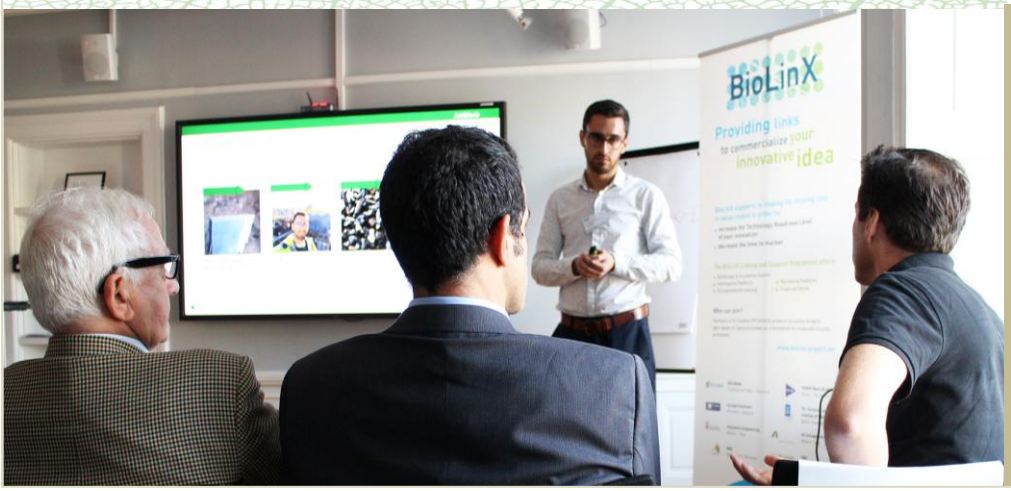
BioLinX legacy document

European bio-regions:
scouting and innovation recommendations



BioLinX, key figures
500+ unique projects contacted
400+ participants to regional events
160+ projects impacted
60+ projects directly supported
30+ SMEs directly supported
10+ regions analysed

BioLinX consortium:

DECHEMA | Frankfurt am Main – Germany

Europe Unlimited | Brussels – Belgium

Innovation Engineering | Milan – Italy

PNO Consultants | Düsseldorf – Germany

REWIN West-Brabant | Breda – the Netherlands

RISE Research Institutes of Sweden | Gothenburg - Sweden

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30 June 2018

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1 Introduction

1.1 BioLinX: its activities and research

European projects draw many partners together, but usually just one partner, the innovation owner, can benefit by pushing the innovation up the hill towards the market afterwards. The H2020 project BioLinX, which ran between 1st January 2015 – 30th June 2018, sought to identify such partners/innovation owners involved in bioeconomy projects and assisted them. Often, a scientist or researcher might not have the contacts necessary or the wherewithal to carry their innovation to the next level by themselves. This is where BioLinX stepped in and helped them navigate a route towards market.

Via the **BioLinX Linking & Support Programme** , innovation owners open to support were given the assistance they needed. This could take the form of training, for instance in venture capital pitching, or help in drawing up a business plan. Sometimes, this meant opening a door to the right funder, either public or private. BioLinX also established connections to new potential partners and provided databases on intellectual property and online brokerage. Help could also come in the form of supporting an analysis, or market research or use of test facilities. BioLinX organized various events in which parties were informed, trained and linked. In short, by providing support BioLinX contributed to increasing the TRL or reducing the gap to the market.

Why this document?

Now that the project has come to an end, the BioLinX consortium of partners deems it only logical to make sure that their *own* projects' research & findings on key European bioeconomy regions does not end up in just BioLinXs' archives. The objective of this document is to **inform European bioeconomy clusters and projects of the analysis performed by BioLinX, so they can, to their own discretion, put BioLinXs' efforts to use in their respective journeys in contributing towards a flourishing European bioeconomy.**

This legacy document contains potential opportunities in matching selected FP7 / H2020 activities with current needs / opportunities within key bioeconomy regions throughout Europe. For this purpose, 12 S3 regions and clusters with a strategic smart specialisation in, or with inherent potential for the development of, bioeconomy were selected and analysed. The regional analyses are, in line with previous analyses for regional bio-economy development in West Sweden and the Netherlands, carried out inspired by the Innovation System framework.

The results of these analyses are presented in this report.

The Innovation System analysis provides a description of each regional bioeconomy innovation system, its key value chains and related stakeholder mapping as well as its strengths and weaknesses in terms of feedstock access, technological portfolio (pre-treatment, conversion or production), local market access (e.g. key brand-owners and/or launching customers), and key innovation activities (i.e. knowledge, business, policy, lobby etc.). The data for the analysis was collected by means of desktop research such as previous innovation system analyses when available, literature reviews and, to some extent, complementary informant interviews with relevant bioeconomy actors.

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The analysed regions are:

- The Botnic region
- The Central Finland region
- Flanders, Belgium
- Košice region, Slovakia
- Northen Italy
- Piedmont, Italy
- Sardinia, Italy
- Saxony-Anhalt & Sazony, Germany
- Scotland, UK
- South West Netherlands
- Tipperary Country, Ireland
- West Sweden chemical and material cluster

Data sources:

- JRC RIS 3 smart specialisation database and support system
- Smart Specialisation Strategies and other existing vision documents
- FP7 results, i.e. R4R and Bio-tic projects
- Documents relevant for each region or cluster, respectively.
- Informant interviews

1.2 Regional development of a bio economy: A reflexive summary

The ability to measuring how innovation systems are functioning is considered as a big breakthrough in innovation systems research. In a number of scientific articles different systems have been evaluated based on Innovation System criteria named 'key processes of innovation systems' (system functions)[1]. These key processes of the innovation systems are focusing on how an innovation system is preforming and are thus strongly related to the specific structure (actors, institutions, networks and technological factors). As regional conditions differ, benchmarking innovation systems, including regions with evolving bio economy, is difficult. However, applying the innovation system terminology, when summarizing enclosed regional analysis, provides a rich understanding of common challenges and enablers faced by the regions enclosed in this report. The data (all enclosed regional analysis) was hence coded into the seven key processes of innovation systems (i.e. a theoretical thematic analysis), resulting in a number of sematic 'themes' around each key process of innovation systems. The evolved themes were given considerable space in some data items, and little or none in others.

The analysis resulted in a combination of themes for each of the key processes of innovation systems constituting the reflexive summary of the enclosed analysis. Below, each key process of innovation systems is explained, followed by the themes evolved under each key process with examples from the data:

[1] Hekkert, M. P., Suurs, R. A., Negro, S. O., Kuhlmann, S., & Smits, R. E. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological forecasting and social change, 74*(4), 413-432.

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Entrepreneurial activities: Translating knowledge into business opportunities and evaluating innovations. Involves projects aimed to prove the usefulness of the emerging technology in a practical and/or commercial environment. Such projects typically take the form of experiments and demonstrations.

Themes for entrepreneurial activities: *'Disruptive business models and value chains'*
'Ruralisation'

Future bioeconomic sector will be constructed by all of the economic sectors that are involved in products, processes and different biological resources and therefore include a variety of industries. In general, there are few start-ups in the field of bio-economy at the moment. Possibly this relates to the dependency of technological infrastructure needed in order to scale up, demonstrate and verify new technologies at industrial scale. This type is infrastructure is scattered, and access is associated with large financial costs. Available support for innovation and growth is mostly organized as a general support and usually not sufficient enough to cover these types of costs and there are generally none, or only limited, thematic support. In addition, incumbents in present industry, focal for the bio economy transition, may not have their R&D departments or management in the region. This makes knowledge development and the establishment of joint regional visions challenging. Other challenges relates to the feedstock of the bio-economy that usually is situated away from larger cities and main capitals, which makes recruitments and knowledge development challenging.

Knowledge development: Primarily involving learning activities, mostly on the emerging technology, but also on markets, networks, users etc. There are various types of learning activities relating to R&D and entrepreneurial experimentation.

Theme for knowledge development: *'Arenas for incumbents'*

There are many different arenas where industry, academy and policymakers can meet in order to develop the diverse aspects of the evolving bioeconomy. However, these arenas have in general limited SME and middle size cooperation participation, resulting in a dominance of mainly large industry actors for example defining future needs of education, both in terms of the development of university degrees in relevant topics and forming training offers for employees that are involved in the development of a bioeconomy.

***Knowledge diffusion*:** The facilitation of knowledge exchange between the actors involved in the innovation system, e.g. networks, places to meet and interact and 'openness' towards actors in the innovation system.

Theme for knowledge diffusion: *'Agenda driven'*

The absorption of knowledge form universities outside clusters or arenas for knowledge exchange are generally weak. One reason may be that the knowledge development is highly associated with the agendas of the incumbents. Other reasons may be related the lack of public understanding and acceptance towards e.g. genetically modified organisms used in chemical processes, rather than used for food production.

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Guidance of the search: Policy directives and support for a particular direction of technology development are considered as a positive Guidance of the Search. In times of transitions, various technological options usually exist within an emerging technological field, all of which require investments in order to develop further. Since resources are usually limited, it is important that specific foci are chosen.

Theme for guidance of the search: *'Unclear terrain'*

The common vision for the future is that biomass feedstock, predominantly wood, will be used in a more circular manner and the current production of bulk products will be complemented with high value products. Even though the number of national strategies for bioeconomy is growing, not all countries have one. There is still an uncertainty regarding long term policy development in the field, both on EU and national level, including lack of labels and standards. Fundamental constructs such as what are to be considered as a renewable and sustainable chemical or material are still undeveloped. This creates uncertainty regarding what production process and application to develop.

Market formation: Involves activities that contribute to the creation of a demand for the emerging technology, for example by financially supporting the use of the emerging technology, or by taxing the use of competing technologies. Public procurement of innovation and Pre-commercial procurement are powerful tools.

Theme for market formation: *'Public leadership'*

Tightly coupled to the challenges within *the guidance of the search* and *entrepreneurial activities*, there is so far no clear market for the bioeconomy. Public sector is a key (customer) for lowering risk and enable market introduction, but with lack of fundamental constructs the public sector has difficulties to act. In general, however, there is willingness for inter-industrial collaboration, e.g. the forest industry is willing to collaborate with the chemical industry. In addition existing policy is particularly supportive of bioenergy and biofuel implementation. However, support for market evolution needs to be developed. In addition to this a security of feedstock is imperative for a healthy biobased economy.

Resources mobilization: Refers to the allocation of financial, material and human capital. Also includes development of relevant educations and R&D facilities.

Theme for Resources mobilization: *'Collective inaction'*

Essential in the development of the Biobased Economy is that the value creation can be distributed along the whole value chain. All partners should be able to grasp the benefits of this new economy. Bioeconomy is strongly motivated by environmental reasons and as a job generating (particularly in rural areas), but there is no current potential large market that can be realized on a short term. National vision and rhetoric supports the transition towards a fossil free society. However, policies related to the use of bio based raw materials are generally short-term and diffuse which creates uncertainty and unwillingness to invest.

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Counteracting resistance to change: Resistance to an emerging technology are often led by incumbents. The Support from Advocacy Coalitions function involves political lobbies and advice activities on behalf of interest groups.

Theme for counter resistance to change: *'Changes don't come easy'*

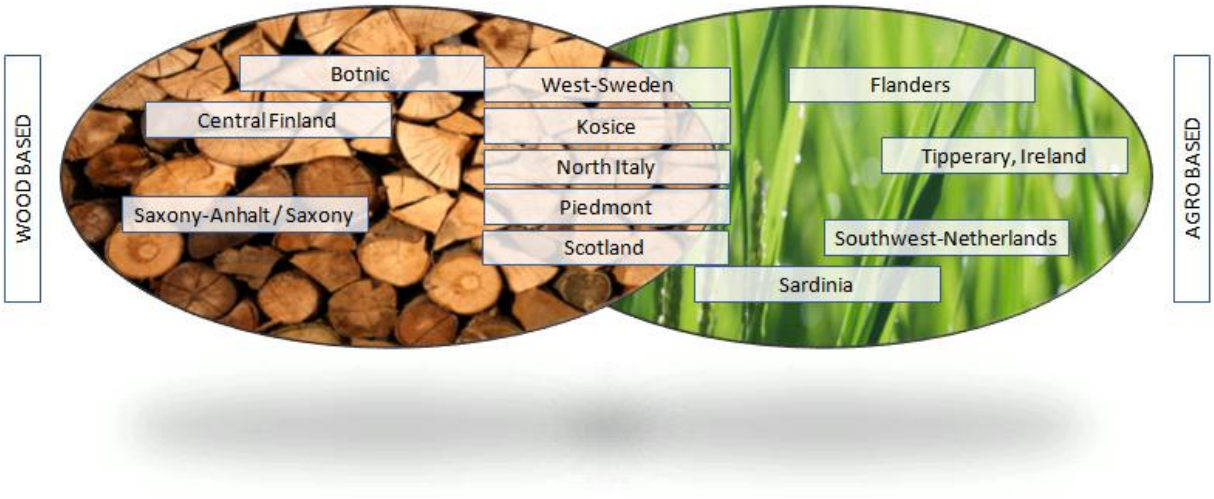
Strong oil and gas industry is lobbying against the development of a bio economy. The fossil economy is growing and dominant actors give priority to their own (economic) interests. The discourse, particularly at EU level, about the sustainability of forestry biomass is a challenge.

The thematic analysis above, made on the key processes of innovation, is an attempt to enrich the summary of all included regional analysis. Unlike traditional TIS analysis, each key process was not given a rating on a six graded scale (0-5) but rather a summative theme in order to provide an overall understanding of the general challenges and enablers related to each key process of innovation.

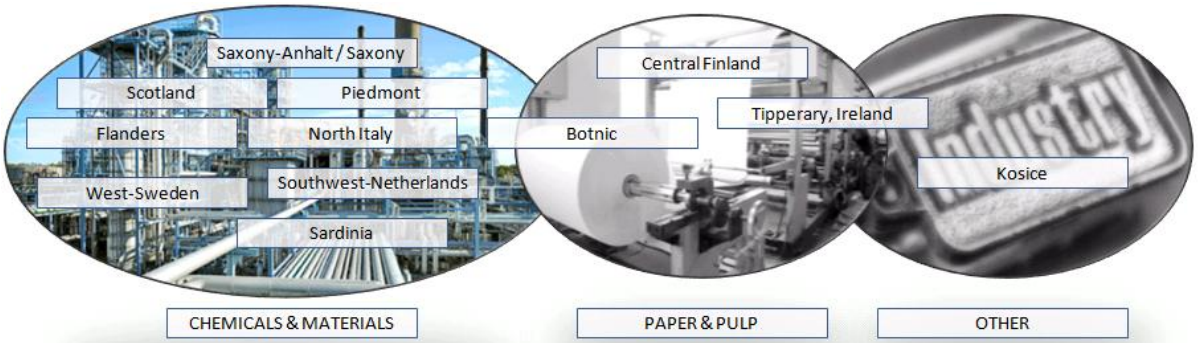
1.3 Taking stock from the regional analysis

1.3.1 Overview of regional focus

The regional analysis all identify the 'main feedstock' position of the regions as well as the 'main industrial base' in that particular region. This can be depicted as follows:



When taking the main industrial base into perspective it is clear that in almost all regions there is strong link to the chemical industry and the 'material development' that links to it.



1.3.2 Examples for overcoming the challenges

In the regional analysis some good examples can be found to overcome the challenges and hurdles. These are clustered by theme. To avoid 'naming and shaming' the areas for improvement are not directly linked to regions:

Key process	Theme	Examples
Entrepreneurial activities:	*Disruptive business models and value chains' 'Ruralisation'*	• Central Finland: Network platform for supporting Bioeconomy start-ups • Southwest-Netherlands: Green Chemistry Campus support for early stage bio-economy companies • Kosice: regional network of business incubators
Knowledge development:	*'Arenas for incumbents'*	• Botnic: clustering and central position of SP Processum Pilot Plant • Flanders: central position of Biobase Europe Pilot Plant
Knowledge diffusion:	*'Agenda driven'*	• Botnic & central Finland: clear agenda on process / technology level • Flanders: Catalisti driving a network & projects for sustainable chemical industry • Scotland: ScotChem as a strategic collaboration between universities
Guidance of the search:	*'Unclear terrain'*	• Flanders & Southwest-Netherlands: set up of interdepartmental collaboration • Southwest-Netherlands: Biobased Delta to address hurdles, policy and so on
Market formation	*'Public leadership'*	• Flanders: Ceebio developing public promotion tools • Norht Italy:Assobiotec stimulating demand for bio
Resources mobilization:	*'Collective inaction'*	• Kosice: Carpathian development institute to stimulate innovative development in regions, cities and municipalities • North-Italy: holistic approach of Chimica Verde (SPRING-Sustainable Process and Resources for Innovation and National Growth), so not only the focus on technology development • West-Sweden: Forestry-Chemistry Cluster to drive collaboration between different kinds of industries
Counteracting resistance to change:	*'Changes don't come easy'*	• Botnic: collaboration between clusters to do joint campaigns • Saxony-Anholt: Leading edge Clusters installment and allocation of funds to these clusters
Entrepreneurial activities:	*Disruptive business models and value chains' 'Ruralisation'*	• Central Finland: Network platform for supporting Bioeconomy start-ups • Southwest-Netherlands: Green Chemistry Campus support for early stage bio-economy companies

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		• Kosice: regional network of business incubators
Knowledge development:	*'Arenas for incumbents'*	• Botnic: clustering and central position of SP Processum Pilot Plant • Flanders: central position of Biobase Europe Pilot Plant
***Knowledge diffusion*:**	*'Agenda driven'*	• Botnic & central Finland: clear agenda on process / technology level • Flanders: Catalisti driving a network & projects for sustainable chemical industry • Scotland: ScotChem as a strategic collaboration between universities
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Counteracting resistance to change:	*'Changes don't come easy'*	• Botnic: collaboration between clusters to do joint campaigns • Saxony-Anholt: Leading edge Clusters installment and allocation of funds to these clusters

1.3.3 Areas for improvement

The regional analysis do not only reveal good practices, they also reveal opportunities or area's for improvement. These area's can als be categorized according to the identified theme's:

Key process	Theme	Examples
Entrepreneurial activities:	*Disruptive business models and value chains'* *'Ruralisation'*	• None of the regions have identify measures that could support the distribution of the revenue over new value chains / no pro-active measures
Knowledge development:	*'Arenas for incumbents'*	• Weakly / loosely link arenas for incumbment
***Knowledge diffusion*:**	*'Agenda driven'*	• No, unclear or not only high level agenda / no targets identified / no clear technology focus
Guidance of the search:	*'Unclear terrain'*	• Lack of detailed agenda's prohibit good policy making
Market formation	*'Public leadership'*	• Agenda often set via the government, bu no clear role identified for the government itself.
Resources mobilization:	*'Collective inaction'*	• Installment of many different clusters / organizations that are weakly / loosely linked

1.4 Transfer of the regional analysis

The detailed regional analysis will not be part of this report. The detailed analysis will be handed over to the Vanguard Initiative for Bio-Economy as part of Task 7.8 Exploitation strategy of BioLinX

project results. This report includes therefore only the characterisatioin of the region and the summary for the region. In case needed, the detailed reports are available at the coordinator (see contact details).

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2 The Botnic region

2.1.1 Summary

Item	Analysis
Type of feedstock	**Wood and agro** Wood: the region has extensive forest resources and various waste streams from forestry and pulp and paper industry Agro: various waste streams from agriculture (smaller extent)
Expect impact bio economy	**High:** Good prerequisites for driving technological development in the bio economy field. This includes; closeness to feedstock, several pilot and demo plants, good infrastructure, technological knowledge and well-established cluster cooperation involving academia, established firms and public sector.
Market potential	**High:** The region, with its center around Örnsköldsvik in Sweden, is central for the development of technologies for processing woody biomass into biofuels, chemicals and materials, e.g. bio-plastics. Another product with is close to market is animal or fish feed made from woody biomass.
Comments	N/A

2.1.2 Characterization of the region

The Botnic region includes the coast of northern Sweden and the Ostrobothnian region in Finland (figure 1). The European Union define these regions are part of the same Interreg region, called Botnia-Atlantic. However, in contrast to the scope of this analysis the Botnia-Atlantic region also includes a part of Norway.

The region has rich forest resources, which provides for large resources of lignocellulose feedstock, and has established forestry as well as pulp and paper industry. Due to the structural changes in the pulp and paper industry, which includes decreasing demand and increasing international competition, there is a need for innovation and growth of new business areas. The bio economy concept attracts a lot of attention and is seen both as a possibility for the region and a means by which the region can contribute to a transition to a more sustainable society (at national and international scale).

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Figure 1. Scope of the analysis

The development of the forest bio economy concept is particularly strong along the coast of northern Sweden, especially around the cities of Örnsköldsvik, Umeå, Sundsvall and Piteå. There are cluster organisations in each of mentioned cities, with the SP Processum triple helix cluster *The Biorefinery of the future* being the most active. The clusters also involve the four universities on the Swedish side and extensive pilot- and demo infrastructure. This forms an important hub for development of new products, energy solutions and fuels based on woody biomass. The connection between stakeholders and projects in the Ostrobothnian region and the coast of Northern Sweden is good. However, the Ostrobothnian region has much weaker triple helix cluster. A step towards a formation of a triple helix structure has been taken with the start of the network *Biovalley* in 2013. This network involves public and private sector as well as the education sector and research institutes.

Ambitions

There is a national bio economy strategy in Finland and work on a similar document for Sweden is ongoing.[2] However, there is no strategy document for the Bothnic region including both countries or for the Swedish or Finnish part of the region, respectively.

[2] Finnish Bioeconomy Strategy, http://www.bioeconomy.fi/facts-and-contacts/finnish-bioeconomy-strategy/
Swedish Research and Innovation Strategy for a Bio-Based Economy,
http://www.formas.se/PageFiles/5074/Strategy_Biobased_Ekonomy_hela.pdf
See also Bioeconomy in the Baltic Sea Region
http://www.bsrbioeconomy.net/about.html
http://www.norden.org/en/theme/nordic-bioeconomy/bioeconomy-in-the-baltic-sea-region/strategy

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Nevertheless, the Regional Development Strategy set up by the County Administrative Board in Västernorrland has the forest as its central component when they are mapping what is driving innovation (figure 2)

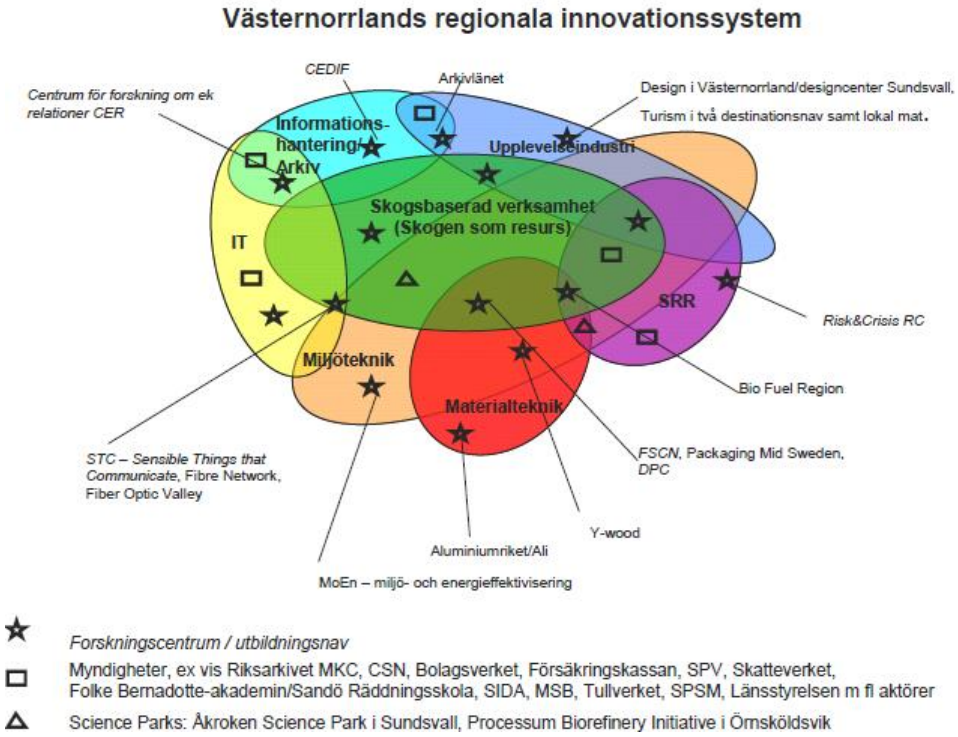

Figure 2. The Regional Development Strategy's view what is driving innovation

Additionally, several of the initiatives in the region have set up bioeconomy strategies. For example, the vision for *The Biorefinery of the future* is '*a world-leading cluster for development of biorefinery processes with SP Processum as the creative hub. Through research and innovation we contribute to the realization of green products, chemicals and materials based, primarily, on forest feedstock.'* Another example is the strategy of the *BioFuel Region*[3] which is to '*support its members' efforts to develop the region's raw materials, expertise, business sector and society by: Promoting the region, Building networks, Sharing knowledge, Shaping opinion and Involving young people'*.

2.1.3 Strenghts, needs and trends

Item	Analysis
Regional strengths / things to offer	• Good knowledge of forest based biorefineries. • The region has extensive forest resources and various waste streams from forestry and pulp and paper industry. • Several established clusters according to the triple helix model. • Regional actors wish to work together and have an open attitude that welcomes cooperation with others. • Regional EU funds have been extensively used to build network and R&D infrastructure.

[3] http://biofuelregion.se

	• Good infrastructure, e.g. Umeå Plan Science Centre. • Many firms in the region are internationally owned with creates an international base.
Regional needs / things to fix	• Cooperation with firms in other parts of the value chain, e.g. producers of consumer gods such as cloths and furniture. • Need for investments. • Lack of start-up firms. • Need for market formation. • Need for stable and long term policies. • Sometimes difficult to recruitment of competent persons.
Regional trends	• Energy markets in general. • A driving force for the development of bio economy in the region and structural changes in the industry is an increased awareness of environmental aspects amongst the public. This leads to an increased demand for products based on renewable sources. • Demographic changes implies a rapidly aging population, particularly in Finland. • In Finland, cuts in education sector might affect the industries possibilities to supply human resources (e.g. chemical engineers) in the future.

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3 The Central Finland region

3.1.1 Summary

Item	Analysis
Type of feedstock	**Forest and some agro:** Mainly lignocellulos (almost 1.4 million hectares or 14 000 km2 forest), but also peat and agro. In addition, there are unexploited water resources.
Expect impact bio economy	**High:** Central Finland is considered a national show case for bioeconomy development. Key assets are the long tradition in the pulp and paper industry and mechanical wood processing, large forest resources, a regional strategy for bioeconomy and large investment in biomass-based combined heat and power (CHP) plants and a new bioproduct plant by Metsä Fibre.
Market potential	**High:** The region is targeting several markets locally, nationally and internationally. Amongst the examples are pulp and paper, food as well as high value products from lignin and other side products from pulp processing.
Comments	N/A

3.1.2 Characterization of the region

Central Finland (Keski-Suomi) is a province situated in the middle of Finland with boarders to the regions Päijät-Häme, Pirkanmaa, Southern Ostrobothnia, Central Ostrobothnia, Northern Ostrobothnia, Pohjois-Savo and Etelä-Savo (figure 1). Central Finland covers an area of 20 000 km^2 out of which 80% is forest and 16% is water. Hence, the region is characterized by its richness in natural resources such as forest, agricultural land and water resources. There are about 274 000 inhabitants in the region and about half of them live in the regional capital Jyväskylä.

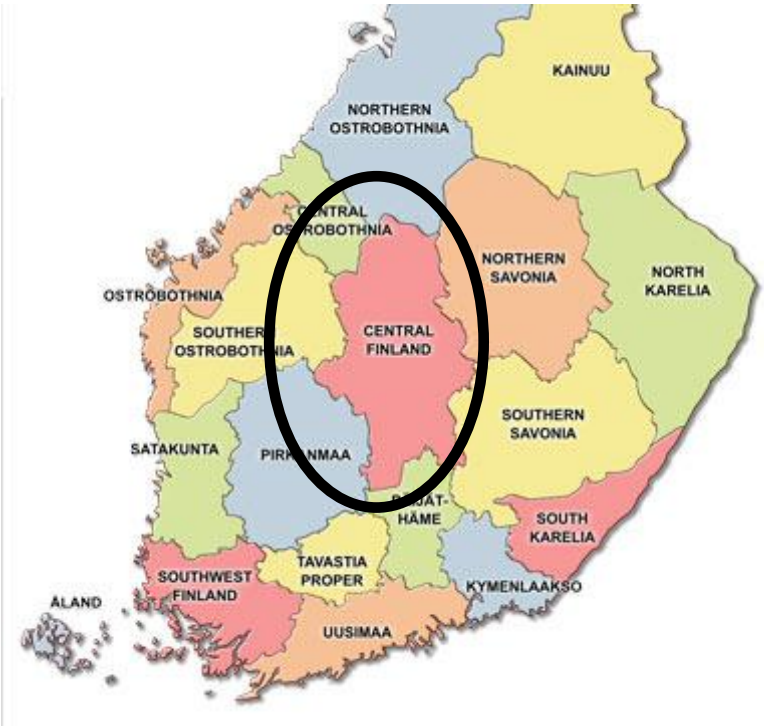

Figure 1. Map over Central Finland. Source: www.freeworldmaps.net

The region holds a mixture of industries, including forestry, production of machinery and equipment, pulp and paper, mechanical wood processing, information technology and bioenergy, and relies on export. In 2015, Metsä Fiber announced that they will construct a large-scale bioproduct mill in Äänekoski, which will be completed in the end of 2017.[4] The total investment is estimated to €1.2 billion, which contributes to increased expectations of further investments and job creation in the region. The region is also characterized by a concentration of applied research and education within the field of pulp and paper, bioenergy and forestry. Key organizations are University of Jyväskylä, JAMK University of Applied Sciences and VTT in Jyväskylä. Vocational colleges create a solid base for well-trained labor in bioeconomy for the region.

Ambitions

The bioeconomy concept has received much attention in the region. In 2014, the 'Central Finland Strategy 2040' was launched[5], which combines the regional strategy and smart specialization strategy in the same document.' Bioeconomy' as one of three focus areas. The other two are 'Digital economy' and 'Knowledge economy'.

The bioeconomy part of the 'Central Finland Strategy 2040' state that the point of departure is the strong knowledge base in agriculture and forestry, high level of R&D and forest resources. Other areas that are pointed out as assets are; local and sustainable production of energy that can increase the local economy, clear water and water technologies that can create new business and the export potential of local and sustainable food.

In the strategy, the following goals are set up for 2014-2017:

- '*Strong, export driven and diverse, sustainable bioeconomy*
- *High level in refinery and refinery technologies*
- *Local renewable energy share is 50% of the total energy consumption'*

The following strategic choices are outlined for the region:

- '*New bio based products and the machinery enabling the production*
- *Increase in renewable energy production*
- *Resource wise Central Finland*
- *Strong entrepreneurs in bioeconomy*
- *Locally produced and processed food'*

Specific targets are set up for a period of four years and until 2040. Table 1 presents the targets for the first four year period and 2040.

Table 1 Bioeconomy targets set in the Central Finland Strategy 2040

	2010/11/12	**2017**	**2040**
Employment (no)	15 000	16 000	19 000
Added value (M€)	1 000	1 400	1 800
Companies (no)	1 100	1 200	1 800
Local renewable energy (%)	42	50	90

[4] http://bioproductmill.com/articles/metsa-group-to-build-next-generation-bioproduct-mill-in-aanekoski
[5] http://www.keskisuomi.fi/in_english/central_finland_strategy_2040

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3.1.3 Strengths, needs and trends

Item	Analysis
Regional strengths / things to offer	• Large biomass resources, particularly forest. • Traditional, strong forest industry and pulp and paper industry. • Several research organizations in the region; University of Jyväskylä, JAMK University of Applied Sciences and a VTT research unit. • Metsä Fiber is investing in a new bioproduct plant.
Regional needs / things to fix	• Stimulate growth of small firms. • Challenge to find first customer for new bio-based products. • Better integration to the international bioeconomy society (R&D, SME sphere, education). • New knowledge and ideas needed for development of new bio-based products.
Regional trends	• Aging population and share of working-aged inhabitants is decreasing. Additionally, urbanization is emptying country-side. • In 2015, unemployment increase faster than in Finland in general, but positive signals of a turn already in 2016. • Substantially increasing demand for pulp wood.

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4 Flanders, Belgium

4.1.1 Summary

Item	Analysis
Type of feedstock	**Agro:** Flanders is home to world-leading companies in the sugar and starch industry. It houses a strong agricultural sector; Belgium approx. produces 4.5M tonnes of sugar beets, out of which 1.5M tonnes comes from Flanders.
Expect impact bio economy	**High:** Flanders has a lively ecosystem of parties that want to engage in the biobased economy. The parties involved have published various documents on the capability of Flanders in the Biobased economy..
Market potential	**High:** Following the various documents available Flanders has a strong food and chemical industry. Turning biomass into chemical feedstock is the market potential for Flanders About 1.5% of the total Flemish gross margin and 0.8% of all Flemish employment is generated by the biobased economy. Compared to the industrial sectors the biobased economy accounts for up to 9% of the gross margin of Flemish industry and 5.7% of employment in Flemish industry.[6]
Comments	Belgium has two distinct area's: Flanders and Wallonia. Flanders has a clear biobased economy approach. Wallonia is not taken into account in this document. In Flanders the biobased economy is also related to sustainable energy production.

4.1.2 Characterization of the region

Flanders is the northern federated state of Belgium with Brussels as its capital. The area is 13.522 square kilometres and has a population of 6,51 million. It has three ports (Antwerp, Zeebrugge and Ghent) and has 5 universities (Antwerp, Ghent, Leuven, Hasselt and Brussels). Four large strategic research centres (IMEC, VIB, VITO and Flanders Make) and a number of smaller competence poles and research centres for specific (mainly sectoral) knowledge development and distribution. Flanders exports 80% of its BBP, 1 out 3 Flemish has an higher education[7].

In the Flanders strategy document, the government has executed a SWOT analysis, resulting in the following overview (direct copy from the document):

- Strengths: knowledge base (biotechnology, process technology), (modern) agriculture, strong industry (food, chemistry, energy), well-developed logistics (land and waterways, port infrastructure), forerunner in collecting and recycling waste;
- Weaknesses: little area, densely populated, high environmental pressure, poor exploitation of research, fragmented research landscape, extensive regulation and complexity of the Belgian constitution, few funding programmes aimed at developing biobased applications;
- Opportunities: existing policy and initiatives, such as New Industrial Policy, transversal materials management action, biomass inventory, the IWG on food losses, innovation steering groups, cooperation with the Netherlands;
- Threats: little own technological development, growing competition from other European cooperation clusters and other pilot installations, insufficiently coordinated regulations and policy.

[6] Sustainable use of and creation of value from renewable raw materials for biobased industrial production such as biomaterials and green chemicals in Flanders, 2013.

[7] www.vlaanderen.be

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4.1.3 Strenghts, needs and trends

Item	Analysis
Regional strengths / things to offer	• Large availability of region-specific 1G/2G feedstocks (sugars and starch) and value chains (food and chemical industry); Strong connection to local individually owned farms; • Qualified workforce; Good quality basic research performed by local Universities and Research and Technology Organisations.
Regional needs / things to fix	• Low degree of triple helix cluster approach. Scattered field of more or less independent organisations; Cross (national) boarder funding of R&D is still difficult.
Regional trends	• Focus on sustainability and putting biobased economy as a part of this sustainable future (not as the only solution) • Strong governmental drive to make biobased economy happen; • Working towards more triple helix cluster approach; • National government cuts budgets for innovation policy and research.

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5 Košice region, Slovakia

5.1.1 Summary

Item	Analysis
Type of feedstock	**Agro, agro waste and forest:** The current available feedstock is limited. However, estimates indicate great potential for development of biobased feedstock in the region.
Expect impact bio economy	The development of the bioeconomy is in its very early phase. It is therefore difficult to estimate expected impact.
Market potential	Due to the early phase of the bioeconomy development in the region it is difficult to assess the market potential. Products to be produced in the future are bio energy, wood as the construction material, and the raw material for bio plastics production.
Comments	In Slovakia there is no national bioeconomy strategy.

5.1.2 Characterization of the region

The Košice Region is situated in the south east of Slovakia (*Figure 1*). It is the fourth largest region in the country with the geographical area of 6 755 square kilometres and the second most populous region with about 770 000 inhabitants.

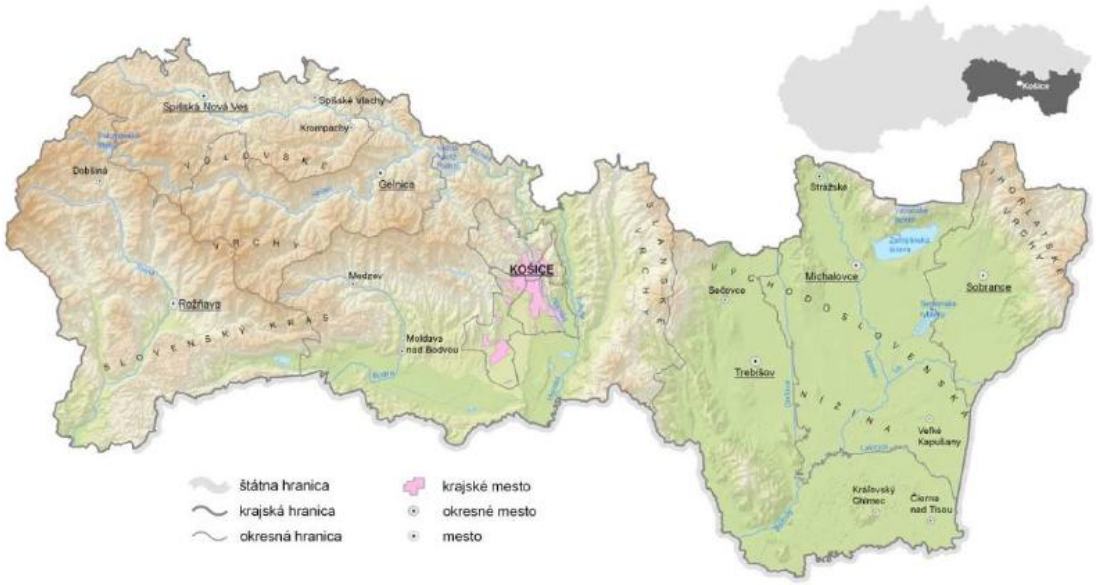

Figure 1 The Košice Region Map, Slovakia.

The Košice Region has mainly rural character with one large urban agglomeration of the regional capital city of Košice. In terms of geography, coniferous and mixed forests cover one half of the area, and the Košice Basin and East Slovakian Lowlands, suitable for agriculture compose the other half (*Figure 2*). The Košice Region is crossed by three European traffic corridors and an important crossroad of European transport routes; both road and rail networks are developed. Additionally, air transport is gradually expanding.

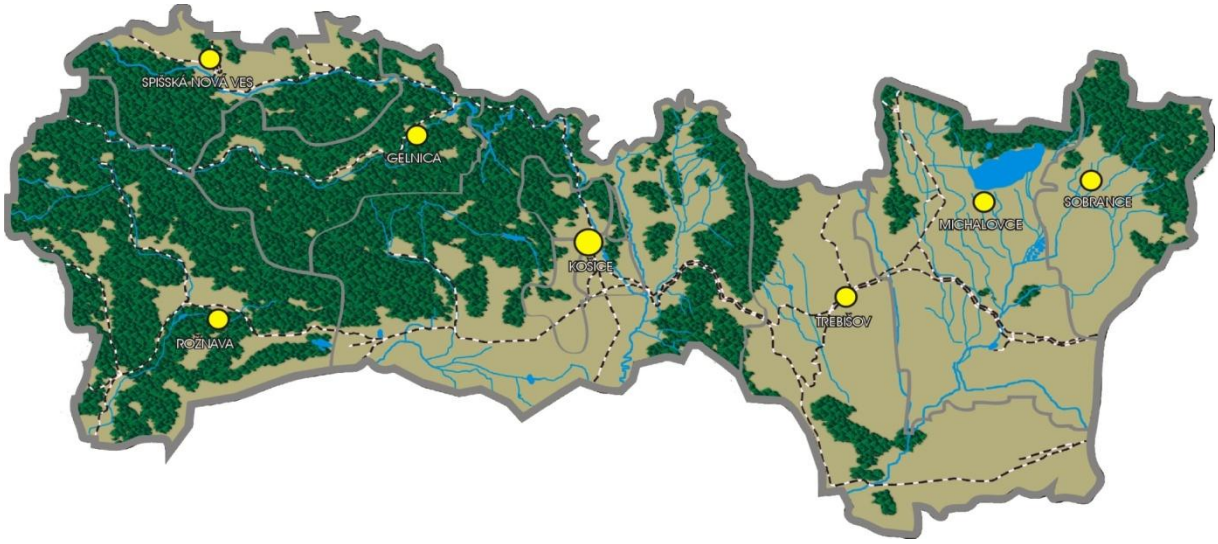

Figure 2 Forested and non-forested areas in the Košice Region.

The regional industry, manufacturing and public sector (Table 1) represented the regional total Gross value added (GVA) of 7 888 million euro in 2014. In 2014, total gross domestic product (GDP) purchasing power parity of the region was 13 126 million and per capita GDP was about 16.5 kEUR/year, considerably below the European average of 27.5 kEUR/year[8]. In fact, the Košice Region is the 10th least developed region of the European Union. Economic performance of the region has shown a long-run declining tendency in a national rating since the Košice Region represents only about 11.5% of regional GDP share of Slovakia although it is the second most populated region and the fourth largest region in terms of size. In 2013, the Košice Region could count on an active population of about 375 100 of citizens with the unemployed rate of about 13% represented as one of the highest rates among Slovak regions. However, despite the low economic performance, the regional GDP has been increasing since 2000 (except for the year crisis in 2008).

Table 1 Gross Value Added in the Košice Region. Source: STATdat – Verejná databáza údajov (URL)

[8] http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

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Gross value added	Mln €
Agriculture, forestry and fishing (A)	**328**
Total industry (BE)	**2185**
Manufacturing (C)	**2084**
Construction (F)	610
Wholesale and retail trade, repair of motor. vehicles and motorcycles; transportation and storage; ubyt. and spent. Service (GI)	1742
Information and communication (J)	491
Financial and insurance activities (K)	174
Real estate activities (L)	535
Professional, scientific and technical activities; Administrative Services (MN)	557
Public administration and defense, compulsory. social. security; education; health and social work (OQ)	**1042**
Arts, entertainment and recreation; Other activities (RU)	224
Total	**7888**

The agriculture, forestry, and food sectors in eastern Slovakia have been greatly diminished after the transformation of economy in 1990's. This implies limited availability of waste and residues from these sectors that could be used as feedstock for a bioeconomy. As a result, 75-80 % of the food is imported to Slovakia today. This development of the agricultural sector is driven by the fact that there are only a few key actors in the primary agricultural sector with a lower share of animal production connected to the local processing production. In addition, during the last couple of years foreign farmers, for example Danish, German, Dutch, but also Chinese, have started to buy Slovak land for animal breading since the costs are lower than in their own countries. However, the Slovak government is aiming to stop the selling of Slovak land to foreign farmers.

Ambitions

The Košice Region has no specific target or strategy for bioeconomy and there is no national bioeconomy strategy. Despite this there are several documents both at regional and national level that affect development of bioeconomy and innovation in this area. For example, the 'Regional Innovation Strategy of the Košice Region 2016 [9] that introduces measures supporting innovation and commercialisation.

Another example is the new Energy Policy adopted by the central Slovak government in November 2014. The main aim of this national policy is to improve resources management and increase the use of renewable energy sources. Several documents have been developed to meet the priorities of the Energy Policy, as for example the 'Concept of energy efficiency'[10,] 'Third Action plan of energy

[9] Regionálna inovačná stratégia Košického kraja 2013 – 2020) – Avaliable at http://web.vucke.sk/files/dokumenty/pub/regionalny_rozvoj/phsr/2015/prilohy/priloha_7_regionalna_inovacna_strategia_kosickeho_kraja_2013_2020.pdf

[10] Slovak Government Resolution No. 576/2007

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efficiency for 2014 – 2016' with the perspective up to 2020[11] and the 'National action plan for the energy from renewable sources'[12].

The development of a Slovak bioeconomy could also be affected by the 'Agriculture Development Policy for the years 2013 – 2020'[13]. Its aim is to promote the efficient utilisation of sources for a smart, sustainable, and inclusive growth of agriculture and rural areas. To reach this aim the 'Action Plan for the Development of Agriculture for the years 2014 – 2020'14 was adopted. This plan set out several measures that should help develop the local production via young farmers, should support the production of high quality regional food, energy sufficiency of the municipalities and local businesses based on renewable sources of energy including biomass. Furthermore, the action plan aims to: stop the loss of agricultural lands; stop further drop of agricultural production; support the increase of livestock and special plant production; increase the competitiveness of Slovak agriculture; improve the cooperation among farms in purchasing inputs and marketing their products; align the employment rate in the agricultural sector with the average EU level; increase the labour productivity in the agriculture to 70-80% of the EU average; increase the level of diversification of agricultural production and non-agricultural activities of farmers; stimulate the demand for specific goods and services in agriculture and food industry and support a sustainable forest management.

In addition to the mentioned documents, DG Grow selected the Košice Region as one of the [6] 'Model Demonstration Regions for Bioeconomy and Sustainable Chemicals'. The Energochemica [15] group and the Košice Self-governing Region are involved in this work, which hopefully can initiate discussions among various actors, including for example the Ministry of Economy and the Ministry of Environment, of how to develop a bioeconomy in Slovakia.

5.1.3 Strenghts, needs and trends

Item	Analysis
Regional strengths / things to offer	• Several universities are located in the region, several of these are involved in life science. There is a strong expertise in the area of applied energy research, and circular economy, and material research. • Good industrial development base especially in the area of sensors, industrial processes and IoT • European focus on enhancing the region (availability of funding programs). • The work with the 'Model Demonstration Region for Bioeconomy and Sustainable Chemicals' could initiate a broader discussion on the possible way to support bioeconomy at national and regional level. • East Slovakian Lowlands have a great potential in their deep earth geo-thermal energy sources (of 4000 MWt), which in combination with the local biomass potential is a good prerequisite for valorisation of starting materials into low-carbon bioeconomy products • With good logistics it is possible to ensure additional biomass resources within the

[11] Slovak Government Resolution No. 350/2014
[12] Národný akčný plán pre energiu z obnoviteľných zdrojov) – Avaliable at http://www.economy.gov.sk/narodny-akcny-plan-pre-energiu-z-obnovitelnych-zdrojov/135436s, Slovak Government Resolution No. 677/2010
[13] Slovak Government Resolution No. 357/2013
[14] Slovak Government Resolution No. 33/2014
[15] http://www.energochemica.eu/

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	perimeter of 50km from the nearby Transcarpathian area (Ukraine) • Industrial availability of other raw material commodities such as zeolite and calcite in bioeconomy
Regional needs / things to fix	• Lack of national initiatives (as well as regional) bioeconomy targets and strategies • Necessity of funding tools to fund applied research and development of prototypes for bioeconomy products • Need to form networks/value chain or clusters in order to increase cooperation amongst actors and between industry and academy. • Scale up of bioeconomy processes could be hindered by lack of feedstock. • Agricultural sector dominated by few large actors with little interest in local production.
Regional trends	• High unemployment

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6 Northern Italy chemical and material cluster

6.1.1 Summary

Item	Analysis
Type of feedstock	**Agro, agro waste and forest:** Dedicated crop from marginal land (SPRING Priority Area 1) to intermediates or high value products; Regional-specific agri-, forestry- and agribusiness- residues (SPRING Priority Area 2),for building blocks or intermediates or high value products; Municipal Solid Wastes (SPRING Priority Area 3) to high value products; 
Expect impact bio economy	**High:** Considering that Northern Italy chemical and material cluster is the biggest chemical industry cluster in Italy and that its key industrial actors are trying to develop a shared vision for the share a vision of reducing their dependance fossil independent transport fuels, chemicals and materials by 2030, the impact of the region on the development of a national bio-economy is expected to be very high.
Market potential	**High:** At National Level it is estimated that the BioEconomy accounts for 7.9% of the Italian GDP, and that it can accounts to up to 39% of the national chemical sector in time..
Comments	Northern Italy is not one Region but 8 regions: Lombardia, Veneto, Emilia-Romagna, Piemonte, Liguria, Friuli-Venezia, Trentino Alto-Adige, Valle d'Aosta having a population above 27 Million people. In Italy there is no national or regional strategy for the BioEconomy, while indeed EU directive apply. The SPRING public private Cluster is taking the lead in the development of a strategy in Italy. http://www.clusterspring.it/chi-siamo/cluster/

6.1.2 Characterization of the region

Within the European Member State Italy, Northern Italy is a loosely defined cultural and geographical region, without a specific administrative correspondence, used to indicate the northern part of the Italian state. According to the Italian national census of 2011, its population was above 27 million people. It consists of 8 regions in northern Italy: Lombardia (10 million), Veneto (4.93 million), Emilia-Romagna (4.45 million), Piemonte (4.42 million), Liguria (1.58 million), Friuli-Venezia Giulia (1.22 million), Trentino Alto-Adige (1.06 million), Valle d'Aosta (0.13 million).

The *Italian Istituto Nazionale di Statistica* (ISTAT) uses the term "Northwest Italy" and "Northeast Italy", the same subdivisions are used to demarcate first level Nomenclature of Territorial Units for Statistics (NUTS) regions ("NUTS 1 regions") within the European Union, and the Italian constituencies for the European Parliament. This section describes the character of the regional as well as its ambitions and innovation pathways to reach that ambition.

Northern Italy is home to a wide number of actors working towards realizing a bio based economy. The “macro-region” contains several of the country’s most important industries, with a potential for increased production or utilization of bio-based and sustainable transport fuels, chemicals and related materials as well as the production of renewable energy. In addition, the region offers an excellent environment for research and innovation through the universities and several research centres that are well recognized within innovation and knowledge creation related to bio-economy and sustainability development. The academia and the public and private sectors cooperate in the already established clusters CLAN and SPRING. Several spontaneous loosely coordinated, private-led bio-economy initiatives are already well under way and have led to the establishment of links with actors in other regions and abroad for delivery of feedstock, technology and other necessary know how to reach this goal.

6.1.3 Strengths, needs and trends

Item	Analysis
Regional strengths / things to offer	• Large industrial areas being dismissed, opens way for cheap CAPEX reconversion; • Large availability of region-specific 1G/2G feedstocks and value chains; • Cheap & qualified Labour; • Wide range of utilities and large ecosystem of upstream/downstream industries; • Good quality basic research performed by local universities;
Regional needs / things to fix	• Lack of professional start-up entrepreneurs; • Lack of connection with rest of Europe; • Lack of language (English) skills; • Risk adverse, provincial, one-man-band business culture; • Very slow regulatory and business development time. • Lack of a common vision/clear ambition guiding action in the region.
Regional trends	• Petrol price stays low; • East European Countries can deliver can deliver similar quality at lower price; • Changes in international trade legislation creates new opportunities for international sugar trade and more level playing field competition; • Increasing corruption and organised crime influence in the waste and industrial sectors; • National government cuts budgets for innovation policy;

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7 Piedmont, Northern Italy

7.1.1 Summary

Item	Analysis
Type of feedstock	**Agro, agro waste and forest:** High availability of dedicated crop from marginal land to intermediates or high value products; Relevant availability of agri-, forestry- and agribusiness- residues,for building blocks or intermediates or high value products; High availability of Municipal Solid Wastes to high value products; Strong connection to local individually owned farms, developed over centuries.
Expect impact bio economy	**High:** Considering that the Northern Italy chemical and material cluster is the biggest chemical industry cluster in Italy and that its key industrial actors are trying to develop a shared vision for reducing their dependence on fossil transport fuels, chemicals and materials by 2030, the impact of the region on the development of a national bio-economy is expected to be very high. Strong presence of important Bioeconomy actors Biochemtex and Crescentino Biorefinery.
Market potential	**High:** At National level it is estimated that the BioEconomy accounts for 7.9% of the Italian GDP, and that it can account to up to 39% of the national chemical sector in time. Important producer of 2G biofuels (diesel and ethanol) in Europe Frontrunner in the field of bioplastics legislation
Comments	Northern Italy is not one Region but 8 regions: Lombardia, Veneto, Emilia-Romagna, In Italy there is no official national or regional strategy for the BioEconomy in place. The SPRING public private Cluster is currently taking the lead in the development of such a strategy in Italy. http://www.clusterspring.it/chi-siamo/cluster/ Despite the absence of an official strategy at national and local level, the national policy is particularly supportive of bioenergy and biofuel implementation as well as for high implementation targets for biofuel and bioplastics utilisation.

7.1.2 Characterization of the region

Piedmont is the second largest of Italy's 20 regions. It has an area of above 25,000 square kilometres and a population of around 4.6 million. Piedmont is surrounded on three sides by the Alps. Its main borders are with France, Switzerland and the Italian regions of Lombardy, Liguria, Aosta Valley. The geography of Piedmont is 43.3% mountainous, hills (30.3%) and plains (26.4%). The capital of Piedmont is Turin, also the first capital of the Kingdom of Italy. At the beginning of twentieth century, Piedmont was one of the most important regions in the first Italian industrialization. Piedmont per-capita GDP was 28 kEUR/year in 2014, slightly above the Italian and European (27 kEUR/year) averages.

Piedmont, as the Northern Italy, is home to a wide number of actors working towards realizing a bio based economy. The region contains several of the country's most important industries, such as Biochemtex and Novamont (founders of the national bioeconomy cluster SPRING), with a potential for increased production or utilization of bio-based and sustainable transport fuels, chemicals and related materials as well as the production of renewable energy. In addition, the region offers an excellent environment for research and innovation through the universities and several research centres that are well recognized within innovation and knowledge creation related to bio-economy and sustainability development. The academia and the public and private sectors cooperate in the

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already established clusters CLAN and SPRING, whose stakeholders are located in Piedmont and other Italian neighbouring regions.

7.1.3 Strengths, needs and trends

Item	Analysis
Regional strengths / things to offer	• Large industrial areas being dismissed, opens way for cheap CAPEX reconversion: • Large availability of region-specific 1G/2G feedstocks and value chains; Strong connection to local individually owned farms, developed over centuries. • Cheap and qualified workforce; • Wide range of utilities and large ecosystem of upstream/downstream industries; Important producer of 2G biofuels (diesel and ethanol) in Europe Strong presence of important Bioeconomy actors Biochemtex and Crescentino Biorefinery. • Frontrunner in the field of bioplastics legislation • Good quality basic research performed by local Universities and Research and Technology Organisations.
Regional needs / things to fix	• Lack of professional start-up entrepreneurs and relevant supporting mechanisms; • Lack of connection with the European market: difficulties in communicating with foreign market and understanding the needs; • No internationalisation mind-set and risk adverse and one-man-band business culture; • Very slow regulatory and business development time..
Regional trends	• Low price of fossil feedstock and possible decrease of fossil fuels cost in the coming years; • Competition between Piedmont and East European Countries which can deliver similar products at lower price; • Changes in international trade legislation creates new opportunities for international sugar trade and more level playing field competition; • Increasing corruption and organised crime influence in the waste and industrial sectors; • National government cuts budgets for innovation policy and research.

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8 Sardinia, Italy

8.1.1 Summary

Item	Analysis
Type of feedstock	**Agro & agro waste:** High availability of grazing land and permanent grassland – about 60% of Agricultural Area Used (SAU); Relevant availability of waste and scrap from agricultural and farming activities..
Expect impact bio economy	Considering the wide involvement of local authorities in building a greener and sustainable economy in the region, the support in creating a national bio-economy is expected to be relevant..
Market potential	**High:** Following the existence of the Matrìca project in the region and its public support from the local authorities, it is reasonable that other economic initiatives in the bioeconomy sector will be undertaken by exploiting the network already established. At National Level it is estimated that the BioEconomy accounts for 7.9% of the Italian GDP, and that it can accounts to up to 39% of the national chemical sector in time.
Comments	In Italy there is no official national or regional strategy for the BioEconomy in place. The SPRING public private Cluster is currently taking the lead in the development of such a strategy in Italy. http://www.clusterspring.it/chi-siamo/cluster/ Despite the absence of an official strategy at national and local level, the national policy is particularly supportive of bioenergy and biofuel implementation as well as for high implementation targets for biofuel and bioplastics utilisation.

8.1.2 Characterization of the region

Sardinia is one of the autonomous regions of Italy. It thus has almost complete free-standing on legislation, administration and finance. Sardinia is an island located in the Western Mediterranean Sea with an area of above 25,000 square kilometres and a population of around 1,660 million. The 13.6% of the island is mountainous, 67.9% hilly and 18.5% flat. The capital of Sardinia is Cagliari. Sardinia per-capita GDP was more than 19 kEUR/year in 2014, considerably below the Italian and European averages (27 kEUR/year). On the other hand, Sardinia is revealing a faint economic upturn: in 2015 employment level and access to finance have increased[16]. Sardinia is not one of the most industrialised Italian regions, however, it contains several industries involved in chemical industry. More specifically, Matrìca Spa is a flagship on-going project which will enable the creation of an integrated third-generation biorefinery by using agricultural raw material and vegetable waste and deeply developing the integrated agricultural production chain. Matrìca is half-owned by Novamont, one of the founders of the national bioeconomy cluster SPRING.

In addition, Sardinia is starting in creating a good environment for research and innovation through the universities and research centres. At the moment, the cluster SPRING can count only three entities located in the region, namely Matrìca spa, University of Cagliari and University of Sassari.

8.1.3 Strenghts, needs and trends

Item	Analysis
Regional strengths / things to offer	• Large availability of region-specific 1G/2G feedstocks and value chains; Strong connection to local individually owned farms, developed over centuries. • Cheap and qualified workforce;

[16] http://www.bancaditalia.it/pubblicazioni/economie-regionali/2016/2016-0020/index.html

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	• Good quality basic research performed by local Universities and Research and Technology Organisations.
Regional needs / things to fix	• Lack of professional start-up entrepreneurs and relevant supporting mechanisms; • Weak cooperation between Academia / Research Centres and Industries; • Lack of connection with the European market: difficulties in communicating with foreign market and understanding the needs; • No internationalisation mind-set and risk adverse and one-man-band business culture; • Frontrunner in the field of bioplastics legislation • Very slow regulatory and business development time.
Regional trends	• Low price of fossil feedstock and possible decrease of fossil fuels cost in the coming years; • Changes in international trade legislation creates new opportunities for international sugar trade and more level playing field competition; • National government cuts budgets for innovation policy and research.

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9 Saxony-Anhalt & Saxony, Germany

9.1.1 Summary

Item	Analysis
Type of feedstock	**Forest** Wood, primarily beechwood
Expect impact bio economy	**High** Clear vision and ambition of the Cluster for internationalisation Excellent visibility of the Cluster as winner of the "Leading Edge Cluster" competition Well established network and interlinking of the Cluster, with good opportunities for synergistic combinations between different members of the value chain Wide range of existing utilities and ecosystems for upstream/ downstream industries Good support from the German public and high interest in themes related to maintenance of the forest/wood ecosystems
Market potential	**High:** Any increase in business and the planned internationalisation will require access to more talents. This may be difficult given the rural character of the region and strong competition from other regions (such as South Germany) for talents, experts and bioeconomy professionals. Further development of knowledge will depend also on innovative start-ups. The current start-up activity in the region is low.
Comments	Clear national and regional policies provide a good framework for the long term development of sustainable bioeconomy in Central Germany

9.1.2 Characterization of the cluster

Regional and national strategy: The Strategy of the Bioeconomy Cluster e.V.

Chemistry meets the timber industry - the BioEconomy Cluster in Central Germany
(http://en.bioeconomy.de)

The BioEconomy Cluster ("the Cluster") is an association made up of companies, research institutes and educational institutions in the German states Saxony-Anhalt (Sachsen-Anhalt, see Figure 1) and Saxony (Sachsen) that work in close partnership to build the foundations of a biobased economy. Their aim is to promote the material and energetic use of biomass in the form of innovative processes used in the production of materials, platform chemicals, products and energy carriers on the basis of renewable non-food resources like beech wood. On the scale of a regional centre of competency in Central Germany, value chains are expanded and sustainably and efficiently optimised through coupled production and cascade utilisation of waste materials.

Figure 1: Geographical position

The Cluster's aim is to create a bioeconomy model region for Germany and Europe. The region covered by the Cluster provides excellent conditions as an

established chemical location and timber region. The regional core area comprises the Südharz timber region and chemical triangle in Saxony-Anhalt and Leipzig, Dresden and the Leuna chemical site in Saxony (see Table 1 for key economic data of both German states). The Cluster enables the relevant sectors to represent a new, unique profile on the international market.

	Saxony-Anhalt	Saxony	Germany
Capital	Magdeburg	Dresden	Berlin
Area	20,452 km²	18,416 km²	357,168 km²
Population total	2,245,470	4,084,851	82,175,700
Population density	110/km²	220/km²	230/km²
GDP/ Nominal	€56 billion (2014)	€108 billion (2014)	3 trillion
GDP per capita	€24,000 (2014)	€25,400 (2014)	€36,708

Source: wikipedia

Table 1: key economic data

Currently more than 116 companies, research institutes and educational institutions are organised within the BioEconomy Cluster (Cluster members A-Z). In 2012 the cluster was one of the winners of the Leading Edge Cluster Competition held by the Federal Ministry of Education and Research (BMBF). In addition, the cluster currently participates in 44 collaborative research projects and about 144 subprojects. By 2017 as much as 80 million euros will have been put towards conducting research and implementing the bioeconomy as part of the funding of Leading Edge Clusters (50% of this coming from industry). Beyond its regional focus, the BioEconomy Cluster is also connected with decision-makers from relevant industries and represents its members throughout Europe.

The Cluster has two strategic objectives:

- To sustainably maximize value creation of non-food biomass through coupled production and cascade utilisation in order to generate chemicals, new materials and energy.
- To speed up innovation through the integrated, temporally and spatially coordinated up-scaling of processes and plants from laboratory to development demonstration scale.

The core competencies of the cluster are the result of its broad range of industries and the corresponding technology and problem-solving competencies of its members. The future bioeconomics sector is made up of all of the economic sectors that produces, process or sustainably use biological resources and therefore includes a variety of industries. The Cluster integrates pre-existing cluster structures in the region such as:

- the “Chemistry/Plastics Central Germany” Cluster,
- the Wood Cluster “Rottleberode”,
- the Energy and Environment Cluster in Leipzig with its network BioEnergy and
- the network surrounding the Fraunhofer Centre for Chemical-Biotechnological Processes (CBP) in Leuna.

Added to this are various branches of the chemical industry, the plastics and plastic processing industry, the paper and pulp industry, machine and plant engineering for processing industries, and renowned research institutions from all related sectors. The core technological competencies are the development, up-scaling and application of innovative technological processes for the sustainable use of biobased raw materials from the non-food sector. These are used to produce high-value products for various industrial sectors. The Wood Cluster “Rottleberode” provides the

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crucial technological competency needed to supply and process wood as a raw material and to mechanically recycle it. The companies at the chemical site in Leuna and the Fraunhofer partners IAP, PAZ and IWMH provide competency in the further processing of basic chemicals. The competency for energy recovery of residual waste streams is covered by DBFZ Leipzig and others from the BioEnergy Network Leipzig. The material flows are monitored by UFZ Leipzig.

Bioeconomy value chain covered by the Cluster

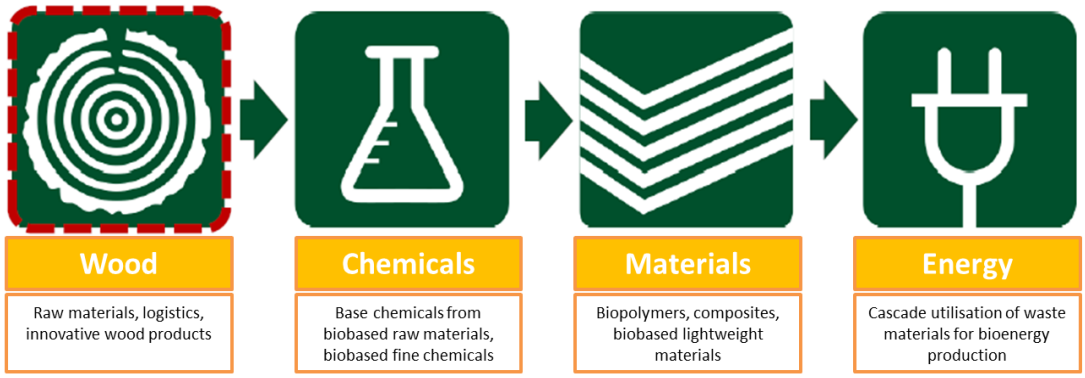

Figure 2: Bioeconomy value chain comprising production of wood, biobased chemicals, materials and energy from waste materials as core activities in the Cluster

9.1.3 Strenghts, needs and trends

Item	Analysis
Regional strengths / things to offer	• Good quality basic research performed by local institutes such as: 8 Fraunhofer Institutes, Fachhochschule Rosenheim - Holztechnik (and other polytechnical colleges), Georg-August Universität Göttingen • Funding opportunities for energy related themes provided by the BMBF and BMWi • Clear vision and ambition of the Cluster for internationalisation • Excellent visibility of the Cluster as winner of the "Leading Edge Cluster" competition • Well established network and interlinking of the Cluster • Wide range of existing utilities and ecosystems for upstream/ downstream industries • Large availability of feedstock, particularly beechwood • General environmental concerns and high interest in sustainable development drive domestic demand for biobased "green" products • Good alignment of the Cluster's activities with German and European RIS3 strategies • Clear national and regional policies provide a good framework for long term development of sustainable bioeconomy in Central Germany • Good support from the German public and high interest in themes related to maintenance of the forest/wood ecosystems
Regional needs / things to fix	• In Germany, the number of entrepreneurs has fallen due to the strong situation of the economy and a risk adverse culture. This may impact negatively in the long term as innovative start-ups are key to knowledge development. • The Cluster has not yet the support from NGOs (such as Greenpeace) who claim that too much of the German beechwood is used for industrial processing
Regional trends	• Growth and internationalization will require additional hiring of qualified personnel and experts. Due to the good situation of the German economy, this access can be difficult particularly for companies located in less attractive regions in Central Germany. • Continuously low prices for fossil-derived products provide significant hurdle for expansion into markets outside of Germany.

10 Scotland, UK

10.1.1 Summary

Item	Analysis
Type of feedstock	**Forestry & agro**
Expect impact bio economy	**High** Scotland has a high bioeconomy potential for the following reasons: 1. Engagement towards climate and sustainability goals. 2. Industrial background and infrastructure. 3. Availability of feedstocks and natural resources. 4. Research and innovation activity in related fields.
Market potential	**High:** Relevant industries, such as the chemicals industry or the food and drink industries are well-established in Scotland, providing a solid industrial and infrastructural basis for companies operating in the bio-based sector. The prevalence of these sectors also ensures an up-to-date knowledge basis and skilled and experienced employees.
Comments	

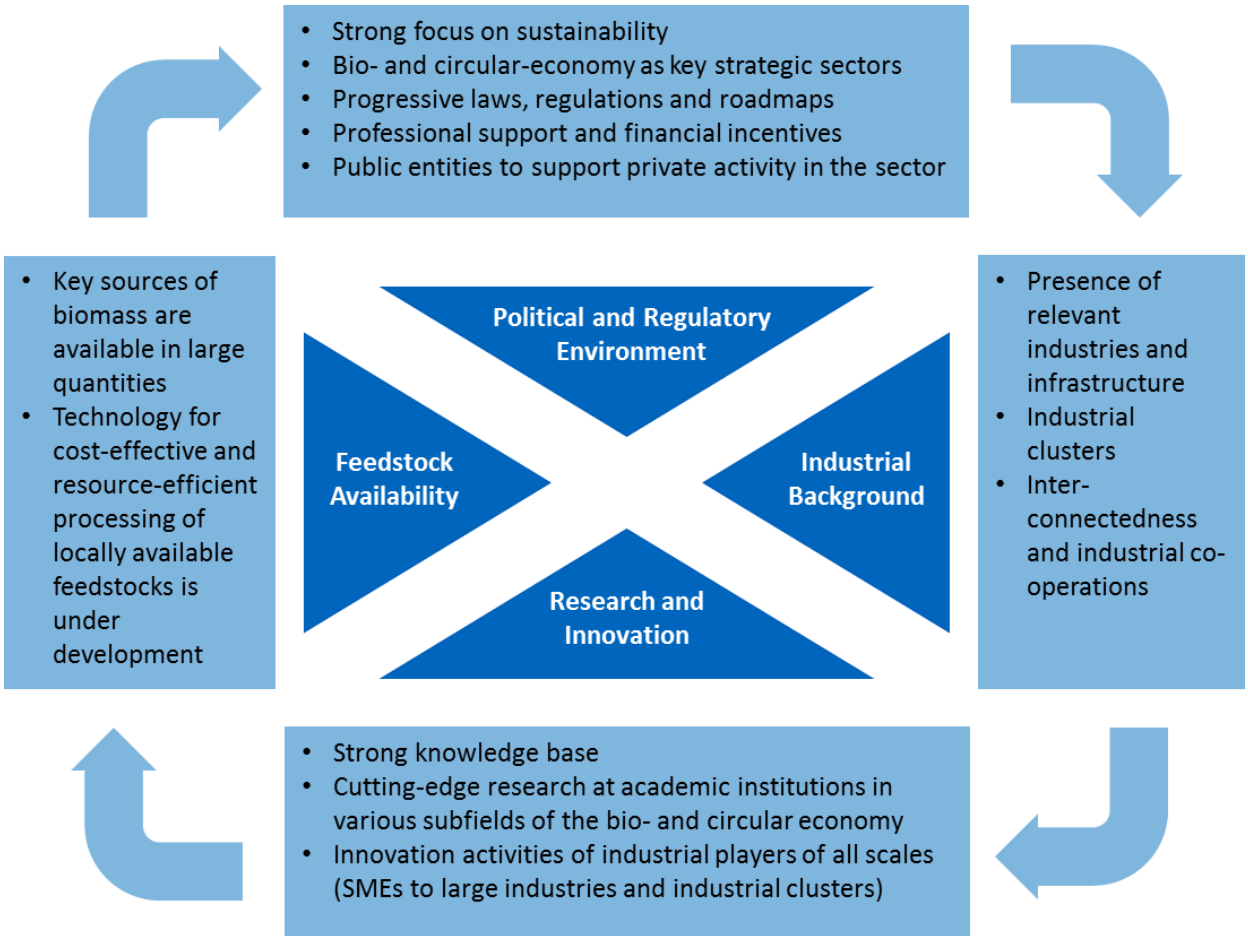

Figure 1: Summary of findings - Scotland's bioeconomy potential

10.1.2 Characterization of the region

Geography

Scotland[17] is the most northerly region of the United Kingdom and occupies about one-third of the island of Great Britain. Traditionally divided into three topographic areas (Highlands in the north, the Midland Valley and the Southern Uplands), a diversity in geologic structure, relief, weather and soil is highly characteristic for the region (see Figure 2). Scotland has a temperate oceanic climate, milder than might be expected from its latitude. Regarding its topography, the east coast contrasts with the west in its' smoother outline and thus creates an east-west distinction as well as a north-south one. Soil also differs greatly in the different geographic areas. In the northwest and on the Islands, the soil is poor and rocky, and cultivation is possible only at river mouths, glens, and coastal strips. On the west coast of some Hebridean islands, however, there are stretches of calcareous sand (the machair) suitable for farming. Peat is widespread on moors and hills. Areas with good, arable land have largely been derived from old red sandstone and younger rocks, as in the Orkney Islands, the eastern Highlands, the north-eastern coastal plain and the Lowlands.[18]

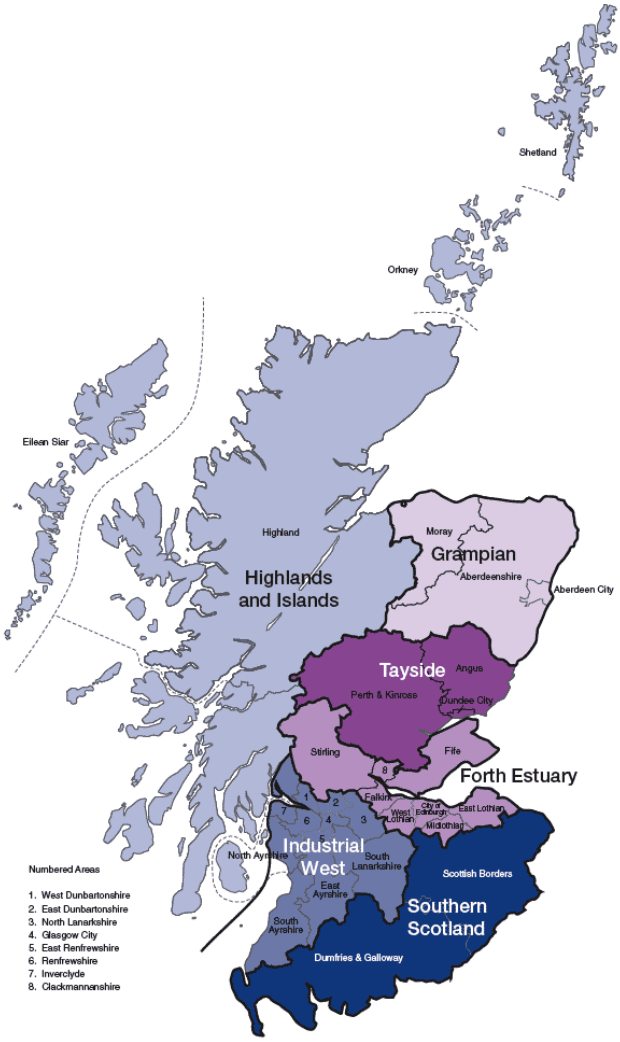

Figure 2: Regions of Scotland

[17] Regions of Scotland (picture): URL
[18] Scotland, Britannica 2017: URL

Population	≈ 5.3 million
Capital (with population)	Edinburgh – 492,680 (2014)
Main cities (with population)	Glasgow – 599,650 (2014) Aberdeen – 228,990 (2014) Dundee – 148,260 (2014) Stirling – 91,580 (2014) Inverness – 56,660 (2014)
Area	78,772 km²
GVA per head	£19,744 (2009)

Table 1: Key facts and figures about Scotland

Agriculture and forestry

At present, 18% of Scotland's land surface is covered by forests which should increase to 25% by 2050[19]. In 2015-2016, 12,500 hectares were newly planted or restocked.[20] The forest and timber technologies sector consists of 1,700 businesses contributing £1bn in GVA to the Scottish economy employing around 25,000 people.[21]

According to 2014 study conducted by the Institute for European Environmental Policy[22], the following land types have a good potential to grow biomass:

- Fallow land in agriculture
- Contaminated land
- Recently abandoned arable land
- Other unutilized land within the current agricultural area
- Recently abandoned grassland

According to 2006 data, the total agricultural area in Scotland is 5.7 million hectares (73 % of Scotland's total land area). As depicted in Figure 3, 55% of the agricultural land is comprised of rough grazing, with about a quarter taken up by grass, and ten per cent used for crops or left fallow. The remainder consisted of woodland (9%) and land for other uses (3%), such as roads, yards, buildings, scree, ponds and other such non-cultivated land.

[19] Scotland's key statistics, Scottish Enterprise 2017: URL
[20] Forestry Statistics 2016, Forestry Commission 2016: URL
[21] Scotland's key statistics, Scottish Enterprise 2017: URL
[22] Space for energy crops – assessing the potential contribution to Europe's energy future, Institute for European Environmental Policy 2014: URL

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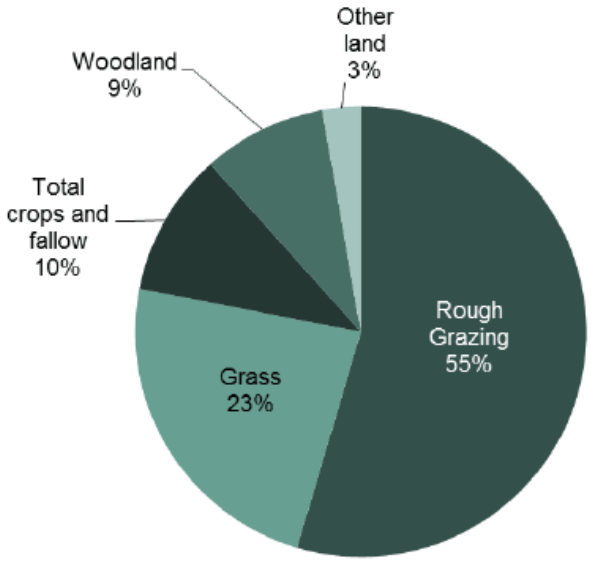

Figure 3: Agricultural land use in Scotland, 2016

Additionally, almost 600,000 hectares of land is used for the common grazing of livestock. Amongst the crops grown in Scotland, excluding grass, cereals accounted for around 75 per cent of the land area, two-thirds of that being barley, one quarter wheat and about 7% oat. There were also considerable area growing oilseed rape (31,000 hectares) and potatoes (27,500 hectares). Out of the 20,000 hectares of fruit and vegetables, a total of 1,000 hectares of strawberries were grown, mainly under cover, and was the largest source of income in horticulture. [23]

10.1.3 Strenghts, needs and trends

Item	Analysis
Regional strengths / things to offer	• Industrial background and infrastructure. Relevant industries, such as the chemicals industry or the food and drink industries are well-established in Scotland, providing a solid industrial and infrastructural basis for companies operating in the bio-based sector. The prevalence of these sectors also ensures an up-to-date knowledge basis and skilled and experienced employees. • Availability of feedstocks and natural resources. Feedstocks and natural resources are available in large quantities and national strategies, such as the Land use strategy, are introduced to take a holistic approach and deploy them in ways that that result in benefits for all stakeholders and sectors, including the environment. • Research and innovation activity. There are thriving academic and industrial communities as well as joint activities and inter-organizational cooperations conducting cutting-edge research and developing innovative technologies in bioeconomy related sectors.
Regional needs / things to fix	• While the factors listed above outline a good bio- and circular economy potential for Scotland, some challenges— in particular political challenges related to Brexit—need to be handled in order to keep Scotland on the right track and ensure the steady growth of the sector. This can set the foundations of a flourishing bio- and circular-economy sector which, in turn, can be a basis of a sustainability-focused, bio-based Scottish economy.
Regional trends	• Engagement towards climate and sustainability goals. Both the Scottish Government and industry players and other stakeholders are strongly engaged towards realizing climate-friendly, sustainable investments enabling the creation of a high-level, bio- and circular economy.

[23] Results from the June 2016 Scottish Agriculture Census, Scottish Government 2016: URL

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11 South West Netherlands

11.1.1 Summary

Item	Analysis
Type of feedstock	**Agro & Wood** Agro: sugar beat, potatoe (starch), cereals Wood: expected large import of wood (green energy act)
Expect impact bio economy	**High** large scale investments foreseen in sugar and wood transition to chemical building blocks SME focused projects to get to a wide variety of end markets (building materials, chemicals, coatings, …)
Market potential	**High:** SME programs are focus on market pull Biobased Delta part of the ARRRA cluster able of picking up new materials rather quickly.
Comments	

11.1.2 Characterization of the region

In the South-western Netherlands entrepreneurs, knowledge institutes and governments in Zeeland, Zuid-Holland and Brabant work together towards a biobased economy. The region is a front runner in this new economy. It has a large agro, horticulture and chemical sector, advantageous geographic location (along the Antwerp-Rotterdam axis), room for various deep sea ports, and provides the setting for collaboration between multinationals, the SME sector, knowledge institutions and government agencies. All of this makes the South-western Netherlands entrepreneurial, distinctive and application-oriented. United under the name 'Biobased Delta', entrepreneurs, knowledge institutes and government agencies strengthen the front runner position of the region in the biobased economy. They work together across borders in several respects, not only between the various sectors in the Netherlands, but also with business professionals in Flanders, northern France and North Rhine-Westphalia. The three provinces combined[24],[25] have approx. 1,5M inhabitants, just over 360.000 companies in total[26], employing just over 2M employees.

The Biobased Delta has access to the ports of Rotterdam (Europe's largest) and Antwerp (2nd). There is a strong and historic presence of the agricultural and chemical industry. The delta is well positioned as the central part between North Rhein Westphalia and Nord Pas de Calais (including Picardie). In the past few years the region has invested 400-600M Euro in over 120 projects[27]. Approximately 10% of the budget was related to R&D and business development, the other 90% was related to investments in new biobased products and bio processes.

Ambitions

The Biobased Delta aims to become a top 3 region in Europe in the field of Agro meets Chemistry with its key themes on Green Feedstock, Green Building Blocks and Sustainable Process Industry. The ambition is to become a top-3 European region (2020), i.e.:

[24] Only the western part of Brabant is part of the Biobased Delta. In view of this document, when referred to Brabant, the reference is specifically to the COROP West-Noord-Brabant

[25] All data from CBS based on COROPs (2014): Leiden-Bollenstreek, 's-Gravenhage, Delft & Westland, Groot-Rijnmond, Oost-Zuid-Holland, Overige Zeeland, West-Noord-Brabant, Zeeuwsch-Vlaanderen, Zuidoost-Zuid-Holland. Except number of employes (based on 2013 figures)

[26] 'consultancy services' and 'culture, sports' companies account, in total, for approx 260.000 companies, 1,5M employees.

[27] Based on

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- Invest another 600 M€ up to 2020 in scaling up current projects and investments and in (regional) flagship initiatives.
- Safeguard 15000 jobs and create additional 2500 jobs.

11.1.3 Strength, needs and trends

Item	Analysis
Regional strengths / things to offer	• Lot of different biomass streams available with high potential for future applications (e.g. sugar). • Strong agrofood industry willing to invest in R&D. • Accessibly of region (harbours, road, rail) • Part of the ARRRA region (biggest and most integrated chemical cluster in the world)
Regional needs / things to fix	• Funding (public / private) to support SMEs to overcome the 'valley of death' • Business cases to convince industry to enter into biobased materials • Waste directive
Regional trends	• Less public funding available for well-developed regions • Market driven initiatives are taking over • No clear political / policy regarding biobased economy.

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12 Tipperary County, Ireland

12.1.1 Summary

Item	Analysis
Type of feedstock	**Agro and agro waste:** Large quantities of waste from agriculture and horticulture are available in Ireland. In addition, there are substantial unexploited marine biomass resources.
Expect impact bio economy	**High** Tipperay has the potential to be a national show case of bioeconomy, but is still in a formative development phase. The assets of the region are a large and motivated agrifood sector, the availability of biomass resources and strong research organisations.
Market potential	Due to the early phase of bioeconomy development in the region it is difficult to assess the market potential. A wide range of products and processes are seen as possible. Examples of products are: cosmetics, plastics, chemicals, 3D printing material as well as bioenergy.
Comments	Ireland has no national bioeconomy strategy, but there is commitment to develop one.

12.1.2 Characterization of the region

With a geographical area of 4,282 km^2 and a population of 158,754 Tipperary is the sixth largest region of the 32 Irish counties by area and the eleventh largest by population (figure 1). The largest towns are Clonmel, Nenagh and Thurles.

Figure 1 Map over Tipperary

In 2014, Southern and Eastern Ireland[28] GDP was about EUR 155,860 million and per-capita GDP was about 46 kEUR/year, considerably above the European average of 27 kEUR/year.

Tipperary is representative for Ireland in terms of bioeconomy as there is much fertile land and a large agriculture sector, the region is particularly strong in dairy farming and cattle raising. Tipperary County also has a varied economy which includes medi-pharma sector as well as manufacturing sector. The area around Clonmel is an important hub for the medi-pharma sector.

[28] Because of the lack of specific data for Tipperary County, the following data refer to NUTS 2 level which encompasses Tipperary County. Source: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=tgs00004&language=en

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Ambitions

Ireland has no national bioeconomy strategy; however there is commitment to develop one. An example of this ambition is the Irish Government-funded Bio-Éire project[29] that is identifying priority opportunities for Ireland's bioeconomy. Likewise there is no bioeconomy strategy for Tipperary County.

There are, however, strategic documents that are of relevance for the development of bioeconomy in Ireland and Tipperary. There are some national reports that describe the basis for bioeconomy development in Ireland; 'Developing the green economy in Ireland' from 2009[30] and the 'Delivering the green potential' from 2012[31]. [32] In addition, there is a national vision to reduce greenhouse gas emissions from the energy system sector by between 80% and 95% compared with 1990 levels by 2015.[33]

Tipperary County Council, with the support of the Tipperary Energy Agency (TEA), is involved in implementing an energy strategy, called 'Draft Tipperary Energy Strategy 2016'[34]. Considering the wide availability of renewable energy resources in Tipperary, this region could effectively reduce the national reliance on fossil fuel imports, achieve a more stable and secure energy supply, contribute to climate change mitigation, employment and growth. In addition, Tipperary is a member of the Covenant of Mayors[35] , whose signatories aim to meet and exceed the European Union targets 20-20-20 in climate and energy. In line with this commitment the Tipperary County Council, with the support of the TEA, will prepare a Sustainable Energy Action Plan (SEAP). It is expected to be completed in 2016 and will set out a ranges of actions aimed at reducing CO_2 emissions.

[29] BioÉire: Identifying pathways to a bioeconomy for Ireland. Funded by the Department of Agriculture, Food and the Marine through the Research Stimulus Fund, the BioÉire project will inform the development of a national bioeconomy strategy for Ireland. Bio Base NWE project partner, the TCBB (hosted at NUI Galway) is one of the project partners in BioÉire. DIT, Teagasc and UCD are the other BioÉire project partners.

[30] https://www.djei.ie/en/Publications/Publication-files/Developing-the-Green-Economy-in-Ireland-01-12-09.pdf

[31] http://www.agriculture.gov.ie/media/migration/ruralenvironment/environment/bioenergyscheme/DeliveringOurGreenPotential171212.pdf

[32] For an overvierview of Irish policy documents relevant for bioeconomy development see https://biobs.jrc.ec.europa.eu/sites/default/files/generated/files/country/National%20Bioeconomy%20Profile%202014%20-%20Ireland%20.pdf

[33] Department of Communications Energy and Natural Resources, (2015), Ireland's Transition to a Low Carbon Energy Future 2015-2030. Available at http://www.dcenr.gov.ie/energy/SiteCollectionDocuments/Energy-Initiatives/Energy%20White%20Paper%20-%20Dec%202015.pdf

[34] http://www.tipperarycoco.ie/sites/default/files/Publications/Volume%201%20Draft%20Renewable%20Energy%20Strategy.pdf

[35] http://www.covenantofmayors.eu/index_en.html

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12.1.3 Strengths, needs and trends

Item	Analysis
Regional strengths / things to offer	• Locally available biomass resources that could be used for development in the region. • Due to some setbacks of the Irish economy (e.g. banking crisis and Brexit) there is a strong motivation to develop a bioeconomy that could generate new jobs, particularly in rural areas. • Strong agri food industry that is motivated to develop new technologies/process and new businesses. • Several universities that represent a knowledge base for bioeconomy development and have new technologies at lab and pilot scale. • Tipperary has good infrastructure in terms of roads, rail and air transport.
Regional needs / things to fix	• Scaling up technologies and showing that they work in industrial scale. • Addressing the need for education and training in bioeconomy • Develop a bioeconomy strategy and coherent policies. • Work actively with assuring stakeholder and general public acceptance.
Regional trends	• General desire to reduce carbon footprint and create sustainable development.

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13 West Sweden chemical and material cluster

13.1.1 Summary

Item	Analysis
Type of feedstock	**Agro, Wood, Algae, Household waste and other non-bio based recycled waste** Agro (partly imported): sugar cane, oil-yielding plants and waste streams from the agricultural industry such as grass and straw Wood: various waste streams from the forest industry Waste: household waste (for e.g. biogas) and other fossil waste Algae: plans to cultivate algae by using waste heat from the industry
Expect impact bio economy	**High:** Considering that the West Sweden chemical and material cluster is the biggest chemical industry cluster in Sweden and that its key industrial actors share a vision of producing fossil independent transport fuels, chemicals and materials by 2030, the impact of the region on the development of a national bio economy is expected to be very high.
Market potential	**High**: The region is leading in Swedish biodiesel production (Preem Evolution diesel and Perstorp RME) and marketing. The region has also built a large biogas production capacity and market. There is also growing market demand for green chemicals and related products by national companies such as Volvo, IKEA and Tarkett, ICA with whom the region collaborates and individual consumers.
Comments	n/a

13.1.2 Characterization of the region

West Sweden is home to a number of actors working towards realizing a bio based economy. The region contains several of the country's most important industries, with a potential for increased production or utilization of bio-based and sustainable transport fuels, chemicals and related materials as well as the production of renewable energy. In addition, the region offers an excellent environment for research and innovation through the universities and several research centers that are well recognized within innovation and knowledge creation related to bio-economy and sustainability development. The academia and the public and private sectors cooperate in an already established chemical industry cluster in Stenungsund, Sweden's largest chemistry and materials cluster.[36] Many bio economy initiatives are already well under way and have led to the establishment of links with actors in other regions and abroad for delivery of feedstock, technology and other necessary know how to reach this goal.

All in all, West Sweden is uniquely suited to lead the development towards a bio based economy. Academia and the public and private sectors see West Sweden as a potential "test bed" that can be used to demonstrate new, unique, and large-scale sustainable and bio based technologies, materials, and products. Joint efforts to showcase the region can be seen as a way to increase its attractiveness to investors and relocating businesses, and to improve its economic competitiveness. The private sector within the green chemical cluster enjoys growing opportunities in the home market and thus also increased credibility in the global market.

[36] In the chemical industry cluster public authorities, private companies and research organizations participate. The regional authorities are: Region Västra Götaland (VGR), Business Region Göteborg (BRG), the cities of Stenungsund and Lysekil, Business Sweden. The private companies are: Aga, AkzoNobel, Borealis, Inovyn, Göteborg Energi, Hogia, Perstorp, Preem, Renova, Swedegas, Södra, Stena Recycling. The research organizations are: IVL Svenska Miljöinstitutet, Swerea, Chalmers University of Technology and SP Technical Research Institute of Sweden.

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Ambitions

The long term ambitions of the West Sweden chemical and material cluster are mainly environmental and economical. It is expressed in the *overall objective of the cluster to contribute to a "fossil-fuel independent West Sweden by 2030" and strengthen the competitiveness among the regional companies.* This goal is to be reached by developing and strengthening the collaboration between participating partners and by initiating and pursuing innovation and development initiatives within the areas renewable transport fuels, chemical and material products

These overall West Sweden cluster objectives are inspired by regional authorities' climate strategy to have a fossil free economy by 2030 as well as by a joint vision "Sustainable chemistry 2030" shared by five chemical companies in Stenungsund (Aga, Akzo Nobel, Borealis, Inovyn and Perstorp) part of the cluster. The joint vision of the chemical companies states that "In 2030 Stenungsund will be the hub for manufacturing of sustainable products in the chemical industry. Our business will be based on renewable feedstock and energy and contribute to a sustainable society."

There are also long term social ambitions, which are linked to the two visions above. The social ambition is expressed in a vision of "A good life" and a related strategy developed by regional authorities in collaboration with the chemical industry among other regional actors. Key for this vision is social sustainability, i.e. *make the region an attractive region to live and work by meeting the social needs of the people*, a goal which according to the vision cannot be met without reaching the goals of environmental and economical sustainability.

13.1.3 Strengths, needs and trends

Item	Analysis
Regional strengths / things to offer	• Access to forest biomass and other waste feedstock with high potential for future applications. • High and advanced competence on second generation conversion technologies (e.g. lignocelluloses to alcohols, HVO-diesel and methane as well as food waste to methane and alcohols) and first generation conversion technologies (e.g. RME). • Access to the world's biggest demonstration unit going all the way from woodchips via synthesis gas to 95% methane vehicle fuel. • A region with triple helix actors (including Sweden´s largest chemical cluster) committed to the cluster ambition of fossil free chemicals and materials production by 2030. • Accessible region though harbour, roads and rail.
Regional needs / things to fix	• Funding (public / private) for scaling up gasification demonstration • Long term policy instruments to support the development of biobased fuels, but mainly chemicals and materials. • Improve collaboration with SMEs to create continuous innovation • Public procurement or other tools for marketing
Regional trends	• If the fossil raw material price is low it will pose threats to the region. If it is high it will pose opportunities. • EU develops sustainability criteria for chemicals and materials can be both threat and opportunity depending on the conclusions. • More stringent international climate mitigation targets or measures in terms of CO2 tax create opportunities.

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14 Concluding note

Looking back on our activities during the BioLinX project, one conclusion stands out: bioeconomy is still very much a 'people's business'. Bringing stakeholders physically together, sharing views and ideas and building mutual trust and understanding lays the foundation for new initiatives, innovations and cooperations. In our view, the regional cluster play a crucial role in facilitating such get-togethers, notably around themes decribed in this document.

Other conclusions and recommendation, specifically aimed at policy makers within the EU, can be found in our separate (enclosed) leaflet on making post project impact.

If you have any questions regarding the BioLinX project and/or the information found in this document, please feel free to contact the BioLinX project coordinator:

REWIN West-Brabant
Dennis van der Pas
d.vanderpas@rewin.nl
+ 31 (0) 51 359 994

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