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Resource Wood
National Research Programme NRP 66

LCA of an Ultralight Particleboard

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- Bern University of Applied Sciences, Architecture, wood and civil engineering

KRONOSWISS WOOD SOLUTIONS
IKEA
Tetra Pak PROTECTS WHAT'S GOOD
KURATLE JAECKER Mach was mit Holz
THÜNEN
COST FP1303 Performance of bio-based building materials
FP1407 ModWoodLife

1. ULPB Technology

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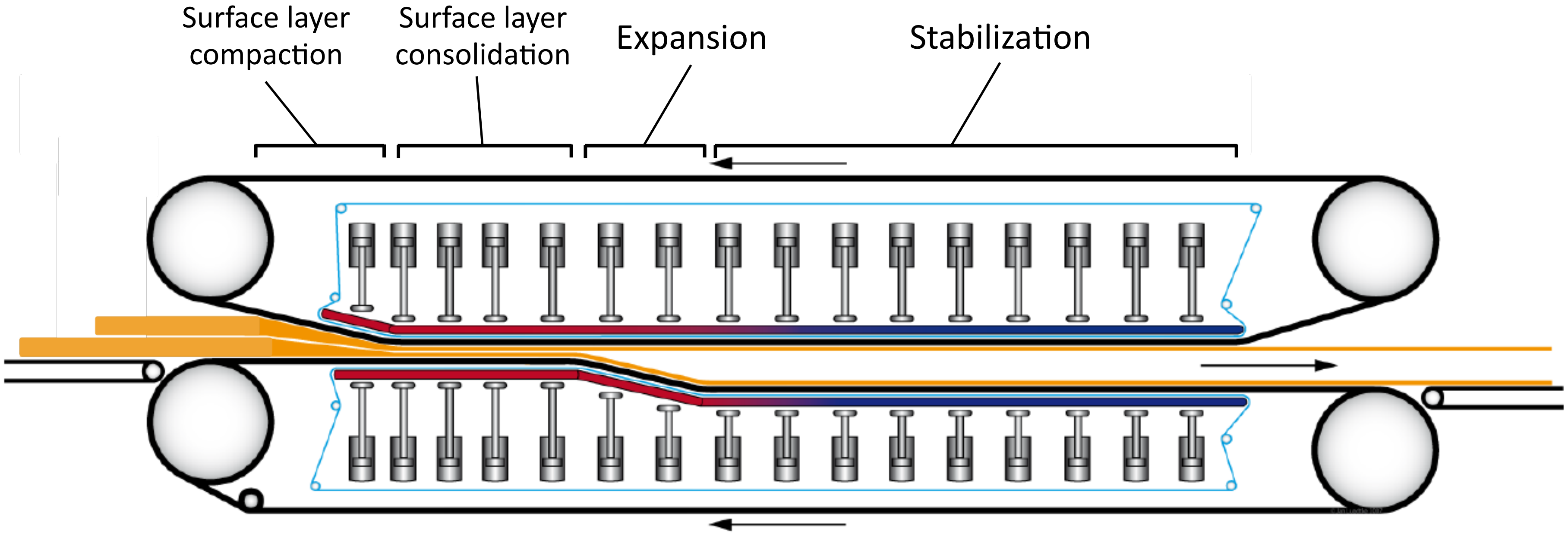
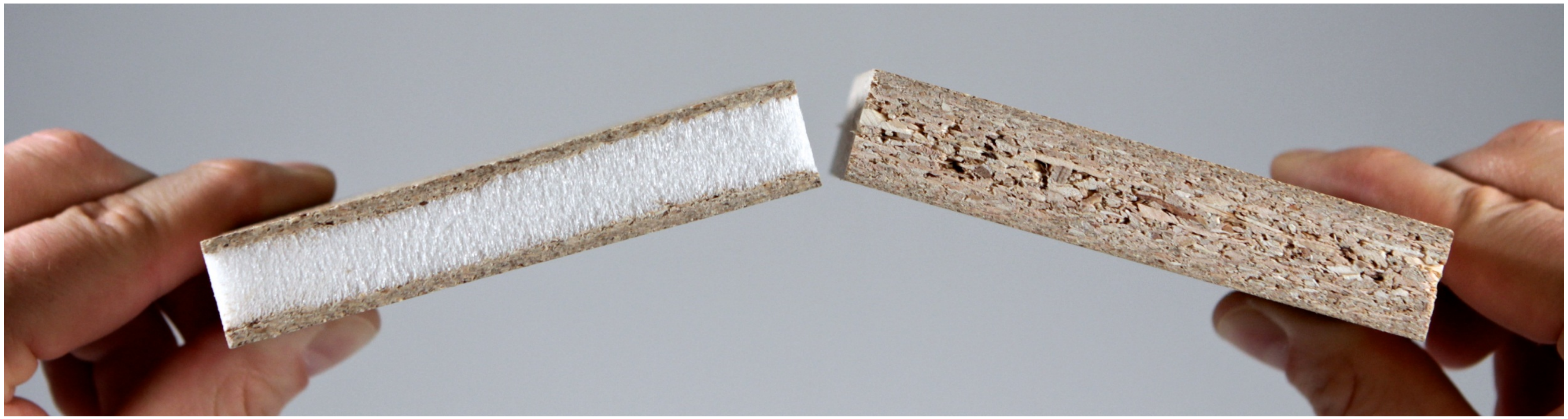




2. Approaches

Environmental Impacts 1 m^3 ULPB
manufactured in Switzerland ?

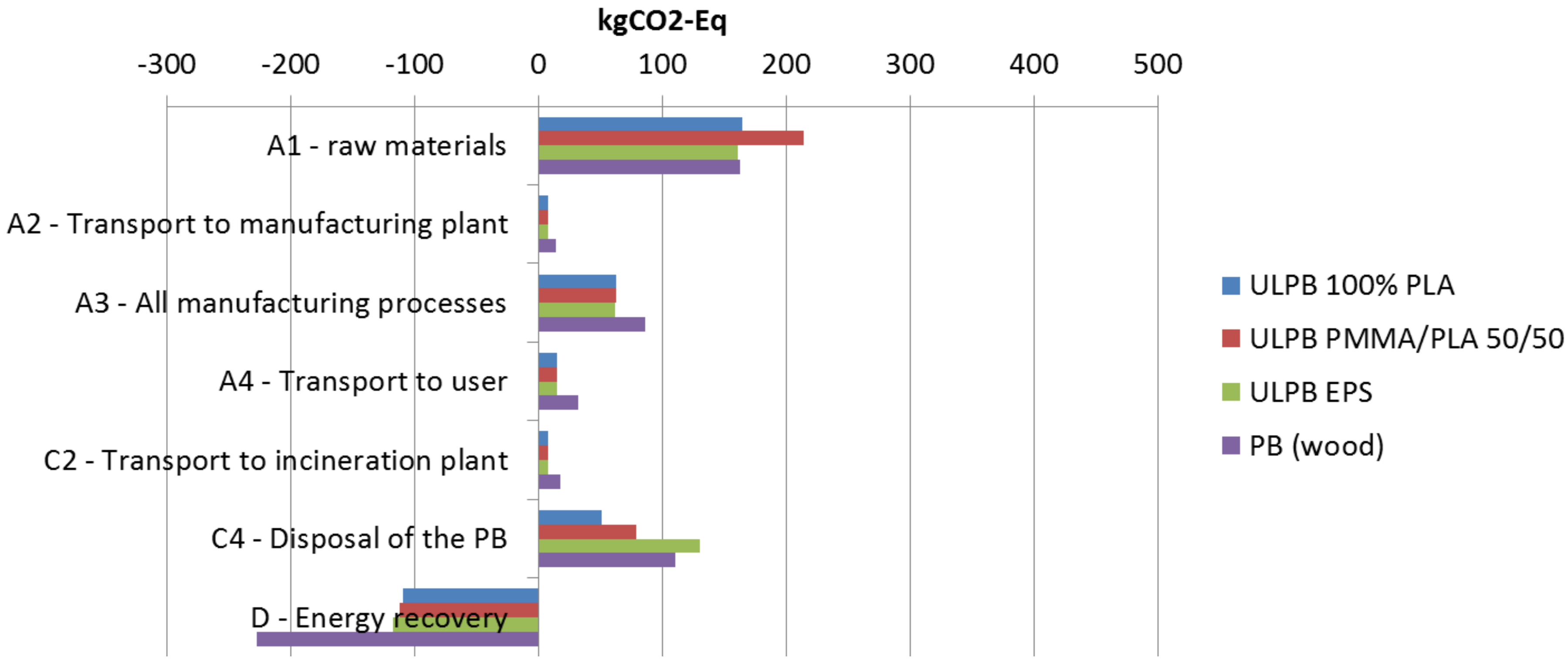
ALCA
(NFP66 tech. ass. rules)
EPD - Following EN 15804 and EN16485

+ Hot Spots
+ Eco-Design
+ Building context

Holistic approach

+ processes affected by a substitution
+ System expansion
+ «What if ?»
+ Market constraints
+ Testing scenario

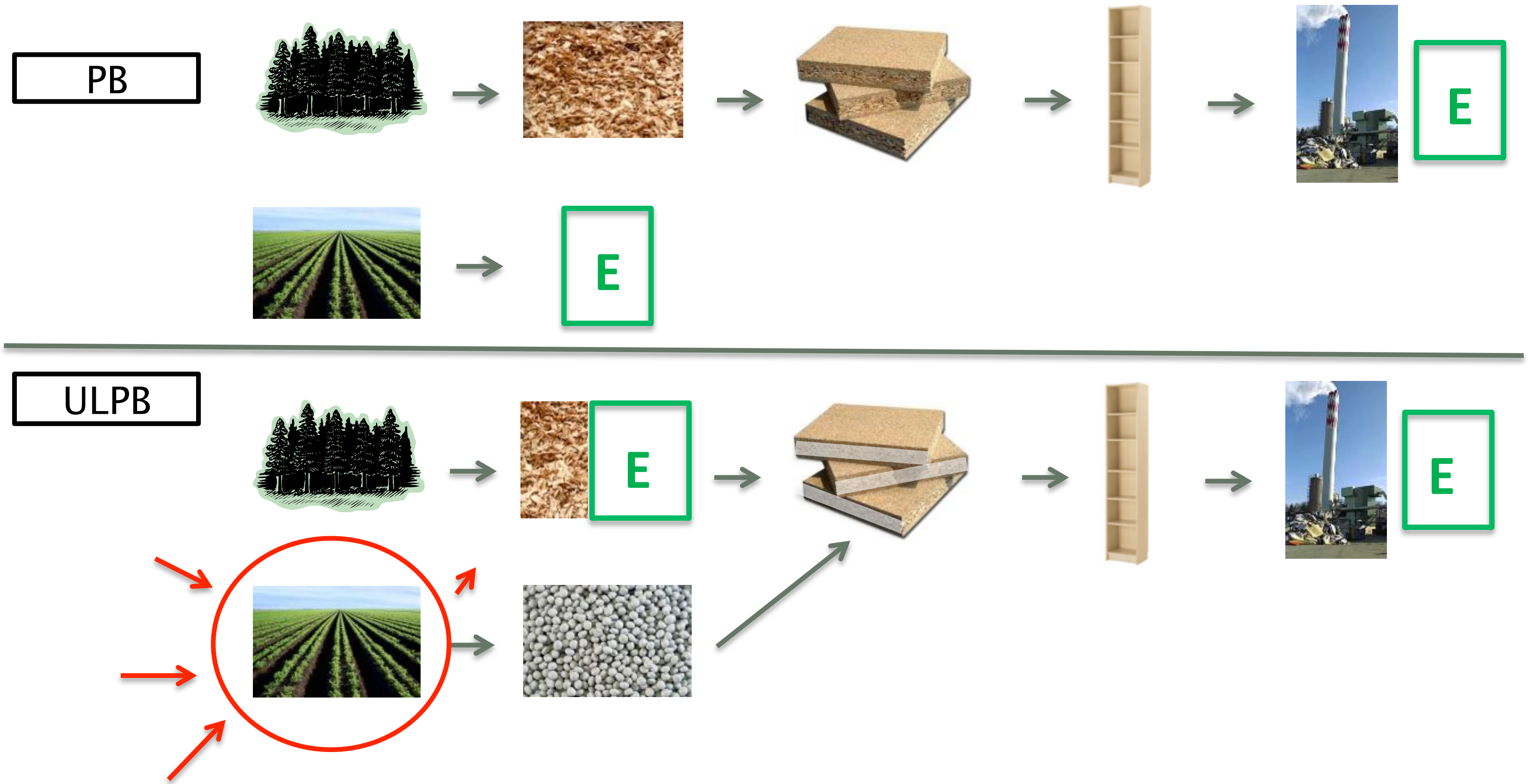
3. Effect of core layer composition substitution on GWP* (without biogenic carbon): comparative assessment



Each kg of PLA substituted by PMMA = increase of 6 kg fossil CO_2 emissions

4. Holistic approach

Problem: What happens if PB is replaced by ULPB in the future?

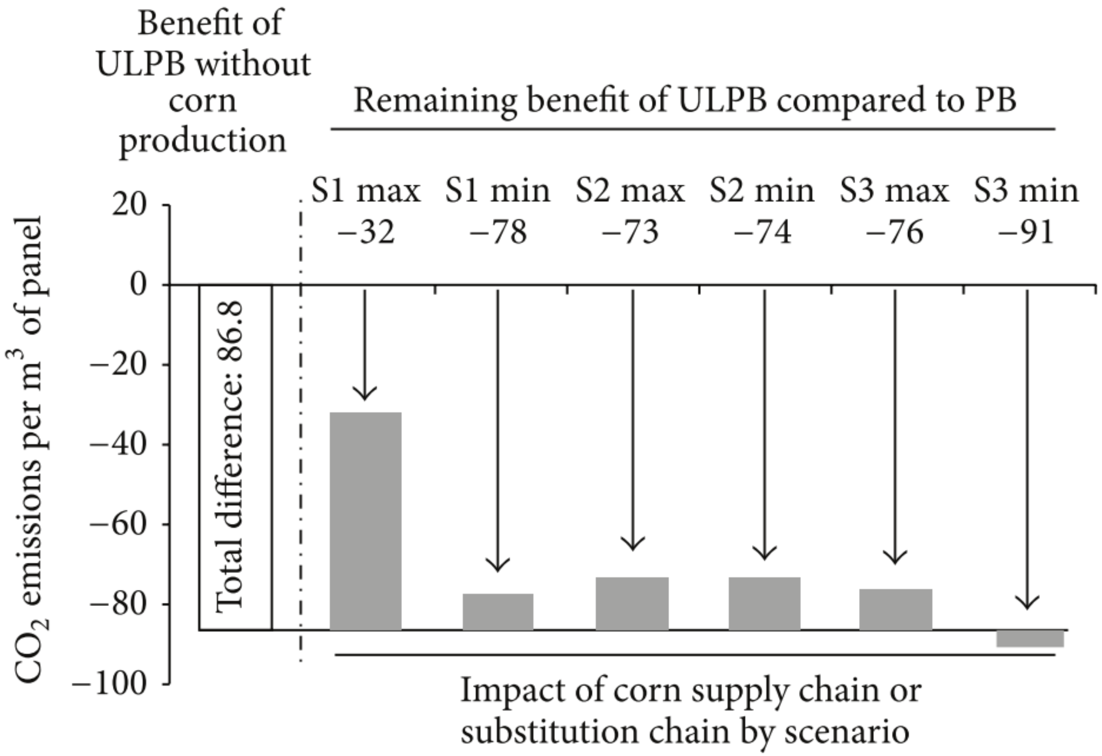


5. Holistic approach: scenario for corn

S1: extra corn has to be produced

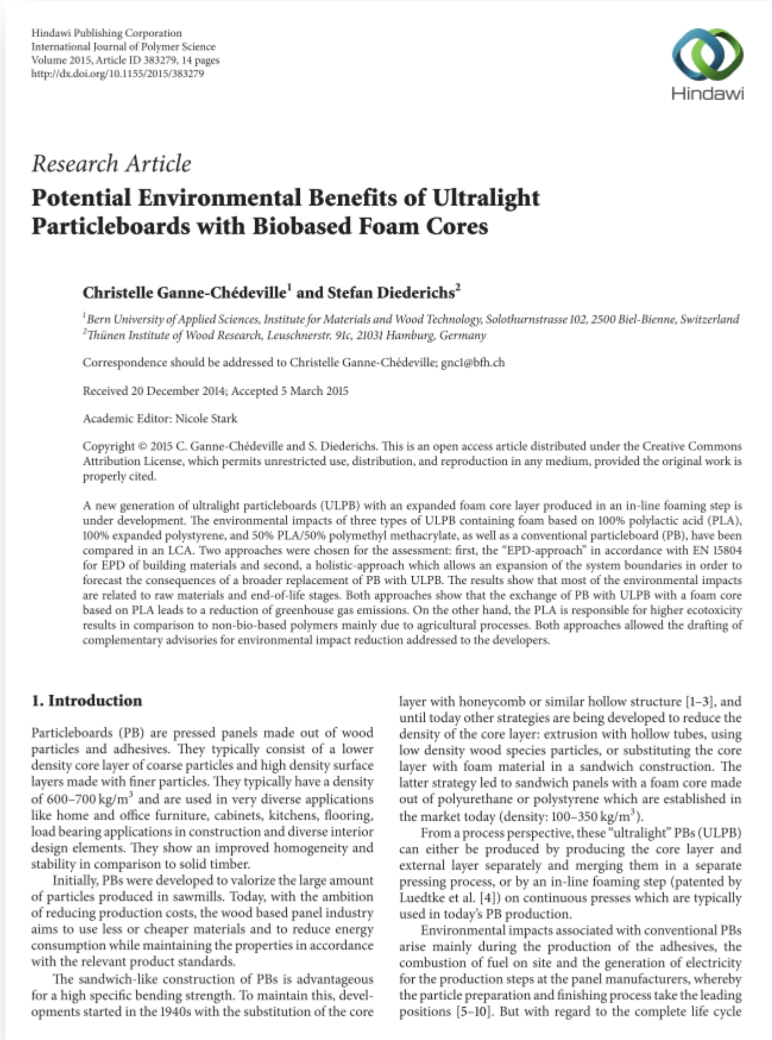
S2: PLA is produced from corn for ethanol production
(substitution by fossil gasoline)

S3: PLA is produced from corn for methane fermentation
(substitution by gas)



6. Conclusion

- From A to C module: ULPB has less GWP* than PB but more ecotoxic effects (due to PLA)
- Less biogenic carbon can be stored in ULPB
- Substitution (PB -> ULPB) should be beneficial for GWP* for all scenarios
- Hotspots are defined for eco-design
- Recommendations for developers are defined



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Research Article

Potential Environmental Benefits of Ultralight Particleboards with Biobased Foam Cores

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A new generation of ultralight particleboards (ULPB) with an expanded foam core layer produced in an in-line foaming step is under development. The environmental impacts of three types of ULPB containing foam based on 100% polylactic acid (PLA), 100% expanded polystyrene, and 50% PLA/50% polymethyl methacrylate, as well as a conventional particleboard (PB), have been compared in an LCA. Two approaches were chosen for the assessment: first, the "EPD-approach" in accordance with EN 15804 for EPD of building materials and second, a holistic-approach which allows an expansion of the system boundaries in order to forecast the consequences of a broader replacement of PB with ULPB. The results show that most of the environmental impacts are related to raw materials and end-of-life stages. Both approaches show that the exchange of PB with ULPB with a foam core based on PLA leads to a reduction of greenhouse gas emissions. On the other hand, the PLA is responsible for higher ecotoxicity results in comparison to non-bio-based polymers mainly due to agricultural processes. Both approaches allowed the drafting of complementary advisories for environmental impact reduction addressed to the developers.

1. Introduction

Particleboards (PB) are pressed panels made out of wood particles and adhesives. They typically consist of a lower density core layer of coarse particles and high density surface layers made with finer particles. They typically have a density of 600–700 kg/m^3 and are used in very diverse applications like home and office furniture, cabinets, kitchens, flooring, load bearing applications in construction and diverse interior design elements. They show an improved homogeneity and stability in comparison to solid timber.

Initially, PBs were developed to valorize the large amount of particles produced in sawmills. Today, with the ambition of reducing production costs, the wood based panel industry aims to use less or cheaper materials and to reduce energy consumption while maintaining the properties in accordance with the relevant product standards.

The sandwich-like construction of PBs is advantageous for a high specific bending strength. To maintain this, developments started in the 1940s with the substitution of the core layer with honeycomb or similar hollow structure [1–3], and until today other strategies are being developed to reduce the density of the core layer: extrusion with hollow tubes, using low density wood species particles, or substituting the core layer with foam material in a sandwich construction. The latter strategy led to sandwich panels with a foam core made out of polyurethane or polystyrene which are established in the market today (density: 100–350 kg/m^3).

From a process perspective, these "ultralight" PBs (ULPB) can either be produced by producing the core layer and external layer separately and merging them in a separate pressing process, or by an in-line foaming step (patented by Luedtke et al. [4]) on continuous presses which are typically used in today's PB production.

Environmental impacts associated with conventional PBs arise mainly during the production of the adhesives, the combustion of fuel on site and the generation of electricity for the production steps at the panel manufacturers, whereby the particle preparation and finishing process take the leading positions [5–10]. But with regard to the complete life cycle

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