

D4.3 – REPORT ON REGIONAL REPLICATION AND ROLL-OUT

Lead Contractor: CTA

Authors: Marta Macias, Carmen Ronchel, Emily Marsh, Thorkild Frandsen, Anna Tenhunen-Lunkka, Emma Sidgwick.



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BIOSWITCH

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Contact persons	Anna Tenhunen-Lunkka anna.tenhunen-lunkka@clcinnovation.fi		
Website	www.bioswitch.eu		

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Deliverable responsible	Fundación Corporación Tecnológica de Andalucía (CTA)	Contact person	Marta Macías Aragonés, marta.macias@corporaciontecnologica.com

Deliverable Contributors				
	Name	Organisation	Role / Title	E-mail
Deliverable leader	Marta Macías	CTA	Innovation consultant	Marta.macias@corporaciontecnologica.com
Contributing Author(s)	Carmen Ronchel	CTA	Biotech area manager	Carmen.ronchel@corporaciontecnologica.com
	Thorkild Frandsen	FBCD	Bioresource team leader	tqf@foodbiocluster.dk
	Anna Tenhunen-Lunkka	CLIC	Project coordinator	anna.tenhunen-lunkka@clcinnovation.fi
	Emily Marsh	MTU	Bioeconomy Project Manager	emily.marsh@mtu.ie
	Emma Sidgwick	FF	Innovation manager	emma.sidgwick@flandersfood.com
Reviewer(s)	Anna Tenhunen-Lunkka	CLIC	Project Coordinator	anna.tenhunen-lunkka@clcinnovation.fi
	Kaisa Vehmas	VTT	WP leader	kaisa.vehmas@vtt.fi
	Anna Tenhunen-Lunkka	CLIC	Project Coordinator	anna.tenhunen-lunkka@clcinnovation.fi



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Final review and quality approval	Heli Kangas	VTT	Technical Manager	Heli.kangas@vtt.fi
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BIOSWITCH

ACRONYMS AND ABBREVIATIONS

ACRONYM	FULL NAME
ACBS	Andalusian Circular Bioeconomy Strategy
BO	Brand owner
FEVIA	Belgian Federation of the Food Industry
CBE	Circular Bioeconomy Europe Joint Undertaking
CLIC	CLIC Innovation Oy, partner in BIOSWITCH
Cluster partners	BIOSWITCH cluster partners are CLIC, CTA, FF and FBCD
CTA	Corporación Tecnológica de Andalucía, partner in BIOSWITCH
DIH	Digital Innovation Hub
DoA	Description of the Action
EU	European Union
FAO	Food and Agricultural Organization
FBCD	Food & Bio Cluster Denmark, partner in BIOSWITCH. FBCD was previously known as partner ABP.
FF	Flanders' FOOD, partner in BIOSWITCH
GA	Grant Agreement
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GHG	Greenhouse gas
GVA	Gross Value Added
IGW BE	Flemish Interdepartmental Working Group for the Bioeconomy
LCA	Life Cycle Analysis
MTU	Munster Technological University, partner in BIOSWITCH. Previously known as partner ITT.
R&D	Research and development
S ₃	Smart Specialisation Strategy
TRL	Technology Readiness Level
WWTP	Wastewater Treatment Plant

SUMMARY

This deliverable presents main results from Task 4.3 (Regional replication and roll-out of the BIOSWITCH project outputs) and is related to the following objectives from WP4:

- To evaluate the replication potential among BIOSWITCH cluster partners brand owners
- To organise regional knowledge transfer workshops to: 1) capitalise the experience gained through the four cases studies implemented during toolbox validation and to use it as example and motivation for other brand owners; 2) spread the word about BIOSWITCH toolbox features; 3) have B2B meetings with brand owners to provide a preliminary guidance for their bio-based transition

Specifically, five regional workshops have been organised by the four cluster partners CTA, FF, CLIC, and FBCD as well as MTU. The workshops were designed to efficiently increase the commitment and involvement in the bioeconomy by dividing the workshop in three specific sections. First section devoted to present the case studies so their results can be capitalised and also serve as motivation to other brand owners. BIOSWITCH Major brand owners were invited to present themselves, their experience and feelings during the toolbox validation process. Second section was devoted to BIOSWITCH toolbox, which will be introduced at regional level in local language, ensuring that the message is properly delivered to regional audience. Finally, during the third section, B2BB2B meetings could be organised between BIOSWITCH corresponding cluster and the brand owners that may ask for it so as to provide them some preliminary guidelines on how to carry out the bio-based transition.

Moreover, a replication assessment has been conducted by FBCD, CTA, CLIC, and FF in order to evaluate the brand owner profiles available in each region and analyse which tools from the developed Toolbox could be used by them. Also, benefits for the rest of stakeholders from the quadruple helix have been identified.

1 INTRODUCTION

1.1 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 BOs to switching to bio-based approaches by following a holistic, systemic approach built on two pillars:

- A framework where BOs 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.

1.2 Objective of Work Package 4

The specific objectives of WP4 (**European roll-out and replication**) are:

- To maximise the impact of project outputs by rolling out the BIOSWITCH toolbox at EU level
- To evaluate the replication potential among BIOSWITCH cluster partners brand owners
- To organise regional knowledge transfer workshops to: 1) capitalise the experience gained through the four cases studies implemented during toolbox validation and to use it as example and motivation for other brand owners; 2) spread the word about BIOSWITCH toolbox features; 3) have B2B meetings with brand owners to provide a preliminary guidance for their bio-based transition
- To produce a guide for the brand owners on how to use the BIOSWITCH toolbox available at project website
- To create a training programme targeting cluster managers, innovation agents and public administration, composed by a roadmap for train-the-trainers on how to support brand owners when switching to bio-based (converted to e-learning materials) and a train-the-trainer event organised at a central location

1.3 Objectives of Task 4.3

Task 4.3 (Regional replication and roll-out of the BIOSWITCH project outputs) relates to the second and third bullet points of the previously presented objectives and aims boosting and maximising project impact at EU level.

Specifically, a regional replication plan will be conducted using a twofold approach. Firstly, five regional workshops are to be organised by the four clusters and MTU, having an agenda with three sections. First section devoted to present the case studies so their results can be capitalised and also serve as motivation to other brand owners. BIOSWITCH Major brand owners are invited to present themselves their experience and feelings during the toolbox validation process. Second section is devoted to BIOSWITCH toolbox, which will be introduced at regional level in local language, ensuring that the message is properly delivered to regional audience. Finally, during the third section, B2B meeting could be maintained between BIOSWITCH corresponding cluster and the brand owners that



may ask for it so as to provide them some preliminary guidelines on how to carry out the bio-based transition.

Secondly, a replication assessment within the consortium is conducted by FBCD, CTA, CLIC, and FF in order to encourage the replication of business cases and schemes demonstrated by the case studies across other key brand owners in their region.

2 REGIONAL EVENTS SHAPING

This section presents the main aspects and outcomes that were agreed by the working group of WP4 in the BIOSWITCH project and that were considered for each event. The following conclusions were drafted:

- To be flexible in the format of the event according to the context and situation of each host and the corresponding region.
- Cluster partners need to involve Major BOs so they can present their experience from participating in the project. As for MTU, they could invite relevant speakers.
- It was agreed that the regional events should be before the end of March 2022.
- Each cluster is responsible of formatting the agenda, involving the Major BO and taking care of the registration process and satisfaction survey feedback gathering.
- Regarding communication of the event, each partner should take the lead on this. BIOSWITCH social media would support event dissemination when possible.
- When possible, networking among attendees would be organised (this would depend on the event being done face-to-face or online).

2.1 Official event title

The name of each of the events was up to the partners to decide, but it was agreed that the words « BIOSWITCH regional event » appears. A unified name ensured that the events could be disseminated properly and also attract a wider audience.

2.2 Objective

The main aim of the regional events was to spread the word about project outputs in order to maximise project impact. The idea was to involve all kind of stakeholders so as to create awareness, do some capacity building about the transition from fossil sources to bio-based approaches and to strength regional bioeconomy networks. Hence, the following objectives can be identified:

1. To maximise project impact
2. To boost regional bioeconomy by delivering the project outputs to regional stakeholders
3. To leverage on Major brand Owners project experience, using this as inspiration for other regional brand owners and private companies
4. To provide support, through bilateral meetings, to those organisations that might need some help with their BIOSWITCH transition journey

The aim was to have an open event where discussion around how to promote and support the BIOSWITCH transition are triggered as well.

2.3 Agenda

An example of a tentative agenda is provided below. The agenda was adapted to each region and cluster partner needs and also to the event format (face-to-face or online).

- Coffee or cocktail networking // Attendees connection
- Welcome and project introduction
- (Optional) WP1 results presentation
- BIOSWITCH Toolbox introduction
- (Optional) Specific BIOSWITCH tool presentation
- Major brand Owner/relevant Brand Owner experience presentation
- Dynamic/interactive session for discussion and debate
- Wrap-up
- Bilateral meetings between the host (MTU or cluster partner) and attendees that might request it in order to receive support and (upon request when registering for attendance).

2.4 Supporting the bioswitch transition from regional organisations: bilateral meetings

In order to support regional stakeholders, the hosts offered the possibility of having B2B meetings between them and attendees that might request it. These bilateral meetings were requested by the attendees when registering at the event. In order to promote fruitful meetings, information about their needs could be asked at the registration time.

During the meeting, the attendee presented their questions, challenges or needs to the host. Time for bilateral meetings was ca. 15-30 min each. The host provided information and answers during the meeting and/or sent further information by email at a later stage.

2.5 Date, host, registration and venue

Date: The regional events needed to be organised before 31st March 2022.

Host: the five events (one per cluster partner and MTU) were done in local language or in English, depending on the regional needs and possibilities with the participation of host and the linked BIOSWITCH Major BO and/or any other relevant BO as speakers. CTA coordinated the homogeneity in the organisation, agenda and events general procedures. Hosting partners were in charge of the actual organisation of each event. From the Major BO side, it was expected that someone presents their bioeconomy and bioswitch journey as well as their BIOSWITCH project participation experience.

Registration: Done by each host using their usual platforms and procedures. All data were managed according to the FAIR principles and good data management practices as well as BIOSWITCH ethical guidelines for personal data and recruiting volunteers, which are GDPR compliant. It is recommended to ask the attendees for the following information:

- Name
- e-mail
- Company
- Position
- Do you want to have a bilateral meeting with [host] representatives? Yes/No

If done face-to-face, it is always advisable to ask the attendee if he/she will participate in the coffee or cocktail networking and if there are any allergies to consider.

Venue: Due to COVID-19 restrictions, it was up to each host to decide if the event would be done face-to-face or online. If done face-to-face, the event could be done at the host partner premises, at the Major BO premises or at external premises such as a meeting room from a hotel or similar. It is important to consider here the rooms needed for the bilateral meetings in order to ensure that confidentiality can be maintained.

2.6 Required equipment, material, logistics

In case the event is done online, each host partner could decide the most suitable platform for such purpose. After the event, the presentations used and BIOSWITCH brochures etc. were sent to attendees by email prior approval of the Major BO and/or invited speakers, together with a satisfaction survey.

In case the event was done face-to-face, coffee or cocktail catering, name tags, project communication material (BIOSWITCH roll-up and brochures) and participant package were provided. As for the participant package, this included a copy of all the presentations used during the event by the host partner and the Major BO/invited speakers prior approval and corporate communication materials from the Major BO/invited speaker and/or the host partner as desired. The satisfaction survey was shared among participants at the end of the event as hard copy and sent by email to those that have not answered.

2.7 Dynamic/interactive session for discussion and debate

In order to make the most out of the opportunity of having regional stakeholders together and to retrieve information that might be useful for the replication assessment exercise, the aim of this agenda slot was to trigger some discussions/debate among event attendees. This could be done face-to-face of using Miro, Mentimeter or a similar platform if the event is done online.

CTA prepared a set of questions that could be used by the host partners when preparing this session, to be selected according to each regional context and needs.

About the Toolbox

- Do you think that the toolbox would be useful for you?
- Which tool do you miss in the Toolbox?
- Are you curious about the Bio-based Readiness Level self-assessment test? Would you use it?
- Are you planning to use the Toolbox? Which tool?

About the bio-based transition

- Which is your biggest barrier to switch to bio-based approaches and products?
- Which kind of support would you like to receive during your bio-transition?
- Which kind of organisation you think that would be more interesting for joint cooperation so as to boost our bio-transition?

About consumers

- What would help improving the opinion of consumers about bio-based products?
- Would that facilitate market access for these products/services?

About regional needs and context

- What steps can be taken to improve knowledge, awareness and uptake of bio-based products among downstream value chain actors (brands, consumers, retailers, etc.) in the bioeconomy?
- What steps could be taken to improve brand uptake of bio-based products in the region?
- What steps could be taken to improve consumer uptake of bio-based products in the region?
- What steps could be taken to improve public awareness and acceptance of the bioeconomy in the region

2.8 Attendees invitation

The events were open events and therefore all types of stakeholders are welcome.

It is recommended to leverage on speaker organisations that could support the host in the event dissemination efforts. In case it might be needed, an email can be sent to specific attendees in the host network. An example of the email that can be sent is provided below so partners can adapt it to the local language, etc.

Dear Mr./Ms.:

[name of host] is participating in the BIOSWITCH project (<https://bioswitch.eu/>), funded by the European Commission through the Bio-Based Industries Joint Undertaking. This project aims to support brand owners in adopting bio-based approaches. Within this scope, it has built a framework that encourages them to take the lead through a set of events and other communication actions. The project has also created the BIOSWITCH toolbox, whose purpose is to help brand owners adopt a bio-based transition.

In the frame of this project and given your expertise in the field, we invite you to participate in the [Final name of the event], where you can hear in detail about the project results and the experience from [Major

BOJ's bio-based transition activity. Also, if you have any need, project idea or want to explore how to start/boost your bio-based transition journey, you could ask for a bilateral meeting with us in order to delve into these issues.

This event will take place **face-to-face/online on xxxx from xxh to xxh**.

The planned programme is as follows: [it can be inserted here as text or the link to the online agenda can be provided]

Please feel free to register here [registration link]

Thank you for your attention. We hope this initiative will be of interest to you.

Kind regards

2.9 Mail to be sent after the event and satisfaction survey

Once the event finished, an email needed to be sent to attendees including all the materials used during the event and the satisfaction survey. Aim of the survey is to assess the success of the action and to learn about attendees' expectations, potential overlooks that might have occurred or tentative improvements that can be considered in further events.

An example of the satisfaction survey can be found in Annex I. This can be done online (link sent by email to attendees, implemented in Ms Forms, GForms or any other platform) or by providing the hard copies as part of the participant package. It is recommended that, for face-to-face events, the satisfaction survey is sent by e-mail to attendees that did not complete it on hard copy. CTA has implemented the satisfaction survey in MsForms. It's in template mode so it can be customised (local language, etc) by each hosting partner.

An example of the email to be sent is provided below:

Dear BIOSWITCH regional event attendee

Thank you so much for join us during the BIOSWITCH regional event. Enclosed/Here[hyperlink] you can find the materials used during the event. Also, please feel free to check the project website in order to get direct access to the BIOSWITCH Toolbox and all project results <https://bioswitch.eu/>.

It would be nice if you could answer the following satisfaction survey and provide your feedback about the event. It would not take you more than five minutes! This information is very important for us in order to improve upcoming activities and to offer you the most relevant event contents and formats.

Should you need anything related to your BIOSWITCH journey, please feel free to contact us.

Best regards,

3 REGIONAL EVENTS ORGANISATION

Results and outcomes of the regional events organised following the previous guidelines are provided next.

3.1 CLIC Innovation regional event

3.1.1 Official event title

CLIC's regional event was held part of CLIC Bioeconomy Thematic Group meeting, which is a multidisciplinary group of stakeholders from Finland. Stakeholders represent industry from chemistry, forestry, agriculture, packaging, plastics, equipment manufacturers, as well as academia, research organisations and universities.

The event was titled CLIC Bioeconomy Thematic Group Meeting Q1/2022, and part of the meeting was a section on BIOSWITCH Toolbox. The meeting was a closed event for the attendees of the Bioeconomy Thematic Group.

3.1.2 Regional customisation

The event was held in English.

3.1.3 Agenda

Agenda of the BIOSWITCH results session was the following:

- Introduction to BIOSWITCH and the BIOSWITCH toolbox, Anna Tenhunen-Lunkka, project coordinator, CLIC
- BIOSWITCH LCA IT-tool, Tiina Vainio-Kaila, research scientist and LCA expert, VTT
- Paptic case study developed in BIOSWITCH in collaboration with Fazer, Hanna Kalliomäki
- Q&A and discussion
- End of meeting

3.1.4 Supporting regional organisations BIOSWITCH transition: bilateral meetings

It was informed that bilateral meetings between CLIC and attendees are offered. During the meeting no requests for bilateral meetings were made. However, Paptic and CLIC continued discussions further to see how CLIC could support Paptic further. Also, further discussions (3-4) with the Bioeconomy Thematic Group members have been held to connect them to RDI.

3.1.5 Date, host, registration and venue

Date: Wednesday 9.3.2022

Host: CLIC Innovation

Registration: The event was a closed session for CLIC Bioeconomy Thematic Group members, so an invitation based event. We had 34 participants.

Venue: Online

3.1.6 Required equipment, material, logistics

No special equipment, material or logistics were required.

3.1.7 Dynamic/interactive session for discussion and debate results

There was a traditional QA and discussion slot after the presentations. CLIC's services and possibilities to support the cluster members in finding new projects and partnerships were discussed. Audience also asked where the BIOSWITCH Toolbox is available and also how long it will continue to be available.

3.1.8 Satisfaction survey results

The satisfaction was qualitatively surveyed online during the session and also quantitatively assessed by sending a follow-up question. All respondents online found the presentations informative and BIOSWITCH project and the Toolbox interesting. Paptic's presentation and highlights on the usefulness of the BIOSWITCH project was well appreciated.

Only a few replies to the quantitative assessment were received. Overall, the feedback was excellent from the ones who replied to the survey.

3.2 Corporación Tecnológica de Andalucía and regional event

3.2.1 Official event title

The event was named "Claves para acelerar la transición 'bio' de la empresa. Evento regional online del proyecto BIOSWITCH", which in English means "Key aspects to accelerate the bioswitch transition of companies. Online regional event from BIOSWITCH project". Below it is presented a picture for the save-the-date used in social media.

3.2.2 Regional customisation

The CTA regional event was done in Spanish to facilitate the participation of people and the discussion. The Andalusian Major brand Owner Grupo La Caña attended the event to present its own experience from using the BIOSWITCH Toolbox and by the end of the event, specific interactive discussion was triggered among attendees.



Figure 1. Save-the-date for the Andalusian regional event

3.2.3 Agenda

The agenda of the event translated from Spanish is provided below.

10:00 – 10:15 Welcome and presentation of the BIOSWITCH project - Marta Macias, CTA

10:15 – 10:25 Introduction to the BIOSWITCH Toolbox for the 'bio' transition - Carmen Ronchel, CTA

10:25 – 10:30 New value chains creation: tool "Build me the value chain" - Marta Macias, CTA

10:30 – 10:40 La Caña Group's experience in bioeconomy – Beatriz Molina, Alejandro Fernández; La Caña Group

10:40 – 10:50 Interactive discussion: how to accelerate the transition to the bioeconomy? - Marta Macias, CTA

10:50 – 11:00 Closing of the session - Carmen Ronchel, CTA

11:00 – Open Bilateral meetings between CTAs and entities that need help/advice in their transition to bio-based processes and products.

3.2.4 Supporting regional organisations Bioswitch transition: bilateral meetings

CTA offered the attendees the possibility of having bilateral meetings with CTA staff in order to get guidance and support for their bioswitch journey. Two SMEs (Sierra Cobo C.B. and BIOVAT) requested a bilateral meeting with CTA. Mails for scheduling the bilateral meetings were sent and only BIOVAT company answered and showed at the online meeting. The company presented their advances in the frame of bioeconomy and asked information about additional funding or relevant organisations that could support the process scale-up. CTA provided the requested information in a follow-up email.

As for the other SME, this was contacted a couple of additional times, but no further answer was received.

3.2.5 Date, host, registration and venue

Date: March 8, 2022

Host: CTA, with Grupo La Caña participating as speaker

Registration: 18 people registered. The registration was done via CTA website: <https://www.corporaciontecnologica.com/es/agenda/calendario-de-eventos-y-convocatorias/Claves-para-acelerar-la-transicion-bio-de-la-empresa/>

Venue: online (Microsoft Teams)



Figure 2. Screen caption from the Andalusian regional event where Alejandro Fernández and Beatriz Molina from Grupo La Caña participated as speakers

3.2.6 Required equipment, material, logistics

The meeting was organised using the MsTeams application and the website of CTA was used for the attendees registration. For the interactive discussions, the online tool Mentimeter was used. Finally, after the event, all presentations were sent to attendees and the event was uploaded at Youtube (<https://www.youtube.com/watch?v=aNK49Pv4ioU&t=2551s> , currently the video has 33 views).

3.2.7 Dynamic/interactive session for discussion and debate results

CTA used the "Menti" tool (Mentimeter) to dynamize the session. Attendees were asked to state from strongly disagree to strongly agree about the potential of Andalusia for bioeconomy development. 100% of the attendees strongly agreed that Andalusia has a high potential in the area of bioeconomy.

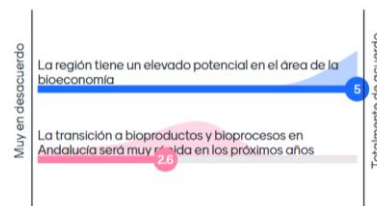
Then, same request was done regarding the affirmation "bioswitch transition will be very fast in the coming years". To this affirmation, attendees stated fairly disagree.

Finally, when asked to select an option according to their opinion, 80% of the attendees stated that the transition to the bioeconomy in Andalusia is in process but there are some relevant efforts pending. Meanwhile, 20% stated that it is very incipient and that there are hardly any cases.

¿Cuál es tu nombre?



Andalucía y la transición a bioproductos y bioprocesos



Pienso que, actualmente, la transición a lo bio en Andalucía...

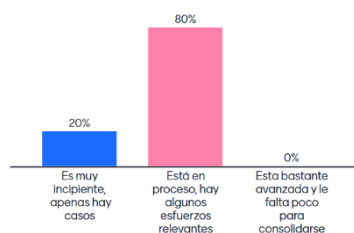


Figure 3. Results from interactive discussions maintained during the Andalusian regional event using Mentimeter

3.2.8 Satisfaction survey results

The survey was sent to 18 attendees and has been answered by 3 of them. Results are as follows:

Organisation [From 1 (Poor) to 5 (Excellent)]: 5

Relevance of the topic and content [From 1 (Poor) to 5 (Excellent)]: 4,67 (average)

Level of the speakers (quality and clarity) [From 1 (Poor) to 5 (Excellent)]: 4,67 (average) Participation and dialogue with the audience [From 1 (Poor) to 5 (Excellent)]: 4,33 (average)

Where did you hear about this event?

- Social Media: 2
- e-mail / Newsletter: 1
- EU Green Week website: 0
- Other: 0

Comment or feedback about the event

- 1 answer: "Despite of the interesting topic, the session was very short, and I had the feeling that further discussion/presentations could have been done."



3.3 Flanders' FOOD regional event

3.3.1 Official event title

The official title of Flanders' FOOD regional event was *BIOSWITCH Replication Workshop – Succesvol de transitie naar bio-based maken* ('making a successful transition towards bio-based')

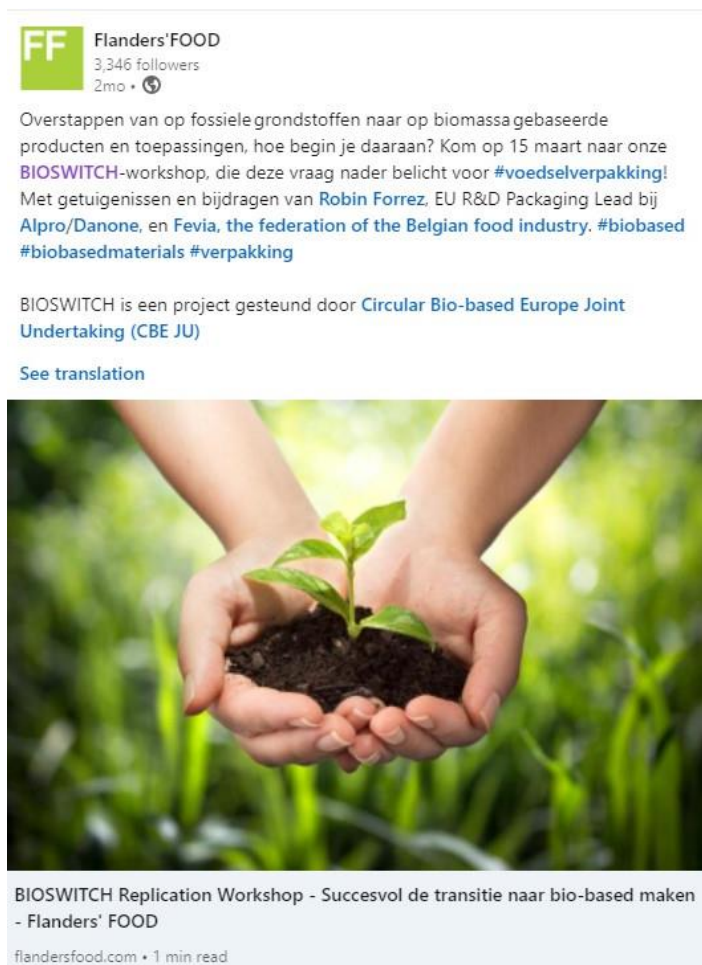


Figure 4. LinkedIn publication for Flanders regional event

3.3.2 Regional customisation

The regional event was held in Dutch. The agenda was focused on the topic of bio-based packaging, given Flanders' FOOD's member companies mainly come from the food processing industry, where sustainable and bio-based packaging are topical themes, as also the Road map 'Food Packaging of the Future' testifies. This Road map is a strategic research and development plan with a focus on the food packaging of the future, developed by Flanders' FOOD together with Pack4Food and the other spearhead clusters VIL (logistics), Catalisti (chemicals-synthetics) and SIM (Materials), in

collaboration with Packaging Developers/Managers from the food industry.¹ Also, Alpro, the major brand owner that Flanders' FOOD collaborated with within the context of the BIOSWITCH project, focused its participation in BIOSWITCH on its transition journey towards fully bio-based packaging. Given brand owners in Flanders are particularly concerned with how policy making will potentially favour whether disfavour their efforts in terms of the uptake of bio-based packaging, Flanders' FOOD also invited the Director Environment and Energy of the Belgian Federation of the Food Industry (FEVIA), to present an outline of the matter.

3.3.3 Agenda

The agenda for the regional event in Flanders was the following:

- 10:00 Introduction to the BIOSWITCH Toolbox, by Emma Sidgwick, Innovation Manager at Flanders' FOOD
- 10:15: Roadmap Food Packaging for the Future, by Michèle Kint, Innovation Manager at Flanders' FOOD
- 10:25: Alpro & Bio-based packaging, by Robin Forrez, EU R&D Packaging Lead Alpro + Danone
- 10:45: Policy trends in bio-based packaging, by Ann Nachtergaele, Director Environment and Energy at Fevia, the federation of the Belgian food industry
- 11:00: Q&A
- 11:30: Optional: 1-to-1 meetings with the innovation managers of Flanders' FOOD

3.3.4 Supporting regional organisations bioswitch transition: bilateral meetings

It was informed that this is offered as a service. Prior to the event only one request for a bilateral meeting was made, that is, by a Belgian market leader in prepacked fresh healthy breads, who wishes to transition towards bio-based packaging. An introductory meeting was held, but a subsequent follow-up meeting was rescheduled due to the feedstock urgencies resulting from the disrupted supply chains in the wake of the Ukraine-Russia crisis.

3.3.5 Date, host, registration and venue

Date: 15th of March 2022, 10:00-11:30 CET

Host: Flanders' FOOD

Registration: Via Flanders' FOOD's registration platform linked to the website.

Venue: online (Teams platform)

¹ <https://www.flandersfood.com/en/world-class-food-production/food-packaging-of-the-future>

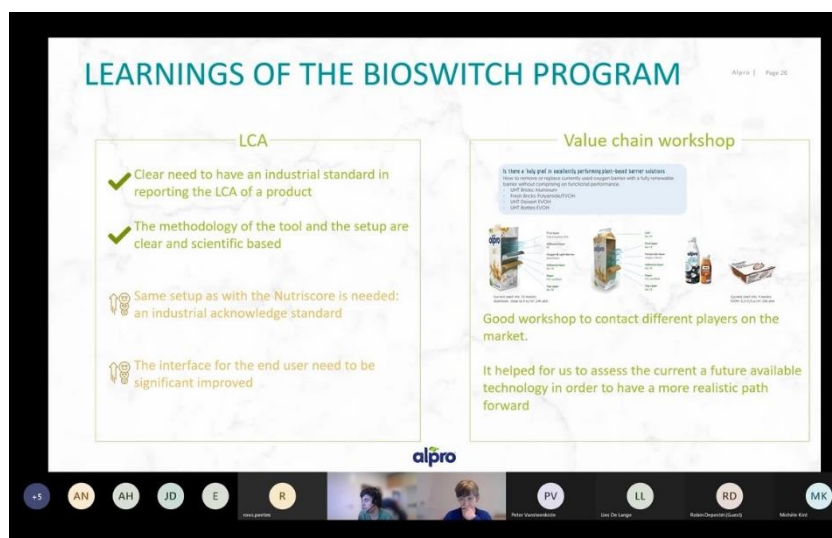


Figure 5. Regional BIOSWITCH event in Flanders (online)

3.3.6 Required equipment, material, logistics

No special equipment, material or logistics were required. In terms of registration and participation, 21 people registered to the event, while 17 people participated.

3.3.7 Dynamic/interactive session for discussion and debate results

There was a traditional QA and discussion slot after the presentations (11:00-11:30 CET). To ensure active participation, a couple of questions were prepared and displayed to the participants:

- Questions/feedback to Flanders' FOOD, Alpro or Fevia?
- Which of the tools in the BIOSWITCH Toolbox raise your interest and why?
- What are key targets/focus points in your own food packaging strategy? To what extent do you consider bio-based packaging? What incentives as well as hurdles are in play?
- What do you think of the policy making in relation to bio-based packaging? How important is policy and regulations in your consideration of the uptake of bio-based packaging?

The actual discussions eventually mainly centred around the final presentation of Ann Nachtergaele Director Environment and Energy at Fevia, the federation of the Belgian food industry, who concluded the event with the presentation of the SWOT analysis on the transition from fossil-based towards bio-based plastics, conducted by the UN Environment Programme in 2018. She especially pointed out the 'threat' of using agricultural land for non-food use, which is relevant for Belgium given its small geographical area, characterised by dense population, leading to the fact that Flanders is and will increasingly become dependent on import from other countries for an important part of its biomass. A second conclusion by Miss Nachtergaele was that she was unable to sketch a fully clear picture of policy trends in bio-based packaging, simply because there does not seem to be a clear policy focus.



Figure 6. Captions from BIOSWITCH regional event in Flanders (online)

Reactions from participants centred around valorising the renewability of resources in bio-based plastics (as the current economic growth model will always require new infeed, and as we are not fully sure to what extent recyclability will eventually require the integration of virgin fossil-based plastics), a point which was also made earlier by Alpro when discussing the importance of renewable material 'infeed' in contrast to fossil-based feedstock. Also, the importance of certification schemes that would confirm their compostability, whether at home or industrial, was raised. However, participants voiced some reservations about whether thorough Life Cycle Analysis (LCA), accounting also for transport, water use, energy use etc., would eventually 'prove' a more positive sustainability impact of bio-based plastics and packaging. In any case, the importance of more objectified, more standardised LCA analysis, allowing for actual comparability between uptake and design choices, was emphasised. One participant indeed confirmed that LCA analysis today is still about "looking at what you want to look at". Flanders' FOOD as well as the participants confirmed that research and innovation are still critical to make advancements in the domain of bio-based packaging, also related to functional performance concerns. The event was concluded with a reflection on the BIOSWITCH Toolbox, with one brand owner stating that he used the different communication type tools (as well as reference to the BIOSWITCH project overall) to provide information on the importance of their switch towards Bio-PE towards their clients (mainly retailers). This with positive outcomes. Nonetheless, this brand owner raised the importance of adopting certification (and thus control mechanisms) across the full value chain, in view of being able to make sound claims on the bio-based content of their packaging; they now just have to 'believe' the converters on their mass balance approach. This issue was corroborated by different brand owners, who also feel reluctant to work with second generation feedstocks, precisely because the mass balance approach makes it difficult to claim packaging as 'bio-based'.

3.3.8 Satisfaction survey results

The satisfaction survey was sent to the participants after the event, but unfortunately no responses were received.

3.4 Food and Bio Cluster Denmark regional event

3.4.1 Official event title

The title of the regional event in Denmark was “*Bio-based materials – Opportunities and challenges*”. The event was implemented as a 2-hour webinar with presentations of the BIOSWITCH toolbox and case studies. The webinar also included an introduction to Circular Bioeconomy Europe Joint Undertaking and time for discussion of possible collaborations between participants.

Biobaserede materialer - muligheder og udfordringer



i Webinar
Sted Online
Pris Gratis / Free
Fra 28. marts 2022 kl. 13:00
Til 28. marts 2022 kl. 15:00

Figure 7. Clip from the Food & Bio Cluster Denmark website presenting the headline for the BIOSWITCH regional event.

3.4.2 Regional customisation

The Food & Bio Cluster Denmark regional event was done in Danish language to facilitate participation of persons, who were not used to communicate professionally in English language.

In Denmark there is presently a great interest for methods to do sustainability assessments of products and processes. To facilitate the discussion about application and perspectives of the BIOSWITCH sustainability assessment tool, a Danish expert in Life Cycle Assessments was invited to the regional event to give a presentation and to engage in the discussions afterwards.

Following recommendations from the Danish Bio-economy Panel, the Danish government submitted in 2020 an action plan for increased application of sustainably sourced polymers including bio-based building blocks, bio-based packaging and bio-based textiles. A presentation of this action plan was integrated in the regional event to relate the BIOSWITCH toolbox to the Danish framework conditions.

A representative from the Danish brand owner Nopa Nordic was invited to present the company and its experience with the BIOSWITCH sustainability tool. However, in the end it was not possible for the Nopa Nordic-representative to join the webinar. Instead, Food & Bio Cluster Denmark did a presentation of Nopa Nordic as one of the BIOSWITCH case studies.

3.4.3 Agenda

The agenda for the Food & Bio Cluster Denmark regional event included the following items:

1. Welcome to the webinar and introduction to the BIOSWITCH project
2. Methods for sustainability assessments when shifting from fossil-based to bio-based
 - Introduction to life cycle assessments
 - Recommendations for brand owners who want quantitative sustainability data
 - Introduction to the BIOSWITCH sustainability tool
3. Results from the BIOSWITCH-study on consumer's perception of bio-based products
4. Results from the BIOSWITCH-study on opportunities and barriers for shifting to bio-based
5. Case studies with presentations of companies with experience in shifting to bio-based
 - Nopa Nordic
 - Dantoy
 - Natural Material Studio
6. Introduction to the Danish government's action plan for sustainably sourced polymers
7. Introduction to Circular Bioeconomy Europe Joint Undertaking (CBE JU)
8. Questions from participants
9. Concluding remarks and closure of the BIOSWITCH webinar

3.4.4 Supporting regional organisations bioswitch transition: bilateral meetings

A participant from Aarhus University requested a bilateral meeting with Food & Bio Cluster Denmark to discuss possibilities for collaboration to develop bio-based textiles made out of sustainably sourced bioresources. This follow-up meeting was scheduled for the 20th of April.

In addition, the director of the Danish company Natural Material Studio requested a bilateral meeting with Food & Bio Cluster Denmark to discuss opportunities for developing a common proposal under Circular Bioeconomy Europe Joint Undertaking. The date for that meeting has not yet been decided since the annual work programme is not yet published yet.

3.4.5 Date, host, registration and venue

Date: Monday the 28th of March 2022 from 13:00 to 15:00 CET.

Host: Food & Bio Cluster Denmark.

Registration: Registration was done via the website of Food & Bio Cluster.

Venue: Online-event using Microsoft Teams as platform.

3.4.6 Required equipment, material, logistics

The BIOSWITCH regional event was promoted in February and March 2022 in the Food & Bio Cluster Denmark newsletter and website. The day before the webinar a link to be used for participation was sent by email to the 34 persons who had registered for the webinar. The 34 registered persons were representatives from different types of organisations:

- 18 representatives from established private companies
- 5 representatives from start-up companies
- 5 representatives from universities or other research and development organisations
- 2 representatives from municipalities
- 4 representatives from other types of organisations, e.g., industrial organisations

On the day of the webinar 24 persons logged on to the webinar meaning that 10 of the registered persons did not join the webinar anyway. According to the experience of Food & Bio Cluster Denmark this share of registered persons who do not show up for webinars is normally seen these days. Some people register for a webinar just to have the presentations sent to them. Also, in the case of the BIOSWITCH regional event the PowerPoint-presentations shown during the webinar were sent to all persons who had registered themselves for the event.

3.4.7 Dynamic/interactive session for discussion and debate results

Interaction with the participants of the Food & Bio Cluster Denmark regional event was done in two ways.

During the presentations the participants could write concrete questions to the speakers using the chat-function of Microsoft Teams. After each presentation there were a few minutes set aside for the speaker to answer these questions.

In the final part of the webinar after all presentations were done there was a timeslot for open discussions and requests from the participants. This was done using the "raise-hand"-function of Microsoft Teams to allow participants to ask questions using the microphone.

3.4.8 Satisfaction survey results

After the completion of the webinar a link to a short evaluation questionnaire was sent by email to all participants. 6 persons corresponding to 25% of the participants filled in this questionnaire.

Results of the evaluation questionnaire showed that 5 out of 6 respondents were "Very satisfied" or "Satisfied" with the content presented at the webinar whereas 1 respondent answered that he/she was "Neutral" regarding the content. No respondents answered that they were "Unsatisfied" or "Very unsatisfied" with the content of the webinar.

Regarding the practical implementation of the webinar 3 persons answered that they were "Very satisfied", and 3 persons answered that they were "Satisfied". No respondents answered that they were "Neutral", "Unsatisfied" or "Very unsatisfied" with the practical implementation.

When asked about their main outcome from participation in the BIOSWITCH webinar 5 persons responded that they mainly benefitted from getting access to new knowledge whereas 1 person answered that his/her main outcome was new inspiration.

Based on the evaluation results it is concluded that the participants found the webinar content relevant, and they were satisfied with the format and the practical implementation. It should be mentioned however, that this conclusion is based on answers from only 6 participants.

3.5 Munster Technological University and regional event

3.5.1 Official event title

The regional event for Ireland was titled **'The role of brand owners and consumers in shaping a green transition for Ireland'** to encompass the knowledge transfer of the main research findings from BIOSWITCH project and Irish bioeconomy expert insights on industry, brand and consumer perspectives.



Figure 8. Picture used for the save-the-date for the Irish regional event

3.5.2 Regional customisation

For Ireland, not a regional cluster partner, there was no major brand owner as part of the BIOSWITCH project. As there was no major brand owner who tested the BIOSWITCH tools who could share their experience, the showcase of the BIOSWITCH Toolbox and Sustainability Assessment Tool was adapted and presented from a project point of view to showcase the tools available and how to use the content of the toolbox. The Ireland regional workshop was held in English, no language adaptation required, as local language for events is English.

Regional customisation involved bringing in national bioeconomy experts for a panel discussion and involving stakeholders in the workshop through an interactive session. The workshop aimed to gain an understanding of Irish perspectives of the bioeconomy and what can be done to improve engagement of brands and consumers with bio-based products. The regional workshops (mapping and analysis exercise) held in WP1 did not include Ireland, so it was beneficial to gain an understanding of multi-actor view on bio-based product uptake in Ireland through WP4 regional workshops (knowledge transfer).

3.5.3 Agenda

09.45-10.00 – Introduction to webinar and overview of BIOSWITCH brand and consumer survey results – James Gaffey, MTU

10.00-10.10 - Introduction to BIOSWITCH Toolbox – Emily Marsh, MTU

10.10-10.20 – Introduction to BIOSWITCH Sustainability Assessment Tool – Tiina Vainio-Kaila, VTT

10.20-10.30 – Overview of incentive measures stimulating brand owners to switch to bio-based – John Vos, BTG

10.30-11.00 – Expert Panel Discussion – Eamonn Tighe, Natureworks, Prof. Maeve Henchion Teagasc & BiOrbic, James Sugrue, Lee Strand

11.00-11.15 – Short workshop to gauge recommendations for improving downstream actor integration within the bioeconomy – James Gaffey & Emily Marsh, MTU

3.5.4 Supporting regional organisations bioswitch transition: bilateral meetings

The Irish event was not held as part of a BIOSWITCH regional cluster event and therefore, bilateral meetings were not offered in conjunction with this event. As outlined above in *regional customisation* the event was adapted to engage Irish businesses and other stakeholders through an expert panel and interactive workshop instead of bilateral meetings. A variety of downstream stakeholders were involved to gauge a wider variety of actors in the Irish bioeconomy, 56 attendees were involved in the knowledge transfer and expert panel sections of the event, with attendees from industry, brands, academia, policy and a more general audience as representatives of Irish consumers. The interactive session gauged knowledge and awareness of bio-based products among downstream value chain actors. The short workshop was held on Miro platform where 21 stakeholders interacted with the board, providing their recommendations for improving downstream actor integration with the bioeconomy. Guidelines on how to carry out bio-based transitions were incorporated into the knowledge transfer section of the event, with presentations on the BIOSWITCH Toolbox and BIOSWITCH Sustainability Assessment Tool.

3.5.5 Date, host, registration and venue

Date: 17th February 2022 09:45 – 11:15 GMT

Host: Munster Technological University

Registration: Eventbrite

Venue: Zoom (online only event)



Figure 9. Caption of the Irish event

3.5.6 Required equipment, material, logistics

The Irish regional event was held over Zoom and Miro platforms, as the event was held online all equipment and materials developed were digital. The logistics involved promoting the event and supporting the attendees with event access instructions and supporting material. The event was promoted through social media channels on the Circular Bioeconomy Research Group and Circular Bioeconomy Cluster South-west Twitter and email newsletter. Eventbrite was the registration platform used, with 97 registered for the event 56 attended the event on Zoom for the knowledge transfer and expert panel sections and 21 interacted with the Miro board in the workshop section of the event.

The event was divided into three sections: knowledge transfer, expert panel and interactive workshop. The knowledge transfer section involved presentations of the main findings and tools available from the BIOSWITCH project, with presentations on.

1. Overview of BIOSWITCH brand and consumer survey results
2. Introduction to BIOSWITCH Toolbox
3. BIOSWITCH Sustainability Assessment Tool
4. Overview of incentive measures stimulating brand owners to switch to bio-based

The second section of the event involved the expert panel to provide insights from Irish brand, industry and consumer perspectives with participants from Munster Technological University, Teagasc, Natureworks PLA, Lee Strand, and BiOrbic. The third section of the event was the interactive session in Miro where a short workshop was held to gauge recommendations for improving downstream actor integration within the bioeconomy.

After the event the presentations, satisfaction survey, event recording and Miro board were shared with participants and all registered. The Miro board was shared with all registered with instructions to allow any that could not attend the event to have the opportunity to input and recommendations

to the workshop board and to give any participant the opportunity input anything more onto the board.

3.5.7 Dynamic/interactive session for discussion and debate results

To engage the audience and stimulate thought on recommendations for improving public knowledge and awareness of bio-based products an expert panel was incorporated into the event. The expert panel included representatives from a local business, industry and academia/policy. The panel of experts in the Irish bioeconomy with representatives from:

- Lee Strand, a dairy company, provided insights on a local leader in the bioeconomy in the south-west region of Ireland and early adopter of bio-based materials, the first to provide 100% bio-based packaging for 2L milk cartons.
- Teagasc providing insights on policy and public perception of bioeconomy in Ireland.
- Natureworks providing industry insights on an EU and US global view and industry involvement in the Irish bioeconomy.

For the interactive session in Miro 5 questions were first developed for the workshop and were narrowed down to 3 questions:

1. What steps could be taken to improve brand uptake of bio-based products in Ireland?
2. What steps could be taken to improve consumer uptake of bio-based products in Ireland?
3. What steps could be taken to improve public awareness and acceptance of the bioeconomy in Ireland?

These three questions were combined to one question due to time constraints of the event and to cater for the multi-actor audience. The question posed in the short workshop and presented on a Miro board for input by the participants to answer:

What steps can be taken to improve knowledge, awareness and uptake of bio-based products among downstream value chain actors (brands, consumers, retailers, etc.) in the bioeconomy?

An introduction and instruction to Miro board was provided and an ice-breaker question 'What is the name of your organisation?'.

The question was delivered to the audience on a Miro board, which is an interactive online platform. A board was created with the question where the participants inputted their answers and recommendations onto the board using sticky notes. This board platform allows for the capture of data from all participating, the anonymous board giving participants confidence in providing open and honest insights.

The recommendations provided by multi-actor participants:

- Marketing on the importance of bio-based products
- Need explanation of labels, what is overall impact not just end of life or the fact that "bio" something
- Promotion at mainstream events
- Advertising/More visibility in the media
- Public awareness programmes

- Focus on increasing public knowledge and impact of their purchases
- Knowledge of alternative (to-fossil) material availability
- Clearer definitions and labelling
- Common material taxonomy
- PR around successful products - demonstrating no lack of performance/functionality and/or improved performance/functionality
- Clear understandable labelling/simple clear message

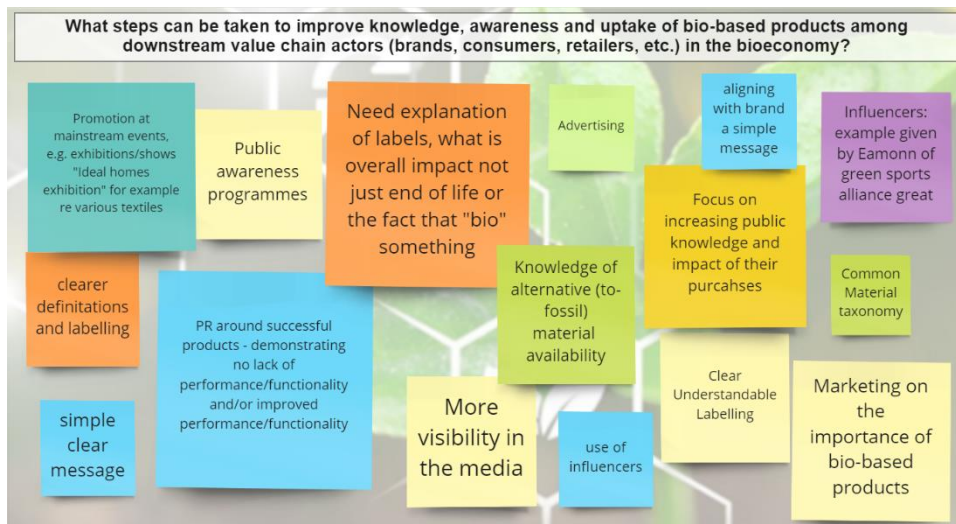
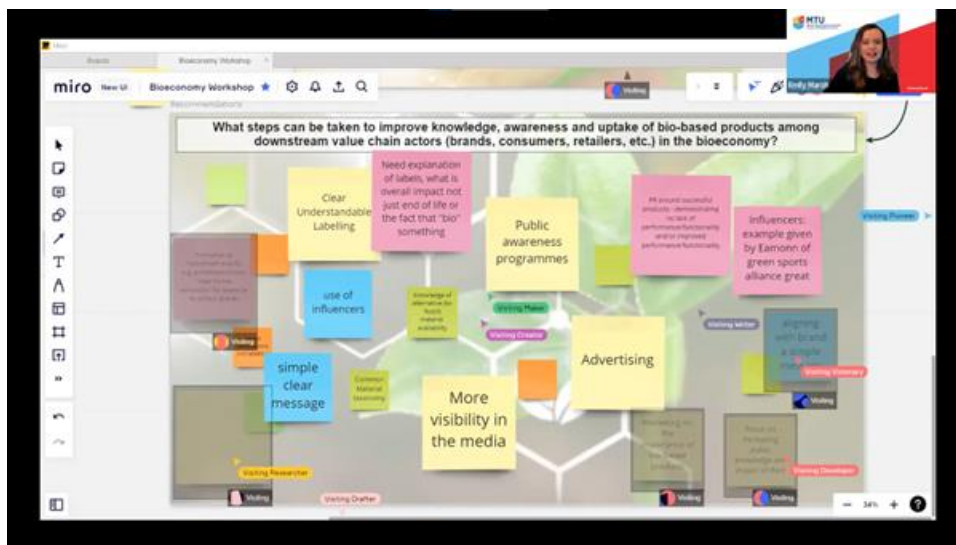


Figure 10. Caption of the interactive discussion organised during the Irish event

3.5.8 Satisfaction survey results

The satisfaction survey was shared with the attendees of the event but there were no responses. Therefore, there is no satisfaction survey results available for the Irish regional workshop.

4 REPLICATION ASSESSMENTS

During the BIOSWITCH project, a dedicated work has been carried out together with the regional Major BOs. In order to maximise project impact, the four cluster partners have conducted a replication assessment so as to identify which is the current status of each cluster linked area (region or country) in terms on bioeconomy development, having analysed the potential of such areas for the bioswitch transition as well. Moreover, different BO profiles have been identified per each region/country according to the most relevant value chains in the bioeconomy field. Once identified, an assessment of which BIOSWITCH tool would be most suitable for them in order to support their bioswitch journey was conducted. Finally, although the BIOSWITCH Toolbox main end-users are the Bos, there are other stakeholders that could benefit as well from the information and support provided by the different tools. Therefore, a special analysis is done as well in order to identify which are the key regional/national stakeholders (other than BOs) that could benefit from BIOSWITCH tools.

Next sections present the result from this replication assessment for each region/country linked to each cluster partner, namely: Andalusia (Spain), Denmark, Finland and Flanders (Belgium). The four assessments are structured in the same way: (1) presentation of the area; (2) review of the bioeconomy implementation in the area; (3) analysis of the potential for bioeconomy of the area, identification of the most relevant BOs according to the present value chains and assessment of the most suitable BIOSWITCH tools for the identified profiles; and (4) review of key stakeholders in the region and assessment of which BIOSWITCH tools could benefit them.

4.1 Andalusia (Spain)

4.1.1 Background

Andalusia is located in the Southwest of Europe with an extension of more than 87.000 km² (ca. 9Mha) and 940 km of coastal area. From that, the agricultural area covers ca. 4,4 Mha and the forest area covers ca. 4,6Mha [1]. This makes it the **fourth region of the European Union (EU) according to its area and the most populated in Spain**, with around 8.400.000 inhabitants. Andalusia has historically been an agricultural region, compared to the rest of Spain and the rest of Europe. The primary sector constitutes an important employment due to the link among people and the environment since 37% of the population lives in rural areas where resources are mainly being produced. More information about the region is provided in the next figure.

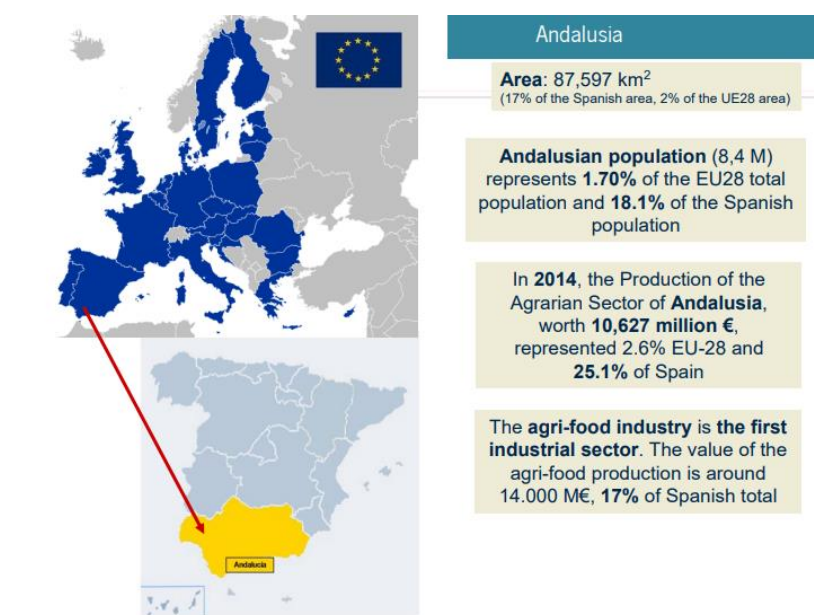


Figure 11. Main figures for the Andalusian region [1]

Andalucía can be therefore pointed out as the **2nd European Region in agricultural production with around 300.000 farms and 5.400 companies in the agroindustry sector**, employing ca. 23% of agri-food employment in Spain [1]. In addition, the agri-food sector has an export value of 11,355 million, the Andalusian agri-food sector contributes 21.4% of the total and is the second largest exporter in Spain [2]. It is worth mentioning the regional activity as well in other areas such as tourism, retail sales, and transportation, where the region has a relevant role in the national and European context. The unemployment rate stood at 25.5% in 2017 and was one of the highest in Spain and Europe [3].

Finally, concerning science, technology and innovation, According to the Outreach Program for Science in Andalusia, Andalusia contributes 14 % of Spain's scientific production behind only Madrid and Catalonia among the autonomous communities [4], even though regional investment in research and development (R&D) as a proportion of Gross Domestic Product (GDP) is below the national average. The lack of research capacity in business and the low participation of the private sector in research has resulted in R&D taking place largely in the public sector. Within the private sphere, although also promoted by public administration, technology parks have been established throughout the Community, such as the Technological Park of Andalusia (Parque Tecnológico de Andalucía) in Málaga, and PCT Cartuja in Seville.

As for H2020 Andalusian results by sectors, BIO sector (food security, agriculture, fisheries and bioeconomy) was in the second place with 47,9 M€ of economic turnback. Furthermore, it was the 12,1% funding received over the national total [5].

4.1.2 Regional bio-based transition status

Andalusia provides a competitive advantage for the development of the circular bioeconomy, for a number of reasons as it is described next.

- Andalusia has more than 5.000 agri-food companies (around 19% of all Spain) and more than 200 chemistry companies.
- It has a fresh fish production, which reached more than 55.000 tonnes in 2021 with a production growth per year of 2.5% and incomes of more than 177 million euros in 2021 with a profit growth per year of 3.3% [6].
- Andalusia has a total agricultural and forestry area of 8.7 million hectares in 2021 [7].
- Regarding biotechnology sector, Andalusia has 550 research groups working in this field; with 200 companies and around 3.000 jobs generated 61% with agri-food activity and 14% with industrial activity 3rd region with the highest investment in biotechnological innovation [8].
- The region is the Spanish leader in electricity generation with biomass (273.98 MW), it has 21 biogas production facilities (33,45 MW) and 27.816 biomass installations for thermal uses (1.809,45 MW) [9].

4.1.2.1 *Bioeconomy and circular bioeconomy at policy level*

At the national level, Spanish Strategy for Bioeconomy Horizon 2030, approved in 2016, is based on the science-economy-society triangle. The public sector is responsible for promoting, stimulating, and coordinating the strategy.

At the regional level, the **Andalusian Circular Bioeconomy Strategy (ACBS)** [8] was developed by the Regional Ministry of Agriculture, Livestock, Fisheries and Sustainable Development (CAGPDS by its name in Spanish) and approved by the Andalusian Government on September 18th, 2018. The strategy focuses on the regional bioeconomy areas less developed and aims to support the implementation of specific actions that facilitate its take-off and consolidation in the medium-long term. The relevant sectors for the bioeconomy include agriculture, forestry, fishing, food and paper production, as well as part of the chemical, biotechnology and energy industries. The time horizon of the strategy is 2030 and has around 1.400 million euros allocated and aimed at specific actions that have been developed with the collaboration of more than 50 external experts from the sectors of interest.

The main objective of the ACBS is to contribute to sustainable growth and development in Andalusia by carrying out actions towards the production of renewable and biological products and processes. Three strategic objectives can be pointed out:

- Increase the availability of sustainable biomass for its use through innovative treatments.
- Increase the number of bio-industries and biorefineries in Andalusia.
- Increase markets and the consumption of bioproducts and bioenergy in Andalusia.

This document establishes four strategic lines that encompass measures and actions to achieve these objectives:

- Promote production and availability of biomass.
- Improve infrastructures and logistics of biomass.
- Facilitate industrial transformation processes of biomass resources and industrial production capacities of bioproducts and bioenergy.
- Development of markets for bioproducts and bioenergy.

These will be implanted through a set of four instrumental programs of a transversal nature: communication and awareness, promotion of RDi and education, access to financing and cooperation and collaboration. In total, 17 measures and 39 actions have been defined.

Aside from this, the government has promoted the creation of rural development working groups aiming to boost the agri-food sector in rural areas. Concerning regulation, the regional Lay for Circular Economy was recently approved by the regional government (February 2022). Also, in 2021, the Andalusian Plan for Waste (PIREC 2030) was issued.

4.1.2.2 *Cluster Andaluz de Bioeconomía (Andalusian bioeconomy cluster)*

Andalusia is in the process of shaping a regional cluster devoted to bioeconomy. It was firstly launched in 2018 linked to the ACBS launch but it is not fully operative yet. The aim for the cluster is to work in favour of knowledge generation, real innovation transfer and effective visibility of the progress of bioeconomy in Andalusia, through collaboration between actors. The key elements of the cluster are: i) sectoral specialisation with member companies covering the whole value chain; ii) public support from (CAGPDS, IFAPA - Instituto Andaluz de Investigación y Formación Agraria, Pesquera, Alimentaria y de la Producción Ecológica (Agricultural and Fishery Research and Training Institute) and business network (such as CTA); iii) territorial distribution, that is to say, the sectors are spread throughout Andalusia, but specialised by areas; iv) dynamism due to changing and increasingly strict legislation, increasing environmental awareness and improving the profitability of processes or products. Its main objectives are:

- Organise the Andalusian bioeconomy sector, both in terms of public and private agents.
- Making the knowledge generated in the bioeconomy area more accessible and economically viable.
- Promoting the development of R&D&I projects among the members of the cluster.
- Encouraging entrepreneurship in the green economy and circular economy.
- Knowing the sector and trends in order to adapt to market demands.
- Raising awareness of environmental sustainability, waste recovery, water use and carbon footprint.

4.1.2.3 *Current bioeconomy positioning and status*

General figures conclude that in 2015 there was a market volume for bioeconomy of 30.068 mill. € with an employment of 290.968 people. Regarding its actual implementation, circular bioeconomy is still at an early stage of development in most sectors of activity although it is gradually progressing, especially in the agri-food sector. **Main biomass opportunities are identified for olive biomass, intensive horticulture and seaweed production.** The main aim is to achieve 'zero waste' and the generation of value from residual biomass. Therefore, it focusses mainly in making better use of existing local biomass, which has been traditionally managed locally through traditional low-medium value processes (composting, animal feeding and energy recovery) [1].

Most of the initiatives carried out leverage on the large size of the relevant companies in the agri-food sector and their competitive position within their core business. Some of these emerging Andalusian business initiatives with higher value-added products include compounds used in cosmetics (e.g., squalene), in construction (building-blocks), biostimulants, microalgae, functional

food (both animal and human), among other products. In addition, initiatives linked to the reuse of water and the conversion of wastewater treatment plants (WWTPs) into 'biofactories' are also noteworthy, a sign of the competitiveness of the water sector in Andalusia, derived from the scarcity of the resource and its high competitiveness.

Delving into these initiatives, it can be drafted that on the one hand, the enabling factors for the success of these business initiatives framed within the circular bioeconomy for Andalusia are: the 'Ethical commitment to the environment', closely followed by 'Specific technological knowledge' and 'Private profitability'. On the other hand, the factors that have acted as limiting factors have been, in the first place, the 'Bureaucracy', followed by the 'Regulations related to the activity' and, in equal level of importance, the 'Financial needs' and the 'Technological barriers' [10]. Consequently, public administration is trying to follow the next recommendations: simplification of procedures, legislative harmonization at the national level, promoting collaborative actions (e.g., clusters and business hubs), facilitating investment (e.g., promoting venture capital models), or specific support for SMEs (e.g., supporting environmental assessment and certification).

About the activity of the companies, Seville, Almeria and Cadiz are the provinces with the highest demand for bioeconomy related services (e.g., proposal preparation service, intellectual property support, raw material analysis and market research). It is also worth highlighting the demand from companies in specific sectors in certain provinces, such as the horticulture sector in the provinces of Almeria, Cadiz and Cordoba. Furthermore, most of the companies that demand services are companies with a consolidated experience in the sector. The number of start-ups and developing companies is significantly smaller.

Nevertheless, it should also be noted that 'biorefinery' type enterprises are absent at the regional level. In the EU, the number of biorefineries with different levels of maturity (commercial, demonstration, pilot, R&D) is estimated at 800, but most of them are located in the vicinity of the major ports of supply of raw materials (commodities. Nonetheless, **the 'biorefinery' model and the obtaining of higher compounds of varying degrees of value through cascading production approaches is an unresolved issue for the Andalusian Circular Bioeconomy.**

The set of relevant actions that have been conducted so far at regional level in order to boost and promote bioeconomy are listed next.

- Bioeconomy Website, Social Media, Communication Plan
- Creation of the Andalusian Bioeconomy Cluster
- Creation of an inter-departmental Commission for boosting and monitoring of actions and measures.
- Bioeconomy Regional Observatory establishment
- Development of a methodology to quantify and qualify biomass resources (Indicators)
- Creation of a hallmark to identify bioproducts and processes for bioeconomy
- Encouraging participation in European initiatives
- Promotion of a Catalogue of Good Practices and a portfolio of successful projects

All described aspects concerning the status of Andalusia regarding bioeconomy are summarised in the next figure.

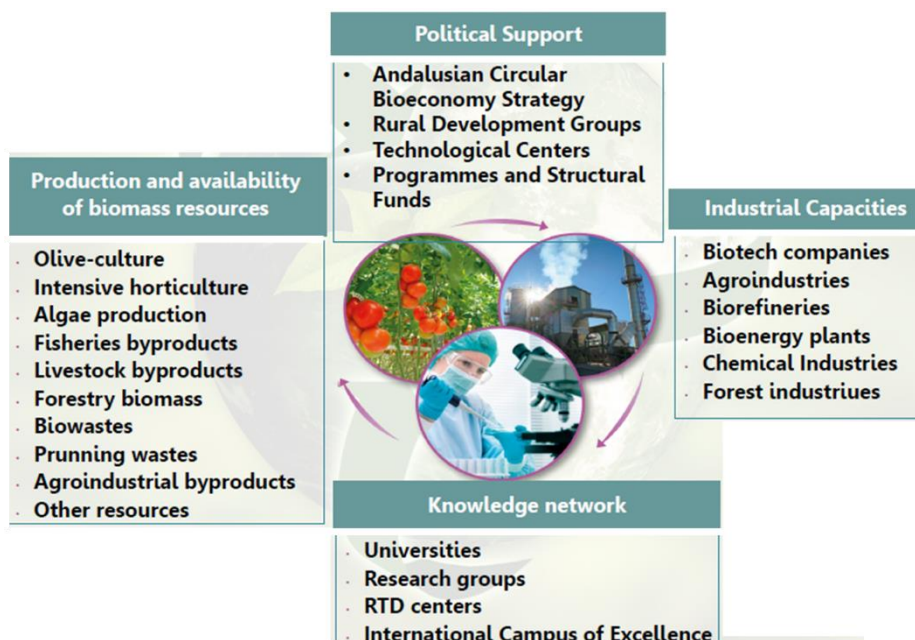


Figure 12. Current status of bioeconomy implementation in Andalusia

Finally, it is worth highlighting that the region was selected as Model Demonstrator Region in Sustainable chemical production for 2016-2017 and the regional ministry CAGPDS joined the Bio-based Industries Consortium (BIC) in 2017. It is worth mentioning that the region has participated in several European projects such as Power4bio, Reainwaste and Symbi, and has also coordinated the project ICT-Biochain.

4.1.3 Regional bio-based transition potential for brand owners

The bio-based industry requires sustainable biomass feedstocks for conversion into value-added products and services. Andalusia has the economic and innovation capacities and the biomass feedstock to rapidly expand bio-based industrial activities on regional and national levels and become a strong partner in the European bioeconomy. In fact, there is significant biomass potential in terms of agricultural biomass [11]. Specifically:

- Only considering agriculture, biomass production reaches 8 million tons a year, highlighting sectors such as olive groves (27%), horticulture (15%), wheat straw (14%) and corn straw (10%) [1].
- The biomass potential amounts to 3.955 ktoe of which 1.322 are agricultural waste, 1.023 industrial waste and 322 forest waste.
- There is also availability of other interesting waste streams such as paper & pulp, sewage sludge, plastics and Municipal Solid Waste.
- Large amount that is not currently use and therefore available.

- The olive oil biorefinery complex is well developed and the pomace oil is being used for different high-value applications. Currently there are 830 olive mills and 38 extraction plants of pomace oil.
- In horticulture and forestry waste streams only less advanced conversion options are operational in Andalusia.

Also, the relevance of food production in the Andalusian economy provides a great opportunity: 15,3% (20.148 million euros) of the region's Gross Value Added (GVA) and 17.2% (502.937 people) of employment in Andalusia is generated by the agri-food sector, making it the largest in Spain. It is characterised by a largely primary composition, with agriculture and fishing accounting for 54.4% of the sector's GVA. The high competitiveness of the Andalusian agri-food sector makes it the fourth most competitive in Spain, 16.8% above the national average [2].

Moreover, Andalusia has up to 3.000 hours of sunny days per year that makes this region an ideal place for the production of biological resources and the development of new economic models, such as the production of microalgae.

With these premises, the resources that the ACBS identifies as a priority for obtaining bioproducts and bioenergy in the region are the following:

- Waste biomass from agricultural crops (plant remains from herbaceous crops) and by-products from the agri-food industry.
 - Olive grove sector.
 - Horticulture sector.
- Algal biomass.

Concerning brand owners and their involvement in regional bioeconomy, the following profiles of brand owners have been identified as working in sectors that could switch from fossil to bio-based.

Profile 1. Brand owners from primary sector

Agriculture (fruits and vegetables producer)

84.2 % of agricultural production in Andalusia is of vegetable origin. Fruit (29.6 %, mainly olives, fresh fruit and citrus), fresh vegetables (24.7 %) and olive oil (14.1 %) are the main products, accounting for 68.5 % of the total. The importance of these products is not limited to the region, but is also important for Spain, since Andalusia provides 38.3 % of the fruit produced in the country, almost half of the fresh vegetables, 79 % of Spanish olive oil and 32.7 % of citrus production. Given Spain's importance in the EU-27 in the production of these products, Andalusia is a key producer in the EU market. Andalusia is main producer worldwide of olive oil and olives, main European producer of ecological products, main fruit and vegetable exporter within Europe, second producer worldwide of strawberries and main European producer of tropical products.

One of the most important agricultural sectors in Andalusia is the greenhouse horticulture of Almería [12]. Nowadays, it represents the highest extension of greenhouses, also commonly called the "plastic sea," due to the important visual landscape impact. Currently, the province of Almería is the largest agricultural region of protected crops in Spain reaching 32.554 ha of greenhouses in 2020. Due to the socio-economic importance of greenhouse agriculture in Almería and its huge need for

plastics, it is essential to identify the opportunities of the agricultural system to obtain its production under the principles of bioeconomy and circular bioeconomy. Further progress must be made in the sustainability of greenhouse crops.

The agriculture sector presents great opportunities for improvement under the framework of the circular bioeconomy, these are:

- Supporting biological pest control as this is a technique that respects the environment and the health of producers and consumers.
- Encouraging farmers to certify their production under organic farming protocols. Thus, generating more value to the production and adapting it to the real market demand. Almost half (45.6%) of the existing organic farming area in Spain is in Andalusia, underlining the importance of sustainability for the sector. In this model, the addition of pesticides and synthetic fertilisers is prohibited and maintaining and improving the fertility of agricultural soils is identified as a key issue. It is therefore of interest to search for new forms of crop protection and fertilisation that do not reduce productivity and maintain or improve the fertility of agricultural systems within the framework of the circular bioeconomy (see profile 3).
- Using biodegradable mulching plastic and natural compostable/biodegradable string (greenhouse agriculture). Same is applicable to fresh fruits and vegetables packaging.
- Better valorisation strategies and processes for agricultural waste far from traditional approaches, e.g., bioactive compounds obtention, biopolymers and biocomposites production.

Players: La Unión, Fresón de Palos, agricultural cooperatives like Casi or DCOOP, among others

Livestock producers

In terms of organic livestock production, the Andalusian region contributes 66% of organic livestock production in general, and in particular 75.9% of beef and 75.7% of sheep and goat production, of the almost 39.000 tonnes of meat produced by the organic livestock industry in Spain in 2020, which highlights the importance of sustainability for the sector.

Currently, the livestock sector emits an estimated 7,1 GT of CO₂-equivalent per year, representing 14,5% of human-induced greenhouse gas (GHG) emissions. Increasing the efficiency of livestock supply chains is key to limiting the growth of GHG emissions in the future [13].

There is wide scope to improve livestock sector practices so that they are more sustainable, more equitable, and pose less risk to animal and human health. Opportunities can be found as well for the use of animal feed that comes from biological sources. Moreover, new valorisation approaches for livestock production waste (e.g., manure) need to be developed. Here, synergies with other sectors could be identified, e.g., through co-digestion with other waste streams. Finally, livestock play a major role in sustainable food systems—for example, manure is a critical source of natural fertilizer, while livestock used as draft animals can help boost productivity in regions where there is low mechanization.

Players: Dairy farmers, livestock cooperatives: COVAP, Ovipor, among others

Fisheries, aquaculture and the blue economy

Based on the Food and Agricultural Organization (FAO), the total fisheries and aquaculture production has shown a considerable increase of more than eightfold between 1954 and 2014, driven by advances in fishing technologies and rapid developments in aquaculture. The total European production of fish by aquaculture is estimated to be 2,570,242 tons in 2019. The Andalusian fisheries sector covers companies along the whole value chain [8]:

- Aquaculture: 114 companies focusing on fish, crustaceans and molluscs
- Extraction industry: 1.500 ships (16,3% Spanish fleet)
- Shellfish catching (by hand): 300 licenses
- Wholesale: 610 companies
- Processing industry: 54 companies

The amount of fish waste has undergone a dramatic increase. Currently, the post-catch fish losses represent a huge economic and environmental concern occurring in most fish distribution chains, with large amounts of landed fish lost or discarded between landing and consumption. An opportunity for circular bioeconomy can be identified here since there are commercial possibilities for the use of fish by-products like collagen, enzymes, and bioactive peptides production or generation of biodiesel from oils derived from fish.

Players: CTAQUA, regional and local associations.

Profile 2. Brand owners from the agri-food industry

Approximately one third of all food produced globally is wasted every year throughout the whole value chain—from farmers to consumers, with the highest waste, 39%, occurring in industry and the primary sector, 42% in the consumption phase, 14% in catering and 5% in distribution. In Andalusia, the primary sector and the subsequent processing sectors have substantial bio-based residual streams and waste, which can be valorised to produce high-value products for food, animal feed, energy or cosmetics. Several Andalusian agri-food companies are involved in European R&D&I projects to advance the development of bio-based products using their own by-products. The current production model of the olive or citrus agro-industrial sector can be considered as an efficient example of cascading resource use in which all organic matter flows are utilised.

According to data from the Survey on Waste Generation in the Industrial Sector, the total production of waste from the agri-food manufacturing industry in Andalusia amounts to 2.795,4 thousand t, of which 2.693,5 thousand t are non-hazardous, while 91,9 thousand t are dangerous. In Andalusia, the number of hazardous waste production centres stood at 35.823 in 2014. 97% of them are considered small producers since they reach a production of less than 10 tons per year. The territorial distribution of these facilities is more or less homogeneous, although there is a concentration of companies, slightly higher, in the provinces of Seville and Malaga. Concerning soil contamination, the global pollutant load of the subsector of the agri-food industry in Andalusia (according to the Ministry of Environment and Territorial Planning) is mainly constituted by olive mill waste, vinasses, washing

waters and yeast treatment. Regarding water use and reutilisation, from the sanitary point of view, the reuse of process water is regulated by RD 140/2003, which establishes the sanitary criteria for the quality of water for human consumption. Due to these limitations, the percentage of water reuse in the food industries is only 2.4%, much lower than that of the manufacturing industry as a whole, which stands at 8.9% [14].

It can be drafted therefore that there are a lot of opportunities for increasing the sustainability of the agri-food industry and to promote the adoption of bio-based approaches, processes and products with the aim of reduce resource consumption and waste generation. Some opportunities that can be pointed out are:

- Development of resource efficient processes with lower resources consumption, specially water (increase its reuse)
- Development of cascading approaches in order to promote better waste valorisation, making the most of biomass processing steps
- Use of feedstock, reagents and processes that are bio-based, decreasing this way the environmental impact.
- Boost the use of biopackaging and other low-environmental impact materials.
- Promote the use of active compounds in order to produce new food formulations with improved properties.

Players: Cítricos del andévalo, La Caña, Acesur, Innovaoleo (Natac), Agrícola el Bosque, Fresón de Palos, DCOOP, among others.

From this Group, there are some organisations that haven't grasped yet the opportunity that bioeconomy brings (profile 2.a) while other organisations have done a step towards bioeconomy approaches adoption and implementation (profile 2.b).

Specifically, there are some companies that are already using and exploring possibilities for suitable packaging material (i.e., biodegradable coatings and films) with enhanced thermal, mechanical and barrier characteristics to prevent from contamination and loss of foodstuff. Some examples are Grupo La Caña and COVAP. Also, Andalusian food manufacturers are involved more and more in innovation actions in order to incorporate bioactive ingredients into their products since there is a growing interest in the benefits of foods promoting health and reducing the risk of disease, within the food industry and amongst health care professionals, consumers and society in general. Some examples are Caña nature (Grupo La Caña), Aurora IN, Biosabor and Puleva (Grupo Lactalis).

Profile 3. Brand owners from biotechnology companies producing bio-based alternatives

Agro-biotech companies

Over the last few years, it has become increasingly clear that sustainable and environmentally friendly agriculture is becoming more and more important. Andalusia has a large number of

companies that develop biofertilisers, biostimulants or biopesticides based on different types of microorganisms, nutrients and other inputs, with the aim of maintaining soil fertility, increasing biodiversity and increasing crop productivity and quality, providing high added value to crops. These products are based on natural compounds, respectful of the ecosystem and harmless to human health which have an impact on the quality of the fruit and vegetables that reach the supermarkets.

In recent years, some of the most commonly used micro-organisms are microalgae, seaweed and cyanobacteria. In Andalusia, companies dedicated to the commercial production of microalgae are located. Its facilities are sophisticated and make significant efforts in research, development and innovation. The destination of the microalgae produced is agriculture, human nutrition, animal feed (including aquaculture), biofuels and cosmetics, among others [15].

Main opportunities here relay on process full optimization and in the development of both growth and processing processes that are sustainable.

Players: Trichodex, Biorizon, Algaenergy, Algades, MCA Algas y derivados, Kimitec, among others.

Bioactive ingredients (Extraction industry)

In Andalusia there are a large number of biotech companies dedicated to the research, development and commercialization of new active ingredients, nutraceuticals and functional foods. These ingredients include the use of probiotics, oils rich in omega 3 or those obtained from vegetable products such as garlic, soya, carob, rosemary or berries.

Scaling-up properly these processes and having access to large volumes of biomass (which is usually scattered over the region since Andalusia has a large extension with lots of rural and coastal areas), ensuring its quality and stability during transportation becomes a key aspect in order to boost this industry.

Players: DOMCA, Biosearch Life, Deretil Nature, among others.

4.1.3.1 *Dedicated analysis of BIOSWITCH replication potential*

Brand owners in the sectors analysed have a different level of maturity in their transition to bio-based approaches. The BIOSWITCH toolbox can support Andalusian brand owners in their transition thanks to the diverse nature and scope of included tools.

The following are the most appropriate tools for each of the sectors described above:

Profile 1. Brand owners from primary sector. Large cooperatives have started to work on bio-based approaches, but in general this is a sector that is just starting the transition. The Learning and Awareness tools can be very useful to understand what it implies. Tools like the one for busting myths of the hall of fame can help in tackling their fears and doubts, and could also provide some inspiration. Also, the BIOSWITCH sustainability assessment tool can help them to compare the improvement they would get. They may also benefit from the tools created to encourage consumer awareness of the added value of bio-based products compared to fossil-based counterparts.

Profile 2. Brand owners from the agri-food industry interested in by-products and waste valorisation. Two groups of brand owners can be identified for this profile. Profile 2.a are brand owners from the agri-food sector that are at the medium stages of the bio-based transition journey. The BIOSWITCH adoption tools can be useful for them in order to consolidate their transition to bio-based processes and products. They could use the sustainability assessment tool to assess the positive environmental impact of by-product or side stream utilisation. The "build me the value chain" service or the "online matching service" can help them to find partners for the development of new technologies or to find solutions to challenges. For these partners it would be very interesting to use the Who can help me? Tool in order to connect with RTD centres and universities or other organisations that could help them in identifying the bioeconomy potential of their processes.

For the profile 2.b group, tools from the Consolidation group would be the most advisable one. Specially the one for open innovation since these companies could benefit from a stronger cooperation with the rest of their innovation ecosystem in order to share the risk and decrease the time-to-market of their new product and processes. Moreover, the tool that aims to create awareness among the brand owner staff can be a key aspect in the consolidation of the bioeconomy activities of the company at internal level.

Both groups may also benefit from the tools created to encourage consumer awareness of the added value of bio-based products compared to fossil-based counterparts.

Profile 3. Brand owners from biotechnology companies producing bio-based alternatives. Brand owners in this sector are fully engaged to switch to bio-based approaches. The most suitable BIOSWITCH tools for them are the consolidation tools. Open innovation tools would allow them identifying new business opportunities and access new markets, improve their positioning, etc. since they could establish new connections with other brand owners whose challenges concerning bioeconomy implementation they can solve. Also, the adoption tools, "build me the value chain service" or "the online matching service" described in profile 2 are useful for this profile. Finally, the sustainability assessment tool would allow them to assess the environmental improvements that their products could have, being this a powerful contribution to the Unique Selling Proposition of their products.

Profiles	Bio-based readiness level	BIOSWITCH Toolbox assessment
Primary sector Agriculture Livestock producers Fisheries, aquaculture and the blue economy	Rookie	<ul style="list-style-type: none"> • Learning and Awareness tools • BIOSWITCH Sustainability assessment tool • Consumers tools
Agri-food industry	Player	<ul style="list-style-type: none"> • Adoption tools: specially, BIOSWITCH Sustainability assessment tool, Build me the value chain services, Online matchmaking service • Consumer tools
	Most experienced player	<ul style="list-style-type: none"> • Adoption tools: BIOSWITCH Sustainability assessment tool, Build me the value chain service and Online matchmaking service

		<ul style="list-style-type: none"> • Consolidation tools. Specially, open innovation tool to find new collaborators • Consumer tools
<p>Biotechnology companies producing bio-based alternatives</p> <p>Agro-biotech companies Bioactive ingredients (Extraction industry)</p>	<p>Most experienced player</p>	<ul style="list-style-type: none"> • Consolidation tools: Open Innovation tool to find new clients • Adoption tools: BIOSWITCH Sustainability assessment tool (to have knowledge about benefits and use it for better USP of their products), Build me the value chain services, Online matchmaking service

Table 1. Dedicated analysis of BIOSWITCH Toolbox replication potential for Andalusia

4.1.4 Regional overview of other users in the value chain amenable to bio-based transition

Firstly, it is worth delving into the SWOT analysis considered in the ACBS in order to see how BIOSWITCH Toolbox could support tackling the challenges identified there. Concerning the generation and availability of biomass sources and the development of new processes, it is identified as a challenge the limited knowledge of features from a wide variety of resources. Also, it is pointed out the lack of adapted technological developments to each type of biological resource. These aspects have big influence in the fact that the region has little development of biorefineries bio-based industries. From the Toolbox, the “Who can help me?” tool could bring some assistance here since it could connect companies that have biomass sources (with unknown potential) and that are looking for new valorisation processes with relevant actors like technology developers, universities and RTD centres.

Moreover, regarding the development of new markets for bioproducts, there is a deficiency for innovation in business culture which makes difficult the technological adaptation to new products and manufacturing processes. In this case, the Open Innovation enabler tool could support companies by providing some awareness and capacity building around open innovation culture and how to best interact with the surrounding ecosystem.

About communication, the ACBS points out that there is some misinformation from citizenship side about what bioeconomy means and what it implies. There are also weaknesses in the promotion of products and services related to bioeconomy fields. Here, it would be very relevant the #Iambio-based tool since this provides key insights on how to better communicate to consumers these aspects.

Lastly, about financial support and policy making, there is a lack of knowledge about bioeconomy due to certain circumstances in other regional ministries and in the public sector (as a rule of thumb). Learning and awareness tools could be used in order to carry out some capacity building among civil servants.

Secondly, from a stakeholder groups perspective and aside from brand owners, there are other actors in the Andalusian region that can benefit from BIOSWITCH Toolbox. Following the quadruple helix approach, the following stakeholder groups can be identified: (1) private sector; (2) policy makers and public bodies; (3) academia; and (4) consumers.

Regarding the private sector, besides brand owners, there are other private companies that can benefit from project results. For start-ups and entrepreneurs developing new processes, services and products in the frame of bioeconomy, the tools related to Learning and awareness can provide them valuable insights about brand owners needs and challenges. This will allow them to better shape their offer and portfolio since they could become aware of brand owners desires, requirements and expectations. Another key actor group from the private sector are materials providers, e.g., packaging producers. In order to make possible the bioswitch journey for brand owners, it is important that the rest of the surrounding supply and value chain is fully aware of bioeconomy and circular bioeconomy practices. For packaging and materials manufacturers, tools under learning and awareness category could be relevant in order to get closer to brand owner needs. Moreover, the tool for Sustainability assessment could become a key tool for them since this can be used under a collaborative approach. This means that the bio-based packaging producer can introduce its own data in the tool and collaborate with the brand owner in assessing the sustainability potential of their products, together with the whole production loop of the brand owner products.

Concerning policy makers and public bodies, main organisation related to bioeconomy and circular bioeconomy is the Regional Ministry of Agriculture, Livestock, Fisheries and Sustainable Development. They have been in charge of developing the current Circular Bioeconomy Andalusian Strategy, being right now focussed on its implementation. Moreover, the region is currently in the process of going from S3 (Smart Specialisation Strategies) to S4 (Smart Specialisation Strategies for Sustainability). Although the regional policy makers are well aware of bioeconomy and circular bioeconomy principles, they could benefit from the “Busting myths about switching to bio-based” tool since this could provide them valuable information for policy shaping and also when developing incentives related mechanisms and financing schemes. From the adoption tools, the methodology and procedures used for the pan-EU event could be used as well by the regional ministry when trying to boost and enhance regional cooperation among key actors.

As for public bodies, there are two organisations that outstand in Andalusia concerning bioeconomy and the agri-food sector. These are the AGAPA - Agencia de Gestión Agraria y Pesquera de Andalucía (Andalusian agency for farming and fishing management) and the IFAPA. AGAPA is a supporting organisation for the regional ministry and could therefore benefit from the same tools. As for IFAPA, this is a public RTD centre organisation and could therefore benefit of using the “Who can help me?” tool in order to promote itself as a supporting organisation for regional brand owners and, also, to find potential collaborators for further RDI projects in the bioeconomy and circular bioeconomy area.

From the academia side, there are 10 different universities in Andalusia with ca.550 research groups devoted to bioeconomy related areas. Moreover, there are several research centres that include bioeconomy related fields in their research agenda, e.g., ANDALTEC (Plastic Technological Centre). Same as for IFAPA, these organisations could benefit from the “Who can help me?” tool.

From the consumers side, the main organisation in Andalusia is the Unión de Consumidores de Andalusia (Andalusian Consumers Union). They have been involved in the project as part of the Advisory Board and have been regularly updated about the most suitable tools that could benefit Andalusian consumers. Currently, and according to the conclusions from the ACBS, there is low consumer engagement concerning bioeconomy aspects. Therefore, Andalusian consumers could

benefit from “Consumers and bio-based: a love story”, “We are all bio-based”, “Consumers perspective on bio-based products and brands” and also “Understanding consumer perspectives of bio-based products”. The Glossary that has been produced in the frame of the project could be useful for them as well.

In addition, there are other regional structures that are relevant for the bioeconomy regional development. These are the Andalusian bioeconomy cluster and the Digital Innovation Hub (DIH) Agrotech. Both the cluster and the DIH could register in the “Who can help me?” tool in order to increase their outreach among Andalusian companies. As for the cluster, this is still in a preliminary phase, but it is foreseen that it provides a set of services related to technical and regulation support concerning bioeconomy and circular bioeconomy. It could benefit then from the train-the-trainer programme in order to spread the word among its members on how to use the BIOSWITCH Toolbox and its linked benefits. Also, the cluster will also provide specific training and will conduct capacity building around these topics. Therefore, the cluster could benefit from using the BIOSWITCH tools for Learning and awareness by including them in their training and capacity building programs. As for the DIH Agrotech, this is mostly related to digitalisation of the agri-food sector. Bioeconomy and transition to bio-based approaches could be a complimentary aspect that would boost and consolidate the growth of regional companies. Sometimes, companies that in a transformation process tackle not only digitalisation but other aspects linked to sustainability so bioeconomy could be a relevant issue for them. Therefore, the DIH could benefit from Learning and awareness tools.

4.2 Denmark

4.2.1 Background

Denmark is a country in Northern Europe made up of a peninsula (Jutland) and more than 400 islands. A great part of the country is surrounded by sea and there is no place with more than 100 km to the coast. To the South Denmark is connected to Germany, which is the main gateway to Central and Southern Europa. Neighbouring countries to the North and East are Norway and Sweden which can be reached by boat or bridge respectively. The capital of Denmark is Copenhagen, which is located on the largest of the islands (Zealand).

The total area of Denmark is 42,943 km² and with a population of 5.87 million people the population density is 137 inhabitants per km². This makes Denmark to the most densely populated country in the Northern region. Denmark’s geography is characterised by flat, arable land, sandy coasts, and temperate climate.



Figure 13. BIOSWITCH region: Denmark

Since 1945 Denmark has developed from a predominantly agricultural country to a country with an industrial base and large service sector. Major industries include wind turbines, pharmaceuticals, medical equipment, machinery and transport equipment, food processing, and construction.

The GDP of Denmark in 2021 was 57.350 EUR per capita in current prices. For comparison the average GDP per capita for the EU (EU-27) in 2021 amounted to 32.270 EUR [16]. The three sectors with biggest contribution to GDP are Trade and transport (23%), Public administration, education, and health (21%) and Manufacturing (15%). The agriculture, forestry, and fishing-sector only contributes with around 1% of total GDP.

4.2.2 National bio-based transition status

4.2.2.1 Land use in Denmark

The Danish soils, landscape, and climate are providing good conditions for farming activities and a relatively large share of the area is used for cultivating crops. The farmed area has been slowly decreasing during the last decades due to reforestation and area used for roads and buildings. Still, the share of the total area used for agricultural crops is around 60%, which can be seen in next figure.

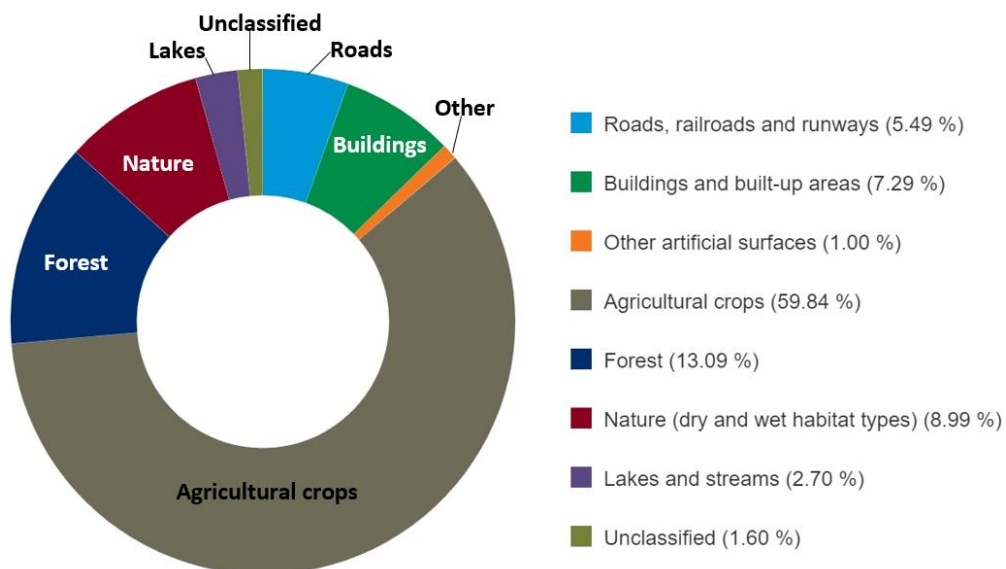


Figure 14. Land use in Denmark in 2018 [17].

4.2.2.2 *Main sources of biomass*

As a result of the present land use the agricultural crops constitute the largest source of biomass in Denmark. The crops grown are mainly starch crops, but also oil crops and sugar crops are grown in Denmark. In addition to the main feed and food products the farmlands are also providing large amounts of residue biomass like straw and maize stalks.

Even though the forest area is slowly increasing, the amount of biomass delivered from the Danish forests is much smaller than the amount of biomass produced on farmed areas. Due to the limited amount of forest-based feedstock the wood processing industry is small in Denmark. There is, however, a small number of sawmills and shipboard industries.

Denmark is characterised by a large livestock production for a small country, and this forms the basis for a large meat processing industry and a large dairy industry. Denmark is home to big food brand owners like Danish Crown and Arla Foods, which are selling their products in many countries all over the world. This is one of the reasons for the Danish agri-food sector being a major contributor to the export earnings. Almost 25% of Denmark's export earnings come from agri-food products [18]. Historically Denmark has been very active in both fishing and aqua culture. This has resulted in a relatively large fish processing industry and a big export of seafood products. Both the primary livestock production, the dairy industries, and the meat and fish processing industries are providing large amounts of secondary biomasses, which can be used as feedstock for the bio-based industry.

4.2.2.3 *The National Bioeconomy Panel*

There is no official bioeconomy strategy for Denmark and there are presently no plans to develop such a strategy. However, in 2014 the Danish government established the so-called National Bioeconomy Panel.

The National Bioeconomy Panel consists of approximately 20 members representing universities, research and technology organisations, industrial organisations, NGOs, and other organisations with knowledge and interest in bioeconomy. The task of the National Bioeconomy Panel is to provide recommendations to the Danish government on how to accelerate the development of a sustainable bioeconomy. These recommendations shall be made considering factors like economy, job creation, environment, nature, and climate.

In general, the National Bioeconomy Panel considers that there is a strong basis for further development of the circular bioeconomy in Denmark:

- Large amounts of feedstocks, which can be used for the bio-based industry and there is even a potential to increase the amount of biomass produced every year.
- Strong research competences within e.g., sustainable biomass production, food processing, biotechnology, and biorefining.
- World leading private companies within e.g., enzymes, food ingredients, feed additives, and logistics.

The National Bioeconomy Panel operates after an annual work cycle. Each year the panel shall focus its work on a new subject related to the development of the bioeconomy. During the year analyses and reports are made. Sometimes these reports are made by the panel itself and sometimes by

external consultants. Results of the undertaken analyses are discussed in a series of workshops and finally the recommendations on that year's subject are described in a report, which is sent to the government.

In EC Joint Research Centre's Technical Report "*How big is the bioeconomy?*" the authors have calculated the contribution of the bioeconomy to the total GDP in six EU member states and in EU-28. The calculations show that in Denmark the bioeconomy contributes 11% of the total GDP. This is the same contribution as in the EU-28. Romania, Poland, Spain, and Finland are examples of countries where the contribution from bioeconomy is higher [19]. Another finding from the abovementioned Technical Report from Joint Research Centre is that differences are seen regarding the individual industry's contribution to the bioeconomy GDP. For Denmark the contribution of crop and animal production to the bioeconomy GDP is relatively low compared to the five other countries. On the other hand, in Denmark the contributions from pharmaceutical industry and from the wholesale trade are higher than the other 5 countries.

4.2.3 National bio-based transition potential for brand owners

Over the last few years many initiatives have been made in Denmark to increase and improve materials recycling:

- Development of more effective systems for collection and recycling of materials
- Redesign products so they are better prepared for recycling
- Legislative requirements for the municipalities to improve source sorting of waste

These initiatives indicate that priority number one is to close the carbon cycles in order to minimize "leakages" of carbon. In other words, carbon recycling is normally considered more sustainable than the use of bio-based materials. On the other hand, it is also well acknowledged that carbon leakages cannot be avoided. The carbon cycles cannot be 100% closed and there will always be a loss. Therefore, there is a need to constantly add new sustainable carbon in the form of bio-based materials to the carbon cycles.

There also seems to be consensus that when biomass is used for making polymers it is preferable to make drop-in polymers, which are identical to synthetic, fossil-based polymers. The advantage of drop-in polymers is that they can be used in the same production and recycling systems as fossil-based polymers. If biomass instead is used for production of new bio-based polymers, then new production and recycling systems have to be developed and applied.

Another trend in Denmark as well as in the EU is the increased focus on utilization of secondary biomass. That is biomass produced during the processing, conversion or decomposition of primary biomass and organic material. Examples of secondary biomass are microbial biomass, residues from agriculture, residues from forestry and forest-based industry, residues from aquatic biomass, residues from recycled bio-based products, and other organic residues. The most common opinion in Denmark is that bio-based polymers and other bio-based materials should be made out of secondary biomass instead of using agricultural crops for polymers.

With regards to the problem of contamination of the nature and the seas with microplastic the predominant view in Denmark is that the best solution is to avoid that plastic ends in the nature. In other words, it is seldom the best solution to make bio-based plastic/bio-based polymers which are designed to be easily degradable in nature. On the contrary, durability and the ability not to be easily degradable are desired properties of bio-based polymers.

In Denmark there is a wish among most brand owners in all sectors to develop processes, products, and value chains, that are more sustainable. It is quite normal to see brand owners raising the bar and commit to sustainability goals, which are more ambitious than the national goals decided by the Danish government.

The Denmark-based dairy company, Arla Foods, is an example of brand owners raising the "sustainability bar". Arla Foods developed and committed itself to a very ambitious target for reduction of carbon footprint more than one year before the Danish government announced its climate targets for the agricultural sector. In addition, Arla Foods' greenhouse gas reduction target is more ambitious than the government's reduction target.

Part of the reason for brand owners' interest in sustainability is that they experience more and more consumers, who prefer products and services, which can be made and delivered with a less negative impact on climate, environment, and biodiversity. However, some brand owners also introduce more sustainable products and processes because it is an essential part of their corporate social responsibly-policy to be frontrunners. In other words, sustainability is part of the company-DNA and considered a "licence to operate".

This focus on sustainability is no new trend. It has developed gradually over the last 10-15 years meaning that many Danish brand owners already have some experience with transition to more sustainable feedstock sources and more sustainable production methods and logistics.

In the following the potential for shifting to bio-based is described for specific brand owner profiles.

Brand owner profile 1: Suppliers of packaging for vegetables, fruit, meat, and dairy products

Large amounts of fossil-based plastic are used as packaging in the food industry. During the last couple of years, the Danish food producers have introduced initiatives to reduce the use of plastic. This is possible especially for fruit and vegetables since consumers now are more open to buy such food products even if they are not wrapped in plastic.

For most meat and dairy products packaging with the functional performance of plastic is used to protect the food from contamination and thereby plastic is needed to secure a long durability. In cooperation with packaging producers some food producing brand owners have analysed and tried to replace fossil-based plastic packaging with bio-based plastic packaging. Even though this is technically possible another trend is seen over the last few years.

Now most plastic packaging for meat and dairy products are made out of recycled plastic since this is considered more sustainable. The sustainable packaging targets of the brand owner Arla Foods can be given as an example. Table below describes the targets and corresponding actions [20].

Arla Foods' targets for packaging	Arla Foods' actions for packaging
<ul style="list-style-type: none"> • 100% recyclable packaging by 2025 • 0% fossil-based virgin plastic by 2025 	<ul style="list-style-type: none"> • Increase the recyclability of our packaging including converting our plastic packaging into monomaterials where possible. • Use less and better plastics by shifting to recycled or bio-based plastic and convert to fibre solutions • Collaborate with stakeholders along the entire value chain to develop new sustainable packaging.

Table 2. Arla Foods' official targets for packaging and corresponding actions to achieve these targets [20].

Brand owner profile 2: Suppliers of cleaning products, detergents and textile washing products

For products from this brand owner profile fossil-based components have been used for many years. Polymers and surfactants are examples of such fossil-based components. The industry has already started to source bio-based polymers and surfactants but there is a potential to replace much larger volumes of fossil-based components than is presently the case.

Companies belonging to this brand owner profile are taking initiatives to increase the use of bio-based polymers and surfactants. One of the main drivers for this development is the demand for products with a smaller carbon footprint. Therefore, it is central that the effect on carbon footprint by switching to bio-based can be properly documented using acknowledged methodologies.

It should be mentioned that the number of private companies in Denmark within this brand owner profile is relatively small. Besides, the Danish producers of cleaning, detergents, and textile washing products are typically sourcing polymers and surfactants from foreign suppliers.

Brand owner profile 3: Producers of textiles for clothes, furniture, and other purposes

Over the last years there has been an increasing focus on achieving more sustainable textiles in Denmark. The Danish Environmental Protection Agency has initiated a number of research and development projects to explore the potential for reducing the textile industry's use of fossil-based polymers and at the same time to make the textile industry (including the fashion industry) less dependent on cotton produced at high environmental and social costs.

Brand owners working with textiles comprise both designers and producers of clothes and designers and producers of furniture and carpets. Even though many of these brand owners over the last years have taken initiatives to increase the use of bio-based feedstocks for textiles there is still a long way to go.

Brand owner profile 4: Producers of children's toys

When people buy presents for kids many people prefer toys with a green profile, but many of the popular products cannot be made without plastic. There is a wish among Danish producers of children's toy to shift to more sustainable feedstock for producing plastic toys. Application of recycled plastic or bio-based plastic are two ways of reducing the use of virgin fossil-based plastic.

One of the major global players in the Children's toy industry is the Danish brand owner LEGO. The ambition of LEGO is to make "...bricks from sustainable sources by 2030 without compromising on quality and safety." [21] On its company website LEGO describes what they consider as a sustainable source: "For the LEGO Group, a sustainable material must be responsibly produced, using renewable or recycled resources, generating little or no waste, use sustainable chemistry and be fully recyclable at the end of its life, while meeting our high standards for safety, quality, and durability. We are joining forces with suppliers, research institutions and other industries to develop these new materials for LEGO bricks of the future." [21]

Based on the recent statements from LEGO it seems that the company will mainly use recycled plastic, but they might also use bio-based plastic for some of their products.

Brand owner profile 5: Suppliers of cosmetics and personal care products

There seems to be a wish among Danish brand owners within cosmetics and personal care products to replace fossil-based components like for instance polymers with bio-based components. One of most important drivers for this development is a wish to reduce the carbon footprint of the product. However, some brand owners also express that they would like to use bio-based components because many consumers consider bio-based components more "natural" and less "synthetic".

Brand owner profile 6: Producers of construction materials

In Denmark there is increasing attention from politicians and consumers to reduce the climate impact from buildings. This leads to a growing interest for bio-based construction materials since such materials could reduce the carbon footprint of new buildings. This is both because bio-based materials in many cases will be less energy demanding to produce and process into building materials. In addition, when bio-based materials are used for buildings carbon, which is taken up by the plants during their growth will be stored for a long period of time as an element in a building with a lifetime of 50-100 years or even longer.

Brand owner profile 7: Suppliers of fertilisers, pesticides, and bio-stimulants

Nitrogen mineral fertilisers require a lot of energy to produce and that results in a relatively large climate footprint. In addition, increasing energy prices lead to increasing prices of the fertilisers. Both these factors give incentives to switch to bio-based fertilisers. Also, when it comes to pesticides there is a growing interest for development of bio-based alternatives to the fossil-based pesticides. Finally, there is a growing interest in using bio-stimulants in the crop production and this can potentially lead to reduced need for pesticides.

4.2.3.1 *Dedicated analysis of BIOSWITCH replication potential*

Several of the communication tools in the BIOSWITCH toolbox are relevant and useful for many brand owners throughout all sectors. Some examples of the most relevant communication tools are:

- **Consumers and bio-based – a love story:** This tool provides valuable insights to the perception of consumers regarding bio-based products. It includes information about incentives for consumers to purchase bio-based products instead of fossil-based products.
- **Understanding the main barriers:** This tool presents the results of a study on perceived risks and barriers for brand owners to shift to bio-based. The tool also includes information on how to overcome the barriers and information to support brand owners to bust some of the myths about bio-based products.
- **BIOSWITCH glossary:** This tool is a help for brand owners to navigate safely among the many terms and concepts involved when discussing sustainability and bio-based products.
- **#IAMBIO-BASED:** For brand owners with limited experience with social media this tool provides useful guidelines and customisable messages and materials to communicate with consumers and customers via key social media channels like Twitter, Instagram, Facebook, and LinkedIn.

The **BIOSWITCH sustainability assessment tool** can be used for instance to simulate material changes in a specific production process of a given brand owner and the effect on carbon footprint can be seen. The sustainability tool is relevant for many of the brand owner profiles since a reduced carbon footprint or other environmental benefits often constitute main drivers for shifting to bio-based.

However, it is assumed that the sustainability assessment tool is especially relevant for brand owner profiles still in the early phase of planning the transition to bio-based. Therefore, the sustainability tool is judged to be extra relevant for brand owner profiles active within product categories like:

- Cleaning products, detergents and textile washing products
- Textiles for clothes, furniture, and other purposes
- Children's toys
- Cosmetics and personal care products
- Construction materials

Both the **Build me the value chain-service** and the **Online matchmaking service** are probably most relevant for sectors characterised by many actors including often both small, medium, and large enterprises. It is assumed that brand owners operating in very specialised sectors will not benefit very much from the two mentioned value chain-tools since they already know all relevant suppliers, consultants, and researchers within their field. That is probably the case for the children’s toy industry, the household cleaning and textile washing industry, and the fertiliser industry.

On the other hand, the Build me the value chain-service and the Online matchmaking service is judged to be relevant for brand owners within product categories like:

- Packaging for vegetables, fruit, meat, and dairy products
- Textiles for clothes, furniture, and other purposes
- Cosmetics and personal care products
- Construction materials
- Fertilisers, pesticides, and bio-stimulants

The table below summarises the BIOSWITCH replication potential for the seven identified brand owner profiles.

Profiles	Bio-based readiness level	BIOSWITCH Toolbox assessment
1. Suppliers of packaging for vegetables, fruit, meat, and dairy products	Rookies	Communication tools
	Players	Value chain building tools
	Most valuable players	Open innovation tools
2. Suppliers of cleaning products, detergents and textile washing products	Rookies	Communication tools
	Players	Sustainability tool
	Most valuable players	Open innovation tools
3. Producers of textiles for clothes, furniture, and other purposes	Rookies	Communication tools
	Players	Sustainability tool, value chain building tools
	Most valuable players	Open innovation tools
4. Producers of children’s toys	Rookies	Communication tools
	Players	Sustainability tool
	Most valuable players	Open innovation tools
5. Suppliers of cosmetics and personal care products.	Rookies	Communication tools
	Players	Sustainability tool, value chain building tools
	Most valuable players	Open innovation tools
6. Producers of construction materials	Rookies	Communication tools
	Players	Sustainability tool, value chain building tools
	Most valuable players	Open innovation tools
7. Suppliers of fertilisers, pesticides, and bio-stimulants	Rookies	Communication tools
	Players	Value chain building tools
	Most valuable players	Open innovation tools

Table 3. Dedicated analysis of BIOSWITCH Toolbox replication potential for Denmark

4.2.4 National overview of other users in the value chain amenable to bio-based transition

In addition to brand owners there are other types of stakeholders who could benefit from the BIOSWITCH toolbox in order to accelerate the transition from fossil-based to bio-based products and approaches.

Private companies other than brand owners. Private companies which are not brand owners can also benefit from several of the tools in the BIOSWITCH toolbox. That is for instance start-up companies and companies which focusses on production of intermediates and product components instead of final branded products. Such companies can benefit from both the communication tools and the BIOSWITCH sustainability assessment tool. In many cases such companies can also benefit from the value chain building tools as well as the open innovation tools.

Investors. Business angels and representatives from venture capital associations can benefit from the BIOSWITCH communication tools to learn about e.g., the risks, barriers and potential benefits of shifting from fossil-based to bio-based approaches. In addition, the BIOSWITCH sustainability tool can be used to examine different scenarios for shifting from fossil-based to bio-based product components for the company in question. Such information is providing useful information about the business potential of a specific private company and thereby the attractiveness of an investor doing an investment in that specific company.

Industrial associations. There are many industrial associations, which could benefit from the BIOSWITCH communication tools in their work to influence policy makers to secure good framework conditions for their member companies. Examples of such industrial association are The Danish Food & Agriculture Council and the Danish Plastics Federation.

Policy makers and public bodies. The BIOSWITCH communication tools are relevant for policy makers, and employees in public bodies involved in defining framework conditions like regulation and subsidies. The tool "Understanding the barriers" is important particularly for Danish and EU politicians to inform them about barriers for shifting to bio-based approaches and to suggest different actions for the politicians to overcome these barriers.

Consumer organisations. Consumers can play an important role in accelerating the transition to the bio-based economy since they have the possibility of selecting bio-based products instead of products based on fossil resources when they go shopping. However, to motivate consumers to shop bio-based they need information about the benefits for the environment and climate when choosing bio-based products. Several of the BIOSWITCH communication tools are relevant to increase consumers awareness and knowledge about bio-based products.

Research and development institutions. Employees and students at the Danish universities and research and technology organisations could benefit from several of the tools developed in the BIOSWITCH project. The sustainability assessment tool can be used to analyse different options for replacing fossil-based components with biobased components. Also, the Open innovation tools are relevant and useful for researchers cooperating with brand owners. Copenhagen University, Aarhus University, Danish Technological University, Aalborg University, and Danish Technological Institute

are all examples of organisations, which are doing research and innovation activities within biorefining and biobased products.

4.3 Finland

4.3.1 Background

Finland is a Scandinavian country located in the Northern Europe, reaching from the Baltic Sea all the way to the Arctic Circle and has a total area of over 338.000 km². Finland has a population of about 5,5 million, which totals up to 18,2 inhabitants per km². Finland is part of the EU (since 1995) and United Nations (since 1955). Finland uses the Euro as its currency.

Finland has been awarded as the Happiest Country for 5 years in a row. Some known key features about Finland is that there is free (financed by the state) and high standard for education, and social security as well as health care. Finland is also known to be the land of thousand lakes - over 187 000 lakes, over 10 % of Finland's total area is covered by sweet water. Unofficially, Finland is also known as the land of thousand engineers and innovations as it has over 200.000 engineers – 60.000 Masters of Science in Technology and 115.000 engineers. Finland has strong research, development and innovation knowhow.

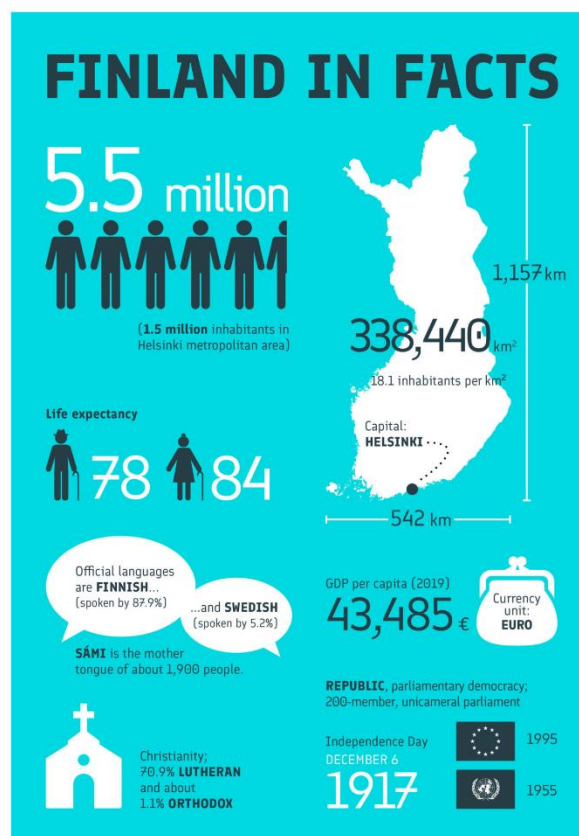


Figure 15. Finland in facts (2021)[22]

The GDP per capita in 42.936 € (2020). The main industries in Finland produce exports for electrotechnical goods, metal products, machinery, transport equipment, wood and paper products, as well as chemicals. Finland imports raw materials, investment goods, energy and consumer goods like cars and textiles.

The wood and paper products as well as chemicals are an important part of Finland's industry. Finland is covered by more than by 75 % of forests. Finland is the most forested country in Europe, hence, has a very long history of forest industry being one of the key industries in Finland. About 7 % of the land area is agricultural land.

4.3.2 National bioeconomy and bio-based transition status

In 2019, the bioeconomy generated EUR 26 billion of value, which is about 13 % of the value added generated in Finland's economy [22]. In the next figure, Finland's share of bioeconomy sectors and the division of the value added between sectors in 2019 is presented. The bioeconomy is mostly created from the forest sector, food sector, other industries, energy, construction, water treatment and supply as well as bioeconomy services. In 2019, the bioeconomy sector employed a total of 301.900 people, which is about 11 % of total employed in Finland. [22]

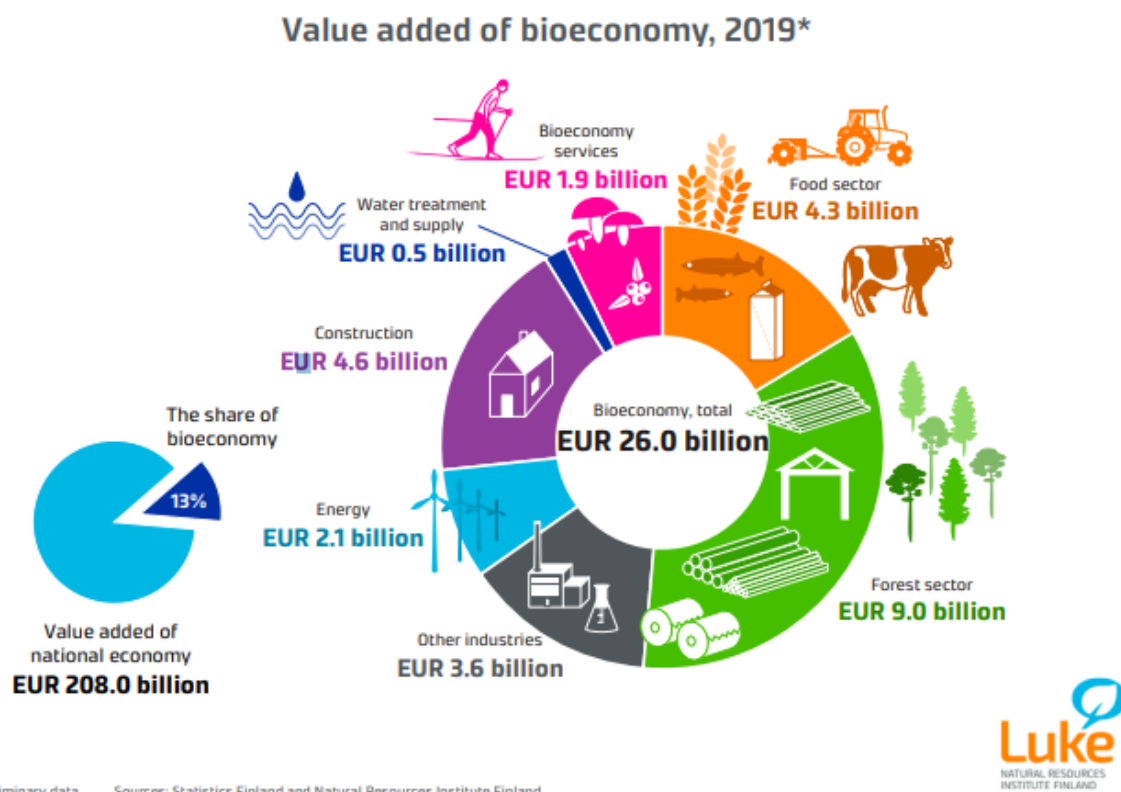


Figure 16. Share of bioeconomy sectors and the division of value added between sectors in Finland 2019 [22]

Finland is a key actor in the development of the European bioeconomy as it has both the natural resources as well as human resources and expertise. The Finnish population is highly educated and skilled, crossing over from chemistry, material, and processing expertise to ICT. Finland's strategic priorities for bioeconomy are based on 1) usability and sustainability of bioresources and other ecosystem services, which lays the foundation for 2) strong competence and technology base, and 3) competitive operating environment, which all together lead to 4) higher value added from the Finnish bioeconomy.

4.3.2.1 Forest industry

The forest industry is a substantial source of jobs in Finland. Finland has approximately 5,5 million people and the forest industry has an employment impact of 74.000. About 20 % of Finnish exports

is reliant on forest industry – Finnish forest industry products are distributed globally, and the export value was EUR 10,4 billion in 2020.

Distribution of export market for Finnish forest industry products in 2020

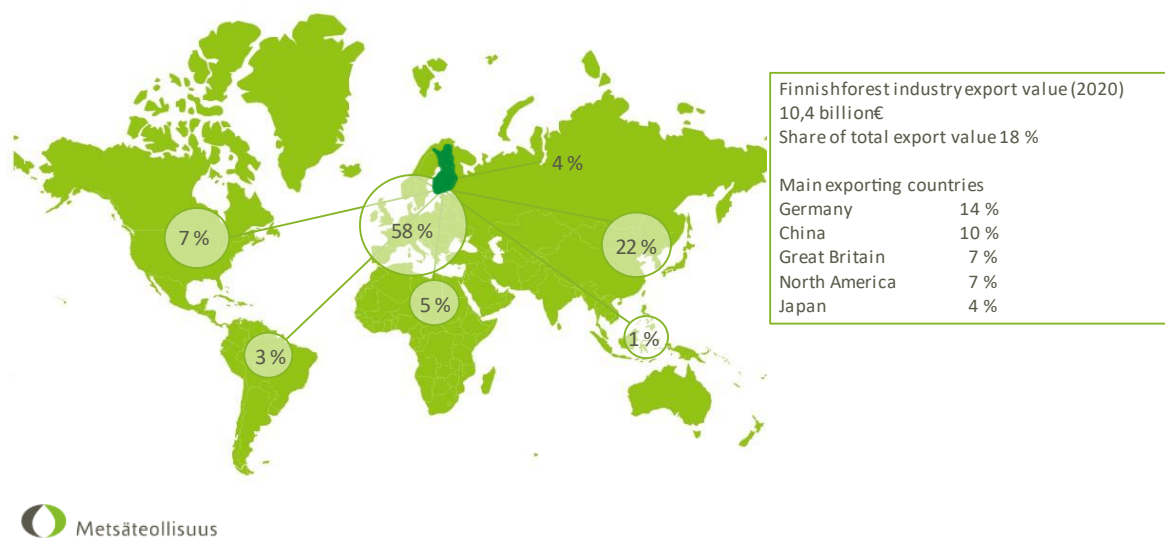


Figure 17. Distribution of Finland's forest industry product exports in 2020. [23]

The forest industry is a key sector in producing traditional and novel products to replace fossil-based materials. It is estimated that the total added value of forest industry could be further increased, which in turn is expected to further increase the role of the forest industry in slowing down climate change. The forest industry is expected to have a significant role in Finland's carbon neutrality target by 2035. Currently, the annual and global climate benefit of forest industry products made from Finnish-grown wood is over 16 million CO₂ tonnes. This amount is five times higher than the direct emissions of forest industry mills and constitutes more than one third of the emissions produced by Finland on the whole. [24]

Finland is a forerunner in sustainable forest management – from ecological, economic and social perspective. The Finnish forests are managed so that the forest resources grow all the time despite the high production levels. Of the annual growth of wood, about 70 % is only used. 90 % of Finnish forests are PEFC certified, which is proof of good forest management and the sustainable origin of timber as raw material. In addition to forest certification, the diversity of commercial forests is supported by the Forest Biodiversity Programme (METSO), which is based on the voluntary conservation of private forests. Majority of the Finnish trees are pine (approximately 50 %), spruce (30 %) and deciduous (20 %). There are about 740 000 forest owners in Finland and the medium size for owned forests is 30 hectares. [24] More than half of Europe's strictly protected forests are in Finland [25].

Agriculture and food and drink industry in Finland

In 2018, Finland has about 49.200 farms (agricultural and horticultural enterprises), with an average land size of over 45 ha. Agriculture provides employment for 118.000 people in Finland. Most of the farms in Finland are family-run (86 %), and it is common for the farms to also own forest.

Finland has about 2,3 million ha of arable land. About half of the area is used to cultivate crops such as wheat, oat, barley, and rye; and about half is used for herbage, oil- and protein crops, vegetables, root vegetables, and so on. About 70 % of farms have crop production as the production line, and about 25 % are livestock farms. From livestock for meat, fur, wool and bioeconomy services, Finland has milk and meat cattle, pigs, chicken/poultry, sheep, horses, reindeer, and fur animals. For example, Finland has approximately 900.000 cattle, of which about a third is producing milk; 1,3 million pigs; 4 million chickens; 130.000 sheep; and about 74 000 horses. Organic farming is increasing steadily in Finland, already by 2017 the organic farming's share was approximately 9,5 %. Almost 90 % of Finnish farms belong to an official agri-environmental programme. [26]

From land use, grain production is the largest sector in agriculture in Finland. Finland is also one of the biggest producers and exporters of oats in the world. Dairy farming is the largest agricultural sector when it comes to turnover, 42 % of the annual agricultural sales revenue came from milk. The total agricultural sales revenue is about EUR 2,5 billion. The total share of agriculture including food industry was about 3,5 %, EUR 6,1 billion of the Finnish GNP. [27]

The foodstuffs (food and drink industry) in Finland employ over 38.000 people and is operated by 1700 companies. The indirect employment effect is 70 000 people. The turnover in 2018 was EUR 11,1 billion, and the average profit was 4,5 %. Approximately 85 % of the production is sold at the national markets and 25 % is exported. From the exported goods, over 70 % is for the European markets. The goods exports are worth EUR 1,75 billion (2019). [28]

4.3.3 National bio-based transition potential for brand owners

The new Finnish Bioeconomy Strategy has been completed early 2022. The aim of the strategy is to double the value added of bioeconomy in ecologically, socially and environmentally sustainable manner and to make Finland carbon neutral by 2035. Bioeconomy is implemented with resource-wisdom by implementing circular economy strategies, creating higher added value from bioeconomy. Finland's targets for carbon neutrality in 2035 and halting the biodiversity as well as targets for the use of natural resources (as set in the Circular Economy Action Plan) are cross-cutting policy targets, which will affect the implementation of the Bioeconomy Strategy.

Finland's objectives for the Bioeconomy Strategy by 2035 are [22]:

- Double the value added of bioeconomy.
- Create competitive and innovative bioeconomy solutions to global problems.
- Generate business that promotes renewal both to the domestic and international markets, which will bring wellbeing to Finland as a whole.
- Increase the resource-wise use and recycling of materials and utilise side streams.
- Reduce dependency on fossil fuels and other non-renewable raw materials.
- Ensure ecological sustainability, social justice, and the renewal capacity of renewable natural resources and to strengthen broad-based competence in the bioeconomy.

- Improve and reform the technology base.

The measures to increase the value added of bioeconomy include an RDI programme for the green transition of bioeconomy and establishing innovative pilot and demonstration facilities and the first industrial-scale plants in Finland. [22] The implementation of the strategy is funded through the Sustainable Growth Programme for Finland, and the implementation is on the responsibility of several Finnish ministries in cooperation with many operators. The regions play a key role in reaching the set objectives and are encouraged to draw up their own bioeconomy action plans. The Sustainable Growth Programme for Finland is funded from the EU recovery package 'Next Generation EU', and it aims to [29]:

- 1) Reduce greenhouse gas emissions.
- 2) Increase productivity.
- 3) Raise the employment rate.
- 4) Ensure quicker access to care.
- 5) Promote regional, social and gender equality.

Finland's strengths lie in extensive experience and competence in sustainable forest management and RDI; world-leading education and research in forest-based industries; established collaboration models between academia and industry from forest to feedstock processing, to material producing and novel bio-based materials, products and components; infra and expertise on extensive piloting; digitalisation and IoT knowhow; strong support for and active formation of new businesses based on renewable raw materials and circular bioeconomy; and especially expertise in paper and packaging value chains.

The global markets for forest industry products are expanding, and the growth is increasingly driven by new products [25], and Finland is in the forefront to produce the raw materials as well as process them into added-value products. Finland is targeting higher added value from development of new raw materials, manufacturing methods, products and services, resource efficiency, and by utilising side streams and circular economy operating models. There are promising developments in sectors such as forestry, food and energy production, pharmaceutical, chemical and textile industries, water supply, fisheries, aquaculture, tourism services and the natural products sector. Targeted bio-based raw materials and products include cosmetics, food materials, biocarbon, hygiene products, films and barriers, adhesives, detergents and disinfectants, packaging solutions, textiles, composites, biochemicals, biomedical and construction and carpeting materials. The aim is to reduce the need for fossil-based products and materials. [22] [25]



Figure 18. Business Finland's presentation on targeted bio-based raw materials and products [25]

The European bioeconomy requires sustainable biomass feedstocks and high added-value products and services. Finland is a major provider of wood-based feedstock as well as wood-based high-added value products, as well as a lot of research and development covering the whole value chain from primary production, conversion and processing technologies to product manufacturing. Thanks to Finland's sustainably managed forests, Finland has good capacity to supply and support the expansion of bioeconomy in Europe.

Within this context, the following brand owner profiles can be defined.

Brand owner profile 1: Forest industry – leading manufacturers of bio-based materials and products

Packaging solutions

Major bio-based material and product manufacturers from Finland are forest-companies like:

Metsä Group: A Finnish forest industry group, produces tissue, greaseproof papers, paperboard, pulp, wood products and wood supply and forest services. Products based on northern wood. Operates in 30 countries, has production in 8 countries, 6.0 billion € sales total, 9500 employees (2021) [30].

Stora Enso: Stora Enso is a leading global provider of renewable solutions in packaging, bio-materials, wooden construction and paper. They produce high-quality renewable packaging

materials on both virgin and recycled fibers. Stora Enso holds leading market positions in various packaging businesses. 23 000 employees, sales in more than 50 countries [25].

UPM-Kymmene: UPM-Kymmene is a Finnish forest industry company, that employees about 17 000 people and had 9.8 billion € turnover. It produces renewable alternatives for fossil-based materials: pulp, timber, wood sourcing and forestry, energy, label materials, speciality papers, communication papers, plywood, biofuels, biochemicals, biomedical, biocomposites [31].

Kotkamills: Kotkamills produce renewable, recyclable and repulpable packaging boards, and utilises virgin fiber in addition to side streams from sawmills. The main products are food-safe consumer boards, high-quality kraft paper, and ecological wood products [25]. Total volume of wood used at the mills was around 1.5 million cubic meters (94 % from Finland). Their turnover was 381 million € and employed over 500 employees (2020) [32].

Pankaboard: Pankaboard is a leading special carton boards manufacturer for various packaging requirements. Pankaboard has an integrated groundwood plant that utilises local fiber production in northern Karelia. In 2020, their turnover was 64 million € and employed 170 personnel [25].

Walki: Walki is a product solutions provider for consumer packaging, industrial packaging and engineered materials. Their turnover in 2021 was over 500 million €, they employ 1400 people, have 14 production plants [33].

They have global operations and sales. They produce sustainable solutions such as high-performance paperboards, plastic-free packaging for food packaging, natural cosmetics and personal care, and e-commerce, as well as cushioning, fluorochemical-free fiber packaging, bio-based foams to replace oil-based polymer foams, renewable plastic label material, sustainable, fully recyclable packaging materials for food service boards and folding boxboards with water-based dispersion technology, speciality carton boards, capseal production materials, structural elements for food underlays and tray applications, solutions to replace aluminium and plastic-based solutions, ovenable tray from renewable fibers, paper-based pouches with 100 % wood-based barriers.

Brand owner profile 2: Forest industry – smaller and emerging manufacturers of bio-based materials and products

Finland fosters smaller and emerging companies, like start-ups and spin-offs, and has a number of these types of companies in the field of bioeconomy. Examples of such companies are like Paptic (packaging), Woodyly (packaging), Sulapac (products and packaging), Jospak (packaging), Esbottle (packaging), Spinnova (textiles), Solar Foods (Food protein from air), Onego Bio (animal-free proteins via biotech such as egg white), CH Bioforce (biomass fractionation), Nordic Bioproducts Group (high-value products from cellulose via biotech), Origin by Ocean (refining marine biomass). Some next generation innovations these emerging companies produce are such as high-performing plastic-like bio-based materials, paperboard-based bottle – organic cardboard free of toxic chemicals, renewable and recyclable boards for diverse and complex applications, straws, jars, just to mention a few.

Packaging solutions

Paptic creates bio-based, recyclable, reusable and biodegradable next-generation packaging material from renewable raw materials. Paptic was established in 2015, and is a high-growth company and has been operating in industrial scale since 2018. Delivers to over 30 countries [25].

Esbottle produces paperboard-based bottles for food and drinks industry. Their first machine started in June 2021 in Finland, and further machine capacity is planned for 2022. The production is fully automated, only one operator is used to control everything, production is 2000-3000 per hour [25].

Jospak was established in 2014 and manufactures gas-tight board-based trays in Finland. The tray is a sustainable packaging solution for food industry and food service, and reduces up to 85 % of plastic use. The board and plastic is combined without adhesives.

Sulapac offers sustainable, functional and aesthetic biocomposites for injection moulding and extrusion, which are used in various applications like high-end cosmetics, luxury and food packaging, clothing hangers, cutlery, jars and straws [25].

Woodly produces carbon neutral and wood-based transparent bio-based plastic material for packaging and products to substitute fossil-based plastics. The material is recyclable [34].

Food and cellular agriculture solutions

Solar Foods produces Solein®, which is natural single-cell protein from using air and sustainably produced electricity. Carbon dioxide from air is combined with hydrogen produced with electricity as well as water, vitamins and minerals to feed and grow microbial biomass, which is used as sustainable and edible protein. The construction of the first factory is ongoing and planned to start operations in 2023. The production does not take up land, use animals, agriculture or aquaculture [35].

Ongeo Bio has raised (2022) 10 M€ seed funding to commercialise a biotechnology to produce egg white without chickens. The start-up is a ground-breaking tech company in cellular agricultural field, and can produce animal-free egg proteins without the need of animals. It is building its pilot production in Finland in the coming years and is acquiring necessary commercial approvals for its first product. The food ingredient product is ideal for baker and confectionary industry and protein supplement for example in the fitness products, but also later sold directly as a branded product to consumers [36].

4.3.3.1 *Dedicated analysis of BIOSWITCH replication potential*

The BIOSWITCH replication potential has been analysed from the perspective of these major forest-based companies as well as smaller and emerging companies, like start-ups and spin-offs, perspective. Further replication analysis from the national and other stakeholders' point-of-view can be found from the following chapter 3.4.

The major forest-based companies are well aware of the advantages of the bio-based economy. Their benefits with the BIOSWITCH Toolbox mainly lie in utilising the materials to support their customers, brand owners, to switch to their solutions. Benefits can be also gained with the BIOSWITCH Sustainability assessment tool, as their solutions can be readily compared to fossil-based counterparts.

The smaller and emerging companies, like start-ups and spin-offs, are well aware of the bioeconomy and what kind of advantages their materials and products have. It is common that resources are scarce with these types of companies, so the different matchmaking services could be more important to growing and smaller companies to accelerate business growth and expand their networks. They are also important opportunities for them to present their innovations. The readymade communication materials could be utilised to communicate about benefits of bio-based alternatives, which would save resources from start-ups/growing companies. However, with these types of companies with ground-breaking technologies, the needs for communication materials might be very specific, which would mean more tailored materials. Information on funding can also be very important for growing companies.

As a summary, a replication assessment from actors active in the packaging space can be found from the tables below with a division between the major forest companies, which are leading manufacturers of bio-based materials and products (mostly most experienced players), and then smaller and emerging manufacturers of bio-based materials and products (mostly in the player scope).

Profiles	Bio-based readiness level	BIOSWITCH Toolbox assessment
Forest industry – leading manufacturers of bio-based materials and products Packaging solutions	Most experienced players	The big forest industry companies in Finland are frontrunners in bioeconomy. Their benefits in the BIOSWITCH Toolbox lie in utilising the materials to support their customers, brand owners, to switch to their solutions. Benefits can be also gained with the BIOSWITCH Sustainability assessment tool, as their solutions can be readily compared to fossil-based counterparts.
Forest industry – smaller and emerging manufacturers of bio-based materials and products Packaging solutions	Player	The start-ups utilising forest-based resources to produce packaging are well aware of the bioeconomy and the benefits of their products. They could benefit from the BIOSWITCH Sustainability assessment tool to be able to showcase their next-generation and high-performing packaging materials' advantages. The readymade communication materials could be utilised to communicate about benefits of bio-based alternatives, which would save resources from start-ups/growing companies. The matchmaking services could be more important to growing and smaller companies to accelerate business growth.
Forest industry – smaller and emerging manufacturers of bio-based materials and products Food and cellular agriculture solutions		The readymade communication materials could be utilised to communicate about benefits of bio-based alternatives, which would save resources from start-ups/growing companies. The matchmaking services and widening existing networks could be more important to recent start-ups to accelerate business growth. With ground-breaking new technologies, the consumers and brand owners need educational and awareness raising materials. Additionally, very specific materials on ground-breaking new emerging technologies would be needed to support communication activities.

Table 4. Dedicated analysis of BIOSWITCH Toolbox replication potential for Finland

4.3.4 National overview of other users in the value chain amenable to bio-based transition

Finland's government is active in implementing ambitious national strategies and programmes. The different programmes have typically associated funding instruments, which support the research, development and innovation actions and collaboration between the academia and RTOs as well as companies across the value chains. Finland's national strategies and programmes and their connection to the Finnish Bioeconomy Strategy is depicted in the next figure. This depicts well the interconnectedness of activities across value chains and stakeholders, which is widely supported also financially in Finland. The strategies commonly have very active approach to reaching out to citizens, consumers and communities. By closely working with the strategies, citizens, consumers and communities reached. The overall implementation of different strategies can benefit from the BIOSWITCH Toolbox by having ready-made materials to support reaching the citizens, consumers and communities, and educating and increasing the awareness of bio-based solutions as well as the importance of taking up bio-based solutions in their everyday lives.

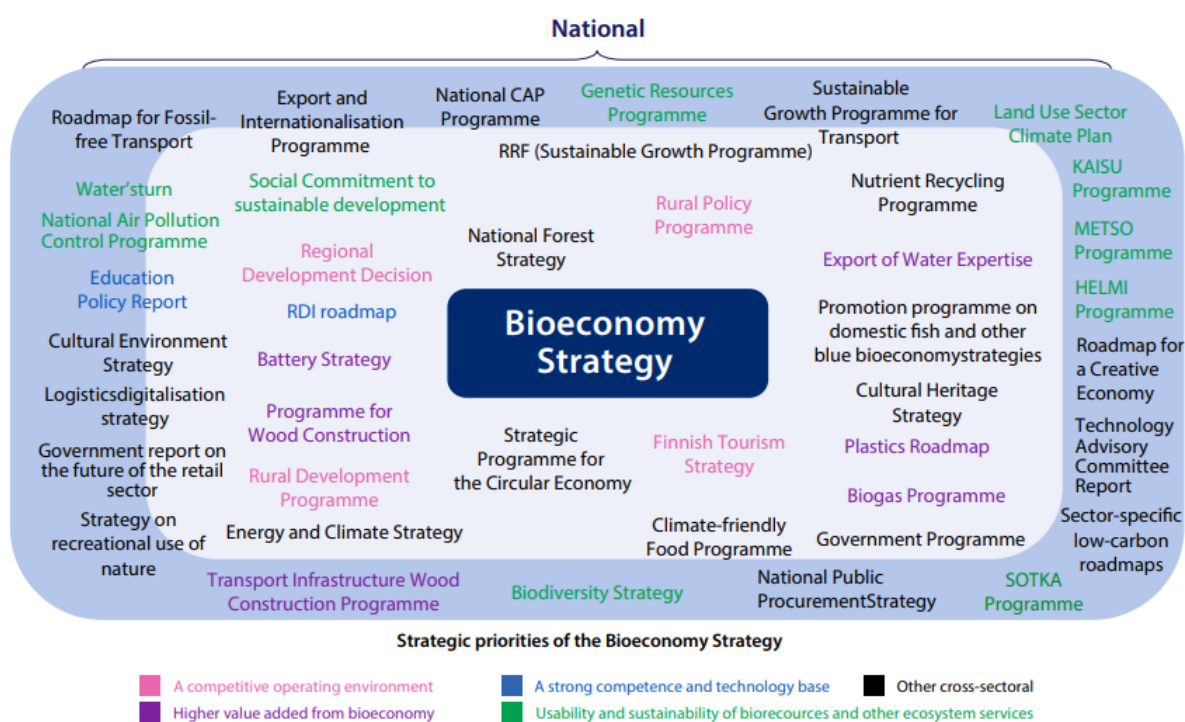


Figure 19. Finland's Bioeconomy Strategy and its interfaces with other national strategies and programmes [22]

The public stakeholders and associations as well as policy and decision makers can benefit from the BIOSWITCH toolbox in order to accelerate the transition from fossil-based to bio-based solutions. Especially the BIOSWITCH communication tools are relevant for policy and makers, universities and educational institutions in order to educate about bioeconomy and bio-based alternatives. Especially the best practices as well as the glossary are tools that are already taken up, especially in university courses. The BIOSWITCH toolbox provides ready-made materials to raise awareness about the

opportunities for shifting to bio-based and support the importance of the forest sector in the bioeconomy. The tool “Understanding the barriers” is important particularly for decision and policy makers to be able to develop a regulatory environment that supports the bioeconomy more efficiently by overcoming these barriers.

Examples of public organisations in Finland, which relate to (forest) bioeconomy in Finland [37] and other relevant actors like foundations and associations:

- **Ministry of Agriculture and Forestry** (*joint responsibility of bioeconomy*)
 - **Finnish Forest Centre:** state-funded organisation that covers whole Finland. Supports and promotes forestry related livelihoods, enforces forestry legislation and manages data related to Finland’s forests. Operates under Ministry of Agriculture and Forestry.
 - **National Resources Institute Finland LUKU:** RTO, natural resources and sustainable food production. Research activities as well as statutory official duties like monitoring natural resources, certifying plant production, inspect control agents, store genetic resources, produce data on GHG, support natural resource policies, produce Finland’s official food and natural resources statistics. Operates within the scope of activities of the Ministry of Agriculture and Forestry.
 - **National Land Survey of Finland:** state authority that deals with cartography and cadastre issues in Finland. NLS is also partially responsible to collect laser scanning data, which is used to collect information about forest resources, and analyse and monitor changes in natural environment.
- **Ministry of Economic Affairs and Employment** (*joint responsibility of bioeconomy*)
 - **VTT Technical Research Centre of Finland:** RTO, one of Europe’s leading research institutions. VTT advances utilisation and commercialisation of research and technology in commerce and society to solve global challenges. VTT is active in the creation of novel, high-performing and sustainable materials and products, technologies and processes as well as business models for circular bioeconomy.
 - **Centre of Economic Development, Transport and the Environment:** Reports and monitors the state of the environment, deals with nature conservation, landscape protection, environmental protection, use and management of water resources, steers and monitors land use.
- **Ministry of Environment** (*joint responsibility of bioeconomy*)
 - **Finnish Environment Institute SYKE:** RTO that solve questions related to the environment and conduct long-term monitoring of state of the environment and related trends. Provides data for example on water resources, the Baltic Sea, the environmental load and distractions, valuable natural environment, land cover and built environment.
- **Other actors under the Finnish Government**
 - **State Forests:** uses, manages and protects state-owned land and water areas, 12.6 million hectares of land and water areas. Tasks include nature conservation, hunting and fishing supervision and provision of recreational opportunities.

- **Tapio:** Advisory and consulting service provider owned by the Finnish Government. Services include forest management, forest resources inventory, forest management planning, forest and bioeconomy policies, and climate change mitigation and adaptation.
- **Business Finland:** Finnish governmental organisation for innovation funding and trade, travel and investment promotion.
- **The Finnish Innovation Fund Sitra:** Independent public foundation, which operates under the supervision of the Finnish Parliament. The fund promotes stable and balanced development of Finland, economic growth and international competitiveness and co-operation. They are active for example in the field of circular economy.
- **Finnish Meteorological Institute:** Operates under the Ministry of Transport and Communications. MTI produces high-quality observation and research data on atmosphere and seas, weather services and physical marine services, develops and maintains new measurement and modelling techniques for the provision of weather, marine, climate and space services and for scientific research.
- **RTOs**
 - **VTT Technical Research Centre of Finland**
 - **National Resources Institute Finland LUKE**
 - **Finnish Environment Institute SYKE**
 - **Finnish Meteorological Institute**
- **Universities and Vocational education institutions (also carrying out research):**
 - **University of Eastern Finland:** School of Forest Sciences (*BSc, 5 MSc programmes, DSc in Forest and Bioresources programme*).
 - **University of Helsinki:** Department of Forest Sciences (*BSc, 2 MSc programmes, several DSc programmes*)
 - **Häme University of Applied Sciences:** Several BScs and MSc for example in information and communication technology in bioeconomy, smart and sustainable design, mechanical engineering and production technology, smart organic farming, sustainable technologies.
 - **Jyväskylä University of Applied Sciences:** Several BSc and MSc in energy and environmental engineering, agricultural and rural industries, bioeconomy development, lifecycle management, sustainable energy.
 - **Seinäjoki University of Applied Sciences:** Several BSc and MSc in agri-food engineering, engineering, bio- and food technology.
 - **Savonia University of Applied Sciences:** Several BSc and MSc in agrology, energy engineering, environmental engineering.
 - **Karelia University of Applied Sciences:** Several BSc and MSc in engineering, natural resources, energy and environmental engineering, forestry.
 - **Oulu University of Applied Sciences:** Several BSc and MSc in water and environmental management, rural development, agrology.
 - **Lapland University of Applied Sciences:** BSc and MSc in forest management engineering, sustainable production development.

- **Forest Management Association:** Organisation for forest owners.

4.4 Flanders (Belgium)

4.4.1 Background

The northern region of Belgium, Flanders is one of Belgium's three autonomous regions. It has the city of Brussels as its capital: home to the European Commission, the EU Council, European Parliament, NATO, and other public and private international decision-making centres. In addition to ranking consistently among the world's most globalized economies, Flanders is situated at the crossroads of three major European cultures: Germanic, Roman and Anglo-Saxon. People in the region are mostly also fluent speakers of Belgium's three official languages – Dutch, French, German – as well as English. Consequently, taken together with the fact that the region is small but populous (6,5 million people living in an area of just over 13.500 square kilometres) and has a comprehensive distribution network, Flanders offers easy access to a diverse society and thus representative test market for products and concepts [38].



Figure 20. Flanders as a gateway to the EU Single Market [39]

The Flemish economy is strongly export-oriented and accounts for 83,2% of Belgium's total export in volume [39]. The strengths of the Flemish economy are amongst others a very diversified activity range, high labour productivity, very qualified and flexible working force, investments in innovation and R&D. Since the financial and economic crisis of 2009, export has steadily been growing, reaching year after year a new record. In

2017 a growth of 4.99% was noted. Almost one third of employment is working for export.

That Flanders is indeed a region rooted in R&D [40], is confirmed by the fact that the region ranks among the biggest R&D spenders in Europe and even around the globe:

- Number 10 worldwide for gross expenditure on R&D [41]
- Number 5 in Europe for R&D intensity measured as gross domestic expenditure on R&D [42]

According to the Center for R&D Monitoring (ECOOM), Flanders spent 3.35% of its GDP on R&D in 2019. This is significantly higher than the European average of 2.10%. According to the *European Innovation Scoreboard 2021* [43] Flanders (and Belgium), for the first time fall into the performance group 'Innovation Leaders' (Sweden is continues to be EU Innovation Leader and is followed by Finland, Denmark and Belgium). Key areas/ sub-regional clusters of innovation are reflected in the activities of Flanders' four leading strategic research centres: biotechnology and life sciences; product

and production technology and processes; sustainable chemistry, materials, energy, land use & health; nano- and digital technologies.



Figure 21. Flanders' four leading strategic research centres [44]

In March 2016 the Flanders Government presented its strategic outlook for the future: a long term strategy for Flanders "2050 vision" [45]. This long-term strategy aims to accelerate some of the essential societal transformations (i.e., transitions) and will require radical innovations. 7 key areas of action were identified: Circular economy transition, Smart living, Industry 4.0, Lifelong learning transition, Caring and living together transition, Mobility transition and energy transition.

4.4.2 Regional bio-based transition status

4.4.2.1 General information on the bioeconomy and its most relevant sectors, in Flanders and in Belgium

The bioeconomy of Flanders includes all activities associated with **the production of biomass and the various ways in which this biomass and its residual streams are subsequently used**. Counting the direct impact (excluding food production) and the indirect impact, that the growth in the bioeconomy has on other sectors, the bioeconomy was responsible for 2.6% of the total Flemish gross margin and 1.4% of all Flemish employment were generated by the bio-based economy in 2016 [46].

In Flanders, **bio-based products** (e.g., paper, wood, bioplastics and biochemicals) already create five times as much added value and ten times more employment than bioenergy. Almost half of the total gross margin from the bio-based economy is generated by fine chemicals, biopolymers and bioplastics. These sectors are also characterised by a high degree of dynamism, growth and innovation.

When looking at the whole of Belgium, the more recent Joint Research Centre Data Catalogue can be consulted. In 2019, **220.6 k people** were employed in biomass producing and converting sectors, and the total value added of biomass producing and converting sectors amounted to **€23 billion** [47].

The biggest bioeconomy sector in Belgium is the **Food, beverages, and tobacco sector**, responsible for 10,17 k million €, which equals to a share of 43,6% of the total value added. The sector of **Bio-**

based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels) ranks second, with a total value added of around 6,86 k million € and a share of 29,4%. The sector with the third highest proportion is **Agriculture**, with 3,05 k million € value added and a share of 13,1%. These 3 largest sectors combined, make up 83.9% of the total added value of the bioeconomy in Belgium.

Four main orientations of **national bioeconomies** were distinguished across the EU Member States in a publication of the JRC-IPTS AGRILIFE unit (European Commission) to the Bioeconomy Observatory [48]. According to this publication Belgium indeed pertains to the group of Member States whose bioeconomy is **geared toward the agri-food industry and bio-based chemical industries**. The term “Bio-chemical industries” comprises here also bio-based chemistry, bio-based pharmaceuticals, and bio-based plastics.

4.4.2.2 Bioeconomy related strategies and policy initiatives in Flanders

Belgium is divided into three regions, Wallonia, Flanders, and Brussels, with different languages and governments, and little policy integration. Bioeconomy governing bodies are present in Flanders and Wallonia.

In 2012, the Flemish Government started the Flemish Interdepartmental Working Group for the Bioeconomy (IWG BE). The goal of this working group was to set out a coherent, cross-policy plan for a sustainable and competitive Flemish bioeconomy, consisting of a vision for the government, a strategy, and a plan of action. The Flemish vision and strategy [49] were finalised and approved in 2013. With the adoption of this strategy, Flanders was one of the first European regions to focus on a regional bioeconomy.

Flanders has a strong chemical industry, food industry and energy sector, intensive agriculture and horticulture and a high population density with large and well-managed material flows. All these assets are important building blocks in the transition to a sustainable bioeconomy. Due to the complexity and cross-sector characteristics of the bioeconomy, the 2013 strategy document focused on ‘transition management’, involving government, civil society, and science. As a facilitator, the government stimulated policy integration, invested in networks, and created experiment areas.

The ‘Vanguard Initiative New growth through Smart Specialisation’ [50] was also established in 2013, with Flanders as a co-initiator. This platform is still active today and unites the most advanced industrial European regions who apply ‘smart specialization’ as a strategic principle by enhancing new growth through bottom-up dynamics originating from the regions. The initiative gathers 39 of the most advanced industrial regions in Europe, connecting their innovation ecosystems and facilitating knowledge sharing, open innovation, and interregional collaboration. One of the main activities of this platform is the implementation of pilot projects, of which many relate to the bioeconomy.

Early 2016, the Flemish government approved the innovation cluster policy [51], selecting 6 spearhead clusters and 20 innovative business networks who focus on increasing competitiveness of the Flemish industries and improve active collaboration. This cluster policy strengthened the knowledge-based identity of the Flemish economy and plays an important role in stimulating the cross-sectoral collaboration needed for a successful bioeconomy. Their strong local interconnectedness with the industry and research centres is a perfect environment to develop new initiatives on a fast track. The resulting clusters still play a pivotal role in the development of the

bioeconomy in Flanders: not only Flanders' FOOD, but also Catalisti (for chemicals and plastics), De Blauwe Cluster/The Blue Cluster (marine and maritime sector), SIM (materials innovation), VIL (logistics), Flux50 (energy sector) [52].

A study on the sustainable use of and value creation from renewable raw materials for bio-based industrial production such as biomaterials and green chemicals, presenting an update of a 2012 study, was published in 2016 as well [46]. This study gives an updated view on the most important statistics to analyse possible trends. The report also highlights the main focus areas of the Flemish policy framework and the linkages with the EU policy lines.

Set in motion by the EU bioeconomy strategy of 2018, the Flemish government published its own policy note in 2020. This is the most recent and all-encompassing document on the creation of a *Flemish policy plan for the bioeconomy* [53]. This policy note builds on the policy framework for the circular economy of Flanders as the bioeconomy plays a crucial role when transitioning to a circular economy. It highlights the 4 biggest assets that make Flanders have great potential for bioeconomy growth: (1) Flanders being a strong knowledge-driven region with high density of research centres and universities of world class, (2) the locally specialized clusters, as highlighted in previous section, (3) the Flemish ports that have a strong interest in technological developments concerning bioeconomy and have all embraced the bioeconomy in their long term strategies and (4) the Flemish agricultural sector, consisting of a broad network of innovative farmers, collaborating with high tech partners to initiate new technologies and value chains.

These assets are disclosed in the brochure *Flanders' bioeconomy. An unfolding story of sustainable growth* [52], published in 2020 by EWI, the Department of Economy, Science and Innovation.

Coupled to these 4 assets are the (already existing) activities Flanders wants to further develop with its bioeconomy policy plan. The activities are categorized in 4 priority areas/themes to turn Flanders into an innovative and competitive landscape for the bioeconomy (see further below). It is clear that Flanders, government, industry and research together, are committed to the ambition of transforming the region into a strong knowledge-based bio-based industrial centre.

Intertwined with the bioeconomy policy efforts, Belgium published a National Energy and Climate plan 2021-2030 [54] and Flanders launched a new action plan on Circular Economy [55] in 2020. Flanders has developed a long-term strategy as well, vision 2050 [56] (see above), a transversal policy framework towards sustainable development.

4.4.2.3 *Main actions, initiatives and actors boosting the bioeconomy in Flanders*

The current policy plan (see above) will free up 11 million euros in total, 10 million of the recovery budgets and 1 million through the regular financing mechanisms, to finance the bioeconomy programme. This programme is indeed structured around 4 themes (also referred as the policy plan's objectives), which can each encompass a wide variety of activities and actions to further research, develop and implement bioeconomy related innovations:

(1) Biomass production.

- This theme focuses on new trajectories for the primary production of biomass and on increasing yields from biomass production, looking into efficiency gains. Biomass is the

feedstock of the bioeconomy and food as well as non-food applications are considered. Also, biotech technologies that contribute to this theme are mentioned.

(2) Synthetic biology and biological prospection.

- The second theme combines both research on applications in synthetic biology and active application-oriented prospection of organisms. There is still a large unknown territory, e.g., microbial biodiversity available for industrial applications, the application areas of marine biomass and side streams, the potential of micro algae and seaweed and the possibilities with natural bio-active materials extracted from primary feedstock.

(3) Technological and chemical transformation of biomass and side streams.

- Flanders has a strong expertise to valorise biomass through technological and chemical transformation. This theme is quite extensive, ranging from catalytic processing to thermo-chemical conversion, to a diverse application set for fermentation.

(4) Support technologies for new, bio-based value chains

- Complementary to the previous theme, Flanders possesses strong knowledge in support technology as well. These support technologies can be interpreted in the broadest sense of the word. Looking from pre-treatments, to digitisation, filtration and purifying techniques, to recycle schemes. Flanders has a widespread and largescale network of pilot infrastructure to test and enable the creation of new applications for the bioeconomy.

To stimulate actions within the 4 themes, the Flemish government has created a governance structure focusing on 4 pillars: Strategic research for low Technology Readiness Levels (TRLs), industrial & economic development of bioeconomy activities and new quadruple helix collaborations for TRL level 4-9 and so-called flanking policies to support all previously mentioned initiatives. This governance structure can be summarized in the visual depiction below, which essentially presents the overview of how Flanders sees to boost the bioeconomy.

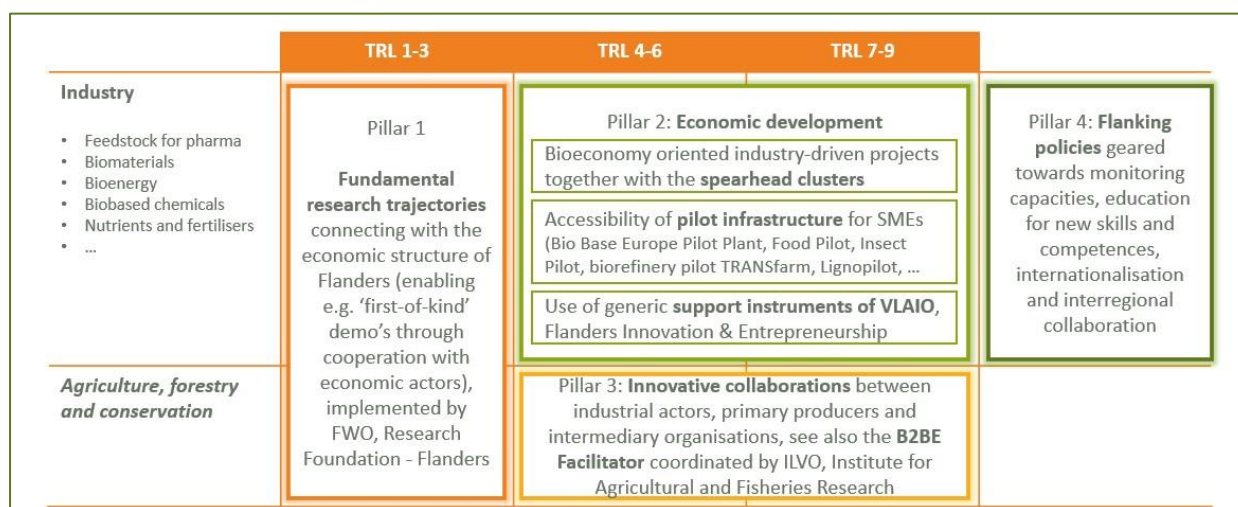


Figure 22. Governance and actions of the Flemish policy plan for the bioeconomy; Flanders' FOOD after [53]

For Pillar 2, as a means to support start-ups and SMEs in the bioeconomy sector, going from research to commercial or industrial scale, Flanders has built out a **vast network of state-of-the-art pilot facilities**, each with its own expertise. Flanders has LignoValuePilot a pilot line for bioaromatics from lignin wood (LignoValue Pilot), The Food Pilot (www.foodpilot.be) where one can carry out tests and analyses of products and processes along the whole food value chain, and the Bio Base Europe Pilot Plant (www.bbeu.org), Flanders' flagship pilot facility for the bioeconomy.

For Pillar 3, the **B2BE Facilitator** [57] is considered a very important 'matchmaking' initiative and platform to accelerate the Flemish bioeconomy. The B2BE facilitator brings entrepreneurs from agriculture, horticulture, marine and food industry together with industrial partners around green innovations in the carbon neutral economy.

Next to the activities mentioned in the *Flemish policy plan for the bioeconomy*, other key actors and initiatives boosting the bioeconomy in the chemistry, agriculture and food sector are worth mentioning.

The **chemical industry sector** is one of the most prominent sectors of Flanders. Together with the life science sector, it represents half of the industrial expenses in R&D and half of the investments abroad [58]. Research trends in the chemical industry sector in Flanders are very much geared towards innovations that help transition towards a more sustainable, bio-based chemistry. Especially in and around the province of Antwerp, which is home to the second-largest chemical cluster in the world, the transition to sustainable chemistry is being pioneered. [59].

The port of Antwerp-Bruges is very important and home to this chemistry cluster. It also has increased focus on renewable energy sources and feedstock processes. To that end, specific land is reserved at the 'NextGen District' [60], a 88-hectare area centrally located in the port and adjacent to the chemical cluster. In this district, where innovative, circular, and bio-based investments can flourish in a plug-and-play environment, there will be a 2-hectare terrain for pilot tests of bio-based and other innovative technologies. Other chemistry companies are located at the North Sea Port, which is a hotspot for bioeconomy, being a key producer of biofuels in Europe. Combined, several firms produce 1 million tonnes of biodiesel and ethanol, with new projects being launched every year.

Another important actor in this innovative ecosystem for sustainable chemistry, is BlueChem [61], a unique partnership between government, industry and knowledge institutions that has the joint ambition to guarantee and strengthen the future of a sustainable chemical industry in Flanders. Concretely, BlueChem operates as the first incubator in Belgium that focuses specifically on innovation and entrepreneurship in sustainable chemistry, such as the effective use of waste and side streams, process optimisation and the development of renewable chemicals and sustainable products.

The **agri-food sector** is one of the most important sectors of industry in Belgium. The biggest subsectors are the meat industry, the dairy industry, the chocolate, sugar, and beverages industry. The agri-food sector is intrinsically connected to numerous other economic domains as well, such as the pharmaceutical industry, chemistry sector, packaging, logistics, etc [62]. The Flemish agriculture sector is setting up new value chains and developing new technologies to accommodate the growing focus on the bioeconomy.

As previously explained, the link between the agri-food sector and the bioeconomy strategy focuses on initiatives concerning prevention and minimization of food waste and reuse and valorisation of waste and side streams. Flanders' FOOD [63], as a spearhead cluster of the agri-food sector, have initiated many innovative projects to valorisation of side streams due to the fact that one of the 4 main programme areas of Flanders' FOOD is directed at 'new and shifting resources', where a specific focus is one 'by-product' from the agri-food sector. Another important facilitating organisation is ILVO [64], the Flemish renowned agri-food centre. ILVO conducts multidisciplinary research that aims to help food companies build ecologically, economically, and socially sustainable businesses.

4.4.3 Regional bio-based transition potential for brand owners

When considering the regional bio-based transition potential in Flanders, this replication assessment will focus on the food processing industry specifically, given the fact that Flanders' FOOD is the spearhead cluster for the agri-food sector with a focus on this subsector, and hence represented this sector in the BIOSWITCH project. In terms of sectoral magnitude, the food processing sector has big bio-based transition potential (cf. figure 3 above). In terms of policy focus, the food processing sector is only narrowly addressed in the most recent *Flemish policy plan for the bioeconomy*. The reasoning behind this is that, while food production and the food value chain in principle pertain to the bioeconomy, food policy is (and has to remain) a separate policy domain. Hence, only actions and initiatives that address the reuse and valorisation of side streams from food production pertain to the bioeconomy policy field.

Nonetheless, bio-based transition is a topical theme in the food processing industry in Flanders as well, giving rise to the development and uptake of bio-based innovative products and services, and this from different application-oriented angels. It are these application-oriented angels that we will adopt to distinguish and define the different brand owners profiles for whom we will assess the replication potential and the usefulness of the BIOSWITCH Toolbox. In sum, we will not categorise brand owners based on subsectors or product categories, but on where in their value chains it may bring added value for them to transition towards bio-based approaches.

Thus, we have identified two brand owner profiles geared towards transitioning themselves from fossil-based to bio-based products (which was the core focus of the BIOSWITCH project): brand owners from the food processing industry **switching from fossil-based to bio-based packaging**, and brand owners from the food processing industry replacing **synthetically derived additives with bio-based alternatives**. A third and final brand owner profile we wish to take along in our assessment, are brand owners from the food processing industry who work on the **valorisation of their side-streams and total biomass valorisation**, which they increasingly come to see as a collection/source of functional ingredients with a potential added-value in different food, feed and/or bio-based product applications. Given the current urgency to make food supply chains more resilient in the face of feedstock / raw materials insecurities and shortages, the latter brand owner profile may certainly rise to prominence in the short term. Finally, given the fact that the *Flemish policy plan for the bioeconomy* only addresses actions and initiatives from food production pertaining to the valorisation of side-streams, it is important to assess the usefulness of the BIOSWITCH Toolbox for this regional brand owner profile.

Brand owner profile 1: Brand owners from the food processing industry switching from fossil-based to bio-based packaging

Transitioning towards more sustainable packaging is a big topic in the food processing industry in Flanders, as testified by different initiatives. One of these is the Green Deal 'Anders Verpakt' [65] (literally 'Packaged Differently'), an initiative of among others the Belgian federation of the food industry (FEVIA), comprising a pledge between two ministers of the Flemish Government and about 80 companies and organisations in Flanders to reduce the use of disposable packaging in the distribution sector by 15.000 tons (or 300 million units) by 2025.

The focus on bio-based packaging in Flanders is often still more R&D-oriented, as exemplified by different collaborative research projects, which Flanders' FOOD initiated in the context of its industry roadmap 'Food Packaging of the Future' [66]. Examples are BIO-FUN, a project researching new generation bio-based, compostable plastics for food packaging and REPAC², researching functional & recyclable coated paper for food packaging materials. Flemish companies from the food processing industry involved are a.o. Lotus Bakeries, Colruyt Group (a retailer), Milcobel, Ter Beke and Gold Meat Belgium. Flanders nevertheless also has a couple of frontrunners who already have made the transition from fossil-based to bio-based packaging, especially in the (alternative) dairy sector, with companies such as Alpro (Danone) and Inex. Also, smaller players such as Bioco, a craft coffee-burning company, have been frontrunning in the uptake of bio-based packaging in Flanders. Given the topicality of sustainable and bio-based packaging for brand owners from the food processing industry, Flanders' FOOD has initiated the S₃ (Smart Specialisation Strategy) Platform Food Packaging, which will be developed in the coming years, and will serve as a vehicle for structural collaboration and research and development projects.

Brand owner profile 2: Brand owners from the food processing industry replacing chemically derived additives with bio-based alternatives

Many brand owners from the food processing industry in Flanders are seeking to replace artificial additives with natural alternatives. Food additives are substances added intentionally to foodstuffs to perform certain technological functions, for example to colour, to sweeten or to help preserve foods. In the EU all food additives are identified by an E-number. Food additives are always included in the ingredient lists of foods in which they are used. The most common additives to appear on food labels are antioxidants (to prevent deterioration caused by oxidation), colorants, emulsifiers, stabilisers, gelling agents and thickeners, preservatives and sweeteners [67].

This transition towards bio-based alternatives in terms of food additives is very much consumer-driven. Consumers are increasingly interested in the 'clean label' concept, which frames in the global trend in products with simpler, natural ingredients, with no artificial additives, a focus on authenticity, traceability, transparency and sustainable development. Examples of brand owners in Flanders working on this are Puratos, Lutosa, La Confiante Milcobel Another important player in Flanders is Solina, a leading global partner for the savoury food industry, for which they design customised ingredient solutions. Additives for which alternatives are often sought, are nitrites and phosphates in meat, colorants, chemically modified starch.

Brand owner profile 3: Brand owners from the food processing industry working on the valorisation of side streams and total biomass valorisation

In the frame of circular economy and bio-based thinking, an increased attention is going to the valorisation of food waste, preferably producing new products/derivatives of the food waste with an added value as high as possible in the valorisation chain. Agri-food companies produce food products and always aim to keep food waste streams to an absolute minimum. Therefore, they are constantly optimizing (and investing in) their operations in order to make their food production systems as efficient as possible and so reducing the volumes of different kind of food waste streams. Nonetheless in a circular economy (or sustainable agri-food system) food waste streams have a business potential. Besides, several companies also explore the potential of processing new biomasses. Both actions are challenging and fit in the larger strategic action plans of food processing brand owners to safeguard their business activities in the future and lower their environmental impact. In the past decades and with this in mind, the agri-food industry has been thus evolving towards a new mindset focusing on circularity: (re)using biomass and exploration of new economic opportunities regarding the valorisation of food waste and side streams in food, feed and non-food applications.

Today, in Flanders already 92% of food waste in the value chain is valorised as either animal feed (43%), energy (21%) or compost (17%) [68]. As an example, in Flanders the company Trotec, pioneer and market leader, collects and transforms all plant-based food waste with at least 40% total solids content (bakery, confectionery, snacks, etc.) into high-grade basic ingredients for animal feed (for pigs, cattle and chickens). Applications for human consumption, although considered more valuable, are fairly rare, however there are some success stories like molasses, a by-product of the sugar refinery, that is fermented by fungal species into citric acid (Citrique Belge) or pectin production from pulp and peels (Cargill). In the molasses case the factory is built next to and directly linked with pipelines to the sugar factory (Tiense Suikerraffinaderij) in Tienen. Additionally, in the transition to a circular economy, frontrunning companies in Flanders (such as Agristo, Citrique Belge and Cosucra, AB Inbev, Alpro, Ardo, Agristo, Avecom, Beneo, Cargill, Citrique Belge, Clarys, Cosucra, Danis, Greenyard, Kemin Ingredients, Konings, Lambers-Seghers, Nuscience, Rousselot, Tiense Suikerraffinaderij, Trotec, Veos) are adopting a redefinition of biomass. While before biomass was either classified as product, side stream or food loss, they are now considering every kind of biomass (edible and inedible) more and more as a collection/source of functional ingredients (macro- and micronutrients) with a potential added-value (cfr. a potential business case) in different food, feed and/or bio-based product applications. This mind shift results in a growing number of demands from the agri-food companies, cluster and non-cluster members, for scientific support to efficiently use biomasses (side streams and new raw materials) as sources of ingredients (mainly proteins and non-starch polysaccharides).

4.4.3.1 *Dedicated analysis of BIOSWITCH replication potential*

Profile 1. Brand owners from the food processing industry switching from fossil-based to bio-based packaging. The BIOSWITCH Toolbox could be of interest to this profile of brand owners from the food processing industry, from three different angles. Firstly, evaluating the positive environmental impact of the transition towards bio-based packaging via Life Cycle Analysis demo

design (cf. the Adoption tool Sustainability Assessment Tool) can address the primary bio-based packaging uptake barrier of Flemish food processing companies. But also Learning and Awareness tools which could support building a more scientifically grounded internal viewpoint on and 'burning platform' for bio-based packaging could be of interest. Further steps in the transition from fossil-based towards bio-based packaging could be facilitated through the Adoption tool 'Build me the value chain workshop' to source and connect with solution providers for specific value chain gaps, as well as the Learning and Awareness tools working on effective B2B and consumer communication.

Profile 2. Brand owners from the food processing industry replacing synthetically derived additives with bio-based alternatives. The BIOSWITCH Toolbox could be of interest to this profile of brand owners from the food processing industry, from the following perspectives. Firstly, the Adoption Tools 'Build me the value chain service' or the 'Online matchmaking service' could help brand owners in sourcing R&D service providers e.g., chemical laboratories that extract value from natural and recovered raw materials for premium applications. One such example is the start-up Plinius Labs, which re-evaluates flax or straw waste by an innovative preparation and extraction process, with natural vanillin (at competitive price point) as the targeted end product for the food and beverage market. A further step in the transition journey of these brand owners would be to consider the Open Innovation Tools, given integrating external knowledge in joint R&D efforts may accelerate product reformulations. Finally, even though the trend behind this bio-based transition is consumer-driven, tools which focus on bringing the message to the consumer may be relevant given a premium price may initially be attached to reformulated products, especially when economies of scale have not yet been reached.

Profile 3. Brand owners from the food processing industry working on the valorisation of side streams and total biomass valorisation. While the replication potential of the BIOSWITCH Toolbox for this brand owner profile may, in comparison with the other profiles, currently still be lower in terms of number of food processing companies actively addressing valorisation activities in their value chain, the Toolbox could be very instrumental in addressing a very specific hurdle. The hurdle to overcome is that companies indicate to lack the technical knowhow and fundamental insights to extract these potentially interesting (functional) ingredients, either from their side streams or from novel biomass streams. R&D efforts on the repurpose of these streams are now mainly 'trial and error'-based. Consolidation tools such as the 'Open Innovation Tools' or Adoption tools such as the 'Build me the value chain service', could be instrumentalised to source the right combination of technology providers (for stabilisation, disintegration and extraction). Working with this specific type of solution providers could support brand owners from the food processing industry in attaining better technical valorisation opportunities and routes. Also, providers of digital technologies for predictive modelling, monitoring, measuring, managing and supporting the intense cooperation among actors in the value chain, could be sources. Finally, the 'Online matchmaking service' could be used to connect with strategic industrial partners/clients to work on the commercial viability and application of these technically and digitally optimised valorisation opportunities and routes.

Profiles	Bio-based readiness level	BIOSWITCH Toolbox assessment
Brand owners from the food processing industry switching from fossil-based to bio-based packaging	Different levels from Rookie to Most experienced player are represented	<ul style="list-style-type: none"> • Sustainability Assessment Tool to overcome primary uptake barrier • Learning and Awareness Tools (Communication vis-à-vis consumers, also to be used B2B, or towards internal management) • Build me the value chain Services, Online matchmaking services
Brand owners from the food processing industry replacing synthetically derived additives with bio-based alternatives	Mostly represented are the levels Player and Most experienced player	<ul style="list-style-type: none"> • Build me the value chain Services, Online matchmaking services to source R&D service providers • Open Innovation Tools to integrate external knowledge in joint R&D efforts • Learning and Awareness Tools (Communication vis-à-vis consumers)
Brand owners from the food processing industry working on the valorisation of side streams and total biomass valorisation	Mostly represented are the levels Rookie and Player	<ul style="list-style-type: none"> • Build me the value chain Services and Open Innovation Tools, to find the right combination of (digital) technology providers • Online matchmaking services to connect with strategic industrial partners/clients

Table 5. Dedicated analysis of BIOSWITCH Toolbox replication potential for Flanders

4.4.4 Regional overview of other users in the value chain amenable to bio-based transition

Across the different brand owner profiles, three stakeholders in Flanders are key in implementing brand owners' bio-based transitions: **policy makers, retailers (distribution) and consumers**. In 2013, a SWOT analysis of the bioeconomy sector of Flanders was performed [49], detecting several threats and weaknesses, which are still prevalent today. One challenge focused on the complexity of the Belgian constitution. With 3 governments, Flanders, Brussels, and Wallonia, writing their own bioeconomy policy framework, extensive regulation has to be put in place, making the matter even more complex. Policy coherence is an absolute necessity to have a well-functioning and innovative bioeconomy market. But also, when we zoom in on current Flemish policy (cf. the *Flemish policy plan for the bioeconomy*), we see that economic development at commercial stage (TRL7-9) focuses on strategic industrial partnerships, but does not make explicit mention of the go-to-market of bioeconomy and bio-based innovations and actors which could be instrumental in that sense. Hence, the BIOSWITCH Toolbox and its different support tools, could be insightful for policy makers in Flanders to understand the commercialisation pathways of bioeconomy and bio-based innovations from a brand owner's perspective. What are the barriers that brand owners should overcome and what type of support offered by the BIOSWITCH Toolbox could be furthered through policy making?

Additionally, while brand owners do play a critical role in implementing bio-based value chains given their connection with upstream and downstream actors, brand owners from the food processing industry in Flanders that were involved in the BIOSWITCH project, often voiced that for them retailers and other distribution networks are *the* key enabling actors. Thus, retailers could be an additional audience for the BIOSWITCH Toolbox, especially for what concerns the diverse set of communication

material type tools that were developed within the Learning and Awareness, Adoption as well as Consolidation Tools.

Finally, perhaps consumers are the stakeholders which are most instrumental in implementing brand owners' bio-based transitions. Brand owners from the food processing industry in Flanders increasingly adopt customer-centric approaches in their product innovations and strategies, and this from the outset. In that sense, brand owners could use different materials produced within the context of the BIOSWITCH Toolbox (e.g., the brochure *Consumers and bio-based products, a love story*), and further co-create and co-design solutions and communication approaches with customers. Furthermore, they could apply the Open Innovation Tools in such customer-centric approach.

Next to the stakeholders listed above that are critical in developing commercialisation pathways for bio-based transitions and that could be additional audiences of the BIOSWITCH Toolbox, for each of the different brand owner profiles described and assessed above, important key actors were identified.

First, for the brand owners from the food processing industry switching from fossil-based to bio-based packaging, who do not produce the packaging themselves, key enabling actors are **material developers**, as they are in the end dependent on their innovations. While the BIOSWITCH Toolbox enabled this profile of brand owners to link directly with material developers and get a sense of bio-based packaging innovations 'in the pipeline' (e.g. through the 'Build me the value chain service'), perhaps material developers could also consult the BIOSWITCH Toolbox, to understand the different elements this profile of brand owners has to take into account when transitioning towards bio-based packaging, such as internal buy-in, sustainability, consumer acceptance, ... For brand owners from the food processing industry replacing synthetically derived additives with bio-based alternatives, key enabling actors are intermediaries who work on the preparation and extraction process of natural components (see above).

And finally, again referring to the SWOT analysis from 2013, one of the main barriers of Flanders is its small geographical area, characterised by dense population, leading to the fact that Flanders is dependent on import from other countries for an important part of its biomass. Especially given the current trend in promoting short domestic sustainable bioeconomy supply chains, this means that food processing companies today should make an optimum use of their biomass. Biomass valorisation – taking biomass residues and wastes that have been through previous uses-or production-phases -is one of the most critical components of building the biomass resilience of food processing companies in the EU Single Market. First, it can increase resource efficiency in strong, integrated, local value chains (valorisation requires integrated collaboration among critical value chain actors). Second, especially when implemented cross-sectoral and enabled through cost-optimizing breakthrough technologies, it can drive new revenue streams and business models. From this perspective, stakeholders that are critical for the successful bio-based transition of brand owners from the food processing industry working on the valorisation of side streams and total biomass valorisation, especially in Flanders, are indeed **technology providers** and **strategic industrial partners (clients)** that could assist them in their, technically and economically optimised, 'zero waste biomass valorisation pathways'.

5 CONCLUSIONS

This deliverable summarises two actions that have been conducted as part of WP4 in order to maximise project impact and to enhance the delivery of project results to more brand owners in the case-study regions.

First action was the organisation of regional events to present main project results and also to share the experience from the BIOSWITCH Major brand owners involved throughout the whole project. Five different events were successfully organised in Andalusia, Denmark, Finland, Flanders and Ireland. Despite the huge efforts to reach a wide audience, the number of attendees was not too high for Andalusia, Denmark and Flanders. This might be due to the fact that these were the third event related to the project organised in each of the aforementioned regions (versus the fact that the Irish event was the first one organised). Moreover, and as seen in other online events organised in the frame of the project, the no-show rate for online events is increasing. This could be due to people being overloaded with lots of online events and also the practice of registering to online events but not attending just to get the presentations used. Anyhow, the feedback from the events was very positive and several bilateral meetings between BIOSWITCH partners and organisations asking for support in their bioswitch journey were maintained. Hence, it could be drafted that the events had a positive impact on attending stakeholders and that the transition to bio-based approaches was triggered and supported.

The second action has been the elaboration of a regional replication assessment. The aim of such study was to delve into the potential of each region concerning the bio-based transition and to identify the profiles of brand owners amenable of benefitting from BIOSWITCH Toolbox. Once identified, an analysis of which tools would be the most relevant for each profile was conducted. The four assessments finalise by presenting an overview of which other stakeholders in the quadruple helix model could benefit as well from the BIOSWITCH Toolbox although it has not been specifically designed for them. From the regional replication assessment, it is interesting to summarise the different profiles identified per region, which shows the diversity of actors in the bioeconomy scene across Europe and the differences in their Bio-based readiness level as well.

Region	Brand owner profiles identified
Andalusia	<ul style="list-style-type: none"> ▪ Primary sector (Agriculture, Livestock producers, Fisheries, aquaculture and the blue economy) ▪ Agri-food industry ▪ Biotechnology companies producing bio-based alternatives ▪ Agro-biotech companies ▪ Bioactive ingredients (Extraction industry)
Denmark	<ul style="list-style-type: none"> ▪ Suppliers of packaging for vegetables, fruit, meat, and dairy products ▪ Suppliers of cleaning products, detergents and textile washing products ▪ Producers of textiles for clothes, furniture, and other purposes ▪ Producers of children´s toys ▪ Suppliers of cosmetics and personal care products. ▪ Producers of construction materials ▪ Suppliers of fertilisers, pesticides, and bio-stimulants



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Finland	<ul style="list-style-type: none">▪ Forest industry – leading manufacturers of bio-based materials and products (Packaging solutions)▪ Forest industry – smaller and emerging manufacturers of bio-based materials and products (Packaging solutions and Food and cellular agriculture solutions)
Flanders	<ul style="list-style-type: none">▪ Brand owners from the food processing industry switching from fossil-based to bio-based packaging▪ Brand owners from the food processing industry replacing synthetically derived additives with bio-based alternatives▪ Brand owners from the food processing industry working on the valorisation of side streams and total biomass valorisation

Table 6. Summary of the different brand owner profiles for the BIOSWITCH case-study regions

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ANNEX I – SATISFACTION SURVEY

With the aim of gathering information about your experience at the [Name of the event], we have created this survey. Your input will help us in the planning and implementation of future activities.

This survey will take no longer than 5 minutes. Thank you very much for your collaboration.

*Mandatory

Please, evaluate the following aspects of the event:

- Organisation *
From 1 (Poor) to 5 (Excellent)

- Relevance of the topic and content *
From 1 (Poor) to 5 (Excellent)

- Level of the speakers (quality and clarity) *
From 1 (Poor) to 5 (Excellent)

- Participation and dialogue with the audience *
From 1 (Poor) to 5 (Excellent)

Where did you hear about this event? *

- Social Media
- e-mail / Newsletter
- EU Green Week website
- Other:...

Please, write below any comment or feedback about the event.

.....

Thank you!

*** If the event is done face-to-face, an additional question related to the location and catering can be included.