



High Performance Bio-based Functional Coatings for Wood and Decorative Applications

PERFE COAT

High Performance Bio-based Functional Coatings for Wood and Decorative Applications

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This project receives funding from the Bio-based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022370. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.



The BBI JU project PERFECOAT

Call for proposals: BBI2020.SO3.R5: Improve the sustainability of coatings

Project type and TRL range: RIA, TRL3-5

Consortium: 12 Partners from 7 countries (4 LEs, 4 SMEs, 3 Universities, 1 RTO)

Project coordination: SINTEF AS (Norway)

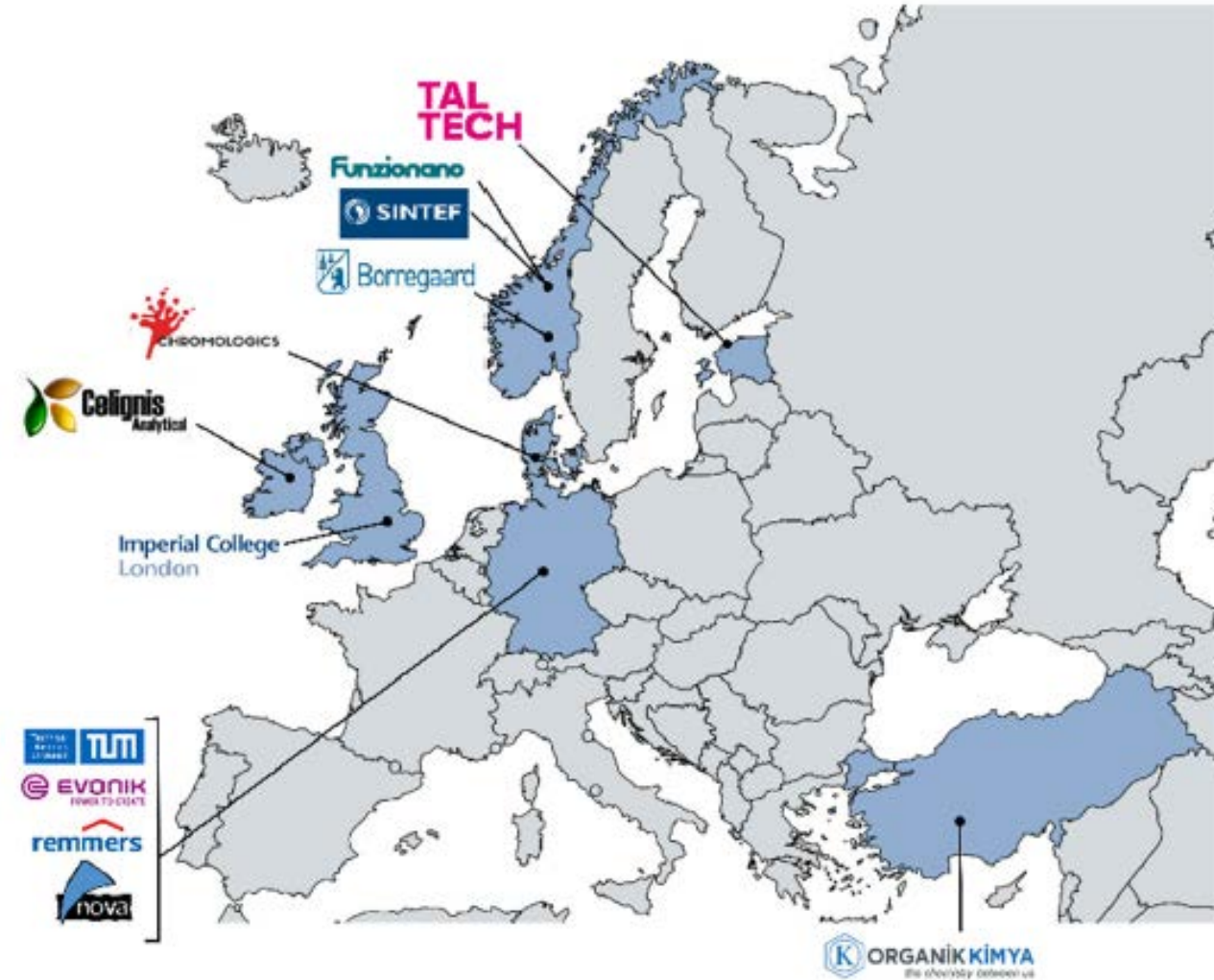
Project period: 01.05.2021 – 30.09.2024 (41 m)

Total budget: € 6,250,541.25

EC/BBI JU contribution: € 4,999,567.50

Website: www.perfeccoat-project.eu

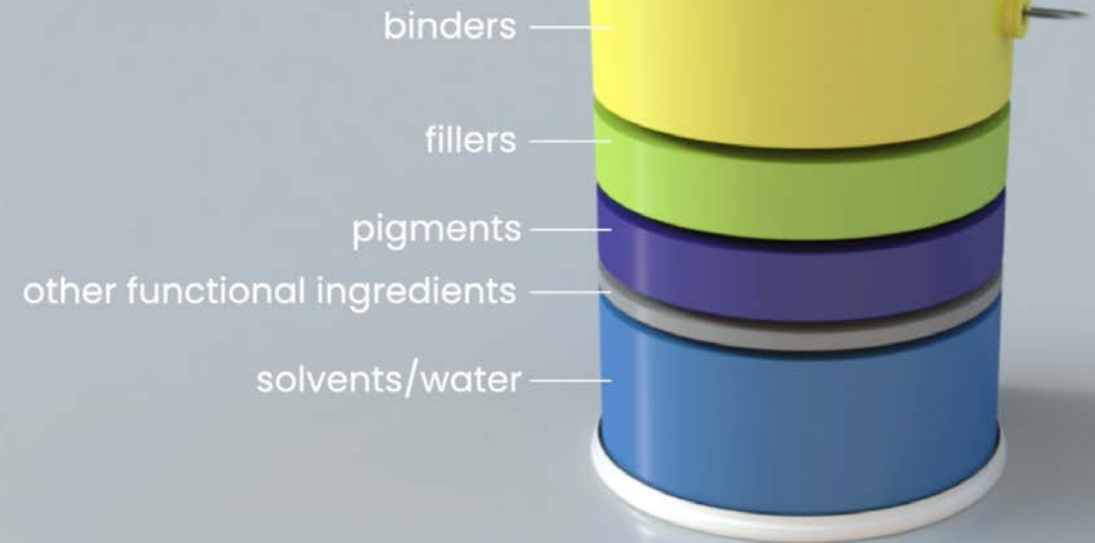
Social media: LinkedIn - #PERFECOAT





The challenge...

The **primary goal** of the **PERFE COAT** project is to develop and validate a new generation of industrial wood and decorative coatings with significantly more than 25% bio-based components that can meet and even surpass the current quality and sustainability standards.





The challenge... and PERFE COAT's modular solution

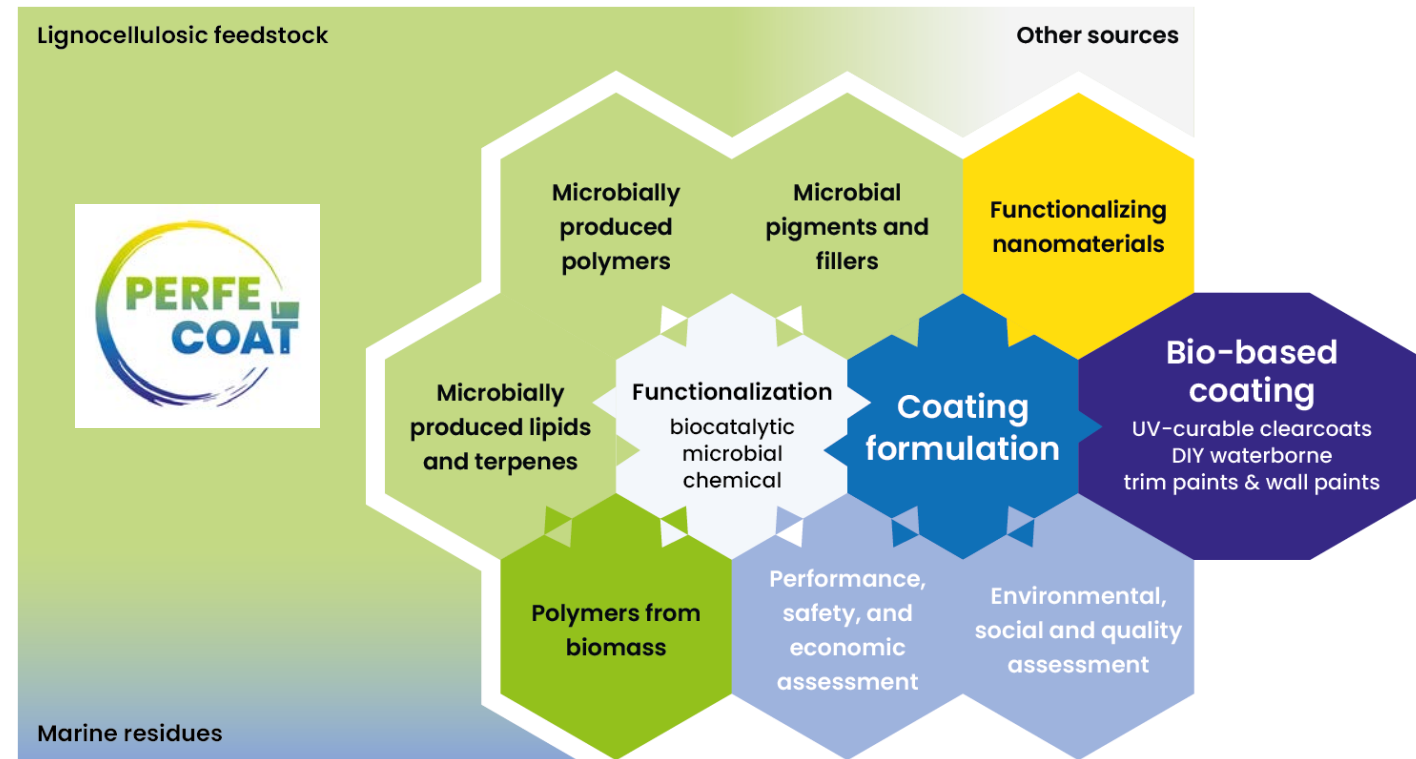
The **primary goal** of the **PERFE COAT** project is to develop and validate a new generation of industrial wood and decorative coatings with significantly more than 25% bio-based components that can meet and even surpass the current quality and sustainability standards.

Our **concept** is based on a flexible technology platform of novel technologies to produce innovative bio-based binders, fillers, and pigments from a range of biopolymers and functionalized materials and assemble and test them in new coating formulations.

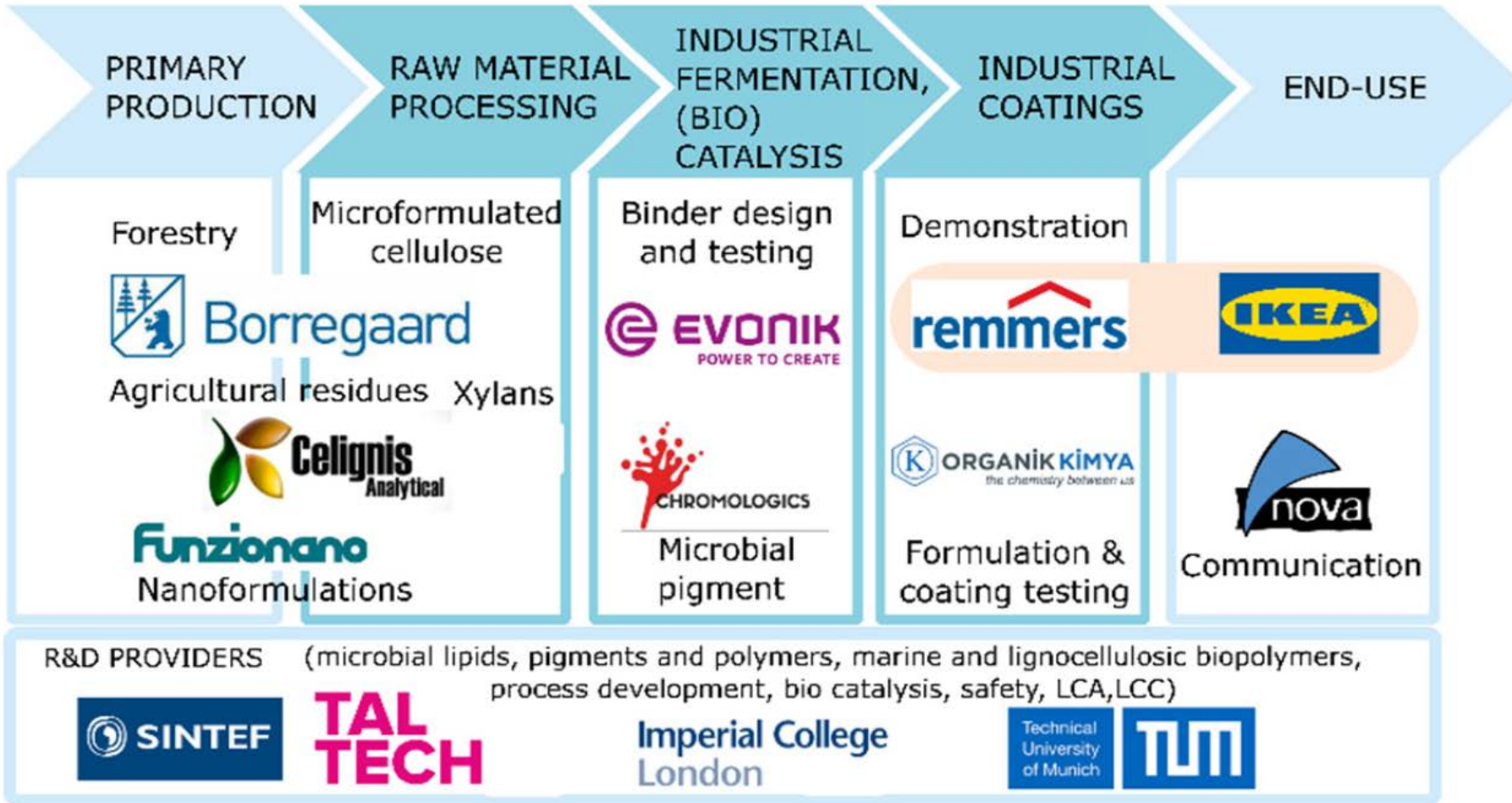
Markets addressed:

- UV-curable furniture clearcoats
- DIY waterborne trim paints
- DIY waterborne wall paints

Modular Approach for the PERFE COAT Coatings Development and Validation



Innovative elements: New value chain

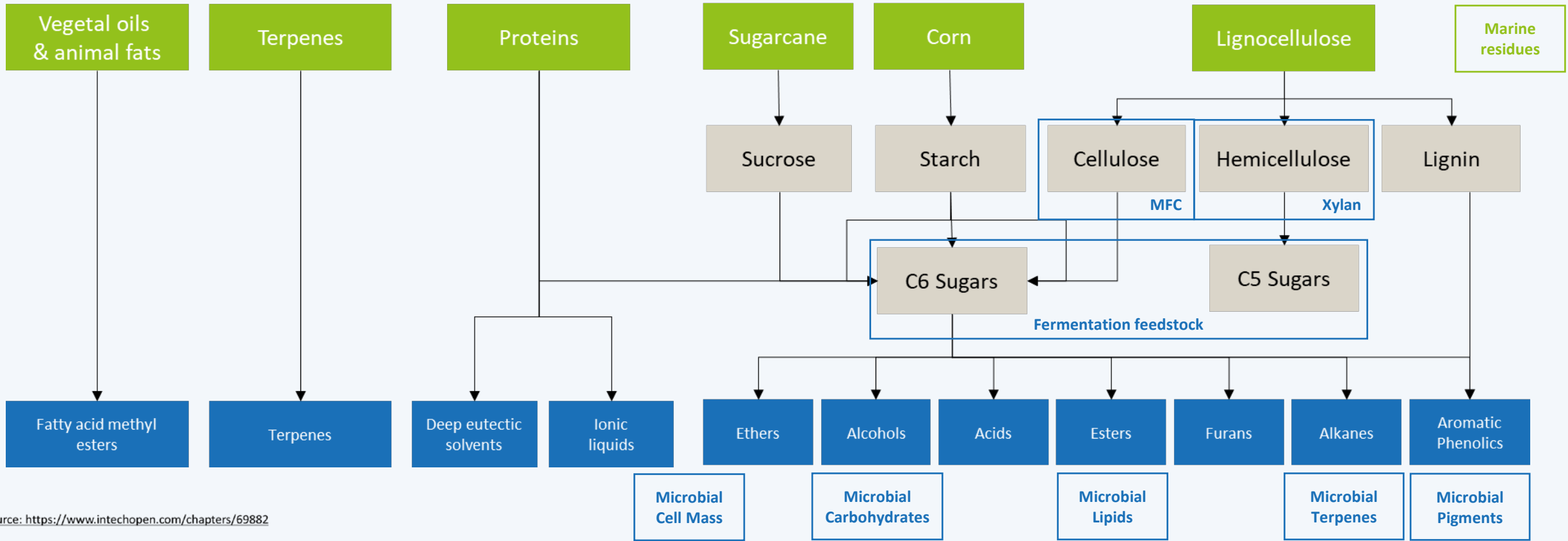


The new value chain being developed in the **PERFE COAT** project and the approximate positioning of the project partners along that value chain.

- Complete value chain from substrate provision to industrial scale-up and quality assessments

Innovative elements: Using biotechnology to produce bio-based paint ingredients

Biobased raw materials



Source: <https://www.intechopen.com/chapters/69882>



Innovative elements and Research work undertaken: Biotechnology + Chemical synthesis + Industrial validation

Through strain engineering, fermentation of lignocellulosic sugars, advanced DSP methods, and scale-up:

- Microbial polymers and oligomers of alginate and xanthan
- Microbial lipids, fatty acids, and terpenes
- Microbial pigments
- Microbial cell mass as fillers

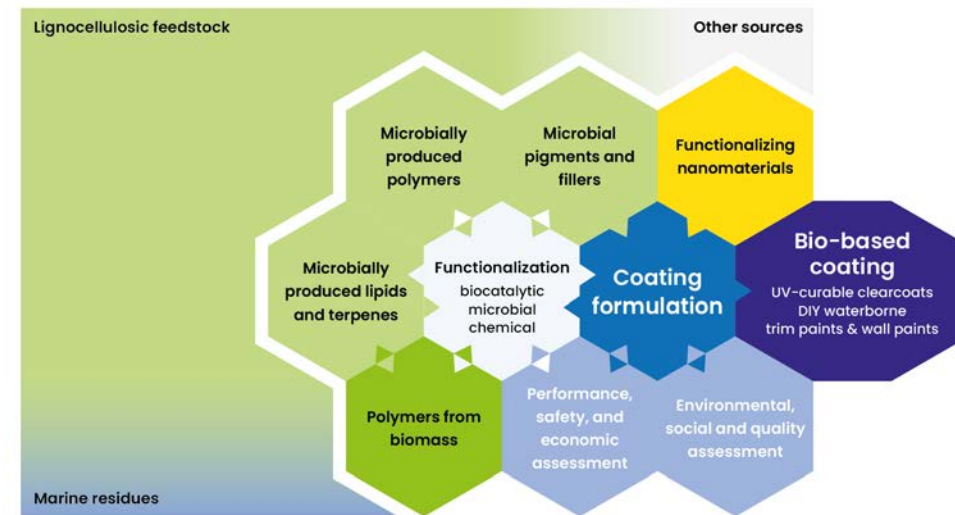
Through chemoenzymatic extraction from lignocellulose residues and scale-up:

- Xylan biopolymers and oligomers
- Micro-fibrillated cellulose (MFC)

Through chemoenzymatic extraction from marine residues:

- Biopolymers chitin and chitosan
- **Chemical upgrading** to achieve the required physical and chemical properties and functional activation
- **Incorporation of POSS** (polyhedral oligomeric silsesquioxanes) and MFC to improve performance

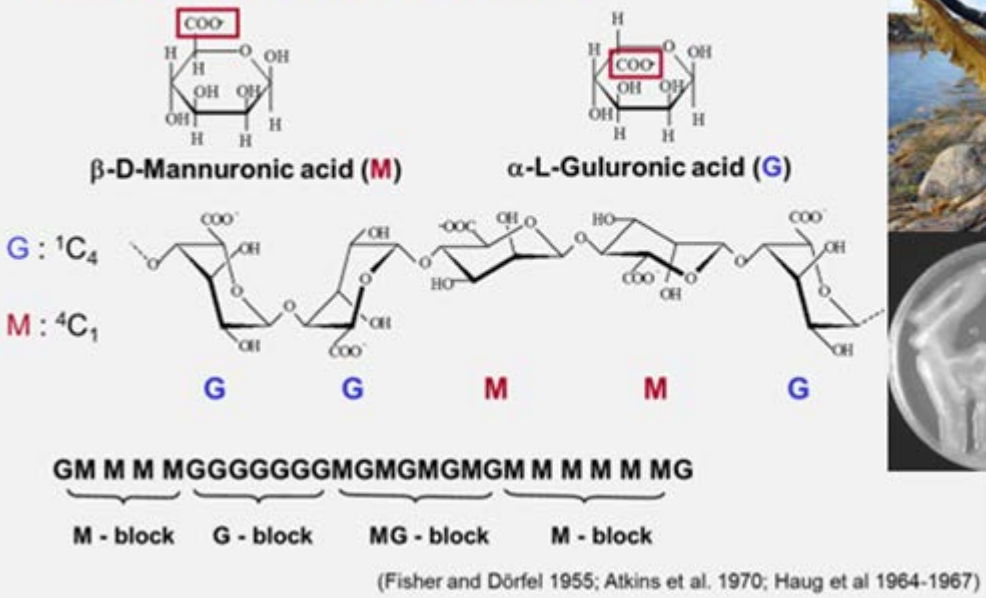
Modular Approach for the PERFE COAT Coatings Development and Validation



- ❖ **Basic and advanced testing** (feedback loop)
- ❖ **Formulation, compatibility, performance**
- ❖ **Demonstration** for UV-curable and waterborne paints and coating applications

Results – Microbial biopolymer and oligomer production

Alginate composition



Mw=93 kDa

Cultivation scale-up to 50 L bioreactor scale and downstream processing for a range of different chain lengths

Microbial alginate production by engineered strains of *Pseudomonas fluorescens*



Chemical hydrophobization with (microbial) fatty acids for use as waterborne binder candidates

Chemical functionalization (hydrophobization, activation) for use as UV-curable binder candidates

Chemical hydrolysis and oligomer purification

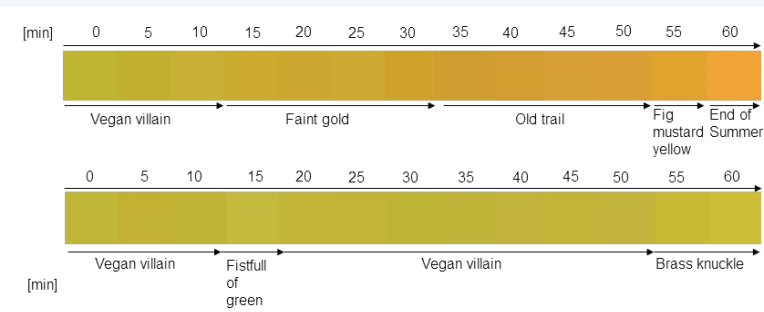


Mw=30-40 kDa

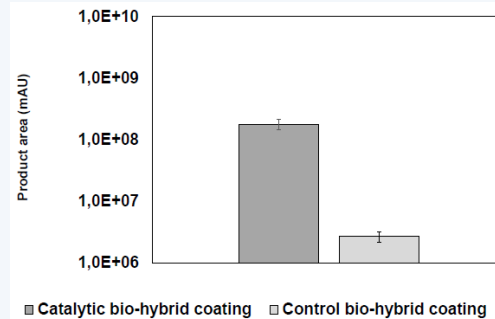
Results – Microbial fillers and Functional nanomaterials



PVC 80 formulations containing bio-based fillers (1-11), calcium carbonate control. Chemically modification (1-7) for improved color properties



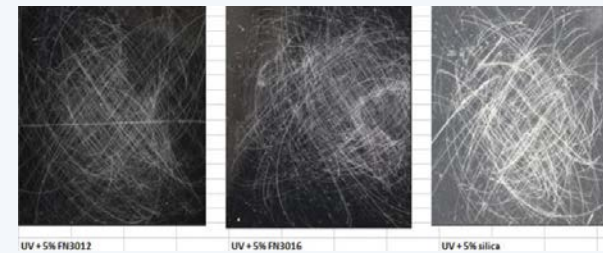
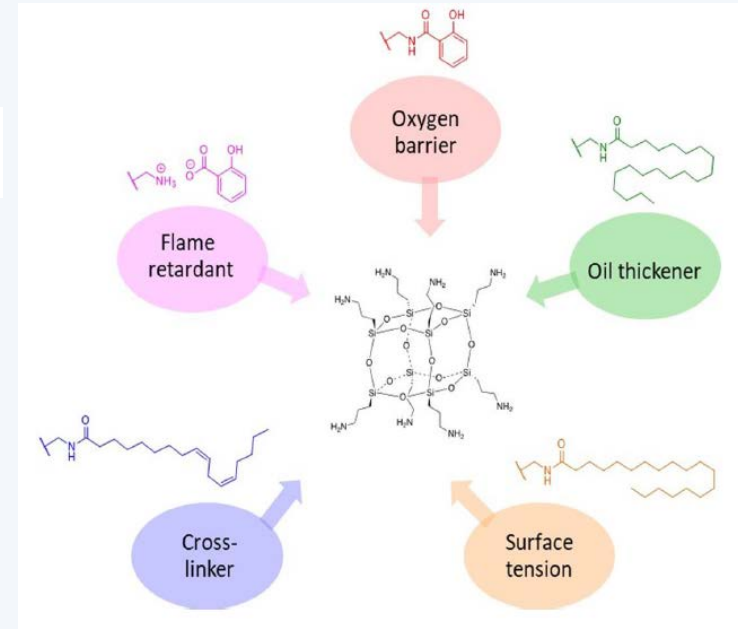
UV-sensing bio-hybrid coatings after UV exposure (top) or stored in the dark (bottom)



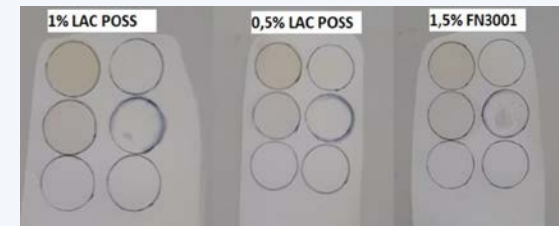
Catalytic bio-hybrid coating able to degrade halogenated VOC



Polyhedral oligomeric silsesquioxane (POSS) as a flexible platform for improving new biobased coating performances



Improved scratch resistance in UV-cured wood coating

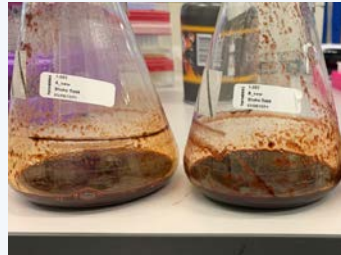


Improved stain and chemical resistance in waterborne coatings

Results – Development and production of microbial pigments



Upscale production and formulation of the fungal red pigment **Atrorosin** and derivatives



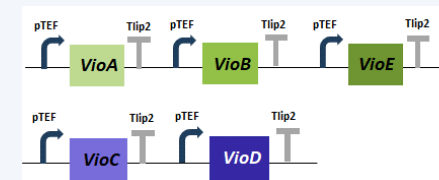
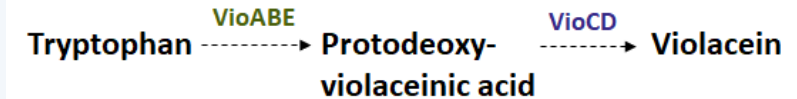
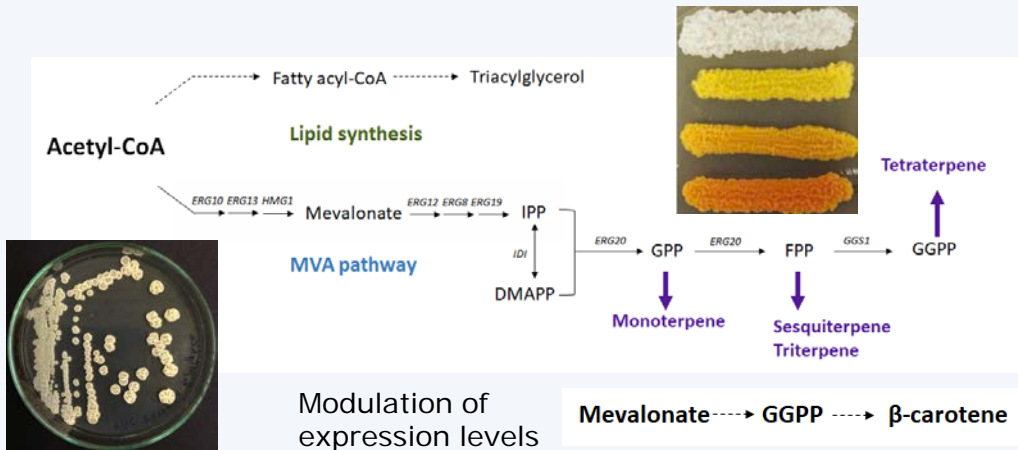
Strain Engineering
Development of strains producing target product

Fermentation scale-up
Target molecule is produced by the host during the fermentation process

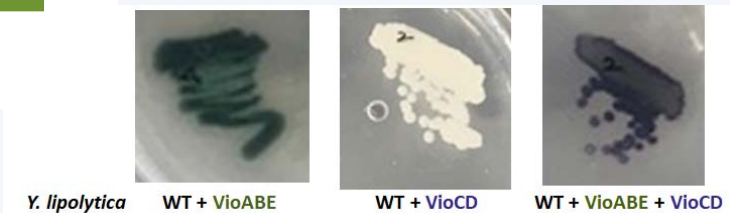
Harvest and purification
Downstream processing includes purification, drying, and formulation

Imperial College London

Terpene production engineering in the non-conventional yeast *Yarrowia lipolytica*



Construction of novel expression cassette



Results – Testing, formulation, and demonstration

Test equipment

Ultrasonic dispersion method established for small quantity biobased pigment samples



Test result:
biobased pigments provide quite intensive colors



Challenge:
stability of color after long-term storage

Test equipment

Wet scrub tester



Test result



Color change and lower abrasion resistance of the prototype filler (left side) compared to the standard (right side)



Test equipment:
Mini Martindale abrasion tester

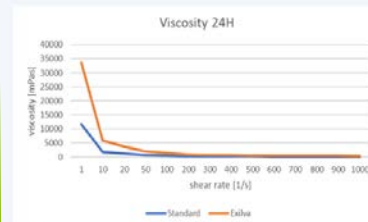


Test result

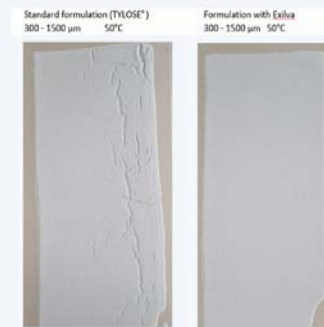


The addition of POSS to the UV wood coating enhances the mechanical resistance - less scratches are seen at the surface compared to a reference without POSS

Test equipment & result rheology:
use of MFC allows to adjust the rheological profile in the desired way



Test result:
favourable cracking resistance of thick films



Application and performance requirements

Requirements	Test method	Class							
		P1	R0	R1	R2	R4	R6	R7	
Water	EN 12720*	24 hrs	24 hrs	24 hrs	24 hrs	16 hrs	6 hrs	1 hour	
Result ≥4 on the assessment scale 1-5.									
Fat (liquid paraffin)	EN 12720*	24 hrs	24 hrs	24 hrs	24 hrs	24 hrs	24 hrs	6 hrs	
Result ≥4 on the assessment scale 1-5.									
Requirements	Test method	Class							
		P1	R0	R1	R4				
Alcohol (48%)	EN 12720*	24 hrs	24 hrs	24 hrs	24 hrs				
Result ≥4 on the assessment scale 1-5.									
Coffee	EN 12720*	24 hrs	24 hrs	24 hrs	24 hrs				
Result ≥4 on the assessment scale 1-5.									
Fat on scratches	IOS-TM-0002, section 2	7 N + 24 hours	7 N + 24 hours	5 N + 24 hours	3 N + 24 hours	2 N + 24 hours			
Acceptable width of a scratch is maximum 0.5 mm. Penetration through the coating film is not acceptable. Result shall be ≥4 on the assessment scale 1-5. If the spreading of fat is not possible to observe, the requirement criteria for penetration are not applicable.									

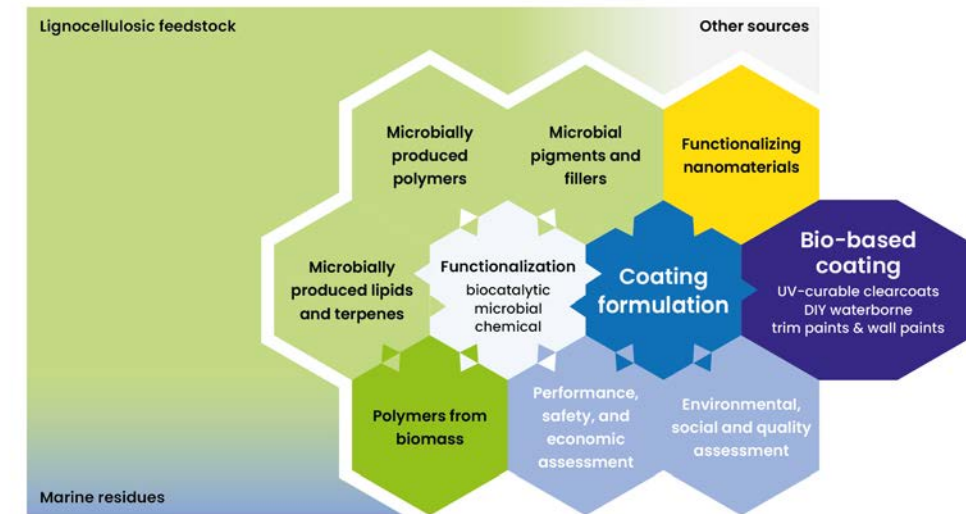
IKEA standards for chemical and mechanical resistance

- Industrial standards-guided demonstration of novel compounds and formulations for markets targeted by PERFE COAT.
- Full assessment (safety, LCC, eLCA, sLCA) of the most promising compounds and formulations

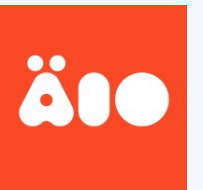
Prospects for market deployment and commercialization

- ✓ Significant progress has been made in exploring a broad spectrum of new biobased solutions for the coatings market, challenging due to its high-performance requirements.
- ✓ TRL uplift has been achieved on a broad basis for diverse new compounds applicable in coatings within the target range of PERFECOAT (TRL3-5).
- ✓ The established modular platform enables diverse new solutions by combining biotechnology and chemical synthesis, including towards other applications and markets than coatings (personal care, packaging, advanced materials, etc.).
- ✓ A few frontrunner compounds, approaches, and processes are being developed and scaled further within the coatings and other markets, involving PERFECOAT commercial partners.
- ✓ New IP and IPR from the project enables involved SME partners to validate and scale their technologies, solidifying their standing and enabling growth.

Modular Approach for the PERFECOAT Coatings Development and Validation



- ✓ Project results have contributed to establishing TalTech spin-off company ÄIO, involved in follow-up CBE JU IA project BIONEER.



Recommendations for future work or next steps

- ✓ **Exploitation and further TRL uplift of PERFECOAT results is already ongoing in several national and European spin-off projects. Additional new project opportunities are being explored.**



SCALED-UP PRODUCTION OF NEXT-GENERATION CARBOHYDRATE-DERIVED BUILDING BLOCKS TO ENHANCE THE COMPETITIVENESS OF A SUSTAINABLE EUROPEAN CHEMICALS INDUSTRY

Project budget: €9.5 million

CBE JU contribution: €7.5 million

Duration: June 2024 – May 2028

Call / GA no.: HORIZON-JU-CBE-2023-IA-06 / 101157779

Consortium: 13 partners from 9 European countries; SINTEF lead
BIONEER's main goal is to demonstrate and advance the potential of lignocellulosic biomass carbohydrate-derived components to replace fossil-based functional building blocks and establish their route to market by showcasing their application potential in coatings and personal care sectors, including everyday consumers' products.



NordiCoats - New biobased epoxy compounds for high-performance applications (Research Council of Norway)

Project budget: NOK 16.5 million (NOK 15 million from RCN)

Duration: 2023 – 2026

Consortium: 7 partners (incl. 4 companies); SINTEF lead

New SINTEF initiatives to CBE JU calls:

- **HORIZON-JU-CBE-2024-IA-07** - Innovative conversion of biogenic gaseous carbon into bio-based chemicals, ingredients, materials
- **HORIZON-JU-CBE-2024-RIA-04** - SSbD bio-based coating materials for applications under demanding and/or extreme conditions
- Contributions to others considered

- ✓ **New funding opportunities at all levels (RIA, IA, Flagship) will be needed also in the future to further support the biobased transition in the European coatings industry.**

Conclusions

- ✓ The **PERFE COAT** project has developed and currently validates a **new generation of bio-based paint ingredients for enabling industrial wood and decorative coatings with at least 25% bio-based content** while meeting current quality and sustainability standards.
- ✓ This has been achieved by building a **flexible technology platform** to produce innovative bio-based binders, fillers, and pigments from a range of biotechnologically produced biopolymers, lipids, and functionalized materials, and assembling and testing them in new coating formulations.
- ✓ Technical developments have throughout the project been guided by rigorous **performance testing and validation** of ingredients and formulations by our industrial partners, supplemented by **assessment of safety, as well as environmental and social sustainability. Demonstration is ongoing...**

Learn more about **PERFE COAT** results:

- Webinar series; final webinar on August 27, 2024, dedicated to **PERFE COAT** results
- Website: www.perfeccoat-project.eu; newsletters, earlier webinar and workshop materials, etc.
- Social media: LinkedIn - **#PERFE COAT**
- Follow-up CBE JU project BIONEER (IA): www.bioneer-project.eu (website under construction)

Acknowledgements

Funding:



Industry partners:



Research partners:



Communication partner:



Thank you for your attention !

Contact:



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