. Renewable resources can be natural plant fibers such as organic cotton, hemp or kapok. Animal-based raw materials such as down, merino wool or leather can also be an alternative to synthetic materials. Fibers from cellulose are also suitable, such as fibers from wood[8].

The company has set concrete objectives for its ambition that "*by 2024, at least 90 % of all VAUDE products will have a renewable (bio-based) or recycled material content of greater than 50 %.*"[9]

[5] https://www.vaude.com/media/pdf/53/1c/78/2018_05_VAUDE-wins-the-GreenTec-Award-2018_en.pdf
[6] https://www.vaude.com/en-GB/Green-Shape-Core-Collection
[7] https://www.effective-project.eu/Partners/VAUDE_1/
[8] VAUDE 2019 CSR report (Aug 2020), https://csr-report.vaude.com/gri-en/product/bioplastics.php
[9] H2020 project EFFECTIVE, https://www.effective-project.eu/f/docs/DOWNLOAD/EFFECTIVE---Spring-Newsletter---A-biobased-economy-for-the-post-virus-world.pdf

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Figure **X**: Green Shape Core Collection[10]

EFFECTIVE Interviewer: *Where do you see the potential of bio-based materials for your products?*

René Bethmann (Innovation Manager Materials and Manufacturing): *"Up to now, most functional fabrics are based on fossil fuels. But, fossil resources are finite. Therefore, synthetic materials made from renewable raw materials must become a part of the solution. We have set ourselves the goal of increasing the amount of renewable raw materials we use. In this way, we can use less fossil resources and diminish our carbon footprint. Bio-based materials are a way for us to reduce our collective impact while also improving technical attributes to drive very high performing materials. Traditional thinking that a sustainable product delivers lower performance might become obsolete. Recycling is just the end perspective of a product or material. We need to start at the beginning of material´s life to close the loop entirely and finally lower our dependency on fossil resources, which not only create environmental sustainability, bio-based materials are also a chance to create a ripple effect throughout other industries, the aim being that virgin fossil-based products should eventually be withdrawn from any raw material portfolio.*

[10] http://www.mountainblog.eu/wp-content/uploads/2018/03/GreenShapeCoreCollection_W1819_Produktuebersicht.jpg

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Examples of switching from fossil to innovative bio-based materials

Working in close collaboration with partners in the value chain, in particular suppliers from the chemical industry, VAUDE has introduced innovative bio-based materials including biopolymers and biocomposites in its Green Shape products. Here are a few examples[11] [12]:

- VAUDE uses polymer materials derived from the **oil of castor beans** to produce trims (such as zippers, buckles and hooks) and high-performance fibers (for clothing). Castor oil is a unique natural material that is obtained from the Ricinus Communis plant, which grows in tropical regions. It is grown in relatively poor soil conditions, and its production does not compete with the food-chain. For developing the buckles of its new bag and backpack collection, VAUDE uses bio-polyamides supplied by Evonik[13]
- In VAUDE's Ceplex Green membrane, used for waterproofing, up to 25% of conventional polyurethane (PU) is replaced by s.Café®. The bio-PU is obtained from **recycled coffee grounds** which are converted into a polyol**.** Bio-PU is a drop-in chemical offering the same performance as its conventional fossil counterpart.
- Bio-based thermoplastic polyurethane (TPU) is used in the heel counter and toe cap to waterproof one of VAUDE trekking boot models. The bio-TPU is made using two building block biochemicals: succinic acid and 1,3-propanediol. The bio-TPU, a joint development of Covestro and Reverdia, has a bio-based content of about 64%.
- Another innovation highlight is the newly developed fleece material in which TENCEL® is used on the inner surface. The TENCEL® fibre is made from 100% wood cellulose, a renewable raw material that has excellent functional properties. And the best thing about it: microparticles that enter the global water cycle during the washing process can biodegrade completely in seawater.

Challenges shifting to bio-based

As mentioned above, VAUDE has the ambition that by 2024, at least 90 % of all VAUDE products will have a renewable (bio-based) or recycled material content of greater than 50%. The company is spending a lot of time and resources on realising these targets. But achieving them is no panacea. What are the main challenges for the company to realise its ambition? The BIOSWITCH project interviewed VAUDE's innovation manager René Bethmann on this topic[14].

"*To increase the renewable or recycled content whilst remaining price competitive is a major challenge*", he mentions. "*In terms of sales price we have little room to manoeuvre. As a brand you are stuck in a specific price range. VAUDE operates at the mid-price level, and there is a natural maximum to the sales*

[11] https://www.vaude.com/en-NL/Equipment/Eco-Fair/Sustainable-Materials/Biobased-plastic
[12] René Bethmann (2019), VAUDE, presented at: Bioplastics and Biocomposites Innovative Building Blocks of the Emerging Bioeconomy, 14 February 2019, Rotorua, New Zealand, https://www.scionresearch.com/__data/assets/pdf_file/0008/65816/Bio2AN-Vaude.pdf
[13] https://corporate.evonik.com/en/evonik-showcases-sustainable-material-solutions-for-the-sports-industry-117644.html
[14] Telephone interview with VAUDE Innovation Manager René Bethmann, 13 October 2020

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price that our consumers consider acceptable. A jacket selling at 250 euro will stay unsold if it is priced 15% higher. In real life we do not experience much of a GreenPremium effect[15].

Our production costs are rising, for various reasons and in many ways. It is not just the higher prices of renewable/recycled feedstock or less harmful chemical components compared to virgin fossil feedstock. It also concerns costs linked to the certification process. The costs of labour in production countries are increasing too.

We work with several large chemical industries but compared to some of the other outfitters in the outdoor sports industry are a relatively small player. Our power to convince our suppliers to adjust their chemical product portfolio is limited. Our modest scale limits the accessibility and availability of new biomaterials such as bioplastics and biocomposites to us and drives up their costs.

Currently there are few economic incentives supporting a (further) switch to bio-based. We hope that fiscal measures that are to be implemented under the European Green Deal, like the carbon tax on fossil resources, will lead to a monetary award for our sustainable practices.

Only few people question the (un-)sustainability of using fossil-based materials. And since the onset of the Covid-19 pandemic prices for fossil oil dropped dramatically. Making it difficult for us making large progress towards achieving our 2024 ambition right now."

Lessons learned and take home messages

VAUDE is a fully family-owned company that has sustainability as part of its DNA and long-term, future-oriented ecological, social and economic goals.

Have set themselves an explicit goal o*f increasing the share of renewable raw materials used.*

Its collection of 19 core products, *for the development of which* nature served as model, taskmaster, and source of inspiration, *ensures a sense of well-being and comfort for a diversity of outdoor activities.*

Already succeeded using bio-based, recycled or purely natural materials for about 90% of the diverse textile materials used in the collection of 19 core products, with the ambition to achieve *a renewable (bio-based) or recycled material content of >50% for almost all (at least 90%) VAUDE products in 2024.*

Bio-based materials are a way to reduce the company's collective impact while also improving technical attributes to drive very high performing materials.

Bio-based materials are also a chance to create a ripple effect throughout other industries.

[15] The term GreenPremium prices is defined by nova-Institute as: "*The additional price a market actor is willing to pay for the additional emotional performance and/or the strategic performance of the intermediate or end product the buyer expects to get when choosing the bio-based alternative compared to the price of the conventional counterpart with the same technical performance."* See e.g. See Carus, M., Eder, A., Beckmann, J. 2014a: nova paper #3: "GreenPremium prices along the value chain of bio- based products". Hürth 2014. http://bio-based.eu/nova-papers/#GreenPremium

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Increasing cost prices, modest company size, lack of monetary reward for sustainable performance and lack of incentives are important barriers to keep up momentum in the ongoing transition from fossil to bio-based.

Further resources (used for the quotes presented in the text boxes)

Textbox 1 and 3: H2020 project EFFECTIVE, spring 2020 newsletter, https://www.effective-project.eu/f/docs/DOWNLOAD/EFFECTIVE---Spring-Newsletter---A-biobased-economy-for-the-post-virus-world.pdf

Textbox 2: http://www.mountainblog.eu/vaude-green-shape-core-collection-receives-if-design-award-in-gold-sustainable-design-award-winning

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BIOSWITCH

Encouraging Brand Owners to Switch-to-Bio-Based in highly innovative ecosystems

1

CASE STUDY 2: **ALHÓNDIGA LA UNIÓN, S.A.**

Marta Macías Aragonés

Corporación Tecnológica de Andalucía (CTA)

Abstract

This project has received funding from the Bio Based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 887727.

Company background

La Unión started as a family business dedicated to the exportation of vegetables and has grown over the years, becoming a model of commercialisation of fruit and vegetables. La Unión is proud to be the first company worldwide in cucumber commercialization.

The success of La Unión model is due to its close relationship with their clients. Distribution chains, supermarkets and markets transmit the ethos of La Unión to the consumer, bringing their products into the homes of the final consumer. All this is without forgetting the marketing, advertising, and online communication, all of these allowing a more direct relationship with families and consumers.

Currently, La Unión leads the commercialization of fruit and vegetable products in Europe, with sales of more than 400,000 metric tonnes of produce. Above 70% of this produce is directed at European markets. Moreover, the company now has 25 operations centres, distributed between Almería and Granada (southern Spain), 1000 employees on average and 3 laboratories which carry out more than 45,000 analyses annually. Some additional figures can be found next.

Figure 1. La Unión business main figures.

La Unión, an export organisation by vocation

Its vocation as exporters has converted La Unión into the main provider of fruit and vegetables in Europe, being present all over the continent. As a mission, they are a leading company which works collaboratively with employees, suppliers, and customers in a responsible way in order to guarantee a high profitability to their related farmers. At the same time, the company offers a product which meets the highest quality and food security standards. Their main aim is to lead the global fruit and vegetable market, offering innovative products and solutions which will inspire and provide a real added value to customers.

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Food safety and product quality as cornerstone

One of the fundamental pillars in La Unión is food safety, which is backed by R&D investment in their three laboratories. The Chemical and Microbiological Analysis laboratory at La Unión was created in 2000, the Agronomic Analysis Laboratory in 2008 and the Agronomic Analysis Laboratory in 2009. Together they employ more than 40 food quality staff that help safeguard the health of consumers across the whole of Europe and the human rights of La Unión's suppliers (farmers) and employees.

The different accreditations and certifications that La Unión has can be divided into three sections: Accreditation for laboratory, certification for agricultural holdings and certification for manufacturing warehouses.

Fig. x. Accreditations and certifications obtained by La Unión.

Environmental commitment as a pillar of their Corporate Social Responsibility (CSR) programme

La Unión is committed to a sustainable environment, where the impact they generate is minimal. One of the key pillars of the company's CSR programme revolves around respect for the environment and the fight for a clean and waste-free world. CSR actions implemented in recent years include: the installation of a 500-panel, 100-kW solar photovoltaic (PV) power system in 2015, supplying 10% of the company energy needs at their facilities at Polygon La Redonda; the collaboration with the Andalusian Centre for the Evaluation and Monitoring of Global Change (CAESCG), acting as official sponsors of the book "Sierra de Gádor, natural heritage and green infrastructure in Almeria"; and the adoption of Integrated Production as a sustainable production system that guarantees environmental protection, quality and job security for farmers and livestock breeders.

Fresh products with high quality standards

La Unión fruits and vegetables are cultivated throughout the year with the highest standards of quality and food safety by expert farmers and qualified technicians.

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Also, in order to reach other consumer segments, La Unión has developed *Shybari*, a premium brand of fruits and vegetables of high quality (e.g. sweet chocolate pepper, California pepper, lamuyo pepper, Palermo pepper diamond tomato, mini watermelon, medlar and custard apple among others). This brand motto is "Desires from the Mediterranean" and main aim is to go further and provide an excellence pursuing lifestyle. In this sense, *Shybari* follows the philosophy and actions of La Unión, focused on promoting sport practices linked to a healthy lifestyle through a healthy and balanced diet. One of the main actions carried out by La Unión to promote *Shybari* and a healthy lifestyle has been to sponsor the Mutua Madrid Open 2018 tennis tournament. There, *Shybari*'s premium fruits and vegetables were exhibited and savoured among all attendees, since the company had exhibition areas and show cooking in the tournament's VIP restaurant.

Moving forward in bio packaging development

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Sustainability is of paramount importance for La Unión, and accordingly, it is one of the main areas covered by the company RDI department. La Unión management team is fully devoted to support and promote a La Unión RDI strategy, backed by its own RDI department. This way, attention is paid to trending technologies and processes, including the use of bio-based packaging. This market trend is supported by consumer choices and preferences, since there is an increasing demand for all products related to "bio", "eco-friendly" and "recycled" concepts.

What steps has the company already undertaken in its innovation journey to switch to bio-based, and where does it currently stand? To help make the transition from a linear to a circular economy, La Union decided to explore the valorisation of its own horticultural waste streams, to produce various bio-based materials and ingredients, including materials for bio-based packaging.

Starting in 2015, first step was the implementation of BIOVEGE, a Spanish collaborative research project led by La Unión that aimed to develop new technologies and/or adapt existing ones in order to use efficiently, both in economic and environmental terms, horticultural waste generated during handling, transportation, and sale. This approach was the basis for the development of:

- Bio additives for packaging production coming from plant residues (fruits such as melon and watermelon and vegetables such as cucumber, pepper, and zucchini).
- New films and biodegradable oriented mesh for the packaging of fruit and vegetable products created using biopolymers coming from fruits and vegetable residues.
- Natural preservatives for a wide spectrum of foods and on their incorporation in novel preservation solutions as an edible coating.
- Extraction of bioactive ingredients from fruit and vegetable residues for the improvement of human health and the use of emulsions to incorporate mixtures of bioactive. The production of such highly-priced biomaterials and food ingredients from food waste co-products allowed adding value to these by-products.

The main conversion steps and applications investigated within the BIOVEGE project are illustrated in Figure XX.

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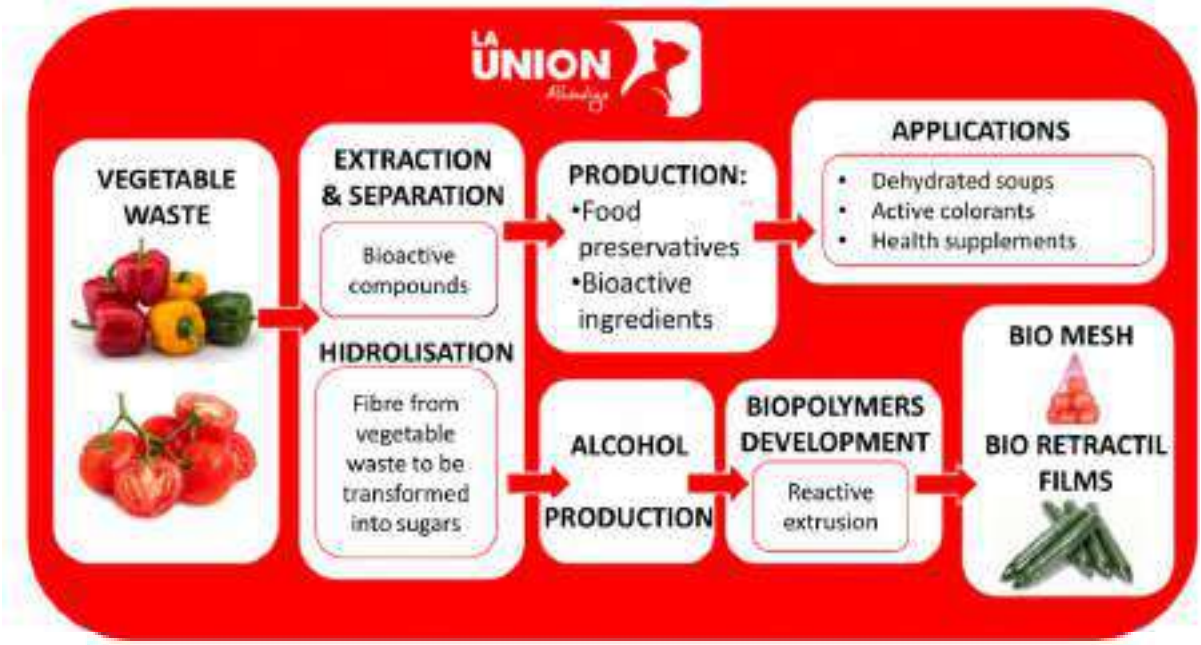

The food-waste derived, certified industrial-compostable biopackaging solutions for mesh, second skin and flow-pack generated in the BIOVEGE project offer great sustainable alternatives for traditonal plastic packaging, and have received international recognition. At the 2018 International Conference on Bio-Based Materials, the jury of the Bio-based Material 2018 competition awarded the third place to the innovative biodegradable net suitable for green beans packaging developed in the BIOVEGE project by Aimplas. The packaging material is more than 80% bio-based, more sustainable than conventional polyethylene (PE) nets, but has similar linear weight and mechanical properties. The material is made combining different biodegradable materials and additives and using a compound that was developed through reactive extrusion. Chemical modification was made by grafting low molecular weight units, such as oleic alcohol, obtained by the fermentation of sugars extracted from vegetable waste (watermelon).

The BIOVEGE project's innovations culminated in the launch of a new 'plastic-free living' brand, called wecarepack. The wecarepack brand was launched at the 2019 IFEMA Fruit Attraction fair, where it received the Accelera award for Best Innovation and Entrepreneurship Project of the year 2019 in the industry category.Jesús M. Barranco, CEO of La Unión, was proud to explain that "*the launch of our product comes after four years of research and hard work by the entire team that makes up La Unión*". Mr. Barranco explained that "*this product disappears in six months after depositing it in the organic matter bin.*" Fernando Batlles, Head of Communication at La Unión, added that "*this product will mark a before and after in the agri-food industry and we intend that in the future all supermarkets will have a WeCarePack area*".

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Further developments of bio-based packaging solutions are being carried out through the VEGE-PACK project. The main objective of VEGE-PACK is to develop compostable packaging based on films and nets with antimicrobial, antifungal and/or antigerminative properties, by including in the biopolymer matrix the functional additives obtained from the fractions of interest from by-products of the pepper, custard apple and/or avocado with the intention of obtaining:

- A flexible film for the "flow pack" packaging of fruit and vegetable products.
- Nets for the packaging of fruit and vegetable products.

These packages, in addition to complying with Directive 94/62/EC on packaging and packaging waste and its modifications in Directive (EU) 2015/720 allow to maintain and/or extend the useful life of packaged products due to their functionalization with the products described.

Pursuing sustainability: circular economy as cornerstone and strong R&D investment following a holistic approach

Beyond the BIOVEGE and VEGE-PACK biowaste valorisation projects, La Unión works in a number of other RDI projects related to circular economy, including knowledge-transfer initiatives e.g. to promote circularity among farmers by using better crops management strategies.

In the MORE-THAN-CLEAN project, the use of clean technologies and automated sanitization processes for fruits and vegetable production has been investigated. In the AGROHEALTH project, La Unión aims to develop natural biofertilizers that stimulate the synthesis of chemo preventive compounds in tomato and avocado fruits and the development of two food products from fruits rich in compounds with chemo preventive properties. Further R&D projects are devoted to remote control, simulation, and decision systems for agronomic management in pepper and cucumber crops greenhouses.

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Challenges shifting to bio-based

Main challenges faced in the journey to switch to bio-based products include

- Market entry for bioplastics is no sinecure as they compete with traditional plastics. Hence, a lot of attention has to be paid to business and marketing aspects.
- It is important to dulyconsider the acceptance criteria of industrial composting plants. Not all plants are prepared to (or capable of) processing bio-based plastics.
- Although consumers demand sustainably-produced products, there is still a long road ahead due to poor consumer acceptance of bioplastics that are not 100% translucent.

Lessons learned and take home messages

Main lessons learned from this bio-based products transition journey are:

- Engage with good partners that are key players in the sector so a nice cooperation environment can be created and excellent knowledge transfer can take place.
- For full production at commercial scale of the bioplastics, it is important to work together with plastic producers, building a strong supply chain.
- The bio-based transition journey can act as trigger at internal level. It supports company staff in opening their minds to developing new products and working methods.

Although not formally mandated yet, both European Commission and Member States are stimulating economic actors to adopt circular economy practices.. Hence, by gaining experience in the bio-based transition journey, companies can be more aligned with what would be expected from them in the upcoming years. In addition, this approach also helps companies being aligned with consumer demands with regard to about green, eco-friendly, bio, recycled products.

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BIOSWITCH

Encouraging Brand Owners to Switch-to-Bio-Based in highly innovative ecosystems

CASE STUDY X: **STORA ENSO**

Anna Tenhunen, Teija Laitinen
CLIC Innovation

Abstract

Stora Enso is a renewable materials company that offers variety of wood- and biomass-based solutions for different sectors from food and beverages to textiles and building. Stora Enso operates in over 30 countries with strong ties to Finland and Sweden. Stora Enso owns and manages millions of hectares of lands and is dedicated to sustainable sourcing e.g. through forest certification schemes. Recently, Stora Enso launched its first single-use food bowls made of renewable molded wood fiber as an alternative to fossil-based plastics. It was important for Stora Enso to be able to meet the typical challenge that fossil-based plastics imposes on biobased solutions – unique and high-performance properties. Stora Enso produced a safe and high-performing plastic-free and PFAS-free solution. Stora Enso estimates the CO_2 footprint of their fiber-based solutions to be even 75% lower compared to alternative packaging materials, such as plastic or bagasse.

This project has received funding from the Bio Based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 887727.

Company background

Stora Enso is a renewable materials company that develops and produces variety of solutions that are based on wood and biomass. The main solutions of Stora Enso are for the food and beverages, retail, building, manufacturing, publishing, pharmaceuticals, cosmetics, confectionary, hygiene and textiles. Their vision is that there is a potential to make anything that's made from fossil-based materials from a tree, and that they drive for a sustainable future with bioeconomy. Stora Enso is listed in Helsinki (Finland) and Stockholm (Sweden) stocks and employ some 26 000 people in more than 30 countries. Stora Enso owns or manages over 2,35 million hectares of lands and 98 % of those forests were covered by the forest certification schemes.

Takeaway food companies to switch from plastic containers to bio-based

Stora Enso launched its first single-use food bowls made of renewable molded wood fiber. The goal is to help takeaway food companies safely switch from fossil-based plastics to bio-based materials.

Eco-friendly customers and tightening legislation drive takeaway food companies to consider alternatives to plastic food containers. EU is banning single-use plastic products starting from the most typical marine litter, such as straws and cutlery, in 2021. Member states will also have to find ways to reduce the use of plastic food containers and drinks cups. Various countries all over the world are planning to impose taxes on single-use plastics.

"The vast majority of takeaway packaging are still made of plastics, but some food companies already say they want to give up all plastics, and others want to reduce the use of plastics. Either way, sustainable packaging will be essential for their future businesses," says **Annica Rasch**, Sales and Marketing Director of Formed Fiber products at Stora Enso.

Stora Enso is a major provider of renewable fiber-based packaging materials, wooden constructions, paper and pulp. It has some 26 000 employees in over 30 countries and its sales in 2018 were EUR 10.5 billion. Stora Enso undoubtedly has a wide range of solutions to offer to the takeaway packaging market. Rasch, however, points out that displacing all plastics in the takeaway sector requires, besides new capacity, also new types of fiber products. She readily admits that the unique properties of plastics are hard to compete with but the company is up for the challenge.

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Challenge #1: Barrier properties

Wood fiber makes a sturdy food bowl, tray or cup, but it tends to absorb water and grease coming from the food. The conventional solution is to spread a thin barrier coating on the paperboard and use it to seal the seams after forming the dish.

Typical barrier coatings are fossil-based plastics, such as PE (polyethylene) or PET (polyethylene terephthalate), both of which function very well as barriers and can be separated from fiber in modern recycling processes, but they will not break down in the natural environment. This applies to the non-fossil alternative, plant-based PE, as well. Another plant-based barrier plastic, PLA (polylactic acid), decomposes in specific composting conditions, but not in the natural environment.

Both fossil and bio-based plastic barriers are increasingly applied as water-based dispersions, which break down in cardboard recycling processes and thus facilitate the recovery of fiber.

Another way to provide fiber packages with barrier properties, is to mix waxy particles into the pulp. Per- and polyfluoroalkyl substances, PFAS, are widely used in this way. They are, however, highly persistent in the environment and in the human body, and some of them have been found harmful to health. Restrictions on PFAS have recently been introduced in various countries, and Denmark was the first to ban them in paper and board.

"When we started to develop our new product line, we wanted to go plastic-free and PFAS-free, and in year 2019 we started collaboration with HS Manufacturing Group to adopt their patented barrier technology, Protean™, for formed fiber applications," Rasch says.

Challenge #2: Design and production

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Besides barrier solutions, Stora Enso wanted to create new shapes and styles and increase efficiency of the packaging production, thus accepting another challenge for fiber-based packaging set by plastics. It is obvious that injection molding of plastics cannot be beaten by folding paperboard, whereas molding of pulp offers a whole different approach.

The method of molding, or forming, pulp is probably best known from egg cartons, many of which can be quite rough on the surface. Modern molding methods, however, allow smooth surfaces and attractive shapes.

Stora Enso is using a molding method called thermoforming to produce high-quality box inserts for the electronics packaging market. This is the method they also acquired for takeway food packaging.

"Thermoforming method is readily available on the market and it suits the takeaway sector. Other methods are coming on board later. We want to experiment with various production methods and components to create new properties and increase production efficiency," Rasch says.

In year 2019 Stora Enso announced its EUR 5 million investment to build a new production line and related infrastructure to manufacture formed fiber products at Hylte Mill in Sweden.

Formed fiber bowls were launched

Stora Enso launched its first formed fiber bowls under the brand name PureFiber™ in September 2020. They were not the first to introduce formed fiber products to the takeaway packaging market, but Rasch believes they were the first, or among the first, to do it without plastics and PFAS.

"We combined formed fiber with Protean™ technology, which is plant-based and offers excellent water, grease and oil resistance."

According to Rasch, PureFiber™ products have already proven recyclable and biodegradable. This means that clean products can be recycled with cardboard. As to biodegradability, the key questions are, how long it will take for the material to decompose and will it require an industrial composting facility.

"We have compostability trials going on, and first results are coming out in the first quarter of next year."

Stora Enso estimates the CO_2 footprint of PureFiber™ products to be 75% lower compared to alternative packaging materials, such as plastic or bagasse.

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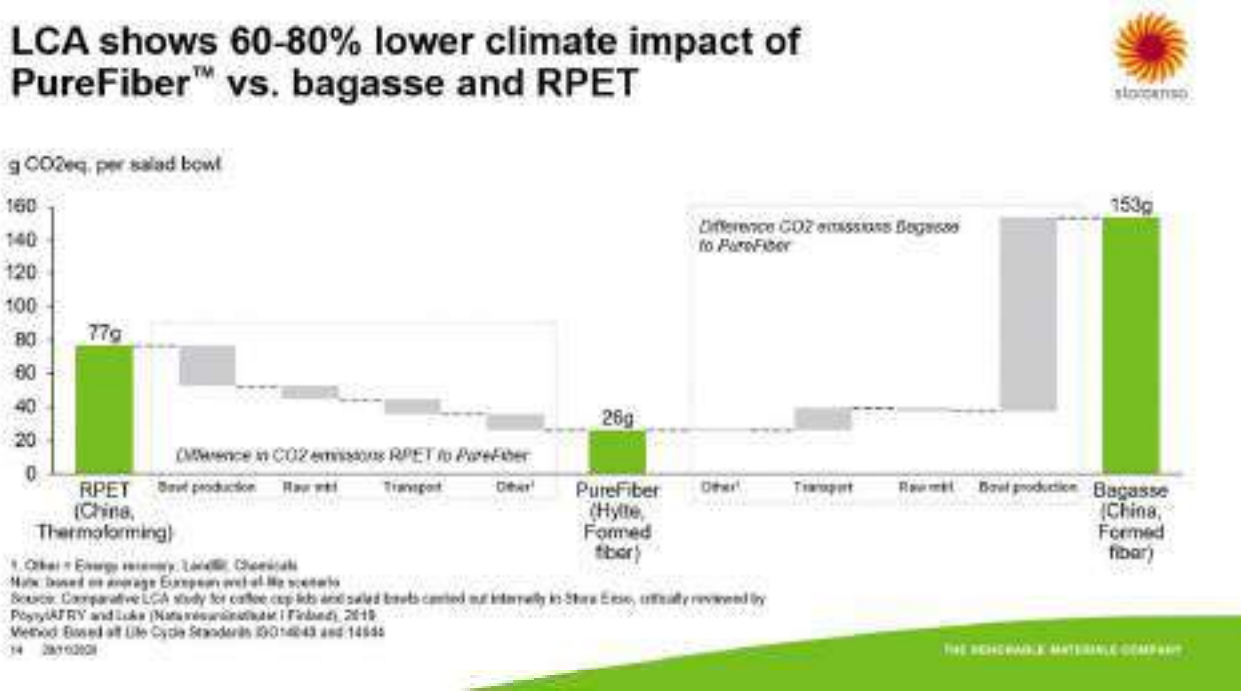

The whole supply chain was needed

Rasch considers the development of new barrier and fiber technologies an essential task when offering alternatives to plastic containers and trays which have been on the market for a long time. To succeed in it, the whole supply chain is needed, she says.

"We need to understand both our customers and consumers. We need to find out how products should be packed, distributed and communicated. We also need to collaborate with the suppliers of barrier and fiber forming technology."

Besides listening to customers and consumers, Stora Enso took a step closer to consumers in the supply chain. While barrier-coated paperboard goes to packaging producers, formed fiber products go to packaging distributors or even directly to large brand owners using packages.

"We are also working on another business model, in which we provide packaging producers with pulp, barrier, recipe and technology. In this way they could benefit from our knowledge of fiber and diverse technologies, and still produce their own packages."

More capacity and innovation in the future

Stora Enso is investing in more formed fiber capacity in Sweden and China. What type of fiber products will eventually capture the market, is not a pressing question to Rasch.

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"I believe there is room for everyone in the market. The main competition is between fiber and plastics."

There is also room for innovation in the formed fiber products.

"We now have our first bowls, but we want to develop our materials and production methods further, together with the supply chain. This is ongoing work."

It is already clear that the PureFiber™ selection can be easily complemented by cups and trays, but Rasch is also looking past the takeaway sector, to the fruit and vegetable sector which typically uses plastics in packaging. Another attractive target could be foods with long shelf-life.

"Longer shelf-life would require oxygen barriers which are more challenging than moisture and grease barriers. Formed fiber products are presently used only with plastic coatings. This is a challenge we want to address."

The only challenge that may seem unattainable for fiber products is to beat the low price of plastics. Rasch points out that raw material prices are actually in favor of fiber, but plastic products still benefit from the efficiency of thermoforming processes that have been refined over decades.

"It's just a matter of time before formed fiber products have the same cost of production as plastics. Until then, we make sure that our prices are competitive with other sustainable products."

**

Tingstad – distributor to lead the change

"*We see a trend that an increasing amount of our customers not only value packaging functionality, but also aspects such as circularity and sustainability. We strive to make sustainability accessible to our customers. For instance, we have released a digital feature letting customers, as we call it, "sustainify" their shopping cart on our e-commerce site. In other words, a tool transforming the content of the customer's order into more sustainable products. We strongly believe that PureFiberTM will play an important role in the transition from plastic to non-plastic food packaging. We are excited about bringing a truly sustainable solution to the market together with Stora Enso."*
- **Emma Diedrich** from Tingstad

Tingstad is a family-owned company and the market-leading distributor of disposables and food service products to the HORECA sector in the Nordic countries. The company has been around for 60 years and has a turnover of EUR 250 million. Tingstad launched the first PureFiberTM food bowls in October 2020.

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