

Revolutionizing Construction through Green Chemistry

Project goal: The NewWave Project, funded by the European Union's Horizon Europe Programme, has been a pioneering initiative to lay the foundations for a sustainable and circular economy by introducing innovative and bio-based raw materials into production lines for the construction sector. The focus lies with the transformation of current fossil-based production lines into new bio-based value chains. Through technological innovation, NewWave aimed to replace toxic and fossil chemicals and reduce the environmental footprint, while ensuring mechanical and physical performance equal to or exceeding that of traditional construction products.

Project highlights

Radical Decarbonization

Developed a "green refinery" (TCF), reducing GHG emissions by up to 97% compared to fossil alternatives.

Green Chemical Production

Platform chemicals (glycols, HMF) utilized in PURs, furan chemicals and formaldehyde-free resins.

Safe & Sustainable by Design (SSbD)

Replaced toxic & fossil-based industrial chemicals (formaldehyde, creosote copper salts, phenol) with non-toxic, bio-based alternatives in wood-based construction materials to improve end-user & environmental safety.



True Circularity

End-of-life construction products are re-processed into new materials. Wastewater streams are converted into biogas (with high methane content), while purified water is recycled in the production process.

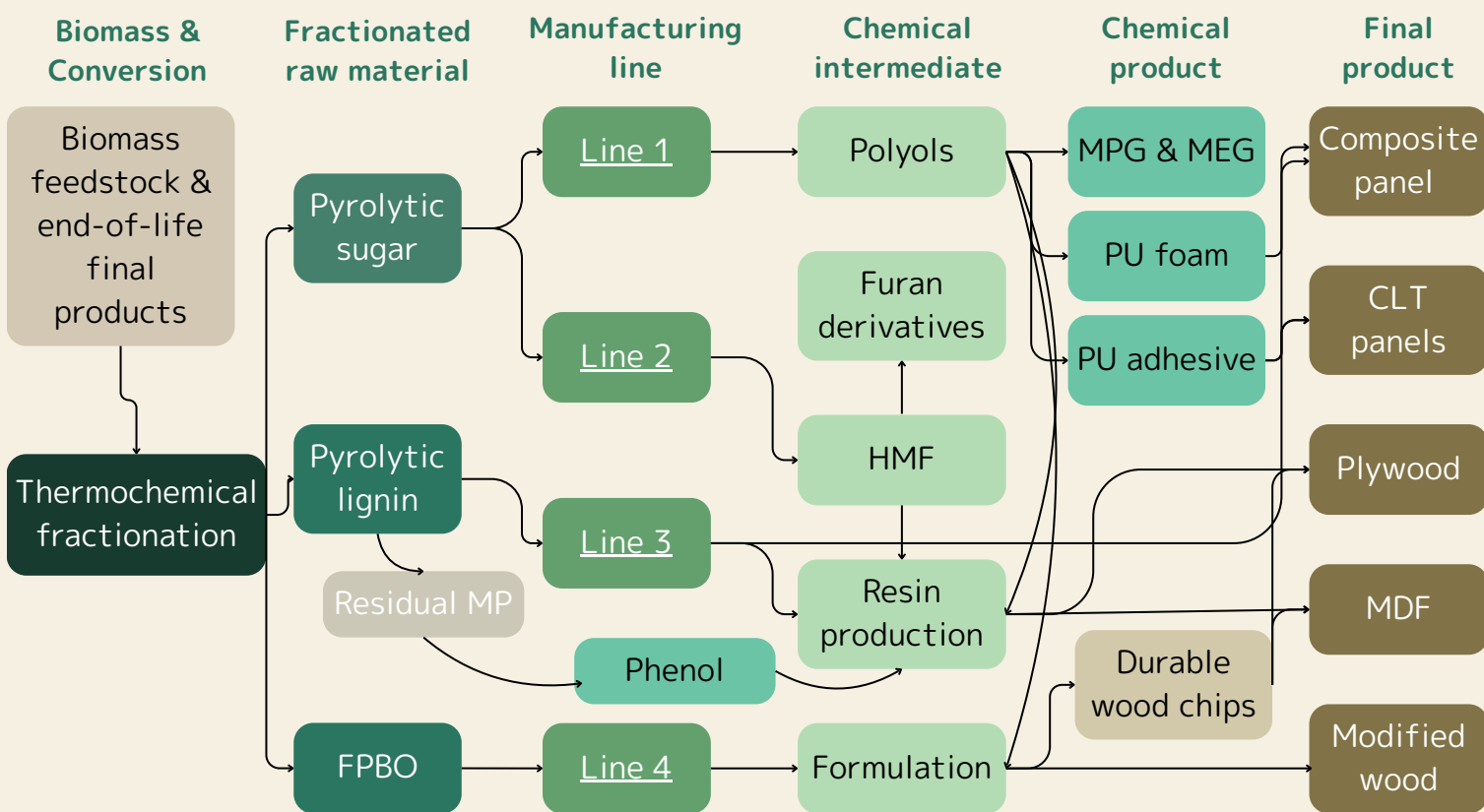
Demonstrator output

- 15 **composite panels** (50x50x5 cm) using bio-based PU foam core sandwiched between eco-friendly plywood layers.
- 8 panels covering 2m² installed in architectural **mock-up**.
- 16 **plywood panels**, 16 **MDF panels** (50x50 cm).
- 2m³ modified wood cladding (Scots pine, Radiata pine, European beech, and Sycamore maple).

The mock-up structure was realized at InnoRenew CoE in Slovenia



Project setup through interconnected manufacturing lines



Thermochemical fractionation

Woody biomass feedstock processed through thermochemical fractionation (TCF) into: pyrolytic lignin, mono phenols, pyrolytic sugar and Fast Pyrolysis Bio Oil (FPBO).

Highlights

- GHG reduction up to 97% compared to fossil alternatives.
- A final batch of 2x900 kg FPBO for pilot plant impregnation of modified wood.
- A final batch of 25 kg Solid Pyrolytic Lignin for pilot-scale resin production.
- Demonstrated that the fractionated raw materials are suitable for usage in different Manufacturing Lines (MLs).

Circularity and by-products

Utilize end-of-life products in TCF, minimize water usage, treatment and recycling of wastewater.

Highlights

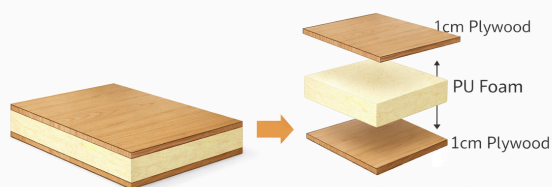
- Final products: modified wood and plywood, successfully reused as feedstock in TCF.
- Proven suitability for reuse of circular FPBO in resin and wood modification applications.
- The new ML1 wastewater treatment train yielded high methane production and water reuse due to good effluent quality.

Technology Readiness Level (TRL)

Polyols	(ML1) TRL 4	MEG / MPG	(ML1) TRL 6
Green solvents	(ML2) TRL 9	Polyurethanes	(ML1) TRL 4-5
Resins	(ML3) TRL 5-6	HMF	(ML2) TRL 4-5
Modified Wood	(ML4) TRL 6	TCF	Fundament TRL 6-7

Composite and CLT panels

Anatomy of a composite panel



- Facing: Two 1 cm-thick plywood layers enclose the core.
- Core: A polyurethane (PU) foam.

PU Foam: Made with bio-glycols produced from FBPO-derived pyrolytic sugar. Bio-polyol share is ca. 11% of the polyol part (polyol blend with additives) and ca. 5% of the total formulation.

Performance: Mechanical, acoustic and thermal insulating properties are comparable to the benchmark.

2K PU adhesives (CLT panels): Fully replacing fossil polyols. Achieved D1 and D2 durability class compliance.

Plywood

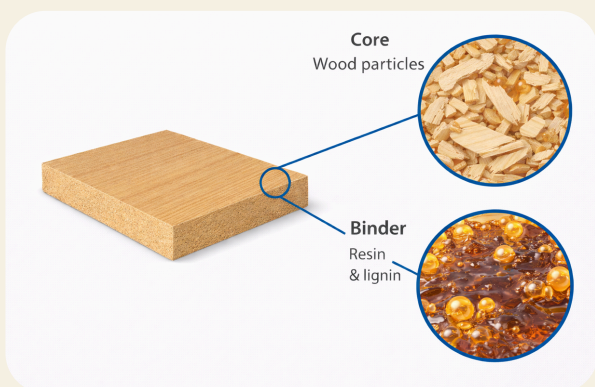


Plywood: Panel in which 50% phenol was replaced with lignin fully met European standards (Class 1 and 2), making them suitable for outdoor applications.

Resin for plywood: A 100% phenol replacement resin was also developed. However, the resulting plywood panel fell short of meeting the required industrial standards.

Proof of concept: To fully replace fossil phenol. The durability was still below standard.

MDF panel



Resin for MDF: The use of 25% phenol replacement resin in MDF panels demonstrated excellent dimensional stability and successfully met all industrial standards.

Green resin: A bio-based formaldehyde & phenol resin was developed for subsequent use in manufacturing particleboard from durable wood chips produced from the modified wood.

Current industrial limitations: High temperature and long polymerization process, rendering green resin less economically competitive than its fossil counterpart.

Modified wood cladding



Modified wood formulation: With 80% FBPO content replaces creosote, copper salts and organic biocides. Combined with NewWave light bio-polyols, a 100% green and safe formulation is obtained.

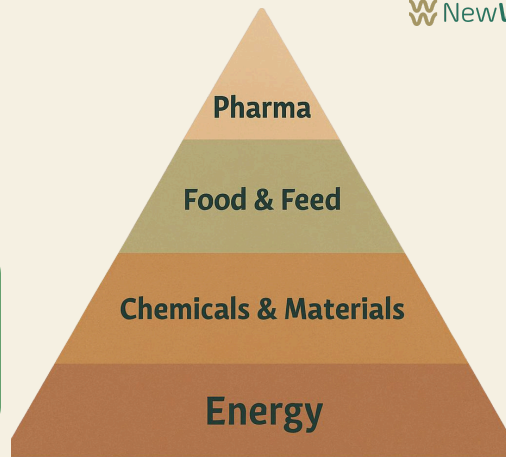
Cladding performance: Suitable for outdoor application, complying to Durability class 2. Dimensional stability (swelling & shrinkage) and resistance to weathering are significantly improved.

Policy recommendations



● Level playing field

A level playing field means creating fair rules, policies, and market conditions so that businesses e.g. bio-based industries vs. fossil industries can compete fairly.



Under the European RED, renewable energy production grants, supporting the installation and operation of e.g. bioenergy generation plants, have stimulated a steady increase in sustainable bioenergy production across EU.



Promoting bio-based products from higher tiers of the biomass value pyramid, along with a similar market push for bio-chemicals, will support their wider adoption.

Pathways towards accelerated market uptake



Banning toxic, fossil derived and persistent chemicals

Where bio-based alternatives are available.



Setting mandates for sustainable materials

Bio-based or recycled materials should be the default for new products.



Public procurement

The public sector can act as a (launching) customer for bio-based materials.



Setting minimum bio-based content share

Set targets when updating regulations for chemicals and materials.



Easier EPD access for bio-based products

System that informs on the environmental performance of materials.

Project partners



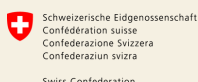
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