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CIRCULAR ECONOMY

CEforestry

Forestry side streams– coniferous needles as source of high added-value products

Linards Klavins, University of Latvia

Science drives innovation, stake holder collaboration ensures adoption

Underutilized Logging Residue

Waste biomass, low
value

Biomass Extraction

Collect diverse
forestry residues

Chemical Characterization

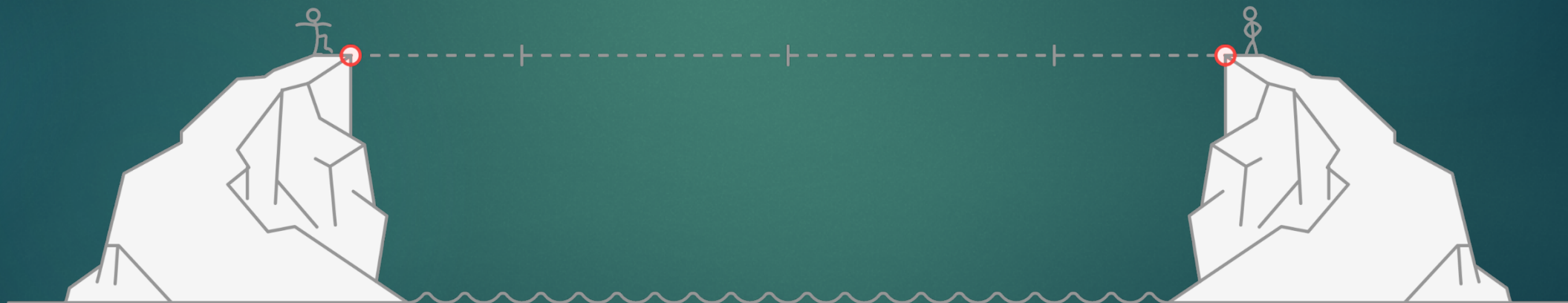
Identify key bioactive
compounds

Application Identification

Potential uses for
compounds

High-Value Products

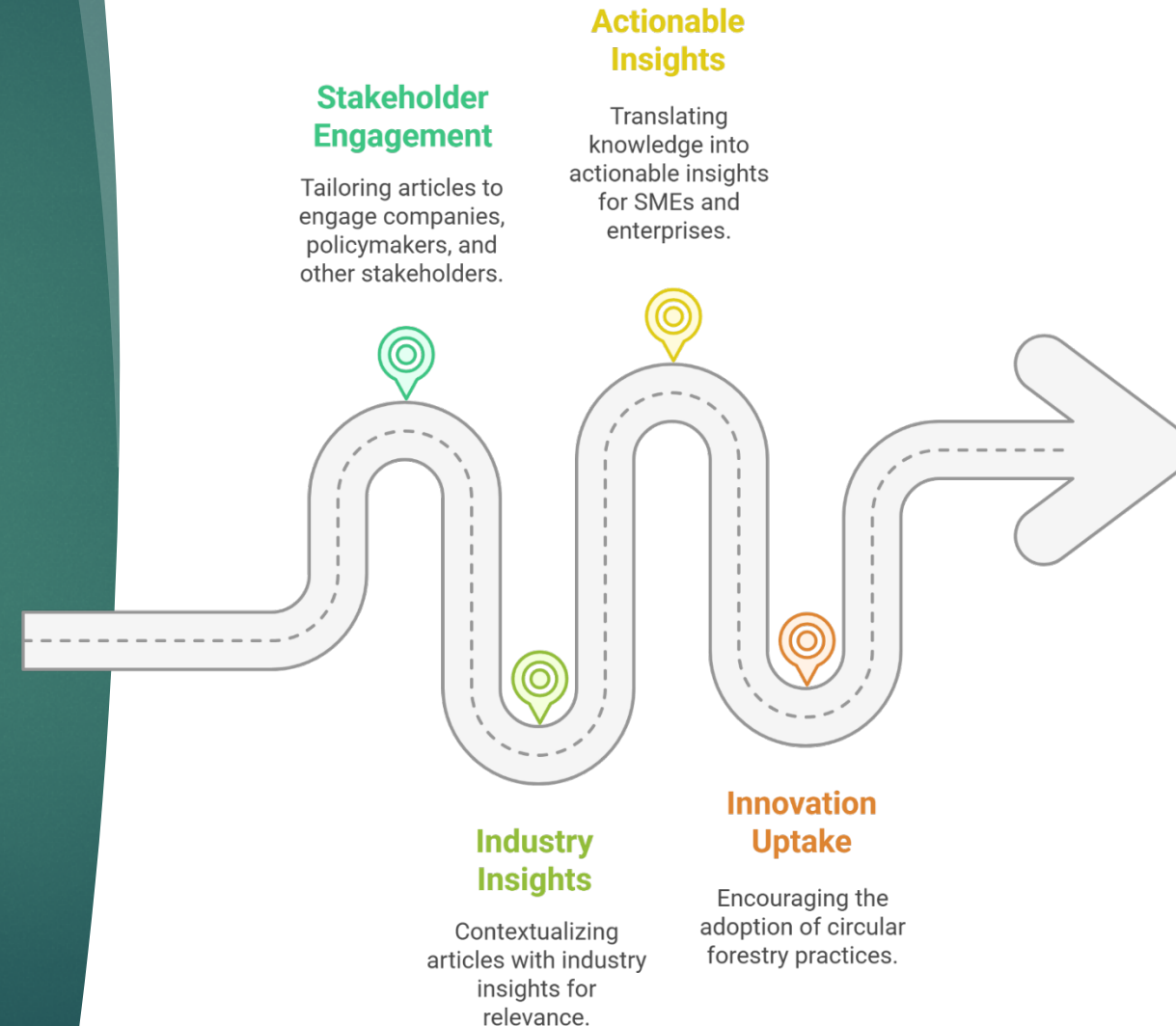
Sustainable product
development



Scientific discovery alone isn't enough - the full value is only realized when knowledge is translated into **actionable insights** and **industrial implementation**.

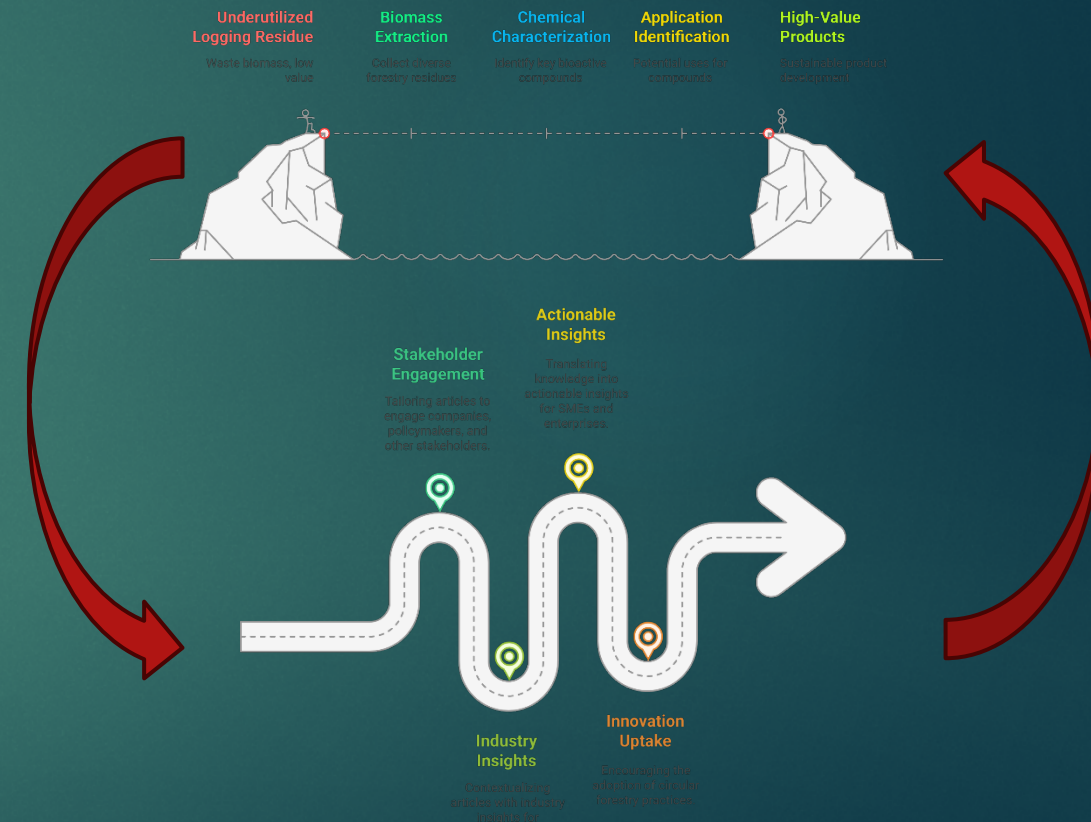
From science to practice

- ▶ Engage companies, policymakers, and other stakeholders to **tailor** research outcomes **to real-world needs**
- ▶ Contextualize findings, **aligning** them **with** current market trends, regulations, and **circular economy strategies**
- ▶ Scientific data is transformed into practical guidelines — e.g., process optimization, environmental impact assessments, and economic feasibility studies for SMEs
- ▶ Ultimately, this leads to adoption — industries implementing circular forestry practices, developing new product lines, and generating added value from coniferous side streams



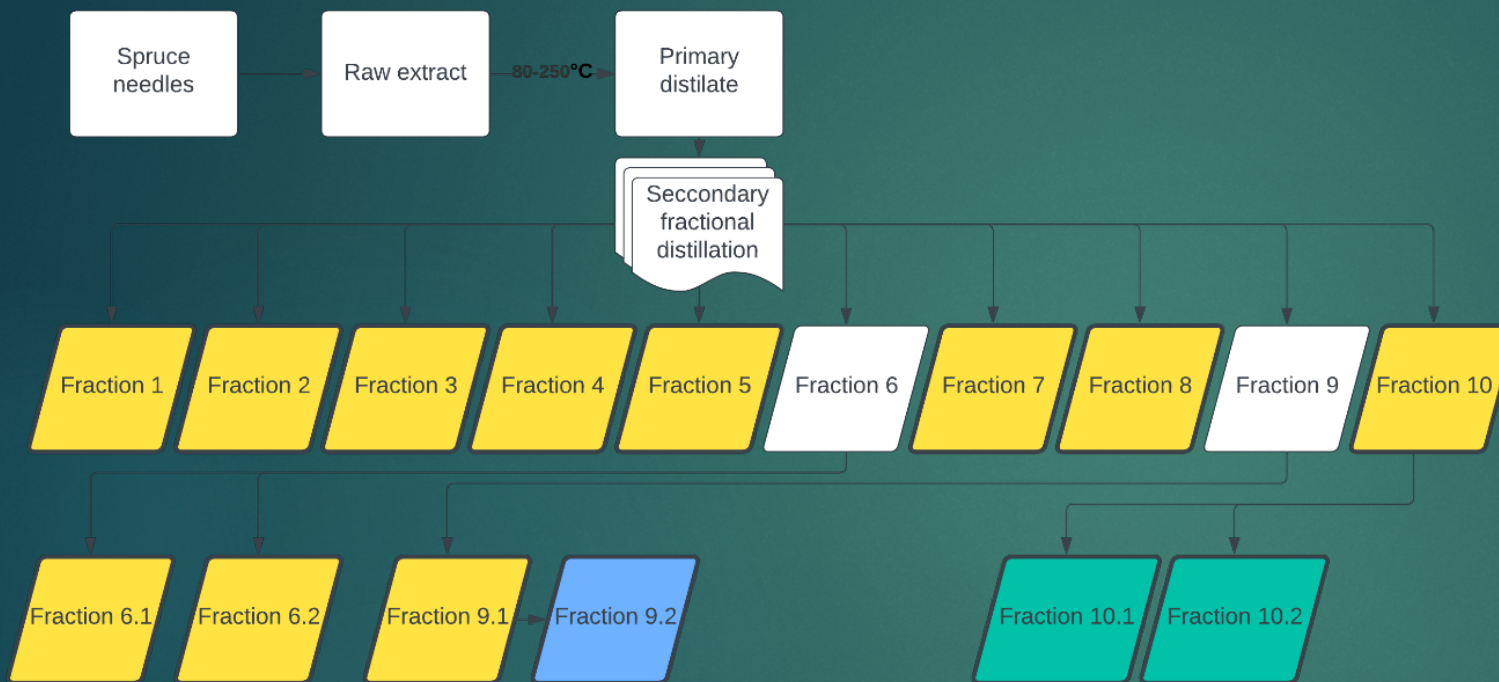
Feedback LOOP between research and industry

- Research has to align with real industrial challenges
 - ensuring lab discoveries can scale to pilot and production levels.
- By engaging industry in early stages
 - The uptake is faster
 - Co-development of products
 - Sharing of testing results
- Systemic circularity
 - Closing also the material loops – waste becomes feedstock reducing dependency on fossil resources



co-creation model reduces the “valley of death” between research and commercialization

Spruce extract fractions



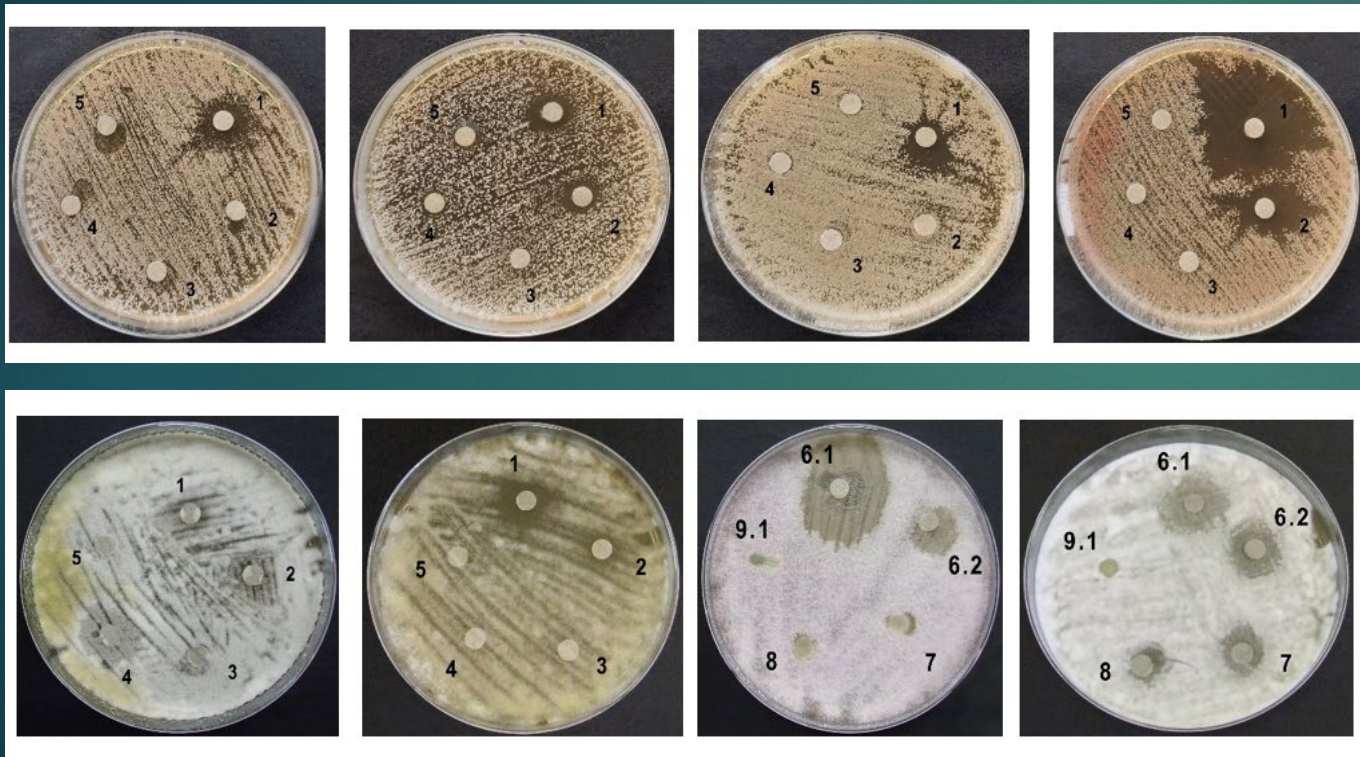
RESEARCH ARTICLE SHORT PATH TO BIOACTIVITY: CHEMICAL PROFILING AND BIOACTIVE POTENTIAL OF LIPOPHILIC NORWAY SPRUCE (*PICEA ABIES*) EXTRACT FRACTIONS

Wood Science and Technology **2025**, 59, 66.
<https://doi.org/10.1007/s00226-025-01671-5>

Spruce logging residues, including needles and small branches, are a rich source of lipophilic compounds such as monoterpenes, sesquiterpenes, diterpenoids, and sterols. Short path distillation can fractionate these non-polar extracts into multiple fractions with distinct chemical profiles, each exhibiting antimicrobial, antifungal, or cytotoxic activities. Valorising these forestry side streams through targeted extraction offers a sustainable approach to producing bioactive compounds while supporting circular bioeconomy strategies in the forestry sector.



Spruce extract fraction biological activity



- ▶ Protection from UV-B potential
- ▶ DPPH activity
- ▶ Cytotoxicity on melanoma cells
- ▶ Antifungal effects
- ▶ Antimicrobial effects

Residual biomass granulation

- ▶ Extraction residues are also a resource
- ▶ Combination of other forest biomass derived industry residues

Biomass → Forestry side streams → Product → Residues



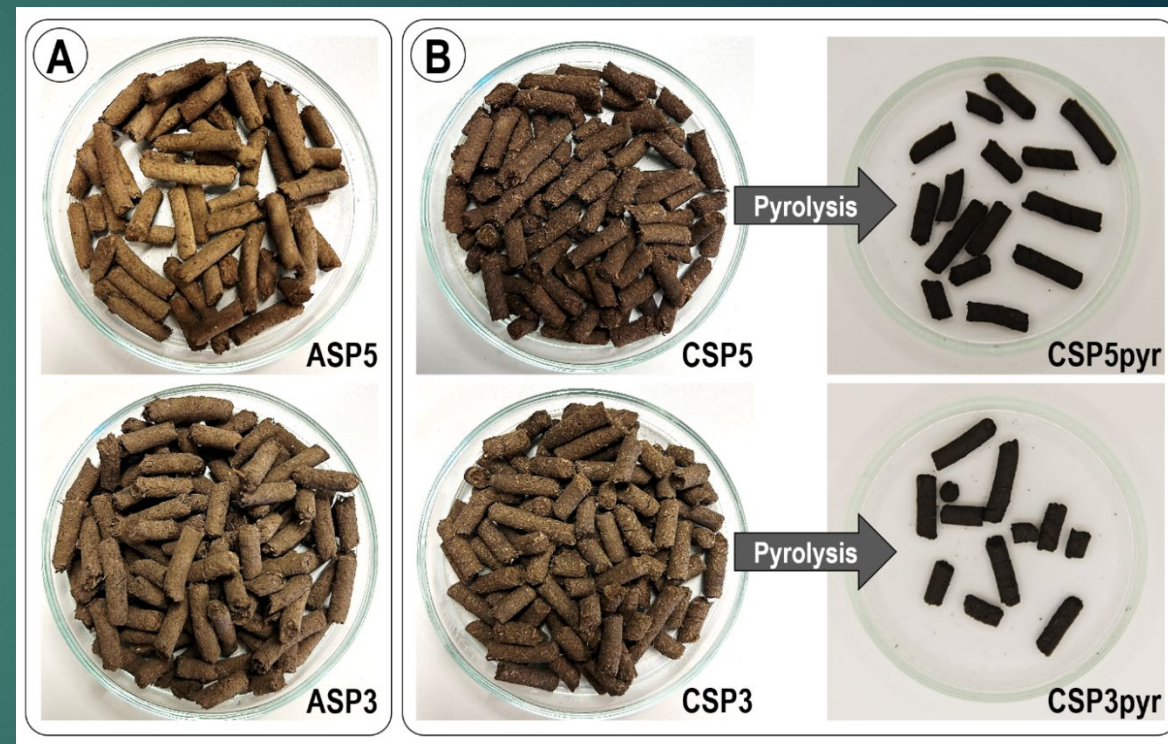
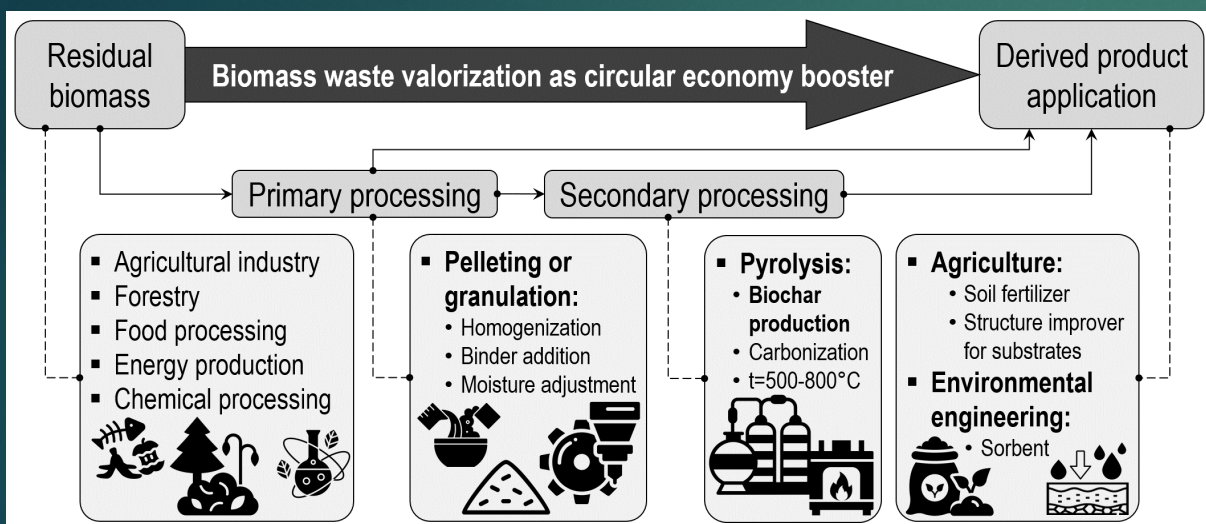
RESEARCH ARTICLE **SELECTED RESIDUAL BIOMASS VALORIZATION INTO PELLETS AS A CIRCULAR ECONOMY-SUPPORTED END-OF-WASTE**

Cleaner materials **2025**, 15, 100295.
<https://doi.org/10.1016/j.clema.2025.100295>

Residual conifer needle biomass and other forestry residues can be converted into valuable products through pelletisation and low-temperature pyrolysis. This process produces biochar pellets suitable for soil improvement, wastewater treatment, and sustainable agriculture. Densifying and carbonizing these residues allows them to be reused as soil enhancers or sorbents, offering an economically viable and environmentally sustainable approach to biomass utilisation.



Residual biomass granulation



Conclusions

► *From residues to resources*

Forestry side streams (e.g., conifer needles) are valuable feedstock, not waste.
Extraction and fractionation unlock bioactive compounds with industrial and health potential.

► *Research → Innovation → Application*

Research provides insights into bioactivity and product potential.
Industry collaboration ensures scalability, adoption, and commercialization

► *Circular Bioeconomy*

Valorization pathways (extracts, pellets, biochar) close resource loops.
Residuals from one process become raw material for another.
Reduces dependency on fossil-based resources while creating sustainable markets.

► *Impact*

Supports green growth, climate goals, and resource efficiency.
Stimulates innovation for SMEs and forestry sector.
Transforms side streams into sustainable, high-value products.



Thank you
Time for a question

Thank you for your interest!

<https://interreg-baltic.eu/project/ceforestry/>