BIOMODEL 4REGIONS

TOWARDS A BIO-BASED ECONOMY IN THE DELTA REGION

A bio-based economy strategy blueprint, prepared in the frame of the BioModel4Regions project

This document has been prepared in the framework of the European project "BIOMODEL4REGIONS – Supporting the establishment of the innovative governance models to achieve better-informed decision-making processes, social engagement, and innovation in the bio-based economy".

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 101060476.

Holland Circular Hotspot; Maasboulevard 100, 3063 NS Rotterdam, The Netherlands

Authors: Heyd Más (HCH), Freek van Eijk (HCH), Anita de Moor (province of Zeeland), Karen van de Vijver (province of Zeeland), and René Beijnen (province of North Brabant)

Contributors: Willem Sederel (CBBD), Hans van Klink (DSD), Cor van Oers (Delphy), Pieter Raes (KicMPi), Leon Joore (Millvision), Jeroen de Boer (Port of Moerdijk), Thomas Desnijder (North Sea Port), Waldo Maaskant (Province of North Brabant), Richard Anthonisse (Province of Zeeland), Thijs Rodenburg (Rodenburg Biopolymers), Jan Arends (University of Ghent), Ralph Pessers (WUR).

December 2024

a. Table of Contents

List of Abbreviations

Abbreviation	Definition
BBPs	Bio-based products
BIC	Bio-based Industries Consortium
CBBD	Circular Biobased Delta
CBE JU	Circular Bio-based Europe Joint Undertaking
GCNE	Green Chemistry New Economy
HCH	Holland Circular Hotspot
JTF	Just Transition Fund
KIA	Knowledge and Innovation Agenda *(translation from Dutch)*
KPI	Key performance indicator
RIV	Regional Innovation Valley
ROM	Regional Development Agency *(translation from Dutch)*
RVO	Netherlands Enterprise Agency *(translation from Dutch)*
SME	Small and Medium-sized Enterprise

Glossary

Keyword	Definition
Bioeconomy	The bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, organic waste), their functions and principles. It encompasses all sectors and associated services and investments that produce, use, process, distribute or consume biological resources, including ecosystem services (agriculture, forestry, fisheries, food industry, pulp and paper, textiles, environmental technology, energy, and industrial sectors such as the chemical and biotechnology sector and finally the user and the consumer). *The EU Bioeconomy Strategy*
Bio-based economy	Use of renewable biological resources, including plant, animal, and microbial materials, to produce materials, chemicals, energy, and other products, thereby reducing dependence on fossil resources. Part of the bioeconomy where bio-based products are produced. It can be about bio-based activities in chemistry, textile industry, pharmaceutical industry, wood processing industry construction, among other ones. *European Commission*
Bio-based products	bio-based materials and bio-based chemicals
Plant-based products	term increasingly used beyond the agri-food domain and for bio industrial topics (here understood as synonym to the term bio-based products)
Triple helix	industry, government, and research institutions

1 OBJECTIVES & SCOPE

The Rhine-Scheldt Delta Region (Delta Region), encompassing Southwest Netherlands and part of Belgian Flanders, is a strategically vital area characterised by its dynamic industries, major ports, and strong potential for driving the bio-based economy transition. This region hosts some of Europe's largest and busiest ports, including the Port of Rotterdam, the Port of Antwerp, and the North Sea Port[1] (which combines the Ports Vlissingen, Terneuzen, and Ghent). The presence of ports represents a series of unique characteristics for the areas where those are located. It attracts multiple industries given strategic transportation routes; it incentivizes the developments of the logistics sectors as well as investments in infra-structure given that ports are key gateways for global trade. These ports not only facilitate international commerce but also play a crucial role in the supply chains of various industries, including chemicals, petrochemicals, food processing, and logistics.

The region's industrial landscape is diverse, with a strong presence of traditional sectors such as manufacturing, energy, and agriculture, alongside emerging bio-based industries that leverage its robust infrastructure and innovation capacity. Still, there is a particular set of companies for which direct access to deep waters, congestion-free connections to the hinterland, reliable energy supply, an underground pipeline network combined with the space for production and storage is even more interesting: the chemical industry. The presence of ARRRA[2], one of the world's largest chemical clusters, frontrunner in the field of sustainability, and covering a large part of this region's territory, brings a strong influence into the region's economy.[3] In the bio-based economy context, this means that green chemicals find a unique context in which to develop. Beyond the chemical industry, another top sector in the region is agrifood, composed of agriculture, horticulture, and fisheries, with emphasis on innovative agriculture and food production. In this industry there is rapidly increasing attention and resources to bio-based solutions[4] for applications from construction to packaging. Here, it is worth noting that the Delta region is strategically positioned in providing the ARRRA region with security of feedstock via regional access, due to the presence of the highly efficient and large-scale sugar beet producing industry.[5]

Considering its well-established industries and port facilities, the Delta Region has a unique setting to integrate circular practices, develop new bio-based value chains, and reduce environmental impact, positioning the region as a key player in Europe's green transition. This is strengthened by clear incentives signalled by the (provincial) public sector. Guiding these

[1] The economic added value of the chemical industrial clusters is of great importance to the region. The cross-border port North Sea Port alone has an added value of approximately €14.5 billion and direct and indirect employment of 100,000. Source www.vnci.nl/over-de-chemie.

[2] The Antwerp- Rotterdam- Rhine- Ruhr Area (ARRRA).

[3] The chemical industry in the Netherlands is the fourth largest in Europe and is essential for the Dutch economy, representing 16 percent of the total export of goods with 45,000 employees and a turnover of €67 billion in 2023. See https://www.vnci.nl/chemie-in-cijfers, www.zeeland.com/nl-nl/live-work/zeeuwse-topsectoren, www.brabant.nl/onderwerpen/economie/innovatie-technologie/ondersteuning-topsectoren/.

[4] Several innovation and collaboration networks are being launched. Most recently, 'The Plant-based Network' (HPN) launched in October 2024. Source https://hetplantbasednetwerk.nl/.

[5] 'The Bio-based Delta: Where agro meets chemistry. A globally competitive region for developing bio-based business' (2015) www.greenchemistrycampus.com/images/uploads/The_Bio-based_Delta_online_3.pdf.

efforts in the Delta region are, to mention a few, the 'Implementation Agenda for the Economy, Knowledge & Talent Development 2024-2027' of North Brabant[6], both the 'Economic Agenda - Implementation Programme for the Economy 2024-2027'[7] and the 'Environmental Vision' (Ambition 3 - A sustainable and innovative agenda)[8] of Zeeland, and the updated Circular Strategy 2024-2037 – 'Building a Circular South Holland Together'[9] of South Holland provinces. These key guiding instruments are further detailed in section 3.1. The public sector in the region also supports the development of the bio-based economy ecosystem via attractive tax regime and multiple incentives. These have special focus on facilitating research, development, and innovation, and fostering collaboration on cutting-edge technological advancements to ensure talented human capital is involved. Academic institutions present in the region, such as Wageningen University and Research, Delft University, Eindhoven University and Ghent University and Universities of Applied Sciences are some of the institutions often involved in such joint projects and initiatives.

In the context of the Biomodel4Regions Horizon Europe project, the efforts to develop this blueprint for the Delta Region has been led by two different organisations throughout the project's timeline. From the beginning of the project until January 2023, the leading organisation was the Circular Bio-based Delta (CBBD), a long-term initiative in the region that for 10 years acted as a key player to connect the triple-helix and advance conversations in the following topics and projects: valorisation of carbohydrates (Sugar Delta), biorefining of lignocellulosic ('Redefinery'), lignin valorisation into binders for asphalt (CHAPLIN), and development of bio-aromatics ('Biorizon').[10] In 2023, Holland Circular Hotspot (HCH) entered the consortium to continue the work of CBBD. Holland Circular Hotspot is a private foundation that aims to accelerate the international transition to a circular economy by connecting companies, knowledge institutes and (local) authorities, and support international collaboration and knowledge exchange on the Dutch circular economy. Both organisations' network, knowledge, and efforts in coordination have been crucial for the process, nonetheless, it is important to highlight that the purpose and relevance of this blueprint could only be achieved by a joint effort of the community of stakeholders in the bio-based space in this region. This blueprint therefore is the result of multiple interactions and contributions from over forty stakeholders who represent the triple helix: public sector, private sector, and knowledge institutions. Several moments have enabled specific and updated insights that were translated into this tool. Various workshops, meetings, and interviews have allowed for furthering the content and providing specific and relevant contributions to this blueprint.

It is important to clarify that although the Delta Region includes both the Netherlands and Belgium, and, the extensive data for the multiple governance key performance indicators (KPIs) used for the baseline context and analysis for recommendations is drawn from the provinces of North Brabant and Zeeland, based in the Netherlands. Although not involved in this project to the same extent as the above-mentioned provinces, both East Flanders (Belgium) and South Holland (the Netherlands) were consulted in different moments and have several economical commonalities to the former provinces. Later in this document, this is reflected in the recommendations for strategic objectives and activities for increased and

[6] See https://www.brabant.nl/actueel/nieuws/provincie-presenteert-plannen/.
[7] See https://www.zeeland.nl/digitaal-archief/ZLD2024-6563.
[8] See https://www.zeeland.nl/actueel/ambitie-3-een-duurzame-en-innovatieve-economie.
[9] See https://circulair.zuid-holland.nl/.
[10] Both projects, CHAPLIN (now called CIRCUROAD) and Biorizon, continue with their activities.

targeted collaboration across the provinces in the Delta. Extensive cross border interactions, complementing value-chains, expanding models, and building on local-knowledge for achieving scale-up and increased European Funding are a strong conclusion drawn from the multiple conversations leading to this blueprint.

The blueprint has therefore focused on key regional common challenges, solutions, and lessons learned. Beyond identifying key common priorities and, when available, sharing on existing solutions to the development of the bio-based economy in the region, the blueprint brings attention to the collaboration opportunity brought by strengthening initiatives between the Netherlands and Belgium. Ultimately, it aims to serve as guidance for creating a bio-based economy for the Delta Region by translating the current needs and hopes from its stakeholders into a clear common vision, strategic objectives, and activities to serve as relevant and practical next steps for the bio-based economy across the provinces in this geography.

2. BASELINE AND ANALYSIS OF LOCAL CONTEXT

2.1 LOCAL POLICY CONTEXT

The Netherlands has been at the forefront of circular economy efforts including the bio-based economy since the launch of its government-wide programme, 'A Circular Economy in the Netherlands by 2050', in 2016, setting the 2050 ambition for a fully circular economy. This foundational plan evolving from the Memorandum on Bio-based Economy[11] published in 2012 was supported by the National Raw Materials Agreement in 2017, followed by another relevant document, the 'Report on Sustainable biomass and bioenergy in the Netherlands for 2030' (2016)[12]. In 2018, the first Circular Economy Implementation Programme (2020-2023) originated five 'Transition Agendas' bringing specific actions for the sectors of Consumer Goods, Plastics, Construction, Manufacturing, and Biomass & Food.[13] The second phase, the National Circular Economy Programme (2023-2030), builds on these efforts by incorporating more compulsory measures to drive sustainable practices, including targeted actions in sectors such as bio-based construction and green chemicals. The bio-based economy is featured within the Transition Agendas and is prominent in the Agendas for Biomass and Food, Construction, and Plastics. It is worth mentioning that a key objective in the National Programme for Circular Economy (NPCE) is sustainable biomass valorisation ('value pyramid') or production of bio-based materials and use of residues for biofuels and heat ('co-production').

In the Netherlands, there is not yet a law specifically dedicated to the Circular Economy. Nevertheless, for years these strong strategies for the Circular (and Bio-based) Economy transition have led to strong advancements within the country and the targets for specific industries brought by such strategies have played a key role. When observing beyond policies and into the legal field, currently, the approach to CE takes place in a perspective of handling waste within the Environmental Act. For example, it is possible to request waste prevention

[11] See https://open.overheid.nl/repository/ronl-archief-8a090fbf-b1f6-4f71-8c9a-fe680d19c08f/1/pdf/hoofdlijnennotitie-bio-based-economy.pdf.
[12] See https://platformduurzamebiobrandstoffen.nl/wp-content/uploads/2020/04/2016_Min-EZ_Biomassa-2030_strategische-visie-op-inzet-biomassa.pdf.
[13] See www.government.nl/topics/circular-economy/accelerating-the-transition-to-a-circular-economy.

plans in Environmental Permits and regulations can also be included regarding the use of (secondary) raw materials. However, this is not yet mandatory and obligated for companies.

The guideline for waste or raw materials is also an important piece. When a company uses waste from another company as raw material, they are considered a waste treatment plant, which means more technical requirements to prevent environmental and public health risks. It is possible to get a declaration that a specific waste stream is not anymore to be qualified as waste, but as raw material. This 'end-of-waste' status given by the public authority (province or municipality) that has issued the environmental permit is, however, a judgement of the material used. It does not have a legal status that provides legal certainty for the company that processes the end-of-waste material into a product. To improve this process, a national platform is being set up by the Interprovincial Consultation and its Environmental Services for permitting surveillance and maintenance of companies to provide validated and uniform 'Waste or raw material declarations'.

Looking at provincial level, in Zeeland, the bio-based economy is seen as integral to the circular economy. This means that policies and regulation include both topics. When it comes to agricultural policies, the region supports the development of the bio-based economy by stimulating knowledge and research on bio-based cultivations. Additionally, there is the support to the establishment of new value chains for agricultural development (to provide farmers with new opportunities). This is stated in the agriculture policy, chapter 3.1.4. With subsidy programmes (European and provincial) where the development of a bio-based economy and cultivation, through innovation projects and investments in machinery is stimulated (GLB - NSP)[14]. Further, the municipalities in the province of Zeeland are currently developing a joint CE policy, which should include the bio-based economy. In the concept policy plan, goals are SMART formulated regarding circular house construction, infrastructure, public space, area development, purchase, consumption, waste, and raw materials. The administrative determination is expected for the beginning of 2025.

North Brabant has since its 2021-2023 Implementation agenda for Circular Economy taken a strong role of responsibility in the raw material transition, including a strategy for biomass and food (under 'bio raw materials'). The most recent policy framework, Implementation Agenda Economy, Knowledge & Talent Development[15] brings next steps in the strategy for the bio-based economy between 2024 and 2030. This aims to lead to CO2 reduction, increasing security of supply and strategic autonomy, combating biodiversity loss and pollution of water, air and soil through less waste and emissions, and water and soil quality.

2.2 BASELINING GOVERNANCE MODEL AND IMPLEMENTATION ECOSYSTEM FOR THE BIO-BASED ECONOMY

National governmental bodies of relevance in the governance structure of the bio-based economy in the Netherlands are the Ministry of Infrastructure and Water Management, the Ministry of Economic Affairs and the Ministry of Climate Policy and Green Growth, the Ministry of Agriculture, Fisheries, Food Security and Nature, and the Netherlands Enterprise Agency.

[14] See www.zeeland.nl/subsidie-aanvragen/nationaal-strategisch-plan-gemeenschappelijk-landbouwbeleid-2023-2027.
[15] See www.brabant.nl/onderwerpen/omgevingsbeleid/beleidskaders.

In addition, created in 2011 by the Ministry of Economic Affairs in response to economic challenges and the need to boost innovation across industries are the Top Sectors[16]. These promote innovation, collaboration, and international competitiveness in key economic areas through public-private partnerships. To arrive at the best solutions, businesses, universities, research centres and government work together on knowledge and innovation. Each top sector defines its Knowledge and Innovation Agenda (KIA)[17] which outlines the strategic research and innovation priorities for the sector based on societal challenges, missions, and opportunities for growth. Within each top sector, the parties are united in the Top Consortium for Knowledge and Innovation (TKI). The TKIs implement the KIAs by drawing up research agendas and objectives and managing specific projects and public-private partnerships for the coming years.[18] Also relevant to the bio-based economy is the cluster organisation Green Chemistry, New Economy (GCNE),[19] which was implemented in 2022 through a collaboration of multiple stakeholders. GCNE acts as a coordinator and enabler in the ecosystem of green chemistry in the Netherlands. It facilitates public-private collaborations and connects various projects and initiatives under the shared goal of advancing sustainable chemical practices. Another initiative, Green Chemistry Accelerator, supports start-ups by removing barriers, 'massaging' the market, and attracting the right investors and already bears fruits, such as the Paques Biomaterials' new demonstration plant.[20]

Briefly mentioned above, in support of Research, Development, and Innovation, the Netherlands has the National Growth Fund[21] which invests in projects that contribute to the sustainable earning capacity of the Netherlands. One of the themes defined is Key Technologies and Valorisation, to which the 'Biobased Circular' project, an initiative of among others, led by Green Chemistry, New Economy, paves the way for the Netherlands to switch to the use of climate-neutral materials and is being implemented in 2024. Invest NL is another funding source, providing financing as participation or as (subordinated) loan. One of their focuses is the bio-based and circular economy solutions. There are also PPPs in R&D programmes across borders (Netherlands and Belgium), such as between TNO and VITO, located at the Green Chemistry Campus, the Biorizon Project.[22] Subsidies and fiscal instruments are used as well (MIA/Vamil for market introduction (subsidy) and WBSO (fiscal), although not specific for bioeconomy). An additional national financing instrument is the Just Transition Fund (JTF)[23], designed to aid in economic diversification and the creation of sustainable jobs is especially relevant for sectors like green chemistry and bio-based industries, where there is potential to transform traditional industries into low-carbon, sustainable operations. Given their industrial heritage and the need to transition away from fossil-fuel-based industries, Zeeland and West-Brabant in the Netherlands are key beneficiaries of this fund.

[16] For instance, ChemistryNL is the name of the Top Sector Chemistry. It executes the mission-driven top sector innovation policy (*MTIB*) of the Ministry of Economic Affairs.
[17] *Kennis en Innovatieagenda's.* https://www.topsectoren.nl/missiesvoordetoekomst.
[18] TKI-BBE (Bio-based Economy): The Top Sectors Chemistry, Energy and Agri & Food provide direction to the research agenda through TKI-BBE and offer companies financial support for research projects. More details can be found at www.biobasedeconomy.nl/tki-bbe/.
[19] *Groen Chemie, Nieuwe Economie*. https://groenechemie.nl/over.
[20] https://www.paquesbiomaterials.nl/.
[21] *Nationaal Groeifond*. https://nationaalgroeifonds.nl/hoe-werkt-het-nationaal-groeifonds.
[22] https://www.biorizon.eu/biorizon/initiators/.
[23] See https://www.uitvoeringvanbeleidszw.nl/subsidies-en-regelingen/just-transition-fund-jtf.

Looking specifically at the Delta region within the Dutch border, which includes the provinces of Zeeland, North Brabant, and South Holland, their provincial governments work in synergy with multiple organisations to develop and implement their strategies. The Regional Development Agencies (ROMs) are an important part of this ecosystem. ROMs invest mainly in innovative and fast-growing, regional companies and help restructure business parks. These provide venture capital to entrepreneurs and may even become shareholders in these companies. They also guide entrepreneurs in their business operations and encourage them to establish themselves in the region. In the province of North Brabant, there are two development agencies, BOM[24] (Brabant) and REWIN[25] (West Brabant), in Zeeland, there is Impuls Zeeland[26] and in South Holland, Innovation Quarter[27] is the ROM. All ROMs have the bio-based economy represented in their themes and activities.

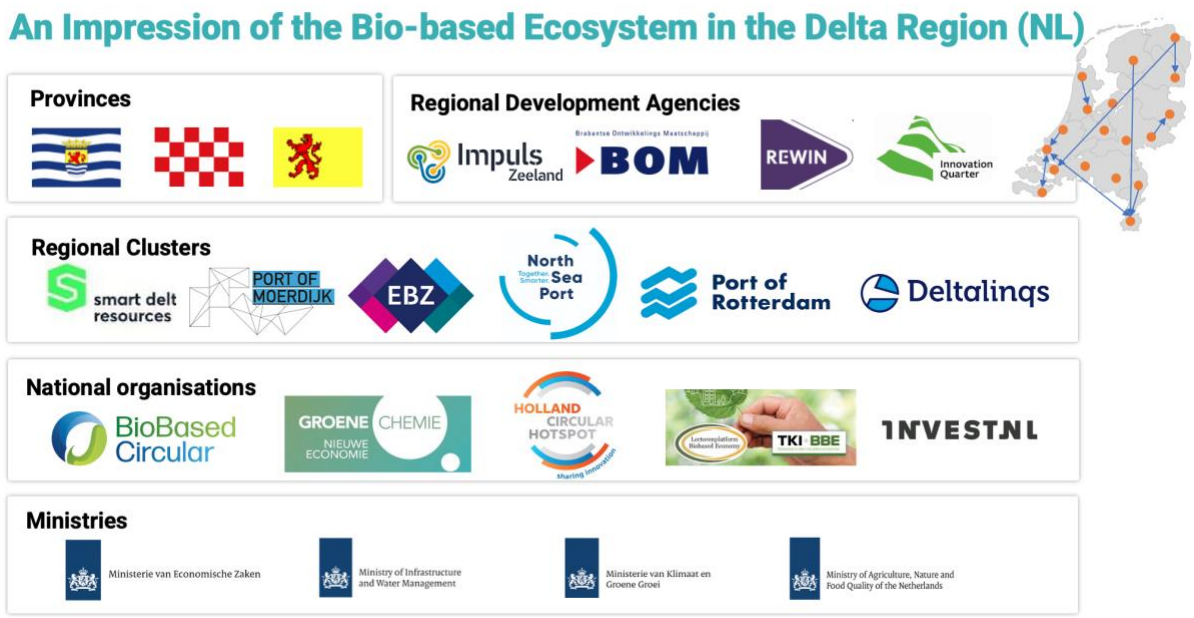


Figure 1: Bio-based Ecosystem in the Delta Region (The Netherlands), adapted from GCNE 2024

It is worth mentioning that the spatial distance between provinces brings substantial challenges in terms of coordination and collaboration. Collaboration often occurs between the regional clusters and development agencies but not as much between municipalities. An organic solution for strategic decision-making that emerged between the provinces and private sector regionally was to set up the cluster Circular Biobased Delta. It was first established as an informal collaboration of the provinces of Zeeland and North Brabant in 2010 and became a foundation in 2013 (the province of South Holland joined in 2014). Its Supervisory Board included representation of the multiple entities working at the bio-based space at the provinces in the region, industry, research, and public stakeholders. A 10-year plan was formulated and discussed at the supervisory board – again consisting of industry, research institutions, and government (triple helix). Biobased Delta's vision was set to drive the transition towards a net-zero and circularity in the Delta region, more specifically, in CBBD's vision and ambition plan the target was set to achieve a 10 megaton CO2 reduction and 50% circularity in the Delta

[24] See www.bom.nl/.
[25] See www.rewin.nl/en/.
[26] See www.impulszeeland.nl/.
[27] See www.innovationquarter.nl/en/.

Region by 2030. These targets were inspired by the National Plan but were adjusted to reflect the regional needs and possibilities. The targets were decided and approved by the triple helix in the region, represented in the Board of the CBBD. The cluster used different national formats and events for networking and communication (e.g. the Dutch Design Week) and it worked closely with European countries and collaborated for instance, with Circular Biobased Europe (via its membership of BIC) and other European cluster organisations (e.g. SPRING and Bioeconomy4Change).

When looking at financial investments for the development of the bio-based economy in the Netherlands, as can be inferred from the paragraphs above on national organisations promoting innovation and green growth, those are available mainly through public channels or R&D investments of companies and a few blended funding options. There are a few additional options besides European programmes (e.g. CBE, EFRO) and national programmes (Dutch National Growth Fund). Some municipalities, e.g. Bergen op Zoom in the region of Brabant, issues vouchers to stimulate the bio-based economy. The 19.000 EUR vouchers are available to small bio-based economy businesses. The fund is made available through the provincial government, focusing on green chemistry. Other regions have similar voucher systems.

In the Netherlands, education programmes on the bio-based economy largely focus on tertiary education (university programs). Universities, schools, and research institutes are the primary source for bio-based innovations in the Delta Region. Spin-offs from universities, when successful and attractive, are usually embraced and widely supported by industry. Regionally, there are cooperations such Avans University of Applied Sciences and HZ University of Applied Sciences creating MNEXT[28], a centre of expertise. Centres of Expertise have been appointed by the Ministry of Education, Culture and Science to strengthen the connection between higher education and regional economic cooperation in the Netherlands. Those are action-orientated partnerships between companies, higher education, government and other public organisations to foster innovation, experimentation and investment that is focused on future-directed vocational education and professional practice. They form highly trained professionals who can implement and transform the transition towards a bio-based society. Another example connecting education and practice can be found at Curio, in Western Brabant, with the 'Teacher-team (*practoraat*) Agrofood & Bio-based'[29]. These are specialized applied research groups embedded within Dutch vocational education (MBO) with focus on practical, hands-on research topics seek to solve challenges faced by industries and society. The methods of practice-based professional learning both support entrepreneurs with new knowledge and introduce students to current practical issues.

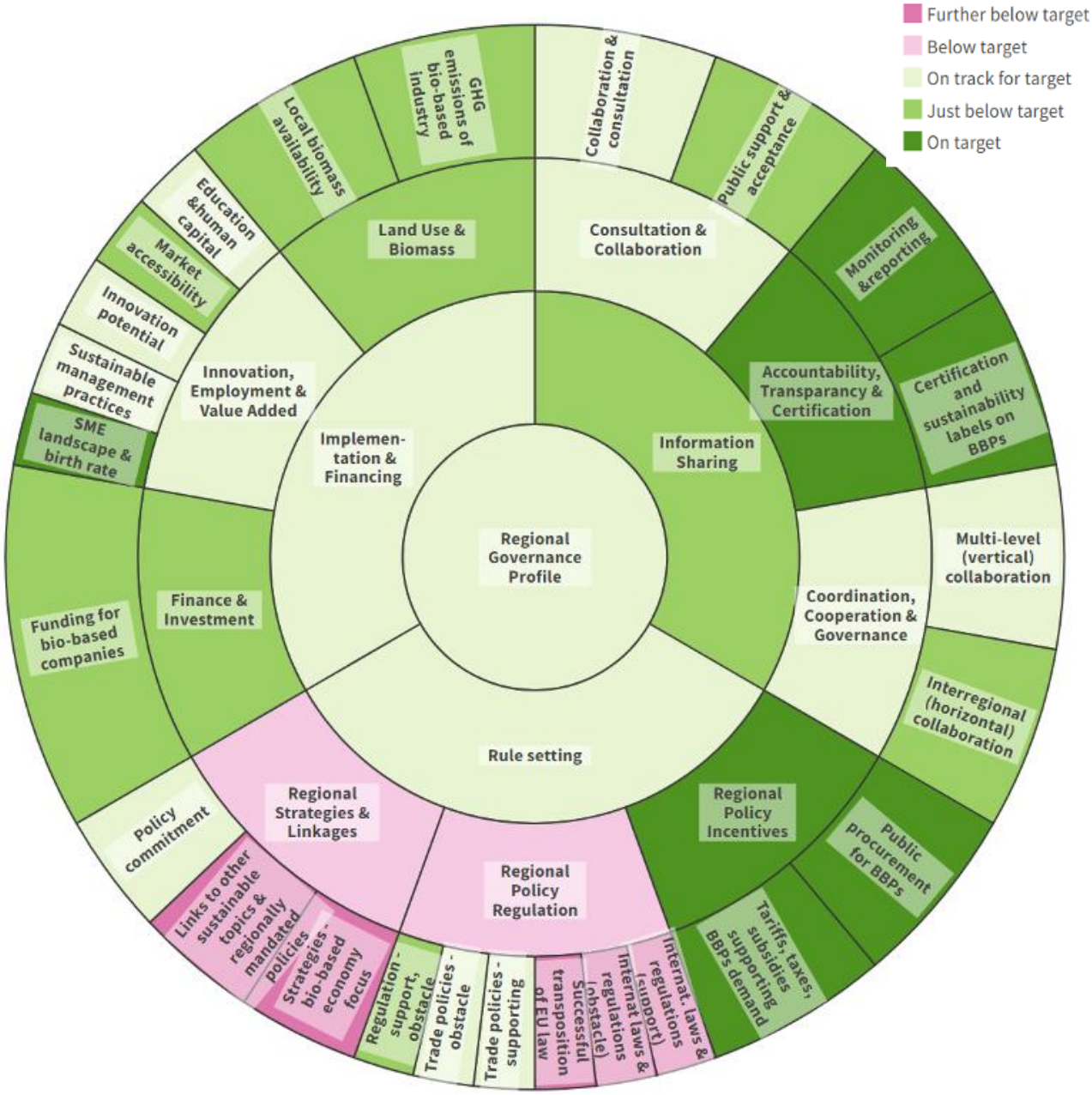
In summary, the governance structure for the bio-based economy in the Delta Region is characterised by triple-helix participation (public, private, and knowledge institutions), and a predominant top-down, centralist approach with a strong regional identity. This reflects the existing public financing and regulation as the provinces implement in regional accents and in developing triple helix ecosystems. The national and regional bioeconomy strategies respectively link strongly with the focus areas of the EU Bioeconomy Strategy. There is a strong horizontal governance scheme both at national and regional level, involving numerous ministries and cross-ministerial steering boards and committees fostering exchange on the topic and enabling trans-regional and national partnerships. The presence of regional organisations, such as CBBD, with focus on a particular sector (the bio-based industry) and

[28] See www.mnext.nl/.
[29] See www.curio.nl/over-ons/onderwijsinnovatie/practoraten/agrofood-en-biobased.

coordinating local stakeholders' interests and needs with national and European agendas and funding strongly contributes to this ecosystem.

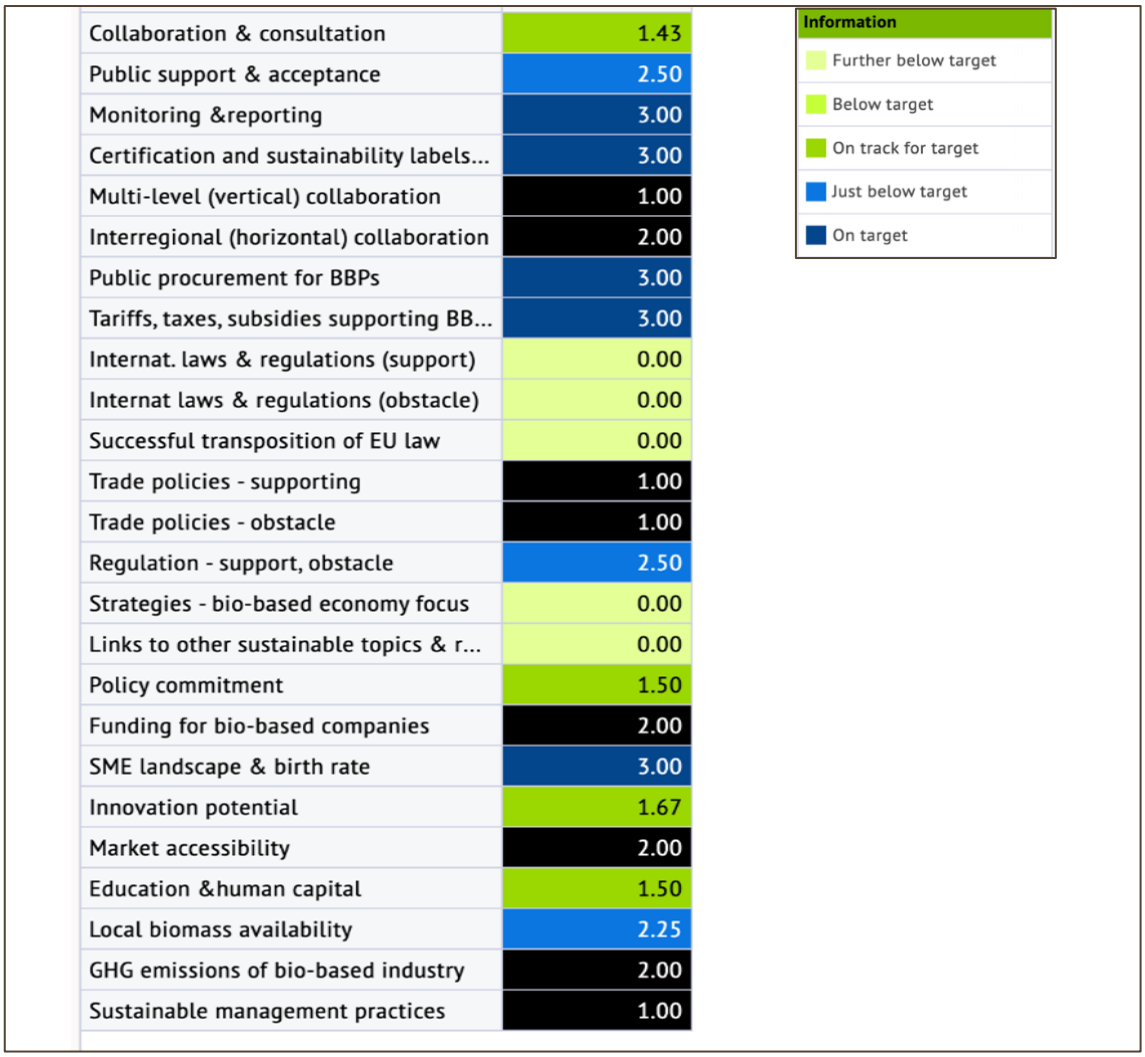
Governance Framework Analysis for the Delta Region

An analysis of the Delta Region Governance framework was performed by Wageningen University and Research. In this section are results of the analysis according to the governance framework developed by Jacobi, Hayder and Connolly (2023), outlining a three-tiered framework consisting of basic governance functions (1st tier), specific bio-based governance functions (2nd tier) and assessment criteria (3rd tier). A set of around 50 indicators was evaluated and benchmarked, following an intensive data collection process by the six Biomodel4Regions pilot regions and their cluster organisations. The data was then processed, cleaning-up errors and filling gaps with reasonable assumptions, to visualise results in the BERST Dashboard.[30]



[30] https://beta-berst.databank.nl/jive

Figure 2: Regional Governance Profile 'the Delta Region', The Netherlands, BERST Dashboard 2023



Collaboration & consultation	1.43
Public support & acceptance	2.50
Monitoring &reporting	3.00
Certification and sustainability labels...	3.00
Multi-level (vertical) collaboration	1.00
Interregional (horizontal) collaboration	2.00
Public procurement for BBPs	3.00
Tariffs, taxes, subsidies supporting BB...	3.00
Internat. laws & regulations (support)	0.00
Internat laws & regulations (obstacle)	0.00
Successful transposition of EU law	0.00
Trade policies - supporting	1.00
Trade policies - obstacle	1.00
Regulation - support, obstacle	2.50
Strategies - bio-based economy focus	0.00
Links to other sustainable topics & r...	0.00
Policy commitment	1.50
Funding for bio-based companies	2.00
SME landscape & birth rate	3.00
Innovation potential	1.67
Market accessibility	2.00
Education &human capital	1.50
Local biomass availability	2.25
GHG emissions of bio-based industry	2.00
Sustainable management practices	1.00

Figure 3: Overview of the assessment criteria (tier 3) including scores, BERST Dashboard 2023

A summary, according to the figure above, the highest scoring criteria include:

- Monitoring & reporting (information-sharing)
- Certification and sustainability labels on BBPs (information-sharing)
- SME landscape & birthrate (implementation & finance)
- Tariffs, taxes, and subsidies (rule-setting)
- Public procurement for BBPs (rule-setting)

Assessment criteria, scored just below benchmark include:

- Local biomass availability (implementation & finance)
- Regulation for the bb economy (rule-setting)
- Public support & acceptance (information-sharing)
- Interregional (horizontal) collaboration (information-sharing)
- Funding for bio-based companies (implementation & finance)
- Market accessibility (implementation & finance)

Criteria scoring low, but with view ('on-track') towards benchmark include:

- Education & human capital (implementation & finance)
- Policy commitment (rule-setting)
- Innovation potential (implementation & finance)
- Coping with trade policies as obstacle (rule-setting)
- Using trade policies for the bb economy (rule-setting)
- Multi-level (vertical) collaboration (information-sharing)
- Collaboration & consultation (information-sharing)
- Sustainable management practices (implementation & finance)

Least scoring areas and therefore biggest challenges according to the evaluation done, include:

- Links to other regional (sustainability strategies) (rule-setting)
- Strategies/policies with bioeconomy focus (rule-setting)
- Successful transposition of EU law (rule-setting)
- Dealing with international/EU laws – in support and as obstacle/challenge (rule-setting)

The regional bio-based economy in the Delta Region has been found to have well established structures for information sharing both vertically (between governance fields/government levels) and horizontally (between actor groups at regional level), including with the public. See in image above, on the 1st tier "basic governance structure", how the Delta Region scores highest on information-sharing. There is a high degree of bio-based industry collaboration. Furthermore, labels for bio-based products (BBPs) are effectively used and applied and certification mechanisms are in place to stimulate and regulate bio-based markets. Additionally, the regional government and its institutions and agencies have been reporting schemes in place to verify progress along a circular bio-based economy transition as for examples to the national monitoring of the Bio-based Economy by the Netherlands Enterprise Agency (RVO) since 2015[31] making *accountability, transparency & certification* the strongest evaluation criteria within this 1st tier governance function (see figure above). From 2020, RVO broadened the earlier focus on the Bio-based Economy to the circular economy.

In terms of *implementation & finance*, the results suggest that the regional bio-based economy is characterised by very robust value chains, strongly developed and partly diversified bio-based market structures. It has high value added, and a workforce employed in well-paid jobs. Although innovation potential and sustainability practices (i.e. share of companies with sustainability credentials) have been evaluated as the lowest KPI in this 1st tier function, the small and medium-sized enterprise (SME) landscape and birth rate appears to be very promising compared to the threshold. Factors that lead to this interpretation are the prospective land and water ecosystems in place to derive feedstock for the bio-based economy and land-use and sector conflicts are minimised; the fact that emissions from bio-based industries are low, only slightly lower than the benchmark; the dedicated public funding

[31] https://www.rvo.nl/onderwerpen/bio-based-economy/feiten-cijfers-circulaire-economie accessed on 21 October 2024.

available for strategic bio-based economy development; and the framework conditions and bio-based technology readiness levels are favourable for private investments. In relative terms, the biggest challenges within the area of implementation & finance appears to be the sustainable management practices of companies involved in the bio-based economy, the innovation potential, and the education and build-up of human capital (see figure above).

In the *rule-setting* space, results based on its dedicated and fairly integrated bio-based economy policy framework suggest that the bio-based economy in the region uses and advocates for using a large variety of incentivising mechanisms available to stimulate production and consumption of BBPs, especially in the area of procurement for BBPs and in terms of taxes and subsidies supporting BBP demand, making *regional policy incentives* the by far the most promising criteria within the 1st tier function of *rule-setting*. Much less pronounced appears to be the area of *regional policy regulation*, where results suggest that the region is hindered by EU and national law and regulation on the bio-based economy, e.g. on waste and its focus on environmental and public health risks which is one of the region's key focus areas in terms of valorisation. Overall, a favourable transposition of EU law in the bio-based economy context is lagging compared to the threshold. The most significant challenges in this governance area appear to be on the degree of integration of bio-based economy policies, regulations and strategies with other policy priorities, or regional mandates. Here, a missing systemic link and harmonisation of the regional bio-based strategic framework with other sustainability targets (e.g. climate resilience, sustainable development goals - SDGs, etc.) as well as the absence or too scarce bio-based content of related regional frameworks, are noteworthy

3. TOWARDS A VISION FOR THE BIO-BASED ECONOMY IN THE DELTA REGION

3.1 POLICY PRIORITIES

Climate change adds pressure on our fossil-based economy. The need to reduce greenhouse gas emissions, the finiteness of fossil resources and the high import dependency for raw materials make a change of course inevitable. To make our economy carbon neutral, the transition to alternative sources and renewable raw materials - such as biomass for materials and chemicals - is of priority importance.

The bio-based economy is one of the elements of the Dutch ambitions to realise CO2 emissions reduction and circularity.[32] Given its focus on agriculture, horticulture, chemical industry, ports, construction and innovation, the Delta region has great potential to play a strong role in the Netherlands regarding bio-based activities and in contributing to CO2 emissions reduction.

The current economic system in the region largely consists of linear chains. The linear economy produces a large part of global CO2 emissions and therefore contributes significantly to climate change. It also leads to loss of value of materials and depletion of finite raw materials. The provinces in the region want to contribute to the transition to a circular economy that increases broad prosperity in the area and enables higher-value products while using fewer raw materials. Additionally, circularity provides a strong positive economic effect for these provinces. It increases the strategic autonomy of the provinces by reducing dependence on raw materials from outside the province and or the region. It gives local companies a competitive advantage because the impending need for a future-proof economy pushes the global economy to transition into a circular economy in the coming decades.

South Holland's policy priorities are structured around eight foundational building blocks as part of its Circular South Holland 2024-2027 strategy[33], aiming to accelerate the transition towards a circular economy. Among these, key building blocks include Circular Innovation and Coalition and Networks, which focus on fostering collaborative efforts and innovative approaches. By 2030, the province envisions that half of the organisations with significant raw material flows will visibly progress towards circularity, collectively achieving a 50% reduction in the use of new metals, minerals, and fossil raw materials compared to 2015 levels. The province plays a facilitative role in supporting networks centred on bio-based construction, circular solar panels, reusable packaging, and the optimal valorisation of natural residual flows. South Holland actively engages in sectors like sustainable agriculture, green ports, smart industry, the port industrial complex, energy, and digitalization by providing subsidies and investments, exchanging knowledge, adapting regulations, and fostering further partnerships.

Moreover, South Holland is driving the transformation of four circular market chains within the sectors of port and industry, construction, agriculture, and maritime due to their significant potential for circular impact, new earning opportunities, and the existing enthusiasm among

[32] Nova institute (2021) indicates that the estimate is that 20% of embedded carbon demanded in 2050 will be supplied via the bio-based track www.renewable-carbon.eu/graphics
[33] See https://magazine.zuid-holland.nl/samen-bouwen-aan-een-circulair-zuid-holland/

stakeholders. This transformation involves creating shared visions with partners, knowledge institutions, and financiers, and developing joint agendas and EU-oriented propositions. The province aims to support at least 15 breakthrough projects that reshape these circular market chains, ranging from circular energy transitions to bio-based crops.

One of Zeeland's primary policy priorities is to maintain and strengthen its diverse economic structure to ensure a robust and sustainable regional economy. The province's economic foundation is built on strong ports, a versatile tourism and recreation sector, diverse retail trade, a traditionally innovative agricultural and fishing sector, and a solid industrial cluster. To address these priorities and overcome challenges, Zeeland's policy spearheads focus on enhancing the business climate and regional image, fostering innovation and development capacity through targeted SME support and funding, and transitioning to a sustainable and climate-neutral economy by embracing the circular economy, promoting sustainability, and integrating nuclear energy into the regional energy mix. Zeeland also aligns these priorities with national and European agendas to reinforce its regional efforts.

The Province of Zeeland supports the national and regional target of 50% reduction of use of primary abiotic raw materials in 2030 and towards 100% reduction in 2050 and has selected three priority sectors to direct their focus on implementing such targets: ports and (Chemical) Industry, construction, and SMEs. With additional priorities in types of raw materials to be set soon after the results from the monitoring report become available (expected for Q4, 2024).

The province of North Brabant promotes the use of green raw materials and the multiple value in using all parts of plant materials with as little energy or waste across as possible. For years the province has been developing chains for bio-based building materials and aims to have 4,000 hectares of fibre cultivation in the province by 2027. In combination with this strategy, North Brabant develops an innovation coalition for having fibres cultivated and to be processed and used in buildings construction, such as housing and factories. Together with partners, the innovation coalition is to promote supportive legislation, to stimulate public-private partnerships of market demand. This innovation coalition is aligned with Building Balance and the EN Zuid program that focuses on using as much as possible substances from plants. North Brabant continuously looks for financial support in European funds. The BioBuild project with partners from Finland, Poland, Greece, and Moldova has been submitted in Interreg Europe's third call.

Recently North Brabant joined forces to take a leading position in the transition into sustainable food systems. The focus is on scaling up ingredients that make plant-based food tasty, nutritious, and affordable. The ambition of the Province of North Brabant, the Brabant Development Company (BOM), and REWIN (West Brabant) is to make Brabant the scaling-up hotspot of Europe. North Brabant is ideally located between the food innovation hotspots Ghent, Delft and Wageningen and has almost the entire chain in-house to produce plant-based food innovations. It will facilitate a network of accessible pilot, demo and full-scale facilities. In addition, long-term sector-specific support is being set up for start-ups in the scale-up phase. Existing companies can also join the initiative and, for example, use part of their capacity to collaborate with start-ups. In addition, the collaborating partners will work on international positioning, acquisition, and entering collaborations with international start-ups. Where possible, the BOM will invest in participating food start-ups.

3.2 OUR VISION FOR A BIO-BASED ECONOMY IN THE DELTA REGION

The vision for a bio-based economy in the Delta Region defined here below is a result of a process of multiple engagement moments with over 50 stakeholders representing the triple helix on the Delta.[34] This effort was coordinated in the scope of the Biomodel4Regions Horizon Europe project, however it builds on ongoing work from the multiple stakeholders, and it seeks to align with recommendations from the knowledge sector as well as with provincial policies and strategies defined by the public sector and goals set by the bio-based industry in the region. It is the group's understanding that a vision statement describes the long-term goals, dreams, and aspirations for the region and its communities. The vision statement sets the bar high in terms of how the region wants to be perceived by the world in the future.

The vision for the bio-based economy in the Delta Region answers the following guiding questions:

- What should be the purpose of the region regarding the bioeconomy transformation by 2050?
- What are the social, environmental, and economic impacts that the region wants to achieve through this vision?
- How does the region want to position itself? and why?

The vision states, therefore, that:

By 2050, the economy in the Delta region will be sustainable and climate neutral. This means use of primary fossil resources and CO2 emissions approaching zero. The necessary knowledge is present in the area, being developed or accessed. This makes the Delta region a thriving and future-proof economy that operates within the carrying capacity of the area. This makes it an area attractive to live, work and learn. The transition to renewable bio-based raw materials is part of achieving this ambition for the region. In fact, the 1st step is the transition to circular which fits into existing process technology. The 2nd step is the transition to bio-based for which new bio-based process technology must be developed and should be started now. This document by B4R is particularly focused on elaborating the transition to renewable bio-based feedstocks and associated process technology.

[34] Central discussion on the vision initiated in June 2024 on the workshop day delivered in Middelburg with the presence of main stakeholders of the triple helix interested and affected by this vision. Continued by online workshops, interviews, and separate meetings for development, clarification, and common agreement to be achieved. Representation from the provinces of Zeeland, North Brabant and East Flanders, local development agencies, bio-based business and knowledge and research institutions. The full-day workshop focused on identifying the elements for a regional vision, discussion of common challenges and suggestions for collaboration for solutions that would benefit the goals beyond one same province. The workshop included a few presentations from ongoing work that is developing the bio-based economy in the different provinces and (Dutch) national and European targets and possibilities for funding. In combination with presentations, the workshop enabled several moments for group discussions, reconvening at the end of each session to share different perspectives and align those further. Key findings led to the initial drafting of this blueprint, which continued to be developed further in consultation and involvement of several of the attendees of this key workshop.

While the transition to renewable bio-based feedstocks is a critical step toward a sustainable Delta region, this vision for the region's future encompasses much more than only a bio-based approach. A truly sustainable and climate-neutral economy will require a comprehensive transformation across all industrial activities, ensuring they operate within the environmental carrying capacity of the area. This entails a robust shift not only toward bio-based raw materials but also toward circularity, efficient energy use, waste minimization, and responsible resource management. The goal here is to foster an overarching sustainable industry that incorporates bio-based principles as a key component, yet remains committed to an inclusive, adaptable framework that addresses broader economic, ecological, and social challenges. By establishing this inclusive vision, the stakeholders create a resilient and attractive region for current and future generations to live, work, and learn.

3.3 STRATEGIC & OPERATIONAL OBJECTIVES

The regional circular bio-based economy revolves on developing viable solutions - from technical, to economic, environmental, (socially)responsible, and transparent, learning how to work together (creating new value chains, involving new players and know-how) and then growing together (scale-up, multiplication, awareness).

Based on the learnings from existing efforts across the pilot region and their results achieved, the core elements to the vision for the Delta Region can be organised into the following three strategic objectives.

3.3.1 Develop Regional Collaboration

Guiding stakeholders' statements linked to the vision

"*…the Delta region a thriving and future-proof economy that operates within the carrying capacity of the area.*"

"*… ensuring strategic autonomy and resilience for the region and its communities.*"

The Delta is unique in the sense that it has so much in common and is interlinked beyond the borders of the Netherlands and Belgium. There is great potential and regional interest in looking into possibilities in the Delta Region that are not solely for Belgian or Dutch stakeholders. A cross-border collaboration brings extra potential if it builds onto the several common aspects. It would build on on-going activities, knowledge, and goals shared and channel resources and efforts into building faster and better technologies and models.

However, it is still the perception of several stakeholders in the region that currently there is not a structure or clear overview of all active parts in the space for the Delta region. The conclusion of the quadruple helix organization Circular Biobased Delta has left a gap that remains only partially addressed. Several initiatives exist within each of the provinces in the region, however, there is difficulty in keeping an oversight of latest developments, hindering optimization of efforts, plans, and investments. This collaboration strategy can solve this

challenge. All the different parts (the triple helix) are necessary to be included and actively involved/ in collaboration to move the vision into strategies, targets, and activities to results. It is a similar situation to leaping frogs, reaching multiple directions. It is necessary to get them to choose the same direction. For this, it is needed to know who they are, get them involved and in agreement to collaborate and act.

To translate this in practical terms, it would be necessary, as a next step, to identify among existing institutions (or a network of institutions) a coordinator(s) which would lead the support to industries and academia in sharing non-competitive knowledge, assist with identification of missing actors in the value chain for new opportunities, and therefore enable consortia to be formed and can apply and obtain investment to reach much needed advancements. Such a leadership to keep focus and ensure involvement of the multiple actors necessary to achieve systemic change has been agreed to pose as a key element to achieve the vision for the region. This could be per sector and on demand from companies. There, knowledge and experience would be exchanged, per sector, and from which consortia could emerge that formulate project applications for innovations that contribute to accelerating the transition.

The coordinating institution could serve as a platform to showcase bio-based projects from various stakeholders leading to potential 'strategic autonomy' or 'regional hub'. Quarterly/bi-annual meetings would help identify common barriers and solutions by ensuring the triple helix stakeholders continuously engage and learn from each other.

It is important to mention that such a coordinating institution would ideally be made financially viable by financing obtained from joint projects developed by the stakeholders in the region and overseen by the coordinating institution. This would ensure a clear framework, and development of topics and activities according to shared regional interests agreed for the projects. An example would be European funding via e.g., Regional Innovation Valleys to finance these coordination activities in (potential) collaboration with the public and private sector.

Proposed operational objectives for the region:

1- Establish a model for a regional coordinating organisation to oversee regional efforts and goals into creating joint opportunities of financing and development of technology and business models in the bio-based economy space. This coordinating organisation model could potentially translate into improving already existing structures, such as the regional Knowledge and Innovation Chain Networks by ensuring cooperation and exchange with stakeholders of the triple helix.

2- Increase the growth of the network alignment via strategic meetings focused on companies, facilitated by public sector and academia, to inform topics and partners of common interest for cross-border and/or cross-province collaboration. Ensure that the data being produced by national agencies is flowing/informing (e.g. via Bio-based accelerating days) the Knowledge & Innovation Networks existing for the different sectors (it is key that specific information reaches the right companies and businesses)

3- Aim for a growth in the number of joint-proposal submissions for funding (Regional Innovation Valleys for Bioeconomy and Food, Horizon Europe, Interreg, IPCEI, regional funds). Jointly set an objective to facilitate an increase in collaborative proposal development, including cross-border and multi-province submissions annually.

Examples of initiatives contributing to regional collaboration:

Regional Innovation Valleys (RIVs)

One of the 25 actions of the New European Innovation Agenda (NEIA). It aims to harness the full innovation potential across Europe, connecting less and more innovative regions and addressing social challenges through cutting edge technology. Involved regions identify their competitive advantages to bridge innovation divide, using their complementary strengths for an improved Research & Innovation (R&I) ecosystem. The R&I ecosystem can be a regional cross-border instrument to find opportunities of innovation at different levels: between regions, in the use of technologies, on investments, through skills development. Bioeconomy-related Regional Innovation Valley ecosystems can strengthen place-based strategic policymaking and exploit funding synergies. A key step in this topic is aligning the region and identifying common topics of interest.

Stakeholders in this project, representative of the triple helix, identify competitive advantages to bridge innovation divides, using their complementary strengths for an improved R&I ecosystem and are interested in applying for receiving a RIV label in future calls. Using as guidance topics the CBE-JU calls for 2024, preliminary conversations during our workshops already indicated clear common interests. The Delta region could propose a route and steps to establish a regional coordination mechanism to create an innovation and upscaling valley for replacing fossil with green raw materials. This could cover all applications of green raw material replacements in products. The target set should be to reduce fossil in the life cycle of specific products, for instance, having 50% replacement with green raw materials by 2030.

Circular Biobased Delta (CBBD)

The Circular Biobased Delta was for 10 years active in the Delta region. Its focus was to bring together organisations that could take steps to deal with raw materials and emissions more intelligently. Financed by some of the provinces and larger companies in the Delta, the CBBD created a regional ecosystem for the bio-based economy and developed a portfolio of projects, ranging from production of new biomass-based chemicals to plastics recycling routes aimed at CO2 emissions reduction. Funding for the CBBD was concluded in December 2023 and from conversations with regional stakeholders during workshops and interviews CBBD contributed to advancing and accelerating the bio-based industries. The stakeholders see the value and importance in identifying the next possible coordination organism to be taking over and expanding the role of CBBD to fulfil the need for a regional collaboration effort, learning from its lessons. *A coordination* mechanism that can promote supportive legislation, stimulate public-private partnerships of market demand, and attract European funding is an effective way of establishing regional collaboration. It would ensure the network is known, visible, and connected. Equally important, it would bring coordination of investment, a key element of the innovation system. For example, the Regional Innovation Valleys initiative.

However, there are a few main lessons learned from CBBD which bring rich insights for future developments in collaboration and information-sharing in the region. Lesson 1: a coordinating organisation needs to ensure to be closely interwoven with existing relevant regional organisations. It was difficult for CBBD to interweave with larger stakeholders in the space of the regional bio-based economy (e.g. Smart Delta Resources). Potentially another route could be via organisations such as Vitaal Sloegebied Kanaalzone (VSK) and BioPark Terneuzen

(BPT), which represent multiple entities interested in developing bio-based solutions in the area. A coalition of the willing. Lesson 2: the focus on higher technology readiness levels (TRLs) projects help prove the case of successful bio-based business models by showing concrete results. Lesson 3: calculate the potential reduction in CO2 emissions and use of raw materials. This provides crucial information for decision-makers to identify where to prioritise to achieve transition to a circular bio-based economy.

3.3.2 Facilitate Innovation and Scale-Up

Guiding stakeholders' statements linked to the vision

"We will encourage that the necessary feedstock for the bio-based raw materials is available to enable the reduction of virgin fossil extraction by providing a more sustainable replacement."[35]

"We will promote a high-quality knowledge cluster" with the objective of innovation to grow regionally, among others.

There are considerable challenges in ensuring feedstock for bio-based products, quantities produced, and optimizations. When looking at solutions to these issues, knowledge exchange, data collection, and testing of new technologies are clear priorities. There is an urgent need for further investigation on crucial data and understanding regarding the regional figures pertinent to the bio-based economy. How much land in the provinces and the flows originating from biomass? How much materials need to replace fossil ones? Estimations of how much to produce, harvest and convert to be replaced. Should the province import the biomass to have enough feedstock for bio-based, would cooperating with (specific) parts of Europe for import be better or worse than increasing local production and therefore consider where new crops would fit, and best be placed? near industry or elsewhere? Should low value high volume biomass be produced near where feedstock is grown?

A lesson learned from CBBD in the Delta region is the need to make an inventory of the potential existing in the region. At an early stage, have an independent engineering firm to globally calculate the potential reduction in CO2 emissions and use of raw materials. This calculation is important for the knowledge & Innovation networks, policy makers and other organisations. This provides insight into which projects/activities should be prioritised (for investments, for adjustments of industrial processes, among other key decisions with long-term impact) to accelerate the transition and increase the impact in terms of reduction.[36]

In addition, it is essential to test new technologies and solutions to determine their viability for large-scale application. While there are already well-known bio-based materials, many other

[35] The publication "Brightsite Transition Outlook 2023" indicates that an entire transition to bio-based ethylene and bio-based ammonia requires 25,000 km2 of cropland (or 90,000 km2 of forest accretion). 1 km2 = 100 hectares. 25,000 km2 = 2.5 million hectares. Assuming the Nova Institute that by 2050 20% of raw materials will be bio-based, then 20% of 2.5 million hectares is 500,000 hectares. The Netherlands had a total of 535,000 hectares of cropland used for food and feed production in 2022. Available at https://brightsitecenter.com/bto-download/.

[36] https://cedelft.eu/publications/co2-reduction-with-the-circular-bio-based-delta/

natural materials may also be suitable but require thorough investigation to confirm their suitability and reliability.[37] This should be complemented and enhanced through the educational system. Facilitating innovative solutions and ability for skilful assessments would benefit from a better-trained working population able to adapt quickly to technological developments and new forms of work organisation. Educational institutions play a crucial role in this context by equipping the workforce with the adaptability to keep pace with technological advancements and new organizational methods.[38] This shift requires that current skills be updated and refined, rather than entirely new training standards being created. Increasing the emphasis on green economy training programs is a powerful lever to enhance employee capabilities, ensuring a workforce that is prepared to step into the sustainable jobs of the future.

Provinces in the region have and continue to play a key role in this strategic objective of facilitating innovation and scale up. They are in a strategic position to consolidate and further develop the ecosystem by understanding how to support the coordinating organisations, as it was the case with the Circular Bio-based Delta, and the Green Chemistry Campus, and networks for the different value chains (Knowledge & Innovation Networks) [39]. Additionally, they can support in creating market impulse for bio-based products, as the local examples of BioVoice (SMEs are challenged by large company to come up with innovative solutions) and Symbioses for growth program (residue streams are identified and neglected chains are formed), as well as seek exploration of opportunities for EU funding/investments and instruments and, supporting feasibility studies and realisation of scaling up production facilities (e.g. Biogate Europe feasibility study biorefinery plant).

Proposed operational objectives for the region:

1- Triple helix regional organisations to increase efforts in identifying common technical barriers and play a role in facilitating interactions of the network (industry-academia dialogues) to find solutions to overcome these.

2- Triple helix regional organisations to grow the use rate of Application Centres where entrepreneurs can test their innovative ideas in an accessible way are other much needed actions.

3- Knowledge and Innovation Networks and Knowledge Institutions (supported by the public and private sectors) identify (and collect) relevant data to inform key decision-making such as for the process of selecting areas for industrial settlement.

4- Expand educational and vocational training programs within regional educational institutions to adapt and update skills for emerging bio-based sectors. Target relevant technical and vocational programs in the region to incorporate specialized modules on bio-based innovation, sustainable materials testing, and circular production processes contributing to workforce readiness for the bio-based economy.

[37] See for example TNO *Bouwinnovatie* Lab https://www.tno.nl/nl/technologie-wetenschap/laboratoria/bouwinnovatie-lab/.
[38] For more details see Skills in Transition – The way to 2035, CEDEFOP, 2023 available at https://www.cedefop.europa.eu/files/4213_en.pdf
[39] https://campuszeeland.nl/kennis-en-innovatienetwerken/

Examples of initiatives contributing to innovation and scale-up:

Bio Base Europe Pilot Plant

The Bio Base Europe Pilot Plant is a flexible and diversified pilot plant for the development, scale-up and custom manufacturing of bio-based processes and products and aims at closing the critical gap between scientific feasibility and industrial application of new biotechnological processes. Infrastructure that enables new products and processes to be tested at the right scale and within reasonable costs is key. The INTERREG Flanders-Netherlands project kicked-off in 2008, on the Flemish side, the project was co-financed by Flanders, the Province of East-Flanders and the City of Ghent. On the Dutch side, the project was co-financed by the Dutch Ministry of Economic Affairs, the Province of Zeeland, Zeeland Seaports, ROC Westerschelde and Delta NV. The Pilot Plant is situated in the Port of Ghent in Belgium and is equipped with state-of-the-art equipment to perform biomass pretreatment, biocatalysis, fermentation, up- and downstream purification and green chemistry. It focuses on conversion of biomass (a.o. agricultural crops and by-products, industrial side streams) into biochemicals, biomaterials, biofuels and other bioproducts.

Application Centres and Knowledge and Innovation Networks

It is important for companies to be able to participate in innovation projects and to learn from other companies and knowledge institutions. It is important for knowledge institutions and governments to be well informed about the questions that exist within companies. This comes together in a K&I network. The provinces in the region have facilitated several Knowledge and Innovation Networks as this allows them to award grants to organisations involved. An example is the Knowledge & Innovation Network Circular Building. This is a public-private initiative that stimulates and organises knowledge exchange and development by bringing together supply and demand in the field of circular construction in Zeeland. The work is based on three pillars: (1) knowledge sharing, (2) networking and (3) initiating. (1) In order to share extensive knowledge and experience, the network regularly organises (theme) meetings on circular topics with excursions to circular construction projects and/or companies. (2) The goal of networking is to strengthen each other, learn together and collaborate in reducing CO2 emissions. (3) The parties involved determine together which themes are addressed. The network guides the development into projects and connects the right participants to ensure that everyone can get started quickly.

Application Centres are part of the R&I ecosystem by providing a space for entrepreneurs to test their innovations at a low cost, facilitating the transition from concept to marketable product. In Zeeland[40], an example is the Bio-based Innovation Garden Rusthoeve[41] which specialises in growing various potential bio-based crops, and supports the testing of small-scale biorefining technologies, helping to bridge the gap between lab research and practical agricultural applications. It serves as a collaborative hub where farmers, researchers, and businesses from sectors like agriculture, construction, and chemistry come together to explore

[40] Also in Zeeland is the Natural Fiber Application Center (NAC), Raamsdonksveer, which for over 10 years fills in the gap between laboratory and pilot, working towards industrial production within the scope of lignocellulosic fibres.

[41] www.impulszeeland.nl/projecten/biobased-innovation-garden-rusthoeve

and develop new applications for green raw materials. In North Brabant[42], an example is the Green Chemistry, an incubator focused on technologies, chemical building blocks and products that enable significant impact: pyrolysis, bio-aromatics, and applications with superior characteristics. At Green Chemistry Campus businesses, governments and knowledge and educational institutions join forces to lead intermediate circular biobased organization in West Brabant that have an economic impact to strengthen the regional circular bio-based ecosystem.

3.3.3. Enhance Market Demand

Guiding stakeholders' statements linked to the vision

"Improved understanding of bio-based economy's key relevance and urgency to increase societal understanding, institutional support, and market demand."

Despite efforts from multiple stakeholders, the positive economic impacts that the bio-based economy can bring are not clear to the market. Purchasers from companies and governmental institutions especially have the power to choose to use bio-based molecules, materials, or products as input for their products, processes, and operations.

Procurement by governmental institutions and companies acts as a powerful lever to drive innovation by creating immediate demand for bio-based solutions, products, and materials, which in turn signals strong market potential. This demand gives innovators a clear incentive to develop competitive, sustainable alternatives to conventional products, knowing there is a committed buyer base. For bio-based industries, this market pull is essential not only to stimulate production at scale but also to justify continued R&D investment. Strong procurement practices also help establish supply chain stability, encourage economies of scale, and build buyer-supplier networks' key factors that reduce costs and promote broader adoption of bio-based innovations. Additionally, when public and corporate buyers commit to sustainable procurement policies, they foster long-term market confidence, helping bio-based sectors attract further private and public funding needed to scale up and compete with established fossil-based solutions.

However, to drive bio-based economy solutions forward, procurement finds it difficult to assess viable options for their needs when it comes to choosing bio-based instead of fossil-based. It is necessary, therefore, to create more opportunities to showcase bio-based solutions using new technologies that are both already available and in the making. Initiatives that create the space for both offer and demand to meet, be informed, ask questions, understand options available for them, agree on needs and possibilities are vital.

The increase of the bio-based economy can allow for new jobs to be created, the development of new technologies, and other potential benefits in addition to environmental ones need to be specifically addressed with different potential targets. From engaging primary producers to understand how to valorise unexploited resources that could enable them to increase their incomes to explaining to the young generations the potential that investing in educational and

[42] Also in North Brabant is KATC (Kunststoffen (Polymer) Application and Training Center), at the Curio (Bergen op Zoom).

career paths to develop their skills for future jobs in the sector represent. It is essential to engage with local communities, raise awareness about the benefits of a bio-based economy, and address potential concerns related to land use, food security, and environmental impacts.

Companies' philosophies also need to change. The bio-based story is a good one. People can understand it once it is presented. The reasoning behind why bio-based is viable, necessary, and how it can grow should be better explained to lead to increased understanding and, consequently, adoption.

Proposed operational objectives for the region:

1- Increase participation of small, middle, and large companies at bio-based events promoting existing businesses and solutions regionally to engage value chains and identify alternatives to fossil-based materials and molecules used in their products.

2- Strengthen focus of bio-based innovation projects communication and dissemination tasks to include more detailed exchanges with potential markets. This would contribute to early-stage identification of specific (technical or other) needs that at a later stage would prevent the adoption by a contracting company.

3- Create a comprehensive, easily accessible platform that connects procurement teams within companies and government bodies to verified suppliers and developers of bio-based solutions. This aims to facilitate targeted buyer-supplier engagement, streamline sourcing processes, and promote visibility of bio-based options aligned with business procurement needs.

Examples of initiatives contributing to the Enhancement of Market Demand:

Bio-based Circular (BBC)

This initiative aims to establish a new sector in the Netherlands focused on bio-based plastics and products. Among its strategies, the one highlighted in the context of enhancement of market demand is the focus brought by BBC to boost the use of carbohydrate-based building blocks for bio-based materials, enhancing economic activity and reducing greenhouse gas emissions. BBC promotes collaboration among SMEs, the agricultural sector, and the chemical industry to create and scale circular value chains. The initiative focuses on setting up five fully circular value chains and expects significant economic growth and job creation by 2050.

3.4 SUMMARY

Vision	Strategic objectives	Operational objectives
By 2050, the economy in the Delta region will be sustainable and climate neutral. This means use of primary fossil resources and CO2 emissions approaching zero. The necessary knowledge is present in the area, being developed or accessed. This makes the Delta region a thriving and future-proof economy that operates within the carrying capacity of the area. This makes it an area attractive to live, work and learn. The transition to renewable bio-based raw materials is part of achieving this ambition for the region. In fact, the1st step is the transition to circular which fits into existing process technology. The 2nd step is the transition to bio-based for which new bio-based process technology must be developed and should be started now	Develop Regional Collaboration	Establish a model for a regional coordinating organisation to oversee regional efforts and goals
		Increase the growth of the network alignment to inform topics and partners of common interest for cross-border and/or cross-province collaboration
		Aim for a growth in the number of joint-proposal submissions for funding
	Facilitate Innovation and Scale-Up	Triple helix regional organisations to increase efforts in identifying common technical barriers and play a role in facilitating industry-academia dialogues to find solutions to overcome these
		Triple helix regional organisations to grow the use rate of Application Centres where entrepreneurs can test their innovative ideas in an accessible way are other much needed actions
		Knowledge and Innovation Networks and Knowledge Institutions identify and collect relevant data to inform key decision-making processes
		Expand educational and vocational training programs within regional educational institutions to adapt and update skills for emerging bio-based sectors
	Enhance Market Demand	Increase participation of small, middle and large companies at bio-based events promoting existing businesses and solutions regionally
		Strengthen focus of bio-based innovation projects communication and dissemination tasks to include more detailed exchanges with potential markets
		Create a comprehensive, easily accessible platform that connects procurement teams within companies and government bodies to verified suppliers and developers of bio-based solutions

5. KEY ACTION FIELDS FOR IMPLEMENTATION

Developing the bio-based economy within the Delta Region requires addressing several common barriers that hinder collaboration and growth. One of the primary challenges is the high cost and relative slow pace of innovation in the bio-based sector. To create affordable, high-performing bio-based products, it is essential to accelerate innovation and find solutions to mitigate the financial risks associated with the bio-based economy. SMEs in particular need support in multiple fronts to have the right tools and knowledge to overcome access to funding and achieve a level of development of its innovation that is market ready.

A critical barrier to this goal is the regulatory framework for the bio-based sector. The lack of policies supporting bio-based product development, added to limiting regulations on various aspects, such as product environmental footprints and waste, nitrogen emissions, impede the growth of the bio-based economy. Policymakers in the Delta Region must collaborate to develop a supportive regulatory environment for the sector and to find short-term solutions while legislation needs time to adjust to most recent developments in societal needs.

As highlighted by Franc Bogovic, Member of the European Parliament, in Brussels the sustainability debate often has a sole focus on nature preservation and technology. However, it should not be forgotten that sustainability includes a social and economic component to which often little attention is given.[43]

To have politicians (*gedeputeerde en provinciale staten*) and companies/businesses (private sector) fully aware of the possibilities for and potential from the bio-based economy also pose a significant challenge. Enhancing the understanding from these groups regarding the benefits and implications of the bio-based economy is vital for setting the urgency which will lead to the level of support needed to achieve the transition from traditional, fossil-based products.

Lastly, infrastructure constraints and limited resources, such as space and energy, hinder the development of the bio-based economy in the Delta Region. Improving infrastructure and efficiently managing resources are crucial to promote growth and collaboration in the sector.

Addressing these barriers requires concerted efforts from policymakers, industry leaders, researchers, and the public to develop strategies and initiatives that drive innovation, strengthen the regulatory environment, increase public awareness, and enhance infrastructure within the Delta Region. By working together, the region can create a conducive environment for the growth and development of the bio-based economy.

4.1 IMPROVING BIO-BASED BUSINESS MODELS IN THE DELTA REGION

In recent years, the provinces in the region have been investing in a strong economic bio-based ecosystem at the interface of agriculture and chemistry, often, they have worked together on projects. In this way, they feel to have contributed in a programmatic way to innovation in plant-based material and product development, and scaling of activities in green chemistry. Their work has contributed to a market impulse for bio-based products, but future

[43] See www.agro-chemistry.com/articles/sugar-as-the-ideal-bio-feedstock-for-the-chemical-industry/.

steps are needed, and the following have been considered below, to strengthen and improve the strategy, based on learnings during the process.

The development of new bio-based economy value chains must incorporate service provider actors (cluster, government etc.) and value-chain actors (SMEs, start-ups). Governance should consider availability of support instruments as subsidies for the different development levels. Good governance should develop a clear long-term vision for a bio-based economy as well as advancing and joint development of a common agenda, joint projects, and common communication. The common elements should target actors from the triple helix. Good governance untangles the complex policy and regulations landscape for better product development and market entry. Including policies that allow multi-dimensional use of material and products (awareness raising and policy support) and prevent greenwashing. Accountability is supported by clear and transparent labelling on the different products which raise better awareness in the retail sector and consumers.

4.1.1 Level the playing field: supportive regulation and access to finance

Developing viable business models that attract investors is crucial for the growth of the bio-based economy. It is essential to educate investors about the unique benefits and long-term profitability of bio-based products compared to fossil fuels. Establishing dedicated funding channels, such as green bonds or sustainability-linked loans, can provide the necessary financial support. Moreover, lobbying for governmental subsidies and incentives specifically for bio-based initiatives can level the playing field against fossil fuel competitors.

A fair playing field includes regulations that recognize the unique attributes of bio-based products and offer them fair treatment compared to fossil-based products. Lobbying for changes in the status of bio-based products to move away from 'waste' categorization will also help in reducing regulatory hurdles

Activities proposed here below contribute to the operational objective of increasing regional collaboration with the aim to accelerate learning and building on knowledge already available, establish new partnerships, and achieve faster and better results.

1. Establish a coordinating organisation with representatives from all stakeholders of the triple helix. This organisation's operations could be (partially) funded via successful regional collaboration project proposals.[44]

2. Map the ecosystem in the region (full mapping of stakeholders, currently multiple fragmented initiatives and out of date).

3. Ensure information flow to and from the region on what regards priority topics and opportunities for its stakeholders.

[44] For instance, by successfully securing CBE-JU funding through collaborative regional project proposals that align with CBE-JU objectives, the coordinating organisation can drive unified regional action in bio-based innovation. This will play a pivotal role in advancing the regional strategic objectives and bringing its vision to fruition.

4. Actively engage in the Bio-based Industries Consortium (BIC)[45]. BIC's core activities are supporting the alignment of funding with local needs, enabling impactful partnerships, and ensuring that regional concerns help shape funding calls to address local challenges via the CBE-JU work programming.

4.1.2 Addressing Technical Barriers through Accelerated Innovation and Education

Accelerating the development of innovations from concept to commercial product is paramount. Traditional steps, such as bender, pilot, and demo stages, must be streamlined or bypassed through integrated development programs that allow simultaneous advancements in various stages. This can be achieved by fostering closer collaborations between research institutions, universities, and industry players to facilitate faster prototype development and testing. Collection and sharing of data on a sufficient scale is paramount. Additionally, enhancing educational programs to focus on the complexities of scale-up processes will prepare a workforce adept at managing these challenges, thus ensuring smoother transitions from laboratory-scale to industrial-scale operations.

Activities proposed here below contribute to the operational objective of facilitating innovation and scale up.

1. Regional organisations such Impuls Zeeland, KIK|MPI (*Kennis en innovatiecentrum Maintenance Procesindustrie*), Smart Delta Resources, Bio-based Innovation Garden bring in their accumulated knowledge to facilitate industry-academia dialogues to overcome technical barriers.

2. Regional organisations such as CO3 Campus in Terneuzen and MNEXT, to propose measures to grow the use rate of Application Centres.

3. Map and perform strategic analysis on regional biomass demand and supply.

4. Collect sufficient data on feedstocks and secondary biomass for better industrial symbiosis and urban planning.

5. Identify relevant factors and trade-offs to define a process to select new industrial areas for scaling-up of the bio-based industry. There is a pressing need for such industrial areas to be created in the region, a challenging task given several consequences in multiple levels that it brings.

[45] The Bio-based Industries Consortium (BIC) is a non-profit organisation which represents the private sector in a Public-Private Partnership (PPP) with the European Commission. BIC's core mission is to support the shift from fossil-based to bio-based, renewable solutions by connecting businesses, innovators, and policymakers, creating opportunities for sustainable development and commercialization in the bio-based sector. Key activities and contributions of BIC include: (1) Facilitating knowledge sharing and networking among members to drive innovation and growth in the bio-based economy. (2) Advocating for favourable policies, regulations, and investment frameworks to support the development and competitiveness of the bio-based industries in Europe. (3) Supporting the Bio-based Industries Joint Undertaking (BBI JU), a €3.7 billion partnership between the European Commission and BIC, which funds research and innovation projects in the bio-based industries.

6. For each project proposal under development conduct an early-phase assessment of the project's potential impact, specifically evaluating expected reductions in CO2 emissions and decreases in reliance on abiotic raw materials.

7. Collaborate with regional educational institutions and vocational training centres to develop targeted programs on bio-based scale-up processes. Aim for each major institution in the region to offer specialized courses or certifications focusing on bio-based production, pilot-to-scale transition management, and sustainable materials testing.

4.1.3 Supporting SMEs

Providing targeted support for SMEs in the bio-based sector through access to funding and markets pose as a main lever to support their growth and success. Establishing networks that connect SMEs with larger industry players, research institutions, and investors can create synergistic opportunities. Giving the stage for visibility and increased familiarity with bio-based innovation improves understanding, which improves acceptance and reflects on market demand.

Additionally, focusing on flagship projects, such as First-of-a-Kind (FOAK) initiatives, and providing them with the necessary resources and support can demonstrate the viability and benefits of bio-based technologies, thus attracting further investment and interest in the sector. An example of a flagship cross-border initiative is the Biorizon Shared Research Center [46](North Brabant). The focus was on converting biomass and residual streams into bio-based aromatics (chemical industry). The project has also developed a community for both global leaders and SMEs providing access to knowledge through a platform.

Activities proposed here below contribute to the combined operational objectives of increasing regional collaboration and enhancement of market demand:

6. Small, medium, and large companies working together in Supply Chain Integration: focus on working with SMEs to integrate them into the supply chains of large bio-based projects or products. This would offer a practical route to market for innovative products.
7. Participate in cross-border consortia that focus on flagship initiatives, such as FOAK projects, to pool resources and share knowledge while accessing new markets and regulatory environments.
8. Define topic of common regional interest for innovation valley: green chemistry or materials (e.g. application on products for construction industry: insulation, coatings). European funding key to support provincial work for the development of the bio-based economy.
9. Establish quarterly sector-specific bio-based webinars to connect bio-based innovators with companies looking to replace fossil-based materials, focusing on case studies that demonstrate successful transitions to bio-based inputs.

[46] For more details visit www.biorizon.eu/biorizon/vision/.

10. Develop and distribute a ‘Market Needs Checklist’ template for bio-based projects. This checklist would guide teams in identifying critical specifications, standards, and regulatory requirements during the research phase to avoid adoption barriers later.
11. Establish partnerships with bio-based industry associations, certification bodies, and regional suppliers to define a vetted list of bio-based suppliers, products, and solutions. Such a continuously updated directory of suppliers who meet industry standards and sustainability certifications, giving procurement teams confidence in their sourcing choices would populate the platform that connects procurement teams with bio-based suppliers.
12. Supplier Spotlight Webinars and Demo Days to showcase bio-based products and allow direct engagement to ask questions and see real-world applications to encourage procurement teams to consider and adopt bio-based solutions, creating a more active and engaged buyer community.

By addressing these priority areas, the Delta region can enhance its business models to better utilise the bio-based potential, can remove barriers and create opportunities. These activities, clustered in the topics listed above contribute to the regional vision of optimal valorisation of residual streams and by-products into higher-value applications.

A first next step from these strategies, suggested by the discussions leading to this blueprint, would be to focus on developing a regional innovation valley proposal jointly developed by stakeholders in the Delta.

At this point it has not been possible to agree on numeric operational targets across provinces and stakeholders. Nonetheless, there is agreement on the importance of those defined operational focus to be increased.

In next steps, as mentioned in chapter 6 'Outlook', this is something to be defined.

Vision	Strategic objectives	Operational objectives	Activities
By 2050, the economy in the Delta region will be sustainable and climate neutral. This means use of primary fossil resources and CO2 emissions approaching zero. The necessary knowledge is present in the area, being developed or accessed. This makes the Delta region a thriving and future-proof economy that operates within the carrying capacity of the area. This makes it an area attractive to live, work and learn. The transition to renewable bio-based raw materials is part of achieving this ambition for the region. Indeed, the1st step is the transition to circular which fits into existing process technology. The 2nd step is the transition to bio-based for which new bio-based	Develop Regional Collaboration	Establish a model for a regional coordinating organisation to oversee regional efforts and goals	Establish a coordinating organisation with representatives from all stakeholders of the triple helix
		Increase the growth of the network alignment to inform topics and partners of common interest for cross-border and/or cross-province collaboration	Ensure information flow to and from the region on what regards priority topics and opportunities for its stakeholders
			Small, medium, and large companies working together in Supply Chain Integration
		Aim for a growth in the number of joint-proposal submissions for funding	Map the ecosystem in the region
			Actively engage in the Bio-based Industries Consortium (BIC)
			Define topic of common regional interest for an Innovation Valley proposal
	Facilitate Innovation and Scale-Up	Triple helix regional organisations to increase efforts in identifying common technical barriers and play a role in facilitating industry-academia dialogues to find solutions to overcome these	Regional organisations bring in their accumulated knowledge to facilitate industry-academia dialogues to overcome technical barriers
		Triple helix regional organisations to grow the use rate of Application Centres where entrepreneurs can test their innovative ideas in an accessible way are other much needed actions	Regional organisations to propose measures to grow the use rate of Application Centres
		Knowledge and Innovation Networks and Knowledge Institutions identify and collect relevant data to inform key decision-making processes	Map and perform strategic analysis on regional biomass demand and supply
			Collect sufficient data on feedstocks and secondary biomass for better industrial symbiosis and urban planning
			Identify relevant factors and trade-offs to establish a process to select new industrial areas for scaling-up of the bio-based industry

Vision	Strategic objectives	Operational objectives	Activities
process technology must be developed and should be started now			For each project proposal under development conduct an early-phase assessment of the project's potential impact, specifically evaluating expected reductions in CO2 emissions and decreases in reliance on abiotic raw materials
		Expand educational and vocational training programs within regional educational institutions to adapt and update skills for emerging bio-based sectors	Collaborate with regional educational institutions and vocational training centres to develop targeted programs on bio-based scale-up processes
	Enhance Market Demand	Increase participation of small, middle and large companies at bio-based events promoting existing businesses and solutions regionally	Establish quarterly sector-specific bio-based webinars to connect bio-based innovators with companies looking to replace fossil-based materials, focusing on case studies that demonstrate successful transitions to bio-based inputs
		Strengthen focus of bio-based innovation projects communication and dissemination tasks to include more detailed exchanges with potential markets	Develop and distribute a 'Market Needs Checklist' template for bio-based projects to guide teams in identifying critical specifications, standards, and regulatory requirements during the research phase to avoid adoption barriers later
			Supplier Spotlight Webinars and Demo Days to showcase bio-based products and allow direct engagement to ask questions and see real-world applications to encourage procurement teams to consider and adopt bio-based solutions, creating a more active and engaged buyer community
		Create a comprehensive, easily accessible platform that connects procurement teams within companies and government bodies to verified suppliers and developers of bio-based solutions	Establish partnerships with bio-based industry associations, certification bodies, and regional suppliers to define a vetted list of bio-based suppliers, products, and solutions to populate a platform that connects procurement teams with bio-based suppliers

5. MONITORING, EVALUATION AND LEARNING

In the Delta Region, a critical initial step toward advancing the bio-based economy is to clearly define a strategy for collaboration. This includes identifying an effective coordination mechanism and a central coordinating organisation that represents all stakeholders. As outlined in Chapter 3, various options are available, each leading to different strategic outcomes. Once this foundational step is in place, it will guide the development of tailored approaches to monitoring, evaluation, and learning (MEL) that align with the region's unique goals and resources.

Reflecting on insights gained from the Circular Bio-Based Delta (CBBD) initiative, the Delta Region can benefit from implementing streamlined, targeted MEL processes that focus on specific priority areas within the bio-based economy. Lessons from CBBD underscore the importance of selecting KPIs that are SMART (Specific, Measurable, Achievable, Relevant, and Time-bound). Overloading the MEL framework with excessive or unreliable indicators risks diluting their impact and undermining strategic clarity.

Clear and accessible communication is also essential for MEL success. CBBD's experience highlights the value of specialised communication resources to convey complex topics effectively, as "a picture is worth a thousand words". Investments in professional reporting and presentation can help stakeholders understand and engage with MEL insights, fostering broader support for bio-based initiatives.

Additionally, clear alignment between investment and measurable outcomes is crucial for building confidence among funders and partners. Investors and partners need to see how their contributions are translated into tangible results. However, it can be challenging for the coordinating organisation to directly correlate financial inputs with specific impacts. Establishing an agreed reporting structure among funders, investors, and other partners can help synchronise expectations and reinforce accountability. When full institutional organisation is not feasible, a temporary coordination model, such as adopting a European funding structure, may offer valuable frameworks for transparent, multi-year monitoring and reporting practices.

A possible outline of an evaluation framework for the Delta Region, for discussion and decision for its adoption by the stakeholders could prioritize the areas and include the categories below.

1. Governance and Stakeholder Engagement
    - Establishment of the Coordinating Organization: Evaluate the setup and efficiency of the proposed coordinating organization, including its success in involving the triple helix stakeholders (public, private, research sectors).
    - Stakeholder Collaboration Metrics:
        - Number and type of partnerships formed.
        - Frequency of stakeholder meetings and engagement activities.
        - Degree of alignment among stakeholders on priorities, with special focus on policy alignment, including the roles of Technology Readiness Levels (TRL) in bio-based innovation.

2. Funding and Financial Leverage
   - Monitoring CBE-JU and Other Funding Streams: Track funding secured from CBE-JU and other relevant EU and national funds, assessing their alignment with regional project objectives.
   - Financial Metrics:
     - Total funds secured from CBE-JU and other sources.
     - Proportion of funds supporting the coordinating organization and project implementation.
     - Level of private sector co-funding attracted.

3. Innovation and Technology Readiness
   - Bio-based Project Development and Maturity: Assess the number and maturity of bio-based projects in the Delta Region, with a focus on Technology Readiness Levels (TRL 1-8) and their scalability.
   - Innovation Metrics:
     - Number of projects advancing through TRLs.
     - Types and scale of bio-based innovations developed (e.g., materials, molecules, products).
     - Number of patents, products commercialized, or new technologies adopted by SMEs and large companies.

4. Environmental and Economic Impact Assessment
   - Carbon Reduction and Resource Efficiency: Track measurable outcomes in CO2 emission reductions, reductions in the use of abiotic raw materials, and the degree to which projects promote resource circularity.
   - Impact Metrics:
     - Annual and cumulative CO2 emissions reductions.
     - Decrease in abiotic resource usage and increases in renewable feedstock use.
     - Job creation and economic growth within the bio-based sector (quantified by jobs, revenue growth, or exports).

5. Policy and Regulatory Advancement
   - Alignment with EU and National Policies: Monitor alignment with relevant EU and Dutch policies, assessing any policy barriers encountered and the success of policy advocacy by the Delta Region's coordinating body.
   - Policy Metrics:
     - Number of new policies or adjustments that support bio-based initiatives.
     - Success in addressing regulatory barriers, including those related to bio-feedstock eligibility.
     - Degree of integration with broader Dutch national policies on bio-based economy and sustainability.

6. Market Development and Demand Stimulation
   - Market Signal and Procurement Success: Evaluate demand generated for bio-based products and materials through regional public procurement policies and private sector adoption.
   - Market Development Metrics:

- Volume of bio-based products purchased by public sector institutions and private firms.
- Adoption rate of bio-based solutions by local businesses and consumers.
- Number and scale of local procurement initiatives supporting bio-based solutions.

7. Public Awareness and Knowledge Transfer
   - Communication and Outreach: Assess the success of efforts to raise public awareness and transfer knowledge about bio-based solutions, such as events, workshops, and educational campaigns.
   - Awareness Metrics:
     - Number of outreach events and attendees.
     - Public knowledge and acceptance rates of bio-based products (e.g., through surveys).
     - Engagement with educational institutions to integrate bio-based topics into curricula.
     -
8. Periodic Review and Adaptive Management
   - Regular Evaluation and Reporting Cycles: Set specific intervals (e.g., annual, biennial) for reporting progress against these metrics, enabling adaptive management and recalibration of objectives as necessary.
   - Adaptive Metrics:
     - Frequency and quality of evaluation reports.
     - Responsiveness to challenges identified in previous cycles.
     - Adjustments made to project selection or strategic focus based on evolving needs.

6. OUTLOOK

The provinces in the Delta region, particularly North Brabant and Zeeland have the Bio-based Economy as a strong priority and clearly integrated in their Circular Economy strategies and implementation agendas. Other provinces in the Delta, including in the Belgium Flanders, have equally dedicated attention to the circular bio-based economy and are interested in exploring regional collaboration to reach larger and better results.

As a result of the multiple triple-helix stakeholders exchanges for the development of this blueprint, the next step is to have the regional stakeholders leading the way to develop a joint proposal to apply for one or more European funding programs. Opportunities preliminarily identified are the Regional Innovation Valleys (RIVs) Initiative, part of the New European Innovation Agenda (NEIA),[47] and CBE-JU calls under Horizon Europe,[48] for funding projects developing innovative and sustainable bio-based solutions.

The group formed during this work can be a starting point to proceed with guided discussions in defining specific topics and targets for the RIVs and or deciding the CBE-JU call in which to apply. The group would also benefit from identifying an existing organisation acting in the regional circular bio-based space to host and coordinate these efforts.

Additional activities, as identified above, should occur in parallel to supporting the process of expanding the knowledge over what already is happening in the provinces and the region. This is necessary to overcome technical challenges as well as to raise awareness of the private sector on the true potential that bio-based products, materials, and solutions have to offer to their businesses. Including defining numeric operational targets for the region, which, at the conclusion of this blueprint was not possible to be defined across provinces and stakeholders given the need to, first, identify a collaboration mechanism (funding, whether via European, national, or other projects or public-private partnerships).

Regarding obtaining extensive and comparable data from the region to bring trends to light, inform discussions, evidence gaps and lacking elements, this would be guided by the process of working together in developing a regional joint proposal.[49] Examples of data of increased relevance are **bio-based market trends** (growth of bio-based industries, including agriculture, chemical recycling, and circularity), **sustainability impacts** (data on CO2 reductions, green chemistry developments, and renewable resource usage), **economic data** (analyses of how the bio-based economy is contributing to regional employment, innovation, and investments), **policy and regulatory impacts** (how current policies are supporting or hindering bio-based

[47] See https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en

[48] See www.cbe.europa.eu/open-calls-proposals

[49] Key organisations actively gathering and analysing data to drive bio-based economy development, providing valuable insights for policymakers and businesses in the region are, BOM (Brabant development agency), REWIN (regional development agency), Green Chemistry Campus (hub for innovation and market research), MNEXT (practice-oriented research powered by Avans Hogeschool and HZ University of Applied Sciences), K&I netwerk Circulair Bouwen at Campus Zeeland and Campus Zeeland more broadly (knowledge and innovation networks), Impuls Zeeland (regional development agency), POM Oost-Vlaanderen (provincial development agency), CAPTURE initiative (research platform for disruptive innovation), ILVO (Institute of Agricultural, Fisheries & Food Research).

initiatives), and **technological advancements** (information on innovations in bio-based technologies, including pilot projects and emerging breakthroughs)[50].

By leveraging the existing momentum and collaborations within the Delta region, the stakeholders involved, representing the triple helix, are bound to enhance cross-border synergies and further solidify the region's leadership in the circular bio-based economy. The blueprint here created with active involvement of several stakeholders of the Delta region serves as a practical and relevant instrument for any initiatives looking into creating measurable impact in the advancement of opportunities in the bio-based economy space and solutions to overcome the bottlenecks faced by the region.

The proposed coordinated efforts will not only strengthen regional stakeholders' capacities to access European funding but also lay a foundation for continuous knowledge-sharing and strategic alignment. In pursuing this vision, the region can collectively drive impactful innovations, foster sustainable economic growth, and position itself as a model for the European Green Deal and beyond.

[50] This is an indication of relevant categories, not a final listing. This needs to be informed and agreed upon by the regional stakeholders involved in the next steps for the regional collaboration activities.