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Understanding the biomass availability, flows and value chains of diverse rural regions in Europe

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Purpose of the work

The Updated EU Bioeconomy 2018 strategy recognises the importance the bioeconomy can play in supporting regions across Europe to meet their sustainability objectives in a competitive manner, creating new industries and jobs in urban, rural and coastal regions (European Commission, 2018). Since European regions are diverse in their industries, and the primary sectors which underpin their agri-food, forestry and marine sectors, it is important to ensure that a regional and territorial approach is adopted to recognise this divergence when developing the bioeconomy across the EU. Since the release of the 2018 strategy, there has been a surge in the number of regions who have been adopting their own strategies on a NUTS1, NUTS2 or NUTS 3 level (Haarich and Kirhmayr-Novak, 2022).
Despite these developments, the majority of European regions are at the early stages of identifying, developing and implementing new bio-based value chains. The aim of the current work is to provide an understanding of selected existing biomass arisings, flows, value chains, stakeholders and innovations in diverse regions in Europe. The approach developed is being implemented and tested in NUTS2-level regions of 7 EU countries, and is taking place within the context of the Horizon Europe MainstreamBIO project, which will provide innovation supports for rural actors to implement new bio-based value chains within their regions (known as Multi-actor Innovation Platform Regions, or MIP regions).

Approach

The approach used is partly based on desk research across 7 diverse regions, supplemented with interviews from key value chain actors within selected value chains for those regions. A data collection template was developed in order to ensure uniform collection of data, related to biomass arisings and flows, biomass price data, value chain actors and bio-based innovations. The collection of biomass value chain data is part-based on Attard et al. (2020), but adapted and expanded to include additional information such as relevant actors and innovations. Upon collection of data from the regions, the data was assessed and converted into Biomass Arising Maps using ArcGIS Pro, for each of the 7 MIP regions and subregions. The relevant key value chain actors from these regions have also been mapped for each value chain, and coded based on the type of stakeholder they represent (e.g., biomass producer, business, policy maker, civil society, research and academia). Biomass flows were developed into Sankey diagrams using PowerBI, in order to show the current end fate of selected biomass streams within the region. This, along with an assessment of the current price of biomass, provides an insight into the accessibility constraints associated with the biomass in these regions. Feedstock-specific value chain innovations are collected from across the regions, to provide a better understanding of the activities underway, but also to understand the cross-regional innovation opportunities.

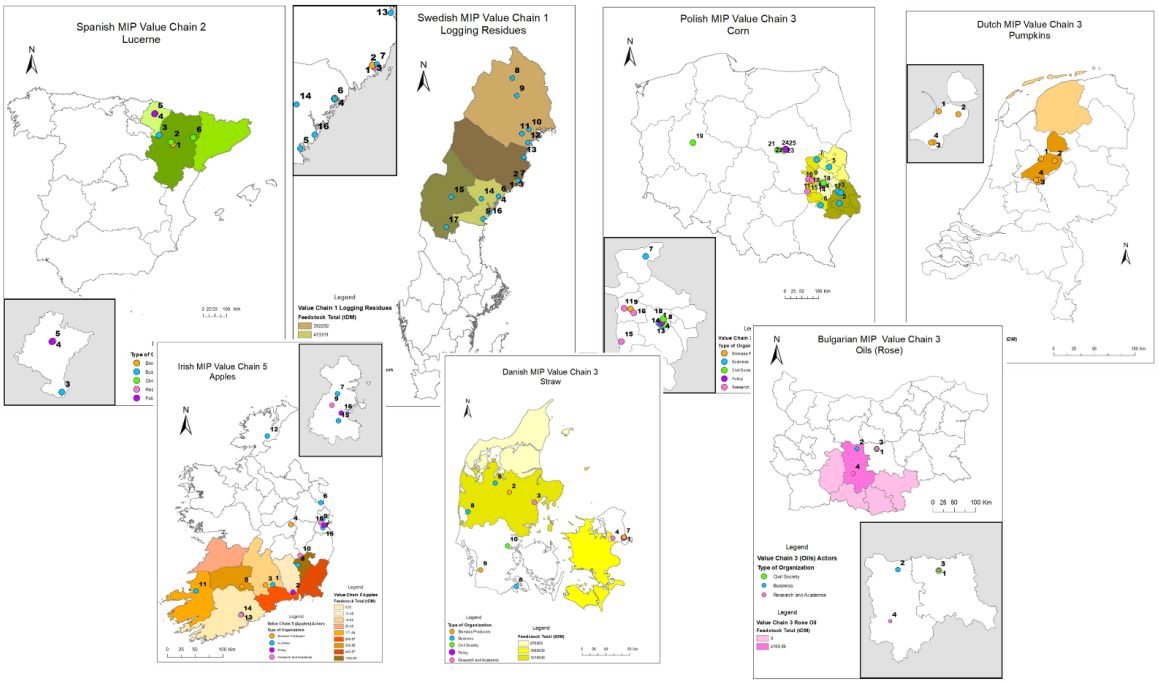
Scientific Innovation and Relevance

While data regarding agriculture arisings, and even biomass arisings may be available at national level, either through agricultural census, national farm or forestry surveys or research activities, the availability of such data at a regional level where value chains are most likely to be implemented is sparse. Providing this regional level information, allows those regional actors to

better assess the potential of bioeconomy activities for that region e.g., suitability and scale of bio-based technologies.
Supporting this with the additional mapping of current value chain stakeholders along with innovative uses or projects, can also help in building bridges towards scaling new value chains around existing biomass opportunities.

Preliminary Results

Within the 7 regions a total of 27 key biomass value chains were identified to further understand the arising, flows, key stakeholders and value chain innovations per region. The biomass arisings were developed into a collection 27 maps, a sample of which are provided below in Figure 1. These provide an understanding, not only of the regional breakdown of biomass across the participating MIP regions, but also provide an insight into the key value chain actors across various stakeholders groupings within those regions (colour-coded based on stakeholder type). A total of 172 million



tonnes of biomass was included within the mapping exercise, which included per regional jurisdiction; Bulgaria (1.75 million tDM); Denmark (51.9 million tDM); Ireland (70.5 million tDM); Netherlands (12.4 million tDM); Poland (3.4 million tDM); Spain (30.9 million tDM) and Sweden (1.9 million tDM).

Figure 1: Sample Biomass Arising and Stakeholder Maps from across the 7 MIP regions

For each value chain included, an understanding of the flow of biomass was gathered and represented via Sankey diagram. Understanding the flow and existing fate of biomass, can help us to understand the possibilities and trade-offs associated with using this biomass in new applications. This diversion from an existing application such as soil nutrition into a new bioeconomy application, has been referred to by Tonini et al. (2016) as “lost opportunities” and

can come with unintended consequence which should be fully considered prior to changing use. Analysing the mapped flow of materials over the 7 regions, we find that the vast majority of mainly by-product feedstocks which have been allocated, may already be serving an important function. For example, Figure 2 below shows that almost 96% of materials which have been allocated are going towards either soil, feed or energy production.

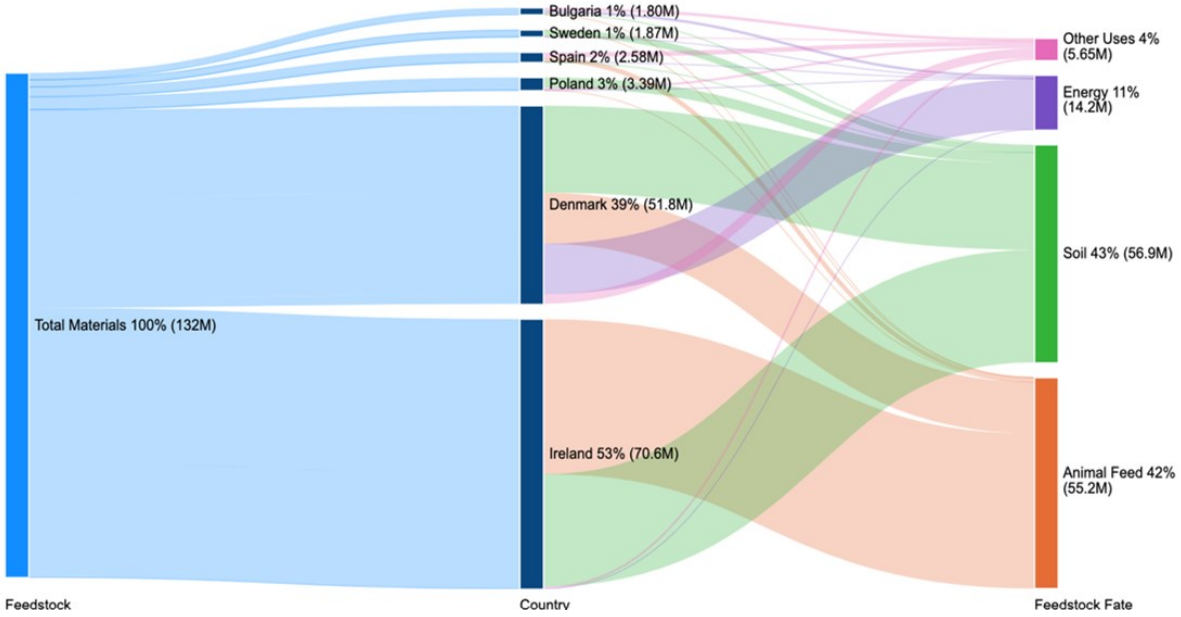


Figure 2: Flow of biomass arisings into different applications per region

Another issue to be factored in when considering feedstock accessibility, is the price of feedstock. The analysis shows that feedstock prices depend on source, current use and country. For example, in the case of accessing grass, this analysis found that the price varies by type and country. Roadside grass and nature grass, which are of interest for biorefining in the Netherlands, range from negative value, to approx. €10 per ton dry matter (tDM), while higher quality grass-clover and ryegrass which are of interest for biorefining in Denmark and Ireland can cost between €100-200 per tDM. Likewise, accessing animal slurry, for example, for anaerobic digestion, seems to range from negative value to, up to, approximately €20 per tDM.

Considering the number of value chains studied within the regions, it is useful to categorize these to identify common themes across regions. Various taxonomy or classification systems to categorize value chains based on their feedstocks or other value chain criteria could be applied (Cherubini et al., 2009; Lange et al., 2016). For the purposes of this study, Lange et al. (2016) who proposed a taxonomy of biorefinery value chains based on colour is used. This is chosen as it's the taxonomy is mainly based on type of feedstock input, which can be closely related to the findings of the research in this study. A preliminary look at some of the common emerging themes from across the 7 regions is presented in Table 1, with particular opportunities in areas of green and yellow biorefineries across the regions.

Table 1: Common areas of value chain interest within the 7 MIP regions

	Green Biorefinery	Yellow Biorefinery	Grey Biorefinery	Blue Biorefinery	Brown Biorefinery
	Green grass and other fresh/green plant materials	Recalcitrant yellow biomass, straw, stover and wood	Agroindustrial sidestreams	Marine biomass, from fish waste and discard; and from macroalgae	Sludge from wastewater treatment for example
Bulgaria	x	x			
Denmark	x	x			x
Ireland	x	x	x	x	x
Netherlands	x				x
Poland	x	x	x		
Spain	x	x			x
Sweden		x	x		

This classification can help in identifying opportunities for deploying new technologies or value chains within and across the regions. It may also help in identifying common areas of interest between the regions, which may support future knowledge transfer and cooperation. For example, the learnings obtained from green biorefinery projects in Denmark, Ireland and Netherlands, including the technologies and collaborators, may be very relevant for sharing and cooperation within these regions, but they may also be relevant for countries like Spain, Bulgaria and Poland, which have identified green biomass feedstock opportunities in case of lucerne, greenhouse biomass and sugar beet leaves respectively. Similarly, some of the opportunities identified from across the forestry sectors of Sweden, Bulgaria and Spain, or the crops sector of Denmark and Ireland, may allow for new learning or collaboration in the scope of yellow biorefining. A number of regions also report animal slurries as a key feedstock area, with various approaches focused on nutrient recycling and energy production reported from the various regions.

Conclusions

The findings show that while each region has diverse primary production and feedstock opportunities, there are often common areas of interest between Europe's region, which may offer opportunities for technology transfer, learning and cooperation. In addition, it is also apparent that much of the largely by-product biomass which has been included, is already going for applications which may be considered low economic opportunities. However, many of these applications, such as soil, feed, energy applications, serve a vital function, and would likely need to be replaced if diverted to new applications. In theory, the replacement materials could end up being less sustainable than the original materials (e.g., importing more soyabean meal to replace diverted

feedstuffs). This indicates that further research is required to better understand how much of the identified biomass can be sustainably diverted for these new bio-based value chain opportunities.

References

- Attard, J., McMahon, H., Doody, P., Belfrage, J., Clark, C., Anda Ugarte, J., Pérez-Camacho, M.N., Cuenca Martin, M.d.S., Giraldez Morales, A.J., Gaffey, J., 2020. Mapping and analysis of biomass supply chains in Andalusia and the Republic of Ireland. Sustainability 12(11), 4595.
- Cherubini, F., Jungmeier, G., Wellisch, M., Willke, T., Skiadas, I., Van Ree, R., de Jong, E., 2009. Toward a common classification approach for biorefinery systems. Biofuels, Bioproducts and Biorefining 3(5), 534-546.
- European Commission, 2018. A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment. Brussels, Belgium.
- Haarich, S., Kirhmayr-Novak, S., 2022. Bioeconomy strategy development in EU regions, in: Centre, E.J.R. (Ed.). EU Joint Research Centre, Brussels.
- Lange, L., Björnsdóttir, B., Brandt, A., Hildén, K., Óli Hreggviðsson, G., Jacobsen, B., Jessen, A., Nordberg Karlsson, E., Lindedam, J., Mäkelä, M., 2016. Development of the Nordic Bioeconomy. Nordic Council of Ministers.
- Tonini, D., Hamelin, L., Astrup, T.F., 2016. Environmental implications of the use of agro-industrial residues for biorefineries: Application of a deterministic model for indirect land-use changes. Gcb Bioenergy 8(4), 690-706.