LATVIJAS VALSTS
KOKSNES ĶĪMIJAS
INSTITŪTS

Latvian State Institute of Wood Chemistry
Registration No. 90002128378
Address: Dzerbenes street 27, Riga LV-1006, Latvia
Phone: +371 67553063, E-mail: kki@kki.lv

State Research Programme
"Research and Sustainable Use of Local Resources for the Development of Latvia 2023-2025"

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"Innovation in Forest Management and Value Chain for Latvia's Growth: New Forest Services, Products and Technologies (Forest4LV)"

WP 3 "Wood products and technologies"

Task 3.5.2 "Increasing efficiency and accuracy in the use of wood resources, smart technology solutions"

Recommendation for practise
"Use of wood-based materials in furniture and construction elements"

Riga, 2025

SRP
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Programme

FOREST4LV

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Phone: +371 67553063, E-mail: kki@kki.lv

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1. Introduction

The Forest4LV WP3 has generated a comprehensive set of innovative wood-based materials and technologies that significantly expand the possibilities for sustainable construction, furniture manufacturing, and interior and exterior applications. These materials include thermally modified hardwoods, juvenile-wood-based glued products, suberinic-acid-bonded particleboards, bio-based polyurethane foams, "green" polyols derived from bark extractives, wood-polymer composites, and lightweight stabilised blockboard systems finished with thermally modified veneers. Together, they form a coherent technological platform that supports Latvia's transition toward a circular, low-carbon bioeconomy. In total five activities were implemented – Wood as material (T.3.1.); Biorefinery (T.3.2); Polymers and insulation (T.3.3); Innovative products from wood residues (T.3.4) and Efficiency of the use of wood resources (T.3.5), which can be seen in the Figure 1.

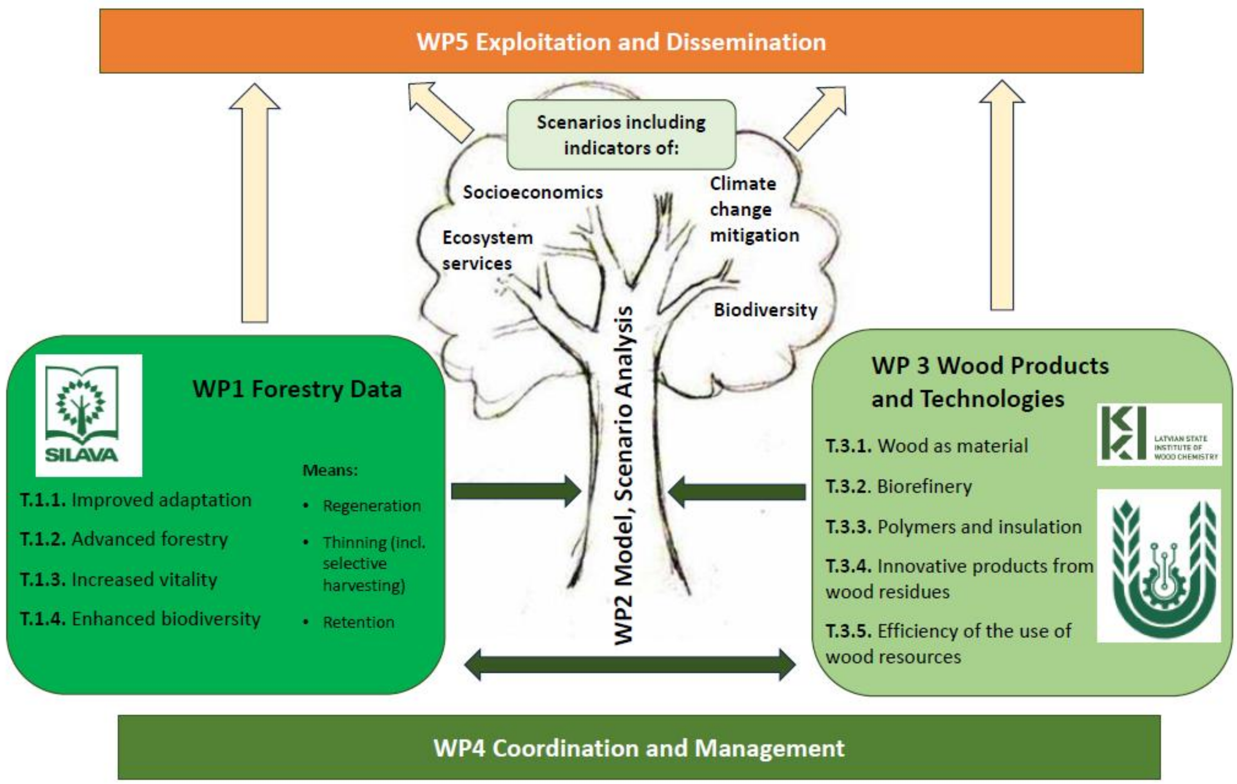

Figure 1. Total scheme of Forest4LV work packages and tasks.

The dominant wood species in Latvia – birch and pine – form the foundation for both traditional wood processing and the emerging bioeconomy. Their full-value utilization enables the creation of high added-value products while simultaneously reducing the use of fossil resources and lowering CO_2 emissions. The circular bioeconomy cycle demonstrates how primary wood and its by-products are transformed into construction materials, furniture, polymers, and medical and chemical products,

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thereby strengthening Latvia's national economy. Research covered five thematic areas: wood as a material, biorefinery, bio-based polymers and insulation, innovative products from residues, and efficient resource use.

This deliverable (D.3.3) provides consolidated recommendations for sector stakeholders - including industry, policymakers, standardisation bodies, and public authorities - on the appropriate use, environmental performance, and end-of-life management of the materials developed within WP3. The recommendations are based on scientific evidence generated during the project and reflect both performance characteristics and broader sustainability considerations.

2. Recommendations for material use in construction and furniture

2.1. Structural and semi-structural applications

The research demonstrates that **juvenile wood (JW)** of pine and birch, traditionally considered a low-value by-product of thinning operations, possesses favourable gluing and delamination resistance. JW can therefore be used in glued laminated products (Figure 2) intended for outdoor applications where direct ground contact is not required.

Figure 2. Glued JW product from pine wood.

Its suitability for **facade elements or cladding, terrace or decking substructures, pergola components, and other semi-structural outdoor elements** provides a new utilisation pathway for small-diameter wood and reduces pressure on mature timber resources.

Thermally modified (TM) aspen and black alder (Figure 3) exhibit significantly improved

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Phone: +371 67553063, E-mail: kki@kki.lv

dimensional stability, reduced hygroscopicity, and enhanced biological durability. These properties make TM hardwoods suitable for **exterior cladding, decking, playground components, garden furniture, and other applications exposed to fluctuating humidity or 3rd Service class according to Eurocode 5**. The project identified specific nitrogen-based TM regimes that balance durability with mechanical integrity, ensuring that these species can be used reliably in demanding outdoor environments.

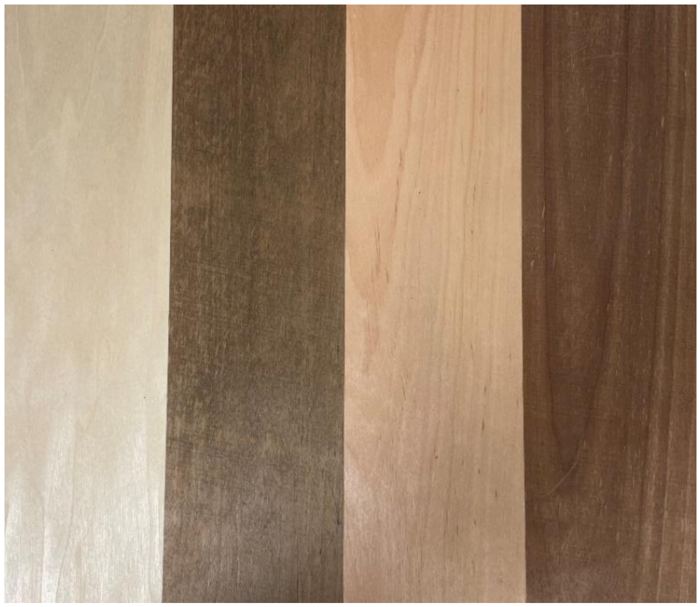

Figure 3. Technology prototypes (from left to right) - untreated aspen, TM aspen, untreated black alder, TM black alder

Lightweight Stabilised Blockboards (LSB), when combined with thermally modified veneers (Figure 4), offer high dimensional stability and reduced weight, making them **suitable for interior partitions, door cores, wall modules, and large-area furniture surfaces**. Their stability under varying humidity conditions makes them particularly appropriate for applications requiring shape retention and low deformation.

A B C

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Figure 4. Dimensionally stable wood lightweight panels glued with thermal veneers: A – middle layer thickness 22 mm; B – middle layer thickness 28 mm; C – middle layer thickness 42 mm

2.2. Interior materials and furniture components

Suberinic-acid-bonded particleboards developed within WP3 meet the requirements of EN 312 Type P2 for interior fitments and provide a formaldehyde-free alternative to conventional synthetic adhesives. Their ability to incorporate recycled particleboard particles and sawdust from cellular wood material production enhances their environmental performance and supports circular-economy principles. These boards are **suitable for cabinet furniture (Figure 5), shelving, interior panels, and carcass elements, particularly in environments where indoor air quality is a priority**.

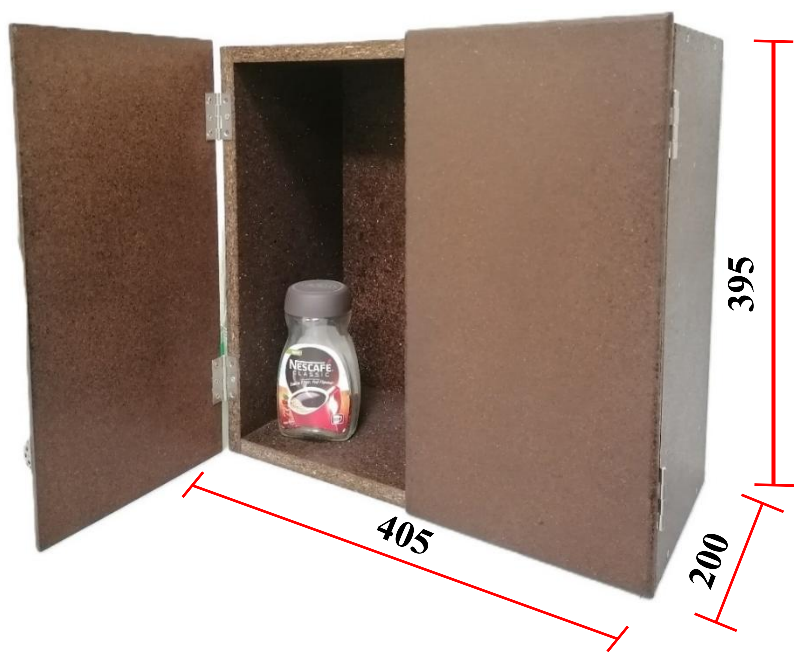

Figure 5. Prototype of cabinet furnitute made of suberinic acids-bonded particleboard.

Thermally modified veneers produced using THERMOVUOTO® technology provide stable, aesthetically appealing surfaces with reduced hygroscopicity. When applied to LSB cores, they create lightweight, dimensionally stable panels (Figure 4) suitable for high-quality interior applications, including wall panels, furniture fronts, and decorative elements.

Juvenile-wood-based glued products also demonstrate strong **potential for interior use, particularly in laminated components, decorative structures, and non-load-bearing architectural elements**.

2.3. Insulation materials

The project developed two complementary **bio-based insulation materials: rigid polyurethane foams** derived from suberinic-acid polyols (Figure 6) and "green" polyols produced from pine bark extractives (Figure 7). Both materials exhibit improved thermal stability and reduced flammability compared to fossil-based foams. The use of ammonium polyphosphate as a flame retardant provides an environmentally safer alternative to halogenated additives.

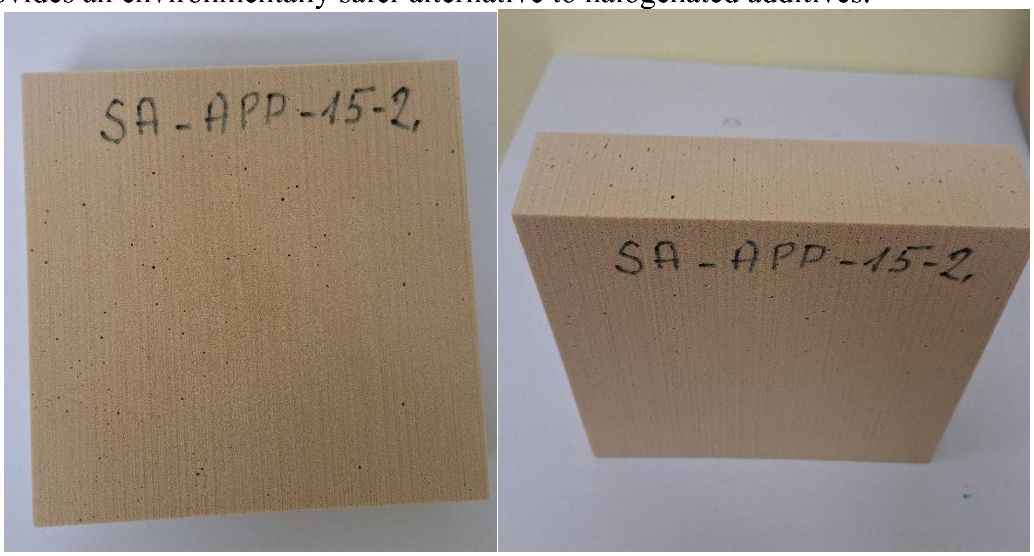

Figure 6. Prototype "Rigid polyurethane foams from suberinic acid polyols with enhanced thermal stability and reduced flammability", size 20×20×5 cm.

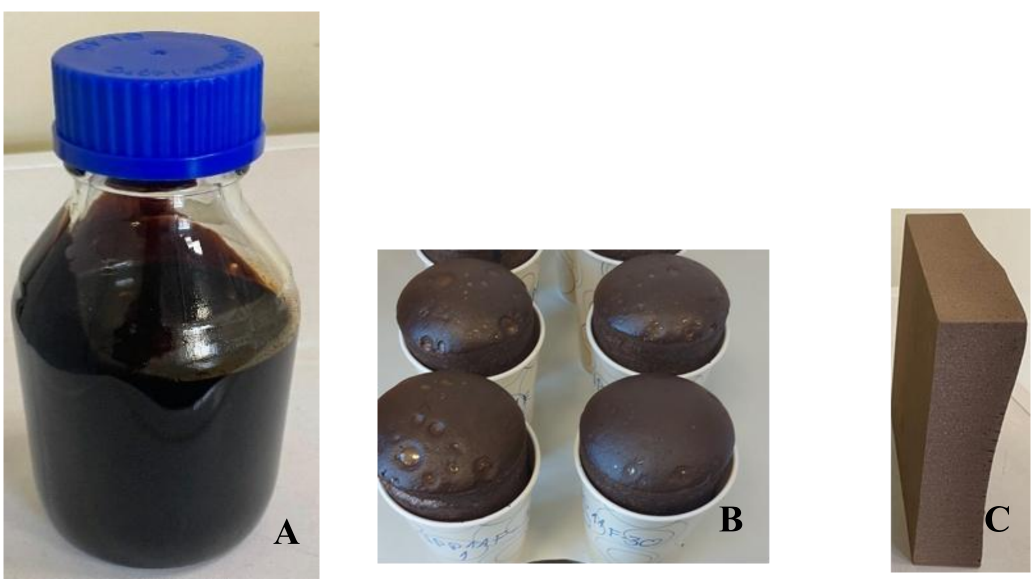

Figure 7.’’Green’’polyol (A) and rigid PUR foam on its basis (B;C).

These foams are **suitable for prefabricated insulation panels, sandwich structures, and technical insulation systems**. Their compatibility with existing industrial equipment facilitates rapid adoption by manufacturers. The enhanced mechanical properties of “green” polyol-based foams further support their use in applications requiring both insulation and structural integrity.

2.4. Exterior applications and composite materials

Wood-polymer composites (WPCs) incorporating recycled polypropylene, alkaline-treated pine sawdust, and bark-derived compatibilisers demonstrate improved processing behaviour, enhanced mechanical properties, and reduced energy consumption (Figure 8). These composites are **suitable for cladding, fencing, terrace boards, and interior trims, particularly in environments where moisture resistance is required**.

Figure 8. A new wood-plastic composite based on recycled polypropylene, alkaline-treated pine sawdust, containing suberinic acids as an internal lubricant

The use of functionalised bark extractives as compatibilisers represents a novel valorisation pathway for bark residues and reduces reliance on petroleum-based additives. This approach strengthens the environmental profile of WPCs and supports the development of high-renewable-content composite materials.

3. Environmental and regulatory considerations

3.1. Raw material efficiency

WP3 results highlight the importance of utilising non-traditional wood fractions - including juvenile wood, sawdust, recycled particleboard, bark extractives, and other residues - to reduce pressure on primary timber resources. **Industry stakeholders are encouraged to integrate these materials into production processes to enhance resource efficiency and reduce waste**.

3.2. Chemical use and end-of-life management

As wood products increasingly incorporate adhesives, coatings, and flame retardants, their end-of-life combustion can generate harmful emissions if chemical content is not regulated. To study the combustion products of glues and wood products and then, based on the results of these studies, determine how much glue, paint, with what paint, etc., can be used, so that it can be burned and energy obtained after the end of the product's life. So, that the manufacturer of wood products does not have to think about what and how will happen after the end of the product's life cycle - in the assessment of the possible consequences of burning and the impact on the environment. Then the manufacturer can purchase glue, paint and incorporate it into the product in the permissible amount to fit into the potentially developed burning standard.

The project **recommends that national authorities develop guidelines defining maximum permissible chemical loads for wood products intended for energy recovery**. Such guidelines would enable manufacturers to select adhesives and coatings that ensure safe disposal while maintaining wood's status as a clean, renewable fuel.
Environmental impact assessments of innovative materials should assume local or regional production of generic chemicals in long-term scenarios, avoiding artificially inflated transport emissions that can distort sustainability evaluations.

3.3. Standardisation and certification

To support industrial adoption, national and European standardisation bodies should consider **developing standards or technical specifications for emerging materials**, including suberinic-acid-bonded particleboards, thermally modified hardwoods, bio-based polyurethane foams, and WPCs incorporating bark-derived compatibilisers. Certification pathways should be established to ensure that these materials can be used in regulated construction and furniture applications.

3.4. Public procurement and market uptake

Public procurement policies should **prioritise low-emission, renewable, and recyclable materials in public building projects**. Demonstration projects using TM wood, SA-bonded boards, bio-based insulation foams, and LSB-based panels would accelerate market uptake and showcase the performance of these materials in real-world conditions.

4. Summary

The materials and technologies developed within WP3 provide a scientifically validated and technologically mature foundation for expanding the use of Latvian wood resources in construction, furniture manufacturing, and interior and exterior applications. To maximise their impact, Latvia should:

- promote bio-based materials across all sectors;
- support certification and standardisation of new products;

- ensure safe chemical use and disposal through regulation;
- encourage industrial uptake via incentives and public procurement;
- integrate circular-economy principles by valorising residues and recycled materials.

These recommendations provide a roadmap for industry, policymakers, and stakeholders to accelerate the adoption of sustainable wood-based materials. By adopting the recommendations outlined in this deliverable, Latvia can strengthen its forest-based bioeconomy, reduce environmental impacts, and position itself as a leader in sustainable material innovation. The integration of bio-based binders, thermally modified hardwoods, juvenile-wood-based products, and high-renewable-content composites into industrial practice will contribute to a more resilient, resource-efficient, and climate-neutral future.

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Latvia University of Life Sciences and Technologies
Institute of Civil Engeneering and Woodworking
Leading researcher, *Dr.sc.ing.* Uldis Spulle

Latvian State Institute of Wood Chemistry
Biorefinery laboratory
Leading researcher, *Dr.sc.ing.* Janis Rizikovs