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CEforestry

O.2.2: CE business model for the forestry biomass residues recovery

IV BUSINESS MODEL

Cosmetics Sector

Prepared by

Mineral and Energy
Economy Research
Institute
Polish Academy of Sciences

&

GreenBack
Innovation for nature

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Business model for cosmetic sector

Prepared by:

Mineral and Energy Economy Research Institute & GreenBack Ltd.

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Executive Summary

This report presents a comprehensive, three-layer business model (BM) for the development, production and commercialization of a novel, multifunctional cosmetic ingredient derived from spruce bark. The proposed product, a bio-based extract, offers both potent preservative (biocidic) and active skincare (antioxidative, cleansing, nutrification) properties, positioning it as a high-value solution for the modern cosmetics industry. The analysis shifts from a previous focus on industrial applications to the more complex and lucrative B2B cosmetics market, with the general public as the ultimate end-user.

The core of the BM is a compelling value proposition that aligns with dominant market trends, including the consumer-driven shift toward "clean beauty," natural ingredients, and sustainability. By valorizing a forestry side-stream (spruce bark), the product offers a powerful upcycling narrative that resonates with environmentally conscious brands and consumers. Its dual functionality as both a preservative and an active ingredient simplifies cosmetic formulations, offering a unique efficiency benefit to product developers.

The primary target customer segments are innovative and premium cosmetic brands, particularly those in the natural and "dermocosmetics" spaces within the European Union (EU). Key markets such as Germany, France, the UK, and the rapidly growing Polish market present the most significant opportunities. Channels to market will be a strategic blend of a specialized direct sales force, partnerships with established specialty ingredient distributors, and a strong presence at key industry trade events, most notably in-cosmetics Global.

However, the path to market is defined by a significant and resource-intensive regulatory challenge. The single greatest barrier to entry is the multifaceted EU regulatory framework, encompassing REACH registration, INCI name allocation, and the generation of a comprehensive safety and efficacy data dossier compliant with the EU Cosmetics Regulation (EC) No 1223/2009 and its stringent non-animal testing requirements. This process is both time-consuming, estimated to take three to five years, and costly, with expenses for testing and registration potentially running into hundreds of thousands of Euros.

Consequently, the financial structure is heavily front-loaded with R&D and compliance costs, requiring substantial upfront capital investment. The recommended revenue model is not a cost-plus approach but a value-based pricing strategy, benchmarking the ingredient against other premium, multifunctional

actives. This strategy is justified by the ingredient's unique combination of performance, sustainability narrative, and formulation benefits.

The environmental and social canvases reinforce the model's strengths, highlighting a circular bioeconomy approach that reduces waste, replaces petrochemicals, and creates skilled jobs in rural and high-tech sectors. The business culture must be rooted in scientific rigor, transparency, and an unwavering commitment to sustainability.

The strategic recommendation is to pursue a phased market entry. The initial phase must focus exclusively on navigating the regulatory pathway and building an unassailable scientific data package. Only then can the business proceed to a seeding phase with innovative partner brands, followed by broader scaling through distribution networks. This venture should be viewed not as a simple manufacturing operation, but as a high-tech, regulatory-focused, green-biotechnology enterprise poised to capitalize on the future of the cosmetics industry.

1. Introduction

This document presents a comprehensive business model (BM) for the production of a natural cosmetic ingredient – a multifunctional extract derived from spruce bark – designed for applications within the skincare and personal care industries. By harnessing the preservative and antioxidant properties of polyphenols and tannins contained in spruce bark, the proposed ingredient provides a sustainable and innovative alternative to conventional synthetic preservatives and antioxidants widely used in cosmetic formulations.

The BM has been developed using the three-layer Business Model Canvas (BMC), encompassing the economic, environmental, and social dimensions of the analyzed venture. This holistic framework allows for a structured evaluation of the extract’s market potential, its ecological footprint, and its broader societal implications. The objective is to assess not only the commercial viability of the business but also its alignment with the principles of sustainable development and circular economy practices.

By extending the analysis beyond the purely economic dimension, the model identifies potential strengths and challenges in terms of environmental performance and social value creation. In this way, it provides a more comprehensive understanding of how the business can contribute simultaneously to profitability, ecological responsibility, and positive social impact. Structuring the model in this manner reflects contemporary sustainability-driven approaches, which emphasize the responsibility of businesses to deliver value beyond financial returns. Such a perspective supports informed strategic

decision-making and fosters the development of more resilient, competitive, and socially responsible business practices.

1.1. Product description

The material flow of the proposed BM (**Figure 1**) is designed in accordance with circular economy principles, ensuring that every stage of the process contributes to resource efficiency and waste minimization. The production chain begins at public and private forestry sites, where spruce trees are harvested for industrial use. During the wood harvesting process, bark is generated as a by-product, which is then transferred to wood processing factories such as sawmills. At this point, the bark, instead of being treated as waste, is valorized as the primary raw material for further processing.

In the next step, the bark undergoes extraction of bio-based actives. Through hot water extraction and subsequent purification processes, tannin-rich compounds are isolated. Depending on the application, extracts can be subjected to additional purification procedures to obtain high-value fractions suitable for sensitive industries such as cosmetics. These purified extracts are then directed towards B2B customers, mainly cosmetic manufacturers, who incorporate them into their formulations as natural preservatives and active skincare ingredients.

Parallel to this, the extraction process generates residual biomass waste. Instead of being discarded, these by-products are collected and subjected to thermal treatment. The thermal conversion serves two functions: energy recovery, which can be reused within the production system, and the generation of bio-ashes. The mineral-rich ashes are subsequently used in the production of fertilisers, creating an additional value stream. The recovered nutrients can re-enter the forestry cycle, supporting sustainable tree cultivation and closing the biological loop.

This integrated approach ensures that all material flows are managed responsibly and productively. From raw material sourcing through extraction and purification, to waste management and nutrient recovery, the model represents a practical implementation of circular economy principles. The **cosmetic industry** benefits from access to natural, multifunctional ingredients, while the forestry sector gains from enhanced sustainability through nutrient recycling.

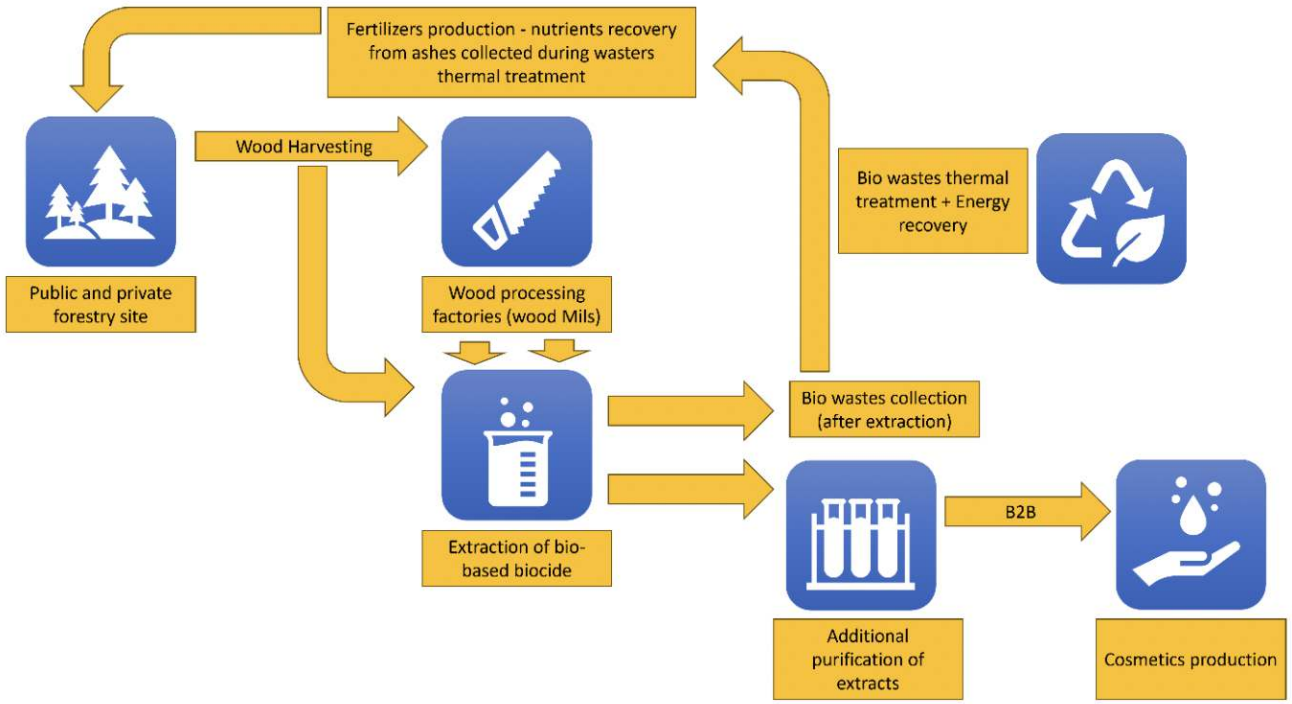

Figure 1. The overview of the materials flow

1.2. Main assumptions

Developing a BM for a novel cosmetic ingredient requires establishing a set of assumptions and clearly defining the boundaries of the analysis. These assumptions ensure that the model is both realistic and adaptable to the specific characteristics of the cosmetics sector. The following framework outlines the key regulatory, technological, and market conditions applied in the preparation of this document.

Model implementation area

The BM has been developed based on data and market indicators for the Baltic Sea region, with special emphasis on Poland, Sweden, Finland, Lithuania, and Latvia. These countries share comparable regulatory environments, economic structures, and consumer behaviors, particularly in the cosmetics sector. While the model has been designed to be universal within this region, applying it outside of this geographic scope may require adjustments to account for differences in regulation, market maturity, and

consumer culture. For example, expansion to non-EU markets such as North America or Asia would involve significant adaptation to distinct regulatory frameworks and consumer expectations.

Entity of the model

The model assumes that the core entity is an independent economic unit operating as a cosmetic ingredient manufacturer, with separate accounting and no reliance on subsidies, grants or intercompany transfers. This approach ensures universality and transparency of the model by excluding external compensatory inflows that might distort financial sustainability. Should the model be applied to entities embedded in larger corporate structures, adjustments would be necessary to reflect shared services, internal transfer pricing, or financial cross-subsidies.

Legal conditions

All proposed solutions are aligned with current EU legislation relevant to cosmetic ingredients. Specifically, the spruce bark extract must comply with the EU Cosmetics Regulation (EC) No 1223/2009, which governs safety, labeling, and market authorization of cosmetic products, as well as with the REACH Regulation (EC) No 1907/2006, requiring the registration of substances produced or imported above one tonne per year. Compliance also includes provision of a complete toxicological and efficacy data package, proper classification and labeling, and documentation such as Safety Data Sheets (SDS) and Certificates of Analysis (CoA) for downstream users. In addition, adherence to Good Manufacturing Practices (GMP, ISO 22716) is mandatory to ensure consistent product quality.

Target market specification

The BM focuses on the cosmetics sector, positioning spruce bark extract as a multifunctional ingredient for professional B2B applications. The target customers are cosmetic brands, contract manufacturers, and formulation houses seeking natural, multifunctional, and sustainable actives. Key applications include skincare formulations where the extract functions both as a natural preservative and as an antioxidant with anti-aging and soothing properties. This positions the product not as a consumer-ready preparation, but as a high-value ingredient integrated into cosmetic products marketed under established brands.

Technological and sanitary requirements

The ingredient must comply with strict technological and sanitary requirements governing cosmetic ingredient production. This includes occupational health and safety regulations for workers,

environmentally responsible production practices, and GMP certification for manufacturing. Quality control standards must be rigorous, as the product is intended for use on human skin. Unlike industrial biocides, which are applied under controlled technical conditions, cosmetic ingredients enter consumer markets directly, necessitating higher levels of testing, traceability, and compliance with consumer safety standards. This includes non-animal testing methods, stability studies, and preservative efficacy tests.

Scale of production

The model assumes production at a medium-to-large industrial scale to meet the needs of B2B customers across multiple European markets. Economies of scale are critical for achieving competitive pricing against synthetic. Distribution is structured around bulk and semi-bulk formats for formulators and manufacturers rather than small-volume retail packaging. Logistics and supply chains must be optimized for cross-border trade within the EU, leveraging distributors specialized in cosmetic ingredients to ensure efficient market penetration. The focus is therefore on wholesale B2B distribution rather than direct-to-consumer sales.

1.3. Market overview

The Baltic Sea region, encompassing Poland, Sweden, Finland, Lithuania, and Latvia, offers substantial market potential for bactericidal products, particularly industrial disinfectants. This potential is driven by the region's significant industrial activities, population density, and economic growth, all of which contribute to a heightened demand for effective hygiene solutions in industrial settings. Poland stands as the most populous country in the group, with approximately 38 million inhabitants, and boasts a diverse industrial sector that includes manufacturing, agriculture, and mining. Sweden and Finland, with populations of about 10 million and 5.5 million respectively, have advanced economies characterized by industries such as engineering, automotive, electronics, and pharmaceuticals. Lithuania and Latvia, though smaller with populations of 2.8 million and 1.9 million, are emerging markets with growing manufacturing, biotechnology, and electronics sectors.

The combined GDP of these countries reflects robust economic health, ranging from Poland's $600 billion to Latvia's $35 billion. The GDP per capita varies significantly, indicating differing levels of individual purchasing power and industrial investment capacity across the region.

The industrial sectors prevalent in these countries are subject to strict hygiene and safety regulations, especially in fields like food processing, pharmaceuticals, biotechnology and electronics manufacturing. The necessity to maintain sterile and contaminant-free environments drives the demand for high-quality

industrial disinfectants. Additionally, recent global health concerns have amplified the emphasis on sanitation, further increasing the need for effective bactericidal products. Additionally, listed countries being part of the EU, these countries benefit from streamlined regulatory frameworks and ease of cross-border trade, which facilitates market entry and expansion for companies specializing in bactericidal products. The region's focus on innovation and sustainable practices also opens avenues for introducing advanced, eco-friendly disinfection solutions tailored to the specific needs of various industries.

Considering the substantial industrial base, significant population, and favorable economic conditions, the Baltic Sea region presents a promising market for bactericidal products, particularly industrial disinfectants. Companies aiming to capitalize on this potential should focus on compliance with regional regulations, address industry-specific hygiene needs, and leverage the region's commitment to innovation and sustainability.

2. Economic Business Model Canvas (EC-BMC)

This section addresses the economic and financial sustainability of the BM. Key economic considerations may include revenue streams, cost structure, pricing strategy, and investment requirements. In TLBMC, the "economic" layer remains the same as in the original model proposed by Osterwalder and Pigneur (**Figure 2**).

<table>
<tr><td rowspan="2">Key Partners</td><td>Key Activities</td><td rowspan="2">Value Proposition</td><td>Customer Relationships</td><td rowspan="2">Customer Segments</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td colspan="3">Cost Structure</td><td colspan="2">Revenue Structure</td></tr>
</table>

Figure 2. Economic Layer of BMC

2.1. Value proposition

The value proposition defines the unique benefit and appeal of the spruce bark extract to its target customers. It is a multi-layered offering that combines superior performance, a compelling sustainability story, and tangible marketing advantages for cosmetic brands.

2.1.1. Dual-action efficacy

The primary and most distinct value of the spruce bark extract lies in its ability to perform two critical functions from a single INCI (International Nomenclature of Cosmetic Ingredients) entry. This dual-action capability is a significant differentiator in a market where formulators constantly seek efficiency and elegance.

1. **Natural preservation**: the extract leverages the inherent antibacterial and antimicrobial properties of tannins and other polyphenols found in spruce bark. This allows it to function as a natural preservative or as a key component in a "preservative-boosting" or "self-preserving" system. It provides a potent alternative to traditional synthetic preservatives like parabens and formaldehyde-releasers, which are facing increasing consumer scrutiny and regulatory pressure. The demand for natural preservatives is a significant market driver, with the natural segment of the cosmetic preservatives market projected to grow at a CAGR of 6.3%.
2. **Active skincare benefits**: beyond preservation, the extract is rich in antioxidants, which protect the skin from oxidative stress caused by environmental aggressors like UV radiation and pollution. This positions it firmly in the high-demand anti-aging and skin health category, a market where consumers actively seek ingredients like vitamins, polyphenols, and carotenoids. Further documented properties of spruce extracts, such as being tonic, cleansing, astringent, and soothing, add layers of functionality, allowing brands to make claims related to skin cleansing, calming irritated skin, and overall nutrification.

2.1.2. “Clean & natural” alignment

The product is intrinsically aligned with the core principles of the "clean beauty" movement, which has moved from a niche trend to a mainstream expectation.

1. **Transparency and traceability**: sourced from responsibly managed Nordic forests, the ingredient offers a clear and traceable supply chain, a key demand of conscious consumers.
2. **Simplified formulations**: by delivering multiple benefits, the extract enables brands to create products with shorter, more understandable ingredient lists. This "skinimalism" approach appeals to consumers wary of long, chemical-sounding INCI lists.
3. **"Free-from" claims**: the extract is naturally free from controversial chemicals that consumers are actively seeking to avoid, such as parabens, silicones, and sulfates, allowing brands to make powerful "free-from" marketing claims.

The combination of these attributes creates a powerful "formulation simplifier" value. Cosmetic formulators are tasked with balancing efficacy, stability, ingredient compatibility, regulatory compliance, cost, and the marketing appeal of the final INCI list. An ingredient that can replace both a preservative and a separate antioxidant is highly attractive. It simplifies the development process, reduces the risk of negative interactions between multiple ingredients, shortens the INCI list, and can even be cost-effective if priced competitively against the combined cost of the ingredients it replaces. Therefore, the sales and marketing strategy must emphasize its role not just as an ingredient, but as a "formulation accelerator" and "INCI list optimizer" for the R&D departments of client companies.

The following **Table 1** provides a comparative analysis to visually demonstrate the superior value proposition of the **spruce bark extract**.

Table 1. Comparative value analysis of cosmetic ingredients

Feature	Spruce bark extract	Synthetic preservative (e.g., phenoxyethanol)	Natural antioxidant (e.g., tocopherol/vitamin E)
Source	Upcycled/renewable (forestry by-product)	Petrochemical/synthetic	Natural or synthetic
Primary function	Preservation and antioxidant (dual-action)	Preservation	Antioxidant
Secondary functions	Anti-inflammatory, skin soothing, astringent	None	Skin conditioning
"Clean beauty" story	Excellent (natural, transparent, upcycled)	Poor (synthetic, "chemical" perception)	Good (well-known vitamin)
Sustainability narrative	Excellent (circular economy, waste Valorization)	Poor (fossil-fuel derived, Linear)	Moderate (depends on sourcing)
Formulation impact	Replaces multiple ingredients, simplifies INCI list	Single function, adds to INCI list	Single function, adds to INCI list

2.2. Customer segments

To maximize market penetration and profitability, it is crucial to focus on specific customer segments that are most receptive to the ingredient's unique value proposition. A broad, unfocused approach would be inefficient and costly. The primary targets are B2B clients within the cosmetics industry.

2.2.1. Primary segments

1. **Natural/indie beauty brands**: these companies are often built on an ethos of natural, sustainable, and innovative ingredients. They are typically more agile, quicker to adopt novel ingredients, and highly value the marketing story of sustainability and upcycling. Polish brands like Four Starlings, which built their success on natural ingredients and traditional methods, represent the ideal early-adopter profile.
2. **Premium & luxury skincare brands**: this segment competes on proven efficacy, exclusivity, and a premium experience. These brands can absorb the higher cost of a novel active ingredient and will leverage the unique story of the spruce extract; its Nordic origin, scientific validation, and sustainability; to justify a premium price point for their final products.
3. **"Dermocosmetics" and "Clean-ical" brands**: this rapidly growing segment bridges the gap between cosmetics and pharmaceuticals, emphasizing scientifically validated, safe, and highly effective ingredients designed to address specific skin concerns like sensitivity, aging, or acne. The spruce extract's proven antioxidant and potential anti-inflammatory properties make it a strong candidate for these "results-driven" brands that value safety and performance claims.
4. **Contract manufacturers (B2B2B)**: these firms are a critical channel to market. They develop and produce cosmetic products for a wide range of brands, from startups to established names. Contract manufacturers are constantly seeking innovative ingredients to present to their clients to help them differentiate their product lines. Securing partnerships with these entities provides leveraged access to a multitude of end brands.

2.2.2. Geographic focus

The European market is the primary strategic target due to its market size, high consumer awareness of clean and natural trends, and sophisticated regulatory environment.

1. **Key markets**: Germany, France, and the UK are consistently identified as the largest and most robust markets for natural and anti-aging skincare products, with strong consumer demand and a high concentration of target brands.

2. **Dynamic growth market**: Poland stands out as a particularly attractive market. It is one of the largest cosmetics markets in Central Europe, characterized by consumers who are open to innovation and show a strong and growing preference for natural, eco-friendly, and vegan products. The success of local Polish brands like Bielenda and OnlyBio underscores the domestic appetite for natural cosmetics.

A more focused initial strategy would be to target the "ingredient-first" brand as a beachhead market. This new wave of brands, popularized by companies like The Ordinary, focuses on educating consumers about specific active ingredients. While many compete on price, a premium segment of this trend is emerging, centered on novel, high-performance actives. The spruce bark extract, with its compelling origin story and dual functionality, is a perfect "hero ingredient" around which a new product or even an entire brand could be built. The initial marketing and sales efforts should therefore be directed at visionary brand founders and product developers who are actively searching for the "next big thing" in active ingredients to create a unique market position.

2.3. Channels

This section outlines the pathways through which the value proposition of the spruce bark extract will be communicated and delivered to the identified customer segments. An integrated, multi-channel approach is essential for a high-value specialty ingredient.

1. **Direct B2B sales force**: a small, highly skilled technical sales team is necessary to establish and manage relationships with key accounts, such as major cosmetic brands and high-volume contract manufacturers.[1] This team must possess deep knowledge of cosmetic science and formulation to engage effectively with R&D departments, discuss technical challenges, and facilitate co-development projects. This direct, high-touch approach is crucial for securing large, long-term contracts.
2. **Strategic partnerships with specialty ingredient distributors**: this is the most critical channel for achieving broad market coverage and scalability. Partnering with established European distributors who specialize in natural, active, and specialty cosmetic ingredients provides immediate access to a wide network of formulators and brands. Research indicates a rich ecosystem of potential partners, including global players like IMCD, Brenntag, and Azelis, as well as regional specialists like Gova-Benelux. These distributors have existing sales teams, logistical infrastructure, and trusted relationships with the target customer segments.
3. **Digital presence and content marketing:** a professional and technically robust online presence is a baseline requirement:

- **technical data portal**: the company website must feature a secure, password-protected portal where registered formulators and clients can access essential documentation. This includes the Technical Data Sheet (TDS), Material Safety Data Sheet (MSDS), formulation guidelines, certificates of analysis (CoA), and summaries of clinical efficacy and safety data. This facilitates the evaluation and formulation process for potential customers,
- **B2B content marketing**: to build authority and credibility, the company must engage in content marketing. This involves publishing technical articles, white papers, and case studies on industry-specific platforms (e.g., SpecialChem, Cosmetics & Toiletries) and its own blog. Topics could include the benefits of upcycled ingredients, challenges in formulating with natural preservatives, and the science behind spruce bark bioactives.

4. **Industry presence and trade shows:** physical presence at key industry events is non-negotiable for launching a new ingredient and building a global network:
    - **in-cosmetics global**: this is the world's leading event for personal care ingredients and is the single most important channel for this business. Exhibiting at this show provides unparalleled access to thousands of cosmetic chemists, formulators, R&D managers, and brand owners from around the globe. It is the ideal platform to launch the ingredient, meet with potential distributors, and gauge market reaction,
    - **targeted award submissions:** actively participating in the awards programs at in-cosmetics Global, such as the **Innovation Zone Best Ingredient Award** and the **Green Ingredient Award**, is a key strategy for gaining high-impact visibility and third-party validation. Winning or being shortlisted in these categories can significantly accelerate market adoption.

2.4. Customer relationship

For a premium, innovative ingredient, the relationship with customers must transcend a simple transactional exchange. The goal is to become a trusted partner in their product development process, fostering loyalty and long-term value. The approach will vary based on the customer segment but will be rooted in collaboration and expertise.

1. **Dedicated technical & formulation support:** this is the cornerstone of the customer relationship strategy. The company will provide expert, responsive support to help customers overcome any challenges in incorporating the spruce extract into their formulations. This includes guidance on dosage, pH stability, compatibility with other ingredients, and optimizing for desired sensory

properties. Providing this high level of support ensures that the customer's final product is successful, which in turn guarantees repeat business and reinforces the company's reputation as an expert partner, not just a commodity supplier.

2. **Co-development and co-creation projects**: for strategic partners, particularly innovative indie or premium brands, the company will actively engage in co-development projects. This involves collaborating from the early stages of a new product concept to design a "hero" product built around the spruce extract. This deep partnership model can lead to exclusive supply agreements, joint marketing efforts, and powerful case studies that can be used to attract other customers. This aligns with the approach of allowing clients to participate in fine-tuning the solution to increase its value and create stronger partnerships.
3. **Transparency and education**: building a community around the brand's values is a powerful relationship-building tool. This involves proactively communicating about the ingredient's journey: its sustainable sourcing from certified forests, the eco-friendly extraction process, and the scientific validation behind its efficacy. This level of transparency meets the demands of the "clean beauty" movement and builds a relationship with customers based on shared ethical commitments.
4. **Primary relationship models:**
    - **dedicated personal assistance**: for high-value key accounts, a specific technical sales representative will be assigned to provide continuous, personalized support,
    - **co-creation**: for strategic innovation partners, the relationship will be one of active collaboration in product design and development,
    - **automated services & community**: for the broader market, a comprehensive online technical portal with FAQs, formulation guides, and a forum for formulators can provide scalable support and foster a community of users.

2.5. Key activities

The key activities are the most crucial and demanding actions the business must undertake to deliver its value proposition. For a novel cosmetic ingredient in the EU, these activities are overwhelmingly dominated by regulatory compliance, scientific validation, and quality-controlled production.

2.5.1. Navigating the EU regulatory

This is the single most critical, time-consuming, and expensive activity cluster. Failure here means failure of the entire BM. The process must be meticulously planned and executed.

Step 1: REACH registration: any substance manufactured in or imported into the EU in quantities over one metric tonne per year must be registered under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation (EC) No 1907/2006. This involves compiling a comprehensive technical dossier on the substance's chemical properties, uses, and safety data. The process requires significant investment in data generation and fees paid to the European Chemicals Agency (ECHA). The cost for a registration number alone can be substantial, with estimates starting at EUR 40,000, not including the much larger cost of generating the required toxicological data.

Step 2: INCI name application: to be legally included on a cosmetic product's ingredient list, the extract must have an official International Nomenclature of Cosmetic Ingredients (INCI) name. The application is submitted electronically to the Personal Care Products Council (PCPC) in the US, which manages the system globally. The process requires a detailed submission including the ingredient's chemical composition, manufacturing method, and intended use. The application fee is currently USD 1,000, and the review and assignment process typically takes between three and six months.

Step 3: Comprehensive safety and efficacy testing (data generation): this is the most resource-intensive phase. The EU Cosmetics Regulation (EC) No 1223/2009 mandates that all ingredients are safe for human health. Due to the strict ban on animal testing for cosmetics in the EU, this safety profile must be established using a battery of validated non-animal testing methods (New Approach Methodologies, or NAMs). The Scientific Committee on Consumer Safety (SCCS) provides detailed "Notes of Guidance" on the required tests, which include assessments for:

- skin irritation and corrosion,
- eye irritation,
- skin sensitization (allergenicity),
- genotoxicity (potential to damage DNA),
- phototoxicity (reaction with UV light).

The cost of this toxicological data package is the largest single expense, potentially reaching hundreds of thousands of Euros depending on the complexity of the substance. In parallel, robust efficacy testing must be conducted to substantiate all marketing claims. This includes preservative efficacy testing

(challenge tests against bacteria and fungi), in-vitro antioxidant capacity assays (e.g., ORAC), and potentially human clinical trials for anti-aging or skin-soothing claims.

Step 4: Cosmetic Product Safety Report (CPSR) Data Package: the final cosmetic product manufacturer is responsible for creating a CPSR for their product. However, the ingredient supplier must provide a complete and high-quality data package to enable this. This package, a key asset and deliverable, includes the full toxicological profile, purity specifications, stability data, trace substance analysis, and efficacy data. The quality and completeness of this data package is a critical factor in a formulator's decision to use the ingredient.

2.5.2. Other key activities

1. **Sustainable sourcing & supply chain certification:** formalizing partnerships with forestry companies and sawmills in the Baltic region. A critical activity is ensuring the entire supply chain is certified under credible schemes like the Forest Stewardship Council (FSC) or the Programme for the Endorsement of Forest Certification (PEFC). This is essential to authentically back up the "sustainable" marketing claim.
2. **GMP-compliant production & quality control:** establishing and operating the hot water extraction and purification facility according to cosmetic Good Manufacturing Practices (GMP), as defined by the ISO 22716 standard. This is a legal requirement and ensures product safety, consistency, and quality. This includes developing processes to produce different grades of the product (e.g., liquid extract, concentrated liquid, spray-dried powder) to meet diverse formulation needs.
3. **Continuous Research & Development (R&D):** ongoing R&D is vital for long-term competitiveness. This includes optimizing the extraction process to increase yields or isolate new bioactives, conducting further clinical studies to generate stronger marketing claims (e.g., "visibly reduces fine lines by 25% in 4 weeks"), and exploring new applications for the extract.

To provide a clear roadmap for this complex process, the following matrix (**Table 2**) outlines the key regulatory steps and their associated resource requirements.

Table 2. EU regulatory pathway and cost-time-effort matrix

Regulatory Step	Governing Body/Regulation	Key Requirements	Estimated Timeline	Estimated Cost (EUR)	Effort Level
REACH Registration	ECHA / Reg. (EC) 1907/2006	Technical dossier, chemical safety report, extensive toxicological data.	12-24 months	€40,000 - €500,000+	Very High
INCI Name Application	PCPC	Chemical composition, manufacturing process, intended function data.	3-6 months	~€1,000 (Application fee)	Medium
Safety Data Generation	SCCS / Reg. (EC) 1223/2009	Battery of in-vitro tests for irritation, sensitization, genotoxicity, etc.	18-36 months	€150,000 - €400,000+	Very High
Efficacy Data Generation	Self-regulated (claims must be proven)	Preservative challenge tests, antioxidant assays, clinical studies.	6-18 months	€20,000 - €100,000+	High
CPSR Data Package	Reg. (EC) 1223/2009	Compilation of all safety, purity, stability, and efficacy data for customers.	Ongoing	Internal cost	High
CPNP Notification Support	European Commission	Provide customers with all necessary data for their final product notification.	N/A (customer activity)	Internal cost	Medium

2.6. Key resources

The successful execution of this BM depends on a specific set of critical assets. These resources are the foundation upon which the company's competitive advantage is built.

1. **Physical resources:**

- **raw material access:** secure, long-term contracts with certified forestry operations for a consistent supply of high-quality, fresh spruce bark are paramount.[1] The freshness is critical for maximizing the yield of active compounds,
- **production facility:** a dedicated extraction and purification facility designed and operated to meet cosmetic Good Manufacturing Practices (GMP/ISO 22716) standards. This is fundamentally different and more stringent than a facility for industrial-grade products.

2. **Intellectual resources:**

- **proprietary process:** the most valuable intellectual property is the specific, proprietary knowledge of the extraction and purification process that optimizes the yield of both the preservative tannins and the valuable antioxidant compounds.[1] This process may be protectable via trade secrets or patents,
- **regulatory and scientific data dossier:** the comprehensive data package containing all toxicological, safety, and efficacy test results is a mission-critical asset. Its value is immense, as it is the key that unlocks market access and justifies a premium price,
- **brand and narrative:** the brand identity, including the name, logo, and the compelling marketing story built around the upcycled, Nordic, scientifically-proven ingredient, is a significant intangible asset.

3. **Human resources:**

- **regulatory and toxicology experts:** this is the most crucial human resource. The complexity of EU cosmetic regulations requires in-house or long-term contracted experts with deep knowledge of REACH, CLP, the Cosmetics Regulation, and the SCCS safety assessment process. These individuals are essential for navigating the approval pathway successfully,
- **scientific team:** a skilled team of chemists, biologists, and technicians for ongoing R&D, formulation support, and stringent quality control is vital for innovation and maintaining product quality,

- **technical sales and marketing:** a B2B sales force that can speak the language of cosmetic formulators and a marketing team that can effectively communicate the complex value proposition to the industry.

4. **Financial resources:** given the long lead time for regulatory approval and the high cost of data generation, substantial upfront financial capital is a prerequisite. This funding is needed to finance the multi-year journey through R&D, testing, and regulatory submissions before any significant revenue can be generated.

2.7. Key partners

Executing this complex BM in isolation is not feasible. Success hinges on building a robust ecosystem of strategic partners who provide essential expertise, resources, and market access.

2.7.1. Upstream partners

1. **Forestry companies and sawmills:** these are the primary suppliers of the raw material, spruce bark. Partnerships must be built on reliability, quality, and a shared commitment to sustainability, verified by certifications like FSC or PEFC.
2. **Technology and equipment providers:** collaboration with engineering firms specializing in extraction, filtration, and purification technologies is necessary to design, build, and maintain the production facility.

2.7.2. Research & validation partners

1. **Universities and Contract Research Organizations (CROs):** these partners are indispensable for conducting the independent, third-party safety and efficacy testing required for the regulatory dossier. Collaborating with respected academic institutions or specialized CROs (e.g., Charles River for toxicology testing) lends significant credibility to the data. Such partnerships can also lead to peer-reviewed publications, which are powerful marketing tools, and potentially uncover new applications or bioactives within the extract.

2.7.3. Go-to-market partners:

1. **Specialty ingredient distributors:** as detailed in the 'Channels' block, these are the primary partners for scaling sales across Europe. Selecting distributors with expertise in natural and active ingredients and strong relationships with the target customer segments is a critical strategic decision.

2. **Regulatory consulting firms:** given the immense complexity of the EU regulatory landscape, partnering with a specialized consulting firm (e.g., Obelis, Freyr, Cosmedesk) is highly advisable. These firms provide expert guidance, manage dossier submissions, and act as the Responsible Person (RP) if needed, significantly de-risking the compliance process.

2.7.4. Industry associations and networks:

1. **Cosmetics Europe and national associations:** membership provides vital access to regulatory updates, industry trends, and networking opportunities with potential customers and partners.
2. **Enterprise Europe Network:** this network can provide support in finding international partners and funding, as demonstrated by the success of Polish brand Four Starlings.

2.8. Cost structure

The cost structure for this business is characterized by extremely high, front-loaded investments in non-tangible assets (data and regulatory approval) followed by more conventional manufacturing costs. A clear understanding of this structure is critical for financial planning and investor communication.

1. **Capital Expenditures (CAPEX)**
    - **Production facility:** the primary capital cost is the construction and commissioning of the extraction and purification plant. Based on the Finnish model for an industrial-grade facility, this is estimated at approximately EUR 2.17 million. This figure would likely need to be revised upwards to account for the stricter requirements of cosmetic GMP (ISO 22716) compliance, including cleanroom environments and specialized quality control laboratories.
2. **Operating Expenditures (OPEX):**

- **Variable costs:** these costs scale with production volume and include energy (primarily steam for hot water extraction), water, and logistics for transporting raw materials. While the initial model assumed bark was a free side-stream, securing a consistent, high-quality, certified supply will likely incur a raw material cost,
- **fixed costs:** these are ongoing costs regardless of production volume. The largest component is labor, including highly skilled scientists, regulatory specialists, quality control personnel, and plant operators. Other fixed costs include administration, facility maintenance, insurance, and marketing.

The dominant cost of compliance and innovation

This category represents the most significant and defining financial aspect of the BM, far exceeding the initial plant construction cost.

1. **Regulatory and testing fees:**
    - **INCI Application:** a fee of USD 1 000 is required per application,
    - **REACH Registration:** ECHA fees can range from EUR 17 000 to over EUR 90 000 depending on company size and tonnage band, but this is only the administrative fee,
    - **toxicological testing:** this is the single largest cost driver. A full suite of required in-vitro toxicological studies to satisfy the SCCS can easily cost between **EUR 150 000 and EUR 400 000**, and potentially more for a complex botanical substance,
    - **efficacy & stability testing:** a budget of **EUR 20 000 to EUR 100 000** should be allocated for preservative challenge testing, antioxidant assays, stability studies, and basic clinical trials to substantiate marketing claims.
2. **Consulting & service fees:**
    - **regulatory consultants:** engaging specialized consultants to manage the REACH and Cosmetics Regulation dossiers can represent a significant cost, but it is a critical investment to ensure success,
    - **CPSR data compilation:** the service of preparing a CPSR for a final product can cost a cosmetic brand between EUR 300 and EUR 900+. This indicates the inherent value of the comprehensive data package that the ingredient supplier must provide to its customers.
3. **Marketing & sales costs:**
    - **trade shows:** exhibiting at a major event like in-cosmetics Global involves significant costs for booth space, design, staffing, and travel, easily exceeding EUR 50 000.
    - **sales team:** salaries, commissions, and travel expenses for the technical sales force can amount to over EUR 200 000 annually.

2.9. Revenue streams

The revenue strategy must be designed to capture the high value created by the ingredient's unique properties and the substantial upfront investment in research and regulation. A commodity pricing approach would be financially unsustainable.

1. **Primary revenue stream:** direct ingredient sales

The core revenue will come from the B2B sale of the spruce bark extract to cosmetic manufacturers and formulators. To meet diverse customer needs, the product will be offered in several forms:

- **standardized liquid extract:** a solution of the extract in a common cosmetic solvent system (e.g., glycerin and water), making it easy to incorporate into aqueous formulations,
- **high-concentration liquid:** a more concentrated version for use in water-free (anhydrous) formulations or for customers who prefer to do their own dilution.

2. **Pricing model:** value-based pricing

The pricing will not be determined by a simple cost-plus calculation. Instead, it will be based on the tangible and intangible value delivered to the customer. This value is composed of:

- **dual functionality:** the cost of the single spruce extract will be benchmarked against the combined cost of a separate preservative and a separate antioxidant that it replaces,
- **marketing power:** a premium is justified by the powerful marketing story (upcycled, sustainable, clean) that allows the end-brand to command a higher retail price for their product,
- **formulation efficiency:** the value of simplifying the R&D process and shortening the INCI list is factored in,
- **claims substantiation:** the investment in robust efficacy data allows brands to make compelling, scientifically-backed claims.

3. **Pricing benchmarks and structure**

The extract will be priced as a premium active ingredient, not a commodity preservative. While small-scale online retailers sell various botanical extracts for prices that equate to EUR 200-600 per liter, B2B bulk pricing will be lower but still reflect this premium positioning. For example, if a standard synthetic preservative costs EUR 20/kg and a separate high-quality antioxidant costs EUR 40/kg, the dual-function spruce extract could be strategically priced at EUR 70-100/kg. This price is justified by its superior performance, added marketing value, and the efficiency it brings to the formulation process.

3. Environmental Business Model Canvas (EV-BMC)

This section analyzes the BM through an environmental lens, which is not an afterthought but a central pillar of its identity and value proposition. The environmental performance is a key driver of its appeal to both B2B customers and the end consumer (**Figure 4**).

<table>
<tr><td rowspan="2">Supplies and Outsourcing</td><td>Production</td><td rowspan="2">Functional Value</td><td>End-of-Life</td><td rowspan="2">User Phase</td></tr>
<tr><td>Materials</td><td>Distribution</td></tr>
<tr><td colspan="3">Environmental Impacts</td><td colspan="2">Environmental Benefits</td></tr>
</table>

Figure 4. Environmental Layer of BMC

3.1. Functional value

The core functional value is to offer the cosmetics industry an ingredient that not only possesses a significantly lower environmental footprint than its synthetic counterparts but also actively contributes to the development of a circular bioeconomy.

1. **Replacing petrochemicals:** the most direct environmental benefit is the substitution of preservatives and antioxidants that are derived from non-renewable fossil fuels. This reduces the industry's reliance on petrochemical feedstocks.
2. **Full biodegradability:** as a natural botanical extract, the product is inherently biodegradable. This means that when cosmetic products containing it are washed off and enter wastewater systems, the ingredient will break down naturally, reducing the long-term chemical load on aquatic ecosystems.This contrasts with some synthetic chemicals that can be persistent in the environment.
3. **Championing the CE:** the BM is a textbook example of CE principles in action. It takes a low-value side-stream from one industry (forestry) and valorizes it into a high-value product for another (cosmetics). The circularity is completed by utilizing the post-extraction biomass for on-site energy generation and converting the resulting ash into a nutrient-rich precursor for agricultural or forestry fertilisers. This creates a closed-loop system that minimizes waste and maximizes resource efficiency, a powerful narrative for B2B customers aiming to meet their own sustainability goals.

3.2. Supplies and outsourcing

The environmental performance of the business begins with how raw materials are sourced and how partnerships are structured. In this case, the supply of spruce bark is based on forestry by-products, which would otherwise represent a low-value waste stream. By formalizing contracts exclusively with certified suppliers under FSC or PEFC schemes, the company ensures that no raw material is linked to

unsustainable or illegal logging practices. This not only provides a safeguard against reputational risk but also guarantees that the ingredient is anchored in a verifiable chain of custody. Outsourcing to local forestry companies and sawmills in the Baltic Sea region further reduces transport emissions and strengthens the environmental sustainability of the supply chain.

3.3. Production

The production process is centered on hot water extraction, a technique consistent with green chemistry principles. Unlike processes that rely on harsh organic solvents, this method eliminates the risk of toxic by-products and minimizes harmful waste streams. The extraction facility is designed to operate under GMP standards, while also incorporating environmental engineering solutions such as high-efficiency heat exchangers for thermal energy recovery and closed-loop systems for water reuse. The process generates not only the core cosmetic extract but also renewable energy through the combustion of residual biomass and mineral-rich ash that can be repurposed as fertiliser. This closed-loop approach demonstrates how production can create multiple streams of value while minimizing environmental impact.

3.4. End-of-Life

Unlike synthetic chemicals that may persist in water systems or accumulate in the environment, spruce bark extract is entirely biodegradable. Once cosmetic products containing the extract are washed off, the ingredient naturally decomposes without contributing to ecotoxicity. At the production site, the residual biomass left after extraction is combusted to produce renewable energy, and the resulting ash is reused as a soil amendment in agriculture and forestry. This end-of-life cycle ensures that no waste is simply discarded; instead, every by-product is transformed into a new input, completing the circular model.

3.5. User phase

During the user phase, the environmental performance of the product is equally important. Cosmetics containing the spruce bark extract are safer for consumers to use and gentler for the environment when rinsed off. Unlike synthetic preservatives and antioxidants that may release persistent or harmful residues, the natural extract minimizes chemical load in wastewater systems. Consumers thus participate in reducing environmental impact simply by choosing products formulated with this ingredient. The user

phase reinforces the broader clean beauty movement, where the environmental consequences of daily routines are becoming a significant factor in purchasing decisions.

3.6. Materials

The BM relies exclusively on renewable, upcycled materials. Spruce bark, a forestry by-product, is the sole primary raw material. Its use prevents underutilization or landfilling and transforms what was once considered waste into a premium cosmetic ingredient. Additional inputs include water and thermal energy, both of which are managed through environmentally conscious systems to minimize consumption. Unlike synthetic alternatives derived from petrochemicals, the material base of the spruce extract is fully aligned with renewable resource strategies, providing a competitive edge in sustainability.

3.7. Distribution

Distribution strategies are designed to minimize environmental impacts. By sourcing raw materials locally within the Baltic Sea region and targeting European markets first, the company reduces the need for long-distance transport of bulky raw materials. Partnerships with regional specialty ingredient distributors not only enhance market access but also limit redundant logistics by leveraging existing infrastructure. Packaging and shipping practices are also aligned with sustainability principles, prioritizing recyclable materials and bulk delivery formats to minimize packaging waste and transport emissions.

3.8. Environmental Impacts

The environmental impacts of the business are overwhelmingly positive compared to conventional synthetic ingredient production. The model prevents waste by valorizing forestry side-streams and contributes to climate goals by reducing reliance on petrochemical feedstocks. Carbon emissions are lowered through local sourcing and renewable energy use in production. However, certain risks must be managed: forestry must be certified to prevent links to unsustainable logging, and water and energy demand from the hot water extraction process must be carefully optimized. Through certifications, energy recovery systems, and water recycling, these risks are mitigated to ensure that the environmental balance remains strongly positive.

To provide a clear, comparative overview of the environmental benefits, the following scorecard can be used (**Table 3**).

Table 3. Environmental impact scorecard

Impact Category	Spruce Bark Extract	Synthetic benchmark (e.g., Phenoxyethanol)
Raw material source	Renewable and upcycled (forestry by-product)	Non-Renewable (fossil fuel)
Biodegradability	High (readily biodegradable)	Low to moderate (persistent)
Ecotoxicity	Low (natural compound)	Moderate to high (potential aquatic toxicity)
End-of-Life	Circular (waste valorized into energy/fertiliser)	Linear
Production Carbon Footprint	Lower (renewable energy use, local sourcing)	Higher (energy-intensive synthesis)

3.9. Environmental Benefits

The environmental benefits of this model extend across the entire lifecycle. By replacing fossil-based preservatives and antioxidants, it contributes to reducing carbon dependency and advancing the bioeconomy. Its biodegradability lessens chemical persistence in water systems, protecting aquatic ecosystems. The circularity of the process, from raw material valorization to renewable energy generation and nutrient recycling, creates a closed-loop system that minimizes waste. For B2B customers, these benefits translate into the ability to meet sustainability targets, improve product life-cycle assessments, and strengthen brand reputation in a market increasingly driven by eco-conscious consumer demand.

4. Social Business Model Canvas (S-BMC)

This canvas evaluates the business's impact on people, society, and culture. In an era of "conscious consumerism," a positive social footprint is not just a benefit but a core component of brand value and a driver of purchasing decisions (**Figure 5**).

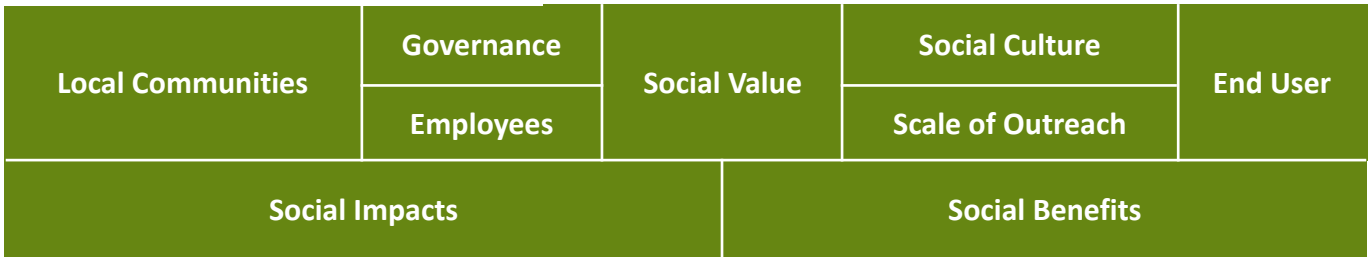

Figure 5. Social Layer of BMC

4.1. Social value

The BMl generates social value on several levels. For end-users, the main benefit is access to safer and more natural cosmetic products that address growing concerns about synthetic chemical ingredients. With transparent formulations, consumers are empowered to make conscious choices aligned with the broader trends of health, wellness, and sustainability. For local communities, the value lies in the creation of stable jobs, both in raw material supply and in highly specialized biotechnological positions. For the cosmetics industry, the model provides proof that circular and sustainable BMs can be commercially viable, encouraging larger players to follow suit.

4.2. Local communities

Relationships with local communities are designed to be mutually beneficial. The company depends on natural resources and local labor, but in return, it delivers employment opportunities, economic stability, and potential social investments. This enables economies traditionally reliant on forestry to diversify and transition into modern bioeconomy sectors. Transparent communication and active engagement with communities foster trust and strengthen long-term cooperation.

4.3. Employees

Employees benefit not only from jobs but also from meaningful career opportunities within the growing green-tech sector. The company places strong emphasis on professional development, offering training programs and advancement pathways. Work becomes a source of pride and purpose, as employees are part of an enterprise that combines economic performance with environmental and social responsibility. Workplace health and safety are prioritized, reinforcing employee loyalty and satisfaction.

4.4. End users

Although the company operates in a B2B model, end-users remain the ultimate recipients of the value created. They benefit from cosmetic products that are safer, more natural, and more ethical, matching their growing expectations of brands. The scale of outreach is global: spruce bark extract can be incorporated into cosmetics sold worldwide. The company supports its B2B partners by providing data, certifications, and storytelling resources that help communicate this value to end consumers.

4.5. Governance

To build trust and verify its claims, the business must pursue governance structures that go beyond mandatory legal compliance.

1. **Commitment to voluntary certifications:** in addition to the required FSC/PEFC certifications for sourcing, the company should seek third-party validation of its social and environmental performance through schemes like B Corp Certification or Fair for Life. These certifications provide a clear, credible signal to stakeholders that the company is committed to high standards of social and environmental responsibility.
2. **Transparent reporting:** the company should commit to annual public sustainability reporting, detailing its progress on key metrics such as waste reduction, energy consumption, water usage, and community impact. This aligns with the social goal of promoting sustainable and responsible business practices.

4.6. Social culture

The company's internal culture is built on three pillars: sustainability, scientific rigor, and radical transparency. These values are not treated as marketing slogans but are embedded in everyday decision-making - from sourcing strategies to process engineering, customer relations, and financial reporting. The organization positions itself as a genuine example of how circular economy principles and innovation can be aligned with social and environmental responsibility.

4.7. Scale of outreach

The outreach of this BMI operates on multiple levels. Locally, the company strengthens Baltic Sea region communities by creating employment opportunities and supporting forestry-dependent economies. On

an industry level, it serves as proof of concept, encouraging other cosmetics companies to adopt more sustainable practices. Globally, it impacts millions of consumers who purchase cosmetics containing spruce bark extract, thus reinforcing the trend toward conscious consumerism.

4.8. Social impacts

The social impact of the model can be observed in several dimensions. It reduces the reliance on harsh synthetic chemicals in cosmetics, improving consumer health and safety. It contributes to regional economic development and generates sustainable jobs, including highly skilled positions in biotechnology. The model also influences the entire industry by proving the economic feasibility of circular practices and setting new standards of sustainability.

4.9. Social benefits

The social benefits are widely distributed across stakeholder groups. Consumers gain access to safer, more ethical products that improve their wellbeing and allow them to feel good about their purchasing decisions. Employees enjoy stable jobs, career development, and safe working environments. Local communities benefit from economic activation, new investments, and greater economic resilience. The cosmetics industry raises its sustainability standards, while society at large benefits from a stronger circular economy and reduced environmental burden.

Strategic synthesis and recommendations

This final section synthesizes the analyses from the economic, environmental and social canvases into a cohesive set of strategic conclusions and actionable recommendations. It outlines the critical factors for success, identifies key risks, and proposes a phased go-to-market strategy.

Critical success factors

The viability of this BM hinges on successful execution in four key areas:

- **successfully navigating the EU regulatory process**: this is the absolute, non-negotiable gateway to the market. All other factors are secondary to achieving full compliance with REACH and the EU Cosmetics Regulation. This requires expertise, patience, and significant capital,
- **building a compelling scientific dossier**: the depth, quality, and credibility of the safety and efficacy data will directly determine market acceptance, the ability to make strong marketing

claims, and the justification for a premium price point. This dossier is the company's most valuable asset,

- **securing strategic distribution partnerships**: gaining access to the fragmented European cosmetics market is impossible without leveraging the networks and expertise of established specialty ingredient distributors. Selecting the right partners is a critical strategic decision for scaling the business,
- **effectively communicating the multifunctional and upcycled value story**: the ingredient's success depends on moving the conversation beyond a simple price-per-kilo comparison. The marketing and sales strategy must effectively articulate the combined value of dual functionality, formulation efficiency, and the powerful sustainability narrative.

Key risks and mitigation strategies

The venture faces several significant risks that must be proactively managed.

1. **Risk:** Regulatory failure or delays

The EU regulatory process is long, complex, and its outcomes are not guaranteed. A negative opinion from the SCCS or unexpected data requirements could delay market entry by years or render the project unviable.

Mitigation: engage top-tier regulatory consultants from day one. Budget conservatively for both the timeline and the cost of the compliance process. Maintain open and proactive communication with regulatory authorities where possible.

2. **Risk:** high cost of entry and capital burn

The substantial upfront investment required for R&D, testing, and facility construction before generating revenue creates significant financial risk.

Mitigation: develop a phased investment strategy tied to regulatory milestones. Actively seek non-dilutive funding, such as green technology or circular economy grants from the EU and national governments. Target investors who understand the long-term nature of biotech ventures and are aligned with the sustainability mission.

3. **Risk:** competitive response

While the ingredient is novel, large specialty chemical companies have the resources to develop competing "nature-inspired" or bio-fermented ingredients.

Mitigation: build a strong brand and protect intellectual property (patents or trade secrets) around the unique extraction process. Emphasize the authentic "upcycled from forestry" story, which is more difficult for large, non-integrated chemical companies to replicate quickly and credibly. Move quickly to establish market leadership and secure key customer accounts.

Phased go-to-market strategy

A staged approach is essential to manage risk and allocate resources effectively.

1. **Phase 1 (years 1-3):** the regulatory and R&D phase. This is the foundational stage. All resources must be focused on achieving the key regulatory milestones: submitting the REACH dossier, securing an INCI name, and, most importantly, generating the complete safety and efficacy data package required by the EU Cosmetics Regulation. During this phase, prototypes of the ingredient are developed and refined.
2. **Phase 2 (year 4):** the seeding and launch phase. With regulatory clearance in sight or achieved, the focus shifts to market entry. The ingredient is officially launched at a major trade show like in-cosmetics Global. The primary sales targets are a select group of innovative indie brands and strategic co-development partners who can serve as early adopters and create powerful case studies. The goal is to secure initial flagship product placements and finalize agreements with key European distributors.
3. **Phase 3 (year 5+):** the scaling phase. With initial market traction and distribution channels in place, the focus turns to scaling. The sales team and distributor networks work to penetrate the broader market, targeting larger cosmetic brands and contract manufacturers. The product line is expanded to include different forms (e.g., a high-purity powder) to meet wider formulation needs. R&D continues to generate new data for expanded claims and potential new applications.

5. Results of modelling

The **ECONOMIC** layer focuses on the financial sustainability of the business model, addressing key factors such as value proposition, customer segments, cost structures, revenue streams, and partnerships.

The value proposition is built on the extraction of spruce bark compounds with proven antioxidant and antimicrobial properties. These natural extracts act as eco-friendly cosmetic ingredients, replacing synthetic preservatives and antioxidants widely used in personal care products. Their use extends

product shelf life, enhances safety, and aligns with the fast-growing consumer demand for natural, transparent, and sustainable formulations. By valorizing forestry side-streams, the model also demonstrates the principles of the circular bioeconomy, creating additional value from what was previously considered low-value biomass.

The **target market** consists primarily of skincare and personal care brands, natural and organic cosmetic manufacturers, dermocosmetic producers, and wellness product companies. Demand for "clean beauty" products and increasing regulatory restrictions on certain synthetic preservatives amplify the market opportunity.

Key partners include certified forestry suppliers, sawmills, biorefinery operators, R&D institutions, regulatory consultants, distributors, and sustainability certification bodies (such as Ecocert or B Corp). These partnerships support efficient operations, innovation, and credibility.

Key resources involve raw spruce bark, extraction and purification technologies, skilled workforce, R&D capabilities, laboratory infrastructure, intellectual property, and distribution networks.

Key activities include sustainable raw material sourcing, hot-water extraction and purification processes, quality testing, regulatory compliance with EU Cosmetics Regulation (1223/2009), product documentation, and sales and marketing strategies.

Customer relationships are based on transparency and co-creation. Detailed product information, life-cycle assessments, and efficacy data support credibility, while formulation support and technical consulting strengthen partnerships.

Distribution channels include direct B2B sales, cooperation with ingredient distributors, industry trade fairs, and digital B2B platforms.

The **cost structure** reflects expenses related to raw material procurement, extraction, purification, energy and water use, labor, packaging, distribution, certification, regulatory compliance, R&D, and marketing. Process optimization and the circular reuse of biomass residues (e.g., energy recovery, fertilisers) reduce long-term costs.

Revenue streams arise from standardized spruce bark extracts, customized ingredient formulations, licensing agreements, co-development projects with cosmetic brands, and consultancy services in sustainable ingredient sourcing. This diversified structure ensures resilience and profitability.

The **SOCIAL** layer highlights the broader societal impact of the business model, focusing on employment, community development, consumer well-being, and governance.

The **social value** emerges through safer, more natural cosmetic products that reduce exposure to controversial synthetic additives. This directly enhances consumer trust, health, and well-being, empowering individuals to make sustainable purchasing decisions aligned with growing conscious consumerism.

For **local communities**, the business creates new economic opportunities in forestry-dependent regions of the Baltic Sea area. Employment is generated both in rural jobs linked to raw material collection and logistics, as well as in skilled positions in biorefineries, laboratories, and quality control. This diversification strengthens local economies and fosters future-oriented expertise.

Employees benefit from career opportunities in the sustainable bioeconomy and "green-tech" industries. Training, professional development, and workplace safety are emphasized, building pride and loyalty among staff.

For **end-users**, although the relationship is indirect (via B2B clients), the social impact is significant: cosmetics containing spruce bark extracts provide reassurance of safety, sustainability, and transparency. This empowers brands to respond to consumer demand for ethical, eco-friendly products.

The **governance structure** reinforces authenticity. Ethical business conduct is demonstrated through voluntary certifications, FSC/PEFC sourcing, and transparent annual sustainability reporting. These measures ensure accountability and strengthen stakeholder trust.

The **scale of outreach** is global, as every consumer purchasing cosmetics containing the extract becomes a beneficiary of its safer, more sustainable profile. At the same time, the business contributes to raising industry standards by promoting circular and eco-innovative practices.

The **ENVIRONMENTAL** layer evaluates the ecological footprint of the business model across the entire life cycle, from raw material sourcing to end-of-life.

The **functional value** of the product lies in its ability to replace petrochemical-based preservatives and antioxidants with fully biodegradable, plant-based alternatives. By using a natural botanical extract, the environmental burden of persistent synthetic chemicals in wastewater and ecosystems is reduced.

The **production process** is designed according to green chemistry principles. Hot-water extraction avoids toxic solvents, while process engineering focuses on water recycling and energy recovery. Inputs include spruce bark (a certified forestry by-product), water, and energy. Outputs include the high-value cosmetic ingredient, renewable energy from biomass combustion, and mineral-rich ash used for fertiliser production.

The **CE model** ensures that forestry side-streams are valorized, and waste is minimized. Post-extraction biomass is thermally treated to generate renewable energy, and nutrient-rich ash is upcycled into fertilisers, which can be reintegrated into forestry or agriculture. **Environmental benefits** include waste valorization, reduced reliance on fossil resources, and lower carbon footprint due to local sourcing in the Baltic Sea region. Compared to exotic botanical imports, this significantly reduces transportation emissions. **Environmental risks** include the potential association with unsustainable forestry practices and the energy intensity of extraction. Mitigation measures involve strict certification requirements (FSC/PEFC), investment in high-efficiency heat exchangers, and closed-loop water recycling systems. The **end-of-life phase** ensures that cosmetic products containing the extracts are safe for disposal: the ingredient is biodegradable, reducing chemical loads on aquatic ecosystems. Overall, the environmental analysis shows that the business model delivers strong ecological value while aligning with EU sustainability goals and the Green Deal.

6. Connection with other project activities

The CEforestry Education Roadmap is a comprehensive document that analyses the educational needs, challenges, and opportunities related to the sustainable use of forest biomass in the Baltic Sea Region. Developed as part of the CEforestry project, the roadmap is designed to support strategic, evidence - based actions that enhance skills development, knowledge transfer, and environmental awareness across the forestry, bioeconomy, and circular economy sectors.

The analysis conducted in five countries - Poland, Finland, Lithuania, Latvia, and Sweden - revealed that current educational offerings in forest management and biomass processing are largely rated as average or insufficient. This highlights a clear gap between available training programmes and the practical needs

of stakeholders. Several key knowledge gaps were identified, particularly in the areas of forest side stream utilisation (e.g., bark, needles), modern recycling technologies, climate change adaptation, and the development of biobased products. Especially concerning is the low level of public awareness regarding the potential of bioproducts, as well as limited access to up-to-date, high-quality educational materials adapted to national languages and regional contexts.

Survey participants expressed a clear preference for flexible and modern learning formats, including mobile applications, online interactive tools, webinars, and MOOCs. These digital formats not only accommodate time constraints but also support personalised, practice - oriented learning. At the same time, the continued importance of printed materials in countries like Sweden demonstrates the need to tailor educational formats to local preferences and traditions.

A crucial insight from the research is the necessity of adapting educational content and delivery methods to the specific needs of different target groups. Professionals in the forestry and agricultural sectors were identified as the highest priority audience. However, students, academic staff, local communities, NGOs, and policymakers also play vital roles and must be actively included. The relatively low visibility of policymakers in educational strategies is particularly noteworthy given their role in creating regulatory frameworks and implementing sustainability policies. An important observation also came from respondents who highlighted the lack of early education in this field, pointing to the need to integrate biomass and bioeconomy topics into school curricula - particularly in biology classes - as a means of fostering environmental literacy from a young age.

Based on the findings, six priority topics were identified to guide future CEforestry educational activities:

- uses of bark and needles across sectors,
- recycling technologies for forest biomass,
- impact of climate change on forestry,
- development of innovative biobased products,
- biorefinery processes,
- CE principles in forestry.

In addition, effective knowledge transfer should be supported through the development of open - access databases, stronger university - industry cooperation networks, and targeted information campaigns via traditional and social media.

The CEforestry Education Roadmap serves not only as a diagnosis of the current educational landscape but also as a practical guide for institutions and organisations engaged in the green transition. By aligning educational content with real labour market demands, environmental challenges, and

stakeholder expectations, the roadmap establishes a strong foundation for building a competent, informed, and innovative bioeconomy across the Baltic Sea Region.

7. Policy recommendations

The European bioeconomy strategy action plan aims to promote the bio-based sector for investments and market. Fossil based materials should be replaced by bio-based raw materials and products. The EU Bioeconomy strategy has 5 goals: ensure food and nutrition security, manage natural resources sustainably, reduce dependence on non-renewable and unsustainable resources, limit and adapt to climate change, strengthen European competitiveness and create jobs.

The EU Circular Economy action plan was adopted in 2015 aiming to the transition of the European economy from a linear to a circular model. The plan includes 54 actions promoting circular economy. The action plan includes initiatives along the entire life cycle of products, promotes circular economy processes and fosters sustainable consumption. The aim is to ensure that the resources used are kept in the EU economy for as long as possible. In addition, sectors that use most resources and where the potential for circularity is high should be focused.

EU Member States have committed to turning the EU into the first climate neutral continent by 2050. This means that emissions have to be reduced at least by 55% by 2030 compared to 1990 level.

Bioeconomy can contribute to the EU Green Deal by circular use of biomass and production of high value-added products from side and waste streams such as bark residues.

Based on the market research and the emerging trends in the forest bioeconomy, the following recommendations are proposed for the Nordic and Baltic countries (full text of Policy Recommendation was presented in O2.5. - Policy recommendations for utilizing forestry side streams in the Baltic Sea region):

1. **Support for integrated biorefinery development**

Governments should establish funding programs and innovation hubs that support the development of integrated biorefineries. These facilities should focus on maximizing the cascading use of forestry side streams - first extracting high-value compounds (e.g., tannins for industrial applications) and then utilizing residual biomass for bioenergy and other uses. Public-private partnerships and targeted R&D investments will be crucial for advancing processing technologies and ensuring economic viability.

2. **Promotion of CBMs**

Policy frameworks should incentivize circular business models that encourage the valorization of forestry residues. This can be achieved through tax breaks, subsidies, or low-interest loans for companies that adopt practices to minimize waste and create diversified product lines. Certification schemes and standardized life-cycle assessments can further help build market trust and ensure compliance with sustainability standards.

3. **Strengthening Regional collaboration and innovation networks**

Nordic and Baltic countries can benefit from enhanced cross-border collaboration in the forest bioeconomy sector. Establishing regional networks and innovation clusters that connect forestry operators, processing firms, research institutions, and end-product manufacturers can facilitate knowledge sharing, joint ventures, and technology transfer. Regional coordination should also align with EU policies on the circular economy and sustainable forestry management.

4. **Enhancing digitalization and supply chain transparency**

Investment in digital monitoring systems is essential for ensuring quality, traceability, and efficiency throughout the forestry value chain. Policies should promote the adoption of digital tools and data analytics to optimize resource management, track sustainability metrics, and improve supply chain transparency. Such measures will help regional industries adapt to changing market demands while maintaining high environmental standards.

5. **Facilitating market access and international trade**

To support the growing demand for natural, sustainable products, governments should work to reduce trade barriers and streamline regulatory processes. This includes harmonizing standards across the Nordic and Baltic regions and ensuring that locally produced bio-based products meet international quality and safety standards. Enhanced market access initiatives can help regional industries expand their reach both within Europe and globally.

6. **Fostering R&D in bio-based innovations**

Continuous investment in R&D is crucial for further improving extraction methods and developing new applications for forestry side streams. Governments should support research projects that focus on green extraction techniques, the valorization of bioactive compounds, and the development of novel bio-based products. This research should be disseminated widely to inform both industry practices and policy formulation.

7. Certification of private forests for organic production

When using ingredients extracted from logging residues in consumer products (such as cosmetics or food products), the origin of the raw material can significantly impact the final product's price. For example, in cosmetics, the use of organic raw materials greatly increases the chances of obtaining a higher-than-usual price for the final product. However, certifying forests for organic production is a difficult and expensive process for private forest owners. For this reason, very few private forests in Finland, for example, have been certified for organic production. The situation is similar in many other EU countries. Additionally, organic certification practices can vary between different EU countries.

For the reasons mentioned above, the certification of private forests for organic production should be simplified and standardized across the EU, making it easy and profitable for forest owners to certify even small forest areas. This would also ensure the availability of logging residues for further processing based on organic production and for high value-added products.