



Sustainability Advantages of Water-Based Laminating Adhesives

Water-based adhesives are an ecological and cost-efficient alternative for more sustainable packaging



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Lamination adhesives

Water-based adhesives are an attractive and sustainable alternative to solvent-based systems



Cost reduction



Time saving



Increased flexibility



Improved safety

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- 7 Water-based adhesives for a sustainable future



01

OUR VISION OF A SUSTAINABLE FUTURE

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Sustainability concerns us all

Let's take action!

- **Sustainability** means satisfying our needs today in a way that future generations will still be able to satisfy their needs
- Industrialization and economic growth often lead to **negative impacts on the environment**
- Goal of a **viable future** with enhanced quality of life for everyone **endangered**
- Focus on sustainability in our **actions** and decisions **along the value chain necessary**

2050:

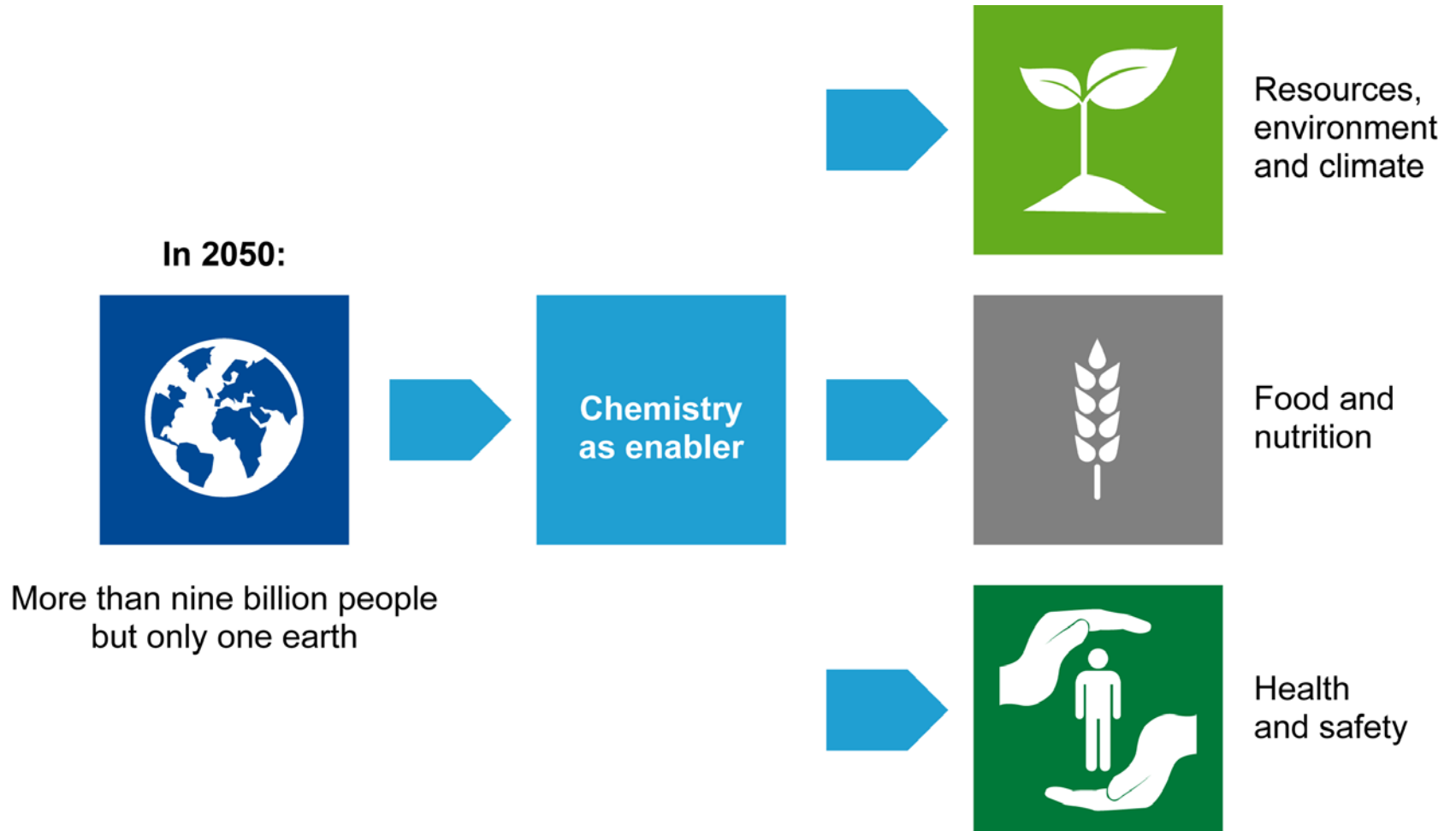
More than 9 billion people
(i.e. +25% over next 30 years),
but just one world



Vision

Chemistry for a sustainable future

Taking action for real change





02

MORE SUSTAINABILITY
IN FOOD PACKAGING!

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Time for responsibility in packaging

How to make a change for the better?

- **Packaging is part of the sustainability challenge** as its demand grows with the population
- Sustainability and packaging: **Choose** such packaging materials that have a low impact on the environment but are still economically viable
- Additionally, health and safety aspects (e.g. reduction of migration potential) are increasingly growing in importance
- In particular, the choice of the **lamination adhesive technology** can play a decisive role in the shift to greater sustainability



A need for orientation

Shift to sustainable lamination – but how?

- Variety of lamination adhesive technologies (solventless, solvent-based, water-based) exist → Which is the **most ecological and economical option?**
- **Market pull:** Brand owners and the general public are increasingly looking for more ecological and safer options
- Traditionally used solvent-based or solvent-less adhesives are not always the best solution
- **Water-based adhesives** have achieved rapid success in past years → But what advantages do they actually offer?





03

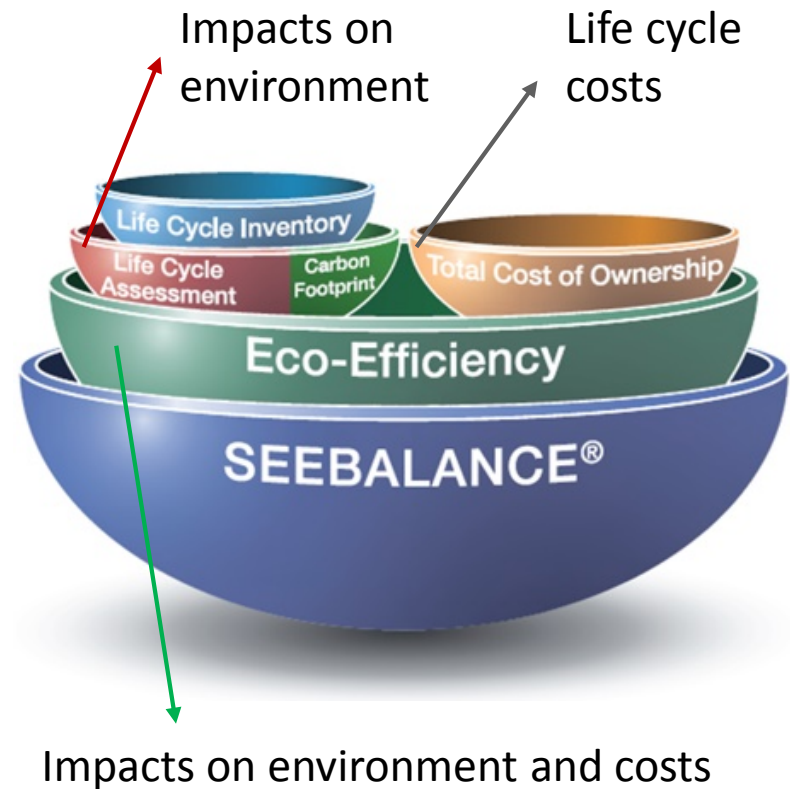
A STUDY TO FIND THE BEST ADHESIVE SYSTEM

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Eco-Efficiency Analysis (EEA)

Method / Tool for measuring sustainability

- **EEA** considers the **environmental** (Life cycle analysis) **and economic** (Life cycle costs) **impacts**
- Method follows ISO standards and is validated by NSF International
- In contrast to the “**Carbon Footprint**”: EEA considers more than just one ecological impact indicator since greenhouse gas emissions alone do not suffice for evaluating the sustainability of a product
- It is desirable that products with an inadequate eco-efficiency are replaced by more eco-efficient alternatives over time



A helpful study by BASF and Comexi

Orientation for a sustainable upgrade

- **BASF** (the world's leading chemical company) and **COMEXI** (a leading supplier of converting solutions for the flexible packaging industry) wanted to find out which laminating adhesive technologies are the most eco-efficient
- EEA study was started in 2013 and finished in 2015
- The results of the study were critically reviewed and validated by a panel of independent experts led by TÜV Rheinland at the beginning of 2016
- In May 2016, BASF was awarded the official **TÜV certificate** for this study



Eco-Efficiency
Analysis

www.tuv.com
ID 0000051842

A comprehensive investigation

Extensive data collection for sound results

- Subject of the study was the production and disposal of 20,000 m² of film-to-film laminate (OPP-ink / adhesive / OPP-met)
- **All life cycle stages** of the production of a flexible packaging were considered (i.e. from raw material production over manufacturing to disposal) → *per life cycle stage*: all relevant emissions and inputs were considered
- **Four adhesive systems** were analyzed

WB-PU

Water-based
polyurethane (PU)
system

WB-A

Water-based
acrylate
system

SB

Solvent-based
polyurethane (PU)
system

SL

Solventless
polyurethane (PU)
system



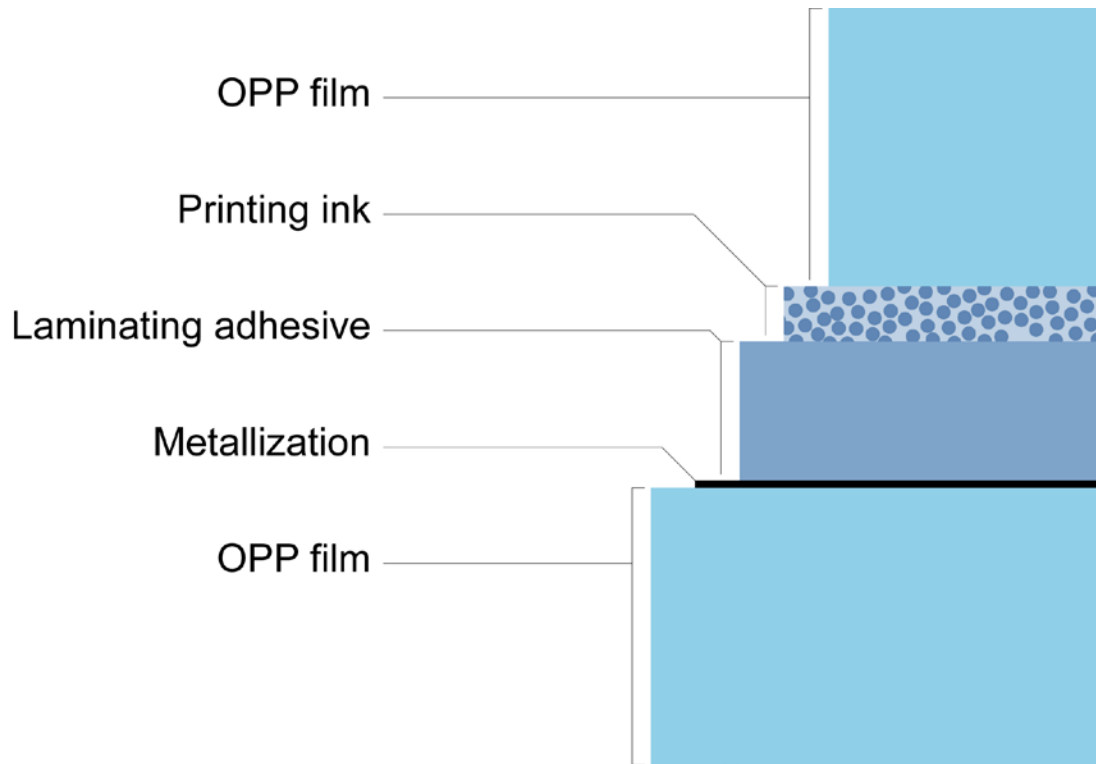
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HOW ECO-EFFICIENCY IS CALCULATED?

EEA in detail

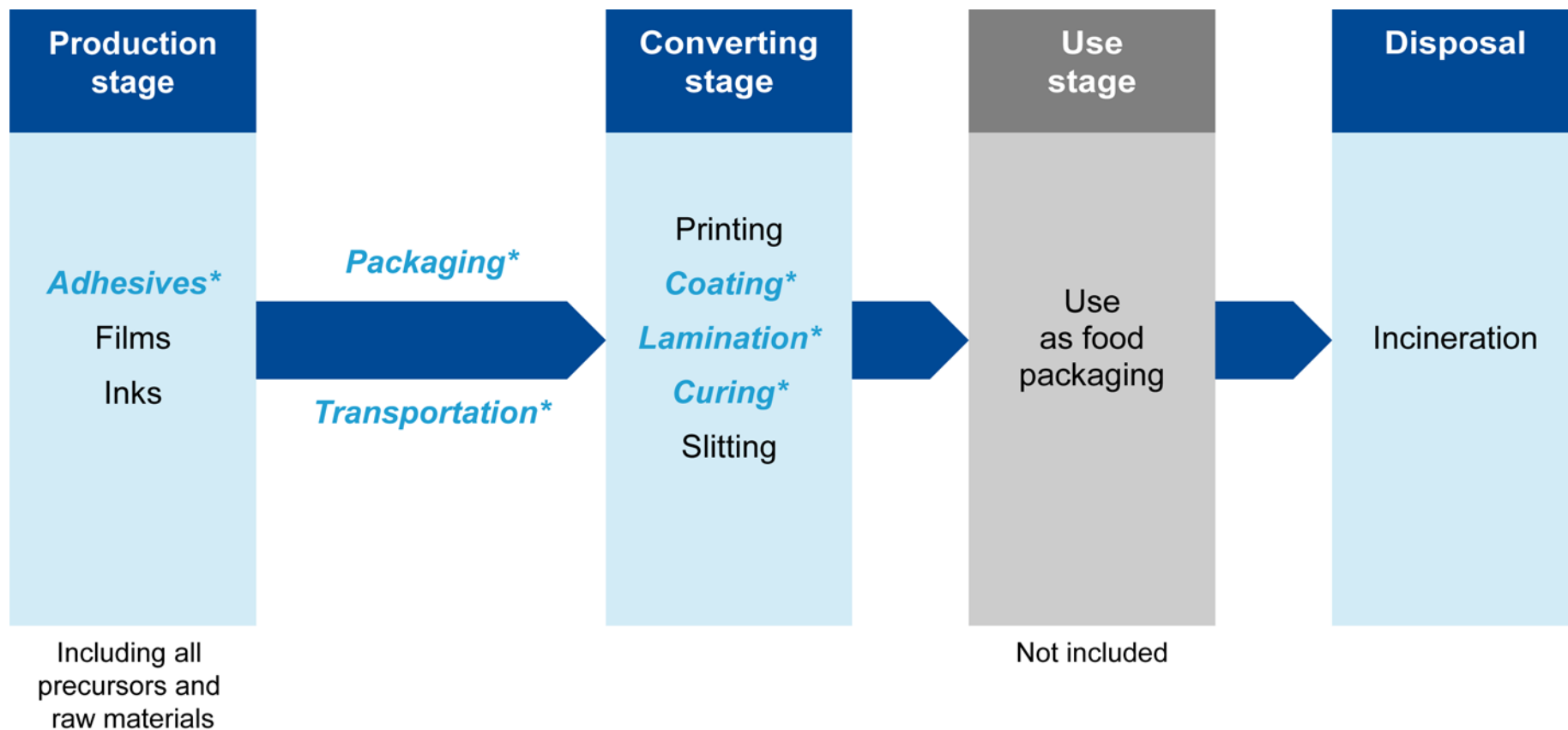
The functional unit

Examined multi-layer structure



System boundaries

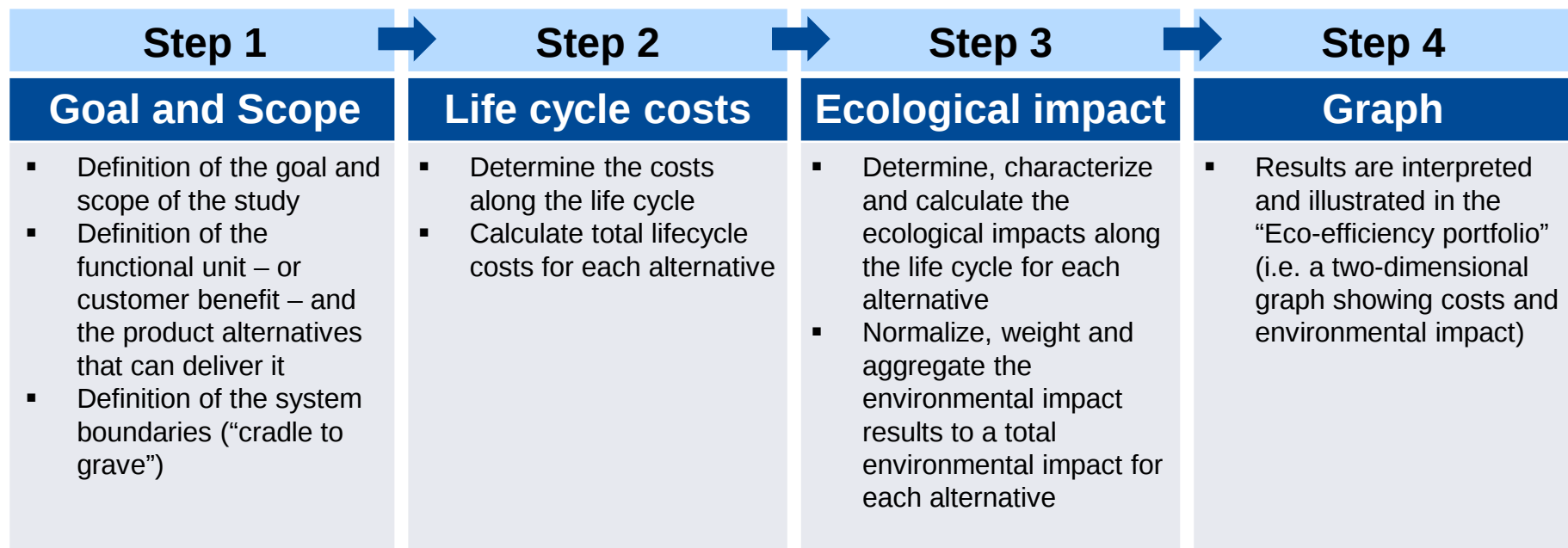
“Cradle-to-grave”



** Vary per adhesive system*

The 4 steps of an Eco-Efficiency Analysis

A closer look at the calculation process



EEA – What is included?

In-depth research on eco-efficiency

Considered factors*



Ecological factors

- Emissions (air, water, waste)
- Abiotic resource consumption (minerals, metals, fossils)
- Human toxicity of final product
- ...



Economic factors

- Adhesive costs
- Machine speed
- Coating weight
- Energy costs
- ...

Not Considered factors*

- Risks resulting from improper product handling (e.g. off-spec risk, risk of primary aromatic amines)
- Risks of toxic ingredients
- ...

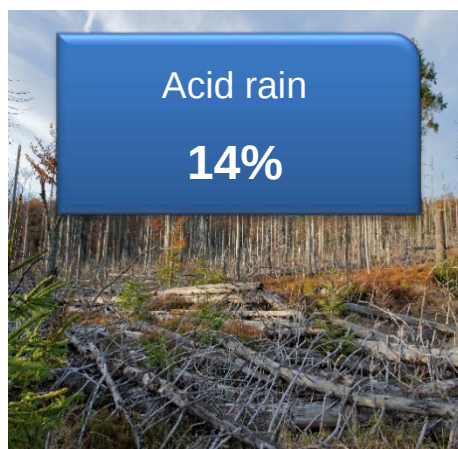
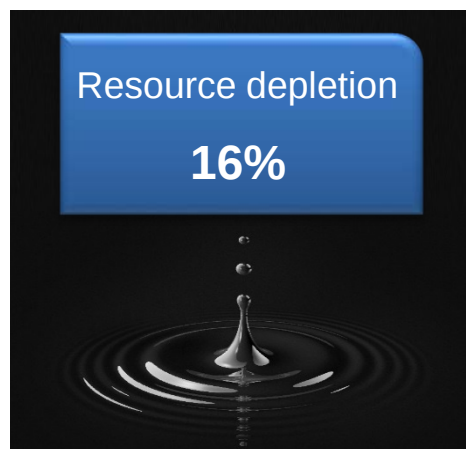
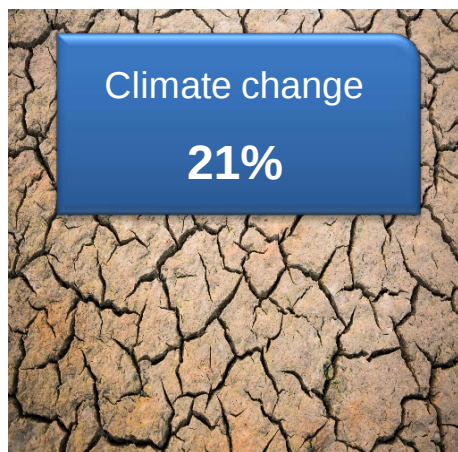
* a complete listing is not possible

Total environmental impact

Normalization, Weighting, Aggregation

Step	Description	Example
1	Normalization per impact category	
	Total EU value of impact category per year $[x]$	4.6e12 CO ₂ e/a
	Total EU population $[y]$	505 million people
	Total EU value per person and year per impact category $[z = x / y]$	9,097kg CO ₂ e/(person*a) $= 4.6e12 \text{ CO}_2\text{e/a} / 505 \text{ million people}$
	Value of impact category for product alternative (as calculated) $[k]$	1,000kg CO ₂ e
	Conversion into person time per category (normalized values - n_i) $[n = k / z]$	$n_i = 0.1 \text{ person*a}$ $= 1,000\text{kg CO}_2\text{e} / [9,097\text{kg CO}_2\text{e}/(\text{person*a})]$
2	Weighting of all impact categories	
	- Weighting factors per category (w_i) are obtained from representative public opinion polls run by TNS Infratest on behalf of BASF - They reflect the importance society attaches to the different forms of environmental impacts	$w_i = 21\%$
3	Aggregation of categories to total impact	$\sum(w_i n_i)$

Environmental impact categories and weighting factors





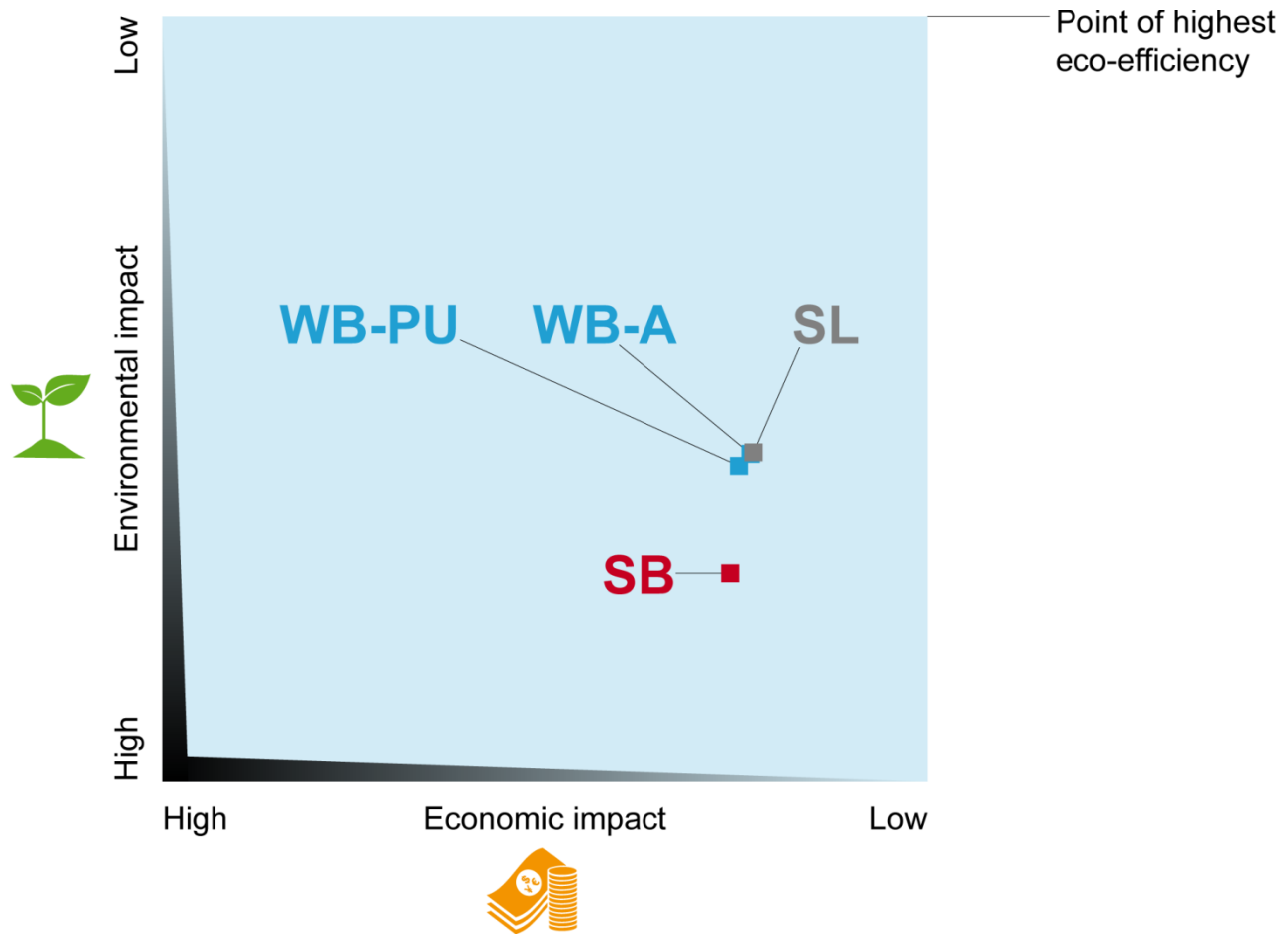
05

WHAT IS THE MOST
ECO-EFFICIENT OPTION?

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WB-Adhesives highly eco-efficient

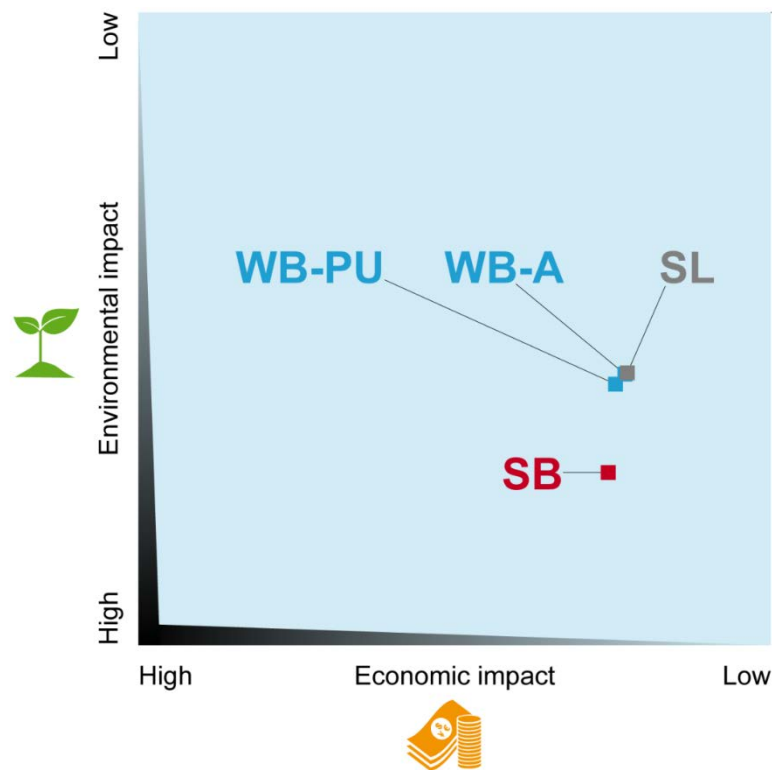
The Eco-Efficiency Portfolio



WB-Adhesives highly eco-efficient

Interpretation of the results

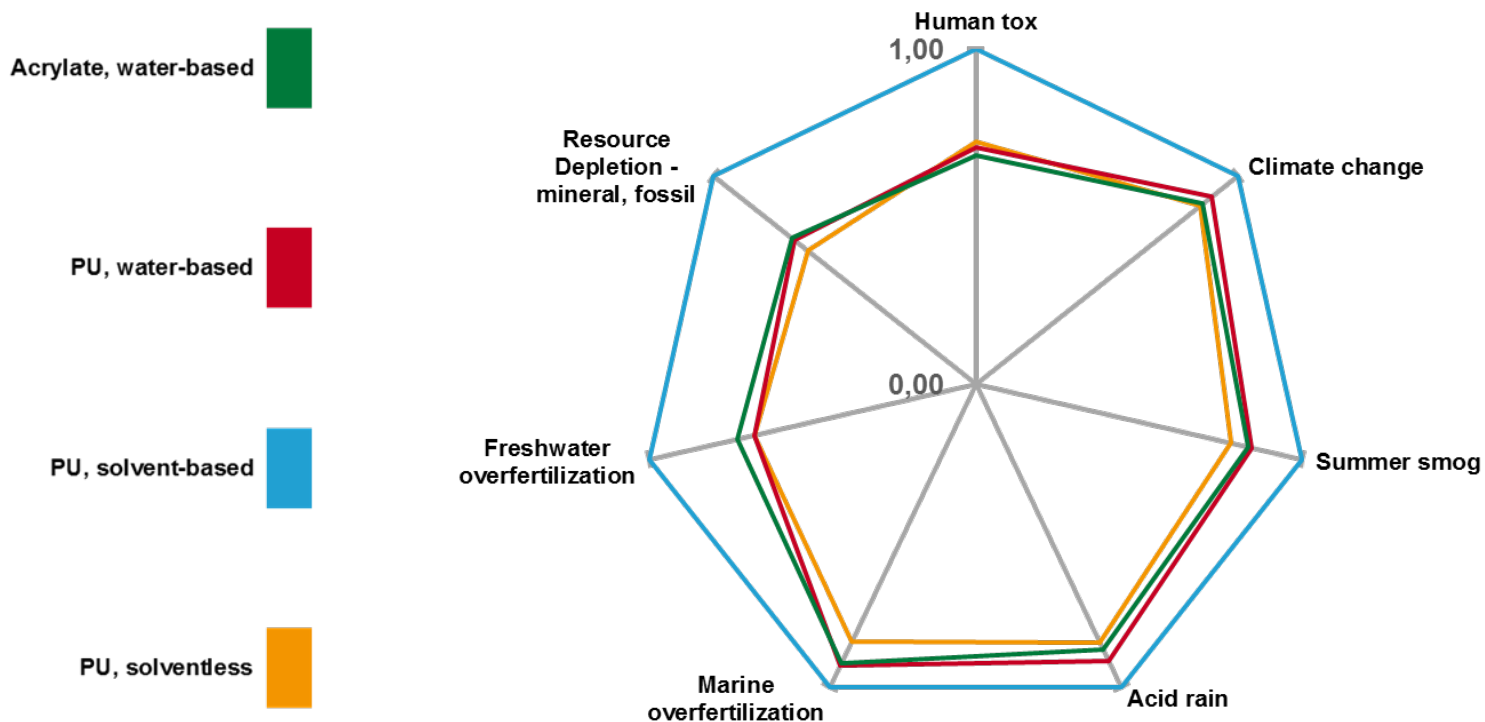
- **Water-based** Epotal® lamination **adhesives** offer **significant advantages over solvent-based adhesives**
- Compared to **solventless adhesives**: the two water-based systems have a **comparable eco-efficiency** (*i.e. the differences do not reach the significance level of the analysis method*)
- Main driver of the environmental differences among all considered alternatives is the production of the organic solvent of the solvent-based PU adhesive system



Results of Eco-Efficiency Analysis

Executive Summary

Key Results: Environmental Fingerprint



Relative results – smaller values indicate better performance. All product systems are normalized between 0 and 1 by the product system with the highest impact per impact category



06

ADDITIONAL BENEFITS OF WB-ADHESIVES

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Additional benefits of water-based adhesives

Reduced off-spec risks

Typical lamination problems

Typical problem sources of solventless and solvent-based adhesives*	Result*	Risk with WB **
Insufficient cure time	▪ Migration of PAAs	Low
Poor drying of solvents	▪ High retained solvents ▪ De-lamination	Medium
Poorly managed mixed ratio	▪ De-lamination ▪ PAA risk	Low
Poor temperature management of nip rollers and adhesive	▪ Low green strength	Low
Material stored in cold conditions after lamination	▪ Longer curing time required	Low
High moisture	▪ Bubbles	Low
Poor green strength	▪ Telescoping	Low

Source: * Packaging Films 4-2015: "Specific challenges of laminating";

** Exclusive Market Study for BASF

Additional benefits of water-based adhesives

WB systems are highly attractive

Benefits vs. solventless and solvent-based adhesives

Benefits of water-based Epotal® adhesives

Cost reduction

- Easier, faster handling
- Reduced off-spec risk

Increased flexibility / Time saving

- “Lean production”
- No interim storage necessary
- Shortest lead times

Improved safety

- No aromatic isocyanates
- No organic solvents, low VOCs
- Very low residual odor / taste

Your advantage:

Laminate and deliver within one day!

Water-based Epotal® adhesives



Traditional solvent-based / solventless adhesives





07

WB-ADHESIVES FOR A
SUSTAINABLE FUTURE!

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Flexibility

Be smart, switch to water-based adhesives!

Water-based adhesives complement digital printing



- Customized printing
- Fast changes
- From file to pouch making in 24h
- Fast curing required
- Instant slitting
- Fast set-up with low waste
- Excellent lamination quality and transparency

HP Indigo 20000 Digital Printing Press



Comexi Nexus L20000 Laminator



Be smart, switch to water-based adhesives!

Your contribution towards a better future

- More sustainable packaging is now easy and affordable
- Make your contribution to a safe and sustainable future – **switch to water-based lamination!**
- Water-based adhesives are an **attractive and sustainable alternative** to solventless and solvent-based adhesives
- **Compostable** version supports zero-waste flexible packaging

Resource-
friendly



Improved health
and safety



Time saving



Cost efficiency



Next steps

For sustainable packaging solutions



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