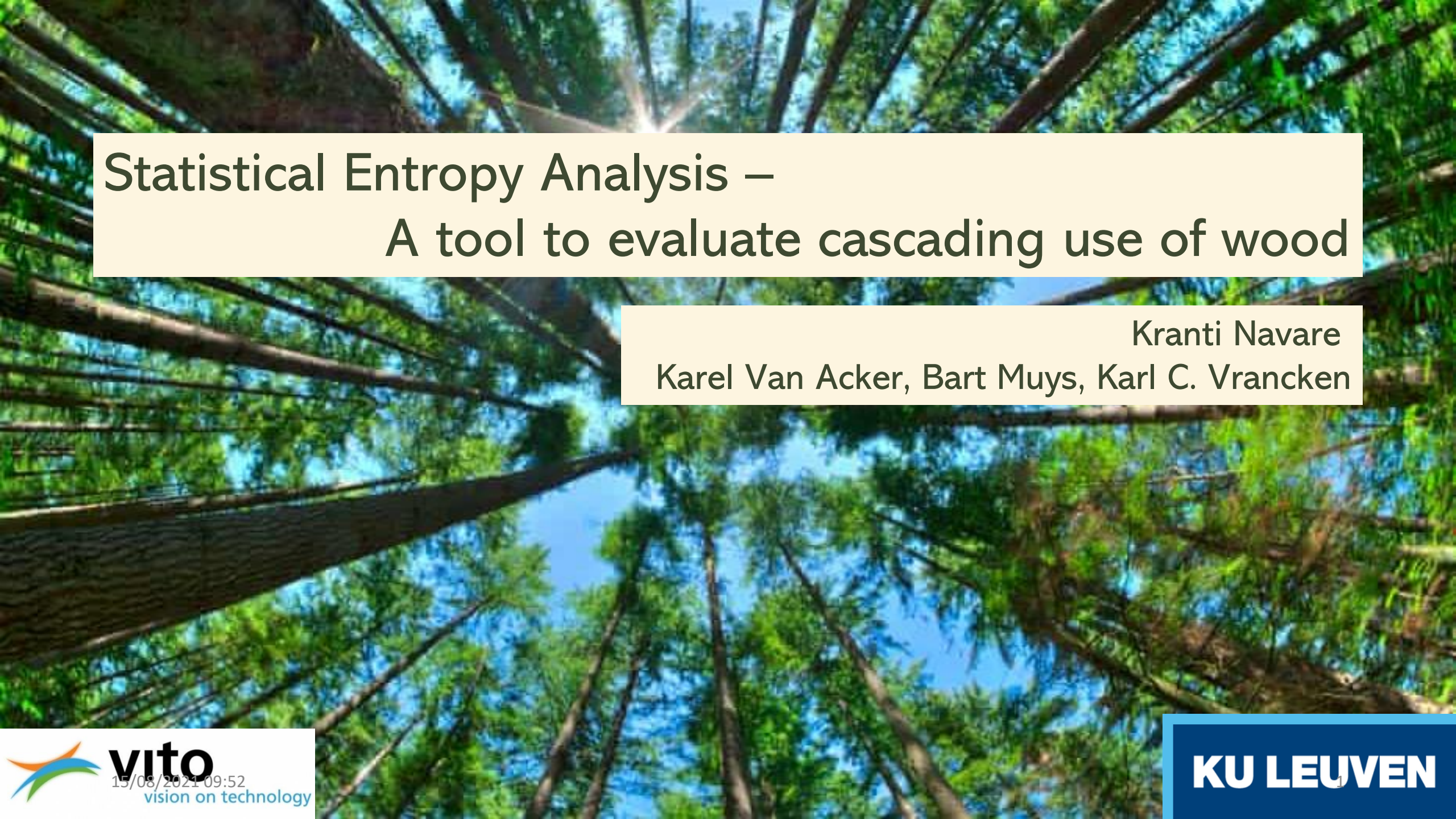

Statistical Entropy Analysis – A tool to evaluate cascading use of wood

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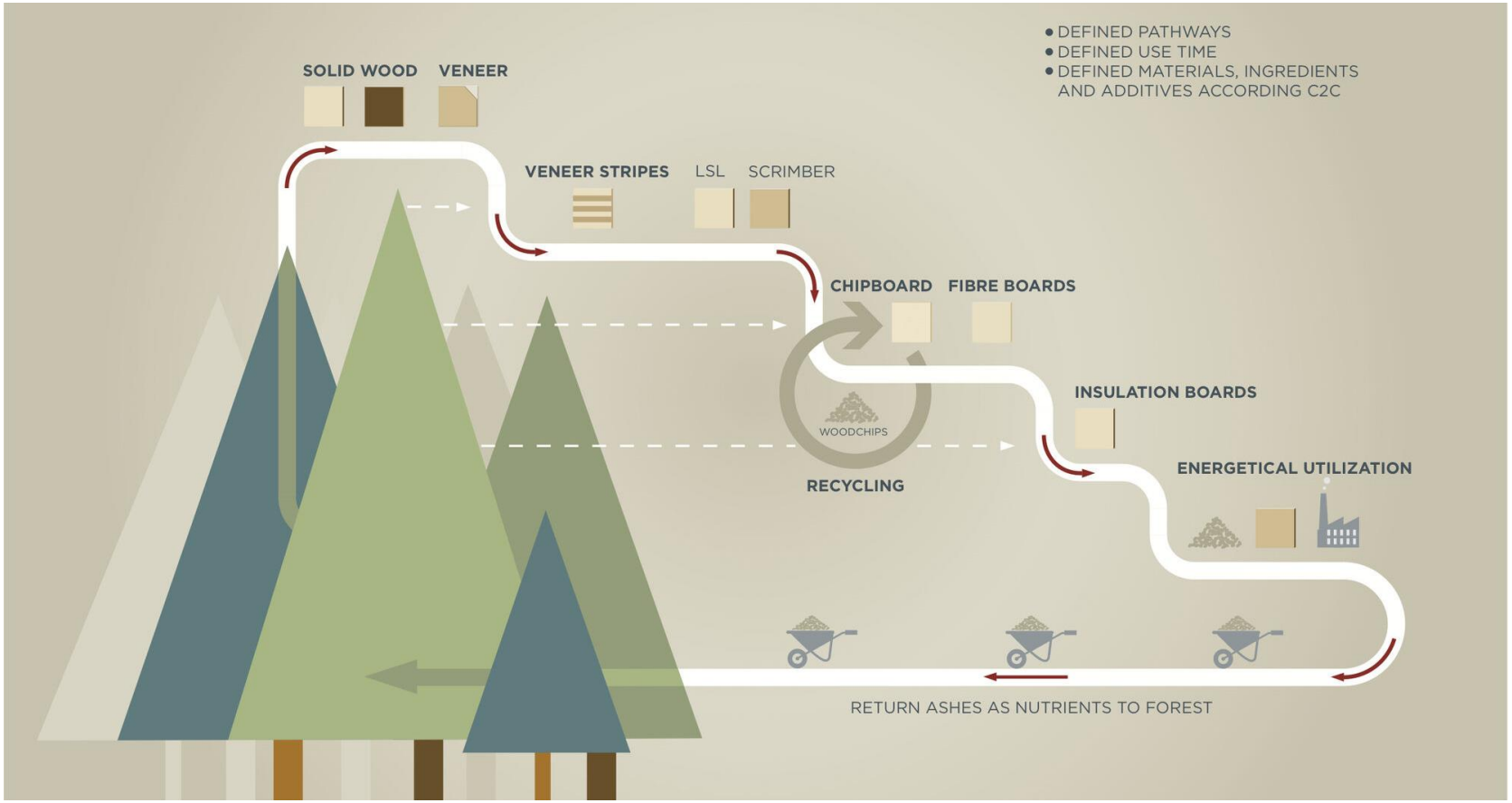
vito vision on technology

KU LEUVEN

Cascading



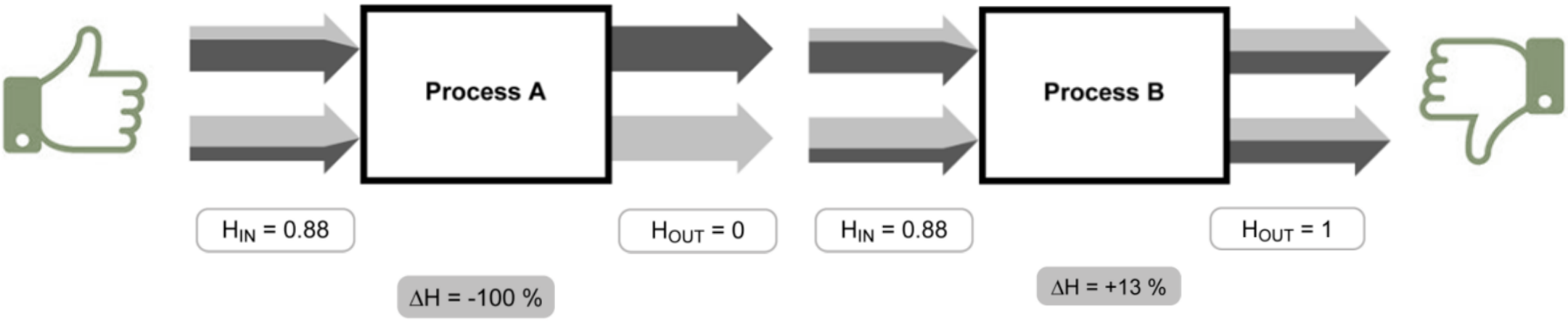
Source: https://thecirculareconomy.fandom.com/wiki/Cascading_Materials

Aspects of cascading

- ❑ Multiple lifetimes of material
- ❑ Material quality
- ❑ Time in use

Statistical Entropy Analysis

Shannon entropy index	Material management
$H' = -\sum_{i=1}^{S} p_i * \log_2(p_i)$	$H_c' = -\sum_{i=1}^{S} c_i * \log_2(c_i)$



Source: Sobańtka, A., Zessner, M., Rechberger, H., 2012. The Extension of Statistical Entropy Analysis to Chemical Compounds. Entropy 14, 2413–2426. https://doi.org/10.3390/e14122413

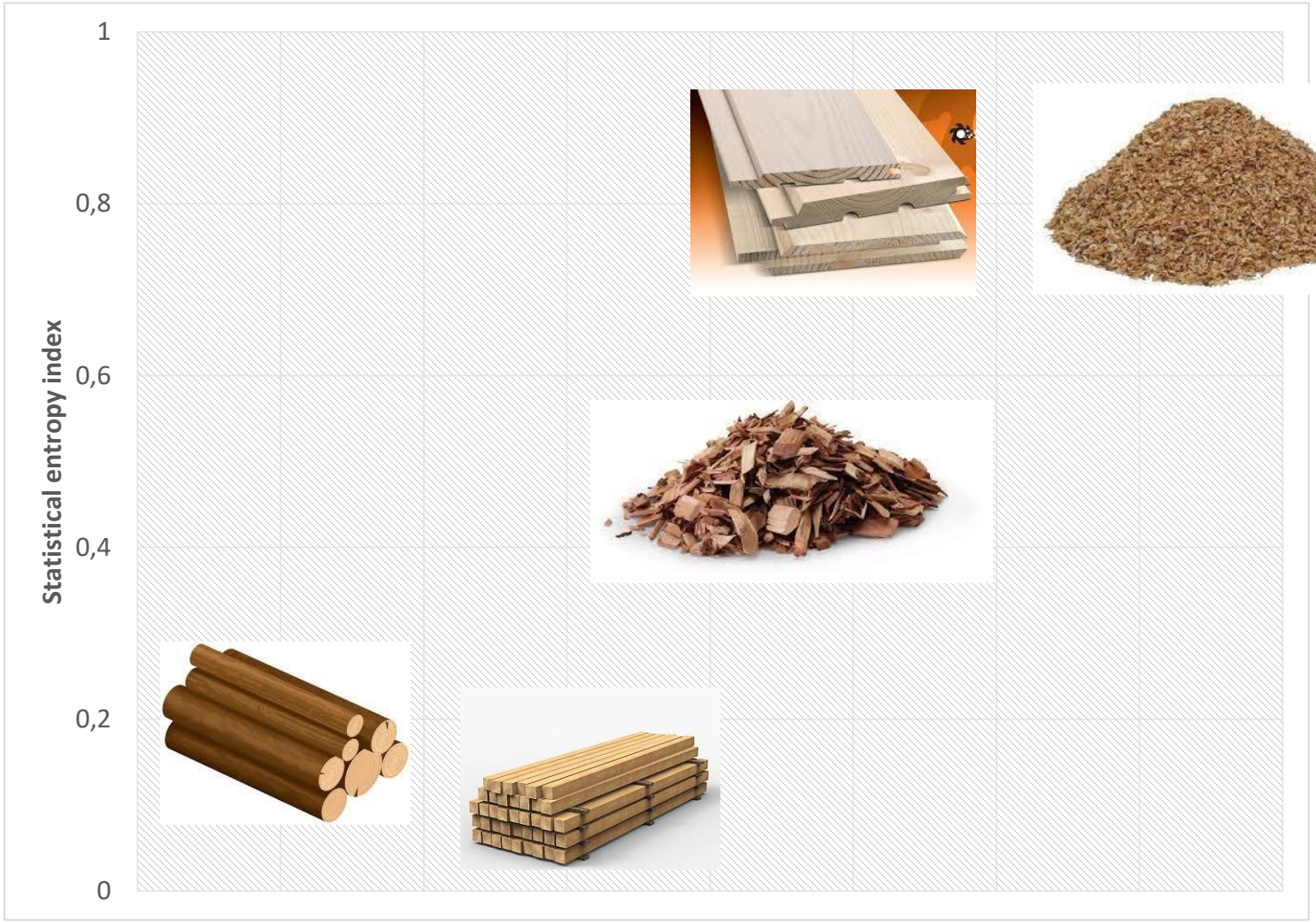
Statistical Entropy Analysis for wood

Wood management

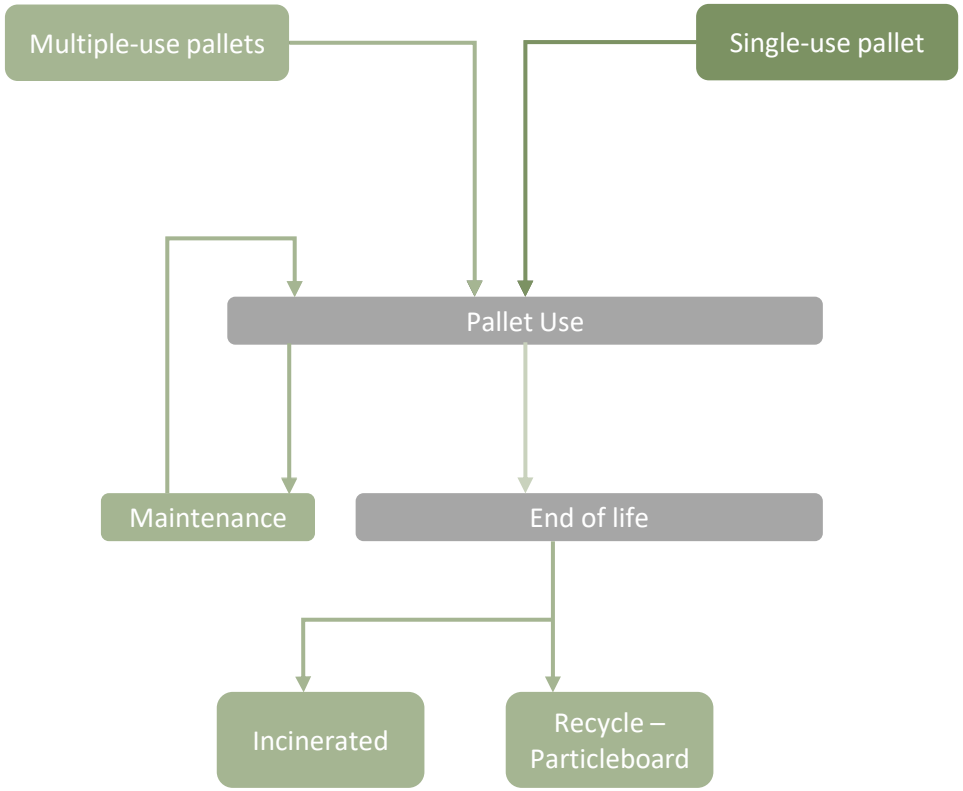
$$H_c' = -\sum_{i=1}^{S} c_i * \log_2(c_i)$$

$$H_s' = -\sum_{i=1}^{S} s_i * \log_2(s_i)$$

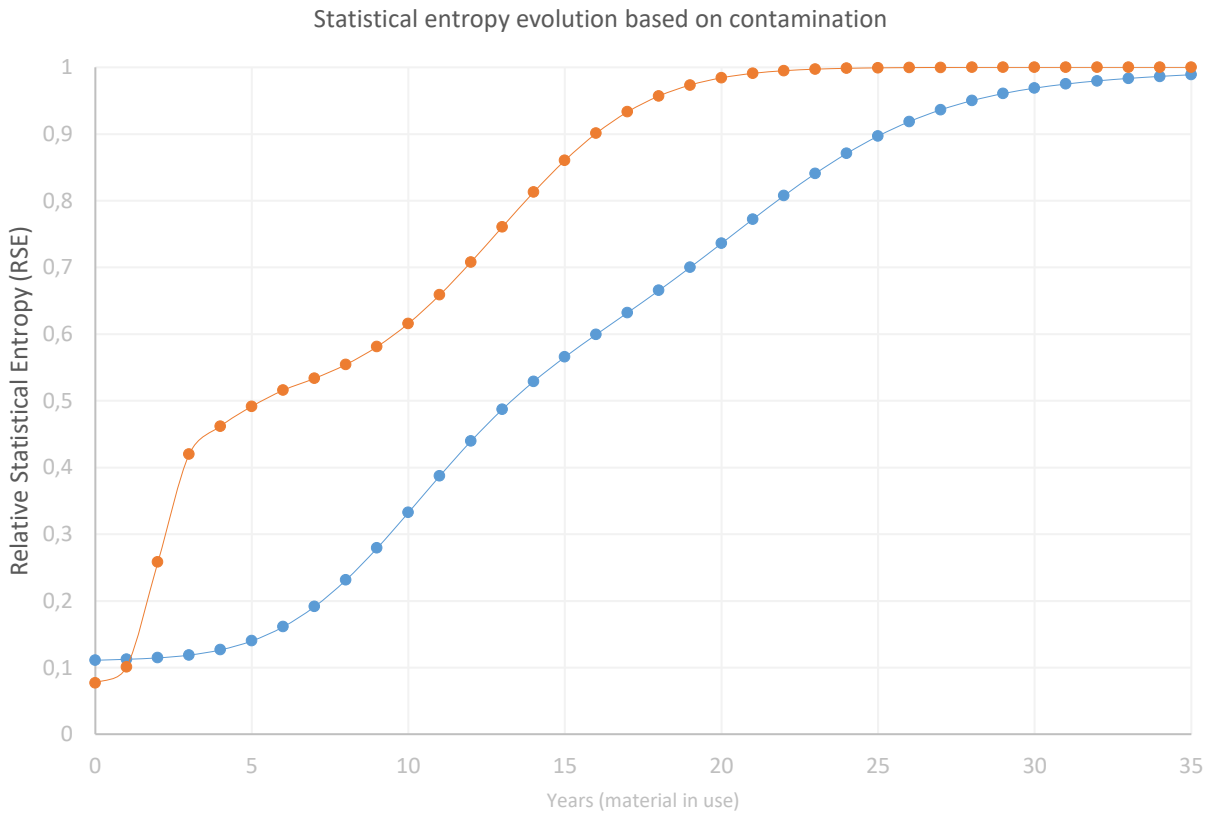
$$s_i = \frac{mass\ of\ piece\ \mathrm{i}}{maximum\ mass\ (for\ the\ specific\ case\ study)}$$

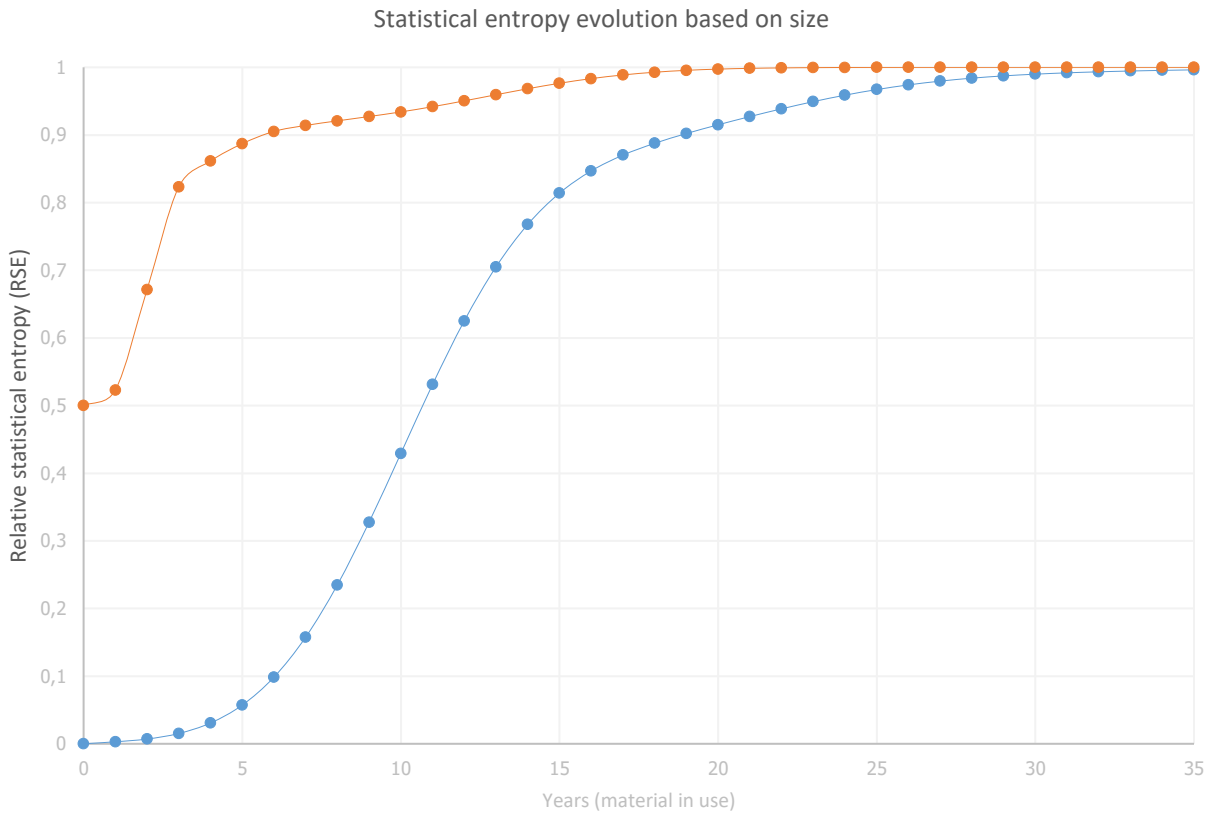


Case study – Wood pallets



SEA – Results





$$H_{max} = -\sum_{j=1}^{n} c_j * \log_2(c_j)$$

$$RSE_{(c)i} = \frac{H_c}{H_{max}}$$

$$RSE_{(max)} = 1 - \frac{1}{(1 + H_s)}$$

Where c_j for each of the three substances *(i.e. wood, physical contaminant, chemical contaminant) is* $0.\overline{3}$. *(*H_{max} *= 1.585 in this situation where n = 3,* $c_{ij} = 0.\overline{3}$*)*

Conclusion

1. SEA evaluates – multiple life cycles, material quality & material lifetime
2. Potentially a useful tool to evaluate cascading
3. Identifies the optimal and highest value pathway for material use
4. Highlights the hotspots for quality loss

Limitations

1. SEA implementation for chemicals
2. SEA implementation for multi-material products


Thank you!