



BIOMODEL
4REGIONS

TOWARDS A BIOBASED ECONOMY IN NORTHERN SWEDEN

A bioeconomy blueprint, prepared in the frame of the
BioModels4Regions project



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1 OBJECTIVES & SCOPE

The Bioeconomy Blueprint for northern Sweden is a strategic framework aimed at guiding the region's transition into a competitive, sustainable, and resilient bioeconomy. This document seeks to integrate the bioeconomy related strategies of the four northern regions, while also aligning with broader national policies and the proposed national bioeconomy strategy (currently under referral revision), as well as European policies and legislation.

The blueprint provides a common vision for northern Sweden, also in line with the proposed national bioeconomy vision and objectives as well as other national strategies that include bioeconomy. This alignment ensures that regional policies are coherent with national and European bioeconomy strategies, facilitating coordinated policy implementation and fostering synergy across different governance levels.

This document serves as a means for strategically coordinating efforts, across the regions in northern Sweden, but the document holds no political mandated bearing. The document can be used as a foundation for the four northern politically steered regions in their work to revise and update strategies and policies pertinent to the bioeconomy sector. The blueprint can also be used by all those involved in the development of the bioeconomy to start implementing the recommended actions herein without delay. As the core of the bioeconomy in northern Sweden, the scope of this Blueprint focuses on the forestry bioeconomy. The key areas and recommendations can be applied to the other bioeconomy sectors.

Today, Northern Sweden is one of the most forest dense areas in Europe. The region has been built by felling one tree at the time to give way for small agricultural patches and roads through the deep forests. Yet, to this day, 97% of the productive land remains covered in forest and about 1% is agricultural land. The economy of northern Sweden has been partly built of the iron ore taken out of the mines, but also of the billions of trees cut down, firstly hand sawn and pulled out by timber horses out of the deep forests and thereafter transported along the rivers by brave timber men down the coast for further valorisation.

Nowadays, modern machines take down the trees and cut their tops and branches, the logging residues, in one swift operation before they are transported on trucks and trains. However, local processing industries, such as pulp mills which produce cellulose-based products of the wood, the majority of forest biomass (about 80%) is exported in minimally processed forms, primarily as raw timber sawn at sawmills, meaning there is still a large untapped potential for further valorisation of the timber, both within the region and for export.

Over the past 150 years, huge investments have been made into industries processing forest biomass. Sawmills, pulp and papermills and CHPs are continuously investing in more innovative and effective processes to stay competitive. This is the main driver for innovations and growth in the forest bioeconomy but is not the focus of this blueprint. Over time, strong synergies as well as competition have developed between these industry segments and forest owners.

1.1 INVOLVEMENT IN THE DEVELOPMENT OF THE BLUEPRINT

The foundation of the Bioeconomy Blueprint has been laid out during work performed during the preparation of the Swedish national Bioeconomy strategy that started during 2022, in which partner organizations of the blueprint held an active role.

In the work, a task has been carried out of coordinating the regions in the national bioeconomy strategy. In addition to workshops with the Government Offices, interviews with regional strategists on behalf of the Government Offices were conducted and a survey performed for them to answer the investigators' questions. This material is now part of the annexes to the report on the new bioeconomy strategy that was completed in December 2023.

In parallel to discussing a strategy from a regional perspective, the national network has also developed the indicators for a new regional bioeconomy statistic, together with Statistics Sweden, which will be published in January 2025. This will be an excellent tool for all regions to track developments in different areas of the bioeconomy, which can also be linked to carbon emissions.

The Bioeconomy Blueprint has been developed together with three main stakeholder groups: regional administration, business (from biobased start-ups to large scale companies), academia and research institutes. In addition, cluster organisations, innovation hubs, politicians, industry associations and national authorities have had input in different forums.

The initial blueprint was drafted during a workshop conducted during the referral process of the National Bioeconomy Strategy, where stakeholders from northern regions contributed with their input on what is important for Northern Sweden in the Bioeconomy Strategy. Also, input has been provided in a joint workshop with the EU-project MainstreamBio, providing input from biobased start-ups within the region and innovation hubs. Finally, the blueprint has been tested with input from the RISE Processum Biorefinery Cluster, composed of some 20s companies ranging from SMEs to large scale enterprises, all active within the bioeconomy of the region.

A Swedish national bioeconomy strategy is still pending approval, awaiting a final proposal from the referral process that was completed the end of summer of 2024. Sweden has parts of the bioeconomy sector already incorporated into national and regional regulated strategies. Once the national strategy is approved, a cascade of alignment work will follow suit to the regionally regulated strategies. We hope this document can be a tool for inspiration in this work for the northern counties of Sweden, in coordinating efforts, aligning vision and goals for different parts of the bioeconomy (food, climate, self-sufficiency, economic growth) to achieve a strong, sustainable, and resilient north.

2 BASELINE AND ANALYSIS OF LOCAL CONTEXT

2.1 BIOECONOMY HISTORY IN NORTHERN SWEDEN

Biomass has always been essential in Northern Swedish's society, initially used for food, energy, clothing, tools, and construction. Northern Sweden's agriculture, forestry, aquaculture,

and fisheries have been vital for the country's economic and cultural development. Over the last century, industrialization and access to fossil resources replaced the bio-based economy with a fossil-based one, shaping societal norms and consumption patterns. Post-World War II industrial growth led to economic progress but also severe environmental issues, including pollution of air, water, and land due to a lack of regulations and purification technology. With growing awareness of climate and environmental challenges, improved purification methods have significantly reduced industrial emissions since the 60's and 70's.

Since the late 1970s, the bioeconomy has expanded in Sweden's energy sector, transitioning from fossil fuels to bioenergy, now widely used for heating buildings and power generation. Policies like the carbon tax (1991) and the EU emissions trading system (2005) have further promoted biofuels, reducing Sweden's carbon emissions by about 33% since 1990. In the last 20 years, biofuels usage has increased, primarily through imported liquid biofuels and domestic production of renewable fuels like biogas. Additionally, production of paper packaging materials and sawn timber for construction has grown significantly over the past 15 years.

2.1.1 Agriculture

Throughout the history of Northern Sweden, agriculture has provided food through crop cultivation and livestock production, as well as materials like flax for textiles, linseed oil, and paints. The textile industry expanded in the 18th century with the import of cheaper flax and cotton, reducing domestic flax production. Historically, Sweden maintained a high degree of self-sufficiency in food, with crop cultivation and livestock mutually supporting nutrient cycles. However, global trade and imports have significantly reduced domestic agricultural production, leading to smaller areas dedicated to crops and livestock.

Over the past 70 years, agriculture has undergone significant modernization. Advances in technology, infrastructure, and fossil-based fertilizers like nitrogen and imported feed have enabled more efficient food production. Despite this intensification, greenhouse gas emissions from agriculture have decreased by over 10% since 1990. Today, there are solutions to produce low-emission fertilizers and domestic feed with reduced climate impacts. However, increased global trade has made agriculture more efficient but also exposed its vulnerabilities, as recent geopolitical tensions and disrupted trade routes have highlighted risks to food security.

Agriculture's primary contribution to the bioeconomy is within food production. Additionally, it supports biobased industries by providing biomass for other products and residual streams that can be transformed into new goods. The sector also contributes to biogas production. While only a small share of agriculture biomass is used for energy, grain and rapeseed are utilized for chemicals and fuels, while straw and willow serve other energy purposes.

Currently, 85% of Sweden's agricultural land is arable, with the remainder used for pasture. Of the arable land, 94% is actively used for producing feed and food raw materials the remaining 6% (162,500 hectares) is fallow. This unused land presents opportunities for increased production for various purposes.

2.1.2 Blue economy

Fishing and aquaculture have historically played an important role in Northern Swedish's food supply and are deeply embedded in Swedish culture and history. Maritime trade and a robust fishing industry have been vital for the Swedish economy and food supply. Today, the contribution of these blue industries to the bioeconomy mainly involves the use of renewable aquatic biomass from marine and freshwater systems, including catches from commercial fishing, aquaculture of animals and plants, and the harvesting of seaweed and algae. Aquatic biomass primarily consists of proteins, fats, and oils. By-products from the fishery supply chain can be used to extract high-value proteins and omega-3 oils.

Environmental issues and overfishing in lakes and seas, have led to reduced fishing activity. Today, fish supply relies heavily on imported fish, mainly from Norway. In 2022, the total catch weight from commercial sea fishing was a mere 121,000 tons of which over 80,000 tons was exported to Denmark and used as ingredients in fish feed. The aquaculture and the fishing industry hold the greatest potential for increased efficiency and added value within the Swedish bioeconomy.

2.1.3 Forestry

Northern Sweden is characterized by vast forest resources, a cold climate, and sparsely populated areas. Bioeconomy is almost totally dominated by forest bioeconomy as 97% of the productive land is covered with forest. Agriculture and fishery make a very small contribution to the economy. The total land area for Northern Sweden is 221 800 km² of which 67 % is forest land (148 920 km²). The total growing forest stock is 1 314 million m³ and the annual growth is 45 million m³. The protected forest area amounts to 42 990 km² or approx. 20 % of the productive forest land. Additional to this there are voluntarily set aside areas made by private forest owners. The annual harvest in the region is on an average 31 million m³. In addition to domestic wood, imported round wood can also contribute to the regional market.

The forest and its industry have been vital to northern Sweden for centuries. Early forest-based products included ships and tar, but major industrial development began in the 19th century with sawmills, followed by technology enabling the conversion of forest biomass into pulp, paper, and packaging, and later into fuels, chemicals, and textiles.

Since 1903, Swedish law has required replanting of trees, so called reforestation, after felling and logging, a principle that is still central to forest management today. Along with improved forestry methods, this law has doubled Sweden's forest biomass since 1923, despite nearly doubled annual harvesting. Sweden now has a vast forest biomass supply compared to many industrialized nations and is the world's fifth-largest exporter of forest products.

A key to competitiveness is the efficient use of the entire tree. Larger logs are processed into sawn timber, while smaller parts and by-products go to pulp and paper production. Residues from pulp mills are used for chemicals, plastics, adhesives, food additives, batteries, and energy. In addition, many homes in cities are heated via district heating from the power plants. Sawn timber is critical to the bioeconomy, providing most of the forest owner's income, making efficient sawmills essential for the entire value chain. Around 80% of Swedish forest products are exported.

In recent years, industrial wooden construction has grown significantly, increasing the share of multi-family homes built with wooden frames. Simultaneously, the paper industry has shifted focus due to digitalization and changing consumption patterns. Since the late 1990s, production of packaging and tissue paper has increased, while graphic paper production has nearly halved. Swedish forest industries were early to transition to high-value-added products, a trend that continues. Many pulp mills have evolved into advanced biorefineries, fractionating raw materials for diverse uses. As efficiency improves, more residues are expected to be refined into new paper materials, plastics, chemicals, fuels, textiles, and other innovations.

2.1.3.1 Is there enough biomass for new users?

Sawn timber products and pulp and paper products have dominated the use over a long time but the use of forest biomass for energy purposes has grown rapidly over the past decades. In the near future, the use of forest biomass in biorefineries is expected to increase and will claim additional supply of biomass. This arises the question if there is enough biomass available for both new and existing users of biomass.

Suppliers of forest biomass in northern Sweden declare an increasing difficulty to increase felling volumes in the future and plans to decrease felling volumes has been declared by the major forest owner in northern Sweden (Sveaskog). As a result of the ongoing war in Ukraine, import of biomass from Russia, Belarus and Baltic states are not more available. As a result of the upcoming EU policies, harvesting volumes may decrease even more. This has resulted in that existing users of biomass (sawmills, pulp mills and heating plants) face increasing difficulties to supply their existing industries and prices for pulpwood and especially for wood fuels has increased significantly. As a result of harvesting operations, large volumes of logging residues (tops and branches) are available in the region.

These residues have hardly been utilized at all since they have a low commercial value due to their location far away from most existing end consumers and the costs of harvesting, transport and storing has been too high compared to the market price of forest industry by products. Recent increases in prices for wood fuels has increased the interest in logging residue extraction. For future expansion of biorefineries, it is important that future policies will focus more on biomass availability and mobilisation. It is likely that new production of bioproducts and biofuels will benefit from finding synergies with existing biomass consuming industries as illustrated in the map below (Figure 1).

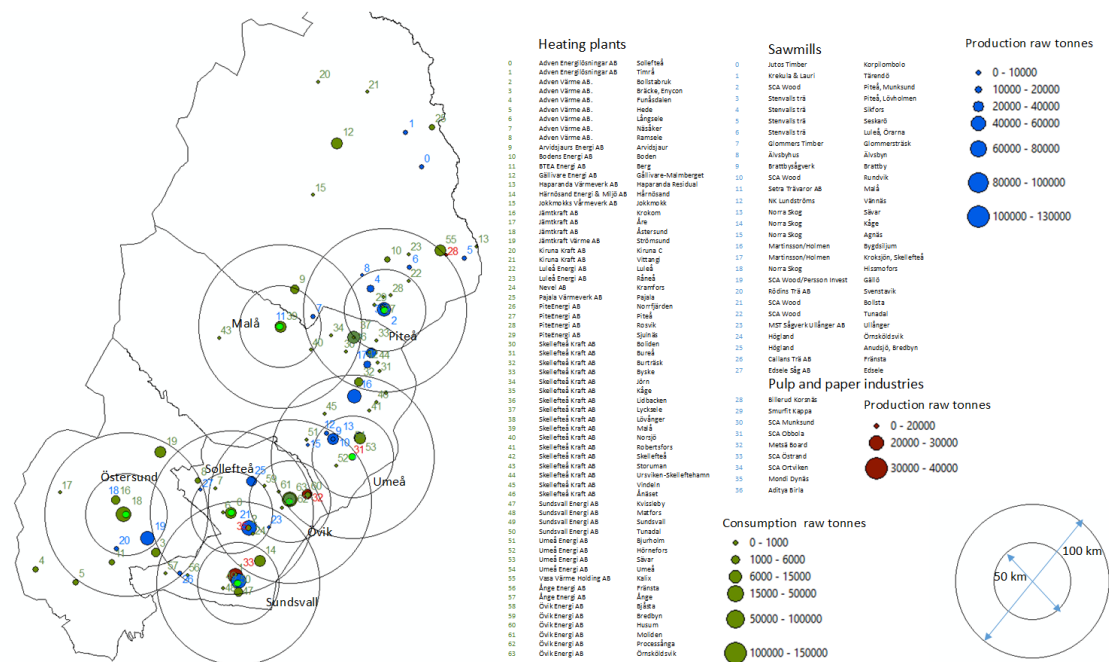


Figure 1 Map of northern Sweden with major industries consuming woody biomass. Raw material supply areas for potential biorefineries.

2.1.4 Status-quo of Bioeconomy Sectors in Northern Sweden

While forestry remains a cornerstone of Northern Sweden's bioeconomy, several other bioeconomy sectors are predicated to also driving sustainable growth and resilience, blurring the traditional sectoral boundaries as an integrated circular biobased economy develops.

Within the region there are several identified areas that are included within the scope of bioeconomy. Some of them are in themselves broader than bioeconomy but enablers for carrying out a bioeconomy. Below, a status quo for the different areas are provided.

Bioenergy

In Sweden and especially in northern Sweden, bioenergy plays a significant role in the energy and electricity supply, contributing to both heat and power production. Bioenergy is generated from various sources of forest industry by products like bark and sawdust to a much smaller extent from agricultural waste, and from anaerobic digestion to biogas.

Bioenergy accounts for about 37% of Sweden's total energy supply, making it the largest single source of energy in the country. When it comes to electricity generation, bioenergy contributes roughly 10-12% of the national electricity mix. This is achieved mainly through combined heat and power (CHP) plants and within forest industries, where biomass combustion generates both electricity and heat. The CHP plants are highly efficient and serve as an important part of providing heat especially during colder months to citizens via the district heating systems installed connected to the CHP and the adjacent cities.

The future potential for bioenergy, particularly from forest residues (the logging residues left behind after felling), is expected to grow in Northern Sweden. The practice of harvesting

logging residues declined in 2014, especially in northern of Sweden as the output of forest industry by products until now been sufficient for the regional demand. Collection of logging residues is still more common in southern based Götaland and Svealand than in northern Sweden. In southern based regions Götaland, during the period 2018–2022, logging residues was extracted on 64 % of the final felled area and in Svealand on 44 % of the area. In Southern Norrland and Northern Norrland (of which half of south Norrland and the whole of Northern Norrland make up the northern Sweden region herein), the corresponding proportions were 19 and 7 %, respectively.

In northern of Sweden there is today a surplus of logging residues. The surplus amounts to nearly 14 TWh per year, while sustainably harvesting around 21 TWh of logging residues annually is feasible. Through to mild winters the early 10' the market declined in the northern and with that the logistic system disappeared. What needs to be managed today is rebuilding the capacity for machinery and logistics systems in the region. The later has found a new interest in recent years following increase in energy prices and a predicted higher demand of electricity in the northern of Sweden.

The Swedish Energy Agency projects a moderate increase in bioenergy's contribution to the electricity mix over the next few decades, driven by enhanced utilization of forest residues and advancements in technology for biomass conversion. By 2035, it is expected that the share of bioenergy in electricity generation could rise to 15-18%, depending on the rate of increase in logging residues utilization and the implementation of new bioenergy technologies.

In Northern Sweden most forest biomass resources are today fully utilized, and established forest industries are competing for the available resources. In the near future, it is not likely that harvesting levels can increase but it is more likely that because of upcoming EU policies, harvesting levels may decrease. Forest Industry by products are today almost fully utilized. Only outputs with high water content like fibre sludge and green liquor (biomass residual streams from pulp mills) etc. are difficult to use. This situation makes it hard for new users to secure long-term and cost-effective raw material supply needed for investments.

There is a potential for growth in bioenergy production and for investments in biorefineries, but the increase in biomass demand must be balanced with sustainability concerns. As new users of biomass most likely will demand biomass assortments of a well-defined quality, like sawdust, today used for combustion. CHPs can compensate for the shortage of sawdust by burning more logging residues. or other more complex biomass assortments not suitable for upgrading. CHP technology is robust and designed to handle more complex fuels. In this way undesirable market distortion can be avoided. If we don't extract the logging residues from the forest they will decompose (5-10 years) in the forest releasing CO₂ to atmosphere anyway. Environmental impact of LR extraction is small and well known and regulated by the national forestry act. The extraction of logging residues needs to be carefully managed to protect soil quality and biodiversity.

Several initiatives for production of biofuels from lignocellulosic biomass have been proven on a demonstration scale (e.g. production of DME, dimethyl ether from black liquor, via gasification) but failed to reach industrial production scale. Northern Sweden has several ongoing projects within carbon capture and utilization (CCU) both applied to heavy industry and to combined heat and power plants at municipal level.

Liquid Wind is advancing its FlagshipTHREE project in partnership with Umeå Energi at the Dåva cogeneration plant in Umeå, Sweden (the largest city in the Northern Sweden region). This facility is part of Liquid Wind's mission to develop green electro fuels to decarbonize sectors like maritime shipping, which relies heavily on fossil fuels. Once operational, the plant aims to reduce CO₂ emissions by 271,000 tons annually.

The project plans to produce approximately 130,000 tons of eMethanol per year. This will be achieved by capturing biogenic CO₂ emissions from the CHP Dåva plant and combining it with green hydrogen derived from renewable electricity, such as wind power. Construction is scheduled to begin in 2024, with the facility expected to be operational by 2027.

In addition to its environmental goals, the project supports Umeå's commitment to becoming climate-neutral by 2030 and aims to stimulate regional economic growth by creating green jobs. This collaboration between Liquid Wind and Umeå Energi exemplifies a symbiotic approach to sustainable energy production, leveraging local resources to drive impactful change.

Biofuels and e-fuels for transportation

Sweden has been a leader in biofuel adoption, with biofuels accounting for a significant portion of its transport fuel mix.

The status of biofuels for transport in Sweden, particularly in northern regions, reflects a dynamic and evolving landscape. Sweden has been a leader in biofuel adoption, with biofuels accounting for a significant portion of its transport fuel mix. Hydrotreated Vegetable Oil (HVO) is a major component, with imports playing a crucial role. In 2022, HVO blending in diesel accounted for 24.7% of the total diesel pool, equivalent to 1.2 million cubic meters, and this trend continued into 2023 (1).

HVO is by far the largest used biofuel in Sweden, accounting for 16 TWh of the 22 TWh (**Error! Reference source not found.**). However, the majority of HVO used in Sweden is imported, with only a small fraction produced domestically. In 2018, for example, only about 5% of the 14 TWh of HVO consumed was produced from Swedish raw materials. 2021, the number had increased to 11% of the 16 TWh of HVO (Table 1). The primary sources of HVO imports include countries like Finland and the United States, with feedstocks ranging from crude tall oil to slaughterhouse waste.

Table 1 Share of renewable fuels in Sweden in 2021 and share of production from Swedish raw materials

Product	Quantity used, TWH	Share from Swedish raw materials, %
HVO	16,0	11
FAME	3,0	4
Ethanol	1,3	25
Biogas	1,6	65

Source: Swedish Energy Agency, 2022a.

In the proposed national bioeconomy strategy, a large investment for liquid biofuels is suggested with high set targets of having a domestic transport fleet operating to 90% on liquid

biofuels, ideally predominantly of national biomass, by 2045, see section Part I Overview of the interim report 'Fossil free transports' (SOU 2023:15)

Bioproducts and Bioplastics

The advancement of high value biochemicals, bioplastics, and biomaterials represents a pivotal objective in the development of the bioeconomy. Forest residual biomass and agricultural residues can be employed in the production of bioplastics, which can assist in reducing reliance on fossil-based plastics and creating new market opportunities. It is of paramount importance to ensure the availability of materials that are capable of undergoing degradation to facilitate the transition towards a circular economy. Areas of innovation include the development of lignin-based materials, cellulose nanofibers, and bio-based packaging solutions.

Traditional and innovative food products from agriculture and forest

Northern Sweden offers unique opportunities for both traditional and innovative food products derived from agriculture and the forest – often described as "the pantry of the forest." Traditional practices such as reindeer herding, hunting for game and small game, and foraging for berries and mushrooms play a vital role in preserving cultural heritage and sustaining livelihoods. These activities provide underutilized resources, including high-quality proteins like smoked reindeer meat and game, which hold potential for higher-value products. The rich forests also offer functional berries such as lingonberries and cloudberries, renowned for their nutritional and health-promoting properties. Innovation in food production focuses on increasing the valorisation of these natural resources, particularly through advanced methods to develop higher-value products.

Opportunities lie in protein extraction technologies for alternative proteins, both for food and feed, as well as the development of fermented plant-based foods and novel functional food products. By combining traditional knowledge with innovative food processing, Northern Sweden can unlock the potential of its natural resources, offering sustainable and high-quality products while maintaining cultural traditions and promoting bioeconomic growth.

Northern Sweden's rich forestry sector also provides opportunities for innovation in sustainable food and feed production, particularly through the development of Single Cell Protein (SCP). SCP involves producing high-quality protein derived from microorganisms such as bacteria, yeast, fungi, or algae. These microorganisms can be cultivated using forestry by-products, including residual biomass like sawdust, wood chips, and lignocellulosic waste, which are abundant in the region's forestry industry. The process of producing SCP begins with breaking down forestry residues into simple sugars or other feedstock through enzymatic or chemical processes. These feedstocks then serve as a substrate for microbial growth in controlled bioreactors. The microorganisms efficiently convert the biomass into protein-rich biomass, which can be harvested, processed, and used as an alternative protein source for food, feed, or functional products.

This innovative approach not only adds value to underutilized forestry by-products but also aligns with circular bioeconomic principles by reducing waste and creating sustainable protein solutions. By integrating SCP production with Northern Sweden's forestry sector, the region

can further enhance its role in developing sustainable, high-value bio-based products, supporting both food security and industrial innovation.

Aquaculture and Blue Bioeconomy

The blue bioeconomy in northern Sweden is growing, particularly through innovative projects like the Big Akwa, which exemplifies industrial symbiosis with the paper industry. The blue bioeconomy focuses on utilizing renewable aquatic biomass from marine and freshwater systems, including fish, shellfish, seaweed, and algae. This sector is crucial for sustainable development, offering high-value products such as dietary supplements, pharmaceuticals, and bio-based materials.

Recirculating Aquaculture Systems (RAS) are a key technology in this region, enabling efficient and sustainable fish farming by recycling water within the system. RAS minimizes environmental impact and allows for the cultivation of fish in controlled environments, enhancing productivity and reducing the need for antibiotics. The Big Akwa building in northern Sweden is a prime example of how RAS can be integrated with other industries. Located near a paper mill, this facility utilizes waste heat and carbon dioxide from the mill to optimize the conditions for aquaculture, creating a symbiotic relationship that benefits both industries.

This integration not only improves the sustainability of fish farming but also enhances the overall efficiency of resource use in the region. By leveraging the by-products of the paper industry, like the Big Akwa project reduces waste and lowers the carbon footprint of both sectors. This model of industrial symbiosis is a promising approach for the future of the blue bioeconomy in northern Sweden, demonstrating how innovative technologies and collaborative efforts can drive sustainable growth and create new economic opportunities.

The blue bioeconomy has significant potential in Northern Sweden due to its vast water resources and growing expertise in aquaculture and innovative technologies. Traditionally, the region has relied on small-scale fisheries and coastal activities, but recent developments have expanded the role of the blue bioeconomy to include sustainable aquaculture, advanced water-based technologies, and industrial synergies.

One of the key players in this development is Big Akwa, a company pioneering land-based aquaculture systems in Northern Sweden. They specialize in Recirculating Aquaculture Systems (RAS), an advanced method that recycles and purifies water within fish farming facilities. RAS minimizes water use, reduces environmental impacts, and allows year-round fish farming, even in the challenging northern climate. This technology not only enhances production efficiency but also aligns with sustainable practices critical for the region's bioeconomy.

Big Akwa is also a strong advocate for industrial symbiosis, where waste and by-products from one industry are used as inputs for another. For instance, excess heat from nearby industrial processes can be utilized to regulate water temperature in aquaculture facilities, while nutrient-rich wastewater from fish farming can be treated and repurposed as fertilizer in agriculture or energy production. This integrated approach reduces resource waste, promotes circularity, and strengthens local economies.

The blue bioeconomy in Northern Sweden is positioned to grow further through collaboration between aquaculture, forestry, agriculture, and energy sectors. With innovative solutions like RAS and industrial symbiosis, companies such as Big Akwa are demonstrating how sustainable aquatic production can thrive in colder climates while contributing to regional economic development and the national bioeconomy agenda.

An example of innovative cross-sectorial work between blue bioeconomy and agriculture is Agtira in Härnösand. Agtira operates Europe's largest circular aquaponic system, combining fish farming with tomato cultivation. Nutrients from rainbow trout farming fertilize the tomatoes, while the plants clean the water, creating a closed-loop, sustainable system. Founded on Pecka Nygård's innovative idea, the company produces around 500 tons of tomatoes and 60 tons of fish annually, meeting demand for Swedish-grown produce year-round. With further expansion, Agtira aims to revolutionize sustainable food production both locally and internationally.

Textiles and Fiber Innovation

Northern Sweden is at the forefront of textile and fibre innovation, leveraging its strong forestry sector to develop bio-based alternatives to cotton and synthetic fibres. Companies like Domsjö Fabriker play a key role by producing dissolved cellulose from wood, a crucial raw material for sustainable textiles. Meanwhile, Renewcell in Sundsvall, now branded as Circulose, pioneers textile recycling, transforming discarded textiles into high-quality recycled cellulose for new garments. Innovation areas include cellulosic yarns, biodegradable fabrics, and non-woven materials, offering solutions for a circular, low-carbon textile industry.

Sustainable agriculture

Agriculture in northern Sweden faces unique challenges due to its colder climate, shorter growing season, and limited arable land compared to the southern regions. Historically, the region relied heavily on hardy crops such as barley, oats, and potatoes, as well as livestock farming, particularly dairy and beef cattle. In recent years, there has been growing interest in expanding sustainable agriculture in the north, focusing on resilient crops and innovative techniques to overcome the climatic challenges.

The proportion of productive land in the four northernmost regions, comprising agricultural land (arable land and pasture), is considerably lower than in other Swedish regions. In the most northern country, Norrbotten, it accounts for less than 1 % of the total area, while in Västerbotten it is 1.4 percent, in Västernorrland it is 2 %, and in Jämtland-Härjedalen it is 1 %. In general, over 90% of the utilised arable land in northern Sweden is used to grow grassland and fodder crops. The harvests from these crops form the basis of the milk and meat production that constitutes the backbone of northern agriculture.

Despite the limitations, northern Sweden holds significant potential for bioeconomy development. Livestock farming provides manure for biogas production, and unused land can be utilized for energy crops like willow or for cultivating legumes and grasses to reduce dependency on imported feed. Additionally, cold-resistant crops and greenhouse technologies are being explored to extend the growing season and diversify agricultural output. Forestry and agriculture often overlap in northern Sweden, providing opportunities to integrate biomass production for biofuels, bioenergy, and other bio-based products. With increased investment

and research into climate-adapted farming, northern agriculture can play a greater role in Sweden's bioeconomy.

Eco-Tourism

Northern Sweden offers significant opportunities for eco-tourism, combining its natural beauty and sustainable practices to promote the bioeconomy. Leveraging the region's forests, farmlands, and waterways, activities such as forest-based wellness tourism, and nature-based experiences allow visitors to engage with sustainable lifestyles while boosting local economies. Innovation in bio-based infrastructure and zero-waste tourism models ensures minimal environmental impact. Additionally, sustainable transport options, like electric vehicles and cycling trails, further reduce the carbon footprint, making Northern Sweden a leader in eco-friendly, immersive tourism experiences.

2.2 LOCAL POLICY CONTEXT

The Swedish bioeconomy strategy is under its last processing, with the 2012 *Research and Innovation Strategy for a Bio-based Economy* serving as its foundation. Sweden's focus on bioeconomy aligns with broader macro-regional initiatives, such as the *Nordic Bio-based Economy* and *Baltic Bio-based Economy*, which impact rural development.

While there is no national strategy, bioeconomy has for a long time been integrated into various regional strategies, particularly in forestry, where the focus is on wood, wood-based products, and biomass such as the Regional Development Strategy, Smart Specialization, Forestry Strategy, Food Strategy, and Circular Strategy. It also intersects with other policy areas, such as sustainable growth, cities, materials, bio marine industries, and circular bio-based industries. Key objectives include sustainable natural resource management, growth, and employment. Biofuels also play a significant role in regional development strategies. Other bioeconomy sectors, such as construction, biomaterials, and research and innovation, are addressed depending on regional economic profiles. Challenges in legislation include transitioning from demonstration to operation, particularly regarding waste legislation. Advocates highlight the need to include hunting, foraging, tourism, and minority group traditions in strategies.

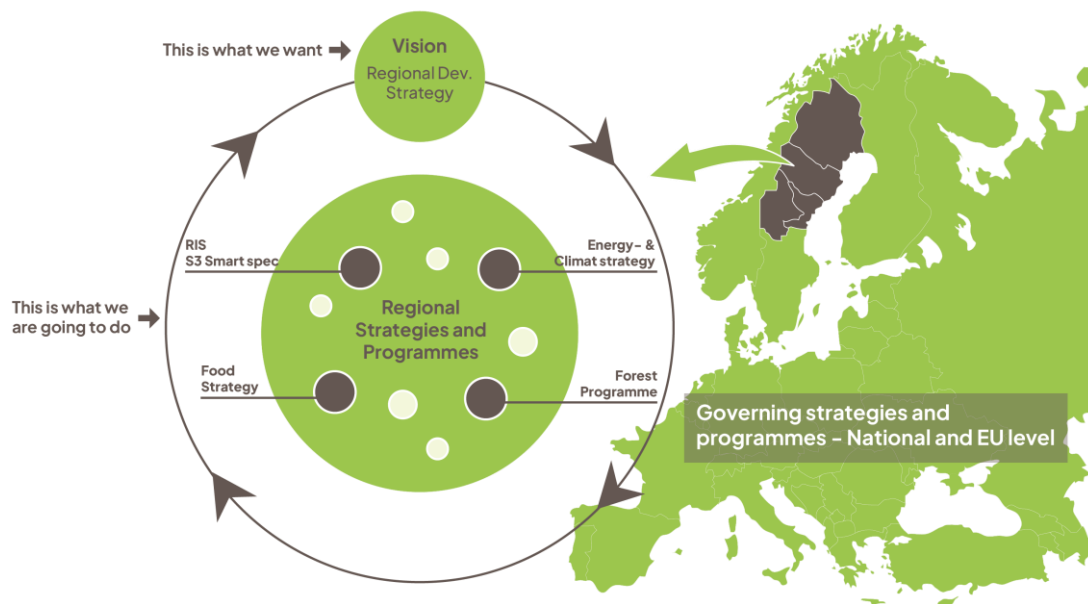


Figure 2 Overview of the policy landscape of Northern Sweden.

At the national level, various ministries collaborate on bioeconomy strategy development, supported by policies like the Carbon Tax, Circular Economy Strategy, and national climate plans. The countries in Northern Sweden, characterized by forestry, agriculture, and sparse rural populations, participates in *S3 programmes*, prioritizing forest-based bioeconomy for 2021–2027. Governance responsibilities for the bioeconomy vary across counties and municipalities, with differing levels of authority and collaboration on topics like food strategies, forestry programs, and energy and climate strategies.

A bioeconomy blueprint for northern Sweden must have good understanding and relate to the existing an upcoming policy landscape on national, and regional levels but the highest ruling Eois U-level. The northern Swedish region operates within the framework and polices of the four northernmost counties (county of Norrbotten, Västerbotten, Västernorrland, and Jämtland-Härjedalen) (Figure 2).

2.2.1 EU governance on forest-based industries and primary forest producers

The forest was not part of the treaty when Sweden joined the EU but was seen as a national competence. But recent legislations i.e. Fit-for-55, the restoration directive, and the EU Deforestation directive, EUDR, have a major impact on forest related industries and primary producers.

Even though Sweden historically had the highest carbon sequestering, in EU reported in LULUCF, an additional burden was decided, leading to lower potential of harvest of forest biomass. Before the revised LULUCF Sweden had 27,9 million hectares of forest of which 18,9 million hectares are available for wood supply and 9 million hectares not available, for various reasons (e.g. formally protected, voluntarily set aside, low production forest land). The

discussion regarding what counts as renewable when it comes to forest biomass has led to uncertainties for users of biomass and entrepreneurs harvesting the same.

The EUDR reveals a mistrust towards the National Forest Inventory and the Swedish Forestry Act, and the certification Schemes used in Sweden (FSC, Forest stewardship council and PEFC). The new legislation will add considerable administrative burdens and costs both for National authorities, forest industries and private forest owners.

The Biodiversity Strategy and the following legislations creates conflicts between nature and man by, to a larger extent than earlier, depriving private forest owners the right to decide how to manage their forests and instead by law forces them to leave them for biodiversity reasons.

Several of the existing strategies on a regional and a national level have been developed before the Fit for 55 package that will be implemented in Swedish law the coming years. Uncertainty about the upcoming regulations and directives from EU poses a big risk for both existing and new investments. Policies are complex, difficult to predict and not coherent and pose a significant risk, both financially and juridical, for future growth and investments in the forest bioeconomy. A challenge for the future is to harmonize bioeconomy related policies on a regional level with national and especially with polices on an EU level (Figure 3).

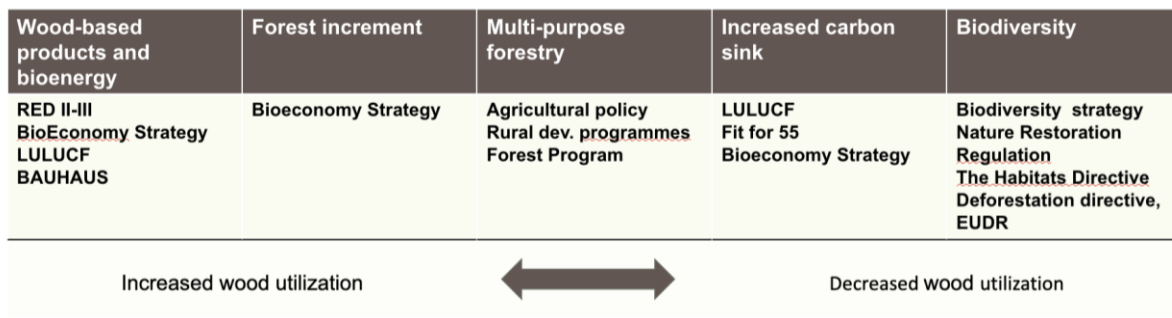


Figure 3 Overview of EU policy, divided by five sectors of ranging from production of biobased products and bioenergy to nature preservation of carbon sinks and biodiversity.

2.2.2 National level

Sweden’s Climate Act and Climate Policy Framework: In 2017, Sweden adopted a climate policy framework. (Came into effect in 2018) The framework consists of a climate law, climate targets and a climate policy council. The purpose of the framework is to create a clear and coherent climate policy to ensure long term signals to the market and other actors. The long-term goal is for Sweden to have no net emissions of greenhouse gases into the atmosphere by 2045, and to achieve negative emissions thereafter. The emissions from domestic transport, except domestic flights, are to be reduced by at least 70 per cent by 2030, compared to 2010. the long-term goal includes emissions covered by the EU's Effort Sharing Regulation (ESR). Emissions covered by the EU Emissions Trading System (EU ETS) are not included.

Policies for decarbonising the heating and the transport sector: Bioenergy is the leading energy source in Sweden today. The Swedish energy system has gone through a major transformation. In the 1970s oil was totally dominating. Today, oil is almost entirely a transport

fuel, whereas bioenergy has taken over in district heating, and plays a major role in industry and in electricity production.

Sweden has the highest share of renewable energy in EU. The overall share of renewable energy (bio, hydro and wind) in Sweden is today 66%. The use of bioenergy in Sweden has increased from 40 TWh/year in the 1970s to around 140 TWh/ year today. Biomass has a dominant position in the Swedish heat market as a fuel for CHP for district heating. Very little fossil fuels are today used for heating. Biomass is also the main energy source for energy intense forest industries. Increased use of bioenergy is the main reason that Sweden has managed to decrease greenhouse gas emissions by 25% between 1990 and 2014. During the same time the total growing volume of forest has increased storing more and more carbon in the forest every year. The main reason for this development is a broad political support for long term and stable energy policies starting with the introduction of carbon tax in 1991 and further developed with green electricity certificates introduced in in 2003. However, the transport sector is still dependent on fossil resources.

In Sweden, the parliament has decided that the vehicle fleet should be fossil independent by 2030. In connection with the decision on the climate policy framework 2017, the parliament decided that greenhouse gas emissions from domestic transport should decrease by at least 70 percent by 2030 compared to 2010. De carbonizing the transport sector is a more complex and difficult task than the heating sector and policies has neither been stable nor long term. In 2018, Sweden had the largest share of renewable fuels for transport in the EU with a 23 % share. The main driver for this development has been the tax exemption that was introduced in 2007. However, the tax exemption has been questioned by EU as state subsidy and permission to extend it has been granted during this period 7 times. This has not created the long term and stable energy policy landscape required for investments in domestic production of biofuels.

In 2018, 85 % of the biofuels used in Sweden were imported and a reduction quota was introduced. The quota stipulates that the distributors of transport fuels are obliged to reduce the carbon footprint from the volumes sold by 19.3 % for diesel and by 2.6 % for gasoline. The reduction quota will step by step be increased until 2030 reaching 28% for petrol and 66% for diesel in 2030. However, these policies were unpopular as the made the diesel fuel more expensive. The new government promised to reduce the price for diesel fuel and drastically lowered the reduction quota to EUs minimum level. In the future, polices for decarbonising the transport sector must harmonise with EU polices as the transport sector will be part of EU ETS in 2017.

National Circular strategy: The national strategy for circular economy from 2020 points out the direction for the transition to circular production, consumption and business models as well as non-toxic and circular material cycles. A circular economy is a tool for reducing society's use of resources and the environmental and climate impact that follows from this. The bioeconomy reinforces and interacts with the circular economy through renewable production and resource-efficient use of organic residual streams. The bioeconomy also focuses on aspects that are not directly covered by the circular economy, such as creating new chemical building blocks, functionality and properties of products that are based on the biological cycle.

National food strategy: In 2017, the overall goal of the food strategy was adopted is a competitive food chain where total food production increases while relevant national

environmental goals are reached, and sustainable growth and employment are created throughout the country. The increase in production, both conventional and organic, should respond to consumer demand. An increase in production could contribute to an increased degree of food self-sufficiency. Vulnerability in the food chain must be reduced.

National Forest program: The forest program is a platform for dialogue between forest stakeholders, authorities and the government. The strategy for the forest program was adopted in 2018.

The five focus areas will contribute to achieving the program's vision, work, and organization. The vision for the forest program is that "The forest, the green gold, should contribute to jobs and sustainable growth throughout the country as well as to the development of a growing bioeconomy.

Fossil Free Sweden: Fossil Free Sweden is an initiative by the Swedish Government to increase the pace of the climate transition. The goal is to build a strong industrial sector and to create more jobs and export opportunities by going fossil free. By working together with companies, industries, municipalities and regions, Fossil Free Sweden is identifying obstacles and opportunities to accelerate developments.

As part of Fossil Free Sweden, 22 different industries have produced their own roadmaps to show how they can enhance their competitiveness by going fossil free or climate neutral. The roadmaps show the opportunities, identify obstacles, and contain proposals for solutions both through the industries own commitments and through political proposals. Taken together, they show what a fossil free business sector will be like. The roadmaps have been presented to the Government and now form a basis for continued work by Fossil Free Sweden and the industries participating.

The 22 roadmaps for fossil free competitiveness produced by the various industries in the business sector show what is required to make industry fossil free or climate neutral. This "jigsaw puzzle of Sweden" cannot be pieced together if all the roadmaps are implemented at the same time. Fossil Free Sweden is therefore developing strategies that show how the challenges can be managed and how the transition can be pressed ahead and benefit Swedish competitiveness in international markets. The strategies containing proposals of measures are produced by Fossil Free Sweden, with support from several companies and universities that essentially back the strategies and are then presented to the Government

All these national ambitions are anchored in the work needed to drive the bioeconomy forward in the regions, but the focus should be based on the regional conditions and needs.

2.2.2.1 The proposal of the Swedish national Bioeconomy Strategy

On 29 March 2023, the interim report fossil free transports (SOU 2023:15) was published, analysing, and proposing measures to promote the efficient production of liquid biofuels based on domestic raw materials in Sweden.

On 1 December 2023, the committee submitted its final report 'SOU 2023:84 A sustainable bioeconomy strategy - for a prosperous fossil-free society'. The assignment was to develop proposals for a national strategy including follow-up goals and measures for a sustainable, competitive, and growing bioeconomy. The final report proposes quantitative goals and

indicator systems, follow-up and evaluation, new statistical assignments and a number of measures that, according to the final report, need to be done within the framework of a strategy.

These two reports undergone a referral process during the summer of 2024, and is currently undergoing a summary of the referrals.

Part I Overview of the interim report ‘Fossil free transports’ (SOU 2023:15)

The focus is on promoting domestic production of renewable transport fuels using raw materials like biomass, carbon dioxide, and electricity. This is seen as part of a broader strategy to enhance the national bioeconomy and green industry. While the primary aim is renewable fuels and intermediate products, the scope also includes value chains that produce other renewable products (e.g., plastics and chemicals) traditionally made from fossil resources. The shift towards renewable fuels aligns with national climate and energy policies, economic growth, and improved supply security. The transport sector, to reduce greenhouse gas emissions, is expected to rely on three main strategies: electrification, efficiency improvements, and renewable fuels. Electrification is progressing, but due to slow changes in the vehicle fleet, especially heavy transport, renewable fuels will remain crucial. In sectors like aviation and maritime transport, the demand for renewable fuels is expected to persist long-term.

Increasing domestic production of renewable fuels could support economic goals by generating jobs and stimulating economic activities throughout the value chain, especially when using domestic raw materials. It also enhances supply security by reducing dependency on imported fuels and raw materials. In scenarios like energy blockades or global raw material shortages, having a domestic supply of renewable fuels would be advantageous for both civilian use and national defence. Overall, the investigation emphasizes the importance of scaling up domestic production of renewable fuels to meet climate targets, enhance economic growth, and improve national supply security.

The proposal has the vision that by 2040 Sweden will have a domestic production of liquid renewable fuels and intermediate products that is at least of the same order of magnitude as the country's needs. The production should be based on a high proportion of domestic raw materials. The increased domestic production of renewable fuels and intermediate products has contributed to sustainable growth, increased employment, and strengthened security of supply of fuels throughout the country. It has also contributed to new biorefineries and the production of other biobased products that replace fossil-based products.

To that end, the investigation concludes that new policy instruments are necessary to increase the domestic production of renewable liquid fuels and intermediates from local raw materials. The current incentives help reduce capital costs for new production investments but do not address revenue risks, particularly for non-established, innovative production technologies. As a result, future production capacity is likely to rely on existing technologies, continuing dependency on imported raw materials.

The investigation highlights the need for new policy measures to improve domestic production of renewable liquid fuels and intermediates from local raw materials. Existing incentives mainly reduce investment costs but do not address revenue risks, especially for new, non-established

technologies. As a result, future production may rely heavily on existing methods, leading to continued import dependency. To address this, the investigation proposes a flexible, long-term revenue guarantee system that would cover the difference between a market reference price and a bid price, thus providing financial stability for producers. Companies could apply for these guarantees through a competitive bidding process, focusing on renewable fuels and intermediates produced in Sweden using specified raw materials like those listed in the EU Renewable Energy Directive, as well as carbon dioxide and electricity.

The revenue guarantee would be granted for a ten-year period, with payments based on production volume and the price differential and is planned to be active from 2024 to 2048, with the first payouts expected in 2029. Regular evaluations would ensure the policy's effectiveness, focusing on improving bidding processes and reference pricing. The policy does not limit the end use of the products, allowing flexibility for various sectors to benefit. This measure aims to stimulate domestic innovation, reduce import reliance, and support economic growth while aligning with climate and energy objectives.

Overall, the proposal aims to encourage domestic innovation in renewable fuel production, reduce dependency on imports, and support economic growth while aligning with climate and energy goals.

Part II - Overview of the proposed Bioeconomy strategy (2023:84)

The aim of “A sustainable bioeconomy strategy – for a prosperous fossil-free society”, SOU 2023:84, is to promote sustainable growth, renewal, and employment across the country, contribute to environmental and climate benefits, and enhance supply capacity while reducing vulnerability in society. This is based on biomass from the forestry, agriculture, and fisheries sectors, as well as by-products from food processing.

The strategy outlines the following tasks: measure the development of the bioeconomy over time, both in individual sectors and assess its climate benefits while suggesting improvements to methodologies if needed. It also includes analysing the socioeconomic impacts of various options, proposing measures to enhance cooperation and dialogue among stakeholders, identifying opportunities to increase access to sustainably produced biomass, and addressing barriers like regulations that limit competitive production and processing. Additionally, it highlights the need to evaluate current education, research, and innovation efforts in the bioeconomy and analyse further actions required for growth, including skills development.

The strategy does not cover all areas of bioeconomy but acknowledges that the strategy needs to be aligned and coherent to other existing strategies that also regulate parts of the Swedish Bioeconomy:

- The Bioeconomy Strategy
- The Circular Economy Strategy
- A Food Strategy for Sweden
- The National Forest Programme
- The Strategy for Swedish Fisheries and Aquaculture
- The Strategy for Sustainable Tourism and the Growing Visitor Industry
- National Strategy for Sustainable Regional Development 2021–2030
- Ongoing Investigation of National Forest Policy, including EU policy.

Notable is that the ensuring a sustainable primary production of biomass is not in scope of the proposed Bioeconomy strategy but suggested to be continued to be managed within the framework of each relevant policy area, as well as within the National Forest Programme, the Food Strategy, and the Strategy for Swedish Fisheries and Aquaculture, that today already regulate the primary production.

The proposed national strategy rests on three pillars (Figure 4), 1) Promote Sustainable Growth, 2) Climate Benefits of the Bioeconomy, and 3) Enhancing national resilience and reducing vulnerability. No pillar is given more weight than another pillar.

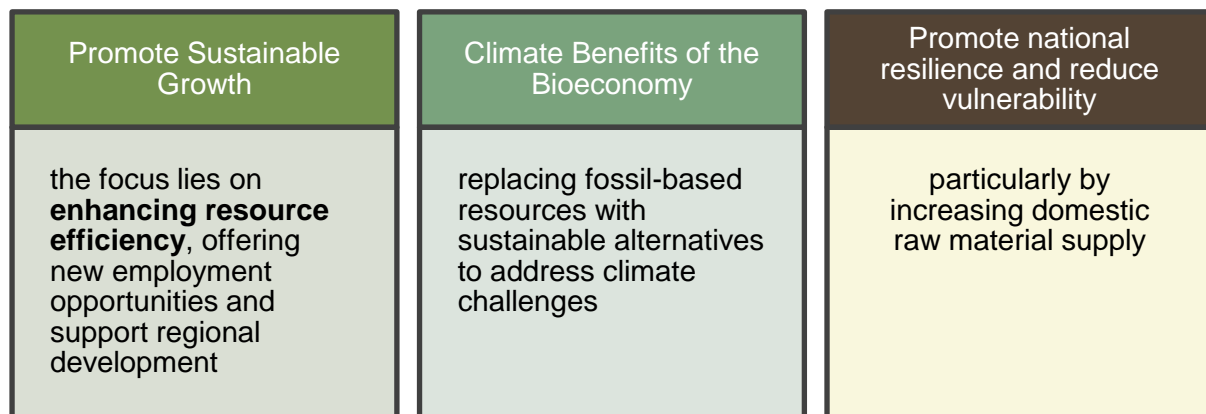


Figure 4 The three pillars of the Swedish national Bioeconomy strategy.

The first pillar of Sweden's national bioeconomy strategy, "*Främja hållbar tillväxt*" (Promote Sustainable Growth), highlights the role of bioeconomy in driving long-term competitiveness, exports, and sustainable job creation across the country. With Sweden's abundant biomass, innovative industries, and expertise in efficient processes, the focus lies on enhancing resource efficiency, increasing recycling, and utilizing rest streams across sectors.

A growing bioeconomy can revitalize rural areas, offering new employment opportunities and supporting regional development through biorefineries, industrial symbioses, and clusters. Collaboration among regions and digital advancements are key to maximizing resource use and fostering innovation nationally and globally.

The second pillar of Sweden's bioeconomy strategy, "*Bioekonomins klimatnytta*" (Climate Benefits of the Bioeconomy), emphasizes the bioeconomy's role in replacing fossil-based resources with sustainable alternatives to address climate challenges. The substitution effect – where bio-based products replace fossil-intensive materials – plays a central role, though its calculation remains complex and depends on geography, market dynamics, and production methods.

In agriculture, climate benefits can be achieved by optimizing processes to reduce emissions, enhancing soil carbon sequestration, and utilizing residues for biorefineries that produce biogas, protein, and biomaterials. Efforts in livestock management, like methane reduction through feed additives and mixed milk-meat production, further contribute to climate goals.

In forestry, Sweden's sustainably managed forests act as a carbon sink, provided growth exceeds harvest rates. Climate-smart forestry, balancing carbon storage and resource use, strengthens resilience against threats like fires and storms. The role of forests sparks ongoing debate, requiring open dialogue to reconcile economic use and preservation goals.

Aquaculture innovations, including land-based fish farming and algae production, reduce emissions and resource use, offering alternatives to fishmeal and fossil-based nutrients. Together, these bio-based solutions demonstrate significant climate potential through resource efficiency, circularity, and substitution of high-emission products, contributing to Sweden's broader climate and sustainability targets.

The third section of the Swedish national bioeconomy strategy, "Stärkt försörjningsförmåga," emphasizes the role of a growing bioeconomy in enhancing national resilience and reducing vulnerability, particularly by increasing domestic raw material supply. Following the geopolitical shifts caused by the COVID-19 pandemic and Russia's invasion of Ukraine, there is a heightened understanding of the need for more robust supply systems.

Goal and vision of the proposed strategy

The vision of the proposed strategy is to: *"We contribute to a prosperous, fossil-free society, through a sustainable bioeconomy."*

The vision describes a future where biobased raw materials, biobased solutions, and systems, together with a high degree of electrification and circular business models, have replaced fossil-based alternatives.

And the goal is that: *"By 2040, Sweden will have a more resource-efficient, resilient, and competitive bioeconomy throughout the country."*

The overall goal consists of three parts: resource efficiency, resilience, and competitiveness. It entails that raw materials and residual streams are taken care of effectively, that there is a high degree of self-sufficiency in critical goods, and that the bioeconomy grows throughout the whole country

As a measure to achieve the set goal, several quantitative indicators and target levels have been set that should measure the inflation-adjusted progress of the change of the Bioeconomy until the year 2040 as compared to 2021:

- The value added of the bioeconomy has increased by 60 percent.
- The substitution effect of the bioeconomy has increased by 50 percent.
- The export value of the bioeconomy has increased by 100 percent.
- Domestic production of renewable fuels as share of fuel demand in the transport sector, excluding electricity, amounts to 90 percent.
- At least 50 percent of the regions have increased the number of employees in the bioeconomy by at least two percent.
- At least 85 percent of the regions have increased the added value within the bioeconomy by at least 60 percent.

The investigation proposes that the overarching goal of the national bioeconomy strategy is that by 2040, Sweden will have a more resource-efficient, resilient, and competitive bioeconomy throughout the country. More specifically, this means that:

- In a more resource-efficient bioeconomy, all bio-based raw materials and residual streams are managed in an efficient and sustainable manner, creating climate benefits and more value from fewer inputs. Bio-based solutions are designed to be reusable and recyclable, and waste becomes a valuable raw material where it arises, or it is distributed and further processed by another actor. A high degree of circularity is the norm.
- In a more resilient bioeconomy, there is a high degree of self-sufficiency in supply-critical goods and services, and thus a greater supply capacity in terms of production, domestic raw materials, and labor.
- In a more competitive bioeconomy, the bioeconomy grows at the expense of the fossil-based economy, contributing to significant climate benefits and good working conditions. The Swedish bioeconomy is also internationally competitive, leading to extensive export of goods, technology, expertise, and solutions.
- In a more resource-efficient, resilient, and competitive bioeconomy throughout the country, there is strong regional cooperation and collaboration based on local and regional conditions for the bioeconomy.

To obtain the above three focus areas have been suggested: (1) More resource-efficient, biobased solutions, (2) Increased regional, national, and international cooperation, (3) A developed knowledge base.

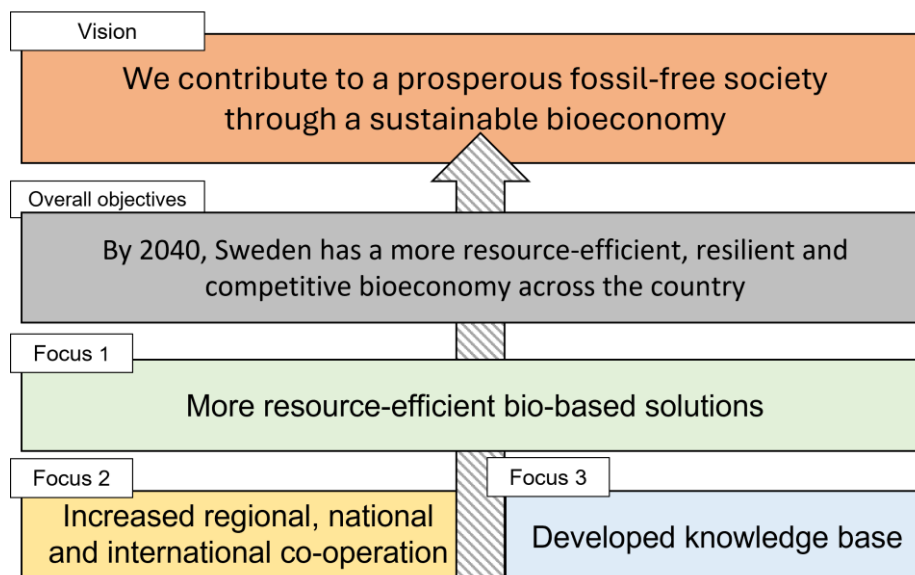


Figure 5 The proposed vision, goal and focus areas of the national Bioeconomy strategy.

The first focus area can be considered the primary focus area, whereas the other two areas are enablers. In other words, measures within these two focus areas contribute to, and create better conditions for, a more resource-efficient, bio-based solutions (Figure 5).

Within these three focus areas, in total 17 actions have been proposed.

1. Revenue guarantees for domestic production of liquid renewable fuels and intermediates.
2. Plan for industrial wood construction and increased wood utilization.
3. Policy instruments to promote bio-based solutions.
4. Data sharing on bio-based residual streams
5. Supply analysis of Sweden's overall need for supply-critical bio-based goods and services.
6. Increase support for procurement of socially critical bio-based solutions.
7. Extend and develop Klimatklivet for a strengthened supply capacity.
8. Include bioeconomy results in regional conditionality decisions.
9. Promote regional bioeconomy networks.
10. Expand risk and vulnerability analyses.
11. Involve the relevant authorities in the work on the bioeconomy strategy.
12. More Swedish bioeconomy experts in EU institutions
13. Establish co-operation between national strategies.
14. Establish bioeconomy networks within the EU.
15. Support for test and demonstration environments for bio-based solutions.
16. Increased investment in interdisciplinary science and cross-sectoral knowledge-building.
17. Establish a national interdisciplinary graduate school.

2.2.3 REGIONAL GOVERNANCE MODEL

Regions in Sweden are governed by directly elected political assemblies known as regional councils, every four years. In addition to their healthcare responsibilities, all regions are also accountable for regional development. It is a statutory requirement for the regions to devise a strategy for the county's development and to oversee the implementation of this strategy. It is about aligning the county's stakeholders to work towards common goals, fostering collective growth and development based on the county's unique circumstances.

Regional Development Strategy (RDS): The leading policy document in regional development work is the RDS, together with the Regional Plan. This strategic Plan is a statement of intent for the Regional Council. The RDS acts as a steering document to coordinate and guide regional development efforts. The strategy is a mandate from the government and is considered by government authorities. It guides and influences the allocation of regional and European project funding. It is the foundation for regional work and the basis for national and international lobbying. The strategy, which is adopted by the regional council, sets out the county's common ambitions and is intended to be a guide for actors in all sectors. It aims to create a comprehensive plan to promote the development of a region through co-operation between municipalities, businesses, and other stakeholders.

Regional Innovation Strategy (RIS): The strategy is based on the directions and priorities of the Regional Development Strategy (RDS) Regional Innovation System (RIS) is a concept that describes the networks and institutions within a region that work together to promote innovation. It can include universities, research institutes, companies, cluster organizations, incubators, and regional authorities. The purpose is to promote innovation by creating synergies between different actors in the region and strengthening knowledge flows. The aim is to create a dynamic environment where new ideas and technologies can be developed and commercialised.

Bioeconomy has been integrated into a variety of regional strategies in Sweden in recent years (Table 2). It has been the focus in all regional forestry strategies, focusing primarily on wood, wood-based products, and forestry biomass. The bioeconomy strategists in northern Sweden have also identified the following strategies that include the bioeconomy. Smart specialization identifies priority areas, a food strategy with action plans and every region also has a strategy to realise the government's policy for energy transition and reduced climate impact. This work is described in an Energy- and Climate strategy.

Table 2 Overview of regional strategies connected to bioeconomy.

REGIONAL DEVELOPMENT STRATEGY	
Norrbottn	2020-2030 Sweden's most welcoming and innovative county
Västerbotten	2020-2030 An attractive region where differences create development power
Västernorrland	2020-2030 Strategic plan
Jämtland/ Härjedalen	2024-2050 An innovative and sustainable region to live, work and develop in
REGIONAL FOREST PROGRAM BASED ON THE NATIONAL STRATEGY	
Norrbottn	2020-2030 Focus areas 1-5: 1: Sustainable forestry with increased climate benefits 2: Multiple use of forests for more jobs and sustainable growth throughout the country 3: World-class innovations and processed forest raw materials 4: Forests to be included as a profile issue in Swedish international co-operation 5: A knowledge leap for sustainable forest management and conservation
Västerbotten	2020-2030 Work for a growing bioeconomy and strengthen the role of forests in a sustainable society. Focus areas 1-5: See above
Västernorrland	2020-2030 The forest as a resource for jobs, sustainable growth, utilisation and conservation in Västernorrland Focus areas 1-5: See above
Jämtland/ Härjedalen	2020-2030 Jämtland County forests for a growing bioeconomy and a sustainable future. Focus areas 1-5: See above
SMART SPECIALIZATION	
Norrbottn	NATURE BASED ECONOMY Areas of development Tourism and hospitality Culture and creative industries Space Arctic testing Energy technology

	Smart Society
Västerbotten	INNOVATIONS STRATEGY 3 focus areas Natural resources Forest bioeconomy Mining & Minerals Sustainable energy systems Manufacturing industry Knowledge resources: Life Science Digitalisation Natural, cultural and knowledge resources: Hospitality Food and beverages Cultural and creative industries
Västernorrland	Forest bioeconomy Manufacturing metal, machinery, vehicles Renewable energy, solar, wind, hydro and bioenergy Govtech Production and business systems Areas of development: FoodTech Autonomous mobility Crisis and rescue Smart Caring
Jämtland/ Härjedalen	Forest, soil, water Sustainable energy Tourism Digital solutions

REGIONAL FOOD STRATEGY BASED ON THE NATIONAL STRATEGY

Norrbottn	2022-2025 CLOSE TO FOOD Increased production, value and food security. Sustainable and local consumption, food more important in strategies and development
Västernorrland	2021-2030 Increased demand and sustainable production of food
Jämtland/ Härjedalen	Increased trust between authorities, business and consumers, More food in private and public meals, increased collaboration for skills supply and product development.
Västerbotten	Sustainable entrepreneurship, Knowledge and innovation, Conscious consumption.

ENERGY & CLIMAT STRATEGY

Norrbottn	Fossil-free transport World-class production Future consumption and trade Resource efficient buildings Flexible and robust energy system
Västerbotten	Energy Forest carbon sequestration and a growing bioeconomy The future of forestry and agriculture
Västernorrland	Transport-efficient society and fossil-free transport Strong and sustainable bioeconomy A sustainable construction and property sector Sustainable consumption The electricity system of the future

Jämtland/
Härjedalen

Fossil fuel free 2030 Jämtland County

Fossil fuel-free transport and machinery
Forest as a resource and carbon sink
Renewable energy
Climate-smart food
Sustainable consumption

Summary

Many of the above priorities can be directly classified as bioeconomy. Most of them belong to the forest bioeconomy. Food strategies also focus on consumer behavior to strengthen the region's self-sufficiency. Renewable energy and climate-friendly solutions, as well as digitalization, require cross-sectoral innovation to boost competitiveness and sustainability. Tourism is linked to natural resources and regional attractiveness. In addition to the regional strategies presented above, two of our regions address reindeer husbandry as part of the bioeconomy. There is currently no overall strategy for the bioeconomy at regional level in the northernmost parts of Sweden. However, strategic bioeconomy development work is included in several of the existing strategies that govern the regions' activities.

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

The baseline of the Northern Sweden's bioeconomy governance can be divided into three governance areas, 1) Information and finance, 2) Rule-setting, and 3) information sharing (Table 3). In Implementation & Finance, Northern Sweden's bioeconomy benefits from robust value chains, favorable funding conditions, and a promising SME landscape. However, challenges persist in innovation potential and market accessibility, especially for new actors. For Rule-Setting, the region has a comprehensive policy framework that integrates EU laws, tariffs, however, challenges include fragmented integration with other sustainability strategies, and obstacles from EU laws and policies. Within Information-Sharing, reporting mechanisms are in place but collaboration across levels of governance and public acceptance need work, indicating significant room for improvement stakeholder engagement across regions.

Table 3 Baseline bioeconomy governance of Northern Sweden

Governance Area	Key Strengths	Moderate Scoring Areas	Challenges
Implementation & Finance	<ul style="list-style-type: none"> Robust value chains and diversified biobased markets. Strong SME landscape and birthrate. Public funding for bioeconomy development. Favourable conditions for private investments. Sustainably managed land and water ecosystems. 	<ul style="list-style-type: none"> Education & human capital development. Local biomass availability. Market accessibility (not logistically) 	<ul style="list-style-type: none"> Innovation potential remains underdeveloped. Market accessibility for new actors can be limited, with large established players on the market.

Governance Area	Key Strengths	Moderate Scoring Areas	Challenges
Rule-Setting	<ul style="list-style-type: none"> Integrated bioeconomy policy framework. Full transposition of EU laws. Supportive tariffs, taxes, and subsidies. 	<ul style="list-style-type: none"> Integration of regulations with other policy priorities. Policy regulations for bioeconomy. 	<ul style="list-style-type: none"> EU laws create obstacles. Policy is inconsistent. Public procurement for bio-based products (BBPs). Use of trade policies for bioeconomy development.
Information-Sharing	<ul style="list-style-type: none"> Monitoring and reporting mechanisms are in place. Certification and sustainability labels. 	<ul style="list-style-type: none"> Multi-level collaboration Collaboration between actor groups. 	<ul style="list-style-type: none"> Public support and acceptance. Limited interregional collaboration.

Out of the three areas, Implementation & Finance and Rule-Setting are the strongest while information-sharing is the most challenging area. Strengthening information sharing and collaboration as mechanisms are key to advance the bioeconomy transition in the region.

3 TOWARDS A VISION FOR THE BIO-BASED ECONOMY IN NORTHERN SWEDEN

3.1 POLICY PRIORITIES

The three key priorities of the Northern Swedish region align with the three pillars that the proposed national strategy rests on 1) promoting sustainable growth, 2) climate benefits of the bioeconomy, and 3) enhancing national resilience and reducing vulnerability (Figure 6).

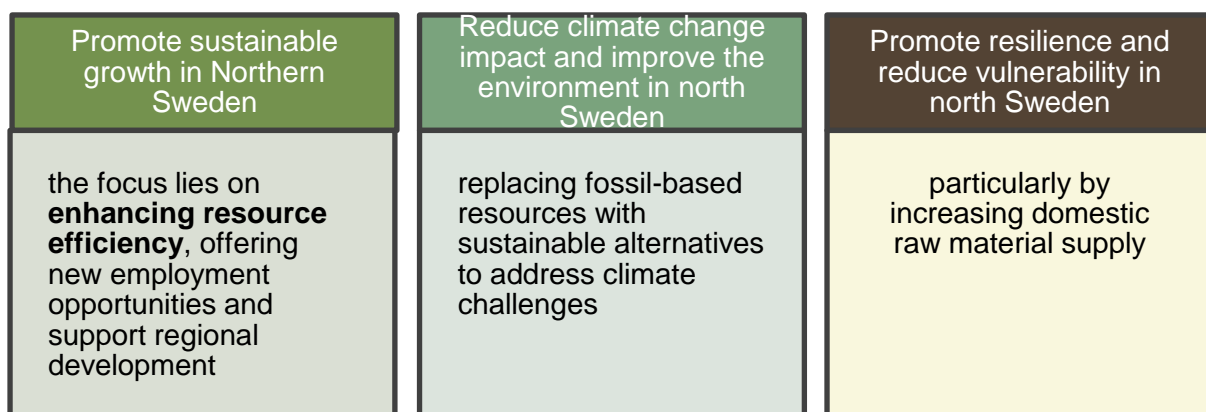


Figure 6 The three pillars of the Northern Swedish Bioeconomy blueprint.

Reducing Climate Change

A clear priority for Northern Sweden's bioeconomy strategy is reducing climate change through the substitution of fossil-based products with biobased alternatives across the full value chain. This includes everything from compounds and chemicals in the production to the final product. Additionally, technologies such as Carbon Capture and Utilization (CCU) and Carbon Capture and Storage (CCS) are emphasized to mitigate CO₂ emissions effectively. Assessing the entire lifecycle of biobased products, including feedstock production,

transportation, and processing, is crucial to fully understand the climate benefits of these substitutions.

Within forestry, climate-smart management plays a pivotal role, as sustainably managed forests act as carbon sinks, provided growth rates exceed harvest levels. This balance strengthens the region's resilience to environmental threats like wildfires and storms while addressing the ongoing debate on economic forest use versus preservation goals. Innovations in aquaculture, such as land-based fish farming, algae production, and sustainable alternatives to fishmeal, further support emissions reductions and resource efficiency.

Promoting Resource Efficiency and Sustainable Growth

Resource efficiency and sustainable bioeconomic growth form the second priority, focusing on regional development and employment generation in Northern Sweden, particularly in rural areas. By advancing bioeconomy sectors, e.g., forestry, agriculture, and aquaculture, there are opportunities to increase jobs and economic growth in a sustainable manner. However, this growth must align with broader social development goals, ensuring equitable access to healthcare, elderly care, education, and transport services across the region. Within agriculture, resource efficiency is enhanced by optimizing processes to reduce emissions and improve soil carbon sequestration. Innovative circular BioSolutions and industrial symbioses are essential for creating new business models that benefit both the local economy and the environment.

Enhancing National Resilience and Resource Security

The third priority highlights the importance of bioeconomy development in strengthening the regions resilience and reducing vulnerability. Northern Sweden has a large potential to increasing the supply of domestic raw materials and advancing self-sufficiency. Utilizing abundant regional biomass ensures that biobased industries can meet national and global demands while reducing dependence on imported resources.

Collaboration across regions, advancements in digital technologies, and the development of industrial clusters are key strategies for optimizing resource use and promoting innovation. By enhancing recycling practices and utilizing residual streams across sectors, Northern Sweden contributes to both climate goals and national resilience, ensuring long-term economic and environmental stability.

3.2 OUR VISION FOR A BIO-BASED ECONOMY IN NORTHERN SWEDEN

By 2040, the vision of Northern Sweden is to have a more resource-efficient, resilient, and competitive bioeconomy. This vision is directly in line with the proposed national Bioeconomy vision, but herein with a vision that this that northern Sweden also in itself shall reach the vision having transitioned to a sustainable bioeconomy.

Vision

By 2040, Northern Sweden has a more resource-efficient, resilient, and competitive bioeconomy that contributes to a nationally prosperous fossil-free society.

The vision rests on the three pillars of the key priority areas: resource efficiency, resilience, and competitiveness. It entails that raw materials and residual streams are taken care of effectively, that there is a high degree of self-sufficiency in critical goods, and that the bioeconomy grows throughout the whole region.

3.3 STRATEGIC & OPERATIONAL OBJECTIVES

To effectively utilize the biobased potential in Northern Sweden several priority areas for action has been identified, that are actions to strengthen weaknesses identified in the governance areas of Implementation & Finance: Rule-Setting, Information-Sharing (Table 4).

Table 4 The three primary bioeconomy governance dimensions: Implementation & Finance, Rule-Setting, and Information-Sharing with identified strategic objections areas

	Key Strengths	Moderate Scoring	Challenges	Strategic Objectives
Implementation & Finance	Robust value chains and diversified biobased markets.	Education & human capital development.	Innovation potential remains underdeveloped.	Enhancing Access to Funding – Improve funding mechanisms for SMEs and innovation actors to unlock potential.
	Strong SME landscape and birthrate.	Local biomass availability.	Market accessibility for new actors can be limited.	Developing Infrastructure for Biobased Products - Enhance logistics, processing, and infrastructure for bio-based solutions.
	Public funding for bioeconomy development.	Market accessibility (not logistically).		Promoting Education and Skills Development – Build a skilled workforce to drive growth and innovation.
	Favourable conditions for private investments.			Leveraging Natural Resources Sustainably – Ensure sustainable land, water, and resource management practices.
	Sustainably managed land and water ecosystems.			
Rule-Setting	Integrated bioeconomy policy framework.	Integration of regulations with other policy priorities.	EU laws create obstacles.	Advocating for Supportive Policies and Regulations – Work towards policies that promote bioeconomy development and resolve conflicts with EU laws.
	Full transposition of EU laws.	Policy regulations for bioeconomy.	Policy is inconsistent.	
	Supportive tariffs, taxes, and subsidies.		Public procurement for bio-based products (BBPs).	
			Use of trade policies for bioeconomy development.	
Information sharing	Monitoring and reporting mechanisms are in place.	Multi-level collaboration.	Public support and acceptance.	Strengthening Collaboration Across Sectors – Improve multi-level and cross-actor collaboration to accelerate knowledge sharing and transparency.
	Certification and sustainability labels.	Collaboration between actor groups.	Limited interregional collaboration.	Fostering Product Development and Market Credibility – Enhance certification, sustainability labels, and public awareness for bio-based products.

Each of the identified strategic objectives are below detailed:

1. Strengthening Collaboration Across Sectors

Strengthening collaboration across sectors is essential for advancing the bioeconomy in Northern Sweden. Aligning strategies at regional, municipal, and national levels creates

coherence and amplifies long-term societal impacts while ensuring the fulfilment of national bioeconomy indicators. By fostering partnerships between academia, industry, and policymakers, a favourable policy and investment landscape can be established, allowing for the integration of proven knowledge and new biobased solutions, particularly in established industries like pulp mills, sawmills, and energy companies. Enhanced knowledge sharing, including data on biobased residual streams and project outcomes, supports matchmaking along the value chain and drives innovation through stronger joint ventures. Collaboration through innovation hubs and incubators further accelerates start-ups' access to funding and expertise, fostering a dynamic ecosystem that leverages regional strengths to create sustainable growth, employment, and rural development.

2. Enhancing Access to Funding

Enhancing access to funding is crucial for accelerating bioeconomy growth in Northern Sweden, particularly for biobased innovation and investment. Strengthening cooperation with traditional industries like pulp mills, sawmills, and energy companies will enable the integration of biobased solutions across established sectors. Developing multi-actor partnerships, involving both academic and non-academic stakeholders, is key to breaking down silos and building strong consortiums that can successfully apply for funding. Simplifying the application process, especially for start-ups and small enterprises, is essential to ease administrative burdens and make it easier for these businesses to participate in larger collaborative projects. Providing targeted support to SMEs and making funding available for early-stage companies to demonstrate new technologies will help bridge the “Valley of Death” – the critical gap between innovation and full-scale commercialization. Ultimately, streamlined access to funding will help foster sustainable growth, ensure a higher success rate for start-ups, and drive the transition to a thriving bioeconomy in Northern Sweden.

3. Developing Infrastructure for Biobased Products

Developing infrastructure to produce biobased commodities is essential to unlock the full potential of the bioeconomy in Northern Sweden. In total, four areas of infrastructure have been identified, 1) energy supply, 2) transport and logistics, 3) digitalization and AI, and 4) research and development infrastructure.

Energy Supply: Ensuring a stable, resilient, and cost-effective renewable energy supply is critical for biobased commodity production. Additionally, strengthening of the power grids is important for enhancing the transmission capacity of renewable energy, supporting investments and societal needs. Supporting the more efficient use of low-value heat sources from industries will further improve energy efficiency and reduce costs.

Transport and Logistics: Investing in infrastructure that supports the logistics and distribution of biobased products is essential. There are vast logistical challenges intraregional through to the share distances but also a congested cargo system and forest industry by products being scattered across large distances at sawmills. Establishing processing facilities needs careful consideration to establish them close enough to raw material sources, yet not too far of reach the market. Local governments can play a pivotal role in creating a conducive environment for these developments in advocating for a viable train infrastructure in the region, in road maintenance and in keeping smaller harbours open (and possible investing in deepening them for larger freight ships). It is also important to mobilize underutilized biomass

resources, such as logging residues, to optimize the biomass supply for Combined Heat and Power (CHP) plants.

Digitalization and AI: The use of digital technologies and AI is increasingly important for driving circularity within the bioeconomy. Developing applications for reuse, recycling, and traceability will improve the management of bio-based products throughout their life cycle. These technologies can streamline processes, enhance efficiency, and enable better decision-making by providing real-time data on material flows, product quality, and environmental impact.

Research and Development Infrastructure: Establishing robust, accessible state of the art R&D infrastructure is essential for advancing biobased technologies and solutions. Access to testbed and demonstration facilities will help to faster bridge the gap between research and commercial-scale production, making new technologies more accessible. Supporting research into more efficient and environmentally friendly biomass utilization and logistics will reduce costs and environmental impacts while improving sustainability. Creating arenas for networking and information sharing among industry stakeholders, policymakers, and researchers will foster collaboration and innovation, increasing competitiveness and enabling knowledge transfer across the bioeconomy sector.

4. Fostering Product Development and Market Credibility

By anticipating market needs and collaborating with customers from the early stages, businesses can align product development with demand and ensure that bio-based products meet market requirements. Also, strengthening the region's resilience and self-sufficiency in critical sectors such as agriculture, transport fuels, and process chemistry is fundamental for securing long-term sustainability.

One of the key strategies for building market credibility is the adoption of certifications and product declarations. Increasing access to sustainability reports, digital product passes, and environmental declarations enables consumers and partners to better understand the environmental benefits of biobased products. This transparency builds trust and demonstrates the positive impact of these products, further driving their adoption. The use of certifications will help companies differentiate themselves in the market, ensuring their products meet both regulatory standards and consumer expectations for sustainability.

5. Promoting Education and Skills Development

Addressing the skills gap in the region is critical for the growth of biobased businesses. Investing in education and training programs focused on bioeconomy and sustainable practices can help attract and retain talent. A clear commitment to gender equality can be a tool. Collaborations among industry, universities and vocational schools can ensure that the workforce is equipped with the necessary skills. Creating attractive communities is important to attract and retain skilled citizens. An additional adjacent area closely connected to this is to improve civil services and living conditions across the whole region of Northern Sweden, to ensure the same level of service, health care, schools for families.

6. Advocating for Supportive Policies and Regulations

Active participation in European bioeconomy networks is important for increasing the knowledge base of Nordic European forestry management within the broader European context. Engaging more proactively in these networks enables the region to elevate its bioeconomy initiatives, ensuring that its unique circumstances, such as its reliance on Nordic forestry, are well-represented. By contributing expertise and experiences to these networks, Northern Sweden can increase understanding of its bioeconomy context in the EU and strengthen its influence on European policy decisions.

One important focus is advocating for a regulatory environment that supports bioeconomy initiatives, with policies that incentivize investments and procurement. Through increased visibility and representation, Northern Sweden can help shape a regulatory framework that fosters growth, reduces barriers to investments, and secures the region's supply chains.

The goal is a regulatory system that supports bioeconomy initiatives and enabling investments and procurement also to increase the degree of self-sufficiency. Focus on measures in the national bioeconomy strategy to get budget for investments.

7. Leveraging Natural Resources Sustainably

At the heart of sustainable bioeconomy development lies the efficient and responsible use of natural resources. With 97% of productive land in Northern Sweden covered by forest, the region has a vast, renewable resource base that must be managed with long-term sustainability in mind. Resource efficiency is crucial in enhancing the value derived from forestry, sawmilling, and pulp and paper industries, ensuring that by-products are fully utilized to their highest potential. Investments in energy-efficient processes, as well as the upgrading of forest industry by-products, can contribute to both the growth of the bioeconomy and the increase in its added value. At the same time, encouraging carbon-efficient practices within forest management, such as increasing forest increment and carbon uptake, will provide significant climate benefits while ensuring that forests continue to act as carbon sinks. A focus on circularity is also vital for sustainable bioeconomy practices. Supporting the reuse of materials such as wood, paper fibres, and other bioproducts will help reduce waste, conserve resources, and contribute to a circular economy. This requires modernizing waste legislation to make it easier to recycle and repurpose biobased products, thereby minimizing environmental impacts.

Operational objectives

Within the proposed national bioeconomy strategy indicators and target levels have been set up (Table 5 & 6). Among the targets set up by the proposed national bioeconomy strategy they all highly apply to the priorities of Northern Sweden, and as follow-up of these indicators and target levels will be conducted by regional authorities as part of evaluating the progress of the bioeconomic strategy on a national level the same indicators will be applicable for northern Sweden. The indicators 1-4, are for on a national level, inflation adjusted for the years 2021-2040. The target levels a-b, relate to the regional advancement across Sweden, where the operational objective for the four northbound counties would be to be among the positively contributing countries.

Table 5 Operational objectives

No.	Objective
1	The value added of the bioeconomy has increased by 60 percent.
2	The substitution effect of the bioeconomy has increased by 50 percent.
3	The export value of the bioeconomy has increased by 100 percent.
4	Domestic production of renewable fuels as share of fuel demand in the transport sector (excluding electricity) amounts to 90 percent.
a	At least 50 percent of the regions have increased the number of employees in the bioeconomy by at least two percent.
b	At least 85 percent of the regions have increased the added value within the bioeconomy by at least 60 percent.

Table 6 The strategic and operational objective

Strategic objectives	Operational objectives
1. Strengthening Collaboration Across Sectors	1- 4, a+b
2. Enhancing Access to Funding	1-4, a+b
3. Developing Infrastructure for Biobased Products	1-4, a+b
4. Fostering Product Development and Market Credibility	1-4, a+b
5. Promoting Education and Skills Development	1-4, a+b
6. Advocating for Supportive Policies and Regulations	1-3, a
7. Leveraging Natural Resources Sustainably	1,3 b

3.4 SUMMARY

In summary, the strategic objectives for advancing the bioeconomy in Northern Sweden focus on strengthening cross-sector collaboration, enhancing access to funding, developing key infrastructure, fostering product development and market credibility, promoting education and skills, advocating for supportive policies, and ensuring the sustainable use of natural resources (Figure 7). These efforts aim to align regional, municipal, and national strategies, integrate biobased solutions across industries, and build a dynamic ecosystem for innovation.

Sustainable forest management and circular economy practices will ensure long-term environmental and economic benefits, while increased collaboration will enhance Northern Sweden's role in the broader European bioeconomy, which the progress thereof can be evaluated through the operational objectives.

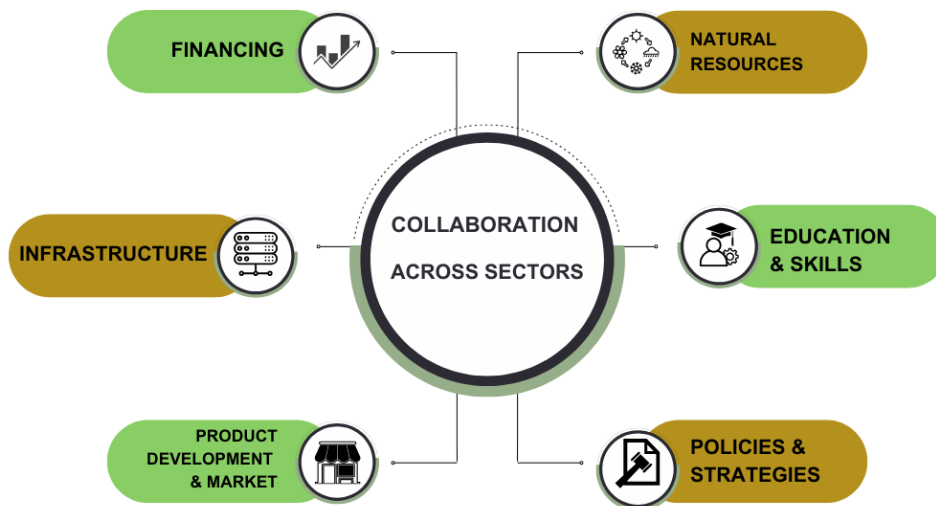


Figure 7 Identified strategic priority areas.

4 KEY ACTION FIELDS FOR IMPLEMENTATION

The strengths and challenges outlined emphasize the need for a resilient, integrated, and collaborative ecosystem to effectively implement biobased solutions. Northern Sweden's vast forest resources and existing industries, such as pulp, sawmills, and energy production, provide a solid foundation for a bioeconomy ecosystem.

The biobased implementation must leverage these strengths while addressing regional challenges. Through an analysis of in-depth interviews with biobased SMEs in the region, several key adoption factors have emerged, detailed as key-pathways for enhancing biobased business models creating long-term growth, innovation, and sustainability.

4.1 CHALLENGES AND BARRIERS FOR A BIOBASED IMPLEMENTATION ECO-SYSTEM

4.1.1 Infrastructure and land use

A lack of reliable electricity production, grid capacity, and other infrastructure, such as railways, roads, and ports, poses significant challenges growth of the bioeconomy. Now this is not a problem, but with several large investments and projects planned for northern of Sweden, this will become a bottle neck. The ongoing green industrial transition will sharply increase electricity demand, and infrastructure gaps risk delaying investments, forcing operations to relocate domestically or internationally.

Conflicts over land use and resources are highlighted by several regions. Traditionally, the focus on timber has been the most apparent contribution of the forest to national interests. However, due to competing land use the identification of the wider role of forests has been recognised. Watersheds and biodiversity together with cultural and social activities related to forests are increasingly included as potential demands on forests in competition with timber production.

One such hindrance to companies' development in the bioeconomy is conflicts over land use and resources, such as reindeer grazing. This issue is specific to the northern region and is a two-sided coin, as reindeer herding is also part of the regional bioeconomy. The Sami, an indigenous people in northern Sweden, have used the land for centuries but do not own it, leading to recurring conflicts with other stakeholders like forestry and mining. Reindeer herding is central to Sami culture but often competes with other land uses such as forestry, tourism, and construction. Another significant conflict is the ongoing mining dispute in northern Sweden, where the Sami oppose mining due to its impact on reindeer migration and environmental risks. Despite having land use rights, these are often insufficiently protected by legislation, making the Sami vulnerable to such challenges. Regions call for a holistic perspective to serve the many landowners in Sweden who have both land and forest in the same company.

4.1.2 Workforce and Skills Shortage

Many stakeholders highlight that insufficient skills development poses a challenge to business competitiveness. There is a need for new knowledge and expertise across academia, the public sector, and industries, especially in digitalization, automation, and energy. Competence gaps exist at all educational levels, from process engineers and operators to researchers and professionals requiring retraining through higher education or short vocational courses.

The Climate Policy Council (Swe: Klimatpolitiska rådet) stresses the necessity for education system reforms to meet workforce needs for the green transition. These reforms must include further training for professionals and improved vocational and secondary education to address skills gaps. Additionally, public agencies need sufficient capacity and knowledge to support businesses in their transition. Enhanced dialogue between government, industries, and academic institutions is critical to meet the growing knowledge demands, ensuring both climate goals and supply security are achieved.

4.1.3 Regulatory Hurdles

Inefficient, unpredictable, and lengthy permitting processes are viewed as significant obstacles to new investments, particularly for the green transition. Many analyses highlight the need for streamlined processes to ensure success in this area. Several government reviews have examined these issues, emphasizing the need to shorten approval times and make processes more effective and predictable. In June 2023, the government launched another review to improve environmental permitting, following earlier findings that current processes require significant reform to support the green transition.

Uncertainty about current rules and future policies discourages investments and hinders technological development, as well as the use of raw materials for production processes. Existing sector-specific incentives, like tax exemptions and investment support, largely focus on bioenergy and biofuels, leaving other biobased solutions underfunded. A broader approach utilizing multiple technologies is necessary to meet climate goals and enhance supply security.

Sweden's bioeconomy growth relies on alignment between national and EU regulations. Strict national requirements beyond EU laws can reduce competitiveness, limit technological development, and hinder efficient raw material use. Swedish representation in EU legislative processes is limited, making it harder to address country-specific concerns.

Current waste laws, designed for linear systems, hinder circular bioeconomy development. Municipal monopolies on waste management can prevent recycling and reuse. Definitions of waste often include valuable materials, complicating their recovery and reuse. Harmonized EU regulations are needed to enable efficient international material flows.

Increased availability of sustainably produced raw materials from forestry, agriculture, and fisheries is essential. Demand for renewable raw materials is growing, but EU regulations may limit their use. This creates concerns about meeting supply needs for a circular, biobased economy.

Additionally, trade policy regulations pose another layer of complexity. The current regulatory environment can be restrictive, making it difficult for biobased products to compete effectively. Compounding this issue is the fact that fossil-based products are often significantly cheaper to produce, creating a challenging competitive landscape for biobased alternatives. This price disparity makes it hard for new entrants to gain a foothold in the market.

4.1.4 Market Development

The journey towards establishing new biobased businesses in Northern Sweden is hampered with several barriers. One of the primary challenges is the dominance of established players in the market, which creates a landscape resistant to change. These traditional industries often maintain a mindset that prioritizes existing practices over innovation, leading to a reluctance among major companies to embrace new biobased solutions. In many cases, these large players actively seek to use established rules and standards, such as ISO standards for mass balance, to slow down the transition, thereby perpetuating the status quo.

Higher costs and risks associated with biobased solutions challenge their competitiveness. Fossil-based alternatives benefit from subsidies, creating price imbalances. Existing government measures target specific bioeconomy sectors, primarily for reducing greenhouse gases, rather than supporting broader growth or resource security.

Regions highlight barriers of complex regulations, and conflicting policies on resource use. Fragmented responsibilities between regional growth and agricultural policies limit holistic approaches. Differing interpretations of project benefits by authorities further hinder support. Regions also struggle to integrate bioeconomy solutions into preparedness for emergencies, such as energy supply issues.

The financing landscape further complicates matters, as the market has cooled off, making it increasingly difficult to secure funding for deep tech ventures. The Swedish government's expectation for businesses to provide parallel equity, for certain calls, when seeking financial support adds another hurdle, as many start-ups struggle to meet these requirements. One of the most pressing issues is the "Valley of Death," a critical phase where companies struggle to secure the necessary funding to bridge the gap between initial development and commercial viability. This dilemma is often compounded by the need for contracts to justify investments in production facilities and raw materials, creating a classic "chicken and egg" scenario. Without contracts, companies hesitate to invest, yet without investment, securing contracts becomes increasingly difficult.

Cross-sectoral collaboration is critical for biobased innovation but often hindered by uncoordinated access to raw materials and expertise. State funding for research, innovation, and test environments helps mitigate risks, but better cooperation across industries is needed to create new value chains.

4.1.5 Strengths and possibilities for a biobased implementation eco-system

4.1.5.1 Abundant Natural Resources

Northern Sweden's vast forest landscapes, covering 97% of its productive land, provide a renewable and sustainable foundation for the bioeconomy. The region's Nordic forestry practices ensure long-term forest management, balancing environmental goals with economic productivity. This renewable resource base offers significant potential for producing biobased products such as pulp and paper, biomaterials, wood products, and biochemicals. Additionally, forestry by-products like sawdust, bark, and logging residues can be utilized to generate value-added outputs, driving resource efficiency, and contributing to a circular economy. By leveraging its natural resource wealth, Northern Sweden can address climate goals while creating opportunities for innovation and industrial growth.

4.1.5.2 Strong Industrial Foundation

Northern Sweden has an established industrial base, including pulp and paper mills, sawmills, and energy companies, which serves as a strong platform for scaling biobased solutions. These industries are equipped with infrastructure, workforce expertise, and logistics networks that can be leveraged to integrate innovative technologies into existing production systems. By upgrading industrial by-products into high-value applications such as bioenergy, biofuels, and advanced biomaterials, the region can maximize resource utilization and reduce waste. Additionally, opportunities for industrial symbiosis – where one industry's by-products are inputs for another – further enhance efficiency and sustainability, positioning the region as a leader in industrial bioeconomy implementation.

4.1.5.3 Collaboration and Innovation Ecosystem

Collaboration among industry, academia, and policymakers is a key strength of Northern Sweden's bioeconomy. This interconnected ecosystem fosters innovation through joint research, knowledge transfer, and cross-sector partnerships. Universities and research institutes contribute cutting-edge expertise in sustainable forestry, biomass utilization, and circular solutions, while testbeds and demonstration facilities accelerate the validation and commercialization of biobased technologies. By supporting innovation hubs and start-ups, the region can drive advancements in biobased products and processes, creating a dynamic environment where businesses and researchers collaborate to solve societal challenges and unlock new market opportunities.

4.1.5.4 R&D as a Catalyst for Innovation

Research and development (R&D) play a crucial role in driving innovation across Northern Sweden's bioeconomy. By providing access to state-of-the-art testbeds and demonstration facilities, the region can bridge the gap between research and commercial-scale production, accelerating the adoption of new technologies. Supporting collaborative R&D projects will

enhance biomass logistics, energy efficiency, and environmental performance while reducing costs. Universities, research centres, and industries can work together to develop solutions that improve resource utilization, create sustainable processes, and drive competitiveness. By prioritizing innovation, Northern Sweden can emerge as a global leader in biobased technology development.

4.1.5.5 Commitment to Sustainability and Circularity

A strong focus on sustainability and circularity underpins Northern Sweden's bioeconomy vision. Sustainable biomass management practices, such as increasing forest increment and carbon uptake, align resource use with climate goals while enhancing the carbon sink capacity of forests. Encouraging the use of long-lasting wood products in construction further contributes to carbon sequestration and reduces reliance on carbon-intensive materials. At the same time, circular practices that emphasize reuse, recycling, and recovery of wood fibers, paper, and bioproducts minimize waste and conserve resources. By modernizing waste systems and legislation, the region can maximize circularity, serving as a model for sustainable resource management.

4.1.6 Key pathways for improving biobased business models

Over the past 150 years, huge investments have been made into industries processing forest biomass. Sawmills, pulp and papermills and CHPs are continuously investing in more innovative and effective processes to stay competitive. Industry driven investments are the main driver for innovations and growth in the forest bioeconomy. Over time, strong synergies as well as competition have developed between these industry segments and forest owners. A few big companies are dominating the market and defending their investments hampering new businesses to enter the market. However, there are several key-pathways for establishing new biobased businesses.

In Sweden, start-ups have access to a variety of funding opportunities that cater to different stages of development and investment needs. For those seeking funding in the early stages of business development there are several call e.g hypothesis testing, which is designed to support early-stage research and development projects. This program typically provides funding to validate innovative ideas and concepts, making it an excellent choice for start-ups looking to test their business models or technologies before scaling up. Another significant initiative for large scale projects is the so called "The Industry Leap" which focuses on promoting sustainable industrial development. This program offers financial support for projects that aim to reduce carbon emissions and enhance resource efficiency.

Start-ups engaged in biobased innovations can particularly benefit from this funding, as it aligns with Sweden's broader goals of transitioning to a greener economy. Additionally, Vinnova, Sweden's innovation agency, provides various funding opportunities for start-ups, including grants and innovation vouchers. These can be utilized for product development, market entry, and collaboration with research institutions, making them highly valuable for new businesses.

The EU regulatory landscape plays a significant role in shaping biobased businesses. Key drivers include emission rights regulations, which compel businesses to adhere to strict emission standards, pushing them towards more sustainable practices. Additionally, the

upcoming deforestation regulation, set to take effect on December 30, 2025, aims to curb deforestation and could impact sourcing strategies for biobased materials. The Corporate Sustainability Reporting Directive (CSRD) and the Carbon Border Adjustment Mechanism (CBAM) introduce additional compliance requirements, which can be both a challenge and a motivator for businesses to adopt sustainable practices.

There are common strengths among the SMEs striving to succeed in this sector. A robust demand for biobased products exists, driven by customers' sustainability goals. Additionally, having a skilled and experienced workforce is crucial, as these employees are essential for driving innovation and product development. Moreover, strong engagement between industry, academia, and incubators, e.g. Örnsköldsvik municipality, fosters innovation and collaboration.

Externally, the potential for biobased businesses is supported by a growing global emphasis on environmental sustainability and supportive political climates. Regulations aimed at boosting biobased initiatives present opportunities for growth. However, threats loom from shifting global politics, such as changes in U.S. leadership and the implications of the ongoing conflict involving Russia, which can affect resource availability and market stability. Furthermore, restrictions imposed by the EU on forest management and the potential for increased customs fees could hinder progress.

4.2 ACTIONS / INTERVENTIONS

The blueprint developed in Northern Sweden is comprised of seven strategic objectives (Table 7). Inspired by the Proposal for a Swedish Bioeconomy these objectives will contribute to the national indicators and targets, which also serve as the operational objectives. Furthermore, the Proposal comprises 17 measures, and an indication (*) is provided as to which national goal our actions are aligned with the strategic objective.

Table 7 Overview of strategic objectives, actions and expected results for 2040.

Strategic objective	Action	*	Expected result
1. Strengthen collaboration across sectors	Strengthen cooperation and coherence between strategies in Northern Sweden	9	Synchronized bioeconomy strategies that align efforts and provide long term effects on society.
	Strengthen cooperation and exchange of best practices between Swedish regions	9	Fulfilment of the national bioeconomy indicators for all regions
	Strengthen collaboration between academy, industry, and policy makers for a favorably policy and investments landscape	11	Multi-stakeholder interaction will ensure that relevant and critical issues for the whole bio-economy sector are included.
	Strengthening cooperation with established bioeconomy industries like pulp mills and sawmills or energy companies to introduce and integrate new biobased solutions.		Increased use of proven knowledge and experiences

Strategic objective	Action	*	Expected result
	Share information about on-going and completed bioeconomy projects, find gaps and future possibilities for cooperation.		Joint project applications and funding to support regional bioeconomy development.
	Share data on biobased residual streams, with a complete view of flows, traceability, volumes, and characteristics. Identify and address barriers utilization.	4	Matchmaking along the biobased value chain to support stronger joint venture for biobased business cases.
2. Enhance access to funding for biobased innovation and investment			
	Develop multi-actor partnerships to avoid silos and build strong consortiums also involving actors outside the academy when applying for funding		More funding and greater impact on prioritized areas,
	Support to SMEs to apply for funding. Simplify the application process for start-ups/small enterprises to take part in larger joint projects. and ease their administrative hurdles.		Start-ups can earlier take part in larger projects, meaning
	Support and make funding available for start-ups/small enterprises to reach demonstration of new technologies and innovations and to overcome the valley of death to reach full scale production.		Greater success rate for startups to reach commercial scale.
3. Develop infrastructure for production of biobased commodities			
3.1 Energy supply	Support investments in resilient production of renewable electricity in Northern Sweden that harmonizes weather dependent electricity supply (wind, solar and bio) with adjustable power supply (hydro) and base power supply. Support investments in power grids for increased and resilient transmission of electricity.		Secure long term and resilient supply of renewable electricity at a stable and attractive price for investments and for the society
	Support more efficient use of low value heat sources from industry		Increased energy efficiency
3.2 Transport & logistics	Support development and investments in cost effective, resilient, and fossil free road and		Costs and CO2 savings in the supply chain.

Strategic objective	Action	*	Expected result
	train transports including biomass terminals.		
	Support initiatives for mobilizing underutilized and complex biomass resources such as logging residues available for CHPs.		Make larger volumes of well-defined biomass resources economically available for production of biobased commodities without causing negative market distortions
3.3 Digitalization and AI	Develop applications for reuse and recycling, streamlining, visualization, traceability		Increased circularity
3.4 Research and technology infrastructure	Spread knowledge about entire value chains and understanding of the value of test beds. Make test and demo facilities visible. Study visits and meeting places for awareness, new ideas and cooperation	15	Increased availability and utilization rate of test and demo facilities, test beds reduce the costumer
	Support research and development of more effective and environmentally friendly biomass use and logistics.		Costs and CO2 savings in the supply chain. Reduced environmental impact.
	Create arenas for information sharing and networking involving industry and policy makers.		Raised awareness of gaps and opportunities in available research infrastructure
	Increase sales of technology knowledge and technology infrastructure.		Increased competitiveness and contributes to knowledge transfer of best-practice technologies.
	Support sustainable and cost-effective infrastructures for energy, water and waste management.		Cost savings and reduced environmental impact. Increased circularity.
4. Foster product development and market credibility			
	Expand risk and vulnerability analyses of Northern Sweden	10	Increased self-sufficiency in critical areas: agriculture (including fertilizers), heat and power, transport fuels/electricity, process chemistry.
Certificates and product declaration	Increase access to sustainability reports, digital product passes, environmental declaration, Central Securities Depository Regulation (CSDR)		Better understanding of the environmental benefits of goods and services
5. Promote education and skills development			
	Analyze and suggest improvements for the use of bioeconomy and related		Bioeconomy – a well-known and well-defined term. Increased

Strategic objective	Action	*	Expected result
	terminology in the school's/ universities and governing documents		public and political awareness and understanding
	Establish a national interdisciplinary graduate school	17	Skilled workforce/competence supply
	Enhance collaboration between academia, research institute and industry	16	Necessary subject and transversal. Skilled workforce/competence supply
	Promote education by making job opportunities and education visible		Skilled workforce/competence supply
	Increase society's attractiveness to facilitate recruitment (diversity and equality)		Skilled workforce/competence supply
6. Advocating for supportive policies and regulations			
	Mobilize and be more active in bioeconomy networks within the EU	14	Increased understanding of the northern Sweden bioeconomy context in the EU and strengthened influence on EU policy
	Involve more experts from Northern Sweden in EU institutions	12	Increased understanding of the northern Sweden bioeconomy context in the EU and strengthened influence on EU policy
	Increase understanding of the Nordic forestry model and the importance of active and sustainable forest management		More drivers and less barriers for investments and growth in the bioeconomy. Increased security of supply
	Promote policy instruments for increased investments in biobased solutions	3	Increased investments in biobased solutions
	Develop a plan for innovations and new business models, as well as increased biomass usage that promotes a circular approach, including enhanced reuse.		Increased incentives to support circular business models
	Increased support for procurement of biobased solutions critical for security of supply	6	Increased market for biobased products and reduced risk for new biobased solutions
	Support for the actions proposed in the national bioeconomy strategy and make budget available when necessary		Increased impact of the bioeconomy strategy
7. Natural resources sustainably			
Resource efficiency	Support investments in processes for energy efficiency and for increased upgrading and adding value to sawn goods, pulp		Increased growth and added value in the bioeconomy

Strategic objective	Action	*	Expected result
	and paper and forest industry by products		
Carbon efficiency cycle	Encourage best practice biomass management practices for increased forest increment and carbon uptake. Support use of long-lasting wood products and biomaterials in construction and in the society	2	Increased climate benefit
Circularity	Encourage and support the reuse of wood, paper fibers and other bioproducts. Modernize waste legislation for increased circularity		Increased circularity

5 MONITORING, EVALUATION AND LEARNING

Regional Statistics Bioeconomy

In many bioeconomy strategies and blueprints ambitious goals are set up for the bioeconomy. In the proposal for a national bioeconomy strategy, clear goals are set up for indicators such as added value and employment (Table 7). However, tools to follow up goal achievement are often missing, especially on a regional level as statistics are often presented on a national level. A growing number of regions need to regularly measure the economic impact of the bioeconomy and how it affects regional development. Target levels for 2040 in the national strategy that are suggested to be followed up is that at least 50% of regions have increased the number of people employed in the bioeconomy by at least 2% and that at least 85% of regions have increased the value added in the bioeconomy by at least 60%. These targets are suggested to be monitored by the regional authorities at six-year intervals.

A network for regions collaborating on the bioeconomy has produced basic information for carrying out regional analyses on the bioeconomy in Sweden. Within Bio4Model4Regions project, a working group has been active with the overall goal to improve, update and to make the national and the regional bioeconomy statistics part of the Swedish official statistics with annual updates.

Statistics Sweden has on commission from BioFuel Region financed from BioModels4Region project developed new and updated regional statistics for industries within the bioeconomy for all 21 Swedish regions. It covers industries that are fully or partly producing goods and services that connects to the use of biomass. In this case biomass refers to plants, forestry, animals and fish. Many industries belong to 100 percent to the bioeconomy. This means that everything these industries do, directly or indirectly, contributes to production or biomass value added. These industries comprise agriculture, forestry, fishing, food and tobacco, wood, paper and paper pulp, accounted for 45 percent of bioeconomy value added in 2015, and the regional level statistics are quality assured. Other industries' regional contributions should be viewed with caution in this pioneer project on regional statistics.

Regional perspective

Identifying a subset of the economy, that is, bioeconomy employment and value added, can be done at national level with an analysis of each industry. Identifying the regional perspective requires more data and detailed analysis of the activities in a specific region.

Specific regional statistics is used, but the share of bioeconomy per industry is the same regardless of region. This means that the regional bioeconomic feature is not as clearly visible as in a regional assessment made by county, in industries that are not completely classified as bioeconomic. For example, the chemical industry may produce bio-based goods in some regions, but this is not visible in the statistics that have been produced. All industries have the same share, regardless of region. Industries identified as fully bioeconomic do not have this effect, and the production in the region can be fully identified (Table 8).

Table 8 Bioeconomy shares by industry (SNI 2007) Activity (SNI 2007)	Bio share, %
A01 – Agriculture	100
A02 – Forestry	100
A03 – Fishing	100
C10-12 Manufacture of food products, manufacture of beverages, manufacture of tobacco products	100
C13-15 – Manufacture of textiles, Manufacture of wearing apparel, Manufacture of leather and related products	48
C16-17 – Manufacture of wood, Manufacture of paper and paper products	100
C18 – Printing and reproduction of recorded media	92
C20-21 – Manufacture of chemicals and chemical products, Manufacture of basic pharmaceutical products and pharmaceutical preparations	15
C22 – Manufacture of rubber and plastic products	7
C28 – Manufacture of machinery and equipment n.e.c.	11
C31-32 – Manufacture of furniture, Other manufacturing	33
D35 – Electricity, gas, steam and air conditioning supply	24
36-39 Water supply; sewerage, waste management and remediation activities	30
F41-43- Construction of buildings, Civil engineering, Specialised construction activities	17
I55-56 – Accommodation, Food and beverage service activities	2
M69-72 – Legal and accounting activities, Activities of head offices; management consultancy activities, Architectural and engineering activities; technical testing and analysis, Scientific research and development	0.3
N78-82 – Employment activities, Travel agency, tour operator and other reservation service and related activities. Security and investigation activities, Services to buildings and landscape activities.	3
R90-93 – Arts, entertainment and recreation	2

The statistics is today available (in Swedish) as an interactive web based tool [here](#).

The methodology is available (in English) [here](#).

6 OUTLOOK

Northern Sweden has great potential for bioeconomic development and growth. We have very good access to biomass based primarily on sustainable forestry. Here is one of the world's strongest forest and processing industries and world-leading research in the field. We are well ahead in the green transition with planning of large investments and conscious consumers and politicians. All in all, we are in a golden position to take a leadership role when the new bioeconomy is now emerging. However, in daily life in both politics and business but also civil society, there is a lack of knowledge and different perceptions of what the bioeconomy is and what significance it can have for our society.

In 2012, the EU developed a strategy for the bioeconomy. It highlights that bioeconomic growth must be based largely on the specific regional conditions. Through a sustainable use

of bioresources, Northern Sweden can help to solve the global challenges such as a growing population, overuse of resources, environmental destruction, and climate change, but our conditions for contributing to the bioeconomy must be highlighted better. For this to happen, however, there are several obstacles that must be removed and a number of strategic investments that must be implemented.

For decisions that promote bio-economic development to take place, knowledge about the conditions of forestry in this area must be significantly strengthened at both EU level and national level. The forest has a key role, and we have a tradition of active forestry that needs to be highlighted both nationally and within the EU. The EU is developing a policy for climate and bioeconomy that affects Sweden, and there is often a lack of understanding of the positive importance of forestry for both the economy and the climate. Forestry is often criticized for a lack of environmental consideration and that prevailing forestry methods lead to an increased extinction of species. It is urgent to gain good acceptance for our forestry, if its potential to contribute to bioeconomic growth is to be fully utilized for the strong and rapid change in society's direction that the climate demands.

For all actors active in bioeconomic development, the blueprint can serve as toolbox for inspiration. Our ambition has been to describe and relate to existing strategies and initiatives on a regional and national level. In Sweden, many such initiatives and strategies exist. This adds complexity to this blueprint but not to describe and consider existing strategies would make the blueprint a document for very few to be inspired by. For greater impact of this blueprint, it has been essential to use the actions and targets set up in the proposal for a Swedish a bioeconomy strategy and find ways how Northern Sweden can contribute as much as possible. This has also been a successful strategy for mobilizing key stakeholders in workshops and to give input into the referral process (Figure 8).

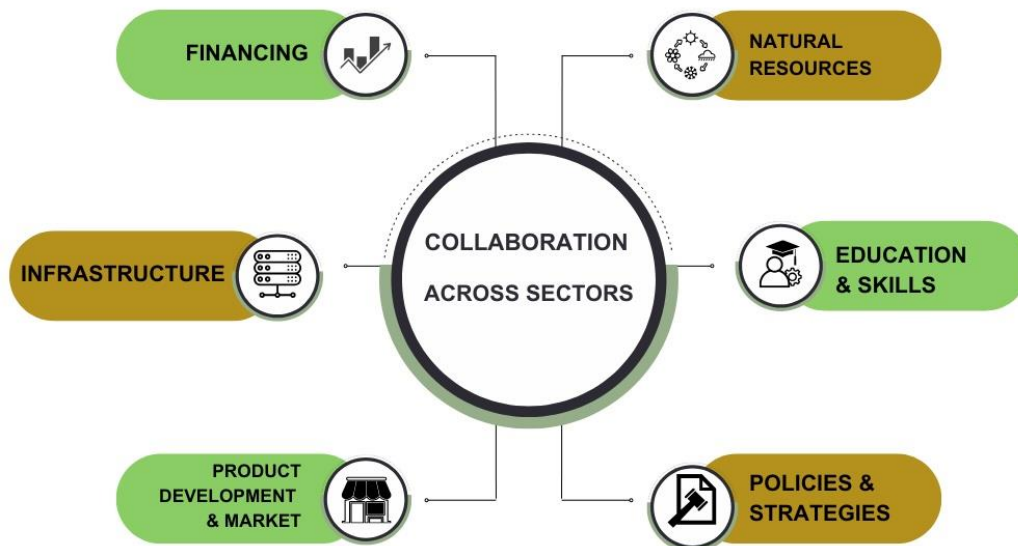


Figure 8 The key actions areas of the Bioeconomy Blueprint of Northern Sweden

For the future, we will continue our work to mobilize stakeholders with workshops and webinars supported by the blueprint, the national bioeconomy strategy and the regional statistics for bioeconomy that will be published in January. With this strategy we believe we

will mobilize a lot more stakeholders and that we can inspire them to further boost the bioeconomy in northern Sweden with the proposed actions in this blueprint.

The proposed national bioeconomy strategy is still pending. Goals and indicators may be subject to change. When the strategy is well approved there will be a synchronized work to update existing strategies to align with the new bioeconomy strategy. There will also be a huge and complex task to harmonize EU policies with policies on national and regional level. To achieve this, strong support and collaboration with North Sweden European Office is crucial. North Sweden European Office is the Brussels representation of Norrbotten, Västerbotten, Jämtland-Härjedalen and Västernorrland, the four northernmost counties of Sweden. In Northern Sweden, several industries, clusters, regions and municipalities, institutes and academies are active in boosting the bioeconomy. We encourage all bioeconomy stakeholders in Northern Sweden to integrate suggested actions in this blueprint, and other related strategies, into their future priorities.

7 APPENDIX STAKEHOLDERS

Organisation/company	Category	F/M	Region
Bio4Energy	academia	M	Northern Sweden
Swedish Univ. of Agricultural Sciences	academia	M	Northern Sweden
Swedish Univ. of Agricultural Sciences	academia	M	Northern Sweden
Umeå University	academia	M	Northern Sweden
North Sweden European Office	Brussels representation of the four northernmost counties of Sweden	F	Brussel
Biocompost	business	M	Northern Sweden
Domsjö Fabriker	business	M	Northern Sweden
Energifabriken i Sverige AB	business	M	Northern Sweden
Envigas	business	M	Northern Sweden
Eurocon	business	M	Northern Sweden
Biobased business	business	M	Northern Sweden
Jämtkraft	business	M	Northern Sweden
Kyl- och Frysexpressen	business	M	Northern Sweden
Metsä Board Sverige	business	F	Northern Sweden
Mondi Dynäs	business	F	Northern Sweden
PulpEye	business	M	Northern Sweden
Ragn-Sells	business	M	Northern Sweden
SCA	business	F	Northern Sweden
Sekab	business	F	Northern Sweden
Sekab	business	F	Northern Sweden
Sekab	business	M	Northern Sweden
Skellefteå Kraft	business	M	Northern Sweden
Valmet AB	business	M	Northern Sweden
Vattenfall	business	M	Northern Sweden
WSP Sweden	business	F	Northern Sweden
Övik Energi AB	business	M	Northern Sweden
Övik Energi AB	business	F	Northern Sweden
BioFuel Region	cluster	F	Northern Sweden
BioFuel Region	cluster	F	Northern Sweden
BioFuel Region	cluster	M	Northern Sweden
BioFuel Region	cluster	F	Northern Sweden
Leader Höga Kusten	cluster	M	Northern Sweden
Piteå Science Park	cluster	M	Northern Sweden
The Cluster of Forest Technology	cluster	F	Northern Sweden
BioFuel Region	cluster	F	Northern Sweden
BioFuel Region	cluster	M	Northern Sweden

Organisation/company	Category	F/M	Region
Statistics Sweden	government institute	M	Sweden
Statistics Sweden	government institute	F	Sweden
Bizmaker	innovation hub	M	Northern Sweden
Bioinnovation	Innovation hub	F	Sweden
Bioinnovation	innovation hub	M	Sweden
Bizmaker	innovation hub	M	Northern Sweden
Dalarna Science Park	innovation hub	F	Sweden
Innovarum	innovation hub	F	Northern Sweden
Örnsköldsviks kommun	local government	F	Northern Sweden
Örnsköldsviks kommun	local government	M	Northern Sweden
Forestral Catalana	MainBIO, Spain	F	Northern Sweden
Government office	national government	F	Sweden
Regeringskansliet	national government	F	Sweden
Regeringskansliet	national government	M	Sweden
Härnösand Municipality	politician	F	Northern Sweden
Sollefteå Municipality	politician	M	Northern Sweden
Storuman Municipality	politician	F	Northern Sweden
Umeå Municipality	politician	F	Northern Sweden
Vännäs Municipality	politician	M	Northern Sweden
Region Dalarna	regional government	F	Sweden
Region Gävleborg	regional government	F	Northern Sweden
Region Gävleborg	regional government	M	Sweden
Region Halland	regional government	M	Sweden
Region Jämtland/Härjedalen	regional government	F	Northern Sweden
Region Kalmar län	regional government	F	Sweden
Region Kalmar län	regional government	M	Sweden
Region Norrbotten	regional government	F	Northern Sweden
Region Norrbotten	regional government	M	Northern Sweden
Region Skåne	regional government	F	Sweden
Region Uppsala	regional government	M	Sweden
Region Värmland	regional government	M	Sweden
Region Västerbotten	regional government	F	Northern Sweden
Region Västernorrland	regional government	F	Northern Sweden
Region Västra Götaland	regional government	F	Sweden
Region Örebro	regional government	F	Sweden
Region Örebro	regional government	F	Sweden
Region Östergötland	regional government	M	Sweden
RISE Processum	research institute	F	Northern Sweden
RISE Processum AB	research institute	F	Northern Sweden

Organisation/company	Category	F/M	Region
RISE Processum AB	research institute	F	Northern Sweden
RISE Processum AB	research institute	F	Northern Sweden
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RISE Processum AB	research institute	F	Northern Sweden
RISE Processum AB	research institute	M	Northern Sweden
Biobased business	start-up	F	Northern Sweden
Biobased business	start-up	M	Northern Sweden
Biobased business	start-up	M	Northern Sweden
RESELO	start-up	F	Northern Sweden
Biobased business	start-up	F	Northern Sweden
Biobased business	start-up	M	Northern Sweden
Biobased business	start-up	M	Northern Sweden
Farmer Association North	trade association	F	Northern Sweden
Farmer Association North	trade association	F	Northern Sweden
Farmer Association North	trade association	F	Northern Sweden
Skogsindustrierna	trade association	M	Sweden