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Deliverable

D4.1 Description of the selected bioeconomy value chains per country and the main challenges for their development at regional level

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DISCLAIMER

Executive summary

This deliverable reports on the selected regions and value chains per country partner of the BRANCHES project, and their SWOT analysis, used for the identification of their status quo and affecting challenges. This task 4.1, had two main goals: 1. to explore the regional bioeconomy conditions of selected regions, by taking an exemplary value chain and carrying its qualitative characterisation 2. to identify for each of these practical cases the hindering and supporting factors (external and internal) to be considered for its development. Likewise, possible latent challenges practitioners are experiencing. These could be related to the functioning of the value chain itself (from raw material to market entry), to the technologies being used, as well as to the possible structural conditions intrinsic to the region.

In doing so, the basis for next activities in Work Package (WP) 4 is laid. So that key factors for the transition towards a thriving regional bioeconomy can be identified and consolidated from all regional experiences (T4.3) and use in the definition of strategic measures to their specific case (T4.4). For instance, to facilitate the uptake of useful good practices collected in WP2 and WP3 and boost innovative regional bioeconomy business models.

List of Abbreviations

BMEL - Federal Ministry of Food and Agriculture
BMBF – Federal Ministry of Education and Research
CHP – Combined Heat and Power
EIMA – International Agricultural and Gardening Machinery Exhibition
ICT - Information and Communication Technologies
NTN – National Thematic Network
NUTs - Nomenclature of Territorial Units for Statistics
PAs – Practice Abstracts
RES – Renewable Energy Sources
SWOT – Strengths, Weaknesses, Opportunities, Threats.
SPs – Sectorial Partners
TPs – Technical Partners
WP – Work Package.

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1. Introduction

It is in the regional level that the shift from a linear bioeconomy towards a more circular bioeconomy begins, as promoted by the European Green Deal (EC 2019). The local level plays a key role to reinforce strategic actions towards the decarbonization of EU economy by 2050. Likewise, regional conditions- e.g. infrastructure, markets, cross-regional co-operations, application of small-scale technologies- influence the potential value chain pathways towards a functional circular bioeconomy.

The last two years of global pandemic has made evident on the one side that we have still a long run towards substituting with bio-based products very dependent fossil-based markets – i.e. one-use packaging materials-. However, at the same time it has highlighted great potential future dynamics for already established bioeconomy sectors and shifts on demand for available bio-based materials. Likewise, the commitment to the green transition and applied circularity principles it is seen as one important pillar to address the economic situation after COVID 19 and enhance resilience by valorising domestic biomass resources and waste (Galanakis et al. 2021). In addition, current attacks to Ukraine have shifted the attention to European security issues. This has had a large impact on the bioeconomy sector through energy, food and forest markets in the short term. In the long term, this may increase the importance of bioeconomy for European and national security.

To manage this transition as efficiently as possible, it is necessary to identify the challenges ahead to focus actions and resources on strategic areas. While the other activities in BRANCHES are carried out at the national level, ensuring the exchange of knowledge between multi-stakeholder networks on innovative practices aimed at practitioners. The work in this Work Package (WP) proposes to look at the regions, their innovation models, and how they are moving ahead in this transition towards a circular bioeconomy. This task is focused on reviewing whether the appropriate conditions exist for the implementation of innovative practices and what is needed. Starting with the identification of the status of the bioeconomy in the regions and looking with a value chain as an example, which are the current challenges. In doing this, we expect to identify specific challenges to some of the most relevant value chains, while also identifying structural aspects that might be affecting other value chains.

This report will present a summary about the selected regions in each participant country, the key aspects of their bioeconomy, such as their main available resources and contributing bioeconomy sectors. Followed by the description of the selected value chains and SWOT analysis. Each regional chapter finalizes with a list of identified challenges for the selected value chains, which will be key for the following activities in this WP.

2. Methodology: Selection of regions, value chains and preparation of SWOT analysis

Selection of regions

The activities in WP4 started on the first week of April 2021, although the kick-off meeting with all involved partners was held on the 25th of March to introduce main goals, methodological aspects and activities ahead. To begin, the criteria for the selection of focus regions was discussed and agreed among members of the management board – WP leaders - (28th of April 2021) and among partners in WP4, as part of the second meeting in Task 4.1.

The discussions yield the following main criteria for the selection of focus regions:

i) Regions to be selected are not necessarily confined by administrative areas. Instead, regions can be selected following specific climatic and ecosystem conditions that are particular to the partner country and influence their value chains of interest.
ii) Regional selection should depict a diverse set of examples as reference for other EU regions. Differentiation between regions among the five partner countries will includes varied bioeconomy maturity levels and different structural change processes[1].

Based on the above defined criteria, a proposal about all five regions was requested from WP4 partners. The template provided the information to categorise the selected region according to the well-known environmental stratification zones in Europe by Metzger et al. (2005). As well as the regional typology developed by Koschatzky and Stahlecker (2019) to identify different types of innovation-based structural change stages in regions. Innovation-based structural change is defined by the authors as describing "…the change in the innovation capacity and innovative competitiveness of regions over time". Lastly, each partner assessed the maturity level of the bioeconomy in the selected region, based on the joint knowledge between TPs and SPs partners.

[1] Depicting regions in diverse structural change processes, which relates to the reduction of regional disparities (at national and EU level) and supporting structurally weak regions* in their structural change.

An initial proposal of regions was made and presented by partners during the second meeting in Task 4.1. Final changes to the selection were made by November 2021 to the regions from Finland, Spain and Germany. Table 1 presents the final selection of regions for each country, and key describing information according to the selection criteria.

Selection of value chains

A template to describe the selected regions and for the mapping and characterization of its main value chains was developed by DBFZ and send to project partners for feedback. The final version after adjustments (see Annex I. Template for selection of region) was sent around in November 2021 to all partners.

The template includes two parts, one dedicated to basic information about the regional bioeconomy such as main regional bioeconomy priorities, key biomass resources, and potential challenges for its utilisation. The second part is dedicated to the value chain mapping, to collect information about the feedstock(s) and final products, the stakeholders involved, key technologies used, as well as markets covered. In relation to the value chain, existing challenges are asked, synergies with other value chains and potential opportunities in relation to the Practice Abstracts (PAs) being collected in WP2 and WP3, whether is because the value chain already applies any of the documented PAs, or could consider the implementation of it.

The partners were instructed to map a maximum of two value chains in order to assess based on the information collected which of these to focus on for the next stages in WP4. This, based on the relevance of the value chain for the regional bioeconomy, considering which structural aspects could be revised through their analysis. Ultimately, bearing in mind which of the mapped value chains could benefit as much as possible from the analysis to be carried out in WP4, i.e. the SWOT analysis, the identification of challenges and the subsequent definition of strategic measures.

Preparation of the SWOT analysis

The SWOT analysis preparation was recommended by DBFZ to be applied on a preferential value chain in each region. For this purpose, a guideline was developed by DBFZ to carry out the SWOT analysis in a workshop format. Thus, support the preparation of the analysis among a diverse group of stakeholders (academia, policy, industry and civil society representatives) that hold expertise or interest in the selected value chain.

The guideline is based on literature review and is depicting a world café approach to enrich discussion among stakeholders. It provides an overview of identified challenges to regional

bioeconomy, followed by indications of aspects to consider before, during and after the SWOT workshop. Finally, to collect the results of the SWOT analysis, the partners were given Template 4.1.3. (see Annex II. Template), including the most essential aspects, which were recommended in the SWOT analysis guide. The results of the SWOT analysis are presented in this report in section 3 and in Annex III.

Reading the Workshop format, there were difficulties of meeting in person for several potential participants due to the pandemic. Based on the project meeting (third T4.1 meeting) and on the discussion with the management board, it was decided to leave open the workshop format.

3. Report on regional value chains and SWOT analysis

The regions, presented here in Table 1, were selected by country project partners (TPs and SPs) following the agreed criteria listed in section 2. In this section, information describing the regional bioeconomy of each region, the selected value chain with its SWOT analysis is presented. Finally, several acknowledge challenges have been summarized at the end of each regional section. These challenges have been collected on one side from the expertise of project partners, on the other side, through the characterisation of regional value chains and by condensing the discussions that took place during the SWOT analysis.

Table 1. Final selection of regions for each of the partner countries in BRANCHES project.

Selected region	**Pedoclimatic zone**	**Bioeconomy maturity**	**Regional structural strength - Typology**
Northern Finland (North Ostrobothnia, Kainuu and Lapland)	Boreal (BOR)	High	International leading high-tech regions
Ebro valley (Aragón and Catalonia))	Mediterranean North (MDN) and Mediterranean South (MDS)	Intermediate	Regions with fragmented, small-scale industrial structures & Partially industrialised regions with inefficient production facilities
Central Italy (5 Regions: Tuscany, Marche, Lazio, Umbria, Abruzzo)	Mediterranean Mountains (MDM) and Mediterranean North (MDN)	Low (great growth potential)	Agricultural regions with technological "islands"
Central Germany region	Continental (CON)	Intermediate	Agricultural regions with technological "islands"

Warmia and Mazury	Continental (CON)	Low	Agricultural regions with technological "islands"

3.1. Ebro Valley region (Aragón and Catalonia) - Spain

The bioeconomy in Spain is a strong contributor to EU bioeconomy, with a bioeconomy share of 16 % to the total GDP, before Poland, Finland and Italy (Kuosmanen et al. 2020). At country level, bioeconomy and the contribution of its sectors are important for the national economy, accounting for approximately 6.5 % of GDP and 9 % of the working population (Lainez et al. 2018). In the national bioeconomy, the agro-food sector - including fisheries-, is the most relevant sector accounting for the 5.59 % of the GDP (M'barek et al. 2018). According to the data modelling platform of resources economics of the European Commission (Ronzon et al.), in 2019, the agriculture and food, beverages and tobacco sectors accounted for 43.3 % and 24.4% of the value added of the bioeconomy in Spain. Only followed by bio-based chemicals, pharmaceuticals, plastics and rubber with a contribution of 5.7 %. Forestry only contributes 1.5 % of the value added in the year.

The Ebro valley selected region includes regional administrations of 7 Autonomous regions (NUTs 2 administrative level in Spain) that are crossed by the Ebro River. These seven 7 regions are Cantabria, Castilla y León, La Rioja, País Vasco, Navarra, Aragón and Catalonia. They have different regional governments, plans and priorities. Ebro Basin extends beyond these 7 regions, and also includes provinces of other 2 Autonomous Regions: Castilla La Mancha and Valencian Community.

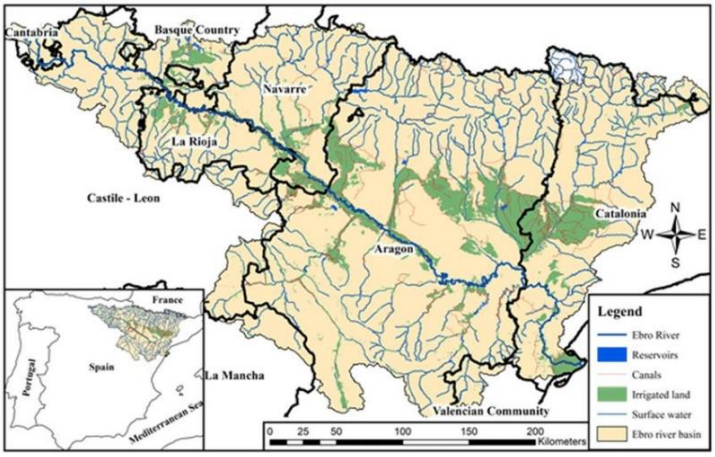

Figure 1. Map of the Ebro Valley. Source: (Almazán-Gómez et al. 2021)

However, territorial and socioeconomic conditions are similar to some extent along the valley. The current work will focus on the area of the **Ebro Valley located in Aragón and Catalonia region** in which the vineyard and fodder/straw value chain targeted have a very relevant role. Catalonia is one of the most densely populated regions in Spain with approx.7.6 million inhabitants (Romero 2021a) and a population density of 242.3 inhabitants per square meter, while Aragón having a larger surface area than Catalonia has only approx. 1.3 million inhabitants (Romero 2021b) and a

population density of 27.9 inhabitants per square meter. Regarding the region's traditional activities and industries, Aragon is predominantly a rural agricultural and livestock region, making its agri-food sector one of the main priorities (Sanz-Hernandez et al. 2019), and is home to innovation structures that could benefit the specialisation of the bioeconomy sectors. Catalonia on the other hand has a long tradition in industry and services (Morales 2020). Its chemical sector alone contributes 42.6 % of total chemical business in Spain and Tarragona is home to the largest petrochemical cluster in Southern Europe (IDOM). Although the agrochemicals, until a few years ago, only generated 1 % of the total chemical industry turnover in the region, the opportunities for the development of the region's bioeconomy are high, in particular from the chemical industry (IDOM).

The potential of the region selected for the bioeconomy lies on the richness of its renewable resources and the strength of its intricate agri-food system. The agriculture activities in the Ebro valley basin, which agricultural and farm production concentrates in valleys, accounts for one fifth of the agrarian production and about one third of the meat supply in Spain. Irrigated agriculture, covering an area of around 700,000 hectares in the valleys of the Ebro is the basis of the agri-food system. The agri-food sector has a significant weight in Aragon region, considering it is responsible for around 10 % of the agri-food regional gross value added (Go Aragón 2021). It also generates around 17,600 employment in Aragón which implies a share of 17.8 % in Aragon and around 4 % in Spain (el Periodico de Aragón 2022).

In Catalonia the agri-food sector employs around 164,000 workers with a turnover around 38,000 million euros which implies 16 % of its gross domestic product (Prodeca 2019).

Therefore, the main resources of the area are related to the agriculture and agri-food sector (agriculture and food industry products but also agriculture and food-industry by-products and residues and livestock farming). Although agriculture has a greater weight, also some industry is located in the region, such as highly competitive power generation sector. The basin produces about one third of the nuclear power of the country, it has one fifth of the installed capacity of hydropower of the country and one tenth of the country’s thermal generation capacity. This important contribution to the generation of electricity is based on a heavily engineered hydrological system, providing a convenient supply of stored and running water (Omedas et al. 2011).

Taking into account the different territory and political conditions, the main common priority in the region, as marked by EU and National plans, is to reach a carbon neutral agricultural system by 2050 by means of improving competitiveness, digitalization, sustainability and resilience in the sector therefore allowing to supply more healthy, secure, innovative, sustainable, and accessible

food to a growing population in line with the "from farm to fork" strategy meeting end users' needs and preferences in line with National and European objectives and strategies.

In this sense the most relevant initiative in the region is the "Ebro Food Valley" proposal launched in January 2021 which was submitted to the Next Generation Funds seeking to transform the agri-food sector in the area. Two of the main value chains in the region are as listed in Table 2, and based on the above, the focus lies on the Vineyard value chain for the analysis in this WP.

Table 2. Key value chains of the Ebro Valley

Feedstock	Final product	Sector
Cereal & fodder	Food and animal food and animal bedding among others (energy purposes).	Agriculture, food & feed, energy
Vineyard	Wine or grape Vineyard pruning (pellet, chips) Grape processing by-products	Agriculture and food and feed Energy Biochemical applications (Pharmacy, Flavouring, etc.)

The Vineyard value chain

Spain holds the largest wine-growing area in the European Union, representing around 30 % of the total 3.19 Mha under vines in the EU (Honorio et al. 2018; Menéndez et al. 2018). Likewise, its wine industry is the third largest producer of residual biomass in the country (Menéndez et al. 2018), making it a key contributor to the circular bioeconomy transition.

The grapes from cultivated vineyards, are utilized in a low percentage as table grapes and mostly towards the wine production. It is in the process of wine production that diverse resultant residual biomass is generated at different stages. In-field interventions generate vineyard pruning residues (lignocellulosic agricultural residues), while on pre-processing stage, when selecting the grapes other leaves and stems (shoots) are generated. These woody residues can be pelletized or used as chips in the energy sector. On the other side, resultant residues from the grape processing by-products can be utilized in diverse biochemical applications, such as food enhancers, nutraceuticals, in cosmetic applications, as products for soil improvement and lastly for composting material (Spigno et al. 2017). Though, targeted application includes bioenergy and biostimulation preferably.

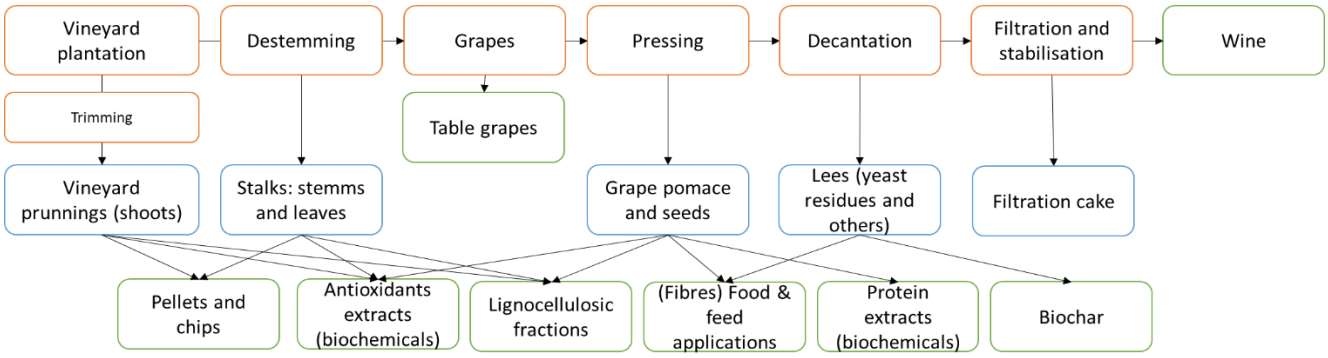

Figure 2. Vineyard value chain depiction (DBFZ Illustration based on (Menéndez et al. 2018) and (Spigno et al. 2017))

Given the multitude of value chain paths and diverse sectors in which the by-products can be utilized, the involved key stakeholders are also quite diverse as mentioned below in Table 3.

Table 3. Stakeholders active in the vineyard value chain

Phase in the value chain	**Name of organisation /institution**
Biomass generation or recycled material	Farmers. Sectorial associations (UAGN, FACA, etc.), agriculture cooperatives or individual exploitations that have not joined a cooperative structure.
Pre-treatment	Wineries, food industry, farmers or biomass suppliers (pelletizing, chipping, etc.)
Conversion	Wineries, food industry, chemical industry, bioenergy plant
End product	Wine, grape, biofuel, pharmacy product, flavouring products, etc.
Customer/Entry to market	Supermarkets, gourmet stores, any kind of stores, pharmacy, energy consumers (houses, buildings, cooperatives, etc.)

Key technologies in the value chain.

Harvesting, processing and pre-treatment technologies need an update many times to improve the efficiency of the processes. Additionally, if vineyard pruning wants to be used, new machinery should be used or adapted to be able to collect the pruning without collecting stones, mud or sand. Prototypes are already available, but many times are not well known and too expensive for small and medium enterprises or small cooperatives. On the other side, lack of digitalisation in general bases and monitoring are a common barrier, although they could highly contribute to increase the productivity of the exploitation or company.

A prototype to collect vineyard pruning and system to clean the biomass has been included in BRANCHES Practice Abstract number 10 corresponding to a new system which integrates in the vineyard pre-pruning system a device to gather the pieces of pruned shoots, shred them in small

pieces and convey to a collection bin, thus allowing a collection of pruning without falling into the soil. Likewise, Practice Abstract number 16 presenting a cleaning system applicable to vineyard pruning dragged out of fields with stones and soil, able to detach the inorganic and deliver a clean biomass material able to be utilised in energy applications.

SWOT analysis - Ebro Valley region

The SWOT analysis for the region of Aragón and Catalonia with focus on the agricultural herbaceous and woody biomass residues (from annual crops and permanent crops respectively) value chain was developed based on the inputs of regional stakeholders and the discussions hold in the workshop *"Bioeconomy with herbaceous and woody agricultural residues in the Ebro Valley – Proposals towards 2030*)"[2]. This event was held on the 26th of April 2022 in the framework of the International Fair of Agricultural Machinery - FIMA, held from 26-29 April 2022 in Zaragoza. The event was connected with the BRANCHES WP2-3 workshop celebrated on the 27th of April also at FIMA, in order to visualise and attract more attendants.

The workshop dealt about on the mobilisation of the abundant herbaceous and woody agricultural residues produced in the region of the Ebro valley, which can be utilised to contribute towards the decarbonisation of the current fossil-based economy. This river basin includes large areas of several regions of Spain, mainly from Catalonia, Aragón, but also Navarra and La Rioja. Therefore, the principal aim of the workshop was to put in common the vision of different actors from the different regions. The results were applicable to agricultural residues in general, both herbaceous and woody residues, therefore the analysis being applicable to Vineyard pruning value chains. Further information about the workshop has been included in Annex III.

Workshop Attendants

Public administration:	1	Province deputation: 1
Enterprises/sectorial :	7	Agroindustry: 2 Agroindustry org: 1 Farmers org: 2 Biomass org: 2
R&D:	6	Technology centres 3 Universities 2 Public research centres 1

[2] Event´s title in the orgininal language: Bioeconomía con restos agrícolas leñosos y herbáceos en el valle del Ebro – Propuestas hacia 2030

NGO:	0	0
Others, please specify:	7	3 consultancies 3 investors 1 freelance engineer
Total	21	21

SWOT Results in the Ebro Valley

The SWOT table has been built with the contribution of the AgroBioHeat key note on bioenergy, the panellist's identification of items to be solved and proposals, and the contribution during the open dialogue. Even though several value chains have been part of the analysis, many of the identified items for the SWOT are common. Others are very specific for value chains. For a more comprehensive understanding, items have been labelled as next:

- [BM]: applies to biomaterials like boards, packaging or plastics
- [BCh]: applies to platform chemicals and drop-in chemicals
- [BP]: apply to bioproducts like biofertilisers or biostimulants
- [BE] applies only to bioenergy
- [noBE] apply to any, but to bioenergy
- No code: applies to any value chain

S – STRENGTHS	**W – WEAKNESSES**
Market S1. Competitive price agrobiomass versus fossil resources S2. Some agrobiomass as good quality as wood, or incorporate very valuable fractions or compounds S3. Existence of quality certification schemes [BE]	*Market* W1. Some agrobiomasses in their supply chain are not developed W2. Economics not always sufficiently appealing to drive the change for new investments W3. Bioproducts / materials for consumers / processes lack of regulation or find barriers there to reach market [noBE] W4. Low consumer awareness on the characteristics of the product consumed / lack of labels - standards [BE,BM] W5. Low demand for quality agrobiomass / products W6. Though existing maps and tables on potentials, lack of detailed resource inventory or structured offer
Environment S4. Very low carbon footprint S5. Use of field agricultural residues solve the issue of disposal, open field burning and phytosanitary threats	
Technology S6. Availability of equipment for transforming and converting into bioenergy [BE] S7. Very prominent position of the Spanish industry and research centres in the development of technology and participation in innovative / research projects	*Technology* W7. More complex biomass in quality and format in respect wood or fossil derived W8 Limited advance in the technology for start commercial operation [noBE] W9. Lack of existing running facilities ([noBE], but also for some agrobiomasses) W10. Limited availability of technology facilitators
Actors	

S8. Proximity of the resource to the rural environment S9. Trust, closeness capacity for local synergies S10. Existing models for active involvement of sector, administration, research and civil society (regional bioclusters) S11. Strong agricultural sector and organisations, able to mobilize farmers and government S12. AKIS ecosystem in Spain and transfer networks through agricultural organisations and regional and national bodies *Regional conditions* S13. Ebro valley one of the largest agricultural producing areas covering 25% aprox of the agricultural production in Spain	*Actors* W11. Agricultural sector focused on main product, less interested to get value from agricultural residues W12. Farmers / agroindustries lack of trust / unused to the possibility of agro residues for BE, BM, BP and BCh W13. Installers / facilitators disinterest because being small niches in respect their as usual business W14. The extension services and agricultural consultants and technicians not familiar with bioeconomy and bioenergy context, business and opportunities *Regional conditions* W15. Ebro valley include several regions, similar crops and climate, though different regulatory and societal context
O – OPPORTUNITIES *Market* O1. High potential of unused field agricultural residues O2. Compatibility for energy and bioeconomy uses (by-products from BM, BCh, BP available for BE) O3. Bioenergy and other bioeconomy uses in expansion O4. Capacity of market to absorb more BE, BP, BCh or BM is huge and larger than the agrobiomass sourcing O5. High prices of electricity and fossil fuels O6. Increasing prices of CO_2 ETS and coming EU Carbon Border Tax *Policy framework* O7. Next generation funds; CAP and rural development funding for decarbonising and bioeconomy O8. High target for Renewable Energies and bioeconomy in Europe O9. Urgent need for decarbonising sectors like building, services, industry [BE] O10. CAP enhanced conditionality and national plan for residues more restrictive for disposal in open fires *Social perception* O11. Biomass use considered an engine for rural development and the "empty Spain" O12. Growing social interest in preventing burning *Regional conditions* O13. Communication infrastructure and relevant industrial and agroindustrial activity	**T - THREATS** *Market* T1. Limited interest or demand in BPs, BCh or BM T2. Potential zonal conflicts for agrobiomass may trigger the general idea that the resource is limited T3. Declaring natural gas as green in the transition to decarbonisation T4. New geopolitical tensions can cause unstable advance of EU towards the green deal objectives. T5. Unstable conditions prevent from investing in long term projects. Fossil based markets used to varying conditions *Policy framework* T6. Prioritization of electricity consumption [BE] T7. CAP – Ecoscheme #7 providing important subsidies to leave pruning on the ground: possible blocking of this resource T8. Environmental and soil protection legislation that may balance agricultural residues use for soils T9. Regulations for small facilities which may limit emissions or limit its installation in cities [BE] T10. Slow development of regulations to obligate or incentive the use of BM, BP, BCh *Social perception* T11. Political perception in certain areas that biomass pollutes [BE] T12. More interest in PV/wind, biomass often forgotten [BE] T13. Limited understanding of decision makers and citizens of the goodness of using agricultural field residues T14. Lack of knowledge / vision by public administrations T15. Perception of volatility of fossil markets, and believe the current situation is merely transitory

O14. Even with the differences the profile of society along the river basin regions the vision keeps more similarities than respect other areas in country (e.g. coastal, large urban centres, southern Spain)	

From the SWOT results and considering the internal as external aspects mentioned, the following key challenges have been identified:

- Overcome the cultural barriers of farmers and agro-industry sector to work and trust agrobiomass. A key item for that are the demonstrative facilities, demonstrative programs and direct transfer actions.
- Beyond convincing and understanding, another challenge is to promote the key actors to make a move and invest. Additionally, to financing schemes, the challenge is to create networks of advisors or technicians ready to guide the agricultural sector or local investors in the right and secure direction.
- Need to make the key technologies very competitive and appealing to the eyes of farmers, agro-industries and users.
- A key challenge is to trigger a real and growing demand of BPs, BCh an BMs not simply by the law of the economics or by the belief that consumers would preferably adopt bioproducts. The challenge is to trigger the intermediate industries and brands to adopt them and incorporate in their products.
- For still non-commercial technologies or processes, the scaling-up to industrial size is crucial. The challenge stays in the successful collaboration of industry, research and technology providers to lead to functional facilities already ready for initiating first commercialisation of BM, BCh or BPs.
- Mobilising the herbaceous and woody field residues entails technical and managerial difficulties to lead to a product with adequate quality and at an affordable cost. It is a challenge to establish new logistics for underutilised feedstock like pruning wood, tree or vines uproots, or corn or sunflower stalks.
- In general, initiatives for new biomass mobilisation and establishing new value chains, require the compromise of multiple actors, from the sourcing of biomass, to the final consumers. Without a coordinated action in a territory, this uptake can very rarely take place, unless a strong driving force (huge profit margins, compulsory laws). Otherwise, the challenge is to create the collaborative structures (like regional bioclusters) with all actors inside (quadruple helix).

- Social acceptance is a challenge. As far as consumers do not realise the use of a biocommodity the acceptance is not necessary (case of ETBE in gasoline, or renewable electricity in the grid). But if it implies a change in format, colour, texture, offer an explicit increase of price, consumers may not have sufficient interest to adopt the new product. Large campaigns and education tools are necessary as horizontal strategy to path the way for enhanced bioeconomy use.
- In contrast to wood, which is usually understood by industry and consumers as a reliable resource, agrobiomass is very diverse, and not always perceived to be effective or appropriate for final uses, as for example: straw for energy, corn stalk for fibre boards, woody residues as alternative in wood-based industry, etc. The challenge is not only to adapt or develop the routes, but also to trigger the interest for those developments to occur.
- The rural areas in Spain are sometimes referred as "emptied Spain" as the migration and growth of population on cities continues in respect population in rural and sometimes remote areas. A challenge for bioeconomy is to bring abilities, technicians and young /medium aged persons to populate these territories.

3.2. Central Italy region - Italy

The region object of the present study is Central Italy and includes 5 administrative regions NUTs2 level of which four regions, Tuscany, Umbria, Marche and Lazio (Rome excluded), are considered Central Italy also by the national statistical system and one, Abruzzi, which is allocated by the national statistical system, to the Southern regions of Italy, although geographically is located in the Central area of the country.

Figure 3. Map of Central Italy region. Adapted from (Lesniewski 2020)

Central Italy region is dominated by hills and by the mountains range of Apennines, with major rivers flowing down from them. The region has few natural plains, but those that exist are rich in soils and fertile. Over the years a process of land reclamation has been taking place turning the coastal swamps and marshes into agricultural land, thus also encouraging the expansion of cities and towns. As detailed in Table 4, Central Italy region encompasses an area of about 6,830,000 ha covered by woods for 36 % of the total surface (more than 2,465,600 ha) (AIEL - Associazione Italiana Energie Agroforestali 2022) while agricultural area covers 42.5 % (more than 2,903,000

ha)(ISTAT 2010). Overall, the rural context, forests and agriculture, plays an important role on the landscape and on the related economy, occupying 78.6 % of the territory (approximately 5.4 million hectares).

Table 4. Forest and agricultural surface distribution in Central Italy. Source: (ISTAT 2010; AIEL 2022)

Regions	**Total Area**	**Forest surface**		**Agriculture surface**	
	ha	**ha**	**%**	**ha**	**%**
Toscana	2.229.000,00	891.600,00	40,00	857.699,00	38,48
Umbria	848.000,00	390.225,00	46,02	326.877,00	38,55
Lazio	1.720.274,00	492.778,00	28,65	724.325,00	42,11
Marche	937.000,00	311.000,00	33,19	471.827,00	50,36
Abruzzo	1.094.700,00	380.000,00	34,71	521.083,00	47,60
Central Italy	**6.828.974,00**	2.465.603,00	36,11	2.901.811,00	42,49

The five regions in Central Italy, have a strong potential to contribute to the national bioeconomy due to the richness of its agriculture and forestry resources, as well as fishing activities in some of the regions - in descending order Marche, Abruzzo, Lazio, and Toscana -. The share of the agriculture forestry and fishing activities to the gross value added (of 2018) is in some of the regions higher than the average for Europe, with a 2.9 % for Abruzzo, 2.7 % for Umbria, 2.5% for Marche, and 1.1 % for Lazio (EUROSTAT 2018). In the region the woody biomass is of key importance for the bioenergy and biochemistry sectors, following the tendency at national level of developing the bioeconomy towards increasing the added value through more efficient interconnection between the primary production sectors and those involved in the transformation of food and non-food biomass and biowaste (Marras et al. 2019).

Wood biomass (agro-forestry) to bioenergy value chain

The use of biomass is a key element of the new national strategic framework linked to the energy and ecological transition. In Italy, considering the wood resources coming from forest and agricultural supply chains, it would be possible to reach a **target of 16.5 Mtoe of thermal energy produced by bioenergy**, against the current 7 Mtoe, of which 8.5 Mtoe from woody biomass, equal to about 146 GW of available installed power (Rinnovabiliti 2017).

From fermentable biomasses (including agro-industrial waste, zootechnical effluents and dedicated crops) the potential of biomass is considerable and could replace as many as 8 billion cubic meters of natural gas a year. In addition to this, there is the added value provided by the positive impact of the use of biomass on the reduction of energy costs.

Key technologies in the value chain.

The region presents a large variety of different biomass types, available under equally variable conditions. In general, the technology is available, since many machine manufacturers have their plants in Central Italy and can offer quality equipment and prompt service. That is typically the case of equipment for recovering pruning residues, which is now general practice. Companies such as Facma, Nobili and Ubaldi – just to mention a few – have been producing and selling that equipment for several years and they have established their market abroad. The technology is proven and is adopted wherever there is a market for low-grade biomass and farm size is large enough to justify recovery. The situation is less favourable for forest biomass. Chippers are widespread, so there is no limitation on the chipping side, rather with cutting and extraction. Steep terrain makes mechanized harvesting difficult, and wood extraction is generally performed with forestry-fitted farm tractors – but only on those sites that are accessible to ground-based equipment due to favourable terrain or the presence of a dense network of skid trails. Yet, a large part of the forests lacks such dense network and are too rugger for machine traffic. There, the best solution would be cable extraction, which is a very popular forest harvesting technique in Northern Italy but is virtually absent from central Italy – except Tuscany and some areas of Northern Latium. The technology is indeed available, but forest owners, managers and operators need to become more familiar with it. Cable yarders are indeed present at EIMA[3] and were discussed during the showcase – although the conditions of the site did not allow for a practical field demonstration of that specific technology.

Four (three in Tuscany region and one in Umbria region) of the seven Practice Abstracts (PAs) prepared by the Italian team have been developed in the present region. These are:

- PA n.2 - Microchip, the locally made replacement for industrial chips: 4-step recipe (Tuscany)
- PA n.3 - Small-scale Pellet Production – Vertical Integration in the Forest-Wood Chain (Umbria)
- PA n.23 - COBRAF Project, Co-products from Biorefinery (Tuscany)
- PA n. 24 - Biochar from lignocellulosic and agriculture residues (Tuscany)

A sustainable exploitation of woody biomass from forests and agriculture, in the region, could supply energy an provide a relevant contribution to address the present energy crisis. For instance, investing in the forest-wood supply chain as a whole, with a systemic and integrated approach, could generate a strong “wood-based” economy. Potentially, thanks to the availability of these biomasses, the consumption of methane gas could be reduced by over 9 billion m^3. This would replace 4 million fossil fuel boilers for domestic use, bringing bioenergy to cover up to 68 % of energy from RES in the thermal sector and up to 37 % of all final thermal consumption. These changes would significantly reduce energy costs for families: with current prices, using firewood

[3] From the Italian from the Italian Esposizione Internazionale di Macchine per l'Agricoltura e il Giardinaggio

or pellets to heat a home allows an average saving compared to methane equal to over 900 € (-55 %) and over, respectively. € 700 (-44 %) ".

A strong synergy has been established with the GESTA Association in Abruzzi region, which brings together public administrations (municipalities) and woodcutters cooperatives with the aim of developing the bioeconomy in areas at risk of marginalization.

SWOT analysis for the wood resources in the agro-forestry value chain

The SWOT analysis was carried out through consultations and by involving several experts – of the Italian NTN advisory board. In this regard, the Italian team (ITABIA and CNR IBE) updated the work developed by the Supply Chain Table for Bioenergy and Green Chemistry set up by the Ministry of the Agricultural, Food and Forestry Policies in 2013. The initial work, that covered the entire country and also included the regions object of the present study, was coordinated by ITABIA and involved about 150 biomass experts coming from companies, research bodies, trade associations, public administration representatives, etc. From January to May 2022, the analysis was reviewed and discussed with representatives of the Italian NTN advisory board, adjusted the needs of the SWOT analysis in BRANCHES and results were compiled in the present study.
The analysis considers the main bioeconomy sectors of the central-southern Italian regions that have shown development potentials. The results and the analysis of the interviews were collected with all the contributions received and reports on strengths, weaknesses, opportunities and threats of four different value chains. These correspond to i) bioenergy (woody biomass), ii) biofuel and bioliquids, iii) biogas-biomethane and iv) green chemistry. However, in the central Italian regions, bioenergy and biochemistry comprise most of the bioeconomy sectors, reason why the focus in this report will lay on the solid biomass value chain.

Number of consulted stakeholders

Public administration:	3
Enterprises:	4
Sectorial associations:	12
R&D:	7
NGO:	4

Others, (members of ITABIA and Chimica Verde bionet):	40 + 40
Total	110

SWOT results Central Italy region

The following results include the analysis for the solid biomass value chain (wood resources), as example. The results of the further SWOT analysis - corresponding to additional bioeconomy sectors of importance - can be found in the Annex III.

S – STRENGTHS	**W – WEAKNESSES**
Market S1. Plurality and a wide availability of raw materials (residual biomass and dedicated crops) S2. Programmability and steadiness of energy production. S3. Availability of several "success stories" related to the entire value chains. *Technical* S4. Tested and reliable technologies, for electrical and thermal production. Strong availability in the country of industrial production and marketing of dedicated plants and related components. *Environmental* S5. Reduction of GHG emissions *Policy Framework* S6. European and national strategies to strengthen the sector development, in line with the objectives of the GREEN DEAL, to achieve climate neutrality by 2050.	*Market* W1. Poor development of biomass production/procurement supply chains at the local level that trigger the need to import W2. High and irreducible generation costs for "product" biomass *Technical* W3. Low conversion efficiency into electricity and still limited use of cogeneration. W4. High implementation costs, per unit of installed power and to assemble district heating networks. W5. Limited availability and reliability of technologies (gasification) to produce electricity with high efficiency in small plants *Environmental* W6. High costs for devices to reduce emissions of fine dusts *Policy Framework* W7. Lack of univocal legislation, at national level, related to the treatment of ashes produced by plants *Regional conditions* W8. Poor communication and public information on sustainability and benefits of the supply chain W9. Need for training of regional administration officials responsible for authorization, testing and monitoring procedures W10. Need for a better management of competences between Ministries
O – OPPORTUNITIES	**T - THREATS**
Market	*Market*

O1. Growth, production diversification and export of the national industrial production in all sectors of the supply chain including agricultural and forestry mechanization, plant engineering and supply components. O2. Recovery and economic enhancement of crop residues (pruning, straw, etc.) whose revenues are integrated into the farm income and favor savings on management costs. O3. Quality standards improvement of the of solid biomass (e.g. solid biofuel certification). O4. Potential establishment of national supply chains based on the use of sustainably managed forests with positive impacts also on the reduction of imports as regards of the thermal production. *Technical* O5. Strengthened use and increased efficiency of biomass in the thermal use. O6. Technological upgrade of existing thermal plants fueled by solid biomass, specifically to reduce PM emissions *Environmental* O7. Proper management and safeguard of the land (care/enhancement of the forests, maintenance of riverbanks, recovery of marginal lands, etc.), mitigation of hydrogeological instability. Ecosystem services. *Regional conditions* O8. Modernization and strengthening of agro-forestry companies that facilitate the increase in employment, profitability, and the identification of new professional figures.	T1. Use of increasing quantities of imported biomasses that are easier to find but which do not have a positive impact on the national territory. T2. Potential conflicts between widespread generation and large plants for the supply of raw materials. T3. Market price fossil fuels decrease because of "dumping" strategies. T4. The unpredictable effects of the war between Russia and Ukraine. *Policy Framework* T5. Unsuitable strategies for long-term programs. T6. Changes to the incentives economic framework, which can weaken the thermal plants business plans. *Social perception* T7. Prejudices and opposition of general public to the construction of new plants (NIMBY effect).

Based on the SWOT results, considering external and internal aspect mentioned for the bioenergy value chain and considering as well the key related aspects for the biochemical sector in the region, the following key challenges have been identified:

- Developing multifunctional and multi-product biorefineries to convert, through integrated biotechnological and chemical processes, renewable raw materials into bio-based products at lower impact.
- Improving all the biorefinery cascading flows (including waste) and increase also energy efficiency, according to a "biorefinery" logic integrated with industries and the territory and with zero waste production.

- Spreading among the stakeholders of the aforementioned supply chains, consolidated and widely disseminated innovative technologies whose success is the result of years of scientific research, with a strong presence of the national industry.
- Recovering and improving livestock waste, crop residues and agro-industry by-products, which allow savings on the related management costs with positive implications on the farm incomes.
- Strengthen the Italian value chain related to high-performance agricultural and forestry machinery in terms of safety, operational efficiency and use of low-emission biofuels (biodiesel, biomethane).
- Define long-term development strategies for all supply chains.
- Raise awareness in society to accept supply chains in local contexts. Through correct information and territorial participation, it is possible to prevent prejudices and opposition of general public to the construction of new plants (NIMBY effect).

3.3. Northern Finland region (incl. North Ostrobothnia, Kainuu and Lapland) - Finland

Finland is one of the leading bioeconomy nations in Europe due to its renewable natural resources, high level of expertise and industrial strengths. According to the latest statistics (Luke 2021), the bioeconomy in 2020 accounted for 12 percent of Finland's gross added value or EUR 24.2 billion, with an output of 68.3 billion and employing approx. 294,000 people. It is estimated that the effect of Corona virus has slowed down the growth tendency shown in previous years, particularly from bioeconomy services. Forestry is maintained as the larger bioeconomy sector (EUR 7.7 billion from the value added), followed by construction (EUR 4.6 billion), food (EUR 4.5 billion), and other industries (EUR 3.5 billion). Activities from the energy sector, bioeconomy services (e.g. Tourism) and water treatment and supply contribute to the remaining approx. EUR 4 billion.

As Finland is home to a vast number of forests, the core element of the country's bioeconomy is the forestry industry. Mainly, wood flows, are used half for products and half for energy by the pulp and paper and mechanical wood industry. Bioeconomy boosted growth, employment and well-being are among the political motivations with observable consensus among policymakers. Finland published in 2014 is comprehensive policy strategy on the bioeconomy in Europe (Finnish Government 2014). As one of the first national bioeconomy strategies in the EU, it presented an ambitious list of measures. After a process initiated in 2020, discussions of the Bioeconomy Panel and consultations with the regions and open public it is reworked this year as the final updated strategy "Bioeconomy Strategy 2022–2035 – Sustainably towards higher value added" (Finnish Government 2022). It has as major aim to increase the value added of the country by the

bioeconomy. Creating economic growth and jobs by generating products and services with the highest value added (Finnish Government 2022).

The region selected for BRANCHES activities is Northern Finland, the northernmost part of Finland. It comprises the administrative NUTs 3 regions of Lapland and the provinces of Kainuu and Northern Ostrobothnia. This region is very sparsely populated, Lapland as being the lowest population density region with about two inhabitants per square kilometre. It is followed by Kainuu and then North Ostrobothnia with a population density of 3.5 and 11.3 inhabitants per square kilometre respectively (Clausnitzer 2022a). In total the three regions comprised almost the 50 % of Finland´s area, with approximately 149,105 km² (Clausnitzer 2022b).

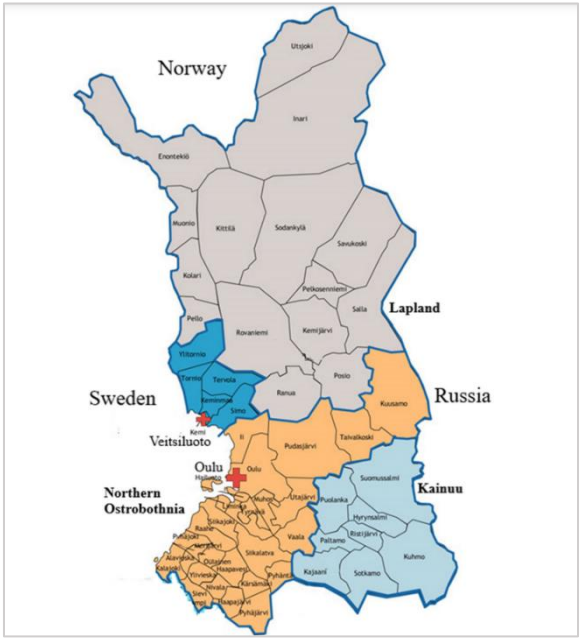

Figure 4. Map of Northern Finland. Source: (Palander and Vesa 2022)

A big part of Lapland stretches north of the Arctic Circle. The environmental zone called Boreal region extends in Finland, covering the lowlands of Scandinavia. The average temperature in the region oscillates between is -2 and 2 °C. In terms of precipitation, rainfall is between 450-700 mm/y (Finnish Meteorological Institute 2021).

Forest, that is available for growth more than 1 m3/ha annually, covers a greater share of land in Finland than in any other European countries, more than three-fourths of the land, some 20.0 million hectares (Mha), is forested (over 75%) (Ministry of Agriculture and Forestry of Finland 2022). In addition, 10% of the total area of the country is water bodies, the rest 12% of the total area, is agricultural land, constructed areas, traffic areas, or other open land areas and not so productive forest lands. The forest land coverage of northern Finland -*North Ostrobothnia, Kainuu and Lapland*- including poorly productive forest land is approximately 11.3 million hectares (LUKE statistic 2020), and although there have been reductions in wood demand in the last years[4], the forestry sector contributes on a high degree on the output share of the bioeconomy and is closely followed by the bio-based construction, food and nature tourism sectors. The current cutting level have been about 13 M.m^3, whereas the largest maintainable cutting level is about 25 M.m^3 according the National Forest Inventory (NFI) (LUKE statistic 2020). The regional value added from

[4] Significant changes in the wood demand, due to several factors, including the closing of Veitsiluoto pulp and paper mills in Kemi were shut down in 2021

forest sector is estimated to increase from 700 M.€ to over 1000 M.€ by 2025 based on wood use and value-added development.

For instance, reporting unprecedented grow of the nature tourism sector in the region of Lapland between 2015 and 2018, while for the same region the forest sector had a reduction during the same period (Business Lapland 2018). Other relevant bioeconomy sectors for these three regions are agriculture for food production, biorefining in the pulp industry, saw industry, other wood products' industry, renewable energy, food processing, reindeer husbandry and natural products.

Fuels from solid wood and peat have conventionally been used in combined heat and power (CHP) production in Finnish district heating and industry. In Finland, the consumption of peat has varied between 50 and 100 PJ annually, depending on the annual demand for heat and electricity, competitive fuel prices and peat availability (Mika et al. 2021). However, the goal is to decrease the use of peat for energy by at least half by 2030, through policy measures such as energy taxation, with wood and other renewables as alternatives to supply the energy demand, among other measures recently proposed by the Broad-based working group on peat (Korhonen et al. 2021).

Key bioeconomy value chains for the region are, as summarized in Table 5, the generation of electricity and heat from forest biomass and peat as well as the offer of winter and nature tourism utilising the ecosystems of the region. For the following analysis stages, the wood supply chain has been selected, which includes the harvesting of wood resources, transformation in the chemical industry traditionally into pulp and paper and its mechanical transformation into timber, plywood, board as well as material for construction and other wood products.

Table 5. Key value chains of northern Finland

Feedstock	**Final product**	**Sector**
Forest (wood)	Pulp and paper Lumber	Printed products, packaging Construction, wood products industry
Forest (small diameter energy wood and logging residues) and peat	Electricity and heat	Heat and power production
Forests, lakes, rivers, public and private land	Services for travellers	Tourism

Traditional wood supply chain

The traditional wood supply starts with the harvesting of forest areas. Depending on the type of wood and its quality, logs get transported to different production facilities, namely the pulp mill or sawmill (see Figure Figure 5. Wood flows in Finland with data from 2015. Illustration from (Koponen et al. 2015) consulted in (Alakangas et al. 2015) for the flow overview). Some of the residues from harvesting goes to fuel terminals to energy production. Logs can be transferred to a log terminal before being distributed to each of the production facilities, or could be directly transported to these. Along the sawmill production, the first step generates as by-products saw mill chips, which then get integrated into the pulp mills line, as well as bark and saw dust redirected to CHP plants, heating plants, or towards pellets and briquets (Carlsson et al. 2009; Johnson and Hart 2016). Conversion continue for the production of lumber, panels and other engineered wood products having as by-products wood-based liquids and condensation vapours that could be integrated into the line of industrial chemical products (Verkasalo et al. 2019).

On the pulp mill conversion line, several processes are carried out for the extraction of wood fibres into pulp and board. These are cooking, screening, O2 delignification and bleaching. Along the cooking process, an evaporation is carried out, generating black liquor and making possible the removal of lignin (Johnson and Hart 2016).

The usual stakeholders involved in this supply chain are as named in Table 6.

Table 6. Stakeholders active in the traditional wood supply chain

Phase in the value chain	**Name of organisation /institution**
Biomass generation or recycled material	State Forest, private landowners, jointly owned forests
Pre-treatment	Private contractors (harvesting enterprises, logistics), forestry owner associations, storage facility operators
Conversion	Pulp and paper/bioproduct mill, sawmills, wood product industry
End product	Pulp, paper, paperboard, fluting, sawn goods, plywood, veneer sheets, particle board, fiberboard, wooden furniture
Customer/Entry to market	Domestic and international market: Publishing houses, construction industry, paper industry, packaging industry

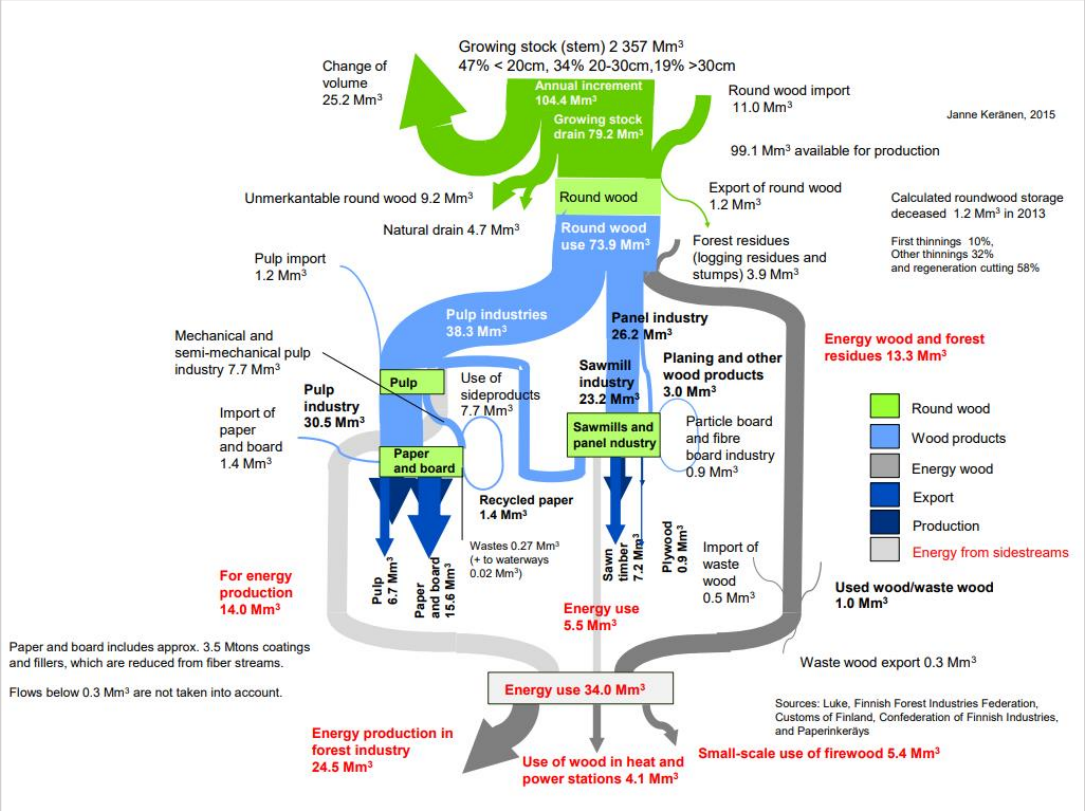

Figure 5. Wood flows in Finland with data from 2015. Illustration from (Koponen et al. 2015) consulted in (Alakangas et al. 2015)

Table 7. Export of wood value chain products. Source: (Statistics Finland and Natural Resources Institute Finland 2021)

Product	Exports, value million € (2021)	Share of export of production, % (2021)
Pulp industries	2606	48
Paper industries	2922	96
Paper board industries	3313	97
Converted paper and paperboard products	437	
Wood product industries	3862	75
Round wood and wood residues	103	
Total	13243	

Key technologies in the value chain

Key technologies in the value chain correspond to those used in the two production lines above described, first for wood harvesting and transport, sawmill and pulp mill technologies and finally

paper manufacturing technologies. Likewise, the Information and Communication Technologies (ICT) plays an important role in the coordination and efficiency of the whole supply chain. The Practice Abstract #12 – Boom corridor thinning - A harvester's working method for young dense stands is an innovative good practice for this value chain in Finland.

Synergies of this value chain with others at national level include the combined storing and logistics with industrial and energy wood and joint multimodal (road, railway, harbour) terminals for wood sourcing companies. Meanwhile, it is expected that due to the close of mills - as previously mentioned - demands might still be affected for the next two years. However, the wood volumes in northern Finland are expected to increase about 50%, from 10 M.m^3 to 15 M.m^3 by 2025, increasing also the value added from forest sector, estimated from 700 M.€ to over 1000 M.€ by 2025 based on wood use and value-added development with most dramatic changes expected to happen in Lapland.

SWOT analysis of Northern Finland

The SWOT analysis for the region of northern Finland with focus on the industrial wood value chain was held on the hybrid workshop "*What is the future of the bioeconomy in Northern Finland?*"[5] on the 26th of April 2022. The workshop was directed towards finding out the situation of forest based bioeconomy in Northern Finland now and the future. The workshop featured presentations and panel discussions on the topic. The audience of the workshop was involved with questions on the topic. It was possible to take part in a survey in advance about the strengths, weaknesses, opportunities and threats of the value chains of the bioeconomy in Northern Finland. During the seminar, several questions were asked from the audience using the Mentimeter platform.

The event was organized for the stakeholders, researchers and customers working in the field of forest based bioeconomy and mainly for industrial wood value chain. The current aspects of regional development were particularly highlighted. Experts participated in answering to prepared questions to elucidate the strengths, weaknesses, opportunities and threats and also potential solutions as described in the SWOT workshop report in Annex III.

Workshop Attendants

Public administration:	12
Enterprises/sectorial :	9

[5] Title of the event in original language: Millainen on biotalouden tulevaisuus Pohjois-Suomessa?

R&D:	15
NGO:	8
Others, please specify:	-
Total	44

SWOT Results Northern Finland region.

Swot results have been compiled with the support of the survey carried out and expert opinions of invited attendants, during workshop discussions.

S – STRENGTHS	**W – WEAKNESSES**
Market S1. Steady felling opportunities S2. Large forest areas *Technical* S3. North area is not so risky for forest destructions *Environmental* S4. Climate S5. Natural resources *Policy Framework* S6. Regional forest programs are potential to develop regional wood use	*Market* W1. Growth of forest has been decreasing lately because of old forest structure W2. Competition of wood very low level *Environmental* W3. Nature conservation areas W4. Snow destruction for forest more in Northern Finland than before *Regional conditions* W5. Long distances W6. Labour availability W7. Infrastructure
O – OPPORTUNITIES	**T - THREATS**
Market O1. Investment potential and boom O2. Artic co-operation potential with Sweden O3: New artic projects with Sweden O4. Potential new products *Technical* O5. Carbon sequestration potential of forest *Environmental* O7. Climate O8. Natural resources *Policy Framework* O9. Research co-operation with companies	*Market* T1. Profitability of wood production T2. Cost-efficiency of supply chains T3. Employees hard to get *Environmental* T4. Nature conservation areas *Policy Framework* T5. Reconciliation/coordination of alternative land uses *Regional conditions* T6. Infrastructure T7. Long distances

O10. Funding opportunities for companies O11. Risk funding *Regional conditions* O12. Competition for wood and land-use will increase opportunities for forest owners 013. Co-operation with research and development should be develop at many levels	T8. Forest owners get older and move far away *Social perception* T9. Acceptability of industrial use of forest

Based on the SWOT results (survey and discussions) and considering the characterisation carried out for the wood value chain, the following key challenges have been identified:

- The growth of forests in Northern Finland has been decreased in the latest forest inventory because forests are getting older in Northern Finland.
- The large forest resources are the long distances in Northern Finland, increases the costs for forest industry and make also the profitability for forest management hard.
- The lack of competition of wood in North Finland has increased the use of forest and wood for other purposes.
- Maintaining labour availability is a challenge for the industrial wood value chain, given the difficulties to operate from small villages and other places in the northern region.
- Land use change challenges – conflicting interests between sectors (mining industry, forestry, energy production, tourism, reindeer husbandry, nature conservation)
- It is to be seen if companies and entrepreneurs in the sector will adjust to current changes, such as new regional investments on bioeconomy, which will rapidly increase the wood demand in the region after few years

3.4. Central Germany region - Germany

Germany being a focal point for technology and research is at the frontline in the implementation of bioeconomy at international level. The sectors of the bioeconomy in Germany generate a value added of €125 billion (Ronzon et al., 2019), which represents the 17 % of the total value added of the bioeconomy in the EU. Food, beverage and tobacco sectors are the three sectors with higher contribution (42.4 %), followed by agriculture (19.5 %) and bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels) (12.1 %). Between 3.1 and 3.6 million people are employed by the bioeconomy in Germany, corresponding to approximately 8-9 % of all employees in the country. More than half of the workforce are employed in the manufacturing sector (51-67%) - food, feed and beverage production-, around three quarters in the manufacturing sector (39-45%) and in the hotel and restaurant industry (27-33%). Followed by agriculture (13-16%), construction

(8- 10%) and finally for research and development and the energy industry, which account for a total of about 5% of the workforce (Bringezu et al. 2020).

With the publication of the National Research Strategy Bioeconomy 2030 in 2010, Germany became one of the first countries to take political measures to make advance in the field. The strategy, under the direction of the Federal Ministry of Education and Research (BMBF) and a supporting group of other six national ministries, proposed a six-year strategy for the implementation of the research agenda for a bio-based transformation of industry and society.

The region of Central Germany, is composed by the federal states of Saxonia, Saxonia-Anhalt and Thuringia (NUTs1). Linking eight districts, seven cities, around 60 structurally important companies as well as chambers, universities and research institutions. The total population in the region is about 8.357.862 inhabitants, being the state of Saxony almost double more populated than the other two states (Statistisches Bundesamt (Destatis) 2021).

Figure 6. Map of Central Germany. Source: (Baars and Schlottmann 2015)

The region, is dominated by continental environmental conditions, with an environment of warm summers and rather cold winters, favouring agricultural activities. In fact, more than half of the total land in Germany – approx. 18. million hectares- is used for agriculture, although recently in a slightly decreasing tendency due to new settlements and roads infrastructure (Statistisches Bundesamt (Destatis) 2020). Forest and water areas correspond to about 32% of the country´s area with a total of 11.42 million hectares (Iost et al. 2020). The forest area in the Central German mining area, on the other hand, takes up a much smaller proportion, occupying 16 % of the regional area, while agriculture accounts for 65 % of the land (DBFZ 2021). Among agriculture crops, Central Germany is characterised by a high level of land use for cereal cultivation, in particular wheat crops as well as winter rape and sugar beet (DBFZ 2021).

The wood production of coniferous (softwood) and deciduous wood in cubic metres (m^3) is higher in Thüringen than in Saxony or Saxony-Anhalt, with a 2.7 million m^3 of coniferous and 0,7 million m^3 of hardwood. Saxony-Anhalt follows with a production of 2.2 million m^3 of softwood and 0,3 million m^3 hardwood and finally Saxony with 2.2 million m^3 of softwood and 0.1 million m^3. For Central Germany its key bioeconomy sectors bioeconomy - based on its resource base, regional industry distinctiveness and existing competences- the food industry, the plastics and chemical

industry (e.g. rubber production) and science, generating already important contributions to the regional bioeconomy (DBFZ 2020).

Among these important sectors, key value chains for the region as are shown in the Table 8.

Table 8. Key value chains in Central Germany

Feedstock	Final products	Sector
Agriculture residues (animal slurry, maize silage, grass silage and other cereals (Keeffe et al. 2013))	Biogas	Heat and power production
Forest wood	Panel boards, composites, other engineered wood products (Hildebrandt and Bezama, A., & Thrän, D: 2020)	Wood industry (higher value added).
Wood and agriculture residues	Sugars, Polymers and resin products (Hildebrandt and Bezama, A., & Thrän, D: 2020)	Biochemicals

For the purposes of the current analysis and towards the following steps in WP4, the value chain from lignocellulose to biochemicals will be taken into consideration for Central Germany.

From lignocellulose to biochemicals

Wood and other biomass residues rich in lignocellulose components are an important resource in the generation of products to substitute fossil-based products. The utilization of wood biorefineries for the extraction of higher value-added components is a novel technological approach, however, it demands for the most efficient utilization of all parts to be economically sensible (Dahmen et al. 2018). In Germany, the utilisation of beech wood has been identified of great importance, given its ample availability in temperate climates of Central Europe and the possibilities for its use for the extraction of cellulose, hemicellulose and lignin (Nitzsche et al. 2021).

According to the type of biomass and its quality, the process of pre-treatment and conversion might differ. However, the first step is the mechanical partition of the material, for which milling and gridding might be used as well as drying processes. Alternatively, biomass could arrive from sawmill residues already partitioned. This is follow by a thermochemical pre-treatment such as the *organosolv* method for pulping, developed by the Fraunhofer-Center for Chemical-Biotechnological Processes (CBP) in Leuna (Saxony-Anhalt, Germany) (Nitzsche et al. 2021; Dahmen et al. 2018; Regestein et al. 2018). As explained by Zeilerbauer et.al., the organosolv

process typically "*involves the deployment of an organic solvent, such as ethanol, methanol, or acetone, with a concentration ranging from 35% to 70%, used in a solid:liquid ratio between 1 : 4 and 1 : 10, at operating temperatures between 120 °C and 200 °C, operating times between 30 and 90 min, and an acidic pH for the effective decomposition of feedstock*" (Zeilerbauer et al. 2022). After this process, lignin can be precipitated or evaporated from the organic solvent, while solid cellulose is obtained and with a next step the dissolved hemicellulose can be regained from the cellulose fibers (Dahmen et al. 2018; Regestein et al. 2018).

Following the organosolv pre-treatment, several other paths can follow, in particular the refinement – for instance by hydrothermal liquefaction - of lignin into other lignin fractions in order to obtain biochemical building blocks. On the other hand, the cellulose and hemicellulose obtained has been conventionally utilise as basis for fermented sugars after going through a hydrolysation process, which can be used in the development of components for the productions of bio-based polymers, such as lactic and succinic acid (Dahmen et al. 2018; Nitzsche et al. 2021).

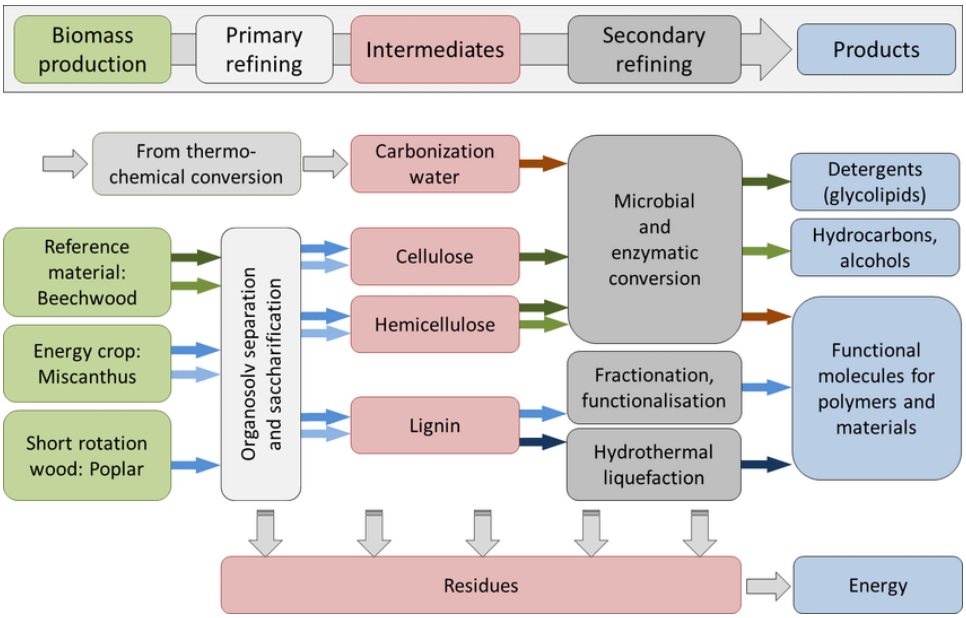

Figure 7. Value chain depiction from lignocellulose to biochemicals. Source: (Dahmen et al. 2018)

Key actors in the value chain, include the wood producers and pre-treatment industries, demonstration facilities where key components of the pre-treatment and conversion are still being studied and refined, and several industries that are linked to the secondary refining.

Table 9. Stakeholders active in the biochemicals value chain

Phase in the value chain	Name of organisation /institution
Biomass generation or recycled material	Forest (state or private owned), sawmills
Pre-treatment	Researchers-Demostration facilities (e.g. Fraunhofer CBP), wood biorefineries, chemical industries
Conversion	Researchers – Demostration facilities (e.g. Fraunhofer CBP), chemical companies (e.g. InfraLeuna GmbH), wood biorefineries, sugar industries, chemical industries.
End product	Biochemical industry, bioplastics (polymers), bioenergy
Customer/Entry to market	Platform biochemicals, fibers, sugars, bioethanol.

Key technologies in the value chain.

Key technologies used in this value include those utilized for biomass harvesting and mobilisation - wood harvesting, transport and sawmills technologies-. Furthermore, Organocat pre-treatment technology used for the application of organosolv method. Other technologies used during the separation process include distillation and evaporation units.

SWOT analysis in Central Germany

The SWOT analysis for the region of Central Germany was carried out as a content analysis based on the thematic presentations and discussions carried out in the Central German Bioeconomy Congress, held on in-person with online transmission on May 2, 2022 and organized by the European Metropolitan Region of Central Germany and the DBFZ - German Biomass Research Center (Working group Resource Mobilisation). The event counted with the participation of several thematic experts at national level, such as Federal Ministry of Food and Agriculture (BMEL), presentations from DBFZ experts, as well as from the Bioeconomy Cluster e.V. Among participants, business, science, politics and administration stakeholders took part.

As part of the congress, a dozen regional bioeconomy projects presented themselves in short pitches and accompanying digital poster exhibition for a comprehensive overview of bioeconomy projects and actors in Saxony, Saxony-Anhalt and Thuringia.

SWOT Results Central Germany

Swot results were compiled between DBFZ and UFZ partners based on the presentation and panel discussions of the event.

S – STRENGTHS	W – WEAKNESSES

Market S1. 10% of jobs in central Germany in bioeconomy S2. Projects like "Bioeconomy Hub" to offer start-ups facilities, so that they can start their business without requiring a high of capital. *Environmental* S3. Reduction of pesticide usage (innovation – company amynova) S4. Usage of waste materials like sawdust, industrial wood (UPM) S5. High input from agriculture and forestry S6. In Thuringia more wood produced than needed *Technical* S7. Established infrastructure from chemistry sector S8. Plants, which have infrastructure for sewage etc. S9. Strong paper industry *Policy Framework* S10. Bioeconomy strategies of federal states S11. Funding programmes for research *Regional conditions* S12. High diversity of biomass resources S13. Many researchers S14. Know-How in chemistry, biotechnology E.g. New biorefinery creates jobs	*Market* W1. Processing of resources with high value creation (like wood) is outsourced in other parts of Germany W2. High investments at the beginning necessary but low capital – competition for funding W3. Not enough people in the industry like processing of biomass W4. Not enough visibility of enterprises in the region W5. More networking necessary W6. No market for "new" bio-based chemicals, 90% of chemical on market are fossil-based products. *Policy framework* W7. Extremely long permission processes W8. Very diverse political frameworks in federal states W9. No common bioeconomy strategy for central Germany *Regional conditions* W10. Seasonality of biomass resources W11. Value creation not in central Germany W12. Infrastructure only concentrated in certain sites like Leuna *Social perception* W13. Public and medial awareness low
O – OPPORTUNITIES *Market* O1. More transition from research to economy possible and necessary. More knowledge must find its way into industry. O2. Recent years rethinking. Market pull, but not enough O3. Investments from public authorities can serve as market incentive *Technical* O5. Facilities for processing need to be built up in the region of central Germany in the future. Value creation in region *Policy Framework* O6. Bottom-up cooperation between federal states in industry and research O7. Potential analysis of Thuringia planned – strengthen specifics of region	**T - THREATS** *Market* T1. Necessary funding should be assured to continue carrying out ambitions plans T2. Several spill-overs from research and innovation institutions that might not survive the "valley of death" due to lack of support in that phase *Environmental* T3. Climate change can affect the forest environments in the regions *Regional conditions* T6. If salaries do not increase, people will leave the region *Social perception* T9. Public perception about bioeconomy and the change from coal regions to bio-based regions should be reinforce.

O8. Legal barriers for wood construction sector will be removed in building regulations (Sächsischer Bauordnung) 2022. Wood specified as equivalent construction material *Regional conditions* O9. Promoting of bioeconomy jobs in schools/universities Many possible jobs in the future *Social perception* O10. Growing awareness of bioeconomy industry about the need of recycling and waste management	

Based on the SWOT analysis and expert knowledge on the forest value chain in the regions, the current challenges include:

- Climate change effects is affecting forest areas in the region, reducing the available wood resources. This is of great relevance, given the regional nature of the value chain, which supply its wood resources mostly from sustainable wood from the region.
- The demand for bio-based products still to be upturned, to generate better economic conditions for the products generated.
- The region is characterised by a high-level of innovation, which is concentrated only in certain island in the three regions. Extending this to other regional areas requires a great support and structural changes.
- Although there are financial mechanisms to support innovation, the stretch after proof of concept towards scaling is not that well covered, leading to several innovative concepts not reaching the market or closing soon afterwards.
- Several actors and initiatives are still not known. Further mapping of active bioeconomy actors (entrepreneurs, start-ups, innovative concepts), their integration, and continuous is still needed.
- Specialist and particularly technical workforce in the regions are not abundant in comparison with the level of activities. Low interest in technical careers or population dynamics affect current workforce availability.

3.5. Warmia and Mazury region in Poland

The bioeconomy in Poland is strongly represented by its agriculture activities, food and feed production. By 2019, bioeconomy activities in the country - biomass producing and converting sectors - amounted to a value added of €37 billion and employed 2.3 million people. Agriculture

activities, generate approx. 30 % of the total value added for that year, however it contributes to around 60 % of employment as a share of the national bioeconomy employment. Only preceded by the food, beverage and tobacco sector, which contributes approx. 38% of the value added (Ronzon et al. 2019). A great biomass potential, which is also used for energy production, conversion to biofuels and as raw materials (Woźniak and Twardowskib 2018).

About 14,406 thousand ha. of area is utilised for agriculture (2016), with a great share dedicated to poultry meat production (19.5% as a share of EU-27), followed by rood products (12.3 % as a share of EU-27).

The Warmia and Mazury Region (administratively called voivodship of Warmia and Mazury) covers an area of 24,000 km² of outstanding natural and tourist values, while holding in average a population density of 60 people per km² (the lowest in Poland). There are many post-glacial hills and forest complexes; over 31 % of the area is covered by forests (ca. 200 m^3 trees per ha) and 6% by water (over 2000 lakes, including 1,800 lakes with an area of over 1 ha. On the other hand, 60% of the land area is protected under various programs. Density of roads with hard pavements (51 roads, total length 1870250 km) is the lowest in Poland; besides no highways but 6 express ways and low density of train lines. The region is classified as agricultural. The agricultural land covers 46.3 % (33.4% arable land). Over 50 % of the rural areas is characterized with the low standard of living (especially in the border area with Russian Federation). The biomass potential is relatively high, nonetheless biomass production for energy purposes is marginal. The highest potential is related to the use of agricultural residues for direct combustion (straw), biogas and forest residues for pellets production.

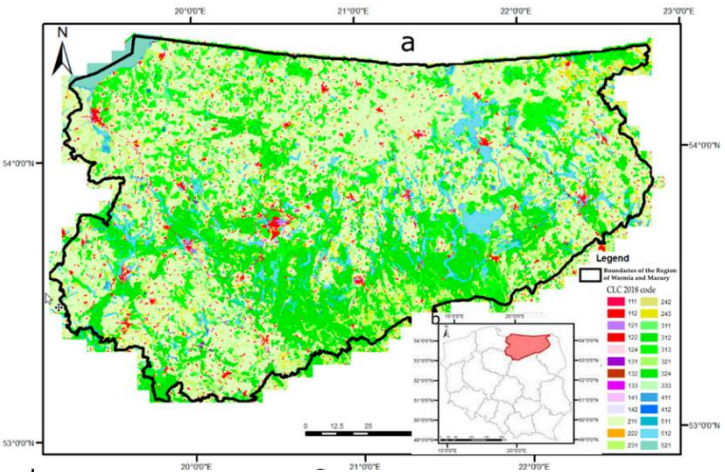

Figure 8. Map of Warmia and Mazury (Poland). Adapted from (Cieślak et al. 2020)

Wood is the main resource of the region for wood-based industries and forestry residues and processed biomass (sawmills), which is used mostly in pellet production. The region counts with about 5.7 thousand active companies, among those for wood acquisition and production of wooden products. Among wood products, other wooden products such as furniture, cork and cork products, willow and straw products amount to a total 22 % of regional exports. Agriculture being also one of the major bioeconomy sectors for the region includes about 42 thousand active farms, from which about 66 % of them are livestock farms with dominant milk and poultry production. The bioenergy sector is as well of key importance, with the presence of numerous biogas plants

(19.6 MW), biomass power plants (28.2 MW). Livestock farms residues for food and residues from livestock production are used in biogas generation as well as crops and its residues and residues of food production goes also into biogas (post-processing residues) and power and heat (available straw).

The region has a great potential to further develop its bioeconomy with a richness of agriculture and forest resources and is high potential for further biomass mobilisation. To continue the development of the regional bioeconomy, some of the key priorities are on the specialisation in the wood and furniture sector, healthy food and water economy. This in the framework of low emissions circular economy. It is also important for the region the adaptation to climate changes, with a focus on energy saving technologies and increased efficiency of renewable energy technologies.

Table 10. Key value chains in Warmia and Mazury

Feedstock	Final products	Sector
Cereal straw and forest residues	Thermal energy and wood chips	Local heating system and Heat and power production
Manure from pig farm, corn silage	Biogas (commercial)	Energy sector (power) Own heat use
Manure from milk farm	Biogas (microscale, own use)	Own power use Own heat use
(sustainable) agricultural crops	Food and feed products	Food and feed

Given the importance of agriculture activities for the region the sustainable potato value chain has been selected as focus value chain for this analysis.

Sustainable potato value chain

The potato is an important crop species cultivated by Polish farmers. However, over the years its production has declined regularly. It is estimated that the potato cultivation acreage in Poland amounted to approx. 328 thousand hectares in 2020 (in 2002 it was 803.4 thousand hectares). There is also an increase in productivity per hectare. The average yield per hectare was 28 tonnes in 2020. According to the data from the Ministry of Agriculture and Rural Development, there is a limited domestic demand for potatoes, which is caused, among others, by a downward trend in potato consumption.

On the other hand, the possibilities of selling Polish potatoes on the markets of other EU countries are limited due to the applicable phytosanitary regulations. This is due to the fact that *Clavibacter*

michiganensis ssp. sepedonicus is commonly occurring in Poland, which limits the access of Polish potatoes to foreign markets. Building a sustainable potato value chain should help to improve the quality of the potatoes produced, among others, by eliminating *Clavibacter michiganensis ssp. sepedonicus*, which will enable free access of Polish potatoes to the markets of other EU countries.

Many stakeholders are involved in the creation of the value chain. Their participation is different at various stages of the chain. The first phase in the chain is related to the production of high-quality, bacteria-free potato. In this phase, important in cooperation between specialists from many disciplines related to the agro-industry, engineering and environmental protection, with leading scientific and research institutes with seed centres that provide certified seed material to farmers.

In the second phase of the value chain, important is cooperation between potato producers and companies dealing with the purchase and processing of raw materials. This phase includes, among others, the development of a professional storage-base (refrigeration / ventilation), in conjunction with eco-energy and the development of a digital trading platform for professionals.

The next phase is wholesale. On the one hand, groups of agricultural producers participate in this phase. This organization form of the potato producers gives them a stronger position in negotiations with potential buyers and the possibility of obtaining more favourable terms of sale. On the other hand, distributors, exporters, companies specializing in purchasing and packaging potatoes participate in this phase. It is particularly important to build an international trade network for Polish potatoes and potato products.

Important activities related to the production, harvesting and storage is to support potato producers and processors in professional advice on the selection of high-tech machinery for cultivation, harvesting and storage and implementation in practice the sorting, preparation and packaging technologies.

The final phase is retail. Its participants can be both chain stores, restaurants and farmers. Particularly important in this phase is creating local brands and enabling the sale of own products by farmers to consumers, as well as shaping consumer patriotism. Therefore, in the promotion of the production and consumption of potatoes, in addition to the previously mentioned stakeholders, should be involved also nutritionists, doctors, cooks, trend designers, influencers and publicists. Important activities at this stage are technologies for packaging of potato and appropriate product labelling to fulfil consumer demands.

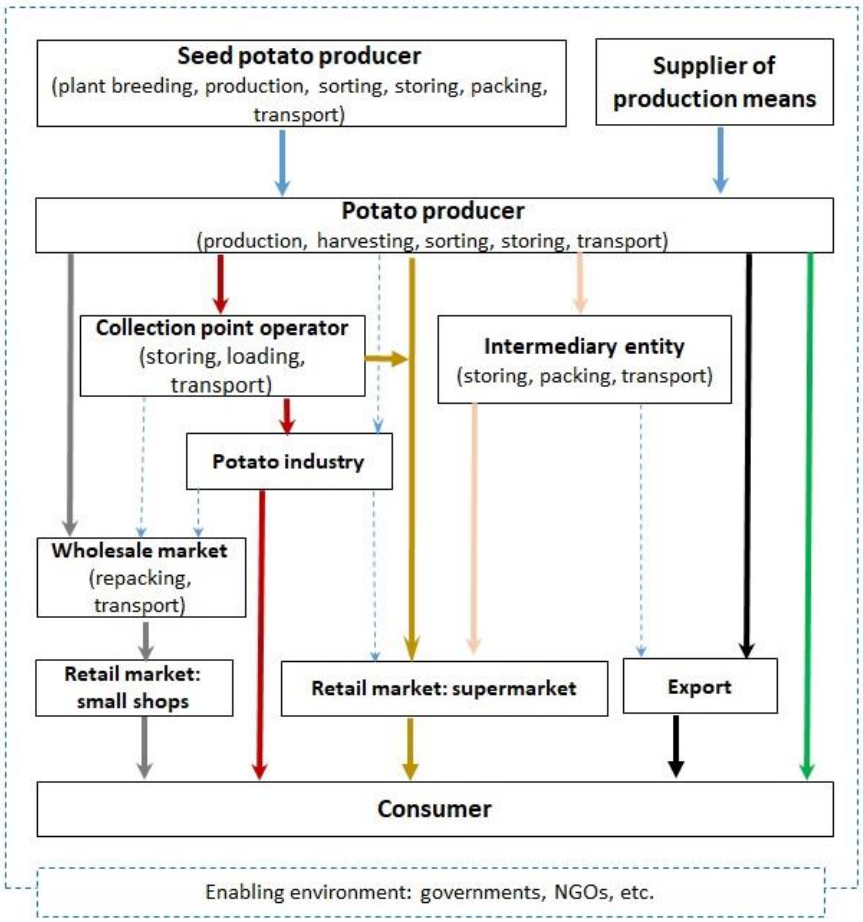

Figure 9. Potential marketing channels of sustainable supply chains of potato market. Source: Presentation during the workshop on April 24, 2022 prepared by Tomasz Bieńkowski and Janusz Gołaszewski.

I: Producer → Consumer (green arrow)
II: Producer → Retail market → Consumer (brown arrow)
III: Producer → Wholesale market → Retail market → Consumer (gray arrow)
IV: Producer → Intermediary entity → Retail market → Consumer (salmon arrow)
V: Producer → Processing → Retail market→ Consumer (red arrow)
VI: Producer → Export→ Consumer (black arrow)

Table 11. Stakeholders active in the potato value chain

Phase in the value chain	Name of organisation /institution
Production	farmers, producers of agricultural machinery, producers of IT technologies for the agri-food industry, seed potato producers, entities specializing in research and qualitative and quantitative analyses in potato cultivation, scientific and research units (incl. universities)

Processing	companies specializing in the production of: dried potatoes, starch and starch products, potato protein, companies specializing in freezing potatoes
Wholesale	groups of agricultural producers, companies specializing in purchasing and packaging potatoes
Retail	Restaurant, chain stores, farmers

Key technologies used in this value chain.

- A high-quality seeds production technology.
- Industrial cultivation technologies, harvesting and long-term storage – high-tech machinery (e.g. related to weed and insect control, cheaper self-propelled harvesters, construction of forced-air and large-crate warehouses, a quality-stabilizing storage climate).
- Renewable energy systems in potato plant breeding, storage and to power industrial processing.

The technologies are specific for different companies that compose the network of potato stakeholders in Poland. The network (Polish Potato Federation) is described in one of the project's Practice Abstracts.

SWOT analysis in Warmia and Mazury

The SWOT analysis was carried out in form of a workshop named "Local bioeconomy and renewable energy systems - good practices for value chains and policies" held as a hybrid event on the 24th of April 2022. The main aim of the workshop was to discuss the internal and external conditions of regional values chains in agriculture, forestry and rural areas as well as regional development models supporting innovations in bioeconomy (WP4). The basis for the discussion were two practice abstracts (WP2) and current activities of Polish and Lithuanian networks (WP1).

Considering good agricultural practices in rural areas, two value chains were presented: i) Vertical and horizontal networking of stakeholders in development of sustainable potato market in Poland, ii) Value chain in the processing of lignocellulosic biomass. In the last part of the workshops, a discussion was held in the form of a world coffee table. The discussion focused on the strengths and weaknesses, as well as opportunities and threats in the field of regional value chains supporting innovation in agriculture, forestry and rural areas.

Workshop attendants

Public administration:	12

Enterprises/sectorial :	7
R&D:	9
NGO:	-
Farmer:	63
Total	**92**

SWOT results Warmia and Mazury.

Although the presented results of SWOT analysis discussed during the workshop are related to potential innovations that can be created by networking of potato market stakeholders they seem to be also relevant to any value chains in the region of Warmia and Mazury.

S – STRENGTHS	**W – WEAKNESSES**
Market S1. Significant potential for the development of agricultural production S2. high availability of bank loans and guarantee funds S3. creation of new work places *Policy Framework* S4. the possibility of obtaining funds to finance the investment *Regional conditions* S5. highly qualified scientific staff S6. an ambitious young generation S6. trainings for farmers and inhabitants of rural areas organized by an agricultural advisory centre	*Market* W1. limited access to financing sources for entities that W2. operate on the market for a short time aversion to innovation *Actors* W3. insufficient horizontal integration W4. no active leaders *Regional conditions* W5. limited trust between entities due to socio-political conditions W6. limited flow of knowledge from science to practice *Social perception* W7. lack of communication and social interest
O – OPPORTUNITIES	**T - THREATS**
Market O1. increasing competitiveness through integration and cooperation O2. increase in farm income *Technical* O3. implementation of new technologies O4. promotion of innovative solutions in agriculture and forestry in social media	*Market* T1. increase in investment costs at the stage of its implementation T2. market volatility T3. additional costs that arise during the implementation of the project *Technical* T4. lack of ability to implement innovations

Actors O5. social consultation *Regional conditions* O6. striving to diversify the sources of income of the rural population	*Policy Framework* T5. frequent changes to tax law *Regional conditions* T6. economic crisis T7. inflation

From the carried-out discussions and the swot analysis, the following challenges have been identified:

- A major challenge of networking of stakeholders in development of sustainable potato market in Poland is insufficient horizontal integration.
- Lack of trust between entities that undertake cooperation.
- In addition, despite the potentially high interest in participating in the network, it is difficult to find leaders who would engage in the promotion and development of the network.
- An important challenge faced by network participants are also fluctuations in the market resulting from general economic conditions (inflation, crisis risk, high prices of energy and energy resources).
- Difficulty to assure investment because an unpredictable increase in costs may occur.

4. Summary and conclusions

This deliverable reports on the selected bioeconomy value chains of five regions, and the main challenges (SWOT) for their development at regional level. The activities presented here were carried out between 2021 and first half of 2022.

As described previously, five regions were selected in the participating countries, in order to focus on local conditions and to get close to stakeholders of the biomass value chains (biomass producers, foresters and farmers) and following adding value activities (e.g. pre-treatment, conversion, refinement) carried out in the region and thus identify local and specific aspects for the regional development.

First, the analysis of specific conditions for each of the regions was carried out (e.g. climatic conditions, availability of resources, capabilities of the region to mobilize and harness its potential). As next, all regional partners identified relevant regional bioeconomy value chains and selected one key value chain, which is representative for the regional dynamics and processes. The selected value

chains cover a broad range of biomass utilisation paths in Europe and can be applied to other regions in the future.

Looking at the overall feedbacks, the following observations can be made, related to the sectors assessed

1. Market

Main strength factors are the biomass itself, its wide availability and good quality, mostly with existing certification. Good examples are important and existing stakeholder groups (e.g. Bioeconomy Hub in Germany).

As of weaknesses, the low demand for quality biomass, also due to low awareness of consumers, economics (e.g. high investment costs, limited financing), low visibility of enterprises and networking, can be named.

The opportunities are also related to biomass (unused biomass), but also the capacity of the market, increasing CO_2 price and pressure on fossil resources are relevant. The possibility for quality improvements and to establish new value chains is given. Increasing farm and farmer conditions and their competitiveness are further opportunities.

Finally, as threats are named the biomass import and conflict on its uses, the market volatility, also due to the Ukraine war, the difficulties to get employees, and a continuous funding to provide security for investors.

2. Technology

Strengths are the existing bioenergy technologies and related infrastructure. Only few weaknesses are named overall, the lack of new concepts from more complex biomass, and technology facilitator, and in some places (Italy) still few cogeneration and so low efficiency and higher cost. Opportunities lie e.g. in the heat sector, to upgrade and increase efficiency, implement new technologies, the use of existing infrastructure and the carbon sequestration. Only one threat is named among all regions, the lack of ability to implement innovations.

3. Regional conditions

About the regional conditions is difficult to have a common picture. Among strength are named the biomass production, biomass diversity, know-how and researchers or existing programs. Training are available e.g. in Spain but lacking in Italy. Weakness are e.g. the long distances, labour availability and infrastructure (Finland) and the seasonality of biomass or low concentration of infrastructure (Germany).

Opportunities lie on existing infrastructure (IT, industry) and co-operation possibilities, as well as introducing bioeconomy in schools and universities, which will create new work forces. Threats are,

similar to the weaknesses, related to infrastructure, long distances or general issues such as economic crisis or inflation.

4. Policy framework

Main strengths are the existing EU and national strategies and programs (e.g. forest) and available funds. As weaknesses are especially specific laws and regulations named (see SWOT tables) and the huge number of regulations. Opportunities lie on the high goals (CO_2, share of renewables), on the co-operation between policy, industry and research. The threats (besides specific ones) are the frequent changes of laws and regulations, their effectiveness and slow development.

Furthermore, Spain, Poland and Germany named actors within its SWOT analysis. Opportunities are the proximity and trust among them, existing good examples, actors with strong mobilisation potential and social consultation, whilst weaknesses are the disinterest for residues and for new business models, and their perception of changing dynamics in the region (e.g. from coal region to bioeconomy region in Central Germany).

Several of the challenges found for the regions refer to structural components, which influence its innovation environments, the capabilities to increment the market entry of bio-based products and that will require mid-to long-term measures to tackle. However, the analysis of strengths and opportunities reveals changes that have been implemented also at the structural level, and (EU) policy, financial instruments and national strategic plans as important driving forces of the development at regional level. The findings of this report will be used together with the policy analysis being carried out in Task 4.2 on one end to identify specific influencing factors that positively or negatively play a role in the regional bioeoconomies, and on the other to device appropriate strategic actions with the participation of regional stakeholder, to generate a consensus among stakeholders, on the priority levels of possible actions to promote the value chains already in progress and focal aspects to work on in the regions.

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Annex I. Template for selection of regions

Mapping of regional value chains

Template 4.1

The following template contains two parts, one dedicated to basic information about the regional bioeconomy and the other to detailing existing and prospective regional value chains. The information here collected will support the identification and analysis of key regional value chains among all participating regions and support the preparation of the SWOT analysis workshops.

Date:	*when the format is filled*
Region:	*Name of the region or delimitation*
Partner:	*Partner filling out the template*

Regional information

The following questions relate to basis information from the bioeconomy in the region, and its framework conditions. Answering these questions will help to understand the status-quo in the region and to communicate it to your regional stakeholders during the SWOT workshop.

1. What are the recognized bioeconomy priorities for the region? *For instance, those embodied by regional programs and strategies and captured in regional bioeconomy initiatives or communicated in position statements.*

2. Has the regional resources base been identified for the region? If yes: a. Please mention which are the main available resources in the region. *Mention which are the main available resources for the regional bioeconomy (e.g. agriculture and residues, forest and residues, food industry waste, bio-fractions from municipal waste, etc)* b. If possible, include the references (links) to regional resource base analysis.
3. What are the main challenges for an effective *collection*, *mobilisation* and *utilization* of these resources? *This question intends to pre-identify the challenges related to biomass availability in general within the region.*
4. Which are the key bioeconomy sectors in the region? *This question intends to identify which opportunities of the regional bioeconomy are already under development.*
5. Are there cross-regional cooperations of importance for the development of the regional bioeconomy? *(e.g imports and exports of biomass, cross-regional value chains, industrial cooperations, shared markets)*

Regional value chains

"A value chain can be defined as the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final customers, and final disposal after use." Hellin, J., & Meijer, M. (2006).

The following questions are intended to carry out a qualitative mapping of the regional value chains of interest. This information will also support an initial identification of Strengths, Weaknesses, Opportunities and Threats for the further development existing bio-based value chains and possible development of new ones.

Please provide qualitative information regarding current active value chains in the regional bioeconomy. Include maximum three value chains, corresponding to the most relevant for the current bioeconomy development.

Value chain 1: [NAME]		
From (Feedstock)	To (valuable final product)	Sector
Include here feedstock. More than one feedstock if, the value chain allows for feedstock flexibility.	*Include here final product*	*Include sector of final product (Agriculture, food & feed, biochemicals, bioplastics, construction, textiles, automotive, etc)*

Which are the key stakeholders in the value chain?

Phase in the value chain	***Name of organisation /institution***
Biomass generation or recycled material	
Pre-treatment	
Conversion	
End product	
Customer/Entry to market	

Key technologies used in this value chain:
(On this section technologies for feedstock production, harvesting, as well as conversion, product refinement might be included)

Have any of the above-mentioned technologies been already included in the BRANCHES Practice Abstracts?

Which is (are) the market(s) of the final product of this value chain?
Are there established synergies of this value chain, with other regional bioeconomy value chains? If not, please only mention, which could be the potential synergies. *(Consider as synergies, utilization of sub-products, end-use valorisation, or established connections for further product refinement).*
Challenges: Are there challenges to the cooperations among value chain actors? *Consider cooperations for feedstock sourcing (intra-regional, cross-regional, with waste producers, etc), among feedstock sourcing and industries, industries and R&D, Industries and downstream actors.* If on the contrary, the regional bioeconomy value chains are good examples of cooperation (sectoral and cross-sectoral), please describe what makes this a good example: Are there challenges for the entry to market of the final product of this value chain?

Any other challenges to the further development of this value chain?

Value chain 2: [NAME]		
From (Feedstock)	To (valuable final product)	Sector
Include here feedstock. More than one feedstock if, the value chain allows for feedstock flexibility.	*Include here final product*	*Include sector of final product (Agriculture, food & feed, biochemicals, bioplastics, construction, textiles, automotive, etc)*

Which are the key stakeholders in the value chain?

Phase in the value chain	***Name of organisation /institution***
Biomass generation or recycled material	
Pre-treatment	
Conversion	
End product	
Customer/Entry to market	

Key technologies used in this value chain:
(On this section technologies for feedstock production, harvesting, as well as conversion, product refinement might be included)

Have any of the above-mentioned technologies been already included in the BRANCHES Practice Abstracts?

Which is (are) the market(s) of the final product of this value chain?
Are there established synergies of this value chain, with other regional bioeconomy value chains? If not, please only mention, which could be the potential synergies. *(Consider as synergies, utilization of sub-products, end-use valorisation, or established connections for further product refinement).*
Challenges: Are there challenges to the cooperations among value chain actors? *Consider cooperations for feedstock sourcing (intra-regional, cross-regional, with waste producers, etc), among feedstock sourcing and industries, industries and R&D, Industries and downstream actors.* If on the contrary, the regional bioeconomy value chains are good examples of cooperation (sectoral and cross-sectoral), please describe what makes this a good example: Are there challenges for the entry to market of the final product of this value chain?

Any other challenges to the further development of this value chain?

Synergies with Practice Abstracts and the regional value chains

6. Which of the current PA´s (technologies/supply chains) (see PA monitoring list) could potentially be implemented in the region? For which value chains?
7. What are the main challenges and opportunities for the implementation of identified PAs and the development of value chains of regional interest?

Annex II. Template for SWOT analysis report

Template 4.1.3 –SWOT analysis report on selected regional value chains

Country:

Region:

Selected value chain:

Name of the event:

Date of the event: Event type: on-site/online/hybrid

Venue/Online platform:

Introduction:

Please include a short introduction about the event describing the main aim of the workshop, and summary of the activities carried out (e.g presentations and their thematic, used workshop methodology, and conclusions achieved).

Number of attendants per stakeholders' group:

Public administration:	
Enterprises/sectorial :	
R&D:	
NGO:	
Others, please specify:	
Total	

Selected value chain:

Please include the description about the selected value chain, presented to workshop attendants. You might include slides or other material shared with the attendants.

Agreed vision for the development of this value chain in the region

The vision is a statement (2-4 sentences) of a desire future/ a desired development for the value chain under discussion. It should consider a long-term perspective (20 – 50 years) and should be commonly agreed among SWOT analysis participants to really define a common ground and common goal. The vision will become the aspired target, based on which the Strengths, Weaknesses, Opportunities and Threats will be discussed over.

SWOT results

Strengths	**Weaknesses**
Opportunities	**Threats**

Identified challenges: Please mention the identified challenges to the value chain and its development in the region, from the results of the SWOT analysis

From the SWOT results above, please mention here the explicit and derived challenges that can be identified.

Key regional conditions

Key regional conditions identified in the SWOT results above that support a sustainable development of the regional bioeconomy.

Annex III. SWOT reports

SWOT analysis report – Ebro Valley

Country: Spain

Region: Ebro Valley

Selected value chain: herbaceous and woody agricultural residues (multipurpose use)

Name of the event:

ES: Bioeconomía con restos agrícolas leñosos y herbáceos en el valle del Ebro – Propuestas hacia 2030

EN: Bioeconomy with herbaceous and woody agricultural residues in the Ebro Valley – Propossals towards 2030

Date of the event: 26 April 2022 **Event type:** on-site (recorded for remote access)

Venue/Online platform: Feria de Zaragoza. Framed in the International Agricultural Machinery Fair - FIMA

Event info site: https://intercambiom.org/2022/03/30/taller-en-fima-2022-bioeconomia-con-restos-agricolas-lenosos-y-herbaceos-en-el-valle-del-ebro-taller-de-propuestas-hacia-2030/

Introduction:

The workshop deals on the mobilisation of the herbaceous and woody agricultural residues produced in the region of the Ebro valley. This river basin includes large areas of several regions of Spain, mainly from Catalonia, Aragón, Navarra and La Rioja.
These abundant resources can be utilised to contribute to decarbonise by means of substituting other fossil or non-renewable materials utilised for energy purposes or as feedstock in the industry.

The principal aim was to put in common the vision of different actors from different regions. The event was framed in FIMA, the International Fair of Agricultural Machinery, held from 26-29 April 2022 in Zaragoza. The event was connected with the BRANCHES WP2-3 workshop celebrated on 27th at FIMA, in order to visualise and attract more attendants.

Given the size of rooms at FIMA and the post-COVID restrictions it was preferred to have a less interactive format, but still keeping relevant testimonials driving the discussion.

The main question to be solved was:
How to ensure that by 2030 the use of agricultural residues such as straw, corn stalks or pruning and uprooting of vines, olive trees and fruit trees become a usual resource for the bioeconomy applications?

The temporal framework was set in the medium term, towards 2030. There is where the innovations already being developed or adopted will make an impact, and where the markets will develop in medium term. Consequently, talking of this time framework is also talking on the innovative practices ready to be adopted by the practitioners, and the corresponding market niches. Going beyond, towards 2040 or 2050, was avoided as it means to switch from the perspective of medium term, innovation and growing or early markets, towards the perspective of long term. In such long term the technologies and markets are more uncertain, non tangible, and the discussion goes usually beyond the knowledge of the stakeholders and practitioners, and require technology experts and researchers, to discuss on the chances of the different low TRL technologies to develop and find a niche and use. More on the vision and prospective, than on the entrepreneurial elements of interest for stakeholders.

In such way the event consisted on four sections:

1) Introduction to BRANCHES and INtercamBIOM network (by CIRCE and AVEBIOM)
2) General framework for bioenergy from herbaceous and woody agricultural residues. Results of the AgroBioHeat project national analysis and strategic plan (by AVEBIOM)
3) Panelists: 6 panelists took a 5 minutes slot to propose the value chains they considered most relevant. And what is needed to speed them up.
4) Discussion: where the voice was open to the room. AVEBIOM together with the Centre for Innovation in Rural Bioeconomy (CITA-Te) took the role to steer the discussion and promote attendants to take voice. A guide was utilised to steer comments towards barriers and driving forces, as well as to promote participants to propose what is needed to be promoted, and who should take the role.

Precise instructions and a powerpoint template with 2 slides were provided to panellists. They should reflect in the first slides the value chains they identified as most interesting to be boosted towards 2030, and a second one with a table where they could place the "barriers" or items to be addressed, and proposals of actions to reach the target.

The power points were provided by all panellists days before, aggregated in a file, which was sent again for sharing vision. AVEBIOM gathered the updates for the final file, with more tuned proposals and vision from panellists.

During the workshop, panellists provided very rich ideas regarding the value chains. They were not restricted to bioenergy, and others like biomass additive as for structuring in plastics, bioplastics, biostimulants, biofertilisers, compost, biochar or torrefied biomass were also proposed (total 11 value chains).

These panellists gave as well input indicating a total of 26 items to be solved and 40 actions needed. Several of them were similar and could be grouped. As well as they explained the inherent barriers, the either internal – weakness or external – threats were evidenced.

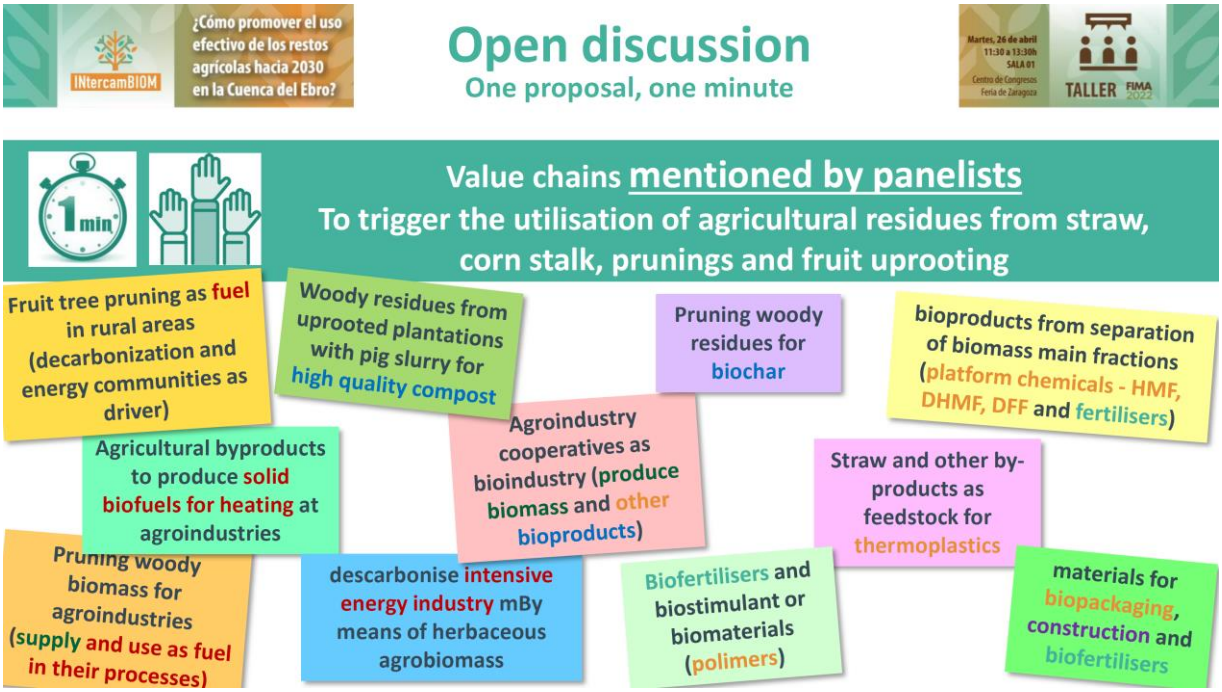
The final open turn consisted on 45 minutes of discussion, where attendants and panellists refined the messages.

The principal conclusions pointed out the crucial role of farmers and agroindustries in driving a change. The need for raising awareness and solve some cultural barriers in perception, and the need to work in the quadruple helix to generate confidence and to trigger coordinated regional initiatives for the more complex value chains.

Additionally, from listed attendants in section 3.1, it also attended one research centre who was participating in the panel as expert with a 5 minutes keynote, in form of video (foreseen in the program to attend, but finally not possible to attend on-site). Few persons did participate partly but did not sign the attendant list.

Selected value chain:

Supply chain of the large resource in the valley, the woody and herbaceous agricultural residues.
These field residues have large potential for the bioeconomy. The principal value chain for them was presented in the introduction: the energy sector. Bioenergy for renewable heat, bioelectricity or advanced biofuels targets towards 2030 are set in the NEPC plan (in Spain denoted PNIEC) and require to increase the mobilisation from 2020 to 2030 in more than 10 Mt of dry biomass per year. As such towards 2030 the bigger expansion in volume is expected to be in the bioenergy.
However, there must be as well a boom in the growth of other added value products for the bioeconomy like plastics, drop-in chemicals or biomaterials. Not so large in volume but with a huge increase rate in percentage towards 2030. As such these uses should not be miss regarded, and were also object of debate.
Even if the problems related to each value chain are in some points different (e.g. product acceptance) most of the frame conditions are similar in respect the issues on supply, and in other issues like the need of demonstrative facilities and experiences, need to trigger industrial pilot demonstrative plants, among others.
The value chains pointed out by panellists, beyond the generic bioenergy routes, are summarised next.



Agreed vision for the development of this value chain in the region

The Ebro Valley is one of the geographical areas of Spain with largest agrarian activity, with a huge amount of underutilised agricultural biomass like the herbaceous and woody agricultural residues. Concurrently the areas have a very important activity in farming and agroindustry, together with some relevant industry poles.

There is a consensus on the huge opportunity and the need to mobilise these residues towards bioeconomy.
The room reached an agreement that the collaboration is crucial, the quadruple helix to promote new initiatives for both, mobilisation of the resources, and the demand by newly established value chains.
Farmers and agroindustries have to take an active role, and for that is necessary demonstrative actions, effective transfer of knowledge, and as well lighthouses and up-scaled plants for novel processes.

Key regional conditions

The principal fact is the huge amount of resources. In total the area of Ebro valley basin, which agricultural and farm production concentrates in valleys counts for 30 % of agricultural land (herbaceous and permanent crops) and 30 % of the meat production in Spain. Rough non accurate estimations would talk about a total availability of herbaceous and woody biomass of circa 4 Mt of dry matter per year.
These figures are coherent with the details provided by panellists during the workshop: Aragón has more than 1 million tons unused of straw and corn and sunflower stalks. Catalonia as well an equivalent amount.
Catalonia has a specific strategic plan for the bioeconomy, whereas Aragon and la Rioja or Navarra include the bioeconomy inside the circular economy strategies. Either with more or less direct policy instruments the regions have deep interest in the development of agribusiness and bioeconomy.
Furthermore these regions have relevant funding for agroindustry and farmers through the FEADER funds and very well positioned networks of farmers.
Initiatives like bioclusters are already in place like the BIOHUB-CAT in Catalonia, an example of the quadruple helix in practice. Or the Food cluster of Ebro Valley.
As such, the expansion of bioeconomy is expected to continue growing, with sub-regional differences due to diversity in regulations and actors.

PICTURES:

Introduction to the workshop

Key note on the analysis for the current use of agrobiomass for energy by AVEBIOM – AgroBioHeat Project

First panellist, Mr. Jesús Abadías, Rural Development and Innovation at Agrifood Cooperatives of Aragon..

Second Panelist. Ms. Carmen Bartolomé, Director of the Circular Economy Group in the Industry and Energy Area of CIRCE technology center (Aragón)

Third Panelist, Ms. Mercé Balcells, Director of the Center for Biotechnological and Agrifood Developments and Professor at the University of Lleida (DBA-UdL Center-Catalonia)

SWOT analysis report – Northern Finland

Country: Finland

Region: Northern Finland

Selected value chain: Bioeconomy / Industrial wood value chain

Name of the event: What is the future of the bioeconomy in Northern Finland? / Millainen on biotalouden tulevaisuus Pohjois-Suomessa?

Date of the event: 26.4.2022

Event type: hybrid

Venue/Online platform: Rovaniemi / Vimeo stream platform

Introduction:

"What is the future of the bioeconomy in Northern Finland?" workshop seminar was implemented on April 26, 2022. The topic of the workshop was to find out the situation of forest based bioeconomy in Northern Finland now and the future. The workshop featured presentations and panel discussions on the topic. The audience of the workshop was involved with questions on the topic. It was possible to take part in a survey in advance about the strengths, weaknesses, opportunities and threats of the value chains of the bioeconomy in Northern Finland. During the seminar several questions were asked from the audience by using Menti platform.

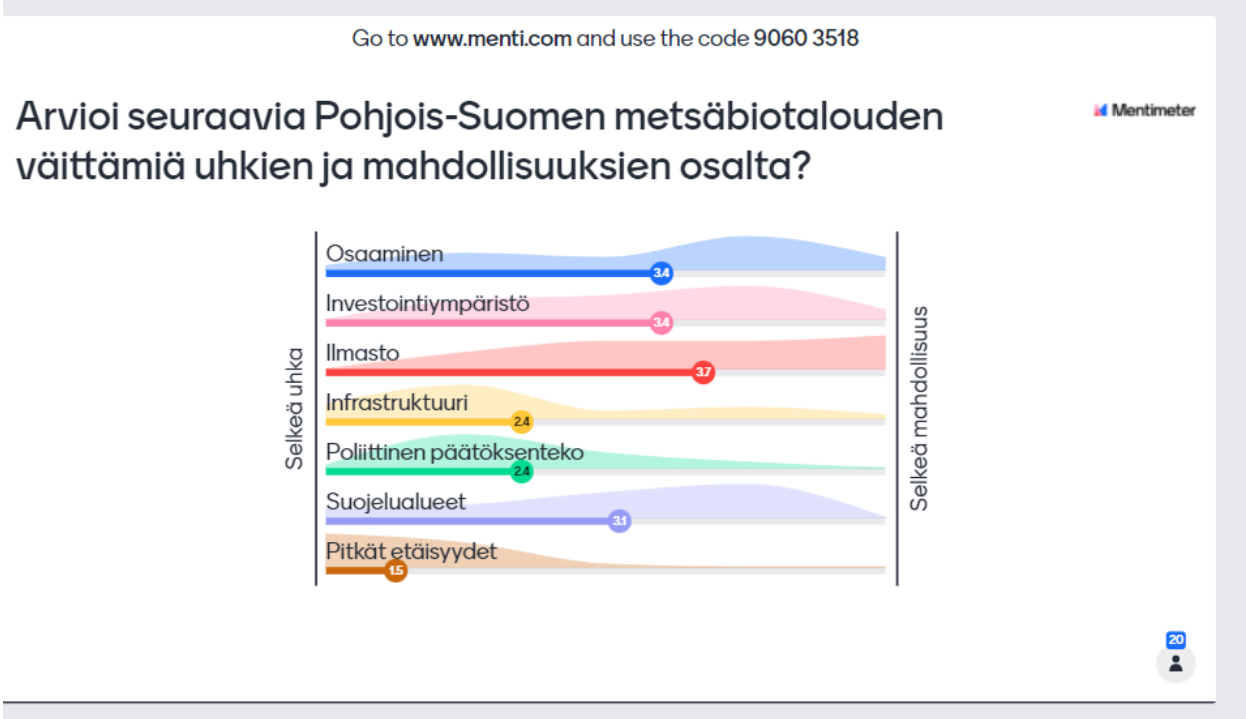
The event was organized for the stakeholders, researchers and customers working in the field of forest based bioeconomy. We wanted to highlight current aspects of regional development. The event was in Finnish and free of charge.

Time: 26/04/2022 from 09:00 to 12:00 (coffee from 08:30)
Venue: Scandic Rovaniemi City, Meeting Room Kaira
Koskikatu 23, 96200 Rovaniemi
Online participation: Stream link upon registration

9.00 - 9.10 Opening: Marko Mäki-Hakola, Forest Director, MTK's Forest Owners chain

Presentations:
• 9.10 - 9.40: Review of the situation in the forest sector in Northern Finland, Metsäkeskus, Ulla Huusko
• 1 Menti question: What is the most important strength of forest based bioeconomy in Northern Finland?
Answers: Forest resources (21), Research and development (2), Acceptability (0)
• 9.40 - 10.00: Development of Northern Finland based on NFI (National Forest Inventory), LUKE, Kari T. Korhonen
• 10.00 - 10.20: New Bio Products, VTT, Elina Pääkkönen
• 2 Menti question: Organize TOP 3 weaknesses according to the forest bioeconomy of Northern Finland
Answers (23): Long distances (1), Labor availability (2), Investment environment (3)
and Answer
• 10.20 - 10.40: Is the operating environment in Northern Finland in good condition from the perspective of the forest industry? Stora Enso, Esa Ojala

• 10.40 - 11.00: Opportunities for forest owners, MTK, Kalle Karttunen
• 3 Menti question: Estimate following claims about the forest bioeconomy of Northern Finland in relation to threats and opportunities
Answers (20):
-Opportunies: Climate (“Ilmasto” 3,7), Investment environment (“Investointiympäristö” 3,4), know-how (“Osaaminen” 3,4)
-Threats: Long distances (“Pitkät etäisyydet” 1,5), Infrastructure (“Infrastruktuuri” 2,4), Political decision making (“Poliittinen päätöksenteko” 2,4)
-Neutral: Conservation areas (“Suojelualueet” 3,1)



11.00 - 11.50 Panel discussion: Solving the challenges of the bioeconomy in Northern Finland. The panel was presented and chaired by Marko Mäki-Hakola, MTK

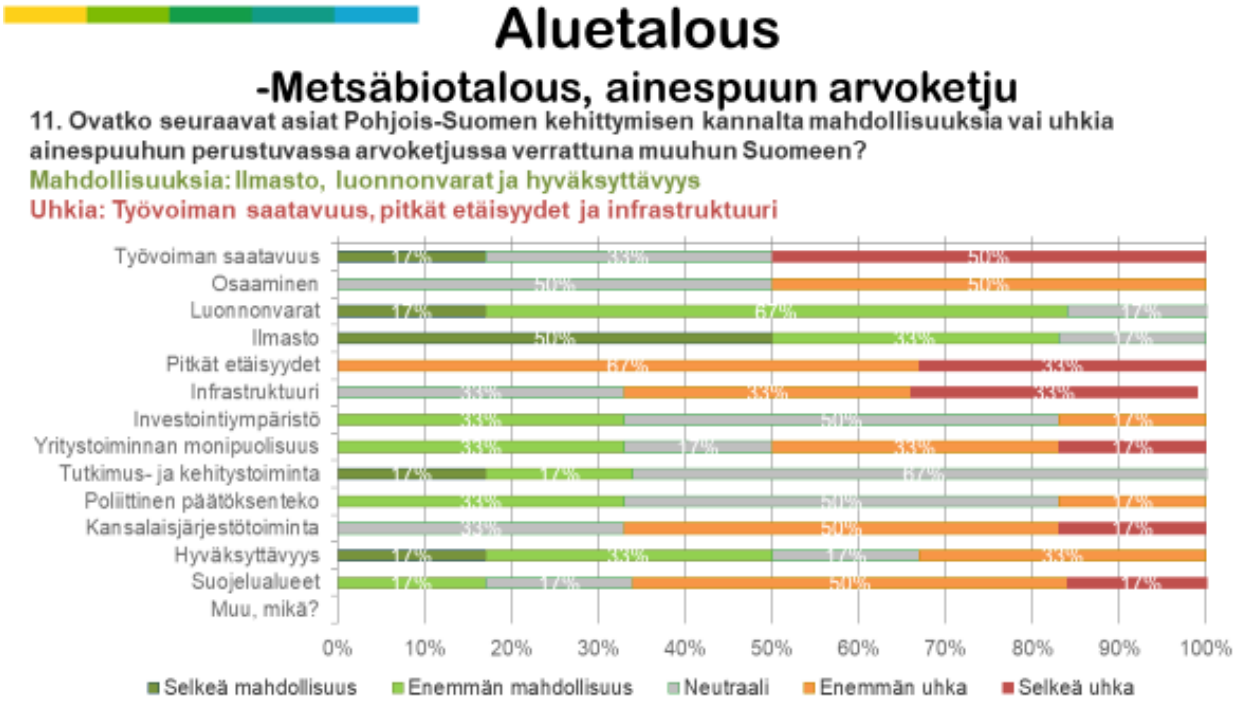
11.50 - 12.00 Final summary, Marko Mäki-Hakola, MTK

Conclusion:
We got the answers from the experts about the value chain and SWOT analysis of bioeconomy development in Northern Finland. We focused on the forest based bioeconomy and mainly for industrial wood value chain. Survey gave the details about the SWOT analysis about the bioeconomy of Northern Finland. Kalle Karttunen introduced the main findings about the survey in his presentation. Menti questions was used to keep the audience aware of the topics presented. Those were used again when talked with the panelists. Audience was active to make questions online via

chat, where presentators/panelists answered. Presentations and the whole stream record of the session was added to the project NTN network website www.branches.fi

Selected value chain:

Value chain based on the traditional industrial wood. Here it was introduced according to the results of the survey for the threats and opportunities. Question was “Are following things more threats or opportunities for the development of industrial wood value chain in Northern Finland compared to other Finland?” The most potential opportunities were climate, natural resources and acceptability. The biggest threats were labor availability, long distances and infrastructure.



Identified challenges: Please mention the identified challenges to the value chain and its development in the region, from the results of the SWOT analysis

From the SWOT results above, please mention here the explicit and derived challenges that can be identified.

Here we introduce SWOT analysis both according to the survey results and workshop results by the presentators and panelists discussion. Natural resources can be understood as forest resources in this context. We selected industrial wood value chain for SWOT analysis.

Climate itself was seen as the strength and opportunity according to the survey results. Climate will change warmer in the future but in Northern Finland it means more positive factors than in Southern Finland. It means more growth for forests and panelists assumed that it´s not that much risk for the forest destructions. On the other hand, the growth of forests in Northern Finland has been decreased in the latest forest inventory because forests are getting older in Northern Finland. Forest cutting level have been very steady at Northern Finland and panelists analysed that it is still more important income for Northern forest owners than in Southern Finland. State forest is also big forest owner to enable steady cuttings. This year may be very low cutting level compared the early figures because heavy pulp user was finished last year. But there will be lot of investments near future which will increase cutting level very fast.

On the other side of the large forest resources are the long distances in Northern Finland, which can be seen as the biggest weakness and threat of industrial wood value chain both by the results of survey and panelists. It increases the costs for forest industry and make also the profitability for forest management hard. Not only the long distances but also the lack of competition of wood in North Finland can be seen as weakness. It has increased to use of forest and wood for other purposes. Acceptability of industrial wood use was analysed to be a threat by the panelists. It also means that there should be more ways to coordinate the alternative land uses. Panelists assumed that there will be potential also for carbon sequestration for forest. The market instruments are coming soon for forest owners. Panelist also analysed that nature tourism can give incomes especially for the large forest owners.

Large investment boom was seen as the great opportunity by the panelists. But it would mean lot of infrastructure investments, which is still at low level in Northern Finland according to the survey and panelists. The investments will increase to use of wood but still the biggest increases will come to the large centralized chemical forest industry. Mechanized forest industry is positive exception. Investments need lot of money and more co-operation. Panelists analysed that research and development could be done more in North Finland together with other artic countries like Sweden. Also risk funding should be increased and research co-operation with the companies.

Nature conservation areas were seen as weakness and threat of industrial wood value chain. It is true that reconciliation must be developed between industrial use and conservation use of forests. Nature conservation areas have been very large at the Northern Finland, so more protection may focus in the Southern Finland in the future. It may give more opportunities to the industrial value chain in Northern Finland. On the other hand there was seen many other risks to reconciliate the alternative land uses.

Labor availability was seen as one of the main weakness of industrial wood value chain by the survey and panelists. Industrial wood value chain needs lot of people to operate near the forests. It is easy to get people to the city but it should be got the people also to the smaller villages and other places. Nowadays it is difficult to get people there.

Key regional conditions

Key regional conditions identified in the SWOT results above that support a sustainable development of the regional bioeconomy.

Climate itself was seen as the strength and opportunity according to the survey results. It means more growth for forests. It´s not that much risk for the forest destructions.

There will be lot of investments near future which will increase cutting level very fast. Still the biggest increases will come to the large centralized chemical forest industry. Mechanized forest industry is positive exception.

There will be potential also for carbon sequestration for forest. Nature tourism can give incomes especially for the large forest owners.

Nature conservation areas have been very large at the Northern Finland, so more protection may focus in the Southern Finland in the future. It may give more opportunities to the industrial value chain in Northern Finland.

Panelists at BRANCHES workshop from forest owner association (MTK), research organisations (Luke & VTT), industry (Stora Enso) and public administration(Finnish Forest Centre).

SWOT analysis report – Warmia and Mazury

Country: **Poland**

Region: **Warmia and Mazury**

Selected value chain: ***Vertical and horizontal networking of stakeholders in development of sustainable potato market in Poland***

Name of the event: **Workshops "Local bioeconomy and renewable energy systems - good practices for value chains and policies"**

Date of the event: **24.04.2022** Event type: **hybrid**

Venue/Online platform: **WMODR Olsztyn/Zoom**

Introduction:

The main aim of the workshop was to discuss the internal and external conditions of regional values chains in agriculture, forestry and rural areas as well as regional development models supporting innovations in bioeconomy (WP4). The basis for the discussion were two practice abstracts (WP2) and current activities of Polish and Lithuanian networks (WP1).
The event was divided into 4 parts:

1. The 1st session concerned two good agricultural practices in rural areas. It was presented two value chains:
   - Vertical and horizontal networking of stakeholders in development of sustainable potato market in Poland,
   - Value chain in the processing of lignocellulosic biomass.
2. The second session was related to the presentation of the BRANCHES network - in addition to the most important information about the branches network were presented: the Lithuanian-Polish cooperation within the BRANCHES project and examples of good practices of Lithuanian agriculture and bioeconomy.
3. Session 3 - Regional development models supporting innovations in the bioeconomy, During this part discussed:
   - activities of W-MODR in the field of innovation support in rural areas,
   - eco-energy technologies in the aspect of regional development models,
   - current support funds as a source of knowledge transfer and innovation in rural areas.

In the last part of the workshops, a discussion was held in the form of a world coffee table. The discussion focused on the strengths and weaknesses, as well as opportunities and threats in the field of regional value chains supporting innovation in agriculture, forestry and rural areas.

Selected value chain:

Vertical and horizontal networking of stakeholders in development of sustainable potato market in Poland

CN Nidzica is a Polish potato company. Its activity covers all stages of potato value chain beginning from plant breeding and ending with numerous potato-related products. Sustainable material and energy use is of the highest importance. The company develops close interlinks with national and foreign potato market actors by its activity in Polish Potato Federation.

How to organize and consolidate the effective vertical and horizontal networking of different stakeholders of potato markets (production, processing, wholesale and retail trade) at local, national and international levels? The Polish potato company CN Nidzica initiated the process of networking of the potato market actors in order to generate benefits from cooperation and increasing market power and mitigate potential drawbacks such as reduction in flexibility or decreasing competitiveness. It was assumed that efficient networking could result in a win-win situation, which would enable everyone to benefit.

It was assumed that efficient networking can result in a win-win situation, i.e. one that will enable each partner to reap benefits. Currently, numerous entities are registered in FPP, including farmers (61), local action groups (2), suppliers of equipment (7), chemicals (3) and services (3), intermediary entity (2), processors (2), gastronomy (3), R&D&I (6) and NGO (1).

The focal points of networking activity were oriented on sustainable use of natural resources and considerations on trade-offs between economic, social and environmental aspects.

Among the economic issues there were considered:

- a variety of suppliers and the business size (SME, large companies);
- reliability of deliveries;
- level of suppliers' dependence;
- contract and payment terms - hedging against risk and purchase price guarantee.

In the context of social aspects the following issues were taken into account:

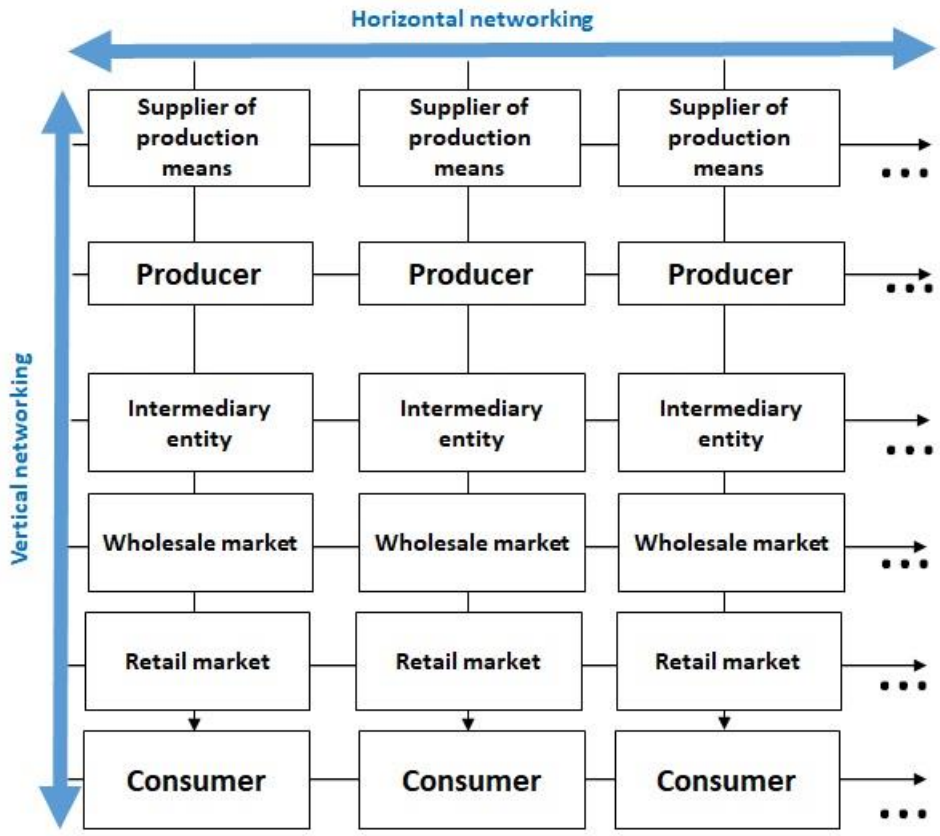
- no discrimination in employment; declaration of fundamental worker rights;
- working and social conditions; fair remuneration;
- positive impact on the local social environment, including technological support, training and promotion.

The main environmental aspects were as follows:

- minimization of GHG emission and no environmental pollution;
- rational use of natural resources (production means: land, water, fertilizers, energy) and no impact on biodiversity and waste management.

The activities of PPF are coordinated by 10 committees: agricultural producers, agrotechnology, potato and storage technology, plant breeding and seed production, potato packaging, processing and feed industry, science, innovation and implementation, food promotion and healthy nutrition, foreign trade, a code of rules and practices in the European potato industry (RUCIP). FPP developed the Program for the Polish Potato adopted by the Ministry of Agriculture and Rural Development.

The average annual income of PPF from various sources, such as Polish and European rural and rural development programs, dedicated support from local and national governments, membership fees, and fees of exhibitors at the fair amount to approx. 450 thousand euro and are allocated to the organization of potato fairs and festivals, conferences, workshops, culinary shows, training, research and international cooperation.



Horizontal and vertical networking of stakeholders of sustainable potato market

Source: Presentation during the workshop on April 24, 2022.

Agreed vision for the development of this value chain in the region

The development of the network and the strengthening of cooperation between its stakeholders, which will improve the competitiveness of Polish potato producers. As a result, it will be possible to increase their importance and share in the world potato market as well as improve the profitability of potato production.

Key regional conditions

Warmia and Mazury region has a significant potential for the development of agricultural production. There are research and development centers with highly qualified staff. These conditions enable the development of potato marked and the creation and implementation of innovative solutions. For the development of the network, it is important to conduct an extensive information campaign about the benefits of participating in the network. Well-functioning social media enables its dissemination.

SWOT analysis report – Central Italy

Country: Italy

Region: Central-southern Italian regions

Selected value chain: Circular bioeconomy applied to agro-forestry value chains

Name of the event: - NO workshop – Continuous contacts and exchange of information with members of the Italian NTN Board

Date of the event: Nov 2021 to date Event type: -

Venue/Online platform: -

Introduction:

This SWOT analysis refers to the main bioeconomy sectors of the central-southern Italian regions that have shown concrete development potentials. In this regard, given the complexity of the issues and their specificity to be taken into consideration, it was decided to engage into face-to-face consultations with the various experts involved through NTN rather than organizing a specific workshop. The results and the analysis of the interviews were collected in a final document that contains all the contributions received. The applied methodology made possible to identify strengths, weaknesses, opportunities and threats of four different value chains.

Selected value chain:

The selected four value chains refer to: 1) bioenergy (woody biomass), 2) biofuel and bioliquids, 3) biogas-biomethane and 4) green chemistry – However, in the central Italian regions, bioenergy e biochemistry comprise most of the bioeconomy sectors.

Agreed vision for the development of this value chain in the region

In carrying the SWOT analysis associated to the bioeconomy of agro-forestry supply chains, we treated separately the main related technological chains: solid biomass, biofuel and bioliquids, biogas and biomethane and green chemistry.

SOLID BIOMASS VALUE CHAIN - SWOT results

Strengths	Weaknesses
Plurality and a wide availability of raw materials (residual biomass and dedicated crops) Tested and reliable technologies, for electrical and thermal production. Strong availability in the country of industrial production and marketing of dedicated plants and related components. Availability of several "success stories" related to the entire value chains Reduction of GHG emissions European and national strategies to strengthen the sector development, in line with the objectives of the GREEN DEAL, to achieve climate neutrality by 2050. Programmability and steadiness of energy production	Poor development of biomass production/procurement supply chains at the local level that trigger the need to import Low conversion efficiency into electricity and still limited use of cogeneration. High implementation costs, per unit of installed power and to assemble district heating networks. High and irreducible generation costs for "product" biomass Limited availability and reliability of technologies (gasification) to produce electricity with high efficiency in small plants High costs for devices to reduce emissions of fine dusts

	Lack of univocal legislation, at national level, related to the treatment of ashes produced by plants Poor communication and public information on sustainability and benefits of the supply chain Need for training of regional administration officials responsible for authorization, testing and monitoring procedures Need for a better management of competences between Ministries
Opportunities Proper management and safeguard of the land (care/enhancement of the forests, maintenance of riverbanks, recovery of marginal lands, etc.), mitigation of hydrogeological instability. Ecosystem services. Growth, production diversification and export of the national industrial production in all sectors of the supply chain including agricultural and forestry mechanization, plant engineering and supply components. Recovery and economic enhancement of crop residues (pruning, straw, etc.) whose revenues are integrated into the farm income and favour savings on management costs. Strengthened use and increased efficiency of biomass in the thermal use. Modernization and strengthening of agro-forestry companies that facilitate the increase in employment, profitability, and the identification of new professional figures Technological upgrade of existing thermal plants fuelled by solid biomass, specifically to reduce PM emissions	**Threats** Use of increasing quantities of imported biomasses that are easier to find but which do not have a positive impact on the national territory. Unsuitable strategies for long-term programs. Market price fossil fuels decrease because of "dumping" strategies. The unpredictable effects of the war between Russia and Ukraine. Prejudices and opposition of general public to the construction of new plants (NIMBY effect). Changes to the incentives economic framework, which can weaken the thermal plants business plans. Potential conflicts between widespread generation and large plants for the supply of raw materials.

Quality standards improvement of the of solid biomass (e.g. solid biofuel certification) Potential establishment of national supply chains based on the use of sustainably managed forests with positive impacts also on the reduction of imports as regards of the thermal production	

BIOGAS E BIOMETHANE - SWOT results

Strengths Consolidated and widely used biogas production technologies, with strong involvement of the national industry. Supply chain capable of producing renewable energy with less involvement of land, well integrated into the various Italian agro-ecological and entrepreneurial contexts. Reduction of production costs for arable land through the use of digestate as a replacement to synthetic fertilizers. Flexibility of anaerobic digestion technology and opportunity to gain, together with biogas and biomethane, new bioproducts (e.g. bioplastics from volatile fatty acids) and fertilizers. New incentive mechanisms to strengthen the biomethane supply chain. Availability of suitable infrastructures (distribution networks) and technologies for the biomethane large-scale use as biofuel. Reliability and stability of energy productions.	**Weaknesses** Economically unsustainable plant costs, per unit of installed power, for most of the farms. Inadequate and inhomogeneous regulatory framework as regards of the authorization procedures, including the control of environmental performance to be carried by the competent Authorities. Difficulty in using some types of by-products and digestate. Unavailability of economically sustainable conversion costs for small plants from biogas to biomethane Lack of information on the positive effects of the supply chain for rural sector and environment Need for a better management of competences between both ministries and bodies involved
Opportunities Reduction of dependence from imported fossil fuels.	**Threats**

Recovery and enhancement of livestock litter, crop residues and agro-industry by-products, which allow savings on management costs and integration of farm income. Production of biofuels, heat and electricity from renewable sources available throughout the country. Modernization and strengthening of rural farms, with an increase in employment and establishment of new competencies and jobs. Growth, production diversification and export of the national industry involving all segments of the supply chain (including infrastructures, machines and components) Availability of an advanced Italian supply chain specialized on production of agricultural machinery with hybrid power (biodiesel, biomethane)	Need for a continuous update of the national strategy, especially in the long term (climate neutrality to 2050) Competition with food and feed production, in the case of excessive utilization of dedicated crops, which may involve rising agricultural product prices and land rents Prejudices and opposition of general public to the construction of new plants (NIMBY effect). Changes to the incentives economic framework, which can weaken the plants business plans.

BIOFUELS AND BIOLIQUIDS VALUE CHAIN - SWOT results

Strengths	Weaknesses
Sudden reduction in the consumption of fossil fuels in the transportation sector. Tested and reliable industrial production technologies for biofuels and derivative co-products for livestock use or of interest for the chemical industry (glycerine). Technical regulations and quality standards to ensure compatibility of bio-blends with petrol and diesel and with the existing vehicle fleet. Use of agricultural raw materials from widely utilized crops (oilseeds, sugar cane, cereals) and available on the market but not only grown in the country.	Production costs related to the market prices of agricultural "commodities" and highly dependent on scale economies, which support only larger plants. Need for significant extensions of land to produce raw materials and poor capability of the national agriculture to significantly contribute to the achievement of the objectives set by the EC Directives. Still insufficient development of technologies to produce innovative new generation biofuels and need to further increase production potential of existing plants.

European voluntary sustainability and traceability certification systems already implemented and effective at international level. Reliability and stability of energy productions.	Severe authorization rules and high costs to produce new generation biofuels. Complex fiscal discipline that still has to be adapted to use self-produced biofuels in agricultural machineries (e.g. pure vegetable oils). National Certification System applicable only in Italy and legislation on certification that is not definitive but under continuous development. Need for a better management of competences between both ministries and bodies involved.
Opportunities Farm productions of renewable energy from crops dedicated to extraction of pure vegetable oils (sustainable bioliquids). Recovery of marginal degraded lands or dismissed agricultural areas, to be cultivated with biomass crops. Presence of advanced national supply chains for production of hybrid-fuelled agricultural machineries (biodiesel, OVP, biomethane). Industrial improvement of residual raw materials (used oils, animal fats, food industry by-products, etc.). Development and export of the sectorial national industry. Availability of large contaminated areas to be potentially used for growing energy crops.	**Threats** Under-utilization or closure of biofuel or bioliquid energy production plants due to high costs and/or difficulties in supplying agricultural raw materials. Negative environmental and social consequences (land grabbing) of large-scale production. Slowdown and possible arrest in the development of the sector due to delays in the initiating of industrial production of new generation biofuels. Slowdown and possible arrest to the development of the sector due to the negative perception by public opinion of land consumption linked to the production of biofuels and consequent conflict "food vs energy".

GREEN CHEMISTRY VALUE CHAIN - SWOT results

Strengths	Weaknesses
Replacement of products with a high environmental impact with by-products from renewable, non-toxic, biodegradable and compostable raw materials. Greater attention of consumers to use products or components from renewable raw materials. Multinationals and large companies particularly interested in using more and more natural components or bioproducts. European interest to be at the forefront on circular bioeconomy. Increase of investments, intersectoral alliances and know-how in the chemical industry to develop bioproducts. Strengthened cooperation between industrial and agricultural development.	Lack of a short-term strategy of the national policy system, with reference to the design of new production models adapted to the needs of the country. Lack of reference legislation with clear definitions of "sustainable" bioproduct which creates confusion among consumers. Market not very transparent and managed mainly by large corporate groups. Lack of tools to measure the increase of benefits resulting from the marketing of bioproducts. Prices that still do not include the environmental and social benefits. Need for a better management of competences between both ministries and bodies involved.
Opportunities	**Threats**
Development of new production paradigms (biorefineries can generate new products). Interest of producers in using sustainable raw materials (health and environment). Strengthening of the agricultural sector through new crops to protect land and biodiversity. Recovery of unproductive and marginal agricultural lands.	Intensive production and simplification of crop systems, up to mono-succession, with loss of soil fertility and biodiversity. Lack of a strategy for the sustainable development of the sector. Prejudices and opposition of general public to the construction of new plants (NIMBY effect).

Development of new first transformation systems that can increase companies' income (short chains). Development of integrated supply chains for small and medium-sized enterprises (farmers, processors, formulators and related industries) capable of capturing and improving innovation. Reconversion and strengthen of industrial structures weakened by the economic and market crisis to protect employment levels.	

Identified challenges: Please mention the identified challenges to the value chain and its development in the region, from the results of the SWOT analysis

Relevant challenges for above described value chains

- Developing multifunctional and multi-product biorefineries to convert, through integrated biotechnological and chemical processes, renewable raw materials into biobased products at lower impact.
- Improving all the biorefinery cascading flows (including waste) and increase also energy efficiency, according to a "biorefinery" logic integrated with industries and the territory and with zero waste production.
- Spreading among the stakeholders of the aforementioned supply chains, consolidated and widely disseminated innovative technologies whose success is the result of years of scientific research, with a strong presence of the national industry.
- Recovering and improving livestock waste, crop residues and agro-industry by-products, which allow savings on the related management costs with positive implications on the farm incomes.
- Strengthen the Italian value chain related to high-performance agricultural and forestry machinery in terms of safety, operational efficiency and use of low-emission biofuels (biodiesel, biomethane).
- Define long-term development strategies for all supply chains.
- Raise awareness in society to accept supply chains in local contexts. Through correct information and territorial participation it is possible to prevent prejudices and opposition of general public to the construction of new plants (NIMBY effect).

Key regional conditions

Key regional conditions identified in the SWOT results above that support a sustainable development of the regional bioeconomy.
In Italy, only a few administrative regions have adopted specific "policies" to promote the supply chains covered by the present study. Even if all the administrative regions identified by the BRANCHES project, could prepare dedicated policies, they refer exclusively to national legislation framework.

However, the Conference of the Regions has recently approved (13 March, 2020) a new programmatic document on bioeconomy in which, among the many objectives foreseen for the next programming period of EU funds (2021-2027), there are also those related to:

- strengthen supports to bioeconomy considered as a transversal concept of territorial development dynamics;
- establish effective links and synergies between the different institutional regional, national and European governmental levels and share new criteria for recognizing and tracing products/processes and new rules to promote development of bioeconomy also by leveraging fiscal measures..

In this regard, we believe that it is very important to also provide professional training for technicians, professionals and managers of public administration involved in evaluating, testing and approving these value chains that are continuously and technologically evolving.