BALTIC INDUSTRIAL SYMBIOSIS

LIVING LAB

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Interreg Baltic Sea Region

EUROPEAN UNION

EUROPEAN REGIONAL DEVELOPMENT FUND

PAPER PROVINCE

usify.

CONTENT

BALTIC INDUSTRIAL SYMBIOSIS

ABOUT THE PROJECT

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BALTIC INDUSTRIAL SYMBIOSIS

Purpose

The project Baltic Industrial Symbiosis (BIS) aims to build knowledge and capacity among innovation actors on approaches to support and accelerate industrial symbiosis development in the Baltic Sea Region. The work package – Accelerating Symbiotic Business Development, will undertake a mapping of a resource stream aiming to identify how one companies secondary resource ("waste") can become another's primary resource, and thereof adding value to under-utilized resources.

Within this work package, the Swedish cluster Paper Province is responsible for the activity 2.4 Living Lab that aims to demonstrate the use of a resource stream. As sub contractors to Paper Province, consultants from Usify will support and contribute to the execution of this activity.

LIVING LAB

Living lab is a co-creative activity performed in this project to demonstrate and test the resource stream with the material and stakeholders engaged in real life context. By following the resource stream together, working co-creatively, we are more likely to understand different perspectives, find a common view and identify possible gaps, opportunities and challenges to learn from.

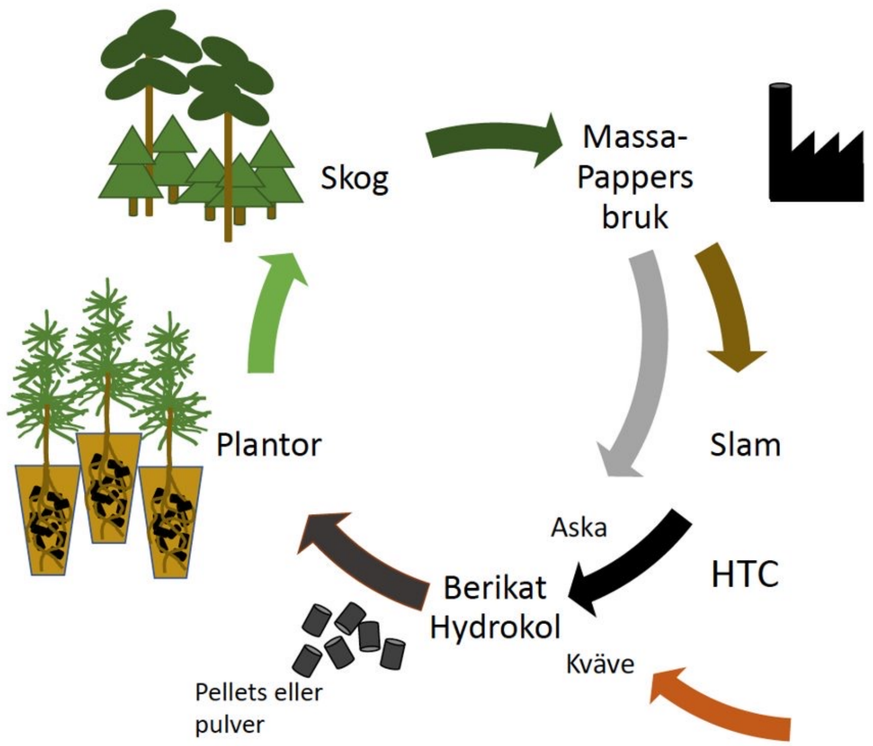
Due to Covid-19 all activites had to be redesigned to fit a digital format. As an important aspect of the living lab activity is that one can experience the resource stream up close, and examine the material and context with all the senses, it was important to make the digital format as engaging and practical as possible.

NÄRSKOG2

Project in focus

Närskog2, is a Vinnova financed project exploring how to increase resource efficiency through circular economy. The purpose with this project is to verify the possibility of using enriched biochar from forest industrial residues as a fertilizer for plants and woodland.

This project was used as a pilot for testing the living lab methodology.



USIFY'S CONTRIBUTION

Usify's expertise

The design consultants from Usify come with an experience of working with explorative and co-creative process where key actors and users are engaged with the aim of developing innovative and user-centered services and experiences.

Contribution

Through interviews, living lab activities and visual mapping Usify have worked to demonstrate and create an understanding of the identified resource stream, both from the perspective of the material and the stakeholders.

Adjustments: Due to Covid–19, the living lab activities were designed to fit a digital format.

BALTIC INDUSTRIAL SYMBIOSIS

PREPATORY WORK

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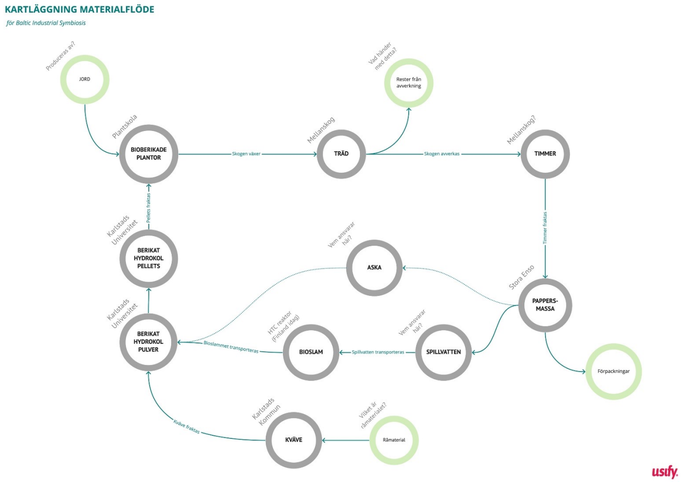
INTERVIEWS

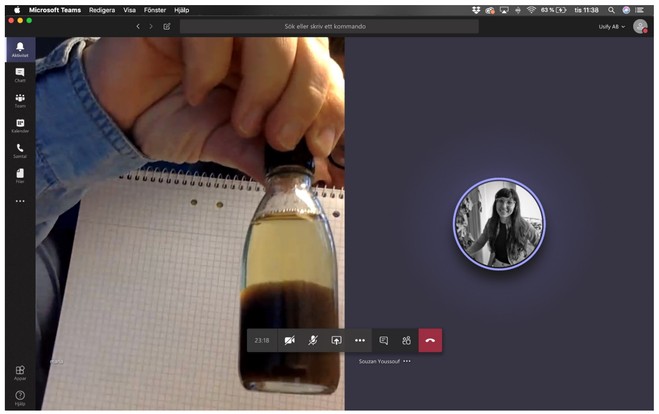
With trigger material

Usify conducted video call interviews with the key stakeholders, using a first draft of the material journey as a trigger for discussion. To compensate for not being able to conduct observations at each locations the interviewees were asked to show and demonstrate some of the materials and key activities with photos.



Initial trigger material, Usify

Feedback from Stora Enso



Bio sludge shown by researcher, Karlstad University

First day of planting, 2020.

Photo: Rickar Moritz, Värneskog

VISUAL MAPPING

Purpose

As a part of the prepatory work for the living lab activities the insights from the interviews were visualized and mapped as a visual story. This helped create an overview of the resource stream and could work as a trigger material for further discussion.

KEY STAKEHOLDERS

Plant Nursery Manager at Stora Enso Forest

University lecturer and Research manager at Karlstad University

Environmental Manager at Stora Enso Skoghall Mill (pulp and paper mill)

Forest Inspector and Forest Management Leader at Mellanskog

Forestry Manager at Värneskog

Process Engineer at the Municipal Treatmant Plant in Karlstad

Transportation Manager at VSV Frakt & Unite Logistics

CTO, C-Green (HTC process)

Business Development, Econova

STAKEHOLDERS' CONTRIBUTION

Task

Each stakeholder was asked to create a 7 minute long video capturing their part of the resource stream, either with a smartphone or a digital camera.

Content

- How the material is transported/converted
- The context/ environment
- What tools or machines that are used
- The actors involved and the work they perform

To have in mind

- The stakeholders were told to think of it as a study visit, and be pedagogical while explaining.
- Capture the sound
- Film with a steady hand
- Use good lightening
- Use a horizontal mode if filming with a smart phone

BALTIC INDUSTRIAL SYMBIOSIS

EXECUTION

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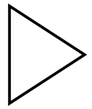
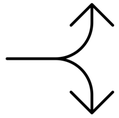
DAY 1 – INSIGHT



Introduction

We described the agenda, purpose and goals for the day.

Defined everyone's roles to set the stage for the day.



Follow the flow

Each participant got to present and familiarize themselves with each step of the resource stream through a pre-recorded video and verbal presentation.

Everyone had the opportunity to ask follow up questions and discuss any surprizing details or the process as a whole.

Go over visualization

A presentation was held to offer insight into the visualization of the material journey. Here the participants were urged to write down any questions for the second day of activites.

Technical support

Participants got a technical run through of the digital whiteboard tool Miro as the second day was focused on co-creative work.

1. From wood chips to sludge

Stora Enso described the process at the paper and pulp mill, their handling of waste streams and the residual products coming from the waste water purification.

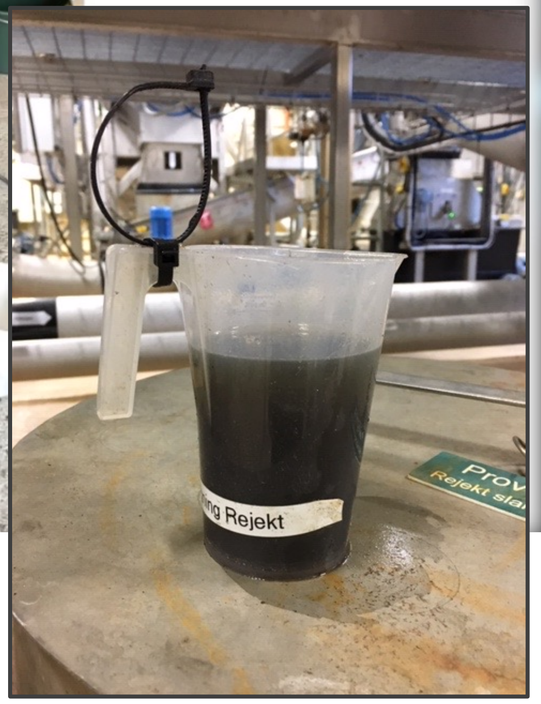
”How advanced is it to run the process? How much maintenance and workforce is needed?”

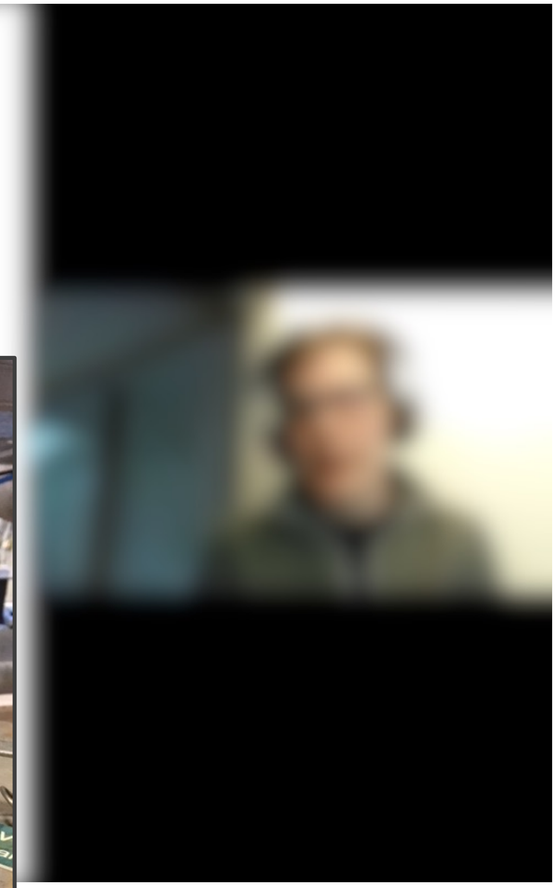
2. HTC Process

C-Green showed how the HTC process at their facility works, where the conversion from sludge to biochar happens.

”It really doesn’t matter, but it’s more energy efficient to have lower moisture content.”

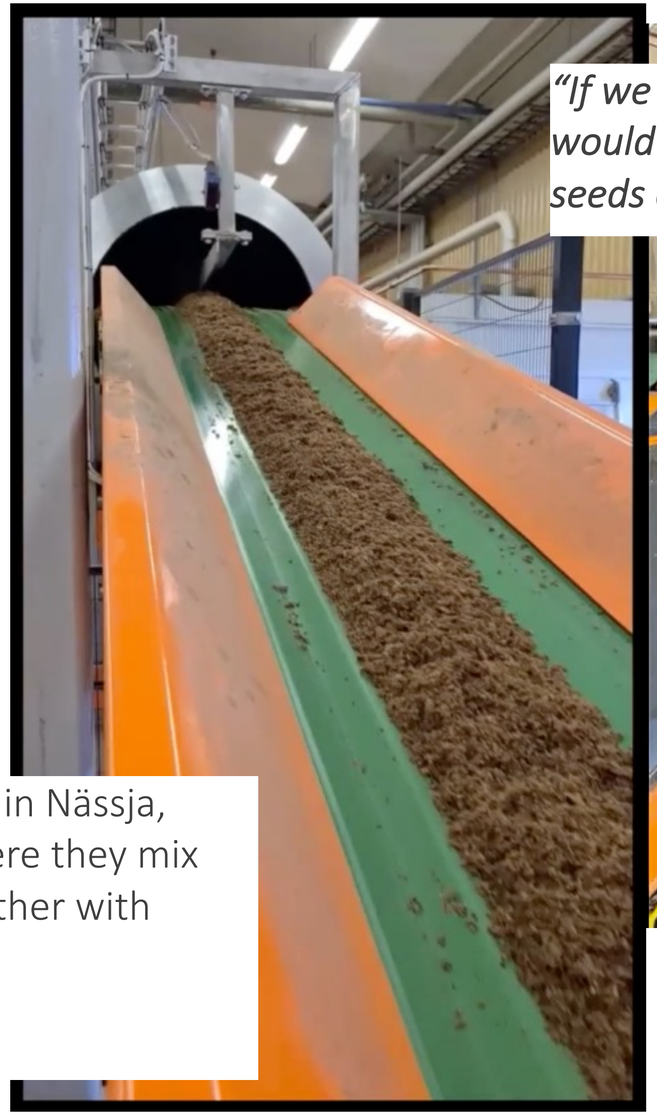
Photo from pilot trial



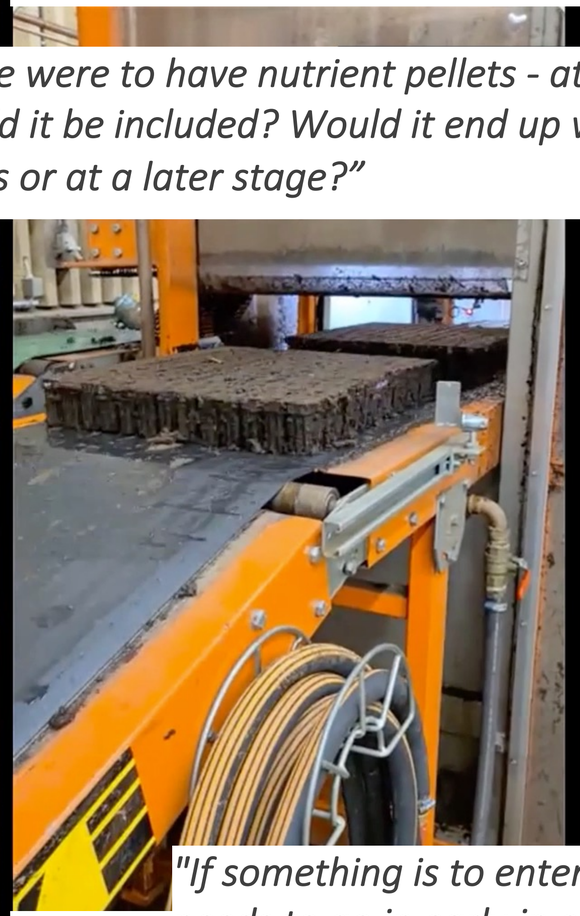


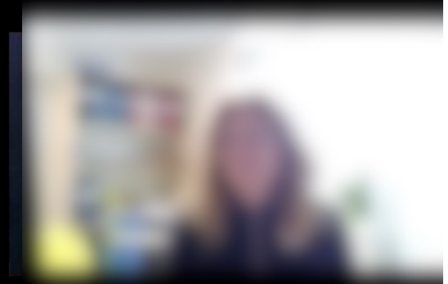
3. Nitrogen enrichment

The Municipal Treatment Plant described how the biochar potentially can be nitrogen enriched with ammonium at their facility.



“If we were to have nutrient pellets - at what stage would it be included? Would it end up with the seeds or at a later stage?”



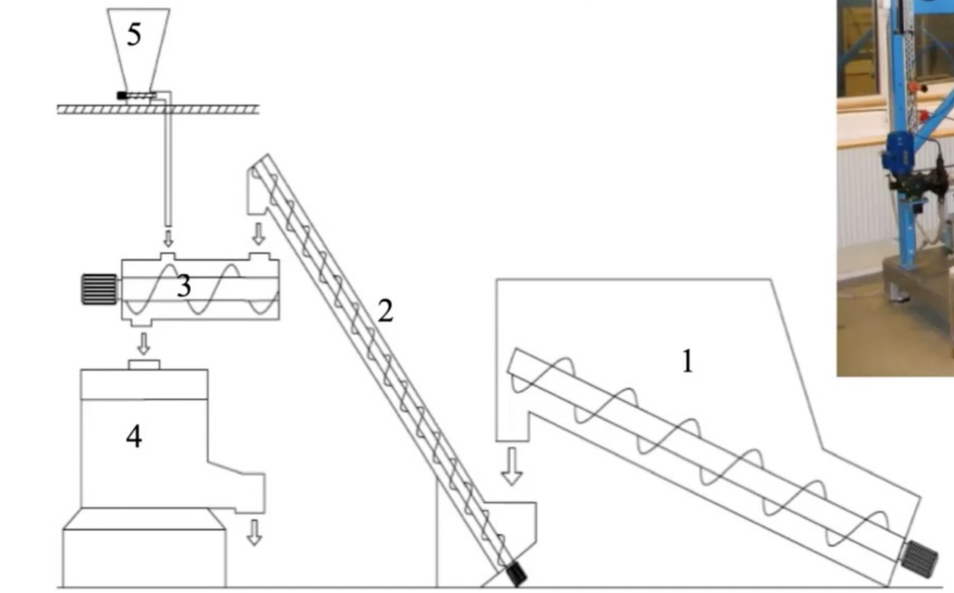


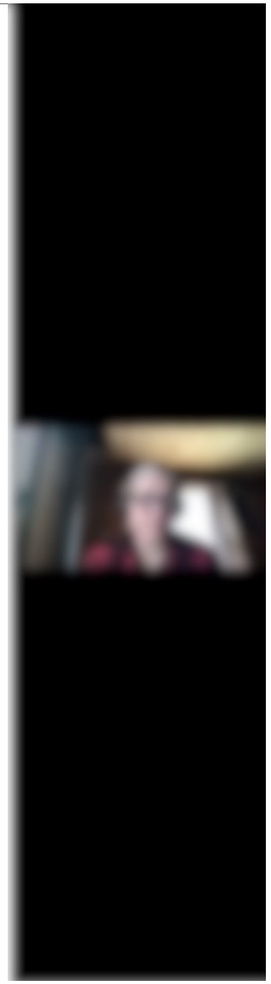
"If something is to enter the soil structure, it needs to go in early in connection with tearing the peat out of the peat bale, and end up on the peat track."

4. Plant nursery

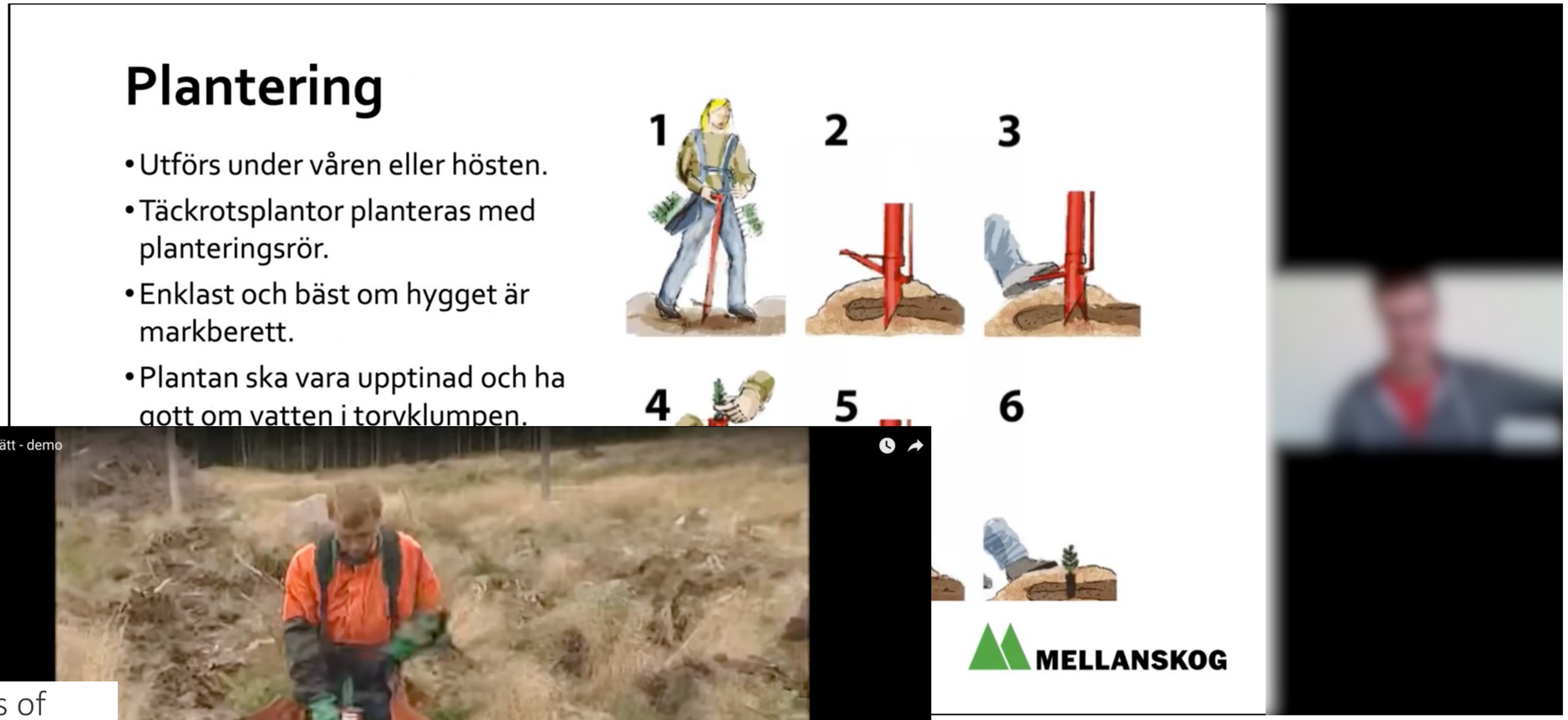
Stora Enso’s Plant Nursery in Nässja, described the process where they mix peat and distribute it together with seeds into pots.

5. Making pellets





Research manager of the project Närskog2, described the process of creating pellets.



6. Planting

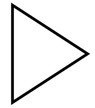
Mellanskog described the process of planting and the requirements for plant growth.

Go over visualization

After all presentations the participants were introduced to the visualization that was based on the previous interviews.

LIVING LAB ACTIVITY

DAY 2 – CO-CREATION



Introduction

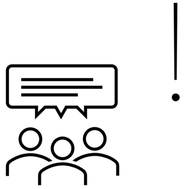
Participants got a technical run through of the digital whiteboard tool Miro.

They also got to reflect on previous day’s insights.

Gaps & Challenges

Participants worked in smaller groups with identifying and defining gaps & challenges for the material flow and stakeholder journey.

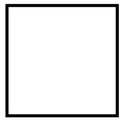
They also got to show & tell to the other groups as a way to give an overview of the results.



Opportunities

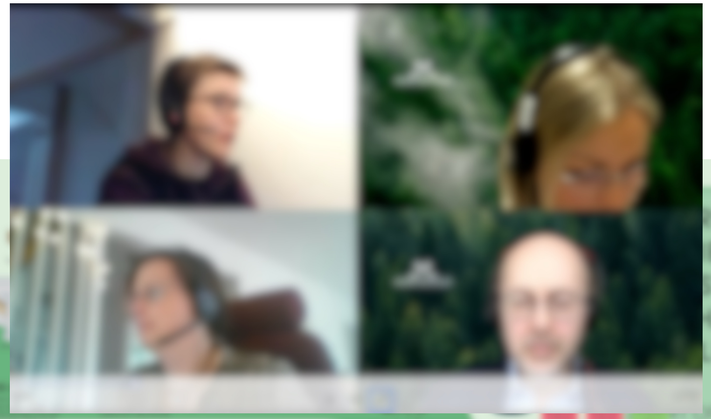
Participants worked in smaller groups with identifying and defining opportunities for the material flow and stakeholder journey.

They also got to show & tell to the other groups as a way to give an overview of the results.



Outro

We booked a time for the follow-up meeting with the particpants and ended with a reflection on the material flow after the workshop, their view on the method and what they will do as a next step.



Gaps & Challenges

What gaps and challenges do you see from a stakeholder perspective?

E.g.

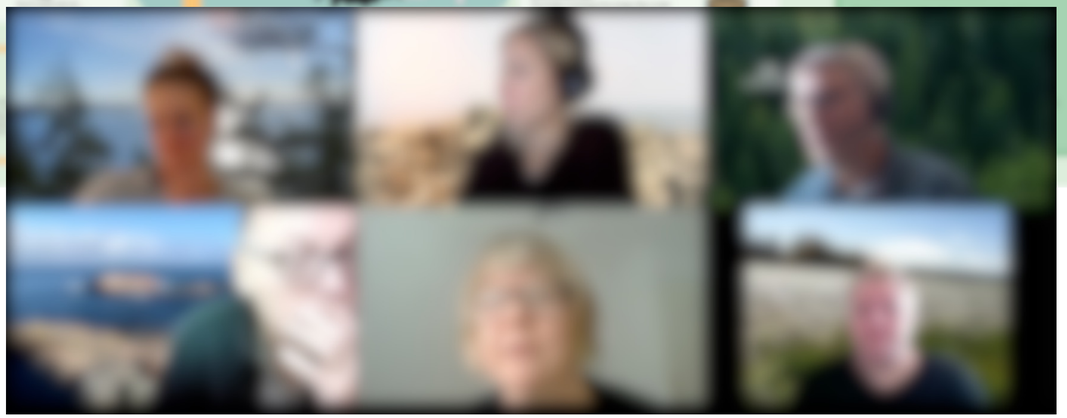
- How do the transfers look like between the stakeholders?
- What skills are lacking?
- Which stakeholders are missing?
- In what form do they need to get the material?
- How are the responsibilities shared between stakeholders?

Gaps & Challenges

What gaps & challenges do you see from a material perspective?

E.g.

- What challenges do you see in the processing process?
- What tools / machines are missing?
- What activities are missing?

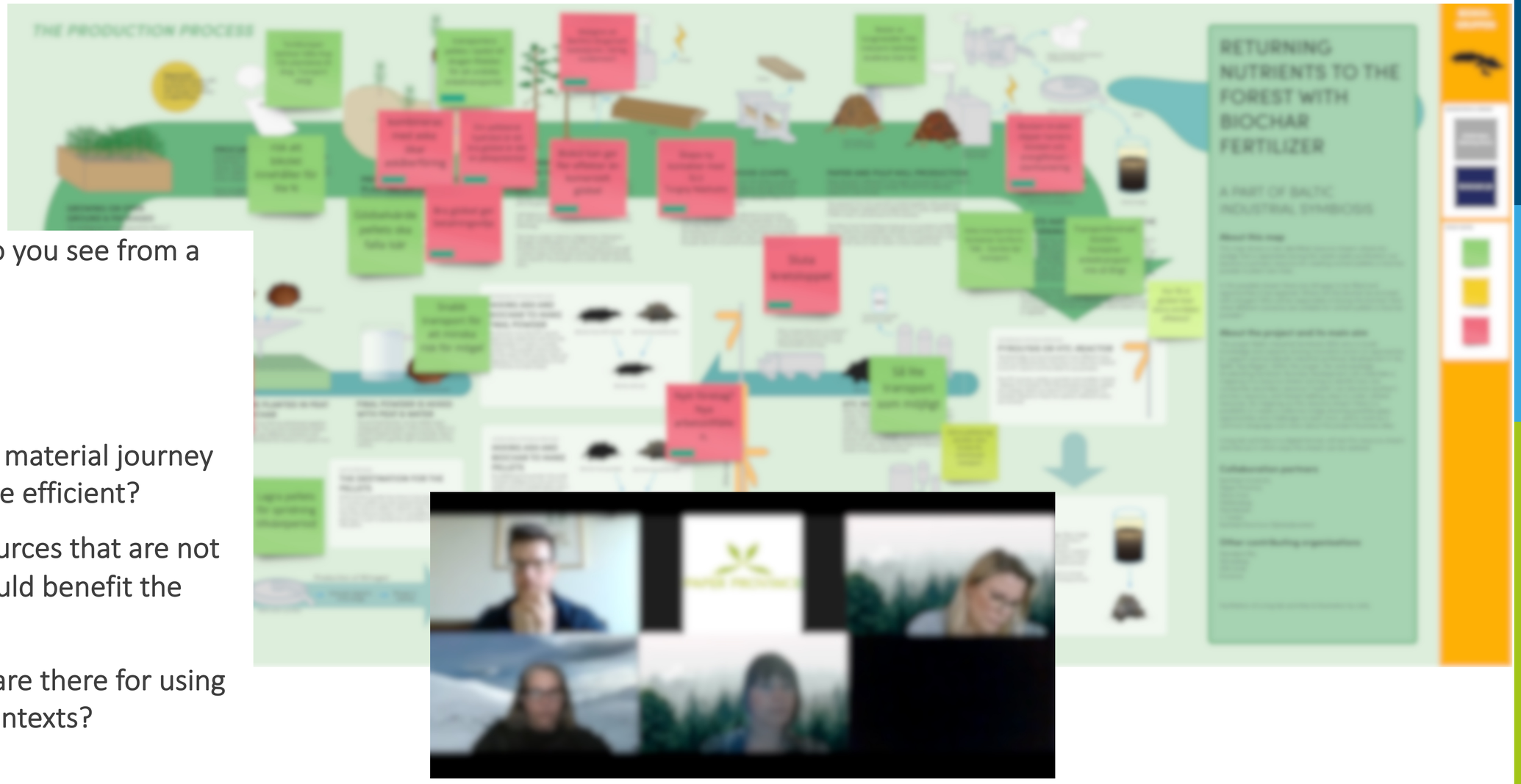


Gaps & Challenges

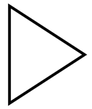
What opportunities do you see from a material perspective?

E.g.

- Which parts of the material journey could become more efficient?
- Are there any resources that are not being used that could benefit the stream?
- What possibilities are there for using biochar in other contexts?



DAY 3 – FOLLOW UP



Introduction

We did a recap of the Living lab activities during day 1 & 2.

Reflections

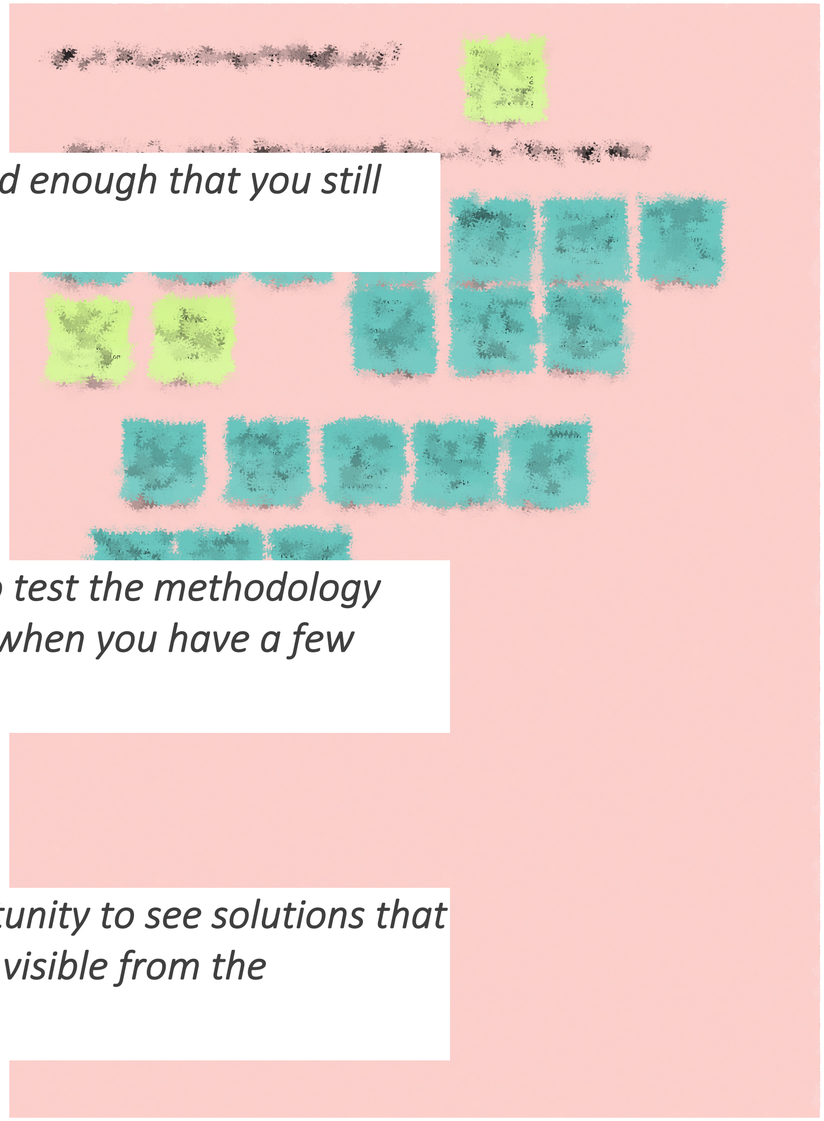
Participants were asked to reflect on the Living lab methodology as a way to map resource streams. Both from the perspective of sharing one’s own role in the stream but also take part of other’s roles.

What worked, what didn’t work and could be different?

Results sketch

We showed a sketch of the results from day 1 & 2 and asked the particpants to comment and complete the map where there were uncertainties.

DAY 3 - REFLECTIONS

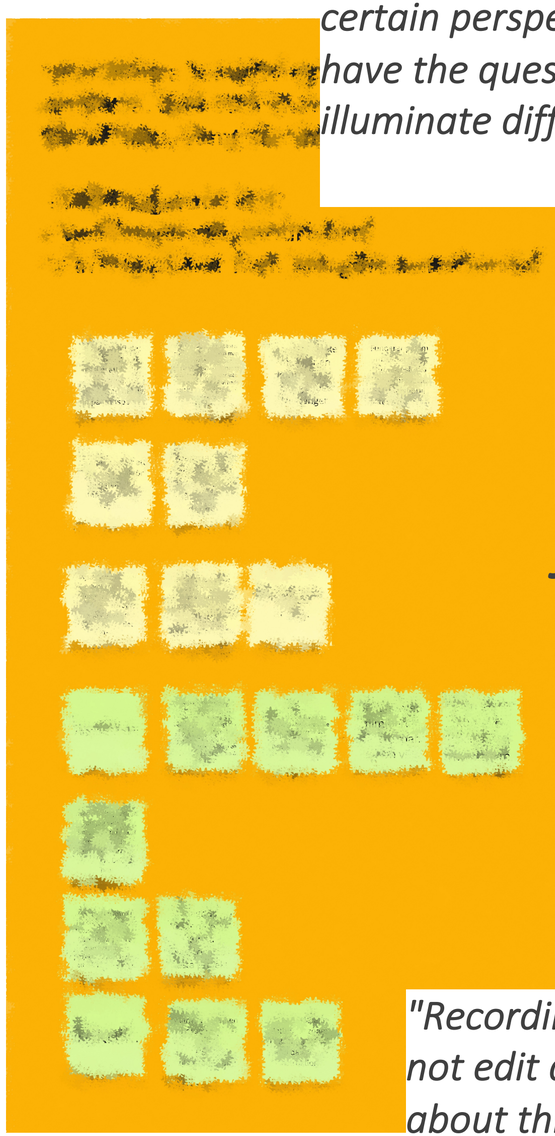


”The films were good enough that you still got an insight.”

”Maybe it's good to test the methodology later in the project when you have a few more answers.”

”You get the opportunity to see solutions that may not have been visible from the beginning.”

”Sometimes you forgot to talk about a certain perspective, but then it was good to have the questions there to be able to illuminate different perspectives.”



“I feel that I could very quickly read into the flow by hearing, and seeing the picture. It was good!"

"Recording a 7 min movie felt too much. I can not edit a movie. I thought ’what should I do about this?’"

DAY 3 – RESULTS SKETCH

BALTIC INDUSTRIAL SYMBIOSIS

THE MATERIAL & STAKEHOLDER JOURNEY

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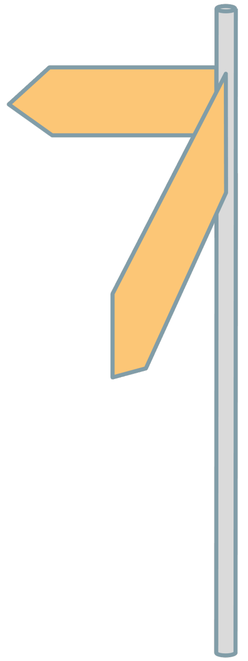
THE PRODUCTION PROCESS
RETURNING NUTRIENTS TO THE FOREST WITH BIOCHAR FERTILIZER
A PART OF BALTIC INDUSTRIAL SYMBIOSIS
THE RETURNING PROCESS

FINDINGS

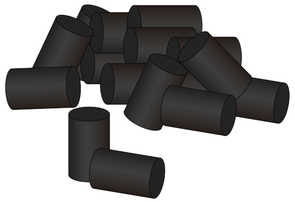


Based on the interviews and the living lab activities gaps, challenges and opportunities have been identified and mapped out in the visualization. The visualization also highlights parts of the resource stream where there are crossroads and different options to chose from.

All of these findings are listed on the following pages.

Challenge:
”The municipalit y has requirements for discharge levels to water, but also strict requirements for their sludge. Nitrogen enrichme nt could be slowed down if substances leached from the hydroenriched biocha r end up in our process.”

CROSSROADS



Adding nitrogen to biochar

The biochar could be enriched with nitrogen in order to make the material more efficient as a fertilizer. One alternative is to add nitrogen coming from the Municipal wastewater treatment where nitrogen is released during the anaerobic digestion process, a techinque that kills most of the dangerous parts of the sludge.

Pyrolysis or HTC

The biosludge can be processed in two different ways to create biochar. One way is to heat the material in an HTC reactor and the other to use pyrolysis.

Powder or pellets

One alternative is to mix the biochar from the HTC process with ash from the biofuel boiler to create a nutrient content in the powder mixture. Another option in the process is pelletizing the powder into small compact shapes and use it as a carbon sink that breaks down over a longer period of time in the forest.

GAPS

Separation of biosludge

Currently there is no separation of biosludge. There is a need of further investigation on how to separate and dry the sludge.

Research on heavy metals

More research is needed to understand the impact heavy metals in ash can have in the forest to ensure that we stay within limits.

HTC

Where could the HTC process be done, and by who?

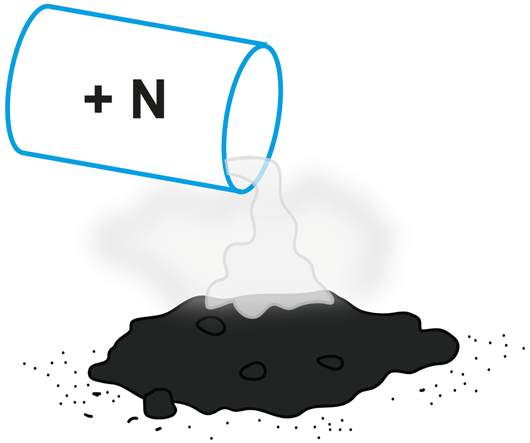
Pyrolysis

Where could the pyrolysis process be done, and by who?

”We have residual products that could come to use for this flow. However, we have no interest in restructuring our core business.”

Paper & pulp mill
(biosludge)

GAPS



Transportation

The transportation has to be balanced against the value of the product. If there is no willingness to pay it requires low transport costs, i.e. close proximity between facilities.

Enriching biochar

Enriching biochar with nitrogen is a relatively unknown process that needs to be developed so that we understand its efficiency. How do we dry the coal after enrichment on a larger scale, for example?

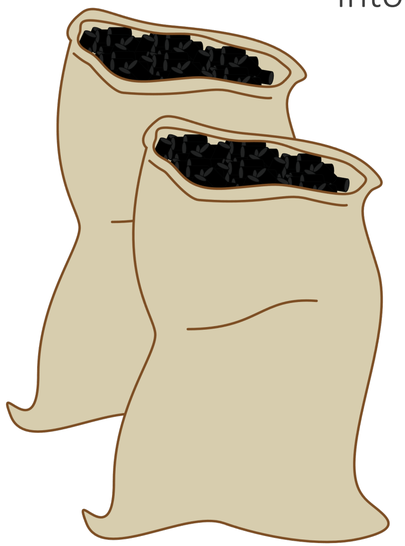
Handling of pellets

While biochar powder has shown to be more suitable for nursery, pellets are best spread directly in nature as it has a poorer ability to absorb water. This means that if the pellets are to be used for spreading over regeneration areas in the forest they need to be stored in sacks. The storage facilities are not yet defined. It is also necessary to take into account that the use of hydrocarbon may occur for a short time of the year.

GAPS

Mixing biochar and peat

Who should mix biochar and peat into a good mixture?



Bags with pellets

How should the bags with pellets be received and opened before spreading it into the forest?

Spreading of pellets

How do we best spread the pellets over a large area efficiently and make sure they deliver nourishment over time?

Research

Research is needed to understand when it is preferable to add the biochar fertilizer in the forest's growth process. As well as research to track how efficient this is over time.

CHALLENGES

Transporting wet sludge

To transport wet biosludge is expensive. The goal should be to minimize this transport if possible.

Drying sludge for pyrolysis

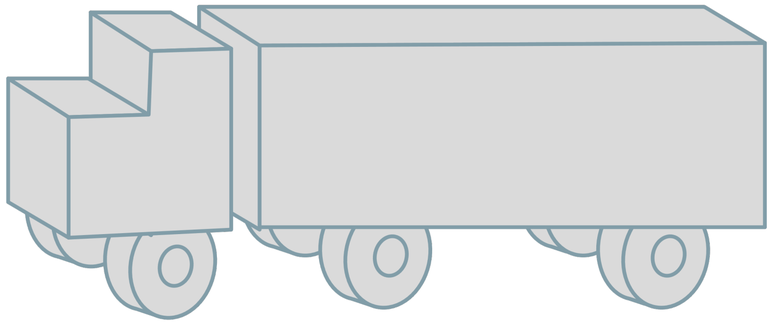
To make sure that the biosludge is free from toxic chemicals it needs to be separated and then dried in order to create biochar from it in a pyrolysis process.

Strict requirements

The municipality has requirements for discharge levels to water, but also strict requirements for their sludge. If substances leached from the hydroenriched biochar end up in our process, nitrogen enrichment could be slowed down by this.

Transporting char

When transporting char it is important to clean the trucks from dust as the pulp and paper mills do not accept contaminated wood chips.



CHALLENGES

Risk of mold, biochar

The transportation of biochar needs to be quick to decrease the risk of mold.

Risk of mold, pellets

There is a risk that pellets that are stored over time will mold.

Control growth

May be difficult to control growth when using powder at the plant nursery.

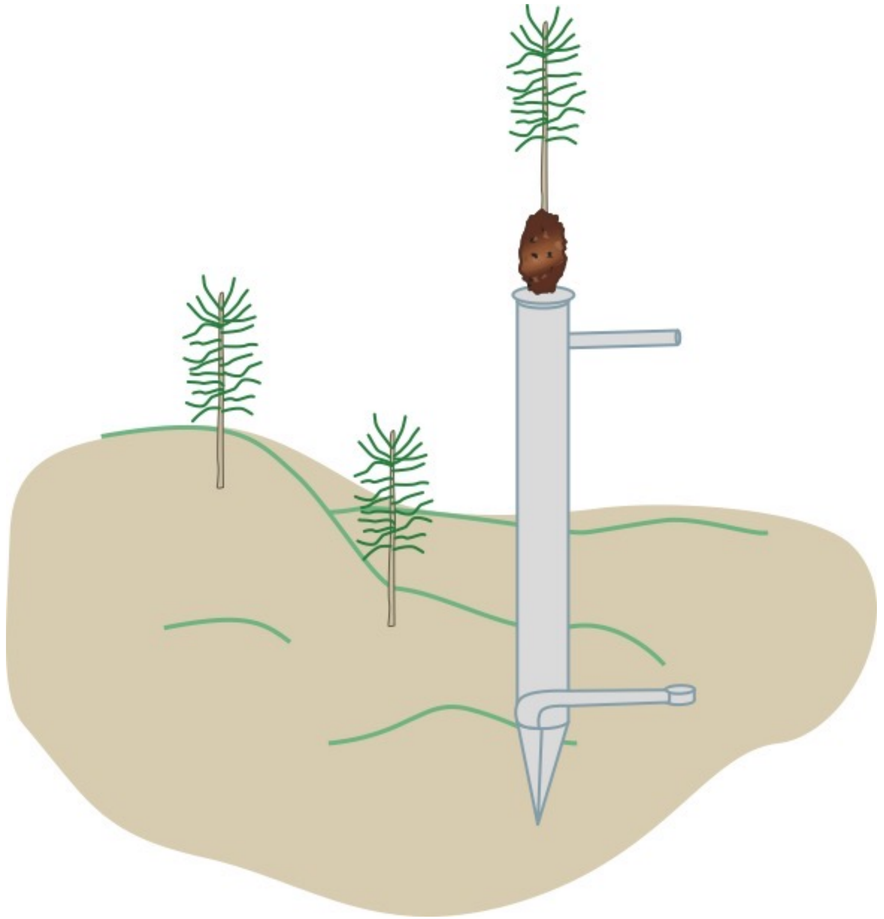
No demand

Today there is no demand for enriched biochar fertilizer. The customer need to know the value of it and why it's worth paying for.

CHALLENGES

Need for good peat

You need peat that doesn’t fall apart when planting. The peat must cope with the handling process up until this point.



OPPORTUNITIES

Container trucks

Transportation of wet mixed sludge can potentially be done by a transportation company that has container trucks suitable for wet sludge.

Usage of sewage sludge

There is an opportunity to use municipal sewage sludge to make biochar in the HTC process, something that could also include municipal energy producers in the process.

Lower cost

Today's peat substrate has good properties and the production plant is adapted to it. But if it is possible to get a lower cost for the fertilizer, it would be advantageous with biochar.

Include forest owner

Include a forest owner with a large forest stand where there is capacity to test the pelleting track and contribute to its development.

OPPORTUNITIES

Track plants’ growth

Today the forest inspector use digital maps to show the forest owner the volume of the land as well as tree types. One opportunity here is to also use the maps to track the plants’ growth and quality.

Spreading pellets

One way to spread the pellets is to do this in connection with ash spreading.

BALTIC INDUSTRIAL SYMBIOSIS

RECOMMENDATIONS

Living lab methodology

PAPER PROVINCE

RECOMMENDATIONS

”The films were good enough that you still got an insight.”

Video

Some participants experienced that making a 7 minute film was a difficult task. As facilitator for future planning of a digital format, it could help to either assist in video taping or clarifying that a simple video with a smart phone is enough. The important thing is to capture the context in which the material is transported/converted in.

Miro

When running a digital living lab it helps to use a digital whiteboard tool such as Miro. In order for each participant to feel comfortable with the digital tool, make sure that you take time for instructions and onboardning.

Visualization

A visualization of the flow is a good way to have the praticipants engage with the resource stream.

The type of visualization that was used for the digital format could also be used in real life context, where participants can draw on it and use post its to add insights and thoughts.

RECOMMENDATIONS

”Maybe it's good to test the methodology later in the project when you have a few more answers.”

Length of living lab

The living lab was conducted as two half-day sessions. This allowed the participants to have time in between for their everyday activities.

When to conduct a living lab?

This living lab was conducted at an early stage in the project Närskog2. While this made it possible to discuss topics and discover challenges early on, some stakeholders also experienced that is was difficult to explain parts that hadn’t been performed or tested yet.

One idea is to conduct the living lab both at an early stage as well as later in the project in order to follow up.

Evaluation of living lab

When performing living lab acitivites it is recommended to start by defining the goal for the activities and later on, after the actitivies have been performed, follow up and evaluate the results. E.g. What has happen since the living lab was performed? Did it lead to any new insights or collaborations?

RECOMMENDATIONS

Engaging the senses

While the videos and visualization helped the participants to engage and discuss, there are still big advantages to performing living lab in real life context. For future digital living labs one could explore what possibilities there are to being even more practical during the session. One idea is to send out materials for the participants to touch and smell during the session, or that each participant show their facilities and production through live video.

Mix format?

Some participants expressed that the digital format saved a lot of time and worked well to get an insight into different parts of the stream. So even though future living lab activities hopefully will not be bound to fit a digital format, there can still be great potential in mixing format and doing some parts digitally for documentation purposes.