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BioMob #4 design workshop: how to look at biomass availability data? – Summary

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Background

Platform Renewable Fuels together with Energy Innovation NL (previously Topsector Energy) and the Green Elephant Alliance organised the 4th edition of the Biomass Mobilisation (BioMob) event where 25 experts in the field ranging from industry players, researchers and policy makers, discussed biomass availability modelling and identified topics for future research.

Since flexibility is extremely important in the new biobased and circular system, and also in the new renewable electricity system, we would like to understand how the current biomass availability modelling is taking into account the inherent dynamic nature of supply and demand, options for optimal use, how to look at actor's behaviours and context-based constraints.

3 main takeaways

1) Wide range of biomass availability reflects the level of action undertaken to optimise biomass supply

The transition to the bio-based economy is faced with a recurring question: is there enough biomass? This question can be challenging to answer whilst studies modelling biomass availability potentials can lead to wide ranges of results. As pointed out by Carlo Hamelinck, this wide range is an expression of how much activity is undertaken to optimise biomass supply. The low assumptions are what you get if you don't act, the high assumptions show what is possible if you act. The low is accepting failures in the agro-food system, for instance with a lot of land in use for growing feed crops for meat. The scenarios pointing out high supply volumes are not accepting those failures and assume a "programmatic" approach to mobilise more biomass in a sustainable land use system.

2) More potential for biomass mobilisation is unlocked when rethinking and optimising current uses

An example of a programmatic approach to mobilising biomass is analysing current stocks and flows and current uses. As shown by Wageningen University and Research, rethinking current uses and optimising use over time can free up more biomass potential. As pointed out by Cyffka, Deutsches Biomasseforschungszentrum gemeinnützige (DBFZ) and many others (e.g. Junginger e.a.) reducing the current worldwide land use for feed for meat (cattle) will at once mobilise a lot of biomass options. These potentials for optimising biomass supply can be shown on system level.

3) Better investment signals can be obtained with dynamic biomass data of regional supply and constrained demand

The dynamic use of supply and demand is more difficult to model. As Cyffka, DBFZ has pointed out actual biomass supply-demand markets are not perfectly described. We have less view on temporal biomass use and supply effects. Also insights on biomass data on

regional level, such as supply costs and insights for regional supply-demand allocation can be improved. For the biomass supply side, assumptions can be made like how a typical crop generates this much residue. But data sources on the demand side, for instance what feedstock and volumes are used, are difficult to find (or private data for reasons of containing competitive information). This lack of information on the demand side is a barrier for optimising biomass supply systems, and hides potential demand signals for the supply side, for instance for landowners to invest in more biomass mobilisation.

In summary, a dynamic data position of supply and demand is lacking, data on the demand side are constrained and regional data positions can be improved.

Recommendations

Cyffka, DBFZ has provided an overview for follow-up actions in biomass data and modelling:

- Regionalised data for biogenic wastes and residues
- Database for novel biomasses & (novel) technologies (e.g. higher residue usability in case of digestate return to fields for humus balance[1], alternative feed use/circularity approaches)
- Cost data and modelling for residues and wastes
- Approaches for comparative market analysis (e.g. feedstock revenue/compensation in GHG quota (transport) vs. Renewable Energy Law (electricity))
- Analysis for efficient cascading concepts within the bioeconomy[2]
- Ownership/stakeholder/regional use data, e.g. Regional Bioeconomy Atlas[3], Biogas plant questionnaire[4], CHP plant questionnaire, industry monitoring
- Future research for regionalised value-added and resilience questions (e.g. due to shocks)

In the Netherlands, biomass availability data can be improved.

Data collected in studies are not updated the moment a project has finished. Continuity in quality and especially updating of biomass data is a point of attention. Currently the ABEL project has kicked off, and one recommendation could be formulated to already think about continuity and accessibility of the data sources in this NWO-funded project.

- RVO warmteatlas is a good example of a biomass data source, for specifically biomass supply for heat. Biomass potential data are from 2022
- The Energy Transition Model, also used for the Dutch National Plan Energy system. Is an example of a biomass availability study that is not kept updated. Based on TNO 2020.
- The Netherlands needs a centre dedicated to addressing and researching questions regarding biomass similar to DBFZ in Germany. We recommend to collaborate with DBFZ on the development of open data source similar to the DBFZ resource database.

Follow up actions

Together with Energy Innovation NL, the Platform has the intention to initiate two data sprints in two regions to model supply and demand at the level of farms (bottom-up) and to analyse how comparative market analysis can contribute to identifying perspectives for feedstock choices. Also to learn whether this could contribute to deal with climate shocks.

The Platform will take an initiative for further thinking about possible dynamics that occur when the fossil tap will be closed, new fossil fuels will immediately be ended.

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[1] SOMenergy (2020): Maintaining soil organic matter levels in arable farming with straw removal for bioenergy production; Witing et al. (2018): Biogas production and changes in soil carbon input - A regional analysis.

[2] ** Schindler (2026): Holzkaskaden in der ErneuerbareEnergien-Richtlinie: Gestaltung effizienter Ausnahmen für Bioenergie.

[3] https://www.dbfz.de/biooekonomieatlas/start

[4] Daniel-Gromke et al. (2023): Biogaserzeugung und -nutzung in Deutschland.

Together with DBFZ, the Platform will initiate thinking about improving data sources on “novel biomasses” along with WUR.

Conclusions

- The models say “go” but the agents say “no”: Modelling biomass availability considers the theoretical, sustainable and technical mobilisation of biomass whilst availability of biomass should also consider the actors (or agents), their behaviours and the constraints that enable or inhibit biomass mobilisation.
- Organising data sprints on regional level will help better understand behaviours of agents involved in biomass systems, their constraints and conditions in which biomass can become available.
- Biomass availability modelling studies provide a lens through which we can understand potentials for biomass supply. Diving into the assumptions made in the modelling tells us more about the points in the biomass system that can be influenced to unlock more biomass.
- More precise and regional data on biomass is needed, including current use and composition of biomass.
- Finding space within existing space: more biomass can become available with more efficient use of land, different crop rotation and the use of degraded and marginal land.
- In addition, with increasing circularity of biomass residue use and choosing for highly effective biomass applications, more biomass can be unlocked.
- Landowners and biomass suppliers are not the only decision-makers when it comes to choosing which and where biomass becomes available.
- To inform investments decision, more biomass data should be available with regards to quality, prices, risks, contract timeline. More transparency and data sharing can accelerate development.
- Giving a voice to the soil to inform the decision making: more knowledge from the point of the soil is needed to understand whether growing biomass can lead to improved or deteriorated soil conditions, under what condition does the soil say yes or no?
- The Netherlands needs a centre dedicated to addressing and researching questions regarding biomass similar to DBFZ in Germany.

Topics for future research

Regional and behavioural insights on current biomass flows

- Developing a database of all biomass sources including composition and destination
  - Current database mostly account for agricultural biomass residues from cultivation, we must have a better overview of all biomasses from different sectors also including food losses
- Projects like the ABEL project are underway to map underutilised biomass in the Netherlands, there is a need to support the ongoing maintenance and updating of biomass databases past the end of funded projects in order for the tool to be relevant for future users
- Organising data sprints in regions to better understand agent in biomass system, their behaviours and constraints for mobilising biomass.
- Modelling the different circularity loops of biomass residues streams to select the highly effective ones

Knowledge sharing and increasing integration between model

- Increase accessibility to the learning from FOAK-projects to better understand supply and output
- Research to increase learning from failures of projects, better understanding why a project did not succeed
- Are we ready for synergies? Similar study to the one done at BOKU university, mapping institutions, modelling work and data sharing to better integrate biomass

New research topics

- Organising a modelling exercise or a workshop 'light': what happens if fossil fuel supply is shut down all together tomorrow? Which actors start to move? With partners such as PBL.
- Soil as agent – when does the soil say yes or no, under what conditions does the soil agree to produce biomass.
- Including brands in projects to encourage bio-based products as they have the most urgency in the supply chain.
- Assessing the data position of agents along the biomass supply chains to inform their decision making.
    - If Argus is the price data bible everyone refers to how can we make this data more readily accessible
- Influence of infrastructure on biomass, opportunities and constraints for transport (e.g. transport of biomass across inland waterways may become more challenging in the future due to droughts and limited river flow).
- Impact of water availability, water scarcity and drought on biomass potentials.

From the landowner / biomass supplier perspective

- What is the knowledge base of farmers / landowners / biomass suppliers and what are their decision making to grow a crop or another based on?
- Who is making the decision in the biomass system?
    - For instance, on which kind of biomass is grown, where it is located, when it gets planted, and the inputs that it requires.
- How can farmers be empowered to join cooperative to aggregate residues and share knowledge?
- To what extent does bringing technology closer to farms incentivise farmers to make biomass residues more available?
- Investigating how to improve residual removal by funding starts up to develop innovative practices (also mentioned in project Drawdown[5])

Welcome and setting the scene – Loes Knotter (Platform Hernieuwbare Brandstoffen)

Loes Knotter, the executive director of the Dutch Platform Renewable Fuels introduced the background of the workshop which aimed to deepen and expand our knowledge to identify the new questions. As policy is often concerned with biomass availability question, the Platform is interested in investigating the how-questions on how to achieve biomass mobilisation.

The previous editions of the BioMob events have led to research projects like the TU Delft Clean Shipping project and the paper on "Land based biomass and energy crops". Together, these editions have brought insights on how to develop more inclusive value chains that also include social justice and deepen our understanding on the need to investigate biomass on a more context basis.

Loes Knotter pointed to the need to create better insights to support investments on biomass feedstock supply which must focus on more regional levels while taking the soil conditions. In response to the SER "Biomass in Balance" report, an approach to give soil a more central role is proposed. In this edition, we investigated biomass availability modelling with questions on how to organise biomass modelling data taking into account circularity and flexibility, in a way that also considers the behaviour of the agents involved in biomass supply chains to better inform investment decisions. The insights from the day help identify the new research topics for follow up.

[5] Reduce Crop Residue Burning (august 2026) https://drawdown.org/explorer/reduce-crop-residue-burning#take-action

Insights from agent-based modelling for the biomass value chain – Maurice Mommen (Energy and Innovation NL)

Maurice Mommen from Energy and Innovation NL shared a perspective on how to look at biomass mobilisation based on the agents that are involved and influencing the decision making along the supply chain. Insights on agent-based modelling were presented using the analogy of the growth and optimisation of the internet, and with examples from the Dutch TV programme “Caviarace” (guineapig race) and the recent headlines of coal power plants opening again in the Netherlands to illustrate how agents respond based on the constraints in their environment. With a shift towards a bio-based economy, we cannot simply recreate the fossil supply chains of the past. Instead, we must better understand the challenges associated with the distributed and living network of biomass flows.

In the current modelling practices, one dominating land function is ascribed on a pixel level while there may be more uses. Maurice Mommen invited the audience to find more space for biomass potential within existing space where one location can fulfil multiple functions simultaneously and over time. Biomass availability studies model based on theoretical, sustainable and feasible potentials whilst the mobilised potential is often overlooked as it pertains to the biomass owners who can make it available. These studies often show that there is a lot of biomass potential whilst it is not yet being mobilised on a large scale for other functions than food and feed. To understand this, we need to better understand the system, its agents and how they behave.

This is what agent-based modelling can bring, an understanding of why people are moving or not within a system. Maurice Mommen argued that both biomass system optimisation and agent-based modelling are needed. The current system optimalisation approach helps identify the best configuration of supply transport infrastructure whilst agent-based modelling can bring insights on how farmers, processors logistics providers, technology and government respond to each other and to changing circumstances.

By organising data sprints as field work to observe and understand the rules of behaviour, we can better understand the motivation of agents, what makes them move, why and how they react to constraints. Maurice Mommen used the example of drought which can help understand what happens when the biomass system is exposed to constraints, what influences biomass supply chains, when does it break or adapts and who carries the consequences?

We need to discover why biomass does not move, why agents are not moving, where is the space within space and which agent need to act differently and what they need to move.

The discussion following the presentation explored:

- How can the agricultural world become more aware that it must serve different functions in the future?
- Who is setting the constraints that influence the decision making of biomass owners? Who is making the decisions?
- How can we take into account the distance that biomass needs to be transported and bring technology closer to farmers?
- How can we increase trust in the biomass system?
- What is the knowledge base of farmers and what are their decision making to grow a crop or another based on?
- How can aspects of time and space in the future be taken into account into the modelling to increase flexibility?

How to think about time and circularity: assessing the circularity of biomass residues – Jan Broeze and Wolter Elbersen (WUR)

Wolter Elbersen and Jan Broeze from Wageningen Food and Bio-based Research shared insights on how to increase the circularity of biomass residues based on their research for the KoM Circ project. New approaches are needed to assess biomass

residue availability as studies currently consider fixed and existing biomass uses. In addition, there is a consensus that residues need to be left in the soil whilst optimising the soil nutrients by leaving residues on the ground also depends on the season when they are applied.

Wolter Elbersen explained the concept of circularity and cascading of biomass where the rules of circular use of biomass are described as follows: food is considered as higher value than feed and materials, maintaining the functionality of biomass as long as possible, postponing final uses and maintaining soil quality In this approach to circularity with the example of wood in Bavaria, cascading leads to 14% savings in wood needed and 7% less greenhouse gas emissions. Ultimately, when biomass is used in a more circular way, more biomass becomes available and land, water, labour and energy is saved. In the KoM Circ project, a formula has been developed to assess the circularity score of different biomass residue applications based on its composition, efficiency, appreciation and functionality.

The case of straw in the Netherlands was presented in which we see that a lot of it is left in the field whilst the straw used for animal bedding, horticulture or animal feed is also brought back to the soil. When looking at the flow of straw, there are opportunities to make the system more circular to free up more biomass. For instance, pelletizing straw for horses to use in their stables was proposed as a more efficient way to use it whilst freeing more straw for other uses.

Jan Broeze further presented the results from the Circularity impact assessment (CAT) method developed to assess the degree of circularity of biomass residue applications This quantitative analysis for circular biomass use considers both resource-use efficiency indicators (biomass composition and yield factor to product) and environmental impact indicator (i.e. consequential greenhouse gas (GHG) emission effect).

The tool effectively helps actors in their decision making to identify more efficient use of residues by comparing the biomass residues application and translating it into a circularity score. The circularity score and GHG effects of different was presented for the case of red peppers, wheat and beet residues. The results are different per material and application as each material has a specific chemical composition and each destination has specific mass balance parameter values.

The group discussion following the presentation focused on:

- How can we design biomass use with more circularity principles in mind (i.e not using led pain on wood so it can be reused and repurposed for other applications)?
- Can we model the different circularity loops of the biomass residues stream to select the highly effective ones?
- How can we steer on efficiency and what are the conditions to make systems more circular?
- What changes can be made in the current biomass system for a more optimised system?

How to look at current data models? - Carlo Hamelinck (studio Gear Up)

Carlo Hamelinck from studio Gear Up shared insights on current biomass availability studies which often result from a policy question asking how much bioenergy can contribute. Starting with an overview of current land use, we see that more space for biomass potential can be found within available and current land use practices. More biomasses can become available when it is grown more efficiently or by changing rotation in crop land and using degraded and abandoned land.

An overview of results from studies on sustainable biomass potential lead to varying results ranging from 27 EJ up to 1272 PJ of global bioenergy potential for 2050 whilst the global energy use in 2023 was 634 EJ. This wide range is determined by the crops, wastes and residues that are included in the modelling and the assumptions that are made regarding technology development, supply chain efficiencies, alternative and competing uses, etc. The results do not tell as much as the assumptions that are made to model biomass availability. These assumptions provide insights on the levers that can be

activated to unlock more biomass potential. Carlo Hamelinck argued that the lowest biomass potential is the outcome of inaction whilst the highest potential shows what is possible when action is taken.

Reflection on current data modelling and DBFZ approach to regional datasets - Karl-Friedrich Cyffka (DBFZ) (online)

Karl-Friedrich Cyffka from the German Biomass Research Center (Deutsches Biomasseforschungszentrum gemeinnützige DBFZ) presented the research projects that DBFZ has carried out and is currently working on. DBFZ has developed R&D methods and tool to map biomass potentials on regional level on a European level. On a national level, they also monitor biomass in the form of biogenic wastes and residues from the agriculture, forestry and fishery sectors. This in turn helps address question on how residues are currently used and measuring the potential of what can be mobilised. The SOBIOII project that DBFZ has carried out provides insights on the cost optimisation of biomass distribution. Karl Cyffka emphasized the need to know the current status of biomass as an important point in the modelling while also needing better insights on regional supply-demand allocations of biomass. DBFZ also developed spatial analysis with GIS which helps assess suitable location for potential production facilities based on available sources and transport options. Lastly, other future research ideas were proposed for instance to create databases for novel biomasses and technologies, cost data and modelling for residues and waste, and analysis for efficient cascading concepts within the bioeconomy.

Co-design session 1 –how to look at agents of biomass system and their constraints

During this first breakout session, participants were divided into three groups to discuss the agents that are involved in biomass systems and grounding these examples into a region in the Netherlands.

The first group picked the Limburg region and identified two interesting clusters region: the chemical industry cluster in Chemelot and the greenhouse horticulture cluster around Venlo and how these two could be linked. They discussed how when classified as a waste, growers have to pay composters to process it whilst growers would rather be paid to supply this "waste/residue" for further processing. However, if classified as a waste, greenhouse by products cannot be sold onwards. Composters have a monopoly on processing wastes. Therefore, the definition of waste and the rules around their processing are problematic and in the way of improving circularity in the system. The group listed several agents that play a role in the biomass system.

In the second group, Delfzijl was chosen as a location, with a focus on SAF production using sugar beets as feedstock. The group identified some of the main challenges for the different agents involved in this system. The nitrogen crisis in the Netherlands was seen as the major challenge for both the farmers and the government. Growing biomass feedstocks for SAF production could solve multiple problems at once. For farmers, there is a large distance between them and the end user of their products, making it difficult to identify biomass feedstocks as potentially interesting crop to start growing. Furthermore, changing the way farmers run their farm, by changing from livestock to sugar beets for example, might be a challenge for some farmers. Then, processing the feedstocks into high density intermediates or directly into SAF, is challenging mostly because of the reliance on feedstocks quality and quantity, and off takers. These processes require large investments, which creates large risks as well. The price and quality of the feedstock is determining the end-product, which makes it difficult to guarantee a certain product standard. This requires a flexible operating process, such that multiple feedstocks can still produce a high-quality SAF.

In the third group, Zeeland was chosen as a region with a discussion centred around the agents that have ownership over the land and those who can influence the biomass system. The group noted that landowners are often connected to an industry and have little influence on the decision making of what biomass or crop is grown. Accessibility is also a determining factor for the viability of biomass supply chains. The group aimed to

identify new opportunity to get landowners to move and increase accessibility to biomass feedstock. For instance, by forming cooperatives and strengthening their information position by informing them of the other benefits that biomass can bring when transformed into energy and chemicals (e.g source of biogenic CO_2, negative emissions, components for high value food applications, addressing other environmental challenges like air or water pollution).

Co design session 2 – what data is available and how to organise it

In the second breakout round, groups were asked to reflect on the data position within the biomass system, with questions on which data do we already have, what kind of data is still needed, and how can it be organised.

The discussions revealed that there is availability of data on the side of primary residues on aggregated level that can be estimated based on the type of business where biomass flows become available. However, there is a lack of data on biomass availability in individual regions or businesses. More data is also required with regards to the quality of biomass flows which can better inform how it can be used. More data on a crop level should also be made available for farmers to better understand the effect of crops on land and possible emissions reductions.

Data on prices is often difficult to find as this is competitive and sensitive information. Argus was mentioned as one of the main sources for providing this price information and permission needs to be obtained to use it publicly. As some of this information can be confidential or sensitive to make publicly available, intermediate program or organisation could be put in place which can decided what information can be directly relevant for which party.