DEVELOPMENT AND PILOT PRODUCTION OF SUSTAINABLE BIO-BINDER SYSTEMS FOR WOOD-BASED PANELS

Deliverable 5.6

Market Uptake Analysis

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Publishable summary

Background

The SUSBIND consortium develops, produces and tests bio-based adhesive systems as an alternative to adhesive systems based on a urea-formaldehyde resin as currently used for wood-based panel boards in furniture mass production. SUSBIND aims at producing and validating these bio-based adhesive systems with leading wood board manufacturers for two product types: P2 particleboard (PB) and medium density fibreboard (MDF).

In the other SUSBIND work packages, the consortium partners have developed a novel partly bio-based and formaldehyde-free resin. The 'SUSBIND resin' is based on fructose (from maize/wheat), hydroxymethylfurfural (HMF) also made from maize/wheat fructose, and bis(hexamethylene)triamine (BHT), a fossil chemical used as crosslinker.

In this market uptake analysis we assess to what extent the SUSBIND resin can compete with current state-of-the art resins and is feasible for post-project production upscaling, from a techno-economic and regulatory perspective.

Analytical framework

To gain more insights into the opportunities for a successful market uptake of SUSBIND resin an analytical framework has been developed. This is illustrated in **Fout! Verwijzingsbron niet gevonden.**.

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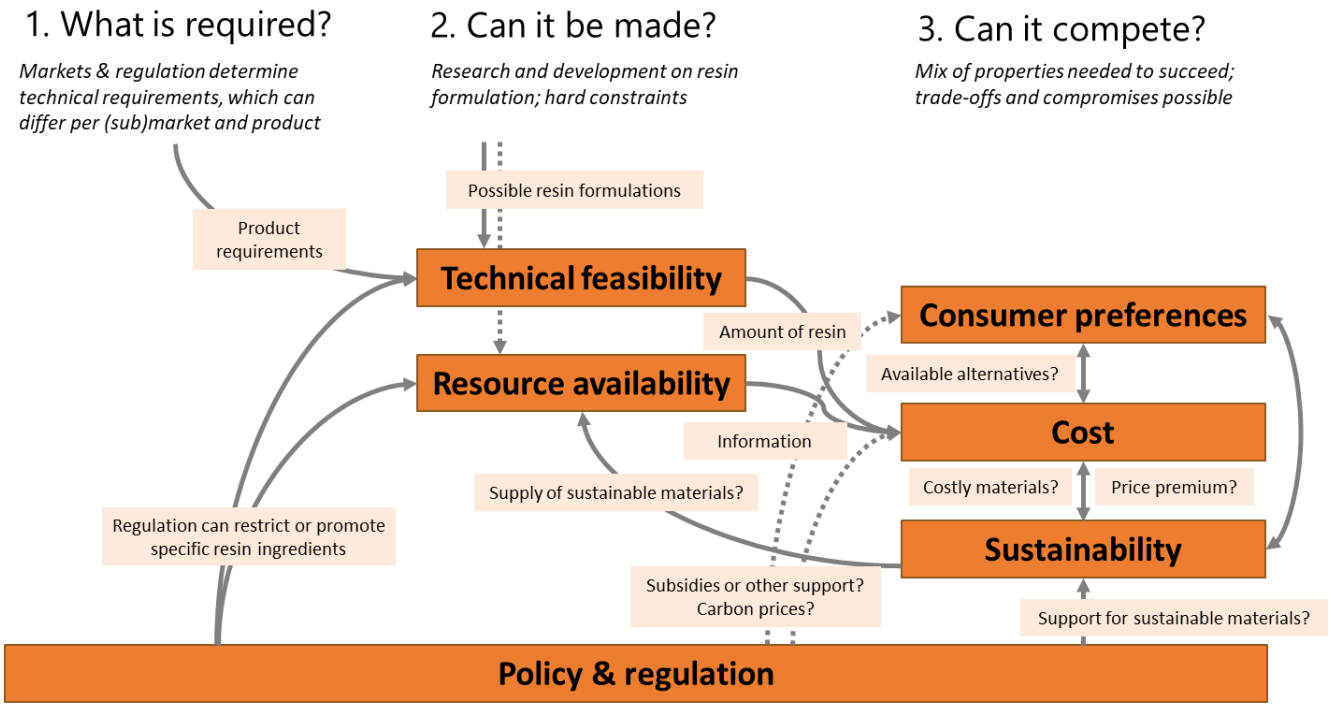
Figure 1 – Analytical framework for investigating the potential market uptake, including (indicative) relations between success factors



The analytical framework is centred around three subsequent questions: 1) What is required? 2) Can it be made? and 3) Can it compete? The first question determines the requirements for the products, in this case a formaldehyde-free bio-based resin for wood-based panels. This market uptake analysis does not focus specifically on the first question, but it is crucial for determining technical feasibility of a new resin (as was done in Work Packages 2, 3 and 4). The technical requirements are driven by market demands and can differ per (sub)sector. In addition, regulation can play a role here.

The second question (can it be made?) is crucial for market uptake and determines whether market introduction of the proposed resin is possible. In this stage, research and development are conducted to develop a resin formulation that can meet the technical requirements. **Technical feasibility** and **resource availability** are two key criteria here.

The third question (can it compete?) further determines whether market introduction is successful. Once it is clear that a resin offers sufficient technical performance and can be produced at scale, other 'softer' criteria determine whether a resin is successful. Here, we structure the discussion around the **business case**, **consumer preferences** and **sustainability**. Between these criteria, trade-offs and compromises are possible. These criteria can be influenced by **policy and regulation**.

Market uptake analysis for the SUSBIND resin

For the SUSBIND resin we analysed the criteria that should be met for a successful market uptake. From the first lab and product prototype tests we expect that technical feasibility is sufficient and that there seem no big problems that negatively affect the upscaling potential.

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While fructose from maize/wheat is sufficiently available, for BHT the availability of resources and production capacity is unsure at the moment, also caused by scarcity in all resource markets. BHT is currently only produced as a by-product, so there is no dedicated production. According to producers, sufficient raw materials are available and production capacity can be created if demand is high enough, although it has to be researched if and how dedicated production can take place. Assuming that new BHT production capacity would need to be built and that this could take several years at least, it would not be possible to scale up the use of SUSBIND resin in the shorter term.

On the environmental aspects, SUSBIND Deliverable 5.4 concluded that the SUSBIND resin is estimated to have a lower[1] human health impact during the use phase than reference UF/MUF boards (which are already well below the legal emission limits), due to their lower formaldehyde emissions. The carbon footprint results show that SUSBIND adhesive systems can come close to the footprint of UF in best case conditions, but that a major carbon footprint reduction is not likely.

The business case for the SUSBIND resin is unsure, particularly because of uncertainty about the bulk BHT price. Assessing the current business case for SUSBIND resin production is complicated by current historically high and volatile resource prices. It is likely that the price of the SUSBIND resin will be higher than the current UF price (which is low due to the optimized production process). Our analysis shows that the maximum price of BHT at which SUSBIND resin is cost-competitive is a factor 5 lower than the current market prices. In case consumers are willing to pay 30% more for a wood-based panel using the SUSBIND resin, the resin would be competitive with UF and resin costs will be 30-50% of total production costs. Regulation can influence product prices if subsidies or other financial incentives are used. On the other hand, prices of the incumbent boards using UF can increase if regulation leads to restrictive production requirements, like the formaldehyde release emission standards for panels containing UF.

Currently, there is no restricting regulation for the SUSBIND resin, but there is always a risk for more stringent regulation with respect to the use of fossil ingredients and food crops for material applications.

Finally, furniture / wood based panel producers decide whether to use the SUSBIND resin whilst consumers decide whether to buy the product. In some market segments, consumers are willing to pay a price premium for a more healthy or sustainable product, but in the bulk market price is important. A market survey conducted within the SUSBIND project shows that more than half of the European consumers is willing to pay a price premium of – on average – around 15% per furniture product. For consumers price and comfort are the most important determinants in a buying decision. Health and sustainability characteristics are less important.

Table 1 below summarizes the perspective towards market uptake in a compliance checklist:

[1] A first assessment based on measured emissions from boards shows that the overall human health impact of SUSBIND boards is expected to be about 40 to 55% lower than that of UF/MUF boards (based on the ReCiPe 2016 human health indicator).

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Table 1 – Compliance checklist for successful market uptake of novel resins for wood-based panels, applied to SUSBIND resin compared to urea-formaldehyde (UF) resins

Criterion	Findings	Conclusion
Technical feasibility	• Resin production proven on a laboratory scale and prototype product • Sufficient technical properties • No insuperable issues	√
Availability of resources and production capacity	• Availability of BHT is uncertain, likely insufficient for large-scale implementation of SUSBIND resin • Sufficient availability of bio-based materials • Dedicated production capacity BHT can be created, but this is a longer-term option that should be further investigated	?
Business case	• Current price of BHT is uncertain and volatile, but price may decrease if production is scaled up • Price of UF is relatively low due to optimized production process; however, higher formaldehyde emission standards could increase price • Business case assessment is complicated by current historically high and volatile resource prices • Without additional willingness to pay by consumers, SUSBIND resin is unlikely to be cost-competitive	?
Sustainability: carbon footprint and human health effects	• Over 50% lower formaldehyde emissions than incumbent UF/MUF boards; other emissions are higher (acetic acid, furfural) but overall reduced human health impact in furniture use phase • Carbon footprint of SUSBIND adhesive system is about 10 – 30% higher than UF adhesive system in default LCA analysis, due to use of fossil BHT • Carbon footprint of SUSBIND can come close to UF in specific cases, but no substantial reduction expected • See details in SUSBIND Deliverable 5.4	?
Regulation, certification and standards	• Regulation and standards (public and private) are becoming increasingly stringent for formaldehyde emissions during the use phase of furniture. • No restricting (or supporting) regulation for the SUSBIND resin at the moment • Risk of more stringent regulations with regard to fossil ingredients and use of food crops for material applications • Opportunity for SUSBIND if formaldehyde regulation becomes more stringent	√
Consumer preferences	• In some market segment, consumers are willing to pay a premium for a formaldehyde-free or lower carbon footprint product, but in bulk market price is important	√

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	• In a SUSBIND survey, consumers indicated they are willing to pay on average 15% more for a formaldehyde-free furniture product • Sustainability and health are important for consumers, but price and comfort are more important • Opportunity for SUSBIND is that acceptance among the general public for formaldehyde-containing products can decrease	

Overall conclusion and recommendations

We conclude that the SUSBIND project has resulted in the development of a resin that meets technical requirements, but as shown in the checklist (Table 1), the price, availability and carbon footprint of BHT are the main uncertainties that can hinder a successful market uptake. As indicated in the checklist (by using a '?' instead of an 'x'), these issues can potentially be overcome, especially in the longer term. The business case for SUSBIND resin can shift over time, partly depending on government policies, and it may be possible to develop and install new production capacity for BHT with a lower carbon footprint.

It is recommended to further investigate the options for upscaling and the find out the adequate price effect. Since BHT is the main barrier for market uptake, in parallel we recommend to continue investigating alternative crosslinkers to replace BHT or to develop alternative production routes for BHT which can address the production capacity, environmental footprint and cost concerns.

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