Bio-based strategies and roadmaps for enhanced rural and regional development in the EU

# The bioeconomy potential of BE-Rural's OIP regions

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## EXECUTIVE SUMMARY

In order to draw strategies and roadmaps for the development of the bioeconomy in a certain region and to engage stakeholders and encourage investments in this field, it is important to analyse first the current situation from different perspectives and look in-depth into the main factors that can influence its development and to define the barriers and the opportunities. This document analyses the bioeconomy potential of BE-Rural's OIP regions based on the Self-Assessment Tool (SAT) launched by the European Commission. The SAT is an online tool composed of two sets of questionnaires which identifies biomass and waste as alternative raw materials and are based on eight Key Factors: Long term, stability and availability of feedstock; infrastructure to handle feedstocks and production; access to finance; skilled workforce, technical expertise and training; existence of support institutions; strength and availability of regional markets; entrepreneurship; and Public support policies.

In the first step, the OIP facilitators were asked to respond to the two sets of questionnaires. Upon filling out the responses online, a spider diagram is produced with marks in each of the factors and shows in which areas the region is strong and which could use improvement. In addition, the SAT produces a document with the main conclusions and recommendations for each Key Factor. In the second step and in order to cover not only bio-based chemicals on which the SAT focuses, but also other small-scale production sectors, WIP conducted further investigations and analyses relying on the interest of the OIP facilitators for certain bio-based products and on its own expertise. In the final step, the results of the SAT and the analysis made by WIP were sent to selected stakeholders in each OIP region, in order to gather their feedback on the analysis.

The results of the analysis show that for Stara Zagora in Bulgaria there is enough feedstock from forest, agricultural residues and waste sufficient for small-scale bio-based industries and bioenergy installations, but what can hinder the development of the bioeconomy is mostly the difficult access to finance and the lack of public support. However, the strong chemical manufacturing sector can bring significant potential if new business models for the production of bio-based chemicals are adapted.

For the Szczecin and Vistula Lagoon in Poland, the analysis covered only the fishery sector. Two scenarios can be envisaged for the development of the bioeconomy in this sector. The first is based on developing a marketing strategy to allow the reuse of the by-catch fish as an edible product as part of promoting sustainable food systems and the second scenario considers the use of the by-catch together with the fish waste coming from fish processing to produce bio-based products. There is no public support available in the areas of research, finance or entrepreneurship, but the presence of Fishery Local Action Groups and fish clusters can compensate to a certain extent for the absence of public support. Stakeholders need to work together to attract investors and start-ups.

In Strumica, North Macedonia, there are enough resources for small-scale applications to be used for the bioeconomy, but there are many obstacles that might hinder the development of the bioeconomy, especially the lack of skilled people, education and trainings in the field of bioeconomy and the lack of public support institutions. Substantial awareness raising and direct dissemination activities about the opportunities that the bioeconomy can bring are crucial for its development.

As for the Covasna region in Romania, it already uses forest biomass for pellet and wood chips production, but there are still unused feedstocks that can be available for other small-scale bio-based industries. The factors that might hinder the development of the bioeconomy is the lack of skilled personnel for the implementation of bio-based industries, because of lack of vocational training and the lack of public support and entrepreneurship.

The situation in Vidzeme and Kurzeme in Latvia is promising for the development of the bioeconomy, as feedstocks are significantly available for small-scale bio-based industry or bioenergy installations. Financing is also available and is supported by private and public bodies. A qualified workforce to implement and manage bio-based industries is present. Furthermore, the region can profit widely from the existing supporting institutions. The barriers, which could hinder the development of the bio-based industry are the lack of a stable biomass resources market which can deliver in a constant manner and on the long-term, the possible lack of entrepreneurship.

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## Abbreviations

| | |
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| **EIB** | European Investment Bank |
| **EIF** | European Investment Fund |
| **FLAG** | Fisheries Local Action Group |
| **NGO** | Non-governmental Organisation |
| **OIP** | Open Innovation Platform |
| **R&D** | Research and Development |
| **SAT** | Self-Assessment Tool |

# 1 Introduction

In order to draw strategies and roadmaps for the development of the bioeconomy in a certain region and to engage stakeholders and encourage investments in this field, it is important to analyse first the current situation from different perspectives and look in-depth into the main factors that can influence its development and to define the barriers and the opportunities. In the BE-Rural project, five Open Innovation Platforms (OIPs) have been established in the following regions: Stara Zagora, Bulgaria; Szczecin Lagoon and Vistula Lagoon, Poland; Strumica, North Macedonia; Covasna, Romania; Vidzeme and Kurzeme, Latvia. As the first step, the macro-environment surrounding these regions was analysed through a PESTEL analysis (Anzaldua et al., 2019) and as the second step, the overall bioeconomy potential was analysed based on the Self-Assessment Tool (SAT).

One of the most important sectors for the development of the bioeconomy is the chemical sector or the production of biochemicals from biomass and waste. Existing chemical industries can switch from using fossil fuels to using biomass and waste for the production of biochemicals. For this purpose and in order to encourage investments in biochemicals production in Europe, the European Commission officially launched the SAT tool (ESCSS, 2017). This tool can help regions determine their readiness level for new investments in the bioeconomy and it was used as a basis for the bioeconomy potential analysis of the OIP regions of the BE-Rural project. In order to complete the analysis and to cover also other small-scale production sectors, WIP conducted further investigations and analyses based on the responses to the SAT questions, the interest of the OIP facilitators for certain bio-based products and relying on its own expertise.

# 2 Methodology

In the first step, BE-Rural's OIP facilitators were asked to respond to the two sets of the SAT questionnaire, one which identifies biomass from agriculture and forestry as alternative raw material, and the second which identifies waste, to produce bio-based chemicals. The SAT carries out the first assessment of the current situation in a region through the following eight key factors (KF):

- Long term, stability and availability of feedstock
- Infrastructure to handle feedstocks and production
- Access to finance
- Skilled workforce, technical expertise and training
- Existence of support institutions
- Strength and availability of regional markets
- Entrepreneurship
- Public support policies

The SAT consists of an online questionnaire for each type of feedstock. Once the questionnaire is filled, a spider diagram is elaborated with marks in each of the factors. The marks range from 0 to 10. They show in which areas the region is strong and which could use improvement. Average marks can be compared with those of other European regions that have already used the tool. This helps clarify where the region stands in a European context. Aside from the spider diagram, the SAT produces a document with the main conclusions and recommendations for each Key Factor. The spider diagrams are included in the respective OIP results chapters (Figure 1 to Figure 9) and the main conclusions and recommendations are included in Annex I.

Based on the responses of the OIP facilitators and the automated SAT results and recommendations document, WIP conducted a more precise analysis of the bioeconomy potential of the regions focusing not only on the chemical sector for the production of bio-based products, but also on the other sectors and based on the interest of the OIP facilitators for certain bio-based products. It is important to mention that in the case of the Polish OIP regions, only the SAT considering waste as raw material was evaluated and the analysis done by WIP focused only on the fishery sector. The analysis of WIP, together with the automated SAT conclusions and recommendations, were sent to the respective OIP facilitators for review. Then, the documents were sent to 2-3 regional stakeholders who were asked to give their feedback by answering the following questions:

- Do you see any errors in the analysis? Do you have any comments on the results?
- Are there any additional barriers or opportunities related to the future bioeconomy development of your region that are not covered by the analysis?
- On the background of the results of the analysis, how do you see the way forward regarding the development of the bioeconomy in your region (from where to start and how to act)?
- Taking into account the identified barriers and opportunities, on which area should BE-Rural focus / where do you think a project like BE-Rural could have the biggest impact?

After receiving the feedback from the stakeholders, conclusions were drawn for each OIP region.

# 3 Results of the analysis

This chapter summaries the results of the SAT questionnaires (one on biomass from agriculture and forestry and one on waste), which have been completed for each of the five OIP regions. It then presents the feedback of selected regional stakeholders on the results and, on that basis, draws overall conclusions regarding the bioeconomy potential of each OIP region and regarding the role which the BE-Rural project could play in this respect.

## 3.1 Stara Zagora, Bulgaria

### 3.1.1 Summary of the analysis based on the SAT

The region seems not to have a high forest biomass potential. Therefore, applications like pellets and wood chips production for bioenergy purposes or small-scale bio-based industries using wood can be considered. On the other hand, there is a significant potential from agricultural residues considering the amount of utilised agricultural area. These can be used in many applications for energy purposes and for the production of bio-based commodities. As neither the amounts nor the type of agricultural residues is known, it is not possible to suggest relevant applications at the moment. Nevertheless, an application combining forest and agricultural residues (e.g. Spawnfoam[1]) could be promising in the area. It is important to note that all these biomass resources are not currently utilised for other purposes and are available for the bio-based industry.

As for waste, the agri-food sector, farming sector and pulp and paper industry offer a high potential of biomass resources. These waste streams can be converted by different processing methods into bio-based materials or can be used for biogas production. Sewage sludge also has good potential and can be diverted to higher value products (e.g. fertilisers, phosphorous).

The infrastructure for transporting biomass is quite satisfactory to fulfil its role, but the absence of logistic centres for biomass handling might slow the development of the bio-based sector especially for pellet and wood chips production or other applications, where biomass needs to be gathered and handled before its use. In this case, the bio-based industry which could be developed, should take into account the need for extra space on their premises, which can serve as a logistics centre or get installed in the existing old industrial sites with sufficient space and where utilities can be supplied. The transport company that already exists and can transport biomass from their sources has a large potential advantage in reducing their investment costs regarding this issue.

Even though the public financial situation is relatively good, no financing lines can be used to finance projects for the bio-based sector. Private banks are in a good financial condition and lending to the private sector is good but with high interest rates. Therefore, one cannot rely on public entities for financing, but on private banks who despite very unfavourable conditions and on EIB/EIF financial intermediaries established in the region. Foreign investment is important in the region. This can be seen as a good opportunity if the investors are informed about the opportunities that the bio-based industry can offer. The BE-Rural project could play an important role in this respect.

[1] Spawnfoam is a technology that has been identified as a best practice example in BE-Rural Deliverable 2.1 "Small-scale technology options for regional bioeconomies" (Colmorgen & Khawaja, 2019)

It was reported in the analysis of the macro-environment surrounding of the region (Anzaldua et al., 2019) that there is a lack of highly qualified young workers that could be employed for biomass procurement activities and for biomass plants. This could be a barrier for the development of the bio-based economy in the region. Efforts should be made to determine if such workforce exists. As for the workforce required for the management, operation and maintenance, the situation seems a bit better as the region offers some post-graduate specialisation in the field of biomass use and waste management and its use, but with vocational training targeted only for waste. Therefore, training sessions for local workforce using forest and agricultural residues biomass needs to be performed privately by the bio-based industry which would be installed or recruited from other regions or countries.

The region does not offer support for research and innovation and the infrastructure and businesses necessary to support companies in the transition to a bio-based economy. This might hinder the development of the bioeconomy and should be addressed by the regional strategy / roadmap developed by the BE-Rural project. The region can offer some services for business plans and finding investments, but there are no special programs for start-ups; however, they can profit from the programs that universities in the region offer.

The biomass resources market is not well developed and there are no biomass suppliers although, as mentioned previously, biomass is available. As a potential first step, a plan which indicates sources, types and quantity of biomass and their operation needs to be developed for a bio-based industry to be put in place. Also, a detailed market study needs to be performed to find out if a certain bio-based product can be marketed or not. There are no procurement policies for green products currently, but Bulgaria's Public Procurement Act of 2001, which could make bio-based products and services sources of supply for government purchases constitute a significant source of demand. The fact that the region has a strong chemical manufacturing sector for additives/paints, coatings, polymers, fertilisers, plastic etc. is an advantage for the region even it is still fossil-fuel based. A promising initiative would be to address these companies and propose to them new business models and look for the possibility to transition to the production of bio-based chemicals. The BE-Rural project, through its stakeholder engagement and business model development activities, will create a positive opportunity to investigate this possibility.

The expenditure on research and innovation is adequate and the regional economy shows an innovative capacity and strong vitality as the birth rate of starting firms in the region is quite good and more than 60% of them survive the first five years. However, there seems to be a closed business environment, which leads to a situation where different actors of a bio-based product value chain might have limited opportunities to network and develop new businesses. One can take advantage of the presence of chemical; polymer and agri-food clusters present in the region to develop the bioeconomy sector and propose new bio-based businesses.

Public support policies for the transition to a bio-based economy are lacking on all levels in the region. In addition, there are some regulations acting against biomass production (e.g. energy crops), even on marginal land. Therefore, it would be important to propose different supporting policies in the context of the regional strategy / roadmap document, which the BE-Rural project will develop, thereby providing guidance for the region on the steps for the further development of the bioeconomy concerning public support.

**Figure 1: Biomass spider chart of Stara Zagora**

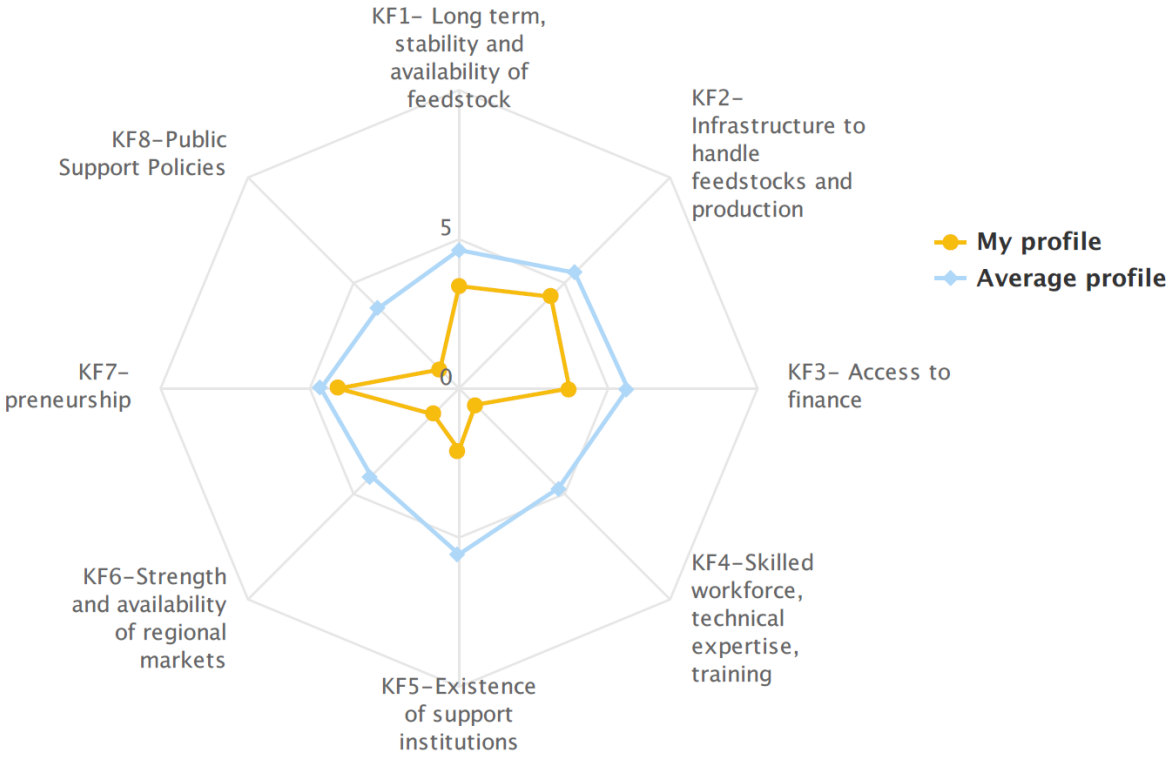
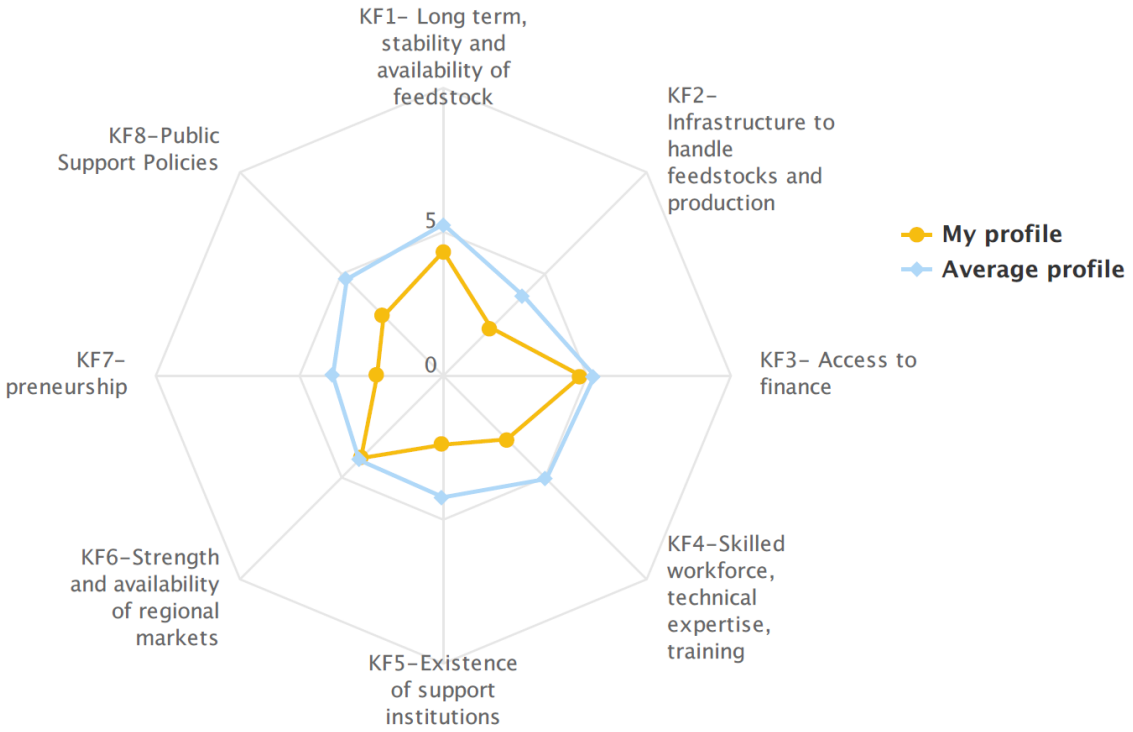



**Figure 2: Waste spider chart of Stara Zagora**




### 3.1.2 Stakeholder feedback

The results of the SAT questionnaire and the analysis above were reviewed by three stakeholders: district authority, private company and local university representatives.

According to the local authority, stating that the existing transport company can be of great advantage in reducing investment costs, is not correct. It seems that in the region there was a straw paper mill, which due to the high transportation costs and to the fact that the resources are scattered, went bankrupt. The infrastructure for biomass transportation is adequate, but one needs to think of pre-handling and compressing larger quantities of waste in order to transport larger quantities with less runs (courses) between destinations, which will accordingly save transportation costs.

A company representative noted that the development of the bioeconomy is hindered by the lack of promotion of the benefits associated with the bioeconomy and currently this is the hardest step which needs to be overcome.

BE-Rural could focus on the info campaigns, meetings, and the possibilities to bring stakeholders together to explore in more depth the problems and barriers faced on a daily basis and how to overcome them. Furthermore, the project could have a greater impact if it explores the best practice examples from other countries and provide capacity building opportunities about them.

### 3.1.3 Conclusion

There is not enough forest and agricultural residues biomass available for a large-scale biorefinery concept, but only for small-scale bio-based industries and bioenergy installations. Waste from the agri-food sector, farming sector and pulp and paper industries also have high potential. First details about the type and quantity of agricultural residues and waste must be estimated in order to be able to suggest appropriate bio-based value chains. The road infrastructure for transporting biomass is adequate, but investments in logistic centres must be foreseen. It is currently not easy to get financing for bio-based projects, especially from the public sector, but as foreign investment is important, ways to attract these investors should be planned. Efforts should be made to train a suitable workforce for biomass procurement and for other managerial and operational positions; alternatively, these need to be recruited from other regions/countries. The region does not offer appropriate support for the development of bio-based products on all levels. There are no established biomass resources markets and this needs to be planned as the first step. The region has a strong chemical manufacturing sector. So, there seems to be potential for new business models for the production of bio-based chemicals.

## 3.2 Szczecin and Vistula Lagoon, Poland

### 3.2.1 Summary of the analysis based on the SAT

The Polish OIP regions covered in BE-Rural have a unique situation compared to the others as the assessment of the bioeconomy potential only concerns the fishery sector. The SAT questionnaire considering biomass from forest and agriculture as raw material is therefore not valid for these regions. As for the SAT considering waste as raw material, it can be adopted, but only partly. In the fishery sector, the raw materials that can be used for the bioeconomy are either the fish that is caught and thrown away because of a lack of market (by-catch fish) and thus considered as waste, or the guts and the waste material resulting from processing the fish to prepare it for consumption. Even though the SAT questionnaire considers other sorts of waste, only the waste from fish was taken into consideration for this analysis.

The sources consulted did not provide information about the quantity and type of waste generated including the agri-food sector, to which waste from fish could belong to, but an approximate quantity can be determined based on expert judgement. The most important waste in this sector in the region is considered to be the roach fish, which is a by-catch that exceeds 25% of the catch and at the moment it is discarded. It is considered that it would be advantageous for the development of the bioeconomy in the region to use this fish in two possible ways: either by developing a marketing campaign to allow the reuse of this fish as an edible product as part of promoting sustainable food systems, or to process them using different applications and technologies for the production of bio-based products such as fish oil and high-grade protein products.

In the first case, the eight Key Factors of the SAT tool are not very relevant. This concept does not need any infrastructure for handling feedstock, does not require investment costs thus financing (even though there are no obstacles for financing in the region in case this is needed for a campaign), does not need skilled workforce, support institutions and public support policies. The only Key Factor that can be considered in this case is the strength and availability of regional markets, and these need to be built from scratch. Fisherman, fishing associations, restaurant owners, tourism agencies and other stakeholders should discuss the validity of this topic and work together to build up a marketing strategy to be able to sell the roach fish. The BE-Rural project can help with initiating this process.

In the second case, not only the roach fish can be used, but also all by-catch fish and all kinds of fish waste generated by fish processing. As this feedstock can be used in different technologies (e.g. BIOMEGA[2]) to produce bio-based products, all Key Factors become relevant. In this sense, concerning the infrastructure, logistic centres are not needed as the processing can be done in a small place on a very small-scale level. The roads for the transportation of waste are existing and well managed. The main issue that should be considered is the supply of electricity and fuel in case of unforeseen electricity interruptions.

Concerning access to finance, there seem to be no obstacles to receive financing for bio-based projects. Most of the banks in the region are in a sound financial situation and lending to the private sector. Even though public financing does not exist, the operational programme (European Maritime and Fisheries Fund line) for fishery exists and the Fisheries Local Action Groups (FLAGs) provide financial support for investments. Furthermore, using the existing network, which involves different stakeholders, could be used to support the development of the strategy towards bio-based production.

The fact that the region offers high-level education, which includes the use of waste as an alternative raw material in the curricula and in some post-graduate/master degrees specialisations, and also offers theoretical vocational/professional trainings in the same field, is of great benefit for the development of the bioeconomy in the region. The bioeconomy development could be enhanced if some public training activities could be undertaken to move from theory to practice and if stakeholders, including industry, take part in the design of the trainings. This should be addressed in the strategy / roadmap document, which will be developed by the BE-Rural project.

It seems that the knowledge support for developing new businesses in the bio-based field in the region should not rely on the public institutions. Even though the regional government has a public institute that covers financial support aspects, but they do not cover waste and bio-based processes. This should be addressed in the strategy / roadmap document, which will be developed by the BE-Rural project. Therefore, for such businesses, one should rely on its own efforts.

The most common products that can be produced from fish waste are fish oil (omega-3), fish protein powder (used for human consumption), fishmeal (used for animal consumption) and collagen. At the moment, the market for these products does not exist, but a marketing plan can be easily put in place as such products usually have high demand. It is advised to conduct a market analysis at regional and national level to know what products can be better marketed on the long-term and focus on them for the decision on the technology option.

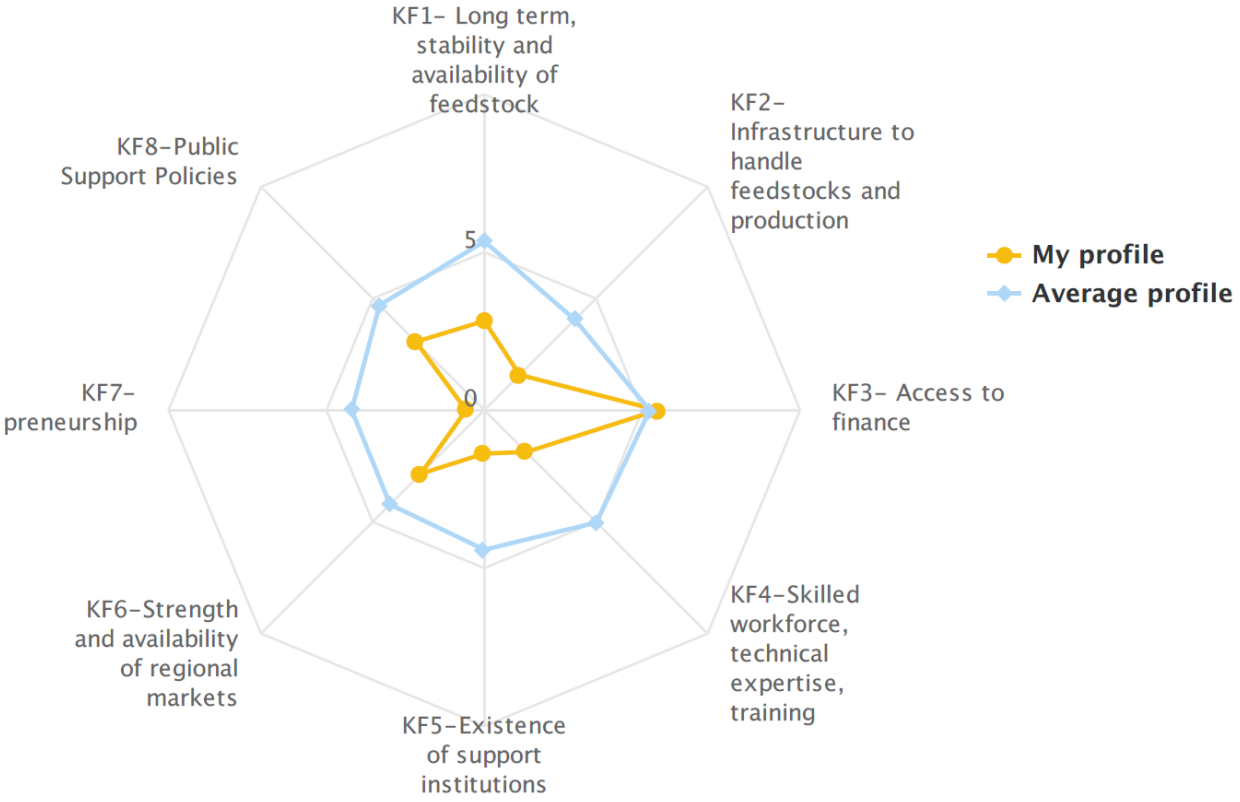
Although the sources consulted did not provide information on the success rate of start-ups in the field of bioeconomy, probably because they are not abundant, the presence of clusters for the fishery sector which are part of an international cluster is very prominent for new start-ups. These clusters need to be informed on the opportunities that the bioeconomy can offer from the fish waste and can open the door for entrepreneurship, especially that business networking in this sector is weak. This process will be initiated by the different stakeholder engagement activities of the BE-Rural project.

Finally, regarding public support policies, innovation planning does not exist for the sector, but there is a local strategy for the development of the area for the fishery sector and it is being implemented by FLAGs. Policymakers should provide support to develop the bioeconomy in the region in the fishery sector. Policy areas such as energy, environment, education and research, waste and raw materials, among others, are required to join forces. Public incentives for innovation, which currently do not exist,

[2] BIOMEGA is a technology that has been identified as a best practice example in BE-Rural Deliverable 2.1 "Small-scale technology options for regional bioeconomies" (Colmorgen & Khawaja, 2019)

can play an important role to stimulate business innovation in this sector. All these issues should be addressed in the strategy / roadmap document which will be developed by the BE-Rural project.

**Figure 3: Waste spider chart of Szczecin and Vistula Lagoon**




### 3.2.2 Stakeholder feedback

The results of the SAT questionnaire and the analysis above were reviewed by a local authority, a local entrepreneur, a fisherman and a civil society representative. Their feedback includes the following:

One of the main barriers identified by local authorities is the lack of activity of local society when undertaking innovative economic activities. They mentioned the fear of taking economic risks, the lack of advisory institutions and non-willingness of many social groups to make efforts to acquire financial resources, which can bring a small extra income but cost more time. At the same time, there is a lack of financial resources in local society to cover their own contribution for investments that can be co-financed by supporting programmes (e.g. for fisheries, agriculture, regional economy).

A local entrepreneur indicated the lack of real support from the local administration. Declarations of support are not paired with activities facilitating undertaken economic activity. There are no administrative activities related to facilitating the establishment of new businesses, and the costs are higher than in nearby large cities. As an example, an entrepreneur (from the IT industry) who was trying to obtain land for the construction of the headquarters had to move to another nearby city, because of administrative barriers and lack of support.

Fishermen are most predisposed to invest in the management of local fish resources, however, due to their advanced age and attachment to traditional forms of obtaining income, and mainly due to the lack of successors, there is no incentive to develop new investments.

The lack of the development of economic activity in the region is due to two opposing opinions. The authorities referred to the need for greater activity among residents and to the fact that there is excessive spending of the state on social support (minimum wage, benefits, support programs), while the inhabitants indicated the need for a greater administrative support (they expect donations, risk sharing, investor preferences, etc.). The development of the bioeconomy is subject to the same restrictions, and an additional lack of understanding of the very essence of the activity has been pointed

out. Local authorities declare support, but in a detailed interview it turns out that they do not understand how the bioeconomy can support the regions' development. Similarly, residents expect help both in consulting and investment preparation. Currently, at no stage, do they have administrative support for the concept of investment in fully utilizing existing resources in the region.

The mentality of the society in Poland is oriented on specific, subject-oriented action. Concepts, multi-annual strategies and framework guidelines are treated as non-important, because they do not generate real income. In the absence of a package relating to an investment support, interest in a project is significantly weakened. In the opinion of local authorities and potential investors, information activities and the promotion of the circular bioeconomy as a factor for the economic growth should be intensified. However, the effectiveness of the campaign will be visible only when reaching the consciousness of the inhabitants. It's not the lofty ideas of economic development of the region, but about the profit of the average citizen, perceptible, real profit and in the current period.

The promotional actions foreseen in the BE-Rural project (pop-ups, workshops, etc.) are a step in the right direction, but the impact in the region would be higher if specific examples regarding the fishing industry and small-scale production of waste (small-scale fishing conducted by individual fishermen with their families) would be promoted.

The need for greater impact on institutions in the region was mentioned in order to provide substantive support to employees and prepare them to consciously support investments in the circular bioeconomy.

### 3.2.3 Conclusion

In the Polish OIP regions, the bioeconomy analysis was conducted with a focus on fish by-catch and fish waste. The fish by-catch can be utilised in two pathways for the development of the bio-based economy in the region: by building a marketing strategy to allow the reuse of this fish as an edible product as part of promoting sustainable food systems, or by using the by-catch together with the fish waste coming from fish processing to produce bio-based products such as fish oil, fishmeal and fish protein powder. There is no public support available in the areas of research, finance or entrepreneurship and also in local administration, but the presence of FLAGs and fish clusters can compensate to a certain extent for the absence of public support. Stakeholders need to work together to attract investors and start-ups. Communication and dissemination activities on the opportunity which fish waste can bring especially to the young generation and to the local government are a key element for the development of the bioeconomy in the region, but first a market analysis should be conducted to see if the bio-based products can be marketed.

## 3.3 Strumica, North Macedonia

### 3.3.1 Summary of the analysis based on the SAT

The region does not possess enough raw material from forest biomass to be used for a biorefinery concept, but this raw material could be sufficient to be used for other small-scale applications like pellets and wood chips production for energy purposes, or for the production of some bio-based lignocellulosic commodities, especially given that there is no competition over this raw material for other uses in the region.

Concerning raw materials coming from agricultural residues, they are also not sufficient for a biorefinery concept, but as it is the case for forest biomass, the raw materials can be used in many other applications for energy purposes and for bio-based products. Statistical information on the type of agricultural residues is needed as the first step in order to propose the appropriate applications. Also, for agricultural residues, there is no competition for other uses.

Furthermore, combining agricultural residues and forest biomass, a number of bio-based commodities can be produced such as pots, containers, construction boards etc.

As for waste, there is no data on the type and quantity of waste generation, but there is a strong agri-food industry which consequently means that such waste exists. More precise information should be

gathered on the type and quantity of waste generated from the agri-food sector in order to determine what kind of bio-based products can be generated. In the simplest scenario and even if this data is lacking, the waste from the agri-food sector – as it is mostly a wet waste – can be used for biogas production in an anaerobic digestion system and consequently produce electricity. In this case, the manure coming from animal husbandry can also be used in the same way. As the livestock farms are scattered in the region, agri-food industries and livestock farmers can cooperate to build up anaerobic digestion systems using both types of waste. As an alternative, these types of waste can be simply composted to produce fertilisers.

The availability of feedstock is an essential but not the only factor for determining the bioeconomy potential of a region. The infrastructure to handle feedstocks and production plays an important role. The existing roads are not in optimal condition, but are suitable enough to transport biomass resources and waste. The main obstacles of using forest biomass is the lack of logistics centres to handle the feedstock, whether it is used for pellet and wood chips production or for other purposes. On the positive side, the appropriate location (distance, supply of utilities etc.) for such centres exists and even one old industrial installation can be used.

Projects for the bio-based economy need financing and loan facilities to cover investment costs. Even though there are some difficulties to acquire appropriate financing, public entities and private banks, which can finance such projects, exist in the region. At the same time, no subsidies related to the use of biomass for energy and bio-based products exists. This issue should be addressed in the regional strategy / roadmap document, which will be developed by BE-Rural. As foreign investment is significant, it can be of significant help for the region, but finding ways for attracting these investments is crucial and BE-Rural with its various stakeholder engagement activities and capacity building events can play an important role in this sense.

The skilled workforce, the technical expertise and trainings are also critical for the development of the bioeconomy in a region. With regard to forest biomass, there is a suitable workforce for procurement activities, but not for bio-based and bioenergy applications. Furthermore, no training actions have been taken in this context. The fact that there is no high-level education in the field of biomass use and no centres of excellence and vocational education and training is seen as an important barrier in the development of the bio-based economy in the region. To overcome this barrier, suitable workforce can be brought from other regions or countries, but for the further stable development of the bioeconomy in the region, it would be important to introduce the topic of biomass use and bioeconomy in schools and universities and offer trainings in the field. In this context, BE-Rural might play an important role as part of the foreseen project activities (educational events etc.).

Another barrier, which could face the development of the bioeconomy in the region, is the lack of support institutions on all levels that could help the implementation of bioeconomy projects. This should be addressed in the regional strategy / roadmap document, which will be developed by BE-Rural. This fact does not make it impossible to proceed in such projects, but more efforts would be required to put into force their implementation.

In addition, the regional market for bio-based products seems also to be lacking. Therefore, extended efforts should be given for the marketing of the products.

Regarding bio-based businesses, there is no precise information on its current development, and it seems that businesses in this field are not known in the region. Stakeholders along the supply chain – from biomass suppliers to investors – need to sit together and look for ways of collaborating to start business in this field. The BE-Rural project will offer such opportunities and will help to initiate the process.

Finally, the lack of public support policies seems to hinder the development of bio-based industries in the region, but at the same time, there are no laws or policies which play against their development. Ways to develop these policies will be addressed in the regional strategy / roadmap document of the BE-Rural project and proposed to policymakers of the region.

**Figure 4: Biomass spider chart of Strumica**

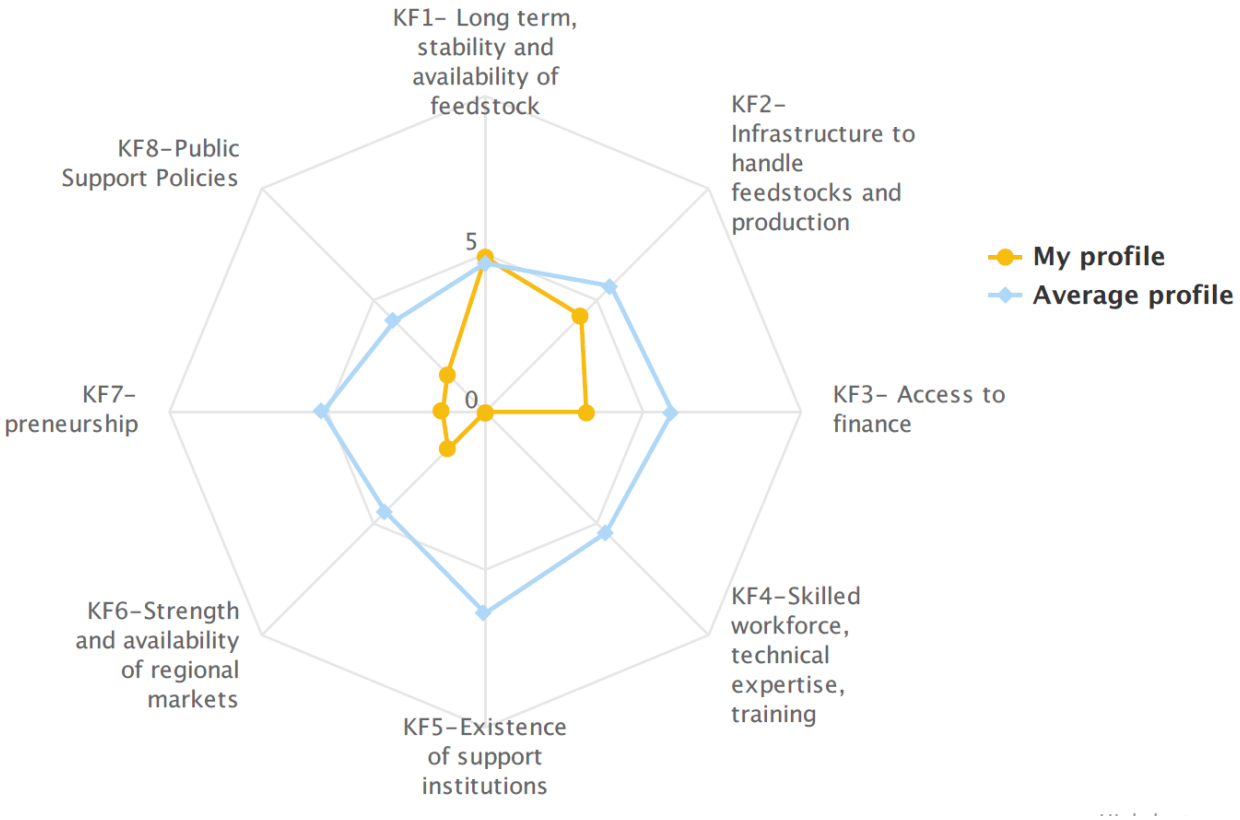
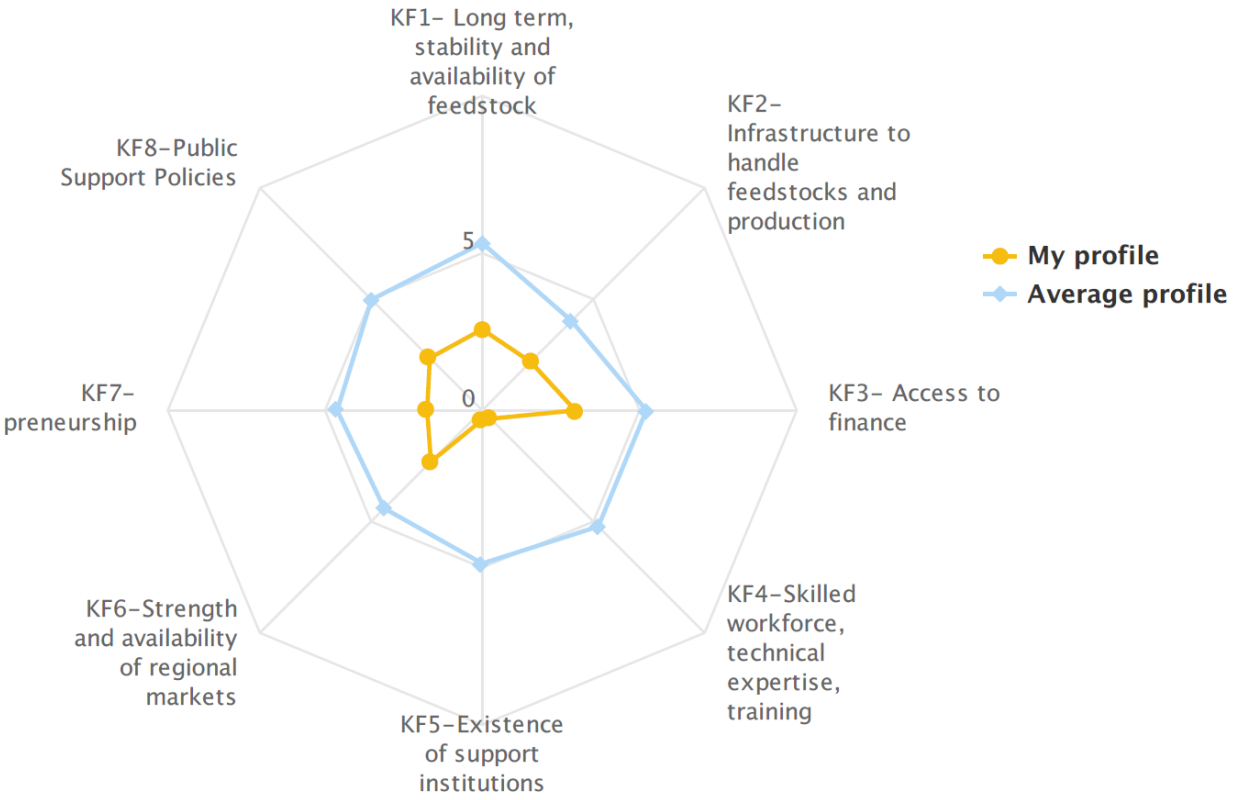



**Figure 5: Waste spider chart of Strumica**



### 3.3.2 Stakeholder feedback

The results of the SAT questionnaires and the analysis above were sent to three stakeholders: one public sector representative, one person from civil society and one from education and science. In addition, the OIP facilitator also provided his opinion.

The overall analysis and results are accurate, and no major lapse was detected.

Concerning the barriers, according to the OIP facilitator there is an insufficient staffing of Local Economic Development services in the municipalities that could foster development in the areas covered by the project. An additional barrier detected by a public representative is the ownership of agricultural land which is on small parcels and therefore is preventing efficient and enlarged production. Thus, the number of residues that should be used for processing with the proposed technologies is low. There is a lack of models for the consolidation of agricultural production or individual association with no financial models to support such an association. An additional opportunity stated by the civil society representative is the existence of The Payment Agency - Agency for Financial Support in Agriculture and Rural Development, which supports and subsidizes agricultural cooperatives and has larger subsidies compared to individual agricultural producers.

The problem/barrier is with traditional farmers' beliefs, their unambitious interest and distrust of inclusion in associations. This approach can be changed, but it is a slow-going process and many activities are needed to raise public awareness and restore confidence in farmers.

According to the OIP facilitator, an enhanced cross-border collaboration between Greece and Bulgaria will open many opportunities for the implementation of new projects that are in the scope of BE-Rural. Regarding the educational system, there are many aspects that should be improved, for example a change in the secondary and higher education that should be in line with the needs and opportunities in this field. Then, trainings as part of the education system should be organised in the fields of agricultural production and reuse of by-products. New innovative technologies and their practical use should be integrated in Master and PhD research programmes. This could contribute to the development of the bioeconomy. The civil society representative thinks that greater financial support and projects for different types of associations (co-operatives, local action group, etc.) are necessary, not only through subsidies, but also through the availability of different funds.

In the opinion of the OIP facilitator, BE-Rural should focus on the development of different measures with the help of the Eastern region administration services. Additionally, the project should provide analysis, studies and further projects that will be ready to apply for various calls for funding. The public representative believes that the project can have a significant impact if it provides examples of technologies and machines that will allow the raw material to be processed to a bio-based end-product (briquettes, wood chips, pellets, insulation products, etc.). As for the civil society representative, the largest impact that projects like BE-Rural could have is to change the conventional approach and understanding of farmers that are throwing away or burning the agriculture residues in the fields, instead of exploiting them. The representative of education and science thinks that BE-Rural could influence the educational institutions to develop master and PhD programmes by suggesting research topics and themes in the field of bioeconomy.

### 3.3.3 Conclusion

It can be concluded that the region does not have enough feedstock for large-scale applications, but there are enough resources for small-scale applications to be used for the bioeconomy. Roads for the transportation of feedstock are not a hindering factor for the development of the bioeconomy, but there are many other obstacles that might do so, especially the lack of skilled people, education and trainings in the field of bioeconomy and the lack of public support institutions especially financial ones. A significant amount of awareness raising and direct dissemination activities about the opportunities that the bioeconomy can bring is crucial for its development, especially for farmers throwing out or burning the agriculture residues in the fields, instead of exploiting them.

## 3.4 Covasna, Romania

### 3.4.1 Summary of the analysis based on the SAT

The region has a significant biomass potential from forests and, to a lesser extent, from agricultural residues and both with assessed amounts and characteristics. There are biomass plants, which are using a part of the biomass, but there are still unused feedstocks that could be available for small-scale bio-based industries using forest raw material to produce, for example textiles, or other bio-based lignocellulosic commodities, or for pellets and wood chips production or even pyrolysis for energy production.

Waste coming from the agri-food sector is important in this region. It can be used for chemicals production, with a diverse range of applications. Waste from pulp and paper industry offer also a good feedstock for chemical building blocks, polymers or resins manufacturing and for nutrients production for fertilisers and it seems that the region is already using this waste for this purpose.

The type of roads is not the most optimal for biomass transportation, but they do not constitute a barrier for that purpose. A large advantage for the region is the existence of biomass logistics centre to handle biomass and there are several interesting locations to build more. Furthermore, industrial parks, which could supply utilities, could be used to set up biomass logistics centres. As there are transport companies that would be able to transport biomass, the costs of investments related to transport equipment could be reduced. In the region, there is an old industrial installation which could host a bio-based industry or bioenergy installation and take advantage of the storage sites that exist there.

Public financing in the region can provide direct or intermediate financing through national and regional public banks, but it is not easily accessible. The private banking sector is also strong and lending to the private sector is good. Furthermore, the existence of an important mechanism of collaboration between the public, private and financing sectors allows an easier access to finance. Also, the subsidies or grants assigned to biomass use for energy purposes is a big advantage, especially for bioenergy installations.

The region already has a deep knowledge in certain technologies for bioenergy production (combustion, pellet manufacturing and cogeneration plants). Therefore, an appropriate workforce for biomass procurement activities exists, but reliable data is lacking. As for the workforce related to the management, operation and maintenance of new installations, beside the ones that already exists in the region, it can be said that it is not fully available. There are some experts with theoretical technical expertise as there are specialisation and post-graduate courses offered by universities in the region in the field of bio-based industries, but there is a lack of applied vocational trainings, which makes it harder to have professional skilled personnel for the implementation of bio-based industries or other bioenergy installations. Some training courses can be integrated as part of the university curricula, especially given that the industry is involved in some activities with universities. Another solution could be that the industry which will be installed, will give training sessions for the required staff. Another solution would be to recruit experts from other regions or countries.

It would be helpful for the development of the bioeconomy in the region to have a research and innovation strategy for smart specialisation focused on the bio-based industry. This should be addressed in the regional strategy / roadmap document developed by the BE-Rural project. The Research and Development infrastructure involving universities, companies and government hybridisation to support companies in the transition to a circular economy exists. On the other hand, regional governmental support for new businesses in this field is lacking, but some regional grant programmes are supporting innovative start-ups, and this can be useful. A helpful tool that can encourage the implementation of bio-based industries or bioenergy installations is the presence of a biomass information service which informs about the availability of feedstocks and indicates opportunities for integrated bio-based and bioenergy installations.

The biomass market is still not fully developed, although there are several biomass suppliers from forestry and agriculture. Some efforts need to be done, e.g. purchase agreements to secure a stable supply over the long term in case a bio-based industry or energy installation is put in place. Moreover, there are some companies who are interested in developing the biomass market. In addition to a secure biomass supply, the marketing of the bio-based products is extremely important. Currently, it seems

that some efforts should be done to find a market for bio-based products coming from bio-based industries as they might not exist in the region. As for bioenergy products (e.g. pellets), the market is a bit better as these products already exist. A market analysis should be conducted in both cases to better understand the demand on the products in the market for their use inside or outside the region.

Entrepreneurship seems generally to be weak, but can be developed at a rapid rate using the networking opportunity that the existing clusters can provide. Some actions are needed within these clusters for the creation of an environment prone to innovation and cooperation towards a circular bio-based industry. Furthermore, the activities within the BE-Rural project can play an important role in this respect.

Public policies supporting Research and Development, providing incentives to stimulate the bioeconomy and supporting a strategy targeting the transition to a circular economy do not exist. Policies should be developed in the region in terms of investment in research, innovation, skills, market development, enhanced competitiveness and also engagement with stakeholders to promote bio-based initiatives. The BE-Rural project could play an important role through the regional strategy / roadmap document that it will develop and through the stakeholder engagement activities.

**Figure 6: Biomass spider chart of Covasna**

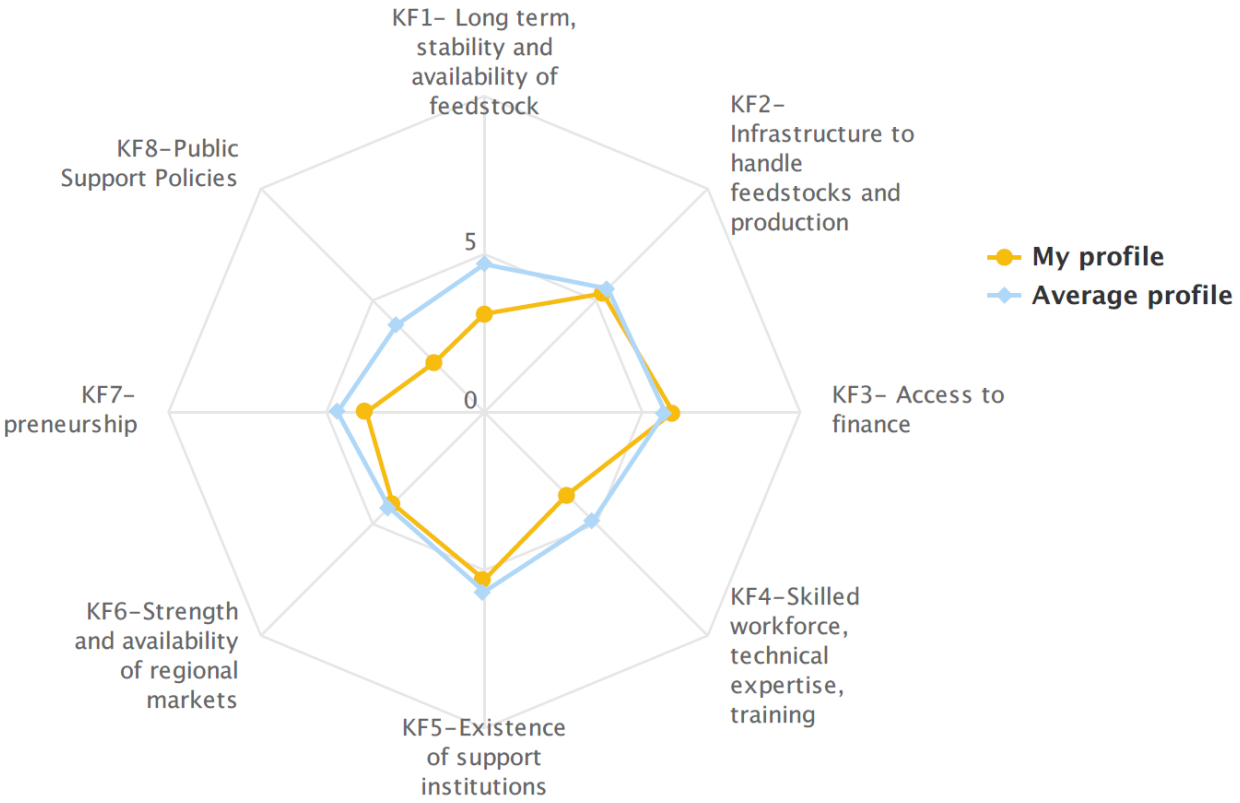
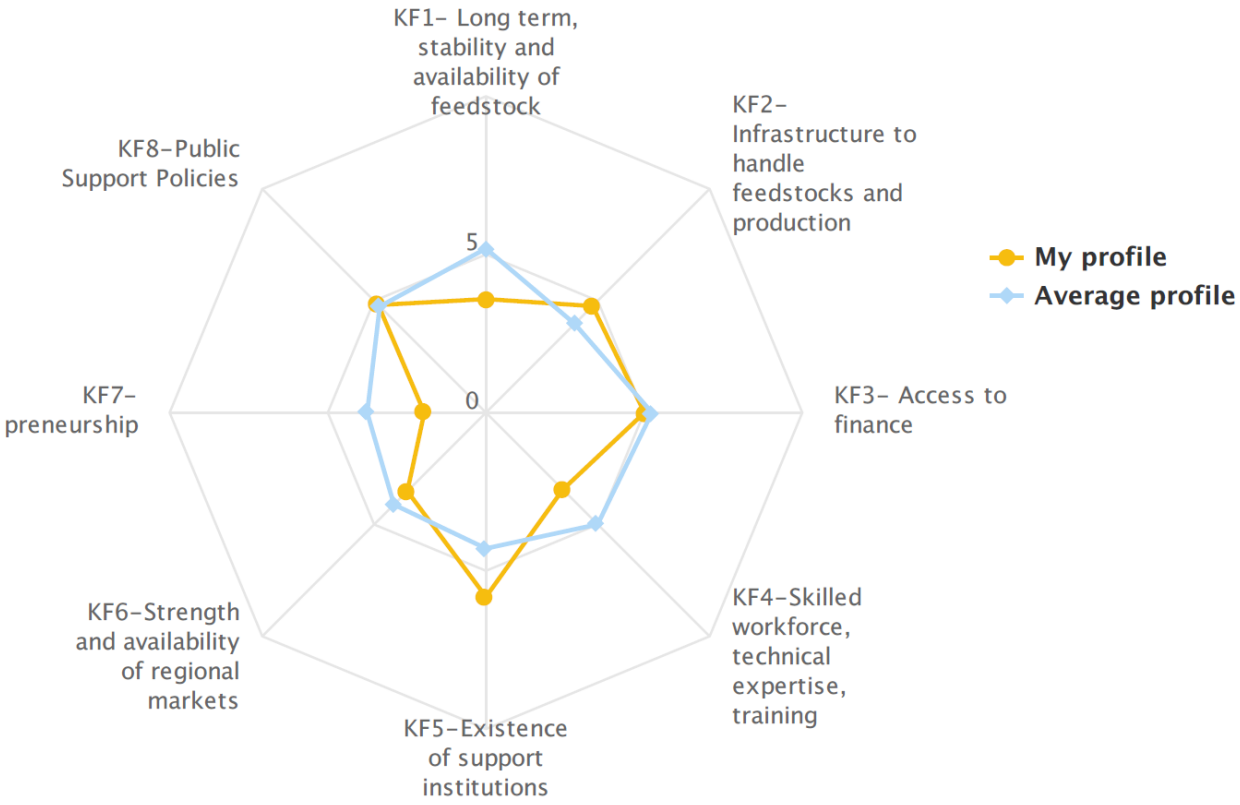


**Figure 7: Waste spider chart of Covasna**




### 3.4.2 Stakeholder feedback

In Romania, feedback was gathered from one stakeholder, a public sector representative, who gave his comments on the analysis without particularly replying to the suggested questions.

The public representative agrees on the fact that the region has a significant volume of waste and that this should be further explored. He also suggested that new studies should examine the region's capabilities for small-scale bioeconomy projects and alternatives using both waste, and agricultural residues as feedstock.

The municipal solid waste is burned as fuel to heat public buildings. The wastewater treatment centre in Sfantu Gheghe produces biogas from a portion of the sewage sludge and another dried portion is used as fertilizer on energy willow fields. In this perspective, there are some best practices on local level, which should be implemented in the rural parts of Covasna as well.

The local facilities which currently use local feedstocks must be assessed to evaluate the quantity of agricultural residues available for other purposes and which can be used for the bio-based industry. The possibility to improve and innovate the present facilities should also be examined.

Furthermore, especially in regional agriculture, new technical approaches should be introduced to increase the harvest of specific agricultural residues, which are currently neglected during harvest.

The pellets and briquettes produced regionally are exported while the local facilities with high energy demand use less efficient and outdated technologies.

As the regional biorefinery sector must be developed from scratch, the collaboration of local stakeholders from the bioeconomy and R&D entities is crucial for Covasna county.

The railways in Covasna are in a very bad condition and as the transportation of biomass is more competitive using railways. They should be modernised and improved specifically between Sfantu Gheorghe and Bretcu.

Local entrepreneurs in the packaging sector and production of plastic products are open for innovation and are willing to switch to using organic packaging material. Partnerships and matchmaking events

with R&D entities, local biomass feedstock producers and representatives of packaging sector are needed for this purpose.

In terms of financing and public funding, there are no specified calls for investments in the bioeconomy. Therefore, the importance of the bioeconomy must be disseminated among the policymakers and advocacy activities in the near future. There are no available regional funding sources. The public funding is centralized as well as the European funds. Venture capital and business angel organisations are not present in the region. A few IT and game developers receive financial support in this way.

The vocational education and training centres are focusing on classical professions such as manufacturing of wood, metal and automotive components, textile and food industry.

In the agri-food industry the by-products are not considered as feedstock for the bio-based industry. Therefore, for the long-term strategy development, it is essential to involve local stakeholders in the process. Without knowledge and awareness, the entrepreneurs are not open to invest in the bioeconomy.

### 3.4.3 Conclusion

There are enough biomass resources available for small-scale bio-based industries. The region already uses forest biomass for pellet and wood chips production, but there are still unused feedstocks that can be available for other small-scale bio-based industries. The infrastructure for biomass transport and handling has room for improvement, especially the railways. Access to finance does not seem to be a barrier for investing in bio-based projects. Skilled workforce for biomass procurement activities exists, but the challenge consists in finding skilled personnel for the implementation of bio-based industries as vocational training is lacking in the region. Regional governmental support for new businesses in this field is lacking, but some regional grant programmes are supporting innovative start-ups. The biomass market is still not fully developed although there are several biomass suppliers from forestry and agriculture. The market for bio-based products is unknown. Therefore, a market analysis should be conducted to better understand the demand. Entrepreneurship seems generally to be weak but can be developed at a rapid rate using the networking opportunity that the existing clusters and BE-Rural can provide. Public support policies are lacking on different levels.

## 3.5 Vidzeme and Kurzeme, Latvia

### 3.5.1 Summary of the analysis based on the SAT

Separate questionnaires have been completed for each of the two Latvian regions, but as the responses were almost the same, one analysis was done for both regions.

It is noticeable that the two regions have significant biomass potential. Raw material from forests and agricultural residues are abundant with assessed amounts and characteristics. This gives the regions a significant advantage for the development of the bio-based economy, especially given that the resources are only partly used for the existing installations and a large portion is still available for other uses. Small-scale bio-based industries for the production of textiles or other bio-based lignocellulosic commodities can be attractive options. Other small-scale applications, like pellets and wood chips production or even pyrolysis for energy purposes, are also suggested.

Concerning the waste potential, it looks also promising, especially for the feedstock coming from the agri-food sector and from sewage sludge. A more in-depth analysis about the type of agri-food waste available needs to be performed in order to look for pathways to produce corresponding bio-based products, but even if this is unknown, anaerobic digestion for biogas production is a good alternative. Sewage sludge is already being used as fertilizer and thus included in the bio-based economy, but it can be also used to produce biogas through anaerobic digestion or for higher value applications such as Phosphorus recovery.

The two regions are well connected by road with biomass feedstock producers and in Kurzeme, transport could be also done on docks, but there are no logistic centres to handle the feedstock. It is

therefore important to invest in building logistic centres, especially since there are several interesting locations to build them. As there are transport companies that currently transport biomass, this is an advantage since it would reduce the costs of investments related to transport equipment.

Aside from the investment in logistic centres, other investments are needed. Therefore, financing is an important issue that needs to be tackled for the development of the bioeconomy. Financing is available in the two regions although the conditions to it are not very desirable. However, the existence of national and regional public banks, which could finance investments in the bio-based sector, and public and private EIB/EIF financial intermediates is an advantage. Furthermore, the fact that private banks are in a good financial situation and that national and international private investment/equity funds are active, make financing more likely to happen. The existence of a sustainable network including banking regulatory bodies, environmental regulators and industry associations is also a strong supporting tool as it ensures that the necessary framework conditions are set up to make financing available.

Regarding the skilled workforce, the two regions have the necessary personnel for the procurement of biomass resources. Furthermore, the regions offer high-level education and vocational/professional training specialised in the biobased industry and waste management, and its use as an alternative raw material and the industry is involved in the curricula design at universities and vocational education. Thus, the regions have professionals and a workforce with technical expertise to complete the cycle of workforce needed for the activities related to management, operation and maintenance of new installations in this field. Therefore, no barriers are foreseen from this point of view for the development of the bio-based sector relying on both biomass feedstock and waste.

Supporting institutions for Research and Development, financing issues, and business development are crucial for a new business and sector development. In the two regions, all these exist. In the research and innovation strategy, one of the focus areas is to develop more sustainable processes and industries including bio-based industries. Research and Development infrastructure and business incubator/accelerator centres which can support companies in the transition to a circular bio-based economy exist, even though they are not specifically targeted for that. With respect to financial support, a public body which tackles this topic from different perspectives exists, but it has no specific focus on the bio-based economy. Therefore, in order to strengthen the support for this sector, it would be advisable to point out this issue in the regional strategy / roadmap document that will be developed in the context of the BE-Rural project. As for the business development, the government offers support, but it is also not targeted towards the bio-based sector. This can be also highlighted in the regional strategy and roadmap. Furthermore, universities provide programs for supporting start-ups and there is a regional program also supporting initial investments in start-ups. Therefore, the regions could profit widely from the existing supporting institutions for the development of biobased projects from both waste and biomass feedstock including bio-based industries and bioenergy installations.

The issue which could be a barrier for the development of the bio-based sector is the lack of a stable biomass resources market. In this sense, efforts should be made to gather information from biomass suppliers about the type and quantity of biomass or waste available, which can be delivered consistently and on the long-term. The positive aspect is that there are many companies who want to do that as they are interested to use biomass themselves, especially for bioenergy purposes. A second important issue is the market of bio-based products and, based on preliminary studies, a market for some bio-based products already exists and bio-based products are encouraged through the procurement policies for green products.

There is a lack of information on the expenditure on Research and Innovation, enterprise birth rate and survival rate of starting firms in the industrial sector. In case these values are low, it can be considered that the development of the bio-based sector is hindered because of the lack of entrepreneurship. In this case, networking between the different stakeholders and informing about such business cases is of crucial importance. The presence of farming, animal husbandry and agri-food clusters could be taken advantage of to facilitate networking. Furthermore, the activities of the BE-Rural project could play an important role in this regard, as it will bring stakeholders together to discuss business opportunities.

Currently, the bio-based industry is not included in the strategy for Research and Development planning and there are no long-term policies designed in the bio-based industries field. These shortcomings, in addition to the lack of incentives to stimulate business Research and Development, might discourage the development of the bio-based sector. These issues should be addressed in the regional strategy / roadmap of the BE-Rural project. However, the existence of a strategy which

supports the transition towards a bio-based economy and the Action Plan for Development of a Knowledge-Driven Bioeconomy Innovation Ecosystem in Vidzeme Region can be advantageous for its development.

**Figure 8: Biomass spider chart of Vidzeme and Kurzeme**

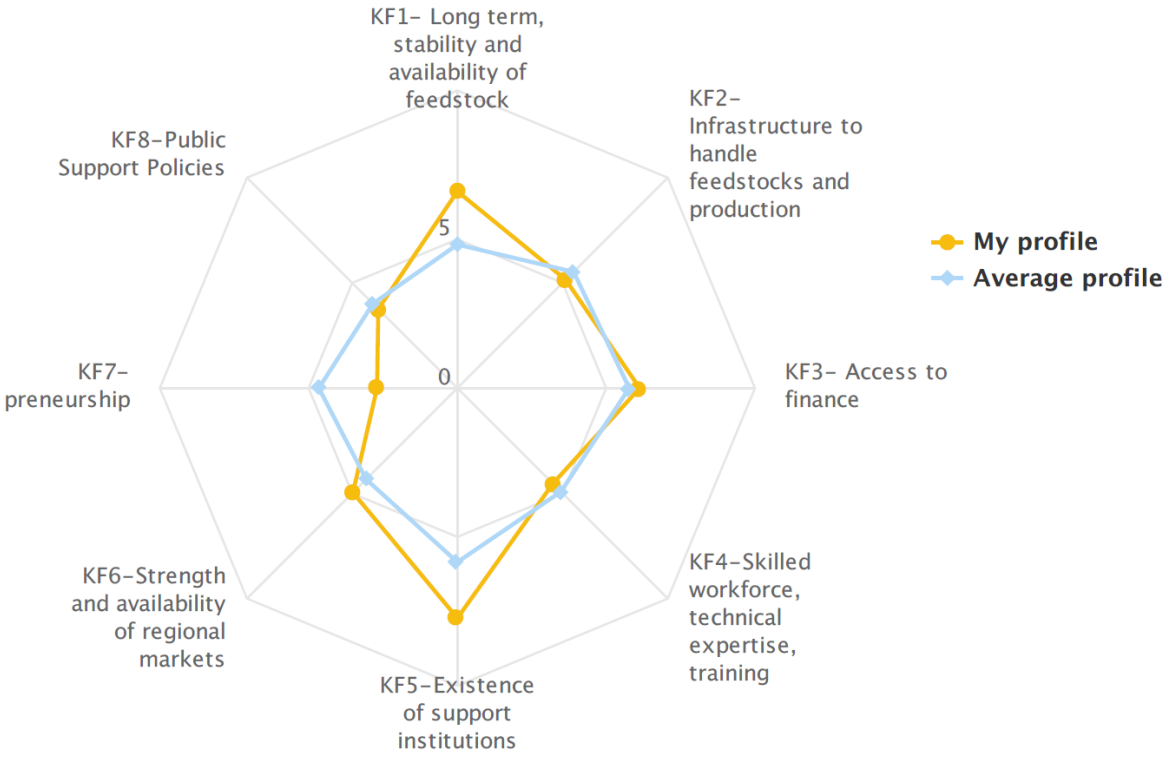
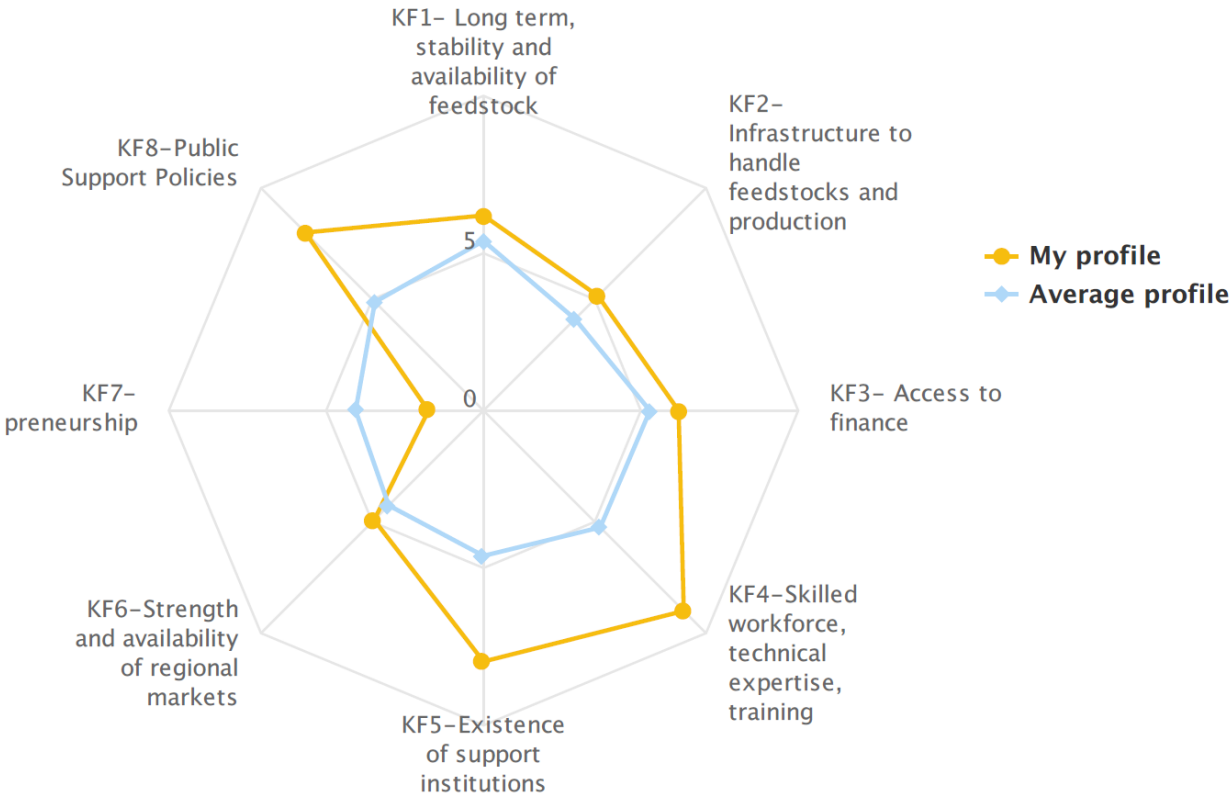



**Figure 9: Waste spider chart of Vidzeme and Kurzeme**



### 3.5.2 Stakeholder feedback

The conclusions and recommendations of the SAT analysis as well as the analysis of WIP have been sent for review to a public representative from the forestry sector who is also a member of the Latvian Forest Owner Association (NGO), a representative from Waste Management Association of Latvia (NGO) and a representative from academia (docent). Additionally, the OIP facilitator provided his comments.

The consulted stakeholders found that the analysis is very well presented and smartly structured with no major errors.

Despite the strong banking sector and relevant actors being active members of the Business Angels Europe (BAE) association, a major barrier for the development of the bioeconomy is the frequent change in policies (e.g. change in the system and amount of taxes, subsidies for few years and suddenly subsidies decreases) which does not offer a safe environment for long-term investments, especially for the waste and biomass sector(s) in the bioeconomy. A recent example was the change of the rules for supporting renewable energy projects such as small-scale hydro energy plants, biogas plants and co-generation stations. Therefore, the bioenergy sector is regarded at as a high-risk investment for the investors.

The bioeconomy is a main driver for Latvia, because agriculture and forestry are the main local and export business sectors. It is essential for the development of the bioeconomy to increase the added value of local products, to decrease the export of raw materials, and to find ways to make use of the biomass forest residues, such as the early thinning biomass and to diversify agriculture.

### 3.5.3 Conclusion

The two regions have enough feedstock, especially from forest and agricultural resources, to develop a small-scale bio-based industry or bioenergy installations (pellets, wood chips, biogas etc). They have also a good infrastructure for biomass transportation, but there are no logistic centres to handle and pre-treat biomass. A bio-based industry or bioenergy installation would have to invest in that. Financing is also available and is supported by private and public bodies. The regions have the required compacity from a qualified workforce to implement and manage bio-based industries and bioenergy installations. Furthermore, they can profit widely from the existing supporting institutions for the development of biobased projects from both waste and biomass feedstock including bio-based industries and bioenergy installations. The barriers, which could hinder the development of the bio-based industry, are the lack of a stable biomass resources market which can deliver in a consistent manner and on the long-term, and the possible lack of entrepreneurship. Some policies to support the bio-based sector exist, but are not optimal on all levels and need to be adapted to play in favour of the sector.

# 4 Conclusions

BE-Rural's OIP regions have very different situations and conditions. Therefore, their potential for the development of the bioeconomy is also different, but the following general observations can be concluded:

- The absence of feedstock in a region is the most limiting factor for its development. Without feedstocks, the bioeconomy in any region cannot exist, but in all BE-Rural's OIP regions, biomass and waste resources exist and sometimes even for large-scale applications like it is the case in Covasna in Romania and Vidzeme and Kurzeme in Latvia. The type of feedstock also plays an important role for defining the possible applications for the bio-based economy.
- The lack of awareness about the opportunities that the bio-based economy can offer is a main hindering factor. The BE-Rural project will play a very important role in this respect as it will bring stakeholders together, engage them and inform them about the bioeconomy and the opportunities that bio-based projects can offer.
- The public policies supporting the bioeconomy on different levels are key elements for the development of the bioeconomy and these are not favourable in most of the OIP regions. The BE-

Rural project aims at addressing existing policy gaps and will suggest solutions in the regional strategy / roadmap document which will be developed for each OIP region.

- Even in the conditions with available feedstock, awareness and favourable policies, the bioeconomy cannot develop if financing is not available or if entrepreneurs and/or investors are not willing to invest in bio-based projects.
- The results of this assessment, together with the outcomes of the study of the macro-environment surrounding BE-Rural's OIPs (D2.2), will feed directly into the ongoing work on identifying promising business models for bio-based economies in the BE-Rural regions (D2.4). These first project outputs provide a good overview of the in-situ conditions at each OIP region and thus will enable an initial screening for opportunities and threats to be explored in later stages of the project.

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# Annex I – Conclusions and Recommendations of the Biomass and Waste SAT questionnaires for all OIP regions

# Conclusions & Recommendations BIOMASS

**Region:** *Stara Zagora, Bulgaria*

# KF1- LONG TERM, STABILITY AND AVAILABILITY OF FEEDSTOCK

The necessity to fulfill the acquired environmental commitments has led to an urgent need to assess sustainable paths to produce biofuels and bio-products minimising the environmental impact related to the land use and land occupation, deforestation, soil impoverishment, eutrophication, ground water or soil contamination, among others, which cause a decrease in the soils production capacity.

The use of biomass obtained from the forest or agriculture landlands or the use of agroindustry/agroforestry sector or other industries in which biomass waste is produced has several advantages if sustainability criteria are considered in the process.

For this matter, international standards included in the EU Renewable Energy Directive (The European Parliament and the Council of the European Union, 2009) and global sustainability certification systems regarding biofuels have been developed.

Certain biomass streams like forestry or agricultural residues, ignored or underutilised in many cases, can potentially be converted into valuable resources to replace the fossil ones traditionally used in the chemical industry and produce higher added value raw materials (biocommodities). The recovery and use of these endogenous biomass streams may imply great positive impacts towards a more circular and sustainable economy.

In the first instance, a region looking to increase bio-based alternatives will need to consider if there are enought resources to supply them. So as a first approach it is important to determine the area occupied by forest or agriculture land and the corresponding raw material (biomass resources) that could be obtained in each location (generally determined by resources to surfaces ratios). According to each type of biomass feedstock's characteristics, the theoretical potential might differ greatly so that it is necessary to distinguish between the main different biomass resources types.

In this regard, the region's forest biomass potential might not be sufficient to cover the demand of new initiatives of the sustainable chemistry sector launched in the region.

On the other hand, even though the region accounts for a significant rate of agricultural land, the total area producing agriculture biomass might not be enough to implement new sustainable chemical sector initiatives based on this raw materials. Further studies should be carried out to determine the region's capabilities.

One of the main advantages of the biorefineries or bio-based initiatives is the wide range of feedstocks that could be used in their processes. Nevertheless, other sectors or facilities which currently use them must be assessed to confirm that there is sufficient raw material for other purposes that could be actually allocated to the sustainable chemistry sector.

It is quite important to determine the actual amount of biomass resources that a new initiative could take advantage of. For this reason, it is necessary to analyse if specific biomass availability assessments have been already carried out in the region and the results obtained (availability of resources).

In this sense, the potential biomass available without having to compete over the price with other biomass consumer sectors for the chemical and biorefinery sector has not yet been assessed. But the region has the required input data on agricultural biomass resources to carry out the study. Actions should be carried out to retrieve the data necessary to also evaluate the forestry biomass potential in the region. This study would be particularly interesting in the region due to agriculture surfaces in the region.

On the other hand, biomass in the region is quite scattered which implies a challenge to implement the feedstock's supply chain and need for further studies to assess the feasibility of this use. However, at the moment there are no other local consumers that would compete over the raw material.

Besides assessing the amount of resources that are or might be available it is important to determine if the region already knows the format in which those biomass feedstocks are or could be supplied. Available formats may imply different procurement chains that should be taken into account by new bio-based initiatives.

In addition, the region accounts with information regarding the format in which biomass is currently supplied that will allow determining if :

- resources would be available in the most suitable format (chips, shredded material, sawdust or bales) for sustainable chemistry initiatives
- any pre-treatments (logs, branches) or additional steps in the supply chain would be necessary (branches or loose straw)
- competence could be expected (pellets and briquettes most likely used within the domestic market, for example)

Concerning competition over the available biomass resources the region is not using biomass for energy purposes, even though there is a significant biomass potential. So, it could be interesting for the sustainable chemistry sector to take advantage of this situation.

Biorefineries or bio-based initiatives installations offer several advantages compared to other biomass resources and other fossil fuels based plants but might involve long term processes to finally succeed. These processes can be reduced if already existing initiatives are close to applying these concepts or are already using biomass feedstocks.

Finally, it is worth noting that the biorefinery sector has to be developed in the region starting from zero. Two important issues should match in this case: the availability of biomass resources as well as interest and capacity to develop new projects.

Finally, the aquaculture industry currently is currently not developed in the region. Therefore, in first instance preliminary studies should be carried out to assess the potential and the interest of the region to produce algae or microalgae.

# KF2- INFRASTRUCTURE TO HANDLE FEEDSTOCKS AND PRODUCTION

The biomass logistics chain faces different challenges that need to be overcome to optimise the supply chain. They include accessibility limitations, low bulk densities and significant volumes, geographical dispersion, low productivity per hectare, etc.

In addition, biomass usually needs to undergo some kind of pre-treatment before its final use for energy purposes or for the production of chemicals. This is, due to its grading, heterogeneity, high moisture content, low density, constraints related to the handling and transport, presence of exogenous mater (stones, dust, metals, etc.). The supply chain involves several steps: collection, pre-treatment (when required), transport, distribution and storage. All of which need to be optimised to increase the environmental and economic feasibility of the supply chain.

Biomass consumers, including the industrial sector, ceramic sector, greenhouses, boilers, power plants, co-firing plants, might have different requirements regarding the raw material according to the conversion pathway used. Any biomass feedstocks consumer will demand a supply guarantee which is an important challenge to be addressed and maintained during a project´s life.

Biomass resources will have to be transported from the site in which they will be produced (even imported) to the new bio-based installation. Local transport infrastructures (roads, rails or ports) will have to be used, the better their condition the lower the transport costs inferred.

In this regard, the region already has the main transport infrastructure for the logistics of biomass raw materials in place. Transport of feedstocks should not endanger these types of projects.the region should look for additional information on biomass logistic centres and transport infrastructure. Projects would enormously benefit if potential biomass suppliers or infrastructures to deliver these resources from the producers' areas to the chemical industries already existed.

Biomass feedstocks supply for new bio-based initiatives can be easily satisfied if any biomass logistics centre is already set up in the region or close to it. Since biomass logistics centres can be crucial for these types of initiatives, it is also important to evaluate if there are any options to set them up in case they do not exist yet.

Biomass transport cost is one of the main drivers of the overall biomass supply cost so optimised chains should be implemented to achieve techno-economically feasible solutions. The existence of transport companies already delivering these types of feedstocks might reduce investment costs related to transport equipment for these types of initiatives.

In addition, the region may take advantage of already existing biomass transport companies. These could deliver biomass products to new bio-based industries or new biorefinery concepts without involving excessive investment costs in this infrastructure.

New bio-based initiatives can take advantage of the storage sites or warehouse of already existing projects, which could be used as new logistics centres.

It is worth noting that there already is an infrastructure in the region to implement the final use of biomass applying biorefinery concepts. It could be a starting point for the sustainable chemistry sector development in the region by, for example, increasing their storage capacity to satisfy new logistics demands.

Finally, biomass logistics centres or the places in which biomass resources will be loaded, unloaded and delivered will require basic supplies to guarantee working conditions.

In this regard, basic supplies are very important for the correct and successful establishment of a biorefinery. A high quality supply of electricity should be ensured in the region.

## KF3- ACCESS TO FINANCE

An appropriate access to finance is essential to transition towards sustainable chemicals production. The adaptation and refurbishment of the existing production sites to use alternative feedstocks – such as biomass or waste – require the installation of new equipment and the modification of the existing processes. Moreover, the development of concepts such as industrial symbiosis often implies investments in new infrastructure – like new pipelines – for the exchange of streams between different sites. In many cases, this means costly investments for the promoters that cannot be covered with their own funds. Particularly when building up a new production site based on non-fossil feedstock, such as a biorefinery.

Both public and private funding can be used to finance these types of projects. In this regard, financing is available in the region but there are some issues, such as high interest rates that need to be addressed to improve the conditions under which the finance is accessed.

Public funding can be attained from multiple sources. Local, regional, national or European bodies usually have direct or intermediate financing mechanisms that could be used to foster the sustainable production of chemicals with biomass feedstocks in different ways.

The region is in a good position for providing direct or intermediate financing for the development of a sustainable chemical industry. If a multiplicative effect of the resource is sought potential synergies should be explored: with the financing lines set up by the national Government and/or the European Institutions in the region or neighboring regions and with the private finance sector. or the European Institutions in the region or neighboring regions and with the private finance sector.

Public finance should not be the main or only source of funding for developing the region´s sustainable chemical industry. The objective is to complement and encourage private funding from companies and the financial sector.

The banking sector in the region is strong and the necessary credit for building up projects in the field of sustainable chemicals is available in the region.

Moreover, it seems that foreign investment is important in the region. Actions should be carried out to attract these types of investors to the sustainable chemicals field by organising investment forums, multilateral meetings andawareness campaigns, etc.

Additionally, the region should ensure that the necessary framework conditions are set up to make financing available in the sustainable chemicals field using biomass resources.

In this regard, the region already has a collaboration network involving most of the stakeholders in the region; but further steps could be taken to make sure that this network is used for supporting the region in the development of the strategy towards sustainable chemicals production.

Apart from the lending provided by the traditional banking sector, other alternative instruments and financial actors are important to make available the necessary financing available for the development of a sustainable chemical industry in the region.

If there is a lack of awareness regarding the presence of these kinds of organisations in the region. It might be worth it to organise a meeting with them to engage them in financing projects and initiatives in the field of sustainable chemistry in the region. This initiative could be helpful to identify the actors that are active in the country through the European associations of these types of organisations, such as Business Angels Europe (BAE) or Invest Europe.

Finally, it is worth noting that, there are no subsidies in the region attributed to the use of biomass for any purposes, so for the moment any project exploring these initiatives would need to be economically feasible on its own without any economic support from public bodies.

## KF4- SKILLED WORKFORCE, TECHNICAL EXPERTISE, TRAINING

The transition to the effective use of alternative raw materials towards developing the biorefinery concept requires a rearrangement not only of value chains but also of society culture, knowledge and skills.

As a first step, the successful implementation of new bio-based initiatives or biorefinery

concepts in a region will require a skilled workforce able to carry out both the activities related to the procurement of the biomass resources and those related to the management, operation and maintenance of new installations. As a second step, training activities and courses need to be developed and implemented to minimise gaps between society knowledge and new installations and their development needs.

It is worth noting that the region does not have enough information to determine whether the skilled workforce required by new bio-based chemical/biorefineries initiatives to be settled in the region will be available. The region should retrieve this information to identify if technical training activities or other initiatives need to be developed to meet this demand.

In addition to the in-depth and specific technical knowledge needed, the introduction of new concepts underpinning biorefinery concepts must be integrated into education curricula from vocational training to higher education. These concepts range from the general green awareness to the "system thinking" principles and the development of skills for multidisciplinary teamwork.

In this sense, the existing specialisation post-graduate/master degrees in the field of biomass use for chemical applications in the region must play an important role. They should be increasing knowledge and awareness, pointing the way towards a sustainable chemical industry by building a strong and updated background knowledge and human capital. However, a deeper integration not only into the specialisation degrees, but also into the university curricula as a whole would bring better results.

The existence of education and training offers in the field of biomass use for chemical applications is evidence of the flexible adaptation to the economic trends, productive systems and future skills needs. Moreover, the presence of people involved in R&D activities in the region may boost the transition to bio-based activities and new biorefineries concepts by shortening response time to solve technology gaps or by implementing training needs.

In this regard, ": it seems that the region does not have the professional expertise that would be needed along the biomass supply chain implemented to supply the sustainable chemical sector and biorefineries. It would be advisable to develop specific courses and training programmes to address this gap.

On the other hand, Skilled workforce in biomass R&D concepts will contribute to developing technology and products and increasing the knowledge regarding biorefineries and bio-based industries. The region should assess the existence and availability of professionals engaged in R&D biomass projects who could contribute to the technology, knowledge and products development for biorefineries and bio-based initiatives.

There are also other desirable supporting bodies or structures in the education field such as the so-called Centres of Excelence (CoE). These centres provide leadership, research,

support and training that play a strategic role in the development of sustainable chemistry concepts.

The set-up of such a centre in the region would be an important enabler for the transition to more sustainable value chains in the chemical industry. On the other hand, to build up this education that is flexible and adapted to the current and future trends, it is also advisable that different stakeholders across the value chain, including industry, take part in the design of curricula and bring together practical and different points of view

Finally, further research would be advisable in order to identify an accessible and affordable technology to process biomass prior to the supply chain implementation. The best technology selection should be identified according to the raw material and site characteristics but also the conversion pathway chosen.

## KF5- EXISTENCE OF SUPPORT INSTITUTIONS

Supporting institutions such as knowledge and know-how transferring bodies, technical support and assistance institutions, as well as, research and development organisations are crucial for a new business or sector development.

Supporting institutions can exist in some or all the links of the complete bio-based or biorefineries chain (R&D activities, financing issues, business tasks, etc.).

With the purpose of launching new business activities in the field of sustainable chemistry based on biomass, it would be ideal to have a research and innovation strategy for smart specialisation (RIS3). Specifically on KETs, focused on developing more sustainable processes and industries in the chemical sector.

Entrepreneurs that establish their company on an R&D&I campus specialised in sustainable chemistry accelerate their business. In this sense, it would be desirable to invest in or include the bio-based and circular economy concept on a campus. Or, alternatively, set one up in an already existing potential centre available and suitable for these types of actions (technical campus covering some of the aspects that a sustainable chemistry campus should address)[2].

With respect to specific financing issues, an institute or body, supporting business is a good starting point, even if it is not specific for circular economy/bio economy/sustainable business. As far as this type of new business is well supported with such a body, specific support in bio-based economy would be desirable if a new kind of business is expected in this area.

And finally, concerning business plans, risks assessments, etc., there are institutions in the region that offer advisory services for building up new projects, supporting the promoters in the development of their business plan, risk assessment or ensuring the necessary financial resources. These services are not available for building up industrial projects in the sustainable chemistry field, maybe due to the providers' lack of technical knowledge. Moreover, this service is not cheap or is difficult to access by the promoters

of the projects. Actions should be taken to ensure that restrictions to this service for the field of interest are removed.

Biomass resources have different quality characteristics. Producers and consumers need to agree on these characteristics to solve the problems that might appear within the biomass supply chain. Standards and certificates help to guarantee success in new bio-based or biorefineries activities.

In this regard, There are no certification and/or standardisation bodies in the region. The creation of this type of body should be promoted in the region since it can contribute to support business from a technical point of view. It will also serves as an instrument of differentiation that makes both new and existing companies and launching new products more competitive.

In terms of the impact of initial investments in start-ups on the local community, other experiences have shown that they can have a big effect on attracting additional investment to a community, even for different firms than the ones promoted. This could bring additional indirect benefits to the wider regional economy.

As new bio-based or biorefineries initiatives will need to take advantage of currently unused biomass resources, having a specific service in the region which might support the connection between biomass resources production and new installations demands will significantly help these activities to succeed.

Facilitating the market uptake of new biomass raw materials or feedstocks, will be reinforced by the transferring of international commercial biotechnology experience, support for closer networking and creating awareness of the regional potential in alternative raw materials. This will be done by disseminating valuable information regarding biomass used as a feedstock, mainly but not only by means of a centralised body for improving market knowledge, transparency, analysis and advice to companies (please visit Germany DERA).

## KF6- STRENGTH AND AVAILABILITY OF REGIONAL MARKETS

The overall shares of renewable energies need to increase to fulfill the raising energy demands and still meet the commitments established. Besides energy generation, biomass can be used in other industrial applications such as raw material for the chemical industry or for liquid fuels and other biocommodities production increasing greenhouse gas emissions savings and the energy security. Biomass use still has a large improvement potential to be developed since biomass markets are not as developed as others. Successful biomass markets display an integrated and sustainable supply chain, from the source to the end-users. If they already exist, taking advantage or additional

biomass resources has fewer difficulties than if they have to be created from the ground up.

Biomass markets development in the region has to be assessed in order to efficiently promote the integration of the supply chains and to develop best practice tools. For this aim, data regarding the sector activity in the region should be compiled including number and type of business. This data should include:

- volumes of biomass produced, used and exported/imported
- consumption flows and current business models based on the feedstocks
- actors along the entire supply chain

In this particular case, it seems that the biomass market is not fully developed in the region so the introduction of the biorefineries' activities will need development to improve cost-effective operation along the whole supply chain and for final use applications.

Furthermore, the security of the raw material supply is one of the main requirements for the successful implementation of any initiative based on biomass. Considering this, a critical mass of suppliers will be necessary. Even though supply could be developed with other stakeholders, the region should work on widening the existing limited supply offer.

On the other hand, actors involved in the whole sustainable chemicals value chain do not seem to look at the biomass resource market as a promising investment at this moment. Activities to motivate them to move in this direction or to attract investments from organisations outside of the region would be needed if the region wants to establish a biomass resource market for the production of chemicals, among other possible uses.

In order to definitively set up new biorefineries or new bio-based initiatives based on biomass resources, it is also extremely important to assess the market conditions for the new biocommodities or for the new products to be developed. If there already is some knowledge in the region regarding these markets, new initiatives may take advantage of this information and may reduce the time to definitively set up.

In this case, there seems to be a lack of information about the potential clients or markets for the sustainable chemical products or for the new biocommodities. So this work should be carried out in the process to conclusively define new bio-based initiatives.

The main market sector for the chemical industry in the region seem to be food and nutraceutical products, agricultural products, pharmaceutical and cosmetic products and polymers, fibres and composite materials. As a first step, the demand for biomaterials in these sectors should be assessed in order to determine if the biomass resources in the region might satisfy the production requirements.

The European Commission's single market for green products initiative proposes a set of actions to overcome the different problems that slow down the final implementation of these products in the market. These actions are:

- establishing two methods to measure environmental performance throughout the lifecycle (the product environmental footprint (PEF) and the organisation environmental footprint (OEF)) and recommending the use of these methods to EU countries, companies, private organisations and the financial community through a Commission Recommendation
- developing product- and sector-specific rules through a multi-stakeholder process
- providing principles for communicating environmental performance, such as transparency, reliability, completeness, comparability and clarity
- supporting international efforts towards more coordination in methodological development and data availability.

In recent years, there have been significant developments in the field of industrial green purchasing and supply. New bio-based or biorefinery initiatives in the region should consider these actions and other green products promotion initiatives to guarantee success.

In this particular case, there is a lack of promotion that should be addressed by the governmental bodies.

Moreover, it is worth noting that the chemical sector is poorly developed in the region. Therefore, the promotion of sustainable chemical initiatives will firstly work on setting up an adequate framework in the region and on identifying if any possibility to set up sustainable chemical initiatives might even exist.

## KF7- ENTREPRENEURSHIP

The transition to more sustainable value chains in the chemical industry entails a significant innovation capacity due to the need for the adoption of new business models and the transformation of the existing ones. In this sense, the expenditure on R+D+I is a widely used indicator that reflects the extent of research and innovation undertaken in a country in terms of resources input.

The region is reasonably aware of the importance of innovation and the expenditure on R+D+I is adequate, although it is not among the top countries. Thus, there is room for improvement. Also taking into account the importance of providing stability to the R+D+I system, as this stability is crucial for long-term success.

On the other hand, there is a lack of information regarding the public and/or private expenditure on R+D+I, this should be addressed in the region due to the important role that research plays in a developing technology such as biorefineries.

The birth rate of starting firms in the region is quite good, around the average, which together with the fact that more than 60% of them survive the first 5 years, shows not only an innovative capacity but also a good vitality of the regional economy.

Networking and cross-value chain and cross-sector cooperation is also a requirement and

a key enabling factor for the transition to sustainable chemical industry. Matchmaking events and other networking actions support the reinforcement of the much needed cooperative business environment.

However, the closed business environment in the region, where there is a reluctance to share information and start cooperative actions, create a major barrier to the success of this transition. Circular thinking requires people to be able to work together with professionals from other fields across the value chain, and outside of their own business.

Also, clusters contribute to support dynamics of market and knowledge exchange among firms and other stakeholders in the region and in international value chain networks, acting as local nodes in global networks.

In this regard, the presence of chemical, polymer, farming and animal husbandry, agri-food and bioeconomy clusters is a reflection of the level of networking in your region. Actions aimed to reinforce their activities and the creation of other clusters, or even more so the reinforcement of inter-cluster relations, will be positive for the creation of an environment prone to innovation and cooperation towards a circular chemical industry.

## KF8- PUBLIC SUPPORT POLICIES

The transition to more circular value chains in the chemical industry by using biomass resources in new or existing processes entails a significant effort on R+D+I. Therefore, well-structured, stable and long term plans to support this transition are of major importance.

The creation of a master plan or strategy in the region tackling the R+D+I needs for this transition would undoubtedly be an enabling factor. It deserves all possible support along the process.

Furthermore, public incentives are somehow the seed for stimulating and encouraging the private sector in launching new sectors or businesses.

In the same way, fiscal and financial incentives to promote the bioeconomy in general and therefore sustainable chemical value chains based on biomass in particular, constitute other means of support . Work is already being done in this sense at European level, exploring the use of market-based instruments to stimulate circular economy in the *Roadmap to a Resource-efficient Europe*.

This could help or motivate to start developing an action in this field. Nevertheless, an in depth assessment on the potential impacts on the different actors of the value chain is advisable. This way, the government can have a clear view of the most effective and

appropriate measures to be taken, according to its particular features. Some examples include[3]

- lower VAT rate on circular economy services
- taxing extracted value instead of added value (a shift from taxing income to taxing materials)
- actively using financial resources from guarantee and disposal funds to further encourage business activity
- actively using financial resources from existing fiscal subsidy instruments promoting environmentally benign investments (MIA or VAMIL) for a broader series of investments or activities that would help increase circularity

Policymakers have a responsibility to lead and ease the transition to a circular economy. A long term, stable, consistent and cross-departmental political strategy needs to be developed together with all stakeholders. Policy areas such as energy, environment, education and research, waste and raw materials, among others, are required to join forces.

This is a key enabling factor that the region should develop and support, and periodically update and upgrade.

The different governmental bodies have the capacity to design, implement, and enforce regulation. This multi-level regulatory framework can be challenging, giving rise to economic stagnation or recession, decreased productivity and less competitiveness, which has to be avoided. Among others, the challenges include avoiding duplicated or overlapping rules, low quality regulation, and uneven enforcement.

Finally, regulation related to the establishment of enterprises in the region should be also taken into account. In this sense, any further step to facilitate the process of setting them up is positive for the region's economy. The region does not have the competence on licensing new bio-based or biorefineries so it should work with the entities that have such a competence to help set-up these initiatives in the region.

Government/regional support schemes for renewable energies can be applied to bioenergy in most instances. Direct government grants and subsidies for biomass production and use could encourage further uptake of sustainable chemistry projects/biorefineries.

Biorefineries and sustainable chemistry projects promoters should be aware of current policies and closely follow any national policy development that might be established in the region or at national level.

The region should promote contact with other regions that have extensive knowledge and experience regarding bio-based applications. The region should also participate in specific forums related to chemical production sustainability to build an appropriate framework for the sustainable chemistry initiatives to progress in the region.

Policies should be developed in the region in terms of investment in research and

innovation and skills, market development and enhanced competitiveness and also engagement with stakeholders to promote bio-based initiatives like biorefineries.

The production of biomass in marginal lands and/or arable lands which will contribute to increase the biomass feedstock production in the region that could be used in biorefineries or sustainable chemical sector. The region has specific regulations against these activities. The possibility to include specific regulatory policies that might open up this possibility could help new bio-based or biorefineries installations to be set up in the region.

[1] A list of intermediaries can be found in the following links:

- For the EIB: http://www.eib.org/products/lending/intermediated/list/index.htm
- For the EIF: http://www.eif.org/what_we_do/where/index.htm

[2] See the green chemistry campus website.
[3] Opportunities for a circular economy in the Netherlands. document.

# Conclusions & Recommendations WASTE

**Region:** *Stara Zagora, Bulgaria*

# KF1- LONG TERM, STABILITY AND AVAILABILITY OF FEEDSTOCK

Certain waste streams, significantly ignored or underutilised, can potentially be converted into valuable resources to replace the fossil ones traditionally used in the chemical industry and produce higher added value than existing uses. The recovery and use of some endogenous waste streams help the move towards a more circular and sustainable economy.

Waste stream(s) that may have a lot of potential in your region and need more in depth analysis could come from:

- The agri-food sector.
- The farming sector.
  However, the seemingly extensive farming system in your region might hamper its use as alternative raw material.
- The pulp & paper industry.

These waste streams can be converted by different processing methods into chemical building blocks, syngas, fertilisers, and polymers, among others. The processes and the products will be very much dependent on their specific characteristics and on the regional market features.

Aside from waste coming from industrial or farming activities, the treatment of citizen waste streams has potential that could be explored. Sewage sludge is one of the most common wastes. It is produced in large volumes and is, surprisingly, one of the least known.

Sewage sludge seems to have an interesting potential in your region, although there appears to be a significant room for improvement regarding the connection of the population to urban waste water plants. Sewage sludge in your region could be diverted from landfill or incineration plants and find a market for higher value products such as fertilisers or phosphorus (critical raw material). In adition, the seemingly centralised production in medium-large plants could facilitate the sludge management.

On the other hand, the organic fraction from MSW can also be a potential alternative raw material, for example, for the production of a fertilisers, biogas or syngas major platform for the further production of chemicals and building blocks.

In addition, plastic fractions recovered or source separated not only from packaging but also from other important sectors, would provide a potential option for producing raw materials for new plastic manufacturing out of cascade recycling. This leads to lower value materials, or serves as an alternative source for other chemical products production, for example for syngas production.

Regardless of the waste streams that can potentially be an opportunity in your region,

the first step for an optimal management and use of waste towards a circular economy is good quality information gathering, availability and accessibility. Your region has apparently done a good job gathering that information. However, a step forward by an assessment of the potential waste streams that could be used as alternative raw material, would highlight the opportunities for new business models in the region.

Finally, it is worth noting that biogas and biofuels production sites existing in your region represent the same demanding sector as the sustainable chemical sector. It is important to have it in mind for the strategy of the region.

## KF2- INFRASTRUCTURE TO HANDLE FEEDSTOCKS AND PRODUCTION

Infrastructure is a key factor for the development and success of the bioeconomy. In addition, it is important to reduce the environmental impacts and to avoid logistical problems, as well as production problems. It is a decisive aspect that companies and investors take into account when deciding to set up and launch new businesses and investments.

As the transport network is fundamental for the correct functioning of the industry, in terms of supplies and manufactured products delivery, it would be desirable to have at the region's disposal a spread out network of highways and national roads and a freight train railway nertwork in order to cover the main demand points of waste feedstock

The efficient provision of infrastructure services is one of the most important aspects of development policies in general, and industry in particular. The suitable availability of infrastructure and the efficient establishment of related services to the industry, contribute to the development of competitive advantages in a country or region and help to achieve a greater degree of productive specialisation. In this sense: our region is apparently well supplied in terms of water. You should consider having a monitoring mechanism in case you are not covering the whole territory of the region to ensure there is always a 100% supply.

For the correct and successful establishment of a sustainable chemical industry, basic supplies are very important. You should consider ensuring a high quality supply of electricity and fuel in your region

## KF3- ACCESS TO FINANCE

An appropriate access to finance is of paramount importance if a transition towards a sustainable chemicals production by means of alternative raw materials is desired. The

adaptation of the existing production sites for use of alternative feedstocks – such as biomass or waste – requires the installation of new equipment and the modification of the existing processes. Moreover, the realisation of concepts such as industrial symbiosis very often implies investments in new infrastructure – like new pipelines – for the exchange of streams between different sites. In many cases, this means costly investments for the promoters that cannot be covered with their own funds, particularly when building up a new production site based on non-fossil feedstock (like biorefineries).

Both public and private funding can be used to finance these types of projects. In this regard, financing is available in your region but there are apparently some issues, such as (select form high interest rates) that could be addressed in order to improve the conditions under which the finance is accessed.

Public funding can be attained from multiple sources: local, regional, national or European bodies usually have direct or intermediate financing mechanisms that could be used to foster the sustainable production of chemicals in different ways.

Your region seems to be a very good position to provide direct or intermediate financing for the development of a sustainable chemical industry. If you wish to multiply the effect of your resources, you could explore potential synergieswith the financing lines set up by the national government or the European Institutions in your region or neighboring regions and with the private finance sector.

It is not advisable that public finance is the main source of funding for developing the region's sustainable chemical industry. The objective is to complement and encourage private funding from companies and the financial sector.

The banking sector in your region appears to be strong enough and the necessary credit for building up projects in the field of sustainable chemicals is available in your region.

Apart from the lending provided by the traditional banking sector, equity funding - through the sale of shares of new business, and financial actors are important to make the necessary financing for the development of a sustainable chemical industry available in your region. If you are not aware of the presence of these kinds of organisations in your region, you might find it useful to consider organising a meeting with them to engage them in financing projects and initiatives in the field of sustainable chemistry in your region. You may identify who is active in your country through the European associations of these types of organisations, such as Business Angels Europe (BAE) or Invest Europe.

Moreover, it seems that the foreign investment is relevant in your region. It would be convenient to attract these types of investors towards the field of sustainable chemicals by organising investment forums, multilateral meetings and awareness campaigns for instance.

Finally, it is also recommended to ensure that the necessary framework conditions to make financing available are set up in the sustainable chemicals field. In this regard, you

could consider developing a network gathering all the stakeholders in your region – chemical industry, technology suppliers, academia and research, financing organisations – to support you in the development of a roadmap and a implementation plan towards the development of a sustainable chemical industry and to serve as a forum for discussion.

## KF4- SKILLED WORKFORCE, TECHNICAL EXPERTISE, TRAINING

The percentage of population with secondary and tertiary education is considered as a good measure of workforce quality, because a more skilled workforce is supposed to be more likely to be able to perform high value-added roles in this transition. Also, the employment structure given specifically by the percentage of the population employed in the industrial sector shows an existing base for the future application of waste-to-raw material concepts. A regional economy based on service sector or primary sector, is considered in principle to have less potential than a region with a strong industrial sector. Last but not least, R+D+I expenditure and its attached professionals are strongly linked and have a direct impact on the innovation performance required in this field.

The transition to the effective use of waste as alternative raw materials towards a more circular economy in the chemical industry requires a rearrangement, not only of value chains, but also of society, culture and knowledge. Therefore, raising and spreading knowledge is a major issue that requires innovative aptitude and attitude, skills and expertise for transition and a multidisciplinary and comprehensive education

In addition to the in the depth and specific technical knowledge needed, the introduction of new concepts underpinning the use of alternative raw materials in the circular economy must be integrated into education curricula from vocational training to higher education. These concepts range from the general green awareness to the “system thinking” principles and the development of skills for multidisciplinary teamwork.

The allegedly existing high-level and vocational education in the field of waste use for the production of more sustainable chemicals in your region could play a key enabling role. It could be increasing knowledge and awareness, pointing the way to a more circular economy in the chemical industry by building strong and updated background knowledge and human capital.

In addition, the existence of an education and training offer in the field of use of waste and sustainable chemistry towards a more circular economy is evidence of the flexible adaptation to the economic trends, productive systems and future skills needs.

The seemingly static training and educational system in your region may probably be an aspect to improve in the near future. This will help introduce and speed-up the awareness of the concepts underpinning the transition to the alternative use of alternative raw materials.It would be an important step towards upgrading the workforce to the current needs if the region organised targeted training sessions.

On the other hand, to build up this education that is flexible and adapted to the current and future trends, it is also advisable that different stakeholders across the value chain, including industry, take part in the design of curricula and bring together practical and different points of view.

There are also other desirable supporting bodies or structures in the education field such as the so-called centres of excelence (CoE). These centres provide the leadership, research, support and training that play a strategic role in the development of sustainable chemistry concepts. The set-up of such a centre in your region would be an important enabler for the transition to the use of alternative raw materials in the chemical industry.

However, it is usual that many companies in the sector lack adequate information and knowledge about their own products and raw materials. The transition to more circular value chains in the chemical industry by using alternative raw materials is not possible without these foundations. Improving this knowledge is first and foremost responsibility of the business sector, which cannot assess the vulnerability of their own value chains and so are unable to respond to risks and explore alternatives.

## KF5- EXISTENCE OF SUPPORT INSTITUTIONS

Supporting institutions such as knowledge and know-how transferring bodies, technical support and assistance institutions, as well as research and development organisations are crucial for a new business or sector development based on innovative technologies using waste as alternative feedstocks.

With the purpose of launching a new business, in the field of sustainable chemistry based on waste feedstock, it would be ideal to develop a research and innovation strategy for smart specialization (RIS3). Specifically, on KETs, focused on developing more sustainable processes and industries in the chemical sector

Entrepreneurs that establish their company on an innovation campus specialised in sustainable chemistry will accelerate their business. In this sense, it would be desirable to invest in or include the waste as raw material concept on the existing campus or other potential centre you have at your disposal.

Waste management is a very critical issue that should be ensured and monitored regionally. In this sense your region seems to take the right actions by establishing monitoring procedures.

In terms of the impact of initial investments in startups on the local community, other experiences show that they can have a big effect on attracting additional investment to a community, even for different firms than the promoted ones. This could bring additional indirect benefits to the wider regional economy.

Facilitating the market uptake of waste feedstock could be reinforced by the transferring of international commercial biotechnology experience, support for closer networking and

creating awareness of the regional potential in waste as alternative resource. This could be done by disseminating valuable information regarding waste diversification, mainly but not only by means of a centralised body for improving market knowledge, transparency, analysis and advice to companies.

There are also some other mechanisms that can foster the inter-sectoral exchange of waste. Tools like a business-to-business waste exchange platform with materials- matching and recovery opportunities would facilitate the exchange of waste streams for making this concept a regular business practice.

New business should be supported by the region to promote and sell the products manufactured within the region in various markets. The region appears to support the new sector by adding value to products produced using waste as raw material, through their promotion and support of the companies. Public administration itself should monitor the performance of private support and coordinate efforts with them to get good results.

Finally, you are aware of the importance of having advisory services in your region for building up new industrial projects in the field of sustainable chemistry and you are developing them. You could additionally make sure that these services are easily accessible for the promoters of the projects.

## KF6- STRENGTH AND AVAILABILITY OF REGIONAL MARKETS

According to *Energ-Ice Project*[2] *"The Chemical industry is placed upstream of various sectors such as construction, transport, food, health, personal cleanliness and home, clothing, electronics, etc..; this industry is also able to supply intermediate products for downstream industries and it contributes directly to create materials for the consumer market. Since chemical industry have a strategic position it is fully involved in the question of industrial sustainability outlined above"*.

The chemical industry in your region seems to be relatively important. In areas such as additives and/or paints and coatings and/or polymers, fertilisers, plastic, other chemical products, the region is taking the right direction towards a sustainable chemical industry and the use waste as feedstock. It should create a comfortable convenient setting where chemical companies can operate for a long period of time. In this sense, setting up a body that provides them legal and technical support when needed would be desirable. In areas such as additives and/or paints and coatings and/or polymers, fertilisers, plastic, other chemical products, replacing conventional materials from fossil oil with alternative raw material as waste, should be considered. This could be done through a regional strategy of creating a regional market for those alternative feedstocks, including public demand and setting up of policies that promote the green public procurement in your region.

The production of waste streams from different sectors and their conversion into every

day products such as food, feed, energy and chemicals is growing fast in some regions and expected to take off in others. This transition towards a more circular economy provides a lot of opportunities for new markets and high-value products not only at regional level, but at global scale, linking very diverse sectors at the same time. Companies need support to access these new markets and to build stable and competitive business over time.

In this regard, your region should conduct a market analysis for the new products coming from the chemical sustainable industry you want to promote, both at regional level and national/international level. This should to be done prior to any other step in the development of the sector to ensure the long term stability of the sector.

A strong regional chemical industry contributes to a competitive region/country - externally as well as internally -. It is a sector which is strongly linked with virtually all other industrial sectors as raw material provider, and now also as waste user. With the potential large range of chemical products and innovative solutions applicable for the use of waste as alternative raw material, the regional chemical industry would contribute to the well-being of the regional economy. In this sense, the regional chemical industry seems to be an important sector which needs to be reinforced and promoted continuously.

Plastic waste might be a potential alternative feedstock in your region. However, the region should design an appealing strategy for attracting new investments for using the surplus, which represents an alternative feedstock for the sustainable chemical industry.

On the other hand, the region should design an appealing strategy for attracting new investments for using the potential waste feedstock, which represents an alternative for the sustainable chemical industry. The region should disseminate information about the benefits of the use of waste as alternative feedstock. It is important to assure the correct context to attract the establishment of new business, taking into consideration key factors such as infrastructure, workforce and transport availability, as well as economical, financial, technological, political and knowledge long-term stability.

Additionally, and no less important, is the status of the industrial network of the region to facilitate the uptake of the new sustainable industry in the region. For your case, it appears, your region is a potential sustainable chemical region where new business can be launched. It is desirable to set a regional strategy to reconvert the industrial parks, becoming old, to new businesses.

## KF7- ENTREPRENEURSHIP

Business demography statistics explain the characteristics and demography of the business population and can be used to analyse the dynamics and innovation of different markets[3], for example entrepreneurship in terms of the predisposition to start a new business.

The birth rate of starting firms in your region is quite good, around the average, which together with the fact that more than 60% of them survive the first 5 years, shows not only an innovative capacity but also a seemingly good vitality of the regional economy.

Entrepreneurs play a key role in the innovation process, economic growth and employment creation. The use of waste as alternative raw materials in the chemical industry entails a significant innovation capacity due to the need for adoption of new business models and the transformation of the existing ones. In this sense, the expenditure on R+D+I is a widely used indicator that reflects the extent of research and innovation undertaken in a country in terms of resources input. The most innovative regions are those with more ability to attract higher risk investments. Your region shows some awareness of the importance of innovation but the expenditure on R+D+I is unfortunately below the average. Therefore, there is room for improvement, also taking into account the importance of providing stability to the R+D+I system, as this stability is crucial for long-term success.

Networking and cross-value chain and cross-sector cooperation are also requirements and key enabling factors for the effective implementation of the mechanisms needed for the widespread use of waste as alternative raw materials in the transition to a circular chemical industry. Match-making events and other networking actions support the reinforcement of the much needed cooperative business environment. By contrast, the reportedly closed business environment in your region, where there seems to be a reluctance to share information and start cooperative actions, may create a barrier to the success of this transition. Circular thinking requires people to be able to work together with professionals from other fields across the value chain, and outside of their own business.

Also, clusters serve as driving force in most regional economies, joining forces towards supporting the dynamics of market and improving knowledge exchange among firms and other stakeholders. And also with international value chain networks, acting as local nodes in global networks. In the end, strong clusters also help attract foreign investments if they are leading centers, and they will attract key players, not only from the region-nation, but also from abroad. Actions aimed to reinforce their activities and the creation of other clusters, or even more so the reinforcement of inter-cluster relations, will be positive for the creation and support of an environment prone to innovation and cooperation towards a circular chemical industry.

Furthermore the integration in international clusters targeting the different concepts behind the transition to a more circular economy in the chemical industry (such as the use of waste as alternative raw material) is a good opportunity. It can be used to complement strengths, reinforce European collaboration and innovation to create competitive products, services and markets for sustainable chemicals.

From an overall perspective, there are regions in which the entrepreneurial environment, usually fostered by other framework conditions or supporting actions, is more prone to adopt early innovations than other regions and take the lead. In this case, for the transition to new ways of manufacturing.

Your region is probably not within the leading regions in sustainable chemicals

production, and the companies in the region do not seem to be among the ´technology early adopters´. This means that more support (at several levels such as educational, infrastructures, financial, policy, etc.) is needed to create a favourable entrepreneurial environment for the activation of investments in this field.

On the other hand, the presence of a green chemistry park in your region, where companies would share facilities and waste in the field of sustainable chemicals production, would be an additional benefit for companies willing to start a business in the field of sustainable chemistry. If this park also integrates common facilities for research and experimentation and support in finance and business development, it would for sure be an accelerator and a real pole for attracting new business and investments.

## KF8- PUBLIC SUPPORT POLICIES

Policymakers have a responsibility to lead and ease the transition to the use of waste as alternative raw materials towards a more circular economy. A long term, stable, consistent and cross-departmental political strategy needs to be developed together with all stakeholders. Policy areas such as energy, environment, education and research, waste and raw materials, among others, are required to join forces. This is a key enabling factor that would be interesting for your region to develop and support, and periodically update and upgrade.

On the other hand, the use of waste as alternative raw material in the chemical industry entails a significant effort on R+D+I, as technologies and processes needed do not have the same maturity as the traditional ones. Therefore, well-structured, stable and long term plans to support this transition are of major importance. The creation in your region of a master Plan or Strategy tackling the R+D+I needs for this transition would be undoubtedly an enabling factor which deserves all possible support along the process.

Public incentives for innovation are the seed for stimulating and encouraging the private sector to launch new sectors or businesses.

In this sense, your region is acting well and playing the correct role to stimulate business innovation in the region, but new types of public incentives could be explored.

Some regulations, such as Waste Regulation, are commonly seen as a barrier among the stakeholders involved. Preventing, for example, small-scale experiments using waste materials and hampering transport, among others things. In general, waste is not perceived as potential raw material and that is translated into regulations. The role of regional government, depending on the country, can be supporting or that of an enabler, or it can also be even more restrictive than the European or national regulations. It would be beneficial for your region to move from a neutral role to a facilitator role, creating leeway for experimentation with new value chains, subduing the obstacles that companies usually found in all matters relating waste management or recovery as raw material. This way, your region could have a great impact upon the success of the transition.

In addition, although it does not seem to be an issue in your region, it is important to take into account that social acceptance can emerge as a powerful barrier to waste-based products development. This can result, for instance, in the failure of market penetration for products using alternative raw materials or in the halt of projects. Therefore, it is important to highlight and consider the social acceptance of this kind of market development, as it can only be sustainable when products and processes are broadly accepted.

The European Commission has approved plans to adopt a set of Regulations, aimed at facilitating the reintroduction of certain 'waste' products into the production cycles, in accordance with the Waste Framework Directive and its end-of-waste criteria. When certain waste meets these criteria, it is no longer considered waste, and therefore can create new business opportunities and markets. This, together with the by-product definition is a key tool in the waste-as-resource management towards a more circular economy. The mechanism is established by law and also states the requirements that the recovered materials and their producers must meet to ensure a high level of environmental protection and human health. It is important that this regulation and its mechanisms are implemented at national level, mobilising investments and markets in the field of the use of waste as alternative raw material.

Fiscal and financial incentives to promote circular economy in general, and therefore circular chemical value chains using waste as raw material in particular, constitute other means of support .Work is already being done in this sense at European level, exploring the use of market-based instruments to stimulate circular economy in the *Roadmap* to a *Resource-efficient Europe*. This could help or motivate to start developing an action in this field. Nevertheless, an in depth assessment of the potential impacts on the different actors of the value chain is advisable. This way, the government can have a clear view of the most effective and appropriate measures to be taken, according to its particular features. Some examples include[5]:

- lower VAT rate on circular economy services
- taxing extracted value instead of added value (a shift from taxing income to taxing materials)
- actively using financial resources from guarantee and disposal funds to further encourage business activity
- actively using financial resources from existing fiscal subsidy instruments promoting environmentally benign investments (MIA or VAMIL) for a broader series of investments or activities that would help increase circularity

[1] A list of intermediaries can be found in the following links:
- For the EIB: http://www.eib.org/products/lending/intermediated/list/index.htm
- For the EIF: http://www.eif.org/what_we_do/where/index.htm

[2] http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=ENERG_ICE_Road_Map.pdf

[3] Eurostat.

[4] OECD Innovation Policy Platform. Cluster Policies.

[5] Opportunities for a circular economy in the Netherlands document

# Conclusions & Recommendations WASTE

**Region:** *Szczecin and Vistuala Lagoon, Poland*

# KF1- LONG TERM, STABILITY AND AVAILABILITY OF FEEDSTOCK

Certain waste streams, significantly ignored or underutilised, can potentially be converted into valuable resources to replace the fossil ones traditionally used in the chemical industry and produce higher added value than existing uses. The recovery and use of some endogenous waste streams help the move towards a more circular and sustainable economy.

Waste stream(s) that may have a lot of potential in your region and need more in depth analysis could come from:

- The pulp & paper industry.

Although might not seem to be important in your region, due to its absolute weight and the disaggregation of companies in your region, it might be interesting to explore the opportunities that this/these waste stream(s) could offer a smaller scale.

These waste streams can be converted by different processing methods into chemical building blocks, syngas, fertilisers, and polymers, among others. The processes and the products will be very much dependent on their specific characteristics and on the regional market features.

Aside from waste coming from industrial or farming activities, the treatment of citizen waste streams has potential that could be explored. Sewage sludge is one of the most common wastes. It is produced in large volumes and is, surprisingly, one of the least known.

In adition, the seemingly centralised production in medium-large plants could facilitate the sludge management.

Due to the features of the seemingly low population density, it does not seem to be a potentially usable waste stream on a large scale due to possibly higher logistical costs that its management would represent. However, the presence of (a) high/medium capacity wastewater treatment plant(s) could open the door to more in depht feasibility assessment.

On the other hand, the organic fraction from MSW can also be a potential alternative raw material, for example, for the production of a fertilisers, biogas or syngas major platform for the further production of chemicals and building blocks.

In addition, plastic fractions recovered or source separated not only from packaging but also from other important sectors, would provide a potential option for producing raw materials for new plastic manufacturing out of cascade recycling. This leads to lower value materials, or serves as an alternative source for other chemical products production, for example for syngas production.

Regardless of the waste streams that can potentially be an opportunity in your region, the first step for an optimal management and use of waste towards a circular economy is good quality information gathering, availability and accessibility. There seems to be some interesting room for improvement in your region regarding waste data gathering and accessibility. In addition, an assessment of the potential waste streams that could be used as alternative raw material would highlight the opportunities for new business models in the region.

## KF2- INFRASTRUCTURE TO HANDLE FEEDSTOCKS AND PRODUCTION

Infrastructure is a key factor for the development and success of the bioeconomy. In addition, it is important to reduce the environmental impacts and to avoid logistical problems, as well as production problems. It is a decisive aspect that companies and investors take into account when deciding to set up and launch new businesses and investments.

As the transport network is fundamental for the correct functioning of the industry, in terms of supplies and manufactured products delivery, it would be desirable to have at the region's disposal a spread out network of highways and national roads and a freight train railway nertwork in order to cover the main demand points of waste feedstock

The efficient provision of infrastructure services is one of the most important aspects of development policies in general, and industry in particular. The suitable availability of infrastructure and the efficient establishment of related services to the industry, contribute to the development of competitive advantages in a country or region and help to achieve a greater degree of productive specialisation. In this sense: our region is apparently well supplied in terms of water. You should consider having a monitoring mechanism in case you are not covering the whole territory of the region to ensure there is always a 100% supply.

For the correct and successful establishment of a sustainable chemical industry, basic supplies are very important. You should consider ensuring a high quality supply of electricity and fuel in your region

## KF3- ACCESS TO FINANCE

An appropriate access to finance is of paramount importance if a transition towards a sustainable chemicals production by means of alternative raw materials is desired. The adaptation of the existing production sites for use of alternative feedstocks – such as biomass or waste – requires the installation of new equipment and the modification of the existing processes. Moreover, the realisation of concepts such as industrial symbiosis

very often implies investments in new infrastructure – like new pipelines – for the exchange of streams between different sites. In many cases, this means costly investments for the promoters that cannot be covered with their own funds, particularly when building up a new production site based on non-fossil feedstock (like biorefineries).

Both public and private funding can be used to finance these types of projects. In this regard, it seems that financing in your region is available to support the development of a sustainable chemical industry.

Public funding can be attained from multiple sources: local, regional, national or European bodies usually have direct or intermediate financing mechanisms that could be used to foster the sustainable production of chemicals in different ways.

Your region had or still has reportedly some public imbalances but some public resources could possibly be used to leverage the necessary investments to developed a sustainable chemical industry in the region, particularly combined with other funds. In this regard, you should explore potential synergies with other public financing lines available in your region or neighboring regions, such as national or European funding – EIB or Structural Funds -, building on the concept of additionality .

It is not advisable that public finance is the main source of funding for developing the region's sustainable chemical industry. The objective is to complement and encourage private funding from companies and the financial sector.

The banking sector in your region appears to be strong enough and the necessary credit for building up projects in the field of sustainable chemicals is available in your region.

Apart from the lending provided by the traditional banking sector, equity funding - through the sale of shares of new business, and financial actors are important to make the necessary financing for the development of a sustainable chemical industry available in your region. If you are not aware of the presence of these kinds of organisations in your region, you might find it useful to consider organising a meeting with them to engage them in financing projects and initiatives in the field of sustainable chemistry in your region. You may identify who is active in your country through the European associations of these types of organisations, such as Business Angels Europe (BAE) or Invest Europe.

Finally, it is also recommended to ensure that the necessary framework conditions to make financing available are set up in the sustainable chemicals field. In this regard, you already have a collaboration network involving most of the stakeholders in your region. Thus, it could be easier to use this network to support you in the development of your strategy towards sustainable chemicals production.

# KF4- SKILLED WORKFORCE, TECHNICAL EXPERTISE, TRAINING

The percentage of population with secondary and tertiary education is considered as a good measure of workforce quality, because a more skilled workforce is supposed to be more likely to be able to perform high value-added roles in this transition. Also, the employment structure given specifically by the percentage of the population employed in the industrial sector shows an existing base for the future application of waste-to-raw material concepts. A regional economy based on service sector or primary sector, is considered in principle to have less potential than a region with a strong industrial sector. Last but not least, R+D+I expenditure and its attached professionals are strongly linked and have a direct impact on the innovation performance required in this field.

The transition to the effective use of waste as alternative raw materials towards a more circular economy in the chemical industry requires a rearrangement, not only of value chains, but also of society, culture and knowledge. Therefore, raising and spreading knowledge is a major issue that requires innovative aptitude and attitude, skills and expertise for transition and a multidisciplinary and comprehensive education

In addition to the in the depth and specific technical knowledge needed, the introduction of new concepts underpinning the use of alternative raw materials in the circular economy must be integrated into education curricula from vocational training to higher education. These concepts range from the general green awareness to the “system thinking” principles and the development of skills for multidisciplinary teamwork.

The allegedly existing high-level and vocational education in the field of waste use for the production of more sustainable chemicals in your region could play a key enabling role. It could be increasing knowledge and awareness, pointing the way to a more circular economy in the chemical industry by building strong and updated background knowledge and human capital.

In addition, the existence of an education and training offer in the field of use of waste and sustainable chemistry towards a more circular economy is evidence of the flexible adaptation to the economic trends, productive systems and future skills needs.

The seemingly static training and educational system in your region may probably be an aspect to improve in the near future. This will help introduce and speed-up the awareness of the concepts underpinning the transition to the alternative use of alternative raw materials.It would be an important step towards upgrading the workforce to the current needs if the region organised targeted training sessions.

On the other hand, to build up this education that is flexible and adapted to the current and future trends, it is also advisable that different stakeholders across the value chain, including industry, take part in the design of curricula and bring together practical and different points of view.

There are also other desirable supporting bodies or structures in the education field such

as the so-called centres of excelence (CoE). These centres provide the leadership, research, support and training that play a strategic role in the development of sustainable chemistry concepts. The set-up of such a centre in your region would be an important enabler for the transition to the use of alternative raw materials in the chemical industry.

However, it is usual that many companies in the sector lack adequate information and knowledge about their own products and raw materials. The transition to more circular value chains in the chemical industry by using alternative raw materials is not possible without these foundations. Improving this knowledge is first and foremost responsibility of the business sector, which cannot assess the vulnerability of their own value chains and so are unable to respond to risks and explore alternatives.

## KF5- EXISTENCE OF SUPPORT INSTITUTIONS

Supporting institutions such as knowledge and know-how transferring bodies, technical support and assistance institutions, as well as research and development organisations are crucial for a new business or sector development based on innovative technologies using waste as alternative feedstocks.

With the purpose of launching a new business, in the field of sustainable chemistry based on waste feedstock, it would be ideal to develop a research and innovation strategy for smart specialization (RIS3). Specifically, on KETs, focused on developing more sustainable processes and industries in the chemical sector

Entrepreneurs that establish their company on an innovation campus specialised in sustainable chemistry will accelerate their business. In this sense, it would be desirable to invest in or include the waste as raw material concept on the existing campus or other potential centre you have at your disposal.

Waste management is a very critical issue that should be ensured and monitored regionally. In this sense, it would be desirable for the region to establish the correct procedures to assure the correct waste management which the waste feedstock availability will depend on.

In terms of the impact of initial investments in startups on the local community, other experiences show that they can have a big effect on attracting additional investment to a community, even for different firms than the promoted ones. This could bring additional indirect benefits to the wider regional economy.

Facilitating the market uptake of waste feedstock could be reinforced by the transferring of international commercial biotechnology experience, support for closer networking and creating awareness of the regional potential in waste as alternative resource. This could be done by disseminating valuable information regarding waste diversification, mainly but not only by means of a centralised body for improving market knowledge, transparency, analysis and advice to companies.

There are also some other mechanisms that can foster the inter-sectoral exchange of waste. Tools like a business-to-business waste exchange platform with materials- matching and recovery opportunities would facilitate the exchange of waste streams for making this concept a regular business practice.

New business should be supported by the region to promote and sell the products manufactured within the region in various markets. It is important to consider its inclusion in the regional strategy.

Finally, you may consider developing a public integral service to support new sustainable projects investments in the region.

## KF6- STRENGTH AND AVAILABILITY OF REGIONAL MARKETS

According to *Energ-Ice Project*[2] *"The Chemical industry is placed upstream of various sectors such as construction, transport, food, health, personal cleanliness and home, clothing, electronics, etc..; this industry is also able to supply intermediate products for downstream industries and it contributes directly to create materials for the consumer market. Since chemical industry have a strategic position it is fully involved in the question of industrial sustainability outlined above"*.

The chemical industry in the region might be not present. However, if the region has a high potential in the delivery of waste as alternative raw materials, you should try to promote and strengthen networking with other regions and foreign markets for the sale of waste. Especially reconverted chemical industry waste into sustainable raw material or fuel.

The production of waste streams from different sectors and their conversion into every day products such as food, feed, energy and chemicals is growing fast in some regions and expected to take off in others. This transition towards a more circular economy provides a lot of opportunities for new markets and high-value products not only at regional level, but at global scale, linking very diverse sectors at the same time. Companies need support to access these new markets and to build stable and competitive business over time.

In this regard, your region should conduct a market analysis for the new products coming from the chemical sustainable industry you want to promote, both at regional level and national/international level. This should to be done prior to any other step in the development of the sector to ensure the long term stability of the sector.

A strong regional chemical industry contributes to a competitive region/country - externally as well as internally -. It is a sector which is strongly linked with virtually all

other industrial sectors as raw material provider, and now also as waste user. With the potential large range of chemical products and innovative solutions applicable for the use of waste as alternative raw material, the regional chemical industry would contribute to the well-being of the regional economy. In this sense, the regional chemical industry seems to be a relevant sector at regional level. New markets should be explored both at national and international level.

On the other hand, the region should design an appealing strategy for attracting new investments for using the potential waste feedstock, which represents an alternative for the sustainable chemical industry. The region should disseminate information about the benefits of the use of waste as alternative feedstock. It is important to assure the correct context to attract the establishment of new business, taking into consideration key factors such as infrastructure, workforce and transport availability, as well as economical, financial, technological, political and knowledge long-term stability.

Additionally, and no less important, is the status of the industrial network of the region to facilitate the uptake of the new sustainable industry in the region. For your case, it appears, your region is a potential sustainable chemical region where new business can be launched. It is desirable to set a regional strategy to reconvert the industrial parks, becoming old, to new businesses.

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Networking and cross-value chain and cross-sector cooperation are also requirements and key enabling factors for the effective implementation of the mechanisms needed for the widespread use of waste as alternative raw materials in the transition to a circular chemical industry. Match-making events and other networking actions support the reinforcement of the much needed cooperative business environment. By contrast, the reportedly closed business environment in your region, where there seems to be a reluctance to share information and start cooperative actions, may create a barrier to the success of this transition. Circular thinking requires people to be able to work together with professionals from other fields across the value chain, and outside of their own business.

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Your region is probably not within the leading regions in sustainable chemicals production, and the companies in the region do not seem to be among the ´technology early adopters´. This means that more support (at several levels such as educational, infrastructures, financial, policy, etc.) is needed to create a favourable entrepreneurial environment for the activation of investments in this field.

On the other hand, the presence of a green chemistry park in your region, where companies would share facilities and waste in the field of sustainable chemicals production, would be an additional benefit for companies willing to start a business in the field of sustainable chemistry. If this park also integrates common facilities for research and experimentation and support in finance and business development, it would for sure be an accelerator and a real pole for attracting new business and investments.

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On the other hand, the use of waste as alternative raw material in the chemical industry

entails a significant effort on R+D+I, as technologies and processes needed do not have the same maturity as the traditional ones. Therefore, well-structured, stable and long term plans to support this transition are of major importance. The inclusion of the transition to more circular value chains in the chemical industry in the region's existing master plan or strategy, tackling the R+D+I needs for this transition would certainly be an enabling factor which deserves all possible support along the process.

Public incentives for innovation are the seed for stimulating and encouraging the private sector to launch new sectors or businesses.

In this sense, it would be worthwhile for the region to use public incentives to stimulate business innovation in the regional sector.

Some regulations, such as Waste Regulation, are commonly seen as a barrier among the stakeholders involved. Preventing, for example, small-scale experiments using waste materials and hampering transport, among others things. In general, waste is not perceived as potential raw material and that is translated into regulations. The role of regional government, depending on the country, can be supporting or that of an enabler, or it can also be even more restrictive than the European or national regulations. It would be beneficial for your region to move from a neutral role to a facilitator role, creating leeway for experimentation with new value chains, subduing the obstacles that companies usually found in all matters relating waste management or recovery as raw material. This way, your region could have a great impact upon the success of the transition.

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The European Commission has approved plans to adopt a set of Regulations, aimed at facilitating the reintroduction of certain 'waste' products into the production cycles, in accordance with the Waste Framework Directive and its end-of-waste criteria. When certain waste meets these criteria, it is no longer considered waste, and therefore can create new business opportunities and markets. This, together with the by-product definition is a key tool in the waste-as-resource management towards a more circular economy. The mechanism is established by law and also states the requirements that the recovered materials and their producers must meet to ensure a high level of environmental protection and human health. It is important that this regulation and its mechanisms are implemented at national level, mobilising investments and markets in the field of the use of waste as alternative raw material.

Fiscal and financial incentives to promote circular economy in general, and therefore circular chemical value chains using waste as raw material in particular, constitute other means of support .Work is already being done in this sense at European level, exploring

the use of market-based instruments to stimulate circular economy in the *Roadmap* to a *Resource-efficient Europe*. This could help or motivate to start developing an action in this field. Nevertheless, an in depth assessment of the potential impacts on the different actors of the value chain is advisable. This way, the government can have a clear view of the most effective and appropriate measures to be taken, according to its particular features. Some examples include[5]:

- lower VAT rate on circular economy services
- taxing extracted value instead of added value (a shift from taxing income to taxing materials)
- actively using financial resources from guarantee and disposal funds to further encourage business activity
- actively using financial resources from existing fiscal subsidy instruments promoting environmentally benign investments (MIA or VAMIL) for a broader series of investments or activities that would help increase circularity

[1] A list of intermediaries can be found in the following links:
- For the EIB: http://www.eib.org/products/lending/intermediated/list/index.htm
- For the EIF: http://www.eif.org/what_we_do/where/index.htm

[2] http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=ENERG_ICE_Road_Map.pdf

[3] Eurostat.

[4] OECD Innovation Policy Platform. Cluster Policies.

[5] Opportunities for a circular economy in the Netherlands document

# Conclusions & Recommendations BIOMASS

**Region:** *Strumica, North Macedonia*

# KF1- LONG TERM, STABILITY AND AVAILABILITY OF FEEDSTOCK

The necessity to fulfill the acquired environmental commitments has led to an urgent need to assess sustainable paths to produce biofuels and bio-products minimising the environmental impact related to the land use and land occupation, deforestation, soil impoverishment, eutrophication, ground water or soil contamination, among others, which cause a decrease in the soils production capacity.

The use of biomass obtained from the forest or agriculture landlands or the use of agroindustry/agroforestry sector or other industries in which biomass waste is produced has several advantages if sustainability criteria are considered in the process.

For this matter, international standards included in the EU Renewable Energy Directive (The European Parliament and the Council of the European Union, 2009) and global sustainability certification systems regarding biofuels have been developed.

Certain biomass streams like forestry or agricultural residues, ignored or underutilised in many cases, can potentially be converted into valuable resources to replace the fossil ones traditionally used in the chemical industry and produce higher added value raw materials (biocommodities). The recovery and use of these endogenous biomass streams may imply great positive impacts towards a more circular and sustainable economy.

In the first instance, a region looking to increase bio-based alternatives will need to consider if there are enought resources to supply them. So as a first approach it is important to determine the area occupied by forest or agriculture land and the corresponding raw material (biomass resources) that could be obtained in each location (generally determined by resources to surfaces ratios). According to each type of biomass feedstock's characteristics, the theoretical potential might differ greatly so that it is necessary to distinguish between the main different biomass resources types.

In this regard, even though the region accounts for a significant rate of forest land, the total area producing forest biomass might not be enough to implement new initiatives related to the sustainable chemical sector based on this raw material. Further studies should be carried out to determine it.

On the other hand, even though the region accounts for a significant rate of agricultural land, the total area producing agriculture biomass might not be enough to implement new sustainable chemical sector initiatives based on this raw materials. Further studies should be carried out to determine the region's capabilities.

One of the main advantages of the biorefineries or bio-based initiatives is the wide range of feedstocks that could be used in their processes. Nevertheless, other sectors or facilities which currently use them must be assessed to confirm that there is sufficient raw material for other purposes that could be actually allocated to the sustainable chemistry sector.

It is quite important to determine the actual amount of biomass resources that a new initiative could take advantage of. For this reason, it is necessary to analyse if specific

biomass availability assessments have been already carried out in the region and the results obtained (availability of resources).

In this sense, the potential biomass available for the chemical and biorefinery sector has not been assessed yet but the region has the required input data regarding the forest biomass to carry out the study. Actions should be carried out to retrieve the data necessary to also evaluate the agriculture biomass potential in the region. This study would be particularly interesting in the region due to the large forestry surfaces in the region.

On the other hand, biomass available in the region is either not used by existing industrial applicationsor is used by some installations in the region but is still available for the chemical and biorefinery sector. Additionally, the region has some information on biomass resources potential. This should be further assessed together with the existing industrial applications that could apply biorefinery concepts so opportunities to promote the sustainable chemical and biorefinery sector can be identified.

Besides assessing the amount of resources that are or might be available it is important to determine if the region already knows the format in which those biomass feedstocks are or could be supplied. Available formats may imply different procurement chains that should be taken into account by new bio-based initiatives.

In addition, the region accounts with information regarding the format in which biomass is currently supplied that will allow determining if :

- resources would be available in the most suitable format (chips, shredded material, sawdust or bales) for sustainable chemistry initiatives
- any pre-treatments (logs, branches) or additional steps in the supply chain would be necessary (branches or loose straw)
- competence could be expected (pellets and briquettes most likely used within the domestic market, for example)

Concerning competition over the available biomass resources the region is not using biomass for energy purposes, even though there is a significant biomass potential. So, it could be interesting for the sustainable chemistry sector to take advantage of this situation.

Biorefineries or bio-based initiatives installations offer several advantages compared to other biomass resources and other fossil fuels based plants but might involve long term processes to finally succeed. These processes can be reduced if already existing initiatives are close to applying these concepts or are already using biomass feedstocks.

Finally, it is worth noting that there are already some initiatives that should be consulted to assess if the biorefinery concept could be applied or developed, taking advantage of previously carried out work. If the region still has biomass resources available and/or enough capacity to develop new projects, it could use this opportunity towards the sustainability of the chemistry sector.

Finally, the aquaculture industry currently is currently not developed in the region. Therefore, in first instance preliminary studies should be carried out to assess the potential and the interest of the region to produce algae or microalgae.

## KF2- INFRASTRUCTURE TO HANDLE FEEDSTOCKS AND PRODUCTION

The biomass logistics chain faces different challenges that need to be overcome to optimise the supply chain. They include accessibility limitations, low bulk densities and significant volumes, geographical dispersion, low productivity per hectare, etc.

In addition, biomass usually needs to undergo some kind of pre-treatment before its final use for energy purposes or for the production of chemicals. This is, due to its grading, heterogeneity, high moisture content, low density, constraints related to the handling and transport, presence of exogenous mater (stones, dust, metals, etc.). The supply chain involves several steps: collection, pre-treatment (when required), transport, distribution and storage. All of which need to be optimised to increase the environmental and economic feasibility of the supply chain.

Biomass consumers, including the industrial sector, ceramic sector, greenhouses, boilers, power plants, co-firing plants, might have different requirements regarding the raw material according to the conversion pathway used. Any biomass feedstocks consumer will demand a supply guarantee which is an important challenge to be addressed and maintained during a project´s life.

Biomass resources will have to be transported from the site in which they will be produced (even imported) to the new bio-based installation. Local transport infrastructures (roads, rails or ports) will have to be used, the better their condition the lower the transport costs inferred.

In this regard, new investment in transport infrastructure roads/railways might be needed.

Biomass feedstocks supply for new bio-based initiatives can be easily satisfied if any biomass logistics centre is already set up in the region or close to it. Since biomass logistics centres can be crucial for these types of initiatives, it is also important to evaluate if there are any options to set them up in case they do not exist yet.

In any case, the possibility of setting up additional biomass logistics centres in the region should be explored: the closer to the chemical industries, the better.

Biomass transport cost is one of the main drivers of the overall biomass supply cost so optimised chains should be implemented to achieve techno-economically feasible solutions. The existence of transport companies already delivering these types of feedstocks might reduce investment costs related to transport equipment for these types

of initiatives.

In addition, the region may take advantage of already existing biomass transport companies. These could deliver biomass products to new bio-based industries or new biorefinery concepts without involving excessive investment costs in this infrastructure.

New bio-based initiatives can take advantage of the storage sites or warehouse of already existing projects, which could be used as new logistics centres.

It is worth noting that there already is an infrastructure in the region to implement the final use of biomass applying biorefinery concepts. It could be a starting point for the sustainable chemistry sector development in the region by, for example, increasing their storage capacity to satisfy new logistics demands.

Finally, biomass logistics centres or the places in which biomass resources will be loaded, unloaded and delivered will require basic supplies to guarantee working conditions.

In this regard, the minimum supply conditions (water, gas, electricity) to apply biorefinery concepts in the region are already in place, so no further limitations related to electricity or water supplies might endanger bio-based industries projects.

## KF3- ACCESS TO FINANCE

An appropriate access to finance is essential to transition towards sustainable chemicals production. The adaptation and refurbishment of the existing production sites to use alternative feedstocks – such as biomass or waste – require the installation of new equipment and the modification of the existing processes. Moreover, the development of concepts such as industrial symbiosis often implies investments in new infrastructure – like new pipelines – for the exchange of streams between different sites. In many cases, this means costly investments for the promoters that cannot be covered with their own funds. Particularly when building up a new production site based on non-fossil feedstock, such as a biorefinery.

Both public and private funding can be used to finance these types of projects. In this regard, financing in your region is available but under very undesirable conditions; several issues need to be tackled to improve access to finance in your region.

Public funding can be attained from multiple sources. Local, regional, national or European bodies usually have direct or intermediate financing mechanisms that could be used to foster the sustainable production of chemicals with biomass feedstocks in different ways.

The region is not in a position to provide direct financing for these types of initiatives at

the moment,but promoters in the region could access the public funding available in the region or neighboring regions through national agencies and/or intermediaries of the European Investment Bank.

Public finance should not be the main or only source of funding for developing the region´s sustainable chemical industry. The objective is to complement and encourage private funding from companies and the financial sector.

The banking sector in the region is strong and the necessary credit for building up projects in the field of sustainable chemicals is available in the region.

Moreover, it seems that foreign investment is important in the region. Actions should be carried out to attract these types of investors to the sustainable chemicals field by organising investment forums, multilateral meetings andawareness campaigns, etc.

Additionally, the region should ensure that the necessary framework conditions are set up to make financing available in the sustainable chemicals field using biomass resources.

In this regard, the region already has a collaboration network involving most of the stakeholders in the region; but further steps could be taken to make sure that this network is used for supporting the region in the development of the strategy towards sustainable chemicals production.

Apart from the lending provided by the traditional banking sector, other alternative instruments and financial actors are important to make available the necessary financing available for the development of a sustainable chemical industry in the region.

Although these instruments exist and are active in the region, they are currently not funding projects/initiatives in the field of sustainable chemicals. It would be worth considering meeting with the managers of the institutions that provide this type of funding, such as venture capital or business angels organisations.

Finally, it is worth noting that, there are no subsidies in the region attributed to the use of biomass for any purposes, so for the moment any project exploring these initiatives would need to be economically feasible on its own without any economic support from public bodies.

## KF4- SKILLED WORKFORCE, TECHNICAL EXPERTISE, TRAINING

The transition to the effective use of alternative raw materials towards developing the biorefinery concept requires a rearrangement not only of value chains but also of society

culture, knowledge and skills.

As a first step, the successful implementation of new bio-based initiatives or biorefinery concepts in a region will require a skilled workforce able to carry out both the activities related to the procurement of the biomass resources and those related to the management, operation and maintenance of new installations. As a second step, training activities and courses need to be developed and implemented to minimise gaps between society knowledge and new installations and their development needs.

It is worth noting that the region has the skilled workforce required for the implementation of a biomass supply chain but does not have information to determine if the region has skilled professionals on the final use of this raw material. It would be interesting for the region to have a look into this issue. In case no skilled professionals on this topic are located in the region, steps should be taken to prepare or attract this type of workforce.

In addition to the in-depth and specific technical knowledge needed, the introduction of new concepts underpinning biorefinery concepts must be integrated into education curricula from vocational training to higher education. These concepts range from the general green awareness to the "system thinking" principles and the development of skills for multidisciplinary teamwork.

In this sense, high-level and vocational education in the field of biomass use for chemical applications seems to show significant room for improvement. A well-structured and mature education and training offer would play a key enabling role, increasing knowledge and awareness, pointing the way to a more sustainable chemical industry by building strong and updated background knowledge and human capital.

The existence of education and training offers in the field of biomass use for chemical applications is evidence of the flexible adaptation to the economic trends, productive systems and future skills needs. Moreover, the presence of people involved in R&D activities in the region may boost the transition to bio-based activities and new biorefineries concepts by shortening response time to solve technology gaps or by implementing training needs.

In this regard, ": it seems that the region does not have the professional expertise that would be needed along the biomass supply chain implemented to supply the sustainable chemical sector and biorefineries. It would be advisable to develop specific courses and training programmes to address this gap.

On the other hand, Skilled workforce in biomass R&D concepts will contribute to developing technology and products and increasing the knowledge regarding biorefineries and bio-based industries. The region should assess the existence and availability of professionals engaged in R&D biomass projects who could contribute to the technology, knowledge and products development for biorefineries and bio-based initiatives.

There are also other desirable supporting bodies or structures in the education field such as the so-called Centres of Excelence (CoE). These centres provide leadership, research, support and training that play a strategic role in the development of sustainable chemistry concepts.

The set-up of such a centre in the region would be an important enabler for the transition to more sustainable value chains in the chemical industry. On the other hand, to build up this education that is flexible and adapted to the current and future trends, it is also advisable that different stakeholders across the value chain, including industry, take part in the design of curricula and bring together practical and different points of view

Finally, further research would be advisable in order to identify an accessible and affordable technology to process biomass prior to the supply chain implementation. The best technology selection should be identified according to the raw material and site characteristics but also the conversion pathway chosen.

## KF5- EXISTENCE OF SUPPORT INSTITUTIONS

Supporting institutions such as knowledge and know-how transferring bodies, technical support and assistance institutions, as well as, research and development organisations are crucial for a new business or sector development.

Supporting institutions can exist in some or all the links of the complete bio-based or biorefineries chain (R&D activities, financing issues, business tasks, etc.).

With the purpose of launching new business activities in the field of sustainable chemistry based on biomass, it would be ideal to have a research and innovation strategy for smart specialisation (RIS3). Specifically on KETs, focused on developing more sustainable processes and industries in the chemical sector.

Entrepreneurs that establish their company on an R&D&I campus specialised in sustainable chemistry accelerate their business. In this sense, it would be desirable to invest in or include the bio-based and circular economy concept on a campus. Or, alternatively, set one up in an already existing potential centre available and suitable for these types of actions (technical campus covering some of the aspects that a sustainable chemistry campus should address)[2].

With respect to specific financing issues, the region should evaluate the possibility to create an institute or body supporting business since it would offer valuable support to promote circular economy/bio economy/sustainable business.

And finally, concerning business plans, risks assessments, etc., the development of a public integral service that supports new sustainable projects investments in the region should be considered.

Biomass resources have different quality characteristics. Producers and consumers need

to agree on these characteristics to solve the problems that might appear within the biomass supply chain. Standards and certificates help to guarantee success in new bio-based or biorefineries activities.

In this regard, There are no certification and/or standardisation bodies in the region. The creation of this type of body should be promoted in the region since it can contribute to support business from a technical point of view. It will also serves as an instrument of differentiation that makes both new and existing companies and launching new products more competitive.

In terms of the impact of initial investments in start-ups on the local community, other experiences have shown that they can have a big effect on attracting additional investment to a community, even for different firms than the ones promoted. This could bring additional indirect benefits to the wider regional economy.

The region should include an initial investment program for start-ups in order to obtain those benefits.

As new bio-based or biorefineries initiatives will need to take advantage of currently unused biomass resources, having a specific service in the region which might support the connection between biomass resources production and new installations demands will significantly help these activities to succeed.

Facilitating the market uptake of new biomass raw materials or feedstocks, will be reinforced by the transferring of international commercial biotechnology experience, support for closer networking and creating awareness of the regional potential in alternative raw materials. This will be done by disseminating valuable information regarding biomass used as a feedstock, mainly but not only by means of a centralised body for improving market knowledge, transparency, analysis and advice to companies (please visit Germany DERA).

## KF6- STRENGTH AND AVAILABILITY OF REGIONAL MARKETS

The overall shares of renewable energies need to increase to fulfill the raising energy demands and still meet the commitments established. Besides energy generation, biomass can be used in other industrial applications such as raw material for the chemical industry or for liquid fuels and other biocommodities production increasing greenhouse gas emissions savings and the energy security. Biomass use still has a large improvement potential to be developed since biomass markets are not as developed as others. Successful biomass markets display an integrated and sustainable supply chain, from the source to the end-users. If they already exist, taking advantage or additional biomass resources has fewer difficulties than if they have to be created from the ground

up.

Biomass markets development in the region has to be assessed in order to efficiently promote the integration of the supply chains and to develop best practice tools. For this aim, data regarding the sector activity in the region should be compiled including number and type of business. This data should include:

- volumes of biomass produced, used and exported/imported
- consumption flows and current business models based on the feedstocks
- actors along the entire supply chain

In this particular case, it seems that the biomass market is not fully developed in the region so the introduction of the biorefineries' activities will need development to improve cost-effective operation along the whole supply chain and for final use applications.

Furthermore, the security of the raw material supply is one of the main requirements for the successful implementation of any initiative based on biomass. Considering this, a critical mass of suppliers will be necessary. Even though supply could be developed with other stakeholders, the region should work on widening the existing limited supply offer.

On the other hand, actors involved in the whole sustainable chemicals value chain do not seem to look at the biomass resource market as a promising investment at this moment. Activities to motivate them to move in this direction or to attract investments from organisations outside of the region would be needed if the region wants to establish a biomass resource market for the production of chemicals, among other possible uses.

In order to definitively set up new biorefineries or new bio-based initiatives based on biomass resources, it is also extremely important to assess the market conditions for the new biocommodities or for the new products to be developed. If there already is some knowledge in the region regarding these markets, new initiatives may take advantage of this information and may reduce the time to definitively set up.

In this case, There seems to be some information regarding the potential markets that could provide a starting point for different stakeholders involved in the supply chain or in the set up of new installations.

The main market sector for the chemical industry in the region seem to be food and nutraceutical products, agricultural products, pharmaceutical and cosmetic products and polymers, fibres and composite materials. As a first step, the demand for biomaterials in these sectors should be assessed in order to determine if the biomass resources in the region might satisfy the production requirements.

The European Commission's single market for green products initiative proposes a set of actions to overcome the different problems that slow down the final implementation of these products in the market. These actions are:

- establishing two methods to measure environmental performance throughout the

lifecycle (the product environmental footprint (PEF) and the organisation environmental footprint (OEF)) and recommending the use of these methods to EU countries, companies, private organisations and the financial community through a Commission Recommendation
- developing product- and sector-specific rules through a multi-stakeholder process
- providing principles for communicating environmental performance, such as transparency, reliability, completeness, comparability and clarity
- supporting international efforts towards more coordination in methodological development and data availability.

In recent years, there have been significant developments in the field of industrial green purchasing and supply. New bio-based or biorefinery initiatives in the region should consider these actions and other green products promotion initiatives to guarantee success.

In this particular case, there is a lack of promotion that should be addressed by the governmental bodies.

Moreover, it is worth noting that the chemical sector is poorly developed in the region. Therefore, the promotion of sustainable chemical initiatives will firstly work on setting up an adequate framework in the region and on identifying if any possibility to set up sustainable chemical initiatives might even exist.

## KF7- ENTREPRENEURSHIP

The transition to more sustainable value chains in the chemical industry entails a significant innovation capacity due to the need for the adoption of new business models and the transformation of the existing ones. In this sense, the expenditure on R+D+I is a widely used indicator that reflects the extent of research and innovation undertaken in a country in terms of resources input.

The region does not seem to be well aware of the importance of innovation and the expenditure on R+D+I is much lower than the top innovative countries and lower than the average. Thus, there is a lot of room for improvement. Also taking into account the importance of providing with stability to the R+D+I system, as this stability is crucial for long-term success.

On the other hand, there is a lack of information regarding the public and/or private expenditure on R+D+I, this should be addressed in the region due to the important role that research plays in a developing technology such as biorefineries.

Networking and cross-value chain and cross-sector cooperation is also a requirement and a key enabling factor for the transition to sustainable chemical industry. Matchmaking events and other networking actions support the reinforcement of the much needed cooperative business environment.

However, the closed business environment in the region, where there is a reluctance to share information and start cooperative actions, create a major barrier to the success of this transition. Circular thinking requires people to be able to work together with professionals from other fields across the value chain, and outside of their own business.

Also, clusters contribute to support dynamics of market and knowledge exchange among firms and other stakeholders in the region and in international value chain networks, acting as local nodes in global networks.

In this regard, the presence of chemical, polymer, farming and animal husbandry, agri-food and bioeconomy clusters is a reflection of the level of networking in your region. Actions aimed to reinforce their activities and the creation of other clusters, or even more so the reinforcement of inter-cluster relations, will be positive for the creation of an environment prone to innovation and cooperation towards a circular chemical industry.

## KF8- PUBLIC SUPPORT POLICIES

The transition to more circular value chains in the chemical industry by using biomass resources in new or existing processes entails a significant effort on R+D+I. Therefore, well-structured, stable and long term plans to support this transition are of major importance.

The creation of a master plan or strategy in the region tackling the R+D+I needs for this transition would undoubtedly be an enabling factor. It deserves all possible support along the process.

Furthermore, public incentives are somehow the seed for stimulating and encouraging the private sector in launching new sectors or businesses.

In the same way, fiscal and financial incentives to promote the bioeconomy in general and therefore sustainable chemical value chains based on biomass in particular, constitute other means of support . Work is already being done in this sense at European level, exploring the use of market-based instruments to stimulate circular economy in the *Roadmap to a Resource-efficient Europe*.

This could help or motivate to start developing an action in this field. Nevertheless, an in depth assessment on the potential impacts on the different actors of the value chain is advisable. This way, the government can have a clear view of the most effective and appropriate measures to be taken, according to its particular features. Some examples include[3]

- lower VAT rate on circular economy services
- taxing extracted value instead of added value (a shift from taxing income to taxing

materials)
- actively using financial resources from guarantee and disposal funds to further encourage business activity
- actively using financial resources from existing fiscal subsidy instruments promoting environmentally benign investments (MIA or VAMIL) for a broader series of investments or activities that would help increase circularity

Policymakers have a responsibility to lead and ease the transition to a circular economy. A long term, stable, consistent and cross-departmental political strategy needs to be developed together with all stakeholders. Policy areas such as energy, environment, education and research, waste and raw materials, among others, are required to join forces.

This is a key enabling factor that the region should develop and support, and periodically update and upgrade.

The different governmental bodies have the capacity to design, implement, and enforce regulation. This multi-level regulatory framework can be challenging, giving rise to economic stagnation or recession, decreased productivity and less competitiveness, which has to be avoided. Among others, the challenges include avoiding duplicated or overlapping rules, low quality regulation, and uneven enforcement.

Finally, regulation related to the establishment of enterprises in the region should be also taken into account. In this sense, any further step to facilitate the process of setting them up is positive for the region's economy. The region has taken into account this very important issue.

Government/regional support schemes for renewable energies can be applied to bioenergy in most instances. Direct government grants and subsidies for biomass production and use could encourage further uptake of sustainable chemistry projects/biorefineries.

Biorefineries and sustainable chemistry projects promoters should be aware of current policies and closely follow any national policy development that might be established in the region or at national level.

The region should promote contact with other regions that have extensive knowledge and experience regarding bio-based applications. The region should also participate in specific forums related to chemical production sustainability to build an appropriate framework for the sustainable chemistry initiatives to progress in the region.

Policies should be developed in the region in terms of investment in research and innovation and skills, market development and enhanced competitiveness and also engagement with stakeholders to promote bio-based initiatives like biorefineries.

The region should address the lack of regulations regarding the production of biomass in marginal lands and/or arable lands. Regulations in this area could contribute to increasing biomass feedstock production in the region that could be used in biorefineries

or sustainable chemical sector.

[1] A list of intermediaries can be found in the following links:

- For the EIB: http://www.eib.org/products/lending/intermediated/list/index.htm
- For the EIF: http://www.eif.org/what_we_do/where/index.htm

[2] See the green chemistry campus website.
[3] Opportunities for a circular economy in the Netherlands. document.

# Conclusions & Recommendations WASTE

**Region:** *Strumica, North Macedonia*

# KF1- LONG TERM, STABILITY AND AVAILABILITY OF FEEDSTOCK

Certain waste streams, significantly ignored or underutilised, can potentially be converted into valuable resources to replace the fossil ones traditionally used in the chemical industry and produce higher added value than existing uses. The recovery and use of some endogenous waste streams help the move towards a more circular and sustainable economy.

Your region seems to have significant potential which is worth exploring, if it has not been explored yet, in terms of waste from:

- The agri-food sector.

Waste stream(s) that may have a lot of potential in your region and need more in depth analysis could come from:

- The pulp & paper industry.

Although might not seem to be important in your region, due to its absolute weight and the disaggregation of companies in your region, it might be interesting to explore the opportunities that this/these waste stream(s) could offer a smaller scale.

These waste streams can be converted by different processing methods into chemical building blocks, syngas, fertilisers, and polymers, among others. The processes and the products will be very much dependent on their specific characteristics and on the regional market features.

Aside from waste coming from industrial or farming activities, the treatment of citizen waste streams has potential that could be explored. Sewage sludge is one of the most common wastes. It is produced in large volumes and is, surprisingly, one of the least known.

In adition, the seemingly centralised production in medium-large plants could facilitate the sludge management.

Due to the features of the seemingly low population density, it does not seem to be a potentially usable waste stream on a large scale due to possibly higher logistical costs that its management would represent. However, the presence of (a) high/medium capacity wastewater treatment plant(s) could open the door to more in depht feasibility assessment.

On the other hand, the organic fraction from MSW can also be a potential alternative raw material, for example, for the production of a fertilisers, biogas or syngas major platform for the further production of chemicals and building blocks.

In addition, plastic fractions recovered or source separated not only from packaging but also from other important sectors, would provide a potential option for producing raw materials for new plastic manufacturing out of cascade recycling. This leads to lower value materials, or serves as an alternative source for other chemical products production, for example for syngas production.

Regardless of the waste streams that can potentially be an opportunity in your region, the first step for an optimal management and use of waste towards a circular economy is good quality information gathering, availability and accessibility. There seems to be some interesting room for improvement in your region regarding waste data gathering and accessibility. In addition, an assessment of the potential waste streams that could be used as alternative raw material would highlight the opportunities for new business models in the region.

## KF2- INFRASTRUCTURE TO HANDLE FEEDSTOCKS AND PRODUCTION

Infrastructure is a key factor for the development and success of the bioeconomy. In addition, it is important to reduce the environmental impacts and to avoid logistical problems, as well as production problems. It is a decisive aspect that companies and investors take into account when deciding to set up and launch new businesses and investments.

As the transport network is fundamental for the correct functioning of the industry, in terms of supplies and manufactured products delivery, it would be desirable to have at the region's disposal a spread out network of highways and national roads and a freight train railway nertwork in order to cover the main demand points of waste feedstock

The efficient provision of infrastructure services is one of the most important aspects of development policies in general, and industry in particular. The suitable availability of infrastructure and the efficient establishment of related services to the industry, contribute to the development of competitive advantages in a country or region and help to achieve a greater degree of productive specialisation. In this sense: our region is apparently well supplied in terms of electricity. You should consider having a monitoring mechanism in case you are not covering the whole territory of the region to ensure there is always a 100% supply. our region is apparently well supplied in terms of water. You should consider having a monitoring mechanism in case you are not covering the whole territory of the region to ensure there is always a 100% supply.

For the correct and successful establishment of a sustainable chemical industry, basic supplies are very important. You should consider ensuring a high quality supply of fuel in your region

# KF3- ACCESS TO FINANCE

An appropriate access to finance is of paramount importance if a transition towards a sustainable chemicals production by means of alternative raw materials is desired. The adaptation of the existing production sites for use of alternative feedstocks – such as biomass or waste – requires the installation of new equipment and the modification of the existing processes. Moreover, the realisation of concepts such as industrial symbiosis very often implies investments in new infrastructure – like new pipelines – for the exchange of streams between different sites. In many cases, this means costly investments for the promoters that cannot be covered with their own funds, particularly when building up a new production site based on non-fossil feedstock (like biorefineries).

Both public and private funding can be used to finance these types of projects. In this regard, financing in your region is available but is apparently not accessible enough; several issues might need to be tackled to improve access to finance in your region.

Public funding can be attained from multiple sources: local, regional, national or European bodies usually have direct or intermediate financing mechanisms that could be used to foster the sustainable production of chemicals in different ways.

It seems that your region may not be in a strong enough position to provide direct financing for these types of initiatives at the moment,but promoters in your region could access the public funding available in your region or neighboring regions through national agencies or intermediaries of the European Investment Bank[1].

It is not advisable that public finance is the main source of funding for developing the region's sustainable chemical industry. The objective is to complement and encourage private funding from companies and the financial sector.

The banking sector in your region appears to be strong enough and the necessary credit for building up projects in the field of sustainable chemicals is available in your region.

Apart from the lending provided by the traditional banking sector, equity funding - through the sale of shares of new business, and financial actors are important to make the necessary financing for the development of a sustainable chemical industry available in your region. Although these instruments exist and are active in your region, they are currently not funding projects/initiatives in the field of sustainable chemicals. Maybe you might find it useful to consider meeting with the managers of the institutions that provide this type of funding, such as venture capital or business angel organisations.

Moreover, it seems that the foreign investment is relevant in your region. It would be convenient to attract these types of investors towards the field of sustainable chemicals by organising investment forums, multilateral meetings and awareness campaigns for instance.

Finally, it is also recommended to ensure that the necessary framework conditions to

make financing available are set up in the sustainable chemicals field. In this regard, you could consider developing a network gathering all the stakeholders in your region – chemical industry, technology suppliers, academia and research, financing organisations – to support you in the development of a roadmap and a implementation plan towards the development of a sustainable chemical industry and to serve as a forum for discussion.

## KF4- SKILLED WORKFORCE, TECHNICAL EXPERTISE, TRAINING

The percentage of population with secondary and tertiary education is considered as a good measure of workforce quality, because a more skilled workforce is supposed to be more likely to be able to perform high value-added roles in this transition. Also, the employment structure given specifically by the percentage of the population employed in the industrial sector shows an existing base for the future application of waste-to-raw material concepts. A regional economy based on service sector or primary sector, is considered in principle to have less potential than a region with a strong industrial sector. Last but not least, R+D+I expenditure and its attached professionals are strongly linked and have a direct impact on the innovation performance required in this field.

The transition to the effective use of waste as alternative raw materials towards a more circular economy in the chemical industry requires a rearrangement, not only of value chains, but also of society, culture and knowledge. Therefore, raising and spreading knowledge is a major issue that requires innovative aptitude and attitude, skills and expertise for transition and a multidisciplinary and comprehensive education

In addition to the in the depth and specific technical knowledge needed, the introduction of new concepts underpinning the use of alternative raw materials in the circular economy must be integrated into education curricula from vocational training to higher education. These concepts range from the general green awareness to the “system thinking” principles and the development of skills for multidisciplinary teamwork.

In your region, high-level and vocational education in the field of sustainable chemistry seem to have interesting and fruitful room for upgrading. A well-structured and mature education and training offer would play a key enabling role. It would be increasing knowledge and awareness, pointing the way to a more circular economy in the chemical industry by building a strong and updated background knowledge and human capital.

In addition, the existence of an education and training offer in the field of use of waste and sustainable chemistry towards a more circular economy is evidence of the flexible adaptation to the economic trends, productive systems and future skills needs.

The seemingly static training and educational system in your region may probably be an aspect to improve in the near future. This will help introduce and speed-up the awareness of the concepts underpinning the transition to the alternative use of alternative raw materials.It would be an important step towards upgrading the workforce to the current needs if the region organised targeted training sessions.

On the other hand, to build up this education that is flexible and adapted to the current and future trends, it is also advisable that different stakeholders across the value chain, including industry, take part in the design of curricula and bring together practical and different points of view.

There are also other desirable supporting bodies or structures in the education field such as the so-called centres of excelence (CoE). These centres provide the leadership, research, support and training that play a strategic role in the development of sustainable chemistry concepts. The set-up of such a centre in your region would be an important enabler for the transition to the use of alternative raw materials in the chemical industry.

However, it is usual that many companies in the sector lack adequate information and knowledge about their own products and raw materials. The transition to more circular value chains in the chemical industry by using alternative raw materials is not possible without these foundations. Improving this knowledge is first and foremost responsibility of the business sector, which cannot assess the vulnerability of their own value chains and so are unable to respond to risks and explore alternatives.

## KF5- EXISTENCE OF SUPPORT INSTITUTIONS

Supporting institutions such as knowledge and know-how transferring bodies, technical support and assistance institutions, as well as research and development organisations are crucial for a new business or sector development based on innovative technologies using waste as alternative feedstocks.

With the purpose of launching a new business, in the field of sustainable chemistry based on waste feedstock, it would be ideal to develop a research and innovation strategy for smart specialization (RIS3). Specifically, on KETs, focused on developing more sustainable processes and industries in the chemical sector

Entrepreneurs that establish their company on an innovation campus specialised in sustainable chemistry will accelerate their business. In this sense, it would be desirable to invest in or include the waste as raw material concept on the existing campus or other potential centre you have at your disposal.

The existence of an institute or body, supporting new business, would be required, for their establishment and launching, even if it is not specifically for waste or other related concepts such as circular economy/bio economy/sustainable business, as most of the objectives of this kind of body are cross sectoral. However to promote the sustainable chemical industry, it would be desirable that most of the supporting actions for new business such as promoting public-private investments, grant loans, promoting the participation of other financial partners and so on, are centralised in a body with a specific target on waste and sustainable processes.

Waste management is a very critical issue that should be ensured and monitored regionally. In this sense, it would be desirable for the region to establish the correct

procedures to assure the correct waste management which the waste feedstock availability will depend on.

In terms of the impact of initial investments in startups on the local community, other experiences show that they can have a big effect on attracting additional investment to a community, even for different firms than the promoted ones. This could bring additional indirect benefits to the wider regional economy.

Facilitating the market uptake of waste feedstock could be reinforced by the transferring of international commercial biotechnology experience, support for closer networking and creating awareness of the regional potential in waste as alternative resource. This could be done by disseminating valuable information regarding waste diversification, mainly but not only by means of a centralised body for improving market knowledge, transparency, analysis and advice to companies.

There are also some other mechanisms that can foster the inter-sectoral exchange of waste. Tools like a business-to-business waste exchange platform with materials- matching and recovery opportunities would facilitate the exchange of waste streams for making this concept a regular business practice.

New business should be supported by the region to promote and sell the products manufactured within the region in various markets. It is important to consider its inclusion in the regional strategy.

Finally, you may consider developing a public integral service to support new sustainable projects investments in the region.

## KF6- STRENGTH AND AVAILABILITY OF REGIONAL MARKETS

According to *Energ-Ice Project*[2] *"The Chemical industry is placed upstream of various sectors such as construction, transport, food, health, personal cleanliness and home, clothing, electronics, etc..; this industry is also able to supply intermediate products for downstream industries and it contributes directly to create materials for the consumer market. Since chemical industry have a strategic position it is fully involved in the question of industrial sustainability outlined above"*.

The chemical industry in the region might be not present. However, if the region has a high potential in the delivery of waste as alternative raw materials, you should try to promote and strengthen networking with other regions and foreign markets for the sale of waste. Especially reconverted chemical industry waste into sustainable raw material or fuel.

The production of waste streams from different sectors and their conversion into every

day products such as food, feed, energy and chemicals is growing fast in some regions and expected to take off in others. This transition towards a more circular economy provides a lot of opportunities for new markets and high-value products not only at regional level, but at global scale, linking very diverse sectors at the same time. Companies need support to access these new markets and to build stable and competitive business over time.

In this regard, your region should conduct a market analysis for the new products coming from the chemical sustainable industry you want to promote, both at regional level and national/international level. This should to be done prior to any other step in the development of the sector to ensure the long term stability of the sector.

A strong regional chemical industry contributes to a competitive region/country - externally as well as internally -. It is a sector which is strongly linked with virtually all other industrial sectors as raw material provider, and now also as waste user. With the potential large range of chemical products and innovative solutions applicable for the use of waste as alternative raw material, the regional chemical industry would contribute to the well-being of the regional economy. In this sense, the regional chemical industry seems to be a relevant sector at regional level. New markets should be explored both at national and international level.

On the other hand, the region should design an appealing strategy for attracting new investments for using the potential waste feedstock, which represents an alternative for the sustainable chemical industry. The region should disseminate information about the benefits of the use of waste as alternative feedstock. It is important to assure the correct context to attract the establishment of new business, taking into consideration key factors such as infrastructure, workforce and transport availability, as well as economical, financial, technological, political and knowledge long-term stability.

Additionally, and no less important, is the status of the industrial network of the region to facilitate the uptake of the new sustainable industry in the region. For your case, it appears, your region is a potential sustainable chemical region where new business can be launched. It is desirable to set a regional strategy to reconvert the industrial parks, becoming old, to new businesses.

## KF7– ENTREPRENEURSHIP

Business demography statistics explain the characteristics and demography of the business population and can be used to analyse the dynamics and innovation of different markets[3], for example entrepreneurship in terms of the predisposition to start a new business.

Entrepreneurs play a key role in the innovation process, economic growth and employment creation. The use of waste as alternative raw materials in the chemical industry entails a significant innovation capacity due to the need for adoption of new

business models and the transformation of the existing ones. In this sense, the expenditure on R+D+I is a widely used indicator that reflects the extent of research and innovation undertaken in a country in terms of resources input. The most innovative regions are those with more ability to attract higher risk investments. It is highly recommended to keep track of these kinds of indicators.

Networking and cross-value chain and cross-sector cooperation are also requirements and key enabling factors for the effective implementation of the mechanisms needed for the widespread use of waste as alternative raw materials in the transition to a circular chemical industry. Match-making events and other networking actions support the reinforcement of the much needed cooperative business environment. This is a point with potential a room for improvement in your region and any action aimed at supporting the creation of an open business network will have significant benefits in the mid-long term.

Also, clusters serve as driving force in most regional economies, joining forces towards supporting the dynamics of market and improving knowledge exchange among firms and other stakeholders. And also with international value chain networks, acting as local nodes in global networks. In the end, strong clusters also help attract foreign investments if they are leading centers, and they will attract key players, not only from the region-nation, but also from abroad.

However, no cluster has been established yet in your region. This situation may point out the need to strengthen cluster policies. These can have an intermediation/facilitation role to link regional and local actors to support clustering, re-orientation of policies, and support clusters through dedicated projects or addressing framework conditions which are important to the prioritised clusters. Therefore, the overall purpose of cluster policies is generally to strengthen a particular regional economy, and thus the national economy. However, the purpose of the different policy instruments will vary depending on the type of cluster and regional needs[4]

Furthermore the integration in international clusters targeting the different concepts behind the transition to a more circular economy in the chemical industry (such as the use of waste as alternative raw material) is a good opportunity. It can be used to complement strengths, reinforce European collaboration and innovation to create competitive products, services and markets for sustainable chemicals.

From an overall perspective, there are regions in which the entrepreneurial environment, usually fostered by other framework conditions or supporting actions, is more prone to adopt early innovations than other regions and take the lead. In this case, for the transition to new ways of manufacturing.

Your region is probably not within the leading regions in sustainable chemicals production, and the companies in the region do not seem to be among the ´technology early adopters´. This means that more support (at several levels such as educational, infrastructures, financial, policy, etc.) is needed to create a favourable entrepreneurial environment for the activation of investments in this field. As a result of this entrepreneurial environment, no/few new projects are starting in the region.

On the other hand, the presence of a green chemistry park in your region, where

companies would share facilities and waste in the field of sustainable chemicals production, would be an additional benefit for companies willing to start a business in the field of sustainable chemistry. If this park also integrates common facilities for research and experimentation and support in finance and business development, it would for sure be an accelerator and a real pole for attracting new business and investments.

## KF8- PUBLIC SUPPORT POLICIES

Policymakers have a responsibility to lead and ease the transition to the use of waste as alternative raw materials towards a more circular economy. A long term, stable, consistent and cross-departmental political strategy needs to be developed together with all stakeholders. Policy areas such as energy, environment, education and research, waste and raw materials, among others, are required to join forces. This is a key enabling factor that would be interesting for your region to develop and support, and periodically update and upgrade.

On the other hand, the use of waste as alternative raw material in the chemical industry entails a significant effort on R+D+I, as technologies and processes needed do not have the same maturity as the traditional ones. Therefore, well-structured, stable and long term plans to support this transition are of major importance. The creation in your region of a master Plan or Strategy tackling the R+D+I needs for this transition would be undoubtedly an enabling factor which deserves all possible support along the process.

Public incentives for innovation are the seed for stimulating and encouraging the private sector to launch new sectors or businesses.

In this sense, it would be worthwhile for the region to use public incentives to stimulate business innovation in the regional sector.

Some regulations, such as Waste Regulation, are commonly seen as a barrier among the stakeholders involved. Preventing, for example, small-scale experiments using waste materials and hampering transport, among others things. In general, waste is not perceived as potential raw material and that is translated into regulations. The role of regional government, depending on the country, can be supporting or that of an enabler, or it can also be even more restrictive than the European or national regulations. It would be beneficial for your region to move from a neutral role to a facilitator role, creating leeway for experimentation with new value chains, subduing the obstacles that companies usually found in all matters relating waste management or recovery as raw material. This way, your region could have a great impact upon the success of the transition.

In addition, as your region has somewhat experienced, social acceptance can emerge as powerful barrier to waste-based products development. This can result, for instance, in the failure of market penetration for products using alternative raw materials or in the halt of projects. Therefore, it is important to highlight and take into account the social

acceptance of this kind of market development, as it can only be sustainable when products and processes are broadly accepted.

The European Commission has approved plans to adopt a set of Regulations, aimed at facilitating the reintroduction of certain 'waste' products into the production cycles, in accordance with the Waste Framework Directive and its end-of-waste criteria. When certain waste meets these criteria, it is no longer considered waste, and therefore can create new business opportunities and markets. This, together with the by-product definition is a key tool in the waste-as-resource management towards a more circular economy. The mechanism is established by law and also states the requirements that the recovered materials and their producers must meet to ensure a high level of environmental protection and human health. It is important that this regulation and its mechanisms are implemented at national level, mobilising investments and markets in the field of the use of waste as alternative raw material.

Fiscal and financial incentives to promote circular economy in general, and therefore circular chemical value chains using waste as raw material in particular, constitute other means of support .Work is already being done in this sense at European level, exploring the use of market-based instruments to stimulate circular economy in the *Roadmap* to a *Resource-efficient Europe*. This could help or motivate to start developing an action in this field. Nevertheless, an in depth assessment of the potential impacts on the different actors of the value chain is advisable. This way, the government can have a clear view of the most effective and appropriate measures to be taken, according to its particular features. Some examples include[5]:

- lower VAT rate on circular economy services
- taxing extracted value instead of added value (a shift from taxing income to taxing materials)
- actively using financial resources from guarantee and disposal funds to further encourage business activity
- actively using financial resources from existing fiscal subsidy instruments promoting environmentally benign investments (MIA or VAMIL) for a broader series of investments or activities that would help increase circularity

Regulation and bureaucracy related to the establishment of industrial installations in the region should not be a barrier to the set up of new waste as raw material business models. In this sense, any further step to facilitate the process of setting them up will be positive for the regional economy. Your region seems to be aware of this very important issue, keeping licensing procedures limited to a reasonable period of time.

[1] A list of intermediaries can be found in the following links:
- For the EIB: http://www.eib.org/products/lending/intermediated/list/index.htm
- For the EIF: http://www.eif.org/what_we_do/where/index.htm

[2] http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=ENERG_ICE_Road_Map.pdf

[3] Eurostat.

[4] OECD Innovation Policy Platform. Cluster Policies.

[5] Opportunities for a circular economy in the Netherlands document

# Conclusions & Recommendations BIOMASS

**Region:** *Covasna, Romania*

# KF1- LONG TERM, STABILITY AND AVAILABILITY OF FEEDSTOCK

The necessity to fulfill the acquired environmental commitments has led to an urgent need to assess sustainable paths to produce biofuels and bio-products minimising the environmental impact related to the land use and land occupation, deforestation, soil impoverishment, eutrophication, ground water or soil contamination, among others, which cause a decrease in the soils production capacity.

The use of biomass obtained from the forest or agriculture landlands or the use of agroindustry/agroforestry sector or other industries in which biomass waste is produced has several advantages if sustainability criteria are considered in the process.

For this matter, international standards included in the EU Renewable Energy Directive (The European Parliament and the Council of the European Union, 2009) and global sustainability certification systems regarding biofuels have been developed.

Certain biomass streams like forestry or agricultural residues, ignored or underutilised in many cases, can potentially be converted into valuable resources to replace the fossil ones traditionally used in the chemical industry and produce higher added value raw materials (biocommodities). The recovery and use of these endogenous biomass streams may imply great positive impacts towards a more circular and sustainable economy.

In the first instance, a region looking to increase bio-based alternatives will need to consider if there are enought resources to supply them. So as a first approach it is important to determine the area occupied by forest or agriculture land and the corresponding raw material (biomass resources) that could be obtained in each location (generally determined by resources to surfaces ratios). According to each type of biomass feedstock's characteristics, the theoretical potential might differ greatly so that it is necessary to distinguish between the main different biomass resources types.

In this regard,

On the other hand, even though the region accounts for a significant rate of agricultural land, the total area producing agriculture biomass might not be enough to implement new sustainable chemical sector initiatives based on this raw materials. Further studies should be carried out to determine the region's capabilities.

One of the main advantages of the biorefineries or bio-based initiatives is the wide range of feedstocks that could be used in their processes. Nevertheless, other sectors or facilities which currently use them must be assessed to confirm that there is sufficient raw material for other purposes that could be actually allocated to the sustainable chemistry sector.

It is quite important to determine the actual amount of biomass resources that a new initiative could take advantage of. For this reason, it is necessary to analyse if specific biomass availability assessments have been already carried out in the region and the results obtained (availability of resources).

In this sense, the potential biomass that is not being used has been assessed in the region and the required information (amount and characteristics) to other likely consumers (i.e., chemical and biorefinery sector) is available. This information helps to determine the available feedstock that could be used, although this feedstock is limited in the region and the raw material demand should be assessed in detail to ensure that it is sufficient.

On the other hand, biomass in the region is quite scattered which implies a challenge to implement the feedstock's supply chain and need for further studies to assess the feasibility of this use. However, at the moment there are no other local consumers that would compete over the raw material.

Besides assessing the amount of resources that are or might be available it is important to determine if the region already knows the format in which those biomass feedstocks are or could be supplied. Available formats may imply different procurement chains that should be taken into account by new bio-based initiatives.

In addition, the region accounts with information regarding the format in which biomass is currently supplied that will allow determining if :

- resources would be available in the most suitable format (chips, shredded material, sawdust or bales) for sustainable chemistry initiatives
- any pre-treatments (logs, branches) or additional steps in the supply chain would be necessary (branches or loose straw)
- competence could be expected (pellets and briquettes most likely used within the domestic market, for example)

Concerning competition over the available biomass resourcesthe region is using the biomass for energy purposes but there is still an important potential that remain unexploited. New initiatives could to take advantage of it.

Biorefineries or bio-based initiatives installations offer several advantages compared to other biomass resources and other fossil fuels based plants but might involve long term processes to finally succeed. These processes can be reduced if already existing initiatives are close to applying these concepts or are already using biomass feedstocks.

Finally, it is worth noting that the biorefinery sector has to be developed in the region starting from zero. Two important issues should match in this case: the availability of biomass resources as well as interest and capacity to develop new projects.

Finally, the aquaculture industry currently is currently not developed in the region. Therefore, in first instance preliminary studies should be carried out to assess the potential and the interest of the region to produce algae or microalgae.

# KF2- INFRASTRUCTURE TO HANDLE FEEDSTOCKS AND PRODUCTION

The biomass logistics chain faces different challenges that need to be overcome to optimise the supply chain. They include accessibility limitations, low bulk densities and significant volumes, geographical dispersion, low productivity per hectare, etc.

In addition, biomass usually needs to undergo some kind of pre-treatment before its final use for energy purposes or for the production of chemicals. This is, due to its grading, heterogeneity, high moisture content, low density, constraints related to the handling and transport, presence of exogenous mater (stones, dust, metals, etc.). The supply chain involves several steps: collection, pre-treatment (when required), transport, distribution and storage. All of which need to be optimised to increase the environmental and economic feasibility of the supply chain.

Biomass consumers, including the industrial sector, ceramic sector, greenhouses, boilers, power plants, co-firing plants, might have different requirements regarding the raw material according to the conversion pathway used. Any biomass feedstocks consumer will demand a supply guarantee which is an important challenge to be addressed and maintained during a project´s life.

Biomass resources will have to be transported from the site in which they will be produced (even imported) to the new bio-based installation. Local transport infrastructures (roads, rails or ports) will have to be used, the better their condition the lower the transport costs inferred.

In this regard, the region already has the main transport infrastructure for the logistics of biomass raw materials in place. Transport of feedstocks should not endanger these types of projects.new investment in transport infrastructure roads/railways might be needed.

Biomass feedstocks supply for new bio-based initiatives can be easily satisfied if any biomass logistics centre is already set up in the region or close to it. Since biomass logistics centres can be crucial for these types of initiatives, it is also important to evaluate if there are any options to set them up in case they do not exist yet.

In this regard, the region may take advantage of already existing biomass suppliers, which could deliver biomass products to new bio-based industries or new biorefinery concepts though transport costs should be deeply assessed to evaluate costs risks.

Moreover, the region might take advantage of the biomass logistics infrastructure existing in the region to efficiently manage the feedstocks that the new projects for the chemical sector would require.

In addition, it should be assessed if the existing forestry: sawmill and waste logistic center could be adapted to manage different biomass feedstocks than the ones they already handle.

In any case, the possibility of setting up additional biomass logistics centres in the region

should be explored: the closer to the chemical industries, the better.

Biomass transport cost is one of the main drivers of the overall biomass supply cost so optimised chains should be implemented to achieve techno-economically feasible solutions. The existence of transport companies already delivering these types of feedstocks might reduce investment costs related to transport equipment for these types of initiatives.

In addition, the region may take advantage of already existing biomass transport companies. These could deliver biomass products to new bio-based industries or new biorefinery concepts without involving excessive investment costs in this infrastructure.

New bio-based initiatives can take advantage of the storage sites or warehouse of already existing projects, which could be used as new logistics centres.

It is worth noting that there already is an infrastructure in the region to implement the final use of biomass applying biorefinery concepts. It could be a starting point for the sustainable chemistry sector development in the region by, for example, increasing their storage capacity to satisfy new logistics demands.

Finally, biomass logistics centres or the places in which biomass resources will be loaded, unloaded and delivered will require basic supplies to guarantee working conditions.

In this regard, basic supplies are very important for the correct and successful establishment of a biorefinery. A high quality supply of electricity should be ensured in the region.

## KF3- ACCESS TO FINANCE

An appropriate access to finance is essential to transition towards sustainable chemicals production. The adaptation and refurbishment of the existing production sites to use alternative feedstocks – such as biomass or waste – require the installation of new equipment and the modification of the existing processes. Moreover, the development of concepts such as industrial symbiosis often implies investments in new infrastructure – like new pipelines – for the exchange of streams between different sites. In many cases, this means costly investments for the promoters that cannot be covered with their own funds. Particularly when building up a new production site based on non-fossil feedstock, such as a biorefinery.

Both public and private funding can be used to finance these types of projects. In this regard, financing in your region is available but under very undesirable conditions; several issues need to be tackled to improve access to finance in your region.

Public funding can be attained from multiple sources. Local, regional, national or European bodies usually have direct or intermediate financing mechanisms that could be used to foster the sustainable production of chemicals with biomass feedstocks in different ways.

The region is in a good position for providing direct or intermediate financing for the development of a sustainable chemical industry. If a multiplicative effect of the resource is sought potential synergies should be explored: with the financing lines set up by the national Government and/or the European Institutions in the region or neighboring regions and with the private finance sector. or the European Institutions in the region or neighboring regions and with the private finance sector.

Public finance should not be the main or only source of funding for developing the region´s sustainable chemical industry. The objective is to complement and encourage private funding from companies and the financial sector.

The banking sector in the region is strong and the necessary credit for building up projects in the field of sustainable chemicals is available in the region.

Moreover, it seems that foreign investment is somewhat in the region. Actions should be carried out to attract these types of investors to the sustainable chemicals field by organising investment forums, multilateral meetings andawareness campaigns, etc.

Additionally, the region should ensure that the necessary framework conditions are set up to make financing available in the sustainable chemicals field using biomass resources.

In this regard, the region already has a collaboration network involving most of the stakeholders in the region; but further steps could be taken to make sure that this network is used for supporting the region in the development of the strategy towards sustainable chemicals production.

Apart from the lending provided by the traditional banking sector, other alternative instruments and financial actors are important to make available the necessary financing available for the development of a sustainable chemical industry in the region.

Fortunately, the region is well aware of this and these kinds of instruments are available and are being used to finance projects and initiatives in the sustainable chemicals area

Finally, it is worth noting that, there are subsidies in the region attributed to the use of biomass for energy and/or transport purposes. This may represent a threat to sustainable chemicals production (it's a better business case for the production of energy or fuels using biomass than for the production of chemicals). Conversely, it may represent an opportunity to sustainable chemicals production (as procurement activities could take advantage of the subsidies and because there are similarities in the technology pathways and value chains).

# KF4- SKILLED WORKFORCE, TECHNICAL EXPERTISE, TRAINING

The transition to the effective use of alternative raw materials towards developing the biorefinery concept requires a rearrangement not only of value chains but also of society culture, knowledge and skills.

As a first step, the successful implementation of new bio-based initiatives or biorefinery concepts in a region will require a skilled workforce able to carry out both the activities related to the procurement of the biomass resources and those related to the management, operation and maintenance of new installations. As a second step, training activities and courses need to be developed and implemented to minimise gaps between society knowledge and new installations and their development needs.

It is worth noting that it seems that the region does not have the skilled workforce required for the implementation of a biomass supply chain and its final use or conversion, so either technical training should be introduced in the region or the region should look to other regions and attract these types of professionals.

In addition to the in-depth and specific technical knowledge needed, the introduction of new concepts underpinning biorefinery concepts must be integrated into education curricula from vocational training to higher education. These concepts range from the general green awareness to the "system thinking" principles and the development of skills for multidisciplinary teamwork.

In this sense, the existing specialisation post-graduate/master degrees in the field of biomass use for chemical applications in the region must play an important role. They should be increasing knowledge and awareness, pointing the way towards a sustainable chemical industry by building a strong and updated background knowledge and human capital. However, a deeper integration not only into the specialisation degrees, but also into the university curricula as a whole would bring better results.

The existence of education and training offers in the field of biomass use for chemical applications is evidence of the flexible adaptation to the economic trends, productive systems and future skills needs. Moreover, the presence of people involved in R&D activities in the region may boost the transition to bio-based activities and new biorefineries concepts by shortening response time to solve technology gaps or by implementing training needs.

In this regard,

On the other hand, Skilled workforce in biomass R&D concepts will contribute to developing technology and products and increasing the knowledge regarding biorefineries and bio-based industries. The region should assess the existence and availability of professionals engaged in R&D biomass projects who could contribute to the technology, knowledge and products development for biorefineries and bio-based initiatives.

There are also other desirable supporting bodies or structures in the education field such as the so-called Centres of Excelence (CoE). These centres provide leadership, research, support and training that play a strategic role in the development of sustainable chemistry concepts.

The set-up of such a centre in the region would be an important enabler for the transition to more sustainable value chains in the chemical industry. On the other hand, to build up this education that is flexible and adapted to the current and future trends, it is also noteworthy that in the region different stakeholders across the value chain, including industry, take part in the design of curricula and bring together practical and different points of view

Finally, combustion, pellet manufacture and cogeneration/electricity generation technology readiness seems to be adequate to promote the use of biomass in the sustainable chemistry industry.

## KF5- EXISTENCE OF SUPPORT INSTITUTIONS

Supporting institutions such as knowledge and know-how transferring bodies, technical support and assistance institutions, as well as, research and development organisations are crucial for a new business or sector development.

Supporting institutions can exist in some or all the links of the complete bio-based or biorefineries chain (R&D activities, financing issues, business tasks, etc.). Regarding R&D development activities, the region has already focused its present and future development on bio-based and biorefinery concepts. It has also set up the R&D grounds that could help new initiatives based on biomass resources to finally be established if other required links of the chain exist.

With the purpose of launching new business activities in the field of sustainable chemistry based on biomass, it would be ideal to have a research and innovation strategy for smart specialisation (RIS3). Specifically on KETs, focused on developing more sustainable processes and industries in the chemical sector.

With respect to specific financing issues, the region should evaluate the possibility to create an institute or body supporting business since it would offer valuable support to promote circular economy/bio economy/sustainable business.

And finally, concerning business plans, risks assessments, etc., the development of a public integral service that supports new sustainable projects investments in the region should be considered.

Biomass resources have different quality characteristics. Producers and consumers need to agree on these characteristics to solve the problems that might appear within the biomass supply chain. Standards and certificates help to guarantee success in new bio-based or biorefineries activities.

In this regard, the existence of a certification and/or standardisation body to support bio-based business is a good starting point. Technical assistance for certification and standardisation is a must in business development and internationalisation. It is an instrument of differentiation that makes both new and existing companies and launching new products more competitive.

In terms of the impact of initial investments in start-ups on the local community, other experiences have shown that they can have a big effect on attracting additional investment to a community, even for different firms than the ones promoted. This could bring additional indirect benefits to the wider regional economy.

As new bio-based or biorefineries initiatives will need to take advantage of currently unused biomass resources, having a specific service in the region which might support the connection between biomass resources production and new installations demands will significantly help these activities to succeed.

The region already has this type of support so that one of the main drawbacks of new bio-based plants can be more easily overcome.

## KF6- STRENGTH AND AVAILABILITY OF REGIONAL MARKETS

The overall shares of renewable energies need to increase to fulfill the raising energy demands and still meet the commitments established. Besides energy generation, biomass can be used in other industrial applications such as raw material for the chemical industry or for liquid fuels and other biocommodities production increasing greenhouse gas emissions savings and the energy security. Biomass use still has a large improvement potential to be developed since biomass markets are not as developed as others. Successful biomass markets display an integrated and sustainable supply chain, from the source to the end-users. If they already exist, taking advantage or additional biomass resources has fewer difficulties than if they have to be created from the ground up.

Biomass markets development in the region has to be assessed in order to efficiently promote the integration of the supply chains and to develop best practice tools. For this aim, data regarding the sector activity in the region should be compiled including number and type of business. This data should include:

- volumes of biomass produced, used and exported/imported
- consumption flows and current business models based on the feedstocks
- actors along the entire supply chain

In this particular case, it seems that the biomass market is not fully developed in the region so the introduction of the biorefineries' activities will need development to improve cost-effective operation along the whole supply chain and for final use

applications.

Furthermore, the security of the raw material supply seems to be ensured in the region when the wide cast of suppliers is considered. Establishing purchase agreements with stakeholders to secure biomass supply chain over the long term would contribute to successful practices and experiences and would help successfully develop new bio-based initiatives.

On the other hand, the region has actors along the sustainable chemicals production value chain that could be interested in investing in the biomass market and can cover the whole value chain.

In order to definitively set up new biorefineries or new bio-based initiatives based on biomass resources, it is also extremely important to assess the market conditions for the new biocommodities or for the new products to be developed. If there already is some knowledge in the region regarding these markets, new initiatives may take advantage of this information and may reduce the time to definitively set up.

In this case, There seems to be some information regarding the potential markets that could provide a starting point for different stakeholders involved in the supply chain or in the set up of new installations.

The main market sector for the chemical industry in the region seem to be food and nutraceutical products, agricultural products, pharmaceutical and cosmetic products and polymers, fibres and composite materials. As a first step, the demand for biomaterials in these sectors should be assessed in order to determine if the biomass resources in the region might satisfy the production requirements.

The European Commission's single market for green products initiative proposes a set of actions to overcome the different problems that slow down the final implementation of these products in the market. These actions are:

- establishing two methods to measure environmental performance throughout the lifecycle (the product environmental footprint (PEF) and the organisation environmental footprint (OEF)) and recommending the use of these methods to EU countries, companies, private organisations and the financial community through a Commission Recommendation
- developing product- and sector-specific rules through a multi-stakeholder process
- providing principles for communicating environmental performance, such as transparency, reliability, completeness, comparability and clarity
- supporting international efforts towards more coordination in methodological development and data availability.

In recent years, there have been significant developments in the field of industrial green purchasing and supply. New bio-based or biorefinery initiatives in the region should consider these actions and other green products promotion initiatives to guarantee success.

In this particular case, policies regarding bio refineries should be implemented in the region as an enforcement measure.

Moreover, it is worth noting that the chemical sector is poorly developed in the region. Therefore, the promotion of sustainable chemical initiatives will firstly work on setting up an adequate framework in the region and on identifying if any possibility to set up sustainable chemical initiatives might even exist.

## KF7- ENTREPRENEURSHIP

The transition to more sustainable value chains in the chemical industry entails a significant innovation capacity due to the need for the adoption of new business models and the transformation of the existing ones. In this sense, the expenditure on R+D+I is a widely used indicator that reflects the extent of research and innovation undertaken in a country in terms of resources input.

On the other hand, there is a lack of information regarding the public and/or private expenditure on R+D+I, this should be addressed in the region due to the important role that research plays in a developing technology such as biorefineries.

The birth rate of starting firms in the region is below the average and less than 60% of them survive the first 5 years, which might be the demonstration of other structural problems that might be a barrier and need further assessment.

Networking and cross-value chain and cross-sector cooperation is also a requirement and a key enabling factor for the transition to sustainable chemical industry. Matchmaking events and other networking actions support the reinforcement of the much needed cooperative business environment.

In this sense, this is a point with room for improvement in the region and any action aimed at supporting the creation of an open business networking will have significant benefits in the mid-long term.

Also, clusters contribute to support dynamics of market and knowledge exchange among firms and other stakeholders in the region and in international value chain networks, acting as local nodes in global networks.

In this regard, the presence of chemical, polymer, farming and animal husbandry, agri-food and bioeconomy clusters is a reflection of the level of networking in your region. Actions aimed to reinforce their activities and the creation of other clusters, or even more so the reinforcement of inter-cluster relations, will be positive for the creation of an environment prone to innovation and cooperation towards a circular chemical industry.

# KF8- PUBLIC SUPPORT POLICIES

The transition to more circular value chains in the chemical industry by using biomass resources in new or existing processes entails a significant effort on R+D+I. Therefore, well-structured, stable and long term plans to support this transition are of major importance.

The creation of a master plan or strategy in the region tackling the R+D+I needs for this transition would undoubtedly be an enabling factor. It deserves all possible support along the process.

Furthermore, public incentives are somehow the seed for stimulating and encouraging the private sector in launching new sectors or businesses.

In this sense, the region should explore the public incentives to stimulate the bioeconomy sector in the region, such as grants, tax exemptions, etc..

In the same way, fiscal and financial incentives to promote the bioeconomy in general and therefore sustainable chemical value chains based on biomass in particular, constitute other means of support . Work is already being done in this sense at European level, exploring the use of market-based instruments to stimulate circular economy in the *Roadmap to a Resource-efficient Europe*.

This could help or motivate to start developing an action in this field. Nevertheless, an in depth assessment on the potential impacts on the different actors of the value chain is advisable. This way, the government can have a clear view of the most effective and appropriate measures to be taken, according to its particular features. Some examples include[3]

- lower VAT rate on circular economy services
- taxing extracted value instead of added value (a shift from taxing income to taxing materials)
- actively using financial resources from guarantee and disposal funds to further encourage business activity
- actively using financial resources from existing fiscal subsidy instruments promoting environmentally benign investments (MIA or VAMIL) for a broader series of investments or activities that would help increase circularity

Policymakers have a responsibility to lead and ease the transition to a circular economy. A long term, stable, consistent and cross-departmental political strategy needs to be developed together with all stakeholders. Policy areas such as energy, environment, education and research, waste and raw materials, among others, are required to join forces.

This is a key enabling factor that the region should develop and support, and periodically update and upgrade.

The different governmental bodies have the capacity to design, implement, and enforce regulation. This multi-level regulatory framework can be challenging, giving rise to economic stagnation or recession, decreased productivity and less competitiveness, which has to be avoided. Among others, the challenges include avoiding duplicated or overlapping rules, low quality regulation, and uneven enforcement.

Finally, regulation related to the establishment of enterprises in the region should be also taken into account. In this sense, any further step to facilitate the process of setting them up is positive for the region's economy. The region does not have the competence on licensing new bio-based or biorefineries so it should work with the entities that have such a competence to help set-up these initiatives in the region.

Government/regional support schemes for renewable energies can be applied to bioenergy in most instances. Direct government grants and subsidies for biomass production and use could encourage further uptake of sustainable chemistry projects/biorefineries.

Biorefineries and sustainable chemistry projects promoters should be aware of current policies and closely follow any national policy development that might be established in the region or at national level.

The region should promote contact with other regions that have extensive knowledge and experience regarding bio-based applications. The region should also participate in specific forums related to chemical production sustainability to build an appropriate framework for the sustainable chemistry initiatives to progress in the region.

Policies should be developed in the region in terms of investment in research and innovation and skills, market development and enhanced competitiveness and also engagement with stakeholders to promote bio-based initiatives like biorefineries.

The region has specific regulations regarding the promotion of energy crops in marginal lands/energy crops in arable lands. These regulations will contribute to increasing biomass feedstock production in the region that could be used in biorefineries or sustainable chemical sector.

[1] A list of intermediaries can be found in the following links:

- For the EIB: http://www.eib.org/products/lending/intermediated/list/index.htm
- For the EIF: http://www.eif.org/what_we_do/where/index.htm

[2] See the green chemistry campus website.
[3] Opportunities for a circular economy in the Netherlands. document.

# Conclusions & Recommendations WASTE

**Region:** *Covasna, Romania*

# KF1- LONG TERM, STABILITY AND AVAILABILITY OF FEEDSTOCK

Certain waste streams, significantly ignored or underutilised, can potentially be converted into valuable resources to replace the fossil ones traditionally used in the chemical industry and produce higher added value than existing uses. The recovery and use of some endogenous waste streams help the move towards a more circular and sustainable economy.

Your region seems to have significant potential which is worth exploring, if it has not been explored yet, in terms of waste from:

- The agri-food sector.

Waste stream(s) that may have a lot of potential in your region and need more in depth analysis could come from:

- The pulp & paper industry.

Although might not seem to be important in your region, due to its absolute weight and the disaggregation of companies in your region, it might be interesting to explore the opportunities that this/these waste stream(s) could offer a smaller scale.

These waste streams can be converted by different processing methods into chemical building blocks, syngas, fertilisers, and polymers, among others. The processes and the products will be very much dependent on their specific characteristics and on the regional market features.

Aside from waste coming from industrial or farming activities, the treatment of citizen waste streams has potential that could be explored. Sewage sludge is one of the most common wastes. It is produced in large volumes and is, surprisingly, one of the least known.

In adition, the seemingly centralised production in medium-large plants could facilitate the sludge management.

Due to the features of the seemingly low population density, it does not seem to be a potentially usable waste stream on a large scale due to possibly higher logistical costs that its management would represent. However, the presence of (a) high/medium capacity wastewater treatment plant(s) could open the door to more in depht feasibility assessment.

On the other hand, the organic fraction from MSW can also be a potential alternative raw material, for example, for the production of a fertilisers, biogas or syngas major platform for the further production of chemicals and building blocks.

In addition, plastic fractions recovered or source separated not only from packaging but also from other important sectors, would provide a potential option for producing raw materials for new plastic manufacturing out of cascade recycling. This leads to lower value materials, or serves as an alternative source for other chemical products production, for example for syngas production.

Regardless of the waste streams that can potentially be an opportunity in your region, the first step for an optimal management and use of waste towards a circular economy is good quality information gathering, availability and accessibility. There seems to be some interesting room for improvement in your region regarding waste data gathering and accessibility. In addition, an assessment of the potential waste streams that could be used as alternative raw material would highlight the opportunities for new business models in the region.

## KF2- INFRASTRUCTURE TO HANDLE FEEDSTOCKS AND PRODUCTION

Infrastructure is a key factor for the development and success of the bioeconomy. In addition, it is important to reduce the environmental impacts and to avoid logistical problems, as well as production problems. It is a decisive aspect that companies and investors take into account when deciding to set up and launch new businesses and investments.

Apparently, your region has a great logistics potential, but it would be advisable to set up a waste logistics centre. Otherwise, it should be ensured a correct and optimised connection among generation, treatment and demand points. The support of a logistics research centre, coordinated with the regional government and the waste management system might be of interest, keeping all stakeholders well aware and informed at the same time.

As the transport network is fundamental for the correct functioning of the industry, in terms of supplies and manufactured products delivery, it would be desirable to have at the region's disposal a spread out network of a freight train railway nertwork in order to cover the main demand points of waste feedstock

The efficient provision of infrastructure services is one of the most important aspects of development policies in general, and industry in particular. The suitable availability of infrastructure and the efficient establishment of related services to the industry, contribute to the development of competitive advantages in a country or region and help to achieve a greater degree of productive specialisation. In this sense: our region is apparently well supplied in terms of water. You should consider having a monitoring mechanism in case you are not covering the whole territory of the region to ensure there is always a 100% supply. it appears your region is well supplied in terms of fuel. You should consider having a monitoring mechanism in case you are not covering the whole territory of the region to ensure there is always a 100% supply.

For the correct and successful establishment of a sustainable chemical industry, basic supplies are very important. You should consider ensuring a high quality supply of electricity in your region

## KF3- ACCESS TO FINANCE

An appropriate access to finance is of paramount importance if a transition towards a sustainable chemicals production by means of alternative raw materials is desired. The adaptation of the existing production sites for use of alternative feedstocks – such as biomass or waste – requires the installation of new equipment and the modification of the existing processes. Moreover, the realisation of concepts such as industrial symbiosis very often implies investments in new infrastructure – like new pipelines – for the exchange of streams between different sites. In many cases, this means costly investments for the promoters that cannot be covered with their own funds, particularly when building up a new production site based on non-fossil feedstock (like biorefineries).

Both public and private funding can be used to finance these types of projects. In this regard, financing in your region is available but is apparently not accessible enough; several issues might need to be tackled to improve access to finance in your region.

Public funding can be attained from multiple sources: local, regional, national or European bodies usually have direct or intermediate financing mechanisms that could be used to foster the sustainable production of chemicals in different ways.

Your region seems to be a very good position to provide direct or intermediate financing for the development of a sustainable chemical industry. If you wish to multiply the effect of your resources, you could explore potential synergieswith the financing lines set up by the national government and the European Institutions in your region or neighboring regions and with the private finance sector.

It is not advisable that public finance is the main source of funding for developing the region's sustainable chemical industry. The objective is to complement and encourage private funding from companies and the financial sector.

Traditional lending instruments, such as loans and credits, provided by the banking sector in your region seems to be somehow limited and the private sector, particularly SMEs, may not access them easily enough. if not yet initiated, it may be interesting to explore the possibility of using regional public resources – in combination with national or European ones if possible – to create intermediate credit lines through the banks established in your region, thus getting credit to flow again.

Apart from the lending provided by the traditional banking sector, equity funding - through the sale of shares of new business, and financial actors are important to make the necessary financing for the development of a sustainable chemical industry available in your region. Although these instruments exist and are active in your region, they are

currently not funding projects/initiatives in the field of sustainable chemicals. Maybe you might find it useful to consider meeting with the managers of the institutions that provide this type of funding, such as venture capital or business angel organisations.

Finally, it is also recommended to ensure that the necessary framework conditions to make financing available are set up in the sustainable chemicals field. In this regard, you already have a collaboration network involving most of the stakeholders in your region. Thus, it could be easier to use this network to support you in the development of your strategy towards sustainable chemicals production.

## KF4- SKILLED WORKFORCE, TECHNICAL EXPERTISE, TRAINING

The percentage of population with secondary and tertiary education is considered as a good measure of workforce quality, because a more skilled workforce is supposed to be more likely to be able to perform high value-added roles in this transition. Also, the employment structure given specifically by the percentage of the population employed in the industrial sector shows an existing base for the future application of waste-to-raw material concepts. A regional economy based on service sector or primary sector, is considered in principle to have less potential than a region with a strong industrial sector. Last but not least, R+D+I expenditure and its attached professionals are strongly linked and have a direct impact on the innovation performance required in this field.

The transition to the effective use of waste as alternative raw materials towards a more circular economy in the chemical industry requires a rearrangement, not only of value chains, but also of society, culture and knowledge. Therefore, raising and spreading knowledge is a major issue that requires innovative aptitude and attitude, skills and expertise for transition and a multidisciplinary and comprehensive education

In addition to the in the depth and specific technical knowledge needed, the introduction of new concepts underpinning the use of alternative raw materials in the circular economy must be integrated into education curricula from vocational training to higher education. These concepts range from the general green awareness to the “system thinking” principles and the development of skills for multidisciplinary teamwork.

In your region, high-level and vocational education in the field of sustainable chemistry seem to have interesting and fruitful room for upgrading. A well-structured and mature education and training offer would play a key enabling role. It would be increasing knowledge and awareness, pointing the way to a more circular economy in the chemical industry by building a strong and updated background knowledge and human capital.

In addition, the existence of an education and training offer in the field of use of waste and sustainable chemistry towards a more circular economy is evidence of the flexible adaptation to the economic trends, productive systems and future skills needs.

The seemingly static training and educational system in your region may probably be an aspect to improve in the near future. This will help introduce and speed-up the awareness of the concepts underpinning the transition to the alternative use of alternative raw materials.It would be an important step towards upgrading the workforce to the current needs if the region organised targeted training sessions.

On the other hand, to build up this education that is flexible and adapted to the current and future trends, it is also noteworthy that in your region different stakeholders across the value chain, including industry, take part in the design of curricula and bring together practical and different points of view.

There are also other desirable supporting bodies or structures in the education field such as the so-called centres of excelence (CoE). These centres provide the leadership, research, support and training that play a strategic role in the development of sustainable chemistry concepts. The presence of such a centre in your region is an important enabler for the transition to more circular value chains in the chemical industry by using waste as feedstock.

However, it is usual that many companies in the sector lack adequate information and knowledge about their own products and raw materials. The transition to more circular value chains in the chemical industry by using alternative raw materials is not possible without these foundations. Improving this knowledge is first and foremost responsibility of the business sector, which cannot assess the vulnerability of their own value chains and so are unable to respond to risks and explore alternatives.

## KF5- EXISTENCE OF SUPPORT INSTITUTIONS

Supporting institutions such as knowledge and know-how transferring bodies, technical support and assistance institutions, as well as research and development organisations are crucial for a new business or sector development based on innovative technologies using waste as alternative feedstocks.

With the purpose of launching a new business, in the field of sustainable chemistry based on waste feedstock, it would be ideal to develop a research and innovation strategy for smart specialization (RIS3). Specifically, on KETs, focused on developing more sustainable processes and industries in the chemical sector

Waste management is a very critical issue that should be ensured and monitored regionally. In this sense your region seems to take the right actions by establishing monitoring procedures, but it should be ensured that they are properly accomplished.

In terms of the impact of initial investments in startups on the local community, other experiences show that they can have a big effect on attracting additional investment to a community, even for different firms than the promoted ones. This could bring additional indirect benefits to the wider regional economy.

Facilitating the market uptake of waste feedstock could be reinforced by the transferring of international commercial biotechnology experience, support for closer networking and creating awareness of the regional potential in waste as alternative resource. This could be done by disseminating valuable information regarding waste diversification, mainly but not only by means of a centralised body for improving market knowledge, transparency, analysis and advice to companies.

There are also some other mechanisms that can foster the inter-sectoral exchange of waste. Tools like a business-to-business waste exchange platform with materials- matching and recovery opportunities would facilitate the exchange of waste streams for making this concept a regular business practice.

New business should be supported by the region to promote and sell the products manufactured within the region in various markets. It is important to consider its inclusion in the regional strategy.

Finally, there are institutions in your region that offer advisory services for building up new projects, supporting the promoters in the development of their business plan, risk assessment or ensuring the necessary financial resources. These services are allegedly not available for building up industrial projects in the sustainable chemistry field, maybe due to the insufficient technical knowledge by the providers.

## KF6- STRENGTH AND AVAILABILITY OF REGIONAL MARKETS

According to *Energ-Ice Project*[2] *"The Chemical industry is placed upstream of various sectors such as construction, transport, food, health, personal cleanliness and home, clothing, electronics, etc..; this industry is also able to supply intermediate products for downstream industries and it contributes directly to create materials for the consumer market. Since chemical industry have a strategic position it is fully involved in the question of industrial sustainability outlined above"*.

The chemical industry in the region might be not present. However, if the region has a high potential in the delivery of waste as alternative raw materials, you should try to promote and strengthen networking with other regions and foreign markets for the sale of waste. Especially reconverted chemical industry waste into sustainable raw material or fuel.

The production of waste streams from different sectors and their conversion into every day products such as food, feed, energy and chemicals is growing fast in some regions and expected to take off in others. This transition towards a more circular economy provides a lot of opportunities for new markets and high-value products not only at regional level, but at global scale, linking very diverse sectors at the same time. Companies need support to access these new markets and to build stable and competitive

business over time.

In this regard, your region should conduct a market analysis for the new products coming from the chemical sustainable industry you want to promote, both at regional level and national/international level. This should to be done prior to any other step in the development of the sector to ensure the long term stability of the sector.

A strong regional chemical industry contributes to a competitive region/country - externally as well as internally -. It is a sector which is strongly linked with virtually all other industrial sectors as raw material provider, and now also as waste user. With the potential large range of chemical products and innovative solutions applicable for the use of waste as alternative raw material, the regional chemical industry would contribute to the well-being of the regional economy. In this sense, the regional chemical industry seems to be an important sector which needs to be reinforced and promoted continuously.

Plastic waste might be a potential alternative feedstock in your region. However, the region should design an appealing strategy for attracting new investments for using the surplus, which represents an alternative feedstock for the sustainable chemical industry.

On the other hand, the region should design an appealing strategy for attracting new investments for using the potential waste feedstock, which represents an alternative for the sustainable chemical industry. The region should disseminate information about the benefits of the use of waste as alternative feedstock. It is important to assure the correct context to attract the establishment of new business, taking into consideration key factors such as infrastructure, workforce and transport availability, as well as economical, financial, technological, political and knowledge long-term stability.

Additionally, and no less important, is the status of the industrial network of the region to facilitate the uptake of the new sustainable industry in the region. For your case, it appears, your region is a potential sustainable chemical region where new business can be launched.

## KF7– ENTREPRENEURSHIP

Business demography statistics explain the characteristics and demography of the business population and can be used to analyse the dynamics and innovation of different markets[3], for example entrepreneurship in terms of the predisposition to start a new business.

Entrepreneurs play a key role in the innovation process, economic growth and employment creation. The use of waste as alternative raw materials in the chemical industry entails a significant innovation capacity due to the need for adoption of new business models and the transformation of the existing ones. In this sense, the expenditure on R+D+I is a widely used indicator that reflects the extent of research and innovation undertaken in a country in terms of resources input. The most innovative

regions are those with more ability to attract higher risk investments. It is highly recommended to keep track of these kinds of indicators.

Networking and cross-value chain and cross-sector cooperation are also requirements and key enabling factors for the effective implementation of the mechanisms needed for the widespread use of waste as alternative raw materials in the transition to a circular chemical industry. Match-making events and other networking actions support the reinforcement of the much needed cooperative business environment. This is a point with potential a room for improvement in your region and any action aimed at supporting the creation of an open business network will have significant benefits in the mid-long term.

Also, clusters serve as driving force in most regional economies, joining forces towards supporting the dynamics of market and improving knowledge exchange among firms and other stakeholders. And also with international value chain networks, acting as local nodes in global networks. In the end, strong clusters also help attract foreign investments if they are leading centers, and they will attract key players, not only from the region-nation, but also from abroad. Actions aimed to reinforce their activities and the creation of other clusters, or even more so the reinforcement of inter-cluster relations, will be positive for the creation and support of an environment prone to innovation and cooperation towards a circular chemical industry.

Furthermore the integration in international clusters targeting the different concepts behind the transition to a more circular economy in the chemical industry (such as the use of waste as alternative raw material) is a good opportunity. It can be used to complement strengths, reinforce European collaboration and innovation to create competitive products, services and markets for sustainable chemicals.

From an overall perspective, there are regions in which the entrepreneurial environment, usually fostered by other framework conditions or supporting actions, is more prone to adopt early innovations than other regions and take the lead. In this case, for the transition to new ways of manufacturing.

Your region is probably not within the leading regions in sustainable chemicals production, and the companies in the region do not seem to be among the ´technology early adopters´. This means that more support (at several levels such as educational, infrastructures, financial, policy, etc.) is needed to create a favourable entrepreneurial environment for the activation of investments in this field.

On the other hand, the presence of a green chemistry park in your region, where companies would share facilities and waste in the field of sustainable chemicals production, would be an additional benefit for companies willing to start a business in the field of sustainable chemistry. If this park also integrates common facilities for research and experimentation and support in finance and business development, it would for sure be an accelerator and a real pole for attracting new business and investments.

# KF8- PUBLIC SUPPORT POLICIES

Policymakers have a responsibility to lead and ease the transition to the use of waste as alternative raw materials towards a more circular economy. A long term, stable, consistent and cross-departmental political strategy needs to be developed together with all stakeholders. Policy areas such as energy, environment, education and research, waste and raw materials, among others, are required to join forces. The fact that other sectorial strategies include supporting actions to foster the transition towards more circular chemical value chains using waste as alternative raw material, is a good starting point for the development of a clear, cross-departmental and consistent specifically devoted political strategy.

On the other hand, the use of waste as alternative raw material in the chemical industry entails a significant effort on R+D+I, as technologies and processes needed do not have the same maturity as the traditional ones. Therefore, well-structured, stable and long term plans to support this transition are of major importance. The inclusion of the transition to more circular value chains in the chemical industry in the region's existing master plan or strategy, tackling the R+D+I needs for this transition would certainly be an enabling factor which deserves all possible support along the process.

Public incentives for innovation are the seed for stimulating and encouraging the private sector to launch new sectors or businesses.

In this sense your region is well acting and playing the correct role to stimulate business innovation in the region.

Some regulations, such as Waste Regulation, are commonly seen as a barrier among the stakeholders involved. Preventing, for example, small-scale experiments using waste materials and hampering transport, among others things. In general, waste is not perceived as potential raw material and that is translated into regulations. The role of regional government, depending on the country, can be supporting or that of an enabler, or it can also be even more restrictive than the European or national regulations. It would be beneficial for your region to move from a neutral role to a facilitator role, creating leeway for experimentation with new value chains, subduing the obstacles that companies usually found in all matters relating waste management or recovery as raw material. This way, your region could have a great impact upon the success of the transition.

In addition, although it does not seem to be an issue in your region, it is important to take into account that social acceptance can emerge as a powerful barrier to waste-based products development. This can result, for instance, in the failure of market penetration for products using alternative raw materials or in the halt of projects. Therefore, it is important to highlight and consider the social acceptance of this kind of market development, as it can only be sustainable when products and processes are broadly accepted.

The European Commission has approved plans to adopt a set of Regulations, aimed at facilitating the reintroduction of certain 'waste' products into the production cycles, in

accordance with the Waste Framework Directive and its end-of-waste criteria. When certain waste meets these criteria, it is no longer considered waste, and therefore can create new business opportunities and markets. This, together with the by-product definition is a key tool in the waste-as-resource management towards a more circular economy. The mechanism is established by law and also states the requirements that the recovered materials and their producers must meet to ensure a high level of environmental protection and human health. It is important that this regulation and its mechanisms are implemented at national level, mobilising investments and markets in the field of the use of waste as alternative raw material.

Fiscal and financial incentives to promote circular economy in general, and therefore circular chemical value chains using waste as raw material in particular, constitute other means of support .Work is already being done in this sense at European level, exploring the use of market-based instruments to stimulate circular economy in the *Roadmap* to a *Resource-efficient Europe*. This could help or motivate to start developing an action in this field. Nevertheless, an in depth assessment of the potential impacts on the different actors of the value chain is advisable. This way, the government can have a clear view of the most effective and appropriate measures to be taken, according to its particular features. Some examples include[5]:

- lower VAT rate on circular economy services
- taxing extracted value instead of added value (a shift from taxing income to taxing materials)
- actively using financial resources from guarantee and disposal funds to further encourage business activity
- actively using financial resources from existing fiscal subsidy instruments promoting environmentally benign investments (MIA or VAMIL) for a broader series of investments or activities that would help increase circularity

[1] A list of intermediaries can be found in the following links:
- For the EIB: http://www.eib.org/products/lending/intermediated/list/index.htm
- For the EIF: http://www.eif.org/what_we_do/where/index.htm

[2] http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=ENERG_ICE_Road_Map.pdf

[3] Eurostat.

[4] OECD Innovation Policy Platform. Cluster Policies.

[5] Opportunities for a circular economy in the Netherlands document

# Conclusions & Recommendations BIOMASS

**Region:** *Vidzeme and Kurzeme, Latvia*

# KF1- LONG TERM, STABILITY AND AVAILABILITY OF FEEDSTOCK

The necessity to fulfill the acquired environmental commitments has led to an urgent need to assess sustainable paths to produce biofuels and bio-products minimising the environmental impact related to the land use and land occupation, deforestation, soil impoverishment, eutrophication, ground water or soil contamination, among others, which cause a decrease in the soils production capacity.

The use of biomass obtained from the forest or agriculture landlands or the use of agroindustry/agroforestry sector or other industries in which biomass waste is produced has several advantages if sustainability criteria are considered in the process.

For this matter, international standards included in the EU Renewable Energy Directive (The European Parliament and the Council of the European Union, 2009) and global sustainability certification systems regarding biofuels have been developed.

Certain biomass streams like forestry or agricultural residues, ignored or underutilised in many cases, can potentially be converted into valuable resources to replace the fossil ones traditionally used in the chemical industry and produce higher added value raw materials (biocommodities). The recovery and use of these endogenous biomass streams may imply great positive impacts towards a more circular and sustainable economy.

In the first instance, a region looking to increase bio-based alternatives will need to consider if there are enought resources to supply them. So as a first approach it is important to determine the area occupied by forest or agriculture land and the corresponding raw material (biomass resources) that could be obtained in each location (generally determined by resources to surfaces ratios). According to each type of biomass feedstock's characteristics, the theoretical potential might differ greatly so that it is necessary to distinguish between the main different biomass resources types.

In this regard,

On the other hand, the region has a significant biomass potential, which is worth exploring in terms of available agricultural biomass resources.

One of the main advantages of the biorefineries or bio-based initiatives is the wide range of feedstocks that could be used in their processes. Nevertheless, other sectors or facilities which currently use them must be assessed to confirm that there is sufficient raw material for other purposes that could be actually allocated to the sustainable chemistry sector.

It is quite important to determine the actual amount of biomass resources that a new initiative could take advantage of. For this reason, it is necessary to analyse if specific biomass availability assessments have been already carried out in the region and the results obtained (availability of resources).

In this sense, the potential biomass that is not being used has been assessed in the region, providing the required information (amount and characteristics) to evaluate the

possibility to use it by other consumers. Based on this feedstock accounting in the region, a significant amount could be available for the chemical and biorefinery sector.

On the other hand, biomass available in the region is either not used by existing industrial applicationsor is used by some installations in the region but is still available for the chemical and biorefinery sector. Additionally, the region has some information on biomass resources potential. This should be further assessed together with the existing industrial applications that could apply biorefinery concepts so opportunities to promote the sustainable chemical and biorefinery sector can be identified.

Besides assessing the amount of resources that are or might be available it is important to determine if the region already knows the format in which those biomass feedstocks are or could be supplied. Available formats may imply different procurement chains that should be taken into account by new bio-based initiatives.

In addition, the region accounts with information regarding the format in which biomass is currently supplied that will allow determining if :

- resources would be available in the most suitable format (chips, shredded material, sawdust or bales) for sustainable chemistry initiatives
- any pre-treatments (logs, branches) or additional steps in the supply chain would be necessary (branches or loose straw)
- competence could be expected (pellets and briquettes most likely used within the domestic market, for example)

Concerning competition over the available biomass resourcesthe region is using the biomass for energy purposes but there is still an important potential that remain unexploited. New initiatives could to take advantage of it.

Biorefineries or bio-based initiatives installations offer several advantages compared to other biomass resources and other fossil fuels based plants but might involve long term processes to finally succeed. These processes can be reduced if already existing initiatives are close to applying these concepts or are already using biomass feedstocks.

Finally, it is worth noting that the biorefinery sector has to be developed in the region starting from zero. Two important issues should match in this case: the availability of biomass resources as well as interest and capacity to develop new projects.

Finally, the aquaculture industry currently is currently not developed in the region. Therefore, in first instance preliminary studies should be carried out to assess the potential and the interest of the region to produce algae or microalgae.

# KF2- INFRASTRUCTURE TO HANDLE FEEDSTOCKS AND PRODUCTION

The biomass logistics chain faces different challenges that need to be overcome to optimise the supply chain. They include accessibility limitations, low bulk densities and significant volumes, geographical dispersion, low productivity per hectare, etc.

In addition, biomass usually needs to undergo some kind of pre-treatment before its final use for energy purposes or for the production of chemicals. This is, due to its grading, heterogeneity, high moisture content, low density, constraints related to the handling and transport, presence of exogenous mater (stones, dust, metals, etc.). The supply chain involves several steps: collection, pre-treatment (when required), transport, distribution and storage. All of which need to be optimised to increase the environmental and economic feasibility of the supply chain.

Biomass consumers, including the industrial sector, ceramic sector, greenhouses, boilers, power plants, co-firing plants, might have different requirements regarding the raw material according to the conversion pathway used. Any biomass feedstocks consumer will demand a supply guarantee which is an important challenge to be addressed and maintained during a project´s life.

Biomass resources will have to be transported from the site in which they will be produced (even imported) to the new bio-based installation. Local transport infrastructures (roads, rails or ports) will have to be used, the better their condition the lower the transport costs inferred.

In this regard, the region already has the main transport infrastructure for the logistics of biomass raw materials in place. Transport of feedstocks should not endanger these types of projects.new investment in transport infrastructure might be needed.

Biomass feedstocks supply for new bio-based initiatives can be easily satisfied if any biomass logistics centre is already set up in the region or close to it. Since biomass logistics centres can be crucial for these types of initiatives, it is also important to evaluate if there are any options to set them up in case they do not exist yet.

Biomass transport cost is one of the main drivers of the overall biomass supply cost so optimised chains should be implemented to achieve techno-economically feasible solutions. The existence of transport companies already delivering these types of feedstocks might reduce investment costs related to transport equipment for these types of initiatives.

In addition, the region may take advantage of already existing biomass transport companies. These could deliver biomass products to new bio-based industries or new biorefinery concepts without involving excessive investment costs in this infrastructure.

New bio-based initiatives can take advantage of the storage sites or warehouse of already existing projects, which could be used as new logistics centres.

It is worth noting that the biorefinery sector has not been developed in the region yet, so other logistics centres should be used or set up to supply biomass products for the new projects.

Finally, biomass logistics centres or the places in which biomass resources will be loaded, unloaded and delivered will require basic supplies to guarantee working conditions.

In this regard, basic supplies are very important for the correct and successful establishment of a biorefinery. A high quality supply of electricity should be ensured in the region.

## KF3- ACCESS TO FINANCE

An appropriate access to finance is essential to transition towards sustainable chemicals production. The adaptation and refurbishment of the existing production sites to use alternative feedstocks – such as biomass or waste – require the installation of new equipment and the modification of the existing processes. Moreover, the development of concepts such as industrial symbiosis often implies investments in new infrastructure – like new pipelines – for the exchange of streams between different sites. In many cases, this means costly investments for the promoters that cannot be covered with their own funds. Particularly when building up a new production site based on non-fossil feedstock, such as a biorefinery.

Both public and private funding can be used to finance these types of projects. In this regard, financing in your region is available but under very undesirable conditions; several issues need to be tackled to improve access to finance in your region.

Public funding can be attained from multiple sources. Local, regional, national or European bodies usually have direct or intermediate financing mechanisms that could be used to foster the sustainable production of chemicals with biomass feedstocks in different ways.

The region had or still has some public imbalances. Even so, some public resources can be used to leverage the necessary investments to develop a sustainable chemical industry in the region based on biomass feedstocks. Particularly, if combined with other funds. In this regard, potential synergies with other public financing lines available in the region or neighboring regions, shoud be explored. Examples are national or European funding – EIB or Structural Funds -, that build on the concept of additionality.

Public finance should not be the main or only source of funding for developing the region´s sustainable chemical industry. The objective is to complement and encourage private funding from companies and the financial sector.

The banking sector in the region is strong and the necessary credit for building up

projects in the field of sustainable chemicals is available in the region.

Furthermore, there are national and/or international private investment and equity funds that have financed projects and companies in the chemical sector in the region in the recent past. They might be interested in continuing theire investments in this sector.

Additionally, the region should ensure that the necessary framework conditions are set up to make financing available in the sustainable chemicals field using biomass resources.

In this regard, the region already has a collaboration network involving most of the stakeholders in the region; but further steps could be taken to make sure that this network is used for supporting the region in the development of the strategy towards sustainable chemicals production.

Apart from the lending provided by the traditional banking sector, other alternative instruments and financial actors are important to make available the necessary financing available for the development of a sustainable chemical industry in the region.

If there is a lack of awareness regarding the presence of these kinds of organisations in the region. It might be worth it to organise a meeting with them to engage them in financing projects and initiatives in the field of sustainable chemistry in the region. This initiative could be helpful to identify the actors that are active in the country through the European associations of these types of organisations, such as Business Angels Europe (BAE) or Invest Europe.

Finally, it is worth noting that, there are subsidies in the region attributed to the use of biomass for energy and/or transport purposes. This may represent a threat to sustainable chemicals production (it's a better business case for the production of energy or fuels using biomass than for the production of chemicals). Conversely, it may represent an opportunity to sustainable chemicals production (as procurement activities could take advantage of the subsidies and because there are similarities in the technology pathways and value chains).

## KF4- SKILLED WORKFORCE, TECHNICAL EXPERTISE, TRAINING

The transition to the effective use of alternative raw materials towards developing the biorefinery concept requires a rearrangement not only of value chains but also of society culture, knowledge and skills.

As a first step, the successful implementation of new bio-based initiatives or biorefinery concepts in a region will require a skilled workforce able to carry out both the activities related to the procurement of the biomass resources and those related to the management, operation and maintenance of new installations. As a second step, training

activities and courses need to be developed and implemented to minimise gaps between society knowledge and new installations and their development needs.

It is worth noting that it seems that the region does not have the skilled workforce required for the implementation of a biomass supply chain and its final use or conversion, so either technical training should be introduced in the region or the region should look to other regions and attract these types of professionals.

In addition to the in-depth and specific technical knowledge needed, the introduction of new concepts underpinning biorefinery concepts must be integrated into education curricula from vocational training to higher education. These concepts range from the general green awareness to the "system thinking" principles and the development of skills for multidisciplinary teamwork.

In this sense, the existing high-level and vocational education in the field of biomass use for chemical applications in the region must play a key enabling role. It should be increasing knowledge and awareness, pointing the way towards a more sustainable chemical industry by building strong and updated background knowledge and human capital.

The existence of education and training offers in the field of biomass use for chemical applications is evidence of the flexible adaptation to the economic trends, productive systems and future skills needs. Moreover, the presence of people involved in R&D activities in the region may boost the transition to bio-based activities and new biorefineries concepts by shortening response time to solve technology gaps or by implementing training needs.

In this regard, the region currently offers the training to cover the required expertise along the whole biomass supply chain. New initiatives can take advantage of this training.

On the other hand, the region has reduced skilled workforce in biomass R&D concepts that will contribute to developing technology and products and increasing the knowledge related to biorefineries and bio-based industries. Therefore, the region should put mechanisms or tools in place to increase these activities.

There are also other desirable supporting bodies or structures in the education field such as the so-called Centres of Excelence (CoE). These centres provide leadership, research, support and training that play a strategic role in the development of sustainable chemistry concepts.

The set-up of such a centre in the region would be an important enabler for the transition to more sustainable value chains in the chemical industry. On the other hand, to build up this education that is flexible and adapted to the current and future trends, it is also noteworthy that in the region different stakeholders across the value chain, including industry, take part in the design of curricula and bring together practical and different

points of view

Finally, the biogas, pellet manufacture, cogeneration/electricity generation and pyrolysis is the most promising pathway to process biomass for the sustainable production of chemicals in the region but further developments are required to optimise the process.

## KF5- EXISTENCE OF SUPPORT INSTITUTIONS

Supporting institutions such as knowledge and know-how transferring bodies, technical support and assistance institutions, as well as, research and development organisations are crucial for a new business or sector development.

Supporting institutions can exist in some or all the links of the complete bio-based or biorefineries chain (R&D activities, financing issues, business tasks, etc.). Regarding R&D development activities, considering that the region has a high potential for the production and utilisation of biomass as feedstock, the regional strategy in R&D should be focused on promotion for new businesses based on them.

With the purpose of launching new business activities in the field of sustainable chemistry based on biomass, it would be ideal to have a research and innovation strategy for smart specialisation (RIS3). Specifically on KETs, focused on developing more sustainable processes and industries in the chemical sector.

Entrepreneurs that establish their company on an R&D&I campus specialised in sustainable chemistry accelerate their business. In this sense, it would be desirable to invest in or include the bio-based and circular economy concept on a campus. Or, alternatively, set one up in an already existing potential centre available and suitable for these types of actions (technical campus covering some of the aspects that a sustainable chemistry campus should address)[2].

With respect to specific financing issues, an institute or body, supporting business is a good starting point, even if it is not specific for circular economy/bio economy/sustainable business. As far as this type of new business is well supported with such a body, specific support in bio-based economy would be desirable if a new kind of business is expected in this area.

And finally, concerning business plans, risks assessments, etc., there are institutions in the region that offer advisory services for building up new projects, supporting the promoters in the development of their business plan, risk assessment or ensuring the necessary financial resources. These services are not available for building up industrial projects in the sustainable chemistry field, maybe due to the providers' lack of technical knowledge.

Biomass resources have different quality characteristics. Producers and consumers need to agree on these characteristics to solve the problems that might appear within the biomass supply chain. Standards and certificates help to guarantee success in new bio-based or biorefineries activities.

In this regard, the existence of a certification and/or standardisation body to support bio-based business is a good starting point. Technical assistance for certification and standardisation is a must in business development and internationalisation. It is an instrument of differentiation that makes both new and existing companies and launching new products more competitive.

In terms of the impact of initial investments in start-ups on the local community, other experiences have shown that they can have a big effect on attracting additional investment to a community, even for different firms than the ones promoted. This could bring additional indirect benefits to the wider regional economy.

The region is improving the benefits of the region by attracting initial investment for seed and start-up business in the chemical sustainable industry.

As new bio-based or biorefineries initiatives will need to take advantage of currently unused biomass resources, having a specific service in the region which might support the connection between biomass resources production and new installations demands will significantly help these activities to succeed.

The region already has this type of support so that one of the main drawbacks of new bio-based plants can be more easily overcome.

## KF6- STRENGTH AND AVAILABILITY OF REGIONAL MARKETS

The overall shares of renewable energies need to increase to fulfill the raising energy demands and still meet the commitments established. Besides energy generation, biomass can be used in other industrial applications such as raw material for the chemical industry or for liquid fuels and other biocommodities production increasing greenhouse gas emissions savings and the energy security. Biomass use still has a large improvement potential to be developed since biomass markets are not as developed as others. Successful biomass markets display an integrated and sustainable supply chain, from the source to the end-users. If they already exist, taking advantage or additional biomass resources has fewer difficulties than if they have to be created from the ground up.

Biomass markets development in the region has to be assessed in order to efficiently promote the integration of the supply chains and to develop best practice tools. For this aim, data regarding the sector activity in the region should be compiled including number and type of business. This data should include:

- volumes of biomass produced, used and exported/imported
- consumption flows and current business models based on the feedstocks
- actors along the entire supply chain

In this particular case, it seems that the biomass market is not fully developed in the region so the introduction of the biorefineries' activities will need development to improve cost-effective operation along the whole supply chain and for final use applications.

Furthermore, the security of the raw material supply is one of the main requirements for the successful implementation of any initiative based on biomass. Considering this, a critical mass of suppliers will be necessary. Even though supply could be developed with other stakeholders, the region should work on widening the existing limited supply offer.

On the other hand, the region has actors along the sustainable chemicals production value chain that could be interested in investing in the biomass market and can cover the whole value chain.

In order to definitively set up new biorefineries or new bio-based initiatives based on biomass resources, it is also extremely important to assess the market conditions for the new biocommodities or for the new products to be developed. If there already is some knowledge in the region regarding these markets, new initiatives may take advantage of this information and may reduce the time to definitively set up.

In this case, There seems to be some information regarding the potential markets that could provide a starting point for different stakeholders involved in the supply chain or in the set up of new installations.

The main market sector for the chemical industry in the region seem to be food and nutraceutical products, agricultural products, pharmaceutical and cosmetic products and polymers, fibres and composite materials. As a first step, the demand for biomaterials in these sectors should be assessed in order to determine if the biomass resources in the region might satisfy the production requirements.

The European Commission's single market for green products initiative proposes a set of actions to overcome the different problems that slow down the final implementation of these products in the market. These actions are:

- establishing two methods to measure environmental performance throughout the lifecycle (the product environmental footprint (PEF) and the organisation environmental footprint (OEF)) and recommending the use of these methods to EU countries, companies, private organisations and the financial community through a Commission Recommendation
- developing product- and sector-specific rules through a multi-stakeholder process
- providing principles for communicating environmental performance, such as transparency, reliability, completeness, comparability and clarity
- supporting international efforts towards more coordination in methodological development and data availability.

In recent years, there have been significant developments in the field of industrial green purchasing and supply. New bio-based or biorefinery initiatives in the region should consider these actions and other green products promotion initiatives to guarantee

success.

In this particular case, an assessment of the existing policies regarding biorefineries should be performed to map their efficiency and further develop policies that will increase the promotion of the sector.

Moreover, it is worth noting that the chemical sector is poorly developed in the region. Therefore, the promotion of sustainable chemical initiatives will firstly work on setting up an adequate framework in the region and on identifying if any possibility to set up sustainable chemical initiatives might even exist.

## KF7- ENTREPRENEURSHIP

The transition to more sustainable value chains in the chemical industry entails a significant innovation capacity due to the need for the adoption of new business models and the transformation of the existing ones. In this sense, the expenditure on R+D+I is a widely used indicator that reflects the extent of research and innovation undertaken in a country in terms of resources input.

On the other hand, there is a lack of information regarding the public and/or private expenditure on R+D+I, this should be addressed in the region due to the important role that research plays in a developing technology such as biorefineries.

Networking and cross-value chain and cross-sector cooperation is also a requirement and a key enabling factor for the transition to sustainable chemical industry. Matchmaking events and other networking actions support the reinforcement of the much needed cooperative business environment.

In this sense, this is a point with room for improvement in the region and any action aimed at supporting the creation of an open business networking will have significant benefits in the mid-long term.

Also, clusters contribute to support dynamics of market and knowledge exchange among firms and other stakeholders in the region and in international value chain networks, acting as local nodes in global networks.

In this regard, the presence of chemical, polymer, farming and animal husbandry, agri-food and bioeconomy clusters is a reflection of the level of networking in your region. Actions aimed to reinforce their activities and the creation of other clusters, or even more so the reinforcement of inter-cluster relations, will be positive for the creation of an environment prone to innovation and cooperation towards a circular chemical industry.

# KF8- PUBLIC SUPPORT POLICIES

The transition to more circular value chains in the chemical industry by using biomass resources in new or existing processes entails a significant effort on R+D+I. Therefore, well-structured, stable and long term plans to support this transition are of major importance.

The inclusion of the transition to more circular value chains in the chemical industry in the region's existing master plan or strategy tackling the R+D+I needs for this transition. This would certainly be an enabling factor that deserves all possible support along the process.

Furthermore, public incentives are somehow the seed for stimulating and encouraging the private sector in launching new sectors or businesses.

In the same way, fiscal and financial incentives to promote the bioeconomy in general and therefore sustainable chemical value chains based on biomass in particular, constitute other means of support . Work is already being done in this sense at European level, exploring the use of market-based instruments to stimulate circular economy in the *Roadmap to a Resource-efficient Europe*.

This could help to develop the foreseen action in this field. However, an in deep assessment on the potential impacts on the different actors of the value chain is advisable. This way the government can have a clear view of the most effective and appropriate measures to be taken according to its particular features. Some examples include[3]:

- lower VAT rate on circular economy services
- taxing extracted value instead of added value (a shift from taxing income to taxing materials)
- actively using financial resources from guarantee and disposal funds to further encourage business activity
- actively using financial resources from existing fiscal subsidy instruments promoting environmentally benign investments (MIA or VAMIL) for a broader series of investments or activities that would help increase circularity

Policymakers have a responsibility to lead and ease the transition to a circular economy. A long term, stable, consistent and cross-departmental political strategy needs to be developed together with all stakeholders. Policy areas such as energy, environment, education and research, waste and raw materials, among others, are required to join forces.

This is a key enabling factor that the region has already developed. However, it is important that these kinds of strategies remain supported and maybe updated/upgraded in the long term.

The different governmental bodies have the capacity to design, implement, and enforce regulation. This multi-level regulatory framework can be challenging, giving rise to economic stagnation or recession, decreased productivity and less competitiveness, which has to be avoided. Among others, the challenges include avoiding duplicated or overlapping rules, low quality regulation, and uneven enforcement.

The region is playing an important facilitator role, subduing the obstacles and controversy that companies usually find in all matters related to biomass utilisation as a raw material.

Finally, regulation related to the establishment of enterprises in the region should be also taken into account. In this sense, any further step to facilitate the process of setting them up is positive for the region's economy. The region does not have the competence on licensing new bio-based or biorefineries so it should work with the entities that have such a competence to help set-up these initiatives in the region.

Government/regional support schemes for renewable energies can be applied to bioenergy in most instances. Direct government grants and subsidies for biomass production and use could encourage further uptake of sustainable chemistry projects/biorefineries.

Biorefineries and sustainable chemistry projects promoters should be aware of current policies and closely follow any national policy development that might be established in the region or at national level.

The region should continue the participation in specific forums related to chemical production sustainability. The region could also establish contact with other regions that have extensive knowledge and experience regarding bio-based applications to build an appropriate framework for the sustainable chemistry initiatives to progress in the region.

Policies should be developed in the region in terms of investment in research and innovation and skills, market development and enhanced competitiveness and also engagement with stakeholders to promote bio-based initiatives like biorefineries.

The region has specific regulations regarding the promotion of energy crops in marginal lands/energy crops in arable lands. These regulations will contribute to increasing biomass feedstock production in the region that could be used in biorefineries or sustainable chemical sector.

[1] A list of intermediaries can be found in the following links:

- For the EIB: http://www.eib.org/products/lending/intermediated/list/index.htm
- For the EIF: http://www.eif.org/what_we_do/where/index.htm

[2] See the green chemistry campus website.
[3] Opportunities for a circular economy in the Netherlands. document.

# Conclusions & Recommendations WASTE

**Region:** *Vidzeme and Kurzeme, Latvia*

# KF1- LONG TERM, STABILITY AND AVAILABILITY OF FEEDSTOCK

Certain waste streams, significantly ignored or underutilised, can potentially be converted into valuable resources to replace the fossil ones traditionally used in the chemical industry and produce higher added value than existing uses. The recovery and use of some endogenous waste streams help the move towards a more circular and sustainable economy.

Waste stream(s) that may have a lot of potential in your region and need more in depth analysis could come from:

- The agri-food sector.
- The farming sector.
- The pulp & paper industry.

These waste streams can be converted by different processing methods into chemical building blocks, syngas, fertilisers, and polymers, among others. The processes and the products will be very much dependent on their specific characteristics and on the regional market features.

Aside from waste coming from industrial or farming activities, the treatment of citizen waste streams has potential that could be explored. Sewage sludge is one of the most common wastes. It is produced in large volumes and is, surprisingly, one of the least known.

Sewage sludge seems to have an interesting potential in your region, although there appears to be a significant room for improvement regarding the connection of the population to urban waste water plants. Your region is well aware of this fact and it seems that there is a market in which companies can start up new business for the recovery of this waste stream. In adition, the seemingly centralised production in medium-large plants could facilitate the sludge management.

On the other hand, the organic fraction from MSW can also be a potential alternative raw material, for example, for the production of a fertilisers, biogas or syngas major platform for the further production of chemicals and building blocks.

In addition, plastic fractions recovered or source separated not only from packaging but also from other important sectors, would provide a potential option for producing raw materials for new plastic manufacturing out of cascade recycling. This leads to lower value materials, or serves as an alternative source for other chemical products production, for example for syngas production.

Regardless of the waste streams that can potentially be an opportunity in your region, the first step for an optimal management and use of waste towards a circular economy is good quality information gathering, availability and accessibility. Your region is

apparently well aware of this fact, it is important to keep updating, tracking and analysing this information. The already identified potential for the production of additives/high value fertilisers/chemical building blocks/ paints and coatings/polymers/other chemical products (add the ones that are selected) is the first step for the further development of new business cases in the field of waste use as alternative raw material.

Finally, it is worth noting that biogas and biofuels production sites existing in your region represent the same demanding sector as the sustainable chemical sector. It is important to have it in mind for the strategy of the region.

## KF2- INFRASTRUCTURE TO HANDLE FEEDSTOCKS AND PRODUCTION

Infrastructure is a key factor for the development and success of the bioeconomy. In addition, it is important to reduce the environmental impacts and to avoid logistical problems, as well as production problems. It is a decisive aspect that companies and investors take into account when deciding to set up and launch new businesses and investments.

Apparently, your region has a great logistics potential, but it would be advisable to set up a waste logistics centre. Otherwise, it should be ensured a correct and optimised connection among generation, treatment and demand points. The support of a logistics research centre, coordinated with the regional government and the waste management system might be of interest, keeping all stakeholders well aware and informed at the same time.

The efficient provision of infrastructure services is one of the most important aspects of development policies in general, and industry in particular. The suitable availability of infrastructure and the efficient establishment of related services to the industry, contribute to the development of competitive advantages in a country or region and help to achieve a greater degree of productive specialisation. In this sense: our region is apparently well supplied in terms of water. You should consider having a monitoring mechanism in case you are not covering the whole territory of the region to ensure there is always a 100% supply.

For the correct and successful establishment of a sustainable chemical industry, basic supplies are very important. You should consider ensuring a high quality supply of electricity and fuel in your region

# KF3- ACCESS TO FINANCE

An appropriate access to finance is of paramount importance if a transition towards a sustainable chemicals production by means of alternative raw materials is desired. The adaptation of the existing production sites for use of alternative feedstocks – such as biomass or waste – requires the installation of new equipment and the modification of the existing processes. Moreover, the realisation of concepts such as industrial symbiosis very often implies investments in new infrastructure – like new pipelines – for the exchange of streams between different sites. In many cases, this means costly investments for the promoters that cannot be covered with their own funds, particularly when building up a new production site based on non-fossil feedstock (like biorefineries).

Both public and private funding can be used to finance these types of projects. In this regard, financing in your region is available but is apparently not accessible enough; several issues might need to be tackled to improve access to finance in your region.

Public funding can be attained from multiple sources: local, regional, national or European bodies usually have direct or intermediate financing mechanisms that could be used to foster the sustainable production of chemicals in different ways.

Your region had or still has reportedly some public imbalances but some public resources could possibly be used to leverage the necessary investments to developed a sustainable chemical industry in the region, particularly combined with other funds. In this regard, you should explore potential synergies with other public financing lines available in your region or neighboring regions, such as national or European funding – EIB or Structural Funds -, building on the concept of additionality .

It is not advisable that public finance is the main source of funding for developing the region's sustainable chemical industry. The objective is to complement and encourage private funding from companies and the financial sector.

The banking sector in your region appears to be strong enough and the necessary credit for building up projects in the field of sustainable chemicals is available in your region.

Apart from the lending provided by the traditional banking sector, equity funding - through the sale of shares of new business, and financial actors are important to make the necessary financing for the development of a sustainable chemical industry available in your region. If you are not aware of the presence of these kinds of organisations in your region, you might find it useful to consider organising a meeting with them to engage them in financing projects and initiatives in the field of sustainable chemistry in your region. You may identify who is active in your country through the European associations of these types of organisations, such as Business Angels Europe (BAE) or Invest Europe.

Furthermore, there are national and/or international private investment and equity funds that have financed projects and companies in the chemical sector in your region in the recent past. They will surely be interested in continue investing in this sector.

Moreover, it seems that the foreign investment is relevant in your region. It would be convenient to attract these types of investors towards the field of sustainable chemicals by organising investment forums, multilateral meetings and awareness campaigns for instance.

Finally, it is also recommended to ensure that the necessary framework conditions to make financing available are set up in the sustainable chemicals field. In this regard, you already have a collaboration network involving most of the stakeholders in your region. Thus, it could be easier to use this network to support you in the development of your strategy towards sustainable chemicals production.

## KF4- SKILLED WORKFORCE, TECHNICAL EXPERTISE, TRAINING

The percentage of population with secondary and tertiary education is considered as a good measure of workforce quality, because a more skilled workforce is supposed to be more likely to be able to perform high value-added roles in this transition. Also, the employment structure given specifically by the percentage of the population employed in the industrial sector shows an existing base for the future application of waste-to-raw material concepts. A regional economy based on service sector or primary sector, is considered in principle to have less potential than a region with a strong industrial sector. Last but not least, R+D+I expenditure and its attached professionals are strongly linked and have a direct impact on the innovation performance required in this field.

The transition to the effective use of waste as alternative raw materials towards a more circular economy in the chemical industry requires a rearrangement, not only of value chains, but also of society, culture and knowledge. Therefore, raising and spreading knowledge is a major issue that requires innovative aptitude and attitude, skills and expertise for transition and a multidisciplinary and comprehensive education

In addition to the in the depth and specific technical knowledge needed, the introduction of new concepts underpinning the use of alternative raw materials in the circular economy must be integrated into education curricula from vocational training to higher education. These concepts range from the general green awareness to the “system thinking” principles and the development of skills for multidisciplinary teamwork.

The allegedly existing high-level and vocational education in the field of waste use for the production of more sustainable chemicals in your region could play a key enabling role. It could be increasing knowledge and awareness, pointing the way to a more circular economy in the chemical industry by building strong and updated background knowledge and human capital.

In addition, the existence of an education and training offer in the field of use of waste and sustainable chemistry towards a more circular economy is evidence of the flexible adaptation to the economic trends, productive systems and future skills needs.

Your region appears to be anticipating and adapting to the new productive strategy and the training and educational system is the key to building the capacity of the region. The already organised training developed in this field by the region is also an important step towards upgrading the workforce to the current needs.

On the other hand, to build up this education that is flexible and adapted to the current and future trends, it is also noteworthy that in your region different stakeholders across the value chain, including industry, take part in the design of curricula and bring together practical and different points of view.

There are also other desirable supporting bodies or structures in the education field such as the so-called centres of excelence (CoE). These centres provide the leadership, research, support and training that play a strategic role in the development of sustainable chemistry concepts. The presence of such a centre in your region is an important enabler for the transition to more circular value chains in the chemical industry by using waste as feedstock.

However, it is usual that many companies in the sector lack adequate information and knowledge about their own products and raw materials. The transition to more circular value chains in the chemical industry by using alternative raw materials is not possible without these foundations. Improving this knowledge is first and foremost responsibility of the business sector, which cannot assess the vulnerability of their own value chains and so are unable to respond to risks and explore alternatives.

## KF5- EXISTENCE OF SUPPORT INSTITUTIONS

Supporting institutions such as knowledge and know-how transferring bodies, technical support and assistance institutions, as well as research and development organisations are crucial for a new business or sector development based on innovative technologies using waste as alternative feedstocks.

Your region represents an ideal framework where the new industry in sustainable chemistry, based on waste feedstock, can be established as well as develop their activities with support.

Waste management is a very critical issue that should be ensured and monitored regionally. In this sense, it would be desirable for the region to establish the correct procedures to assure the correct waste management which the waste feedstock availability will depend on.

In terms of the impact of initial investments in startups on the local community, other experiences show that they can have a big effect on attracting additional investment to a community, even for different firms than the promoted ones. This could bring additional indirect benefits to the wider regional economy.

There are also some other mechanisms that can foster the inter-sectoral exchange of

waste. Tools like a business-to-business waste exchange platform with materials- matching and recovery opportunities would facilitate the exchange of waste streams for making this concept a regular business practice.

New business should be supported by the region to promote and sell the products manufactured within the region in various markets. The region appears to support the new sector by adding value to products produced using waste through their promotion and support of the companies.

Finally, there are financial institutions in your region that offer advisory services for building up new projects, supporting the promoters in the development of their business plan, risk assessment or ensuring the necessary financial resources. These services are allegedly not available for building up industrial projects in the sustainable chemistry field, maybe due to the insufficient technical knowledge by the providers.

## KF6- STRENGTH AND AVAILABILITY OF REGIONAL MARKETS

According to *Energ-Ice Project*[2] *"The Chemical industry is placed upstream of various sectors such as construction, transport, food, health, personal cleanliness and home, clothing, electronics, etc..; this industry is also able to supply intermediate products for downstream industries and it contributes directly to create materials for the consumer market. Since chemical industry have a strategic position it is fully involved in the question of industrial sustainability outlined above"*.

The chemical industry in the region might be not present. However, if the region has a high potential in the delivery of waste as alternative raw materials, you should try to promote and strengthen networking with other regions and foreign markets for the sale of waste. Especially reconverted chemical industry waste into sustainable raw material or fuel.

The production of waste streams from different sectors and their conversion into every day products such as food, feed, energy and chemicals is growing fast in some regions and expected to take off in others. This transition towards a more circular economy provides a lot of opportunities for new markets and high-value products not only at regional level, but at global scale, linking very diverse sectors at the same time. Companies need support to access these new markets and to build stable and competitive business over time.

In this regard, your region seems to be fully aware of the potential market for the new industry through a preliminary market analysis of the potential demanding sectors of new products made with waste.

A strong regional chemical industry contributes to a competitive region/country -externally as well as internally -. It is a sector which is strongly linked with virtually all other industrial sectors as raw material provider, and now also as waste user. With the potential large range of chemical products and innovative solutions applicable for the use of waste as alternative raw material, the regional chemical industry would contribute to the well-being of the regional economy. In this sense, the regional chemical industry seems to be an important sector which needs to be reinforced and promoted continuously.

Plastic waste might be a potential alternative feedstock in your region. However, the region should design an appealing strategy for attracting new investments for using the surplus, which represents an alternative feedstock for the sustainable chemical industry.

On the other hand, the region should design an appealing strategy for attracting new investments for using the potential waste feedstock, which represents an alternative for the sustainable chemical industry. The region should disseminate information about the benefits of the use of waste as alternative feedstock. It is important to assure the correct context to attract the establishment of new business, taking into consideration key factors such as infrastructure, workforce and transport availability, as well as economical, financial, technological, political and knowledge long-term stability.

Additionally, and no less important, is the status of the industrial network of the region to facilitate the uptake of the new sustainable industry in the region. For your case, it appears, your region is a potential sustainable chemical region where new business can be launched.

## KF7– ENTREPRENEURSHIP

Business demography statistics explain the characteristics and demography of the business population and can be used to analyse the dynamics and innovation of different markets[3], for example entrepreneurship in terms of the predisposition to start a new business.

Entrepreneurs play a key role in the innovation process, economic growth and employment creation. The use of waste as alternative raw materials in the chemical industry entails a significant innovation capacity due to the need for adoption of new business models and the transformation of the existing ones. In this sense, the expenditure on R+D+I is a widely used indicator that reflects the extent of research and innovation undertaken in a country in terms of resources input. The most innovative regions are those with more ability to attract higher risk investments. It is highly recommended to keep track of these kinds of indicators.

Networking and cross-value chain and cross-sector cooperation are also requirements and key enabling factors for the effective implementation of the mechanisms needed for the widespread use of waste as alternative raw materials in the transition to a circular chemical industry. Match-making events and other networking actions support the reinforcement of the much needed cooperative business environment. This is a point with

potential a room for improvement in your region and any action aimed at supporting the creation of an open business network will have significant benefits in the mid-long term.

Also, clusters serve as driving force in most regional economies, joining forces towards supporting the dynamics of market and improving knowledge exchange among firms and other stakeholders. And also with international value chain networks, acting as local nodes in global networks. In the end, strong clusters also help attract foreign investments if they are leading centers, and they will attract key players, not only from the region-nation, but also from abroad. Actions aimed to reinforce their activities and the creation of other clusters, or even more so the reinforcement of inter-cluster relations, will be positive for the creation and support of an environment prone to innovation and cooperation towards a circular chemical industry.

Furthermore the integration in international clusters targeting the different concepts behind the transition to a more circular economy in the chemical industry (such as the use of waste as alternative raw material) is a good opportunity. It can be used to complement strengths, reinforce European collaboration and innovation to create competitive products, services and markets for sustainable chemicals.

From an overall perspective, there are regions in which the entrepreneurial environment, usually fostered by other framework conditions or supporting actions, is more prone to adopt early innovations than other regions and take the lead. In this case, for the transition to new ways of manufacturing.

Your region is probably not within the leading regions in sustainable chemicals production, and the companies in the region do not seem to be among the ´technology early adopters´. This means that more support (at several levels such as educational, infrastructures, financial, policy, etc.) is needed to create a favourable entrepreneurial environment for the activation of investments in this field.

On the other hand, the presence of a green chemistry park in your region, where companies would share facilities and waste in the field of sustainable chemicals production, would be an additional benefit for companies willing to start a business in the field of sustainable chemistry. If this park also integrates common facilities for research and experimentation and support in finance and business development, it would for sure be an accelerator and a real pole for attracting new business and investments.

## KF8- PUBLIC SUPPORT POLICIES

Policymakers have a responsibility to lead and ease the transition to the use of waste as alternative raw materials towards a more circular economy. A long term, stable, consistent and cross-departmental political strategy needs to be developed together with all stakeholders. Policy areas such as energy, environment, education and research, waste and raw materials, among others, are required to join forces. This is a key enabling factor that your region has already developed. However, it is important that this kind of

strategies remain supported and maybe updated/upgraded in the long-term.

On the other hand, the use of waste as alternative raw material in the chemical industry entails a significant effort on R+D+I, as technologies and processes needed do not have the same maturity as the traditional ones. Therefore, well-structured, stable and long term plans to support this transition are of major importance. The presence in your region of a master plan or strategy tackling the R+D+I needs for this transition is undoubtedly an enabling factor, which deserves all possible support along the process.

Public incentives for innovation are the seed for stimulating and encouraging the private sector to launch new sectors or businesses.

In this sense, your region is acting well and playing the correct role to stimulate business innovation in the region, but new types of public incentives could be explored.

Some regulations, such as Waste Regulation, are commonly seen as a barrier among the stakeholders involved. Preventing, for example, small-scale experiments using waste materials and hampering transport, among others things. In general, waste is not perceived as potential raw material and that is translated into regulations. The role of regional government, depending on the country, can be supporting or that of an enabler, or it can also be even more restrictive than the European or national regulations. Your region is seemingly playing an important facilitator role, subduing the obstacles that companies usually found in all matters relating waste management or recovery as raw material.

In addition, although it does not seem to be an issue in your region, it is important to take into account that social acceptance can emerge as a powerful barrier to waste-based products development. This can result, for instance, in the failure of market penetration for products using alternative raw materials or in the halt of projects. Therefore, it is important to highlight and consider the social acceptance of this kind of market development, as it can only be sustainable when products and processes are broadly accepted.

The European Commission has approved plans to adopt a set of Regulations, aimed at facilitating the reintroduction of certain 'waste' products into the production cycles, in accordance with the Waste Framework Directive and its end-of-waste criteria. When certain waste meets these criteria, it is no longer considered waste, and therefore can create new business opportunities and markets. This, together with the by-product definition is a key tool in the waste-as-resource management towards a more circular economy. The mechanism is established by law and also states the requirements that the recovered materials and their producers must meet to ensure a high level of environmental protection and human health. Your region shows to be active, boosting the implementation of this regulation, and thus, the investments in the field of waste recovery and use.

Fiscal and financial incentives to promote circular economy in general, and therefore circular chemical value chains using waste as raw material in particular, constitute other means of support .Work is already being done in this sense at European level, exploring

the use of market-based instruments to stimulate circular economy in the *Roadmap* to a *Resource-efficient Europe*. This could help to develop your foreseen action in this field. However, an in depth assessment of the potential impacts on the different actors of the value chain would be of interest. This way, the government can have a clear view of the most effective and appropriate measures to be taken according to its particular features. Some examples include:

- lower VAT rate on circular economy services
- taxing extracted value instead of added value (a shift from taxing income to taxing materials)
- actively using financial resources from guarantee and disposal funds to further encourage business activity
- actively using financial resources from existing fiscal subsidy instruments promoting environmentally benign investments (MIA or VAMIL) for a broader series of investments or activities that would help increase circularity

[1] A list of intermediaries can be found in the following links:
- For the EIB: http://www.eib.org/products/lending/intermediated/list/index.htm
- For the EIF: http://www.eif.org/what_we_do/where/index.htm

[2] http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=ENERG_ICE_Road_Map.pdf

[3] Eurostat.

[4] OECD Innovation Policy Platform. Cluster Policies.

[5] Opportunities for a circular economy in the Netherlands document