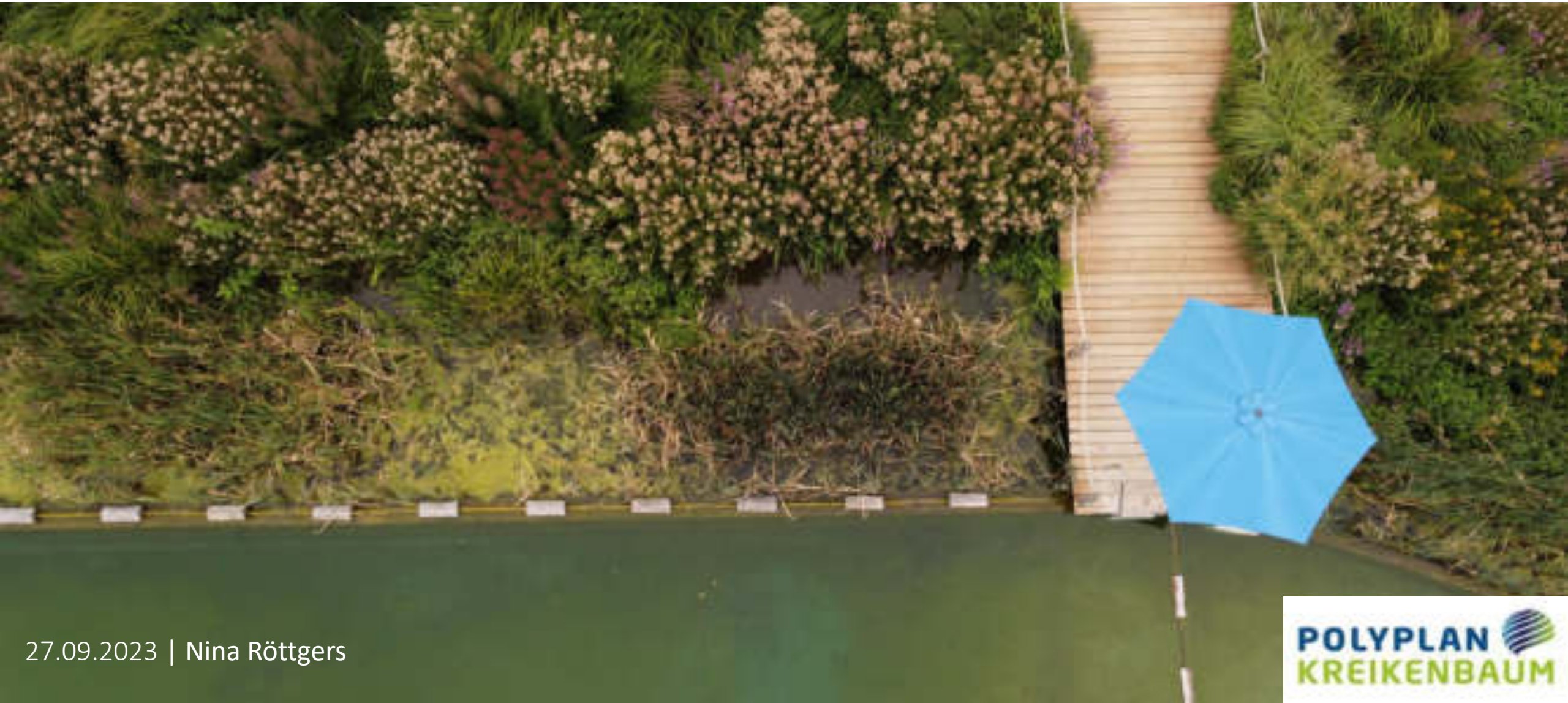
Ecological footprint of various liners



27.09.2023 | Nina Röttgers

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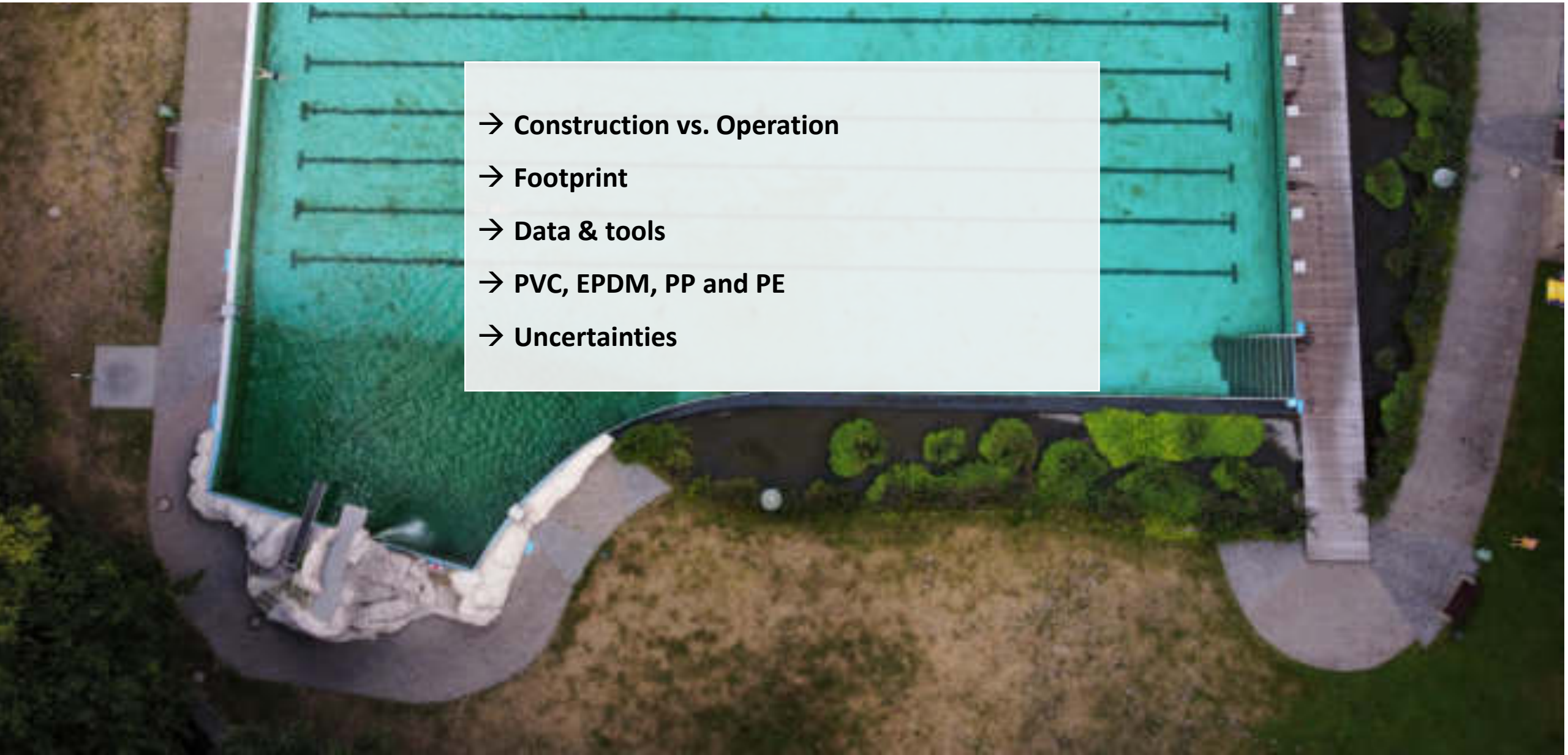
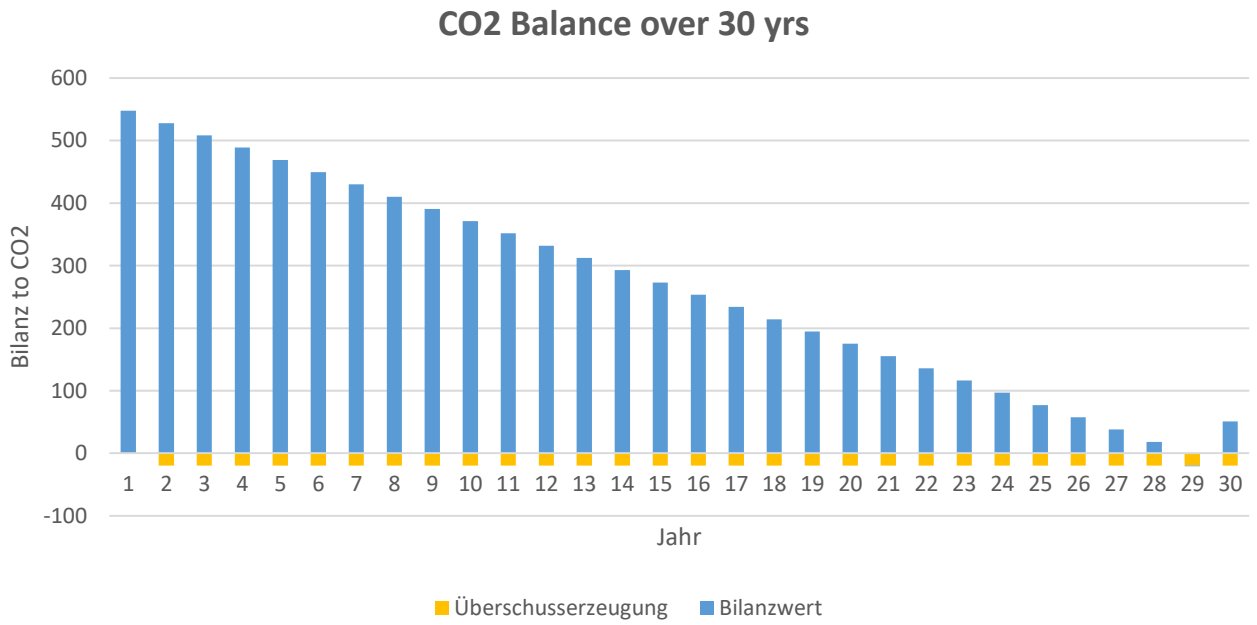
Overview



- → **Construction vs. Operation**
- → **Footprint**
- → **Data & tools**
- → **PVC, EPDM, PP and PE**
- → **Uncertainties**

Construction vs. Operation

- **Increasingly targeted in public projects**
- **Highest potential for reduction within planning processs**



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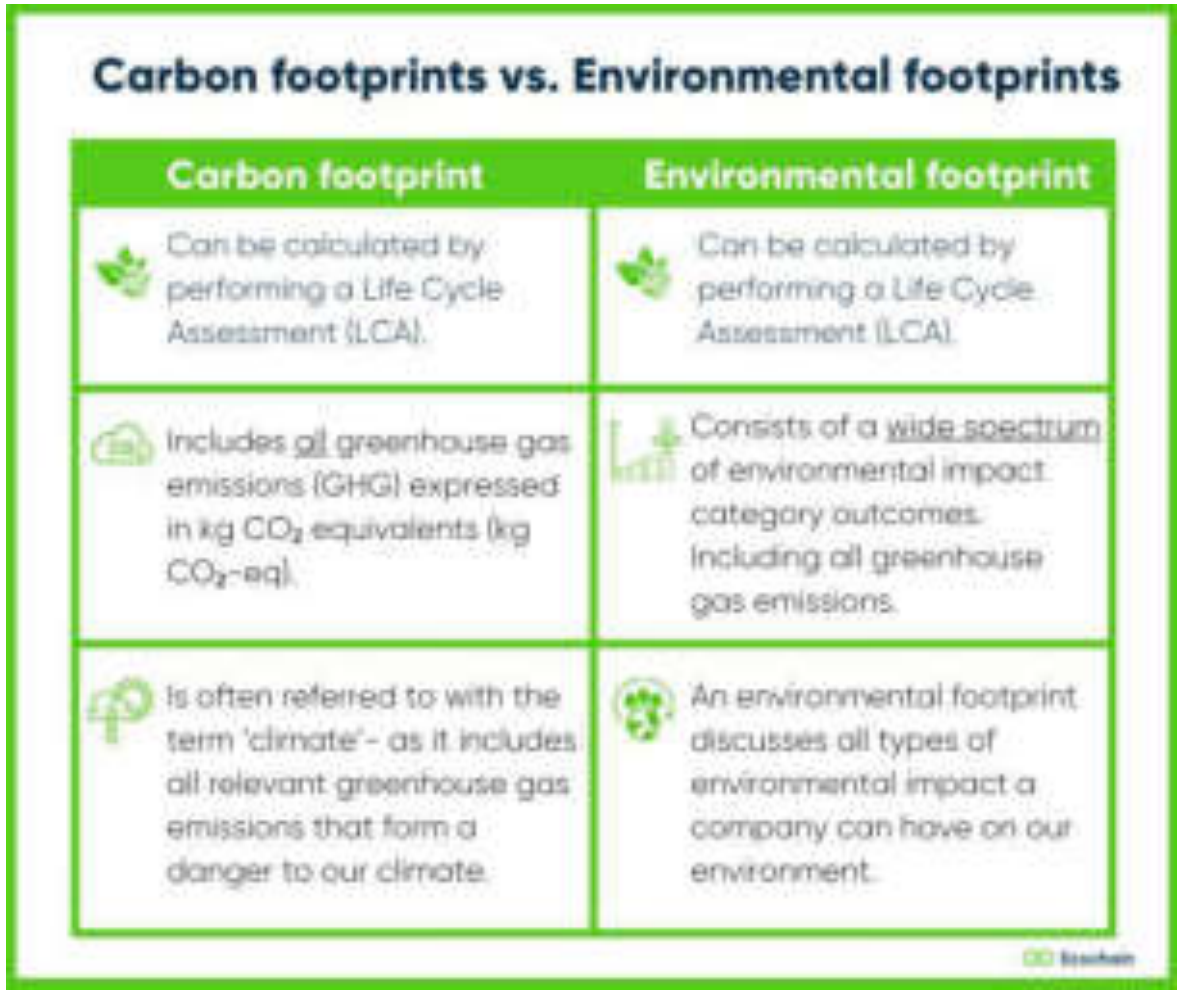
Footprint – same same but different



Carbon footprints vs. Environmental footprints

Carbon footprint	Environmental footprint
Can be calculated by performing a Life Cycle Assessment (LCA).	Can be calculated by performing a Life Cycle Assessment (LCA).
Includes all greenhouse gas emissions (GHG) expressed in kg CO_2 equivalents (kg CO_2-eq).	Consists of a wide spectrum of environmental impact category outcomes. Including all greenhouse gas emissions.
Is often referred to with the term 'climate' - as it includes all relevant greenhouse gas emissions that form a danger to our climate.	An environmental footprint discusses all types of environmental impact a company can have on our environment.

- **Ecological Footprint,**
- **Water footprint,**
- **Carbon footprint, ….**

Source: https://ecochain.com/blog/product-co2-footprint-vs-environmental-footprint/

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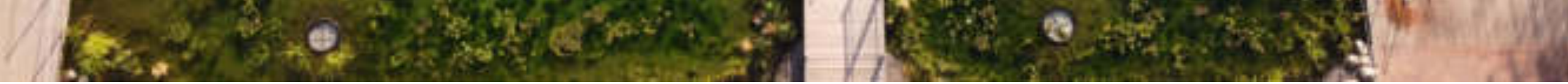

Footprint – same same but different

© ESU-services Ltd. (2023)		Eine Belastung		Verschiedene Belastungen				
	Indikator: / Umweltbelastung	Primärenergie-bedarf	CO2-Fussabdruck	Umweltbelastungs-punkte	ReCiPe	Umwelt-fussabdruck	ImpactWorld+, Midpoint	Belastungs-kapazität der Erde
Ressourcen	Energie, nicht erneuerbar	√	∅	√	√	√	√	∅
	Energie, erneuerbar	√	∅	√	∅	∅	∅	∅
	Erze und Mineralien	∅	∅	√	√	√	√	∅
	Wasser	∅	∅	√	√	√	√	√
	Biomasse	∅	∅	√	∅	∅	∅	∅
	Landnutzung	∅	∅	√	√	√	√	√
	Landumwandlung	∅	∅	∅	√	√	∅	∅
Emissionen	Nur CO2	∅	∅	∅	∅	∅	∅	∅
	Treibhausgase inkl. CO2	∅	√	√	√	√	√	√
	Ozonabbau	∅	∅	√	√	√	√	√
	Gesundheitsschäden	∅	∅	√	√	√	√	∅
	Staub	∅	∅	√	√	√	√	∅
	Sommersmog	∅	∅	√	√	√	∅	∅
	Giftigkeit für Tiere und Pflanzen	∅	∅	√	√	√	√	∅
	Versauerung	∅	∅	√	√	√	√	√
	Überdüngung	∅	∅	√	√	√	√	√
	Persistente organische Schadstoffe	∅	∅	√	∅	∅	∅	∅
	Geruch	∅	∅	∅	∅	∅	∅	∅
	Lärm	∅	∅	√	∅	∅	∅	∅
	Radioaktivität	∅	∅	√	√	√	√	∅
	Hormone	∅	∅	√	∅	∅	∅	∅

Source: Niels Jungbluth (2023) Bewertungsmethoden in der Ökobilanzierung. ESU-services GmbH, Schaffhausen, Schweiz, www.esu-services.ch/de/publications/

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Footprint - EPDs

Category	Unit
GWP – Global Warming Potential	Kg CO_2-eqv
ODP – Depletion potential of the stratospheric ozone layer	Kg CFC_{11}-eqv
POCP – Formation potential of tropospheric photochemical oxidants	Kg C_2H_4-eqv
AP – Acidification potential of land and water	Kg SO_2-eqv
EP – Eutropication potential	Kg PO_4-eqv
ADPM – Abiotic depletion potential for non fossile resources	Kg Sb-eqv
ADPE – Abiotic depletion potential for fossile resources	MJ

→ **Too much focus on CO_2 ?**

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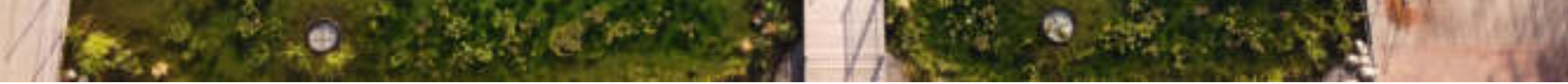

Data and tools

Thesis: Ökobilanzielle Bewertung kunststoffbasierter Abdichtungsfolien für den Einsatz in Naturfreibädern
By Annika Maria Niemann

	IBU (DE)	Norwegian EPD System	International EPD	UL EPD (USA)	GaBi-Datensätze
PE	1[2]	0	0	0	0
PP	3[3]	0	0	0	0
PVC	8[4]	1[5]	2[6]	0	1
EPDM	1[7]	0	1[8]	2[9]	1

Tabelle 3.: Überblick über EPDs ähnlicher Produkte

[2] [Köster Bauchemie AG, 2016]
[3] [Firestone Building Products, 2019b; Paul Bauder GmbH & Co. KG, 2016a; Paul Bauder GmbH & Co. KG, 2016b]
[4] [Sika Deutschland GmbH, 2021; Sika Deutschland GmbH, 2017; Sika Deutschland GmbH, 2016; Paul Bauder GmbH & Co. KG, 2016c; BMI Group Holdings UK Ltd, 2020b; BMI Group Holdings UK Ltd, 2020c; BMI Group Holdings UK Ltd, 2020a; GEORG BÖRNER GmbH & Co. KG, 2019]
[5] [Protan AS, 2019]
[6] [Polyglass SpA, 2018; Renolit, 2017]
[7] [SaarGummi Construction Deutschland GmbH, 2018]
[8] [Firestone Building Products, 2018]
[9] [Firestone Building Products, 2019a; Carlisle SynTec Systems, 2018]

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Footprint - EPDs

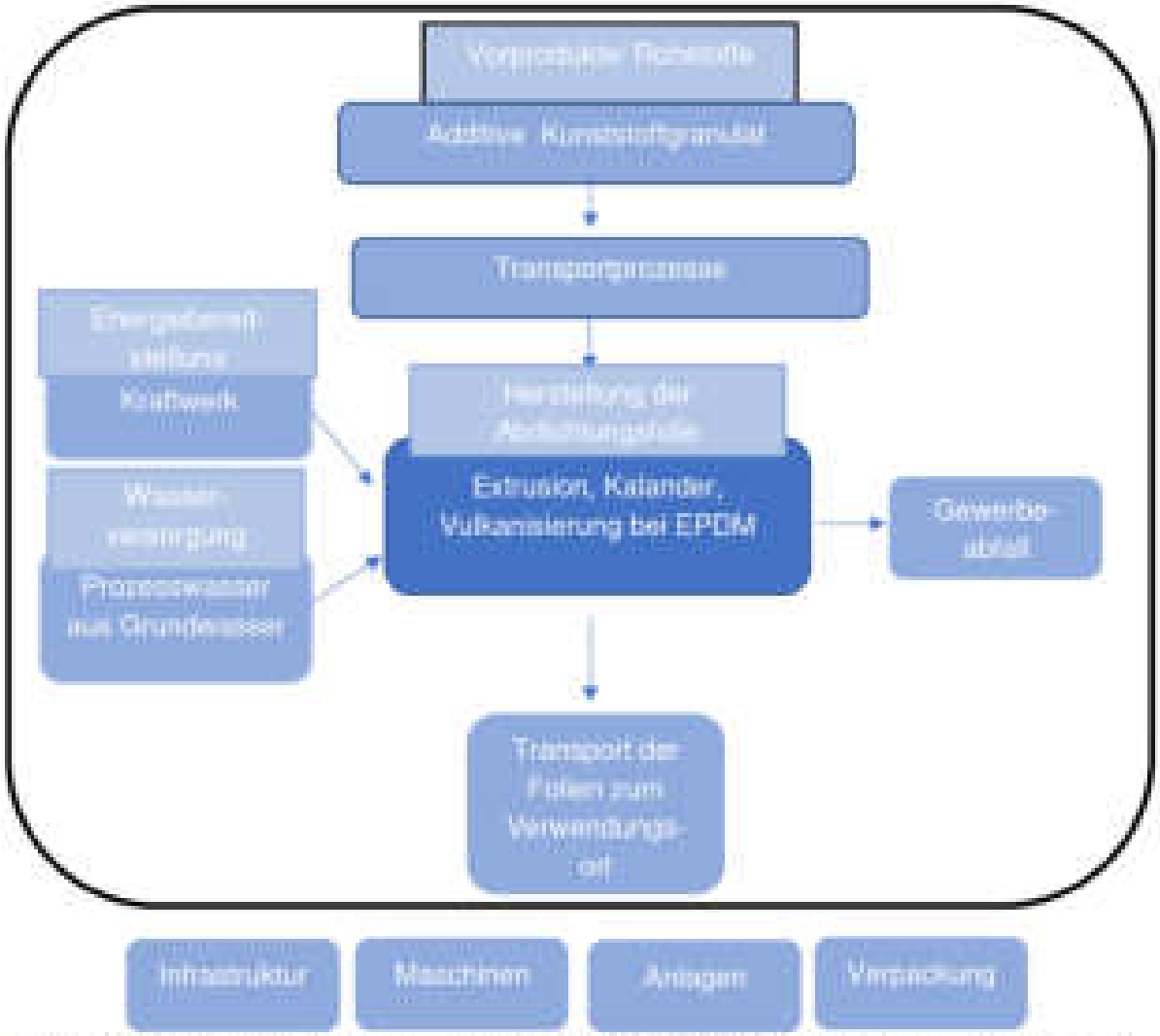
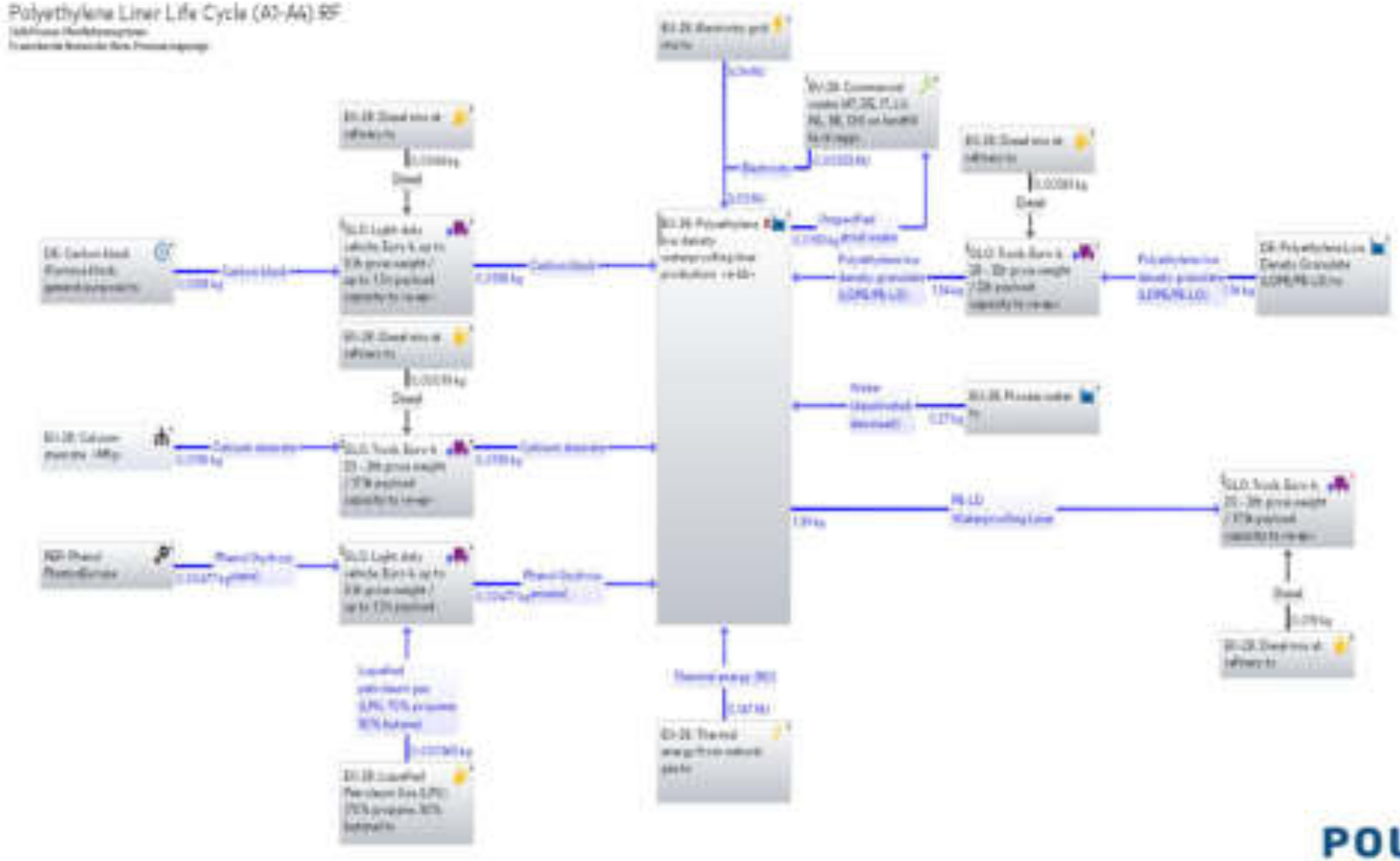
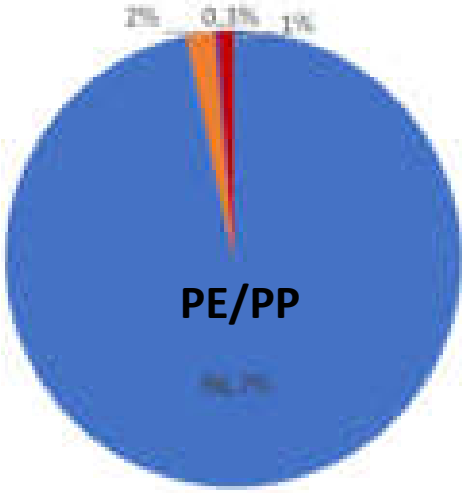


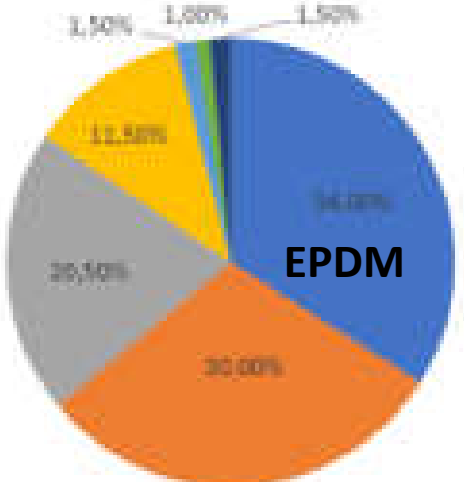
Abbildung 10.: Systemgrenzen der Modellierungen von PE-, PP-, PVC- und EPDM-basierten Abdichtungsfolien

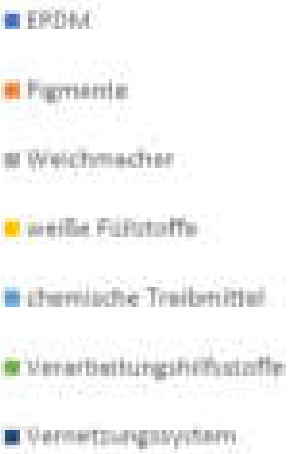
Study

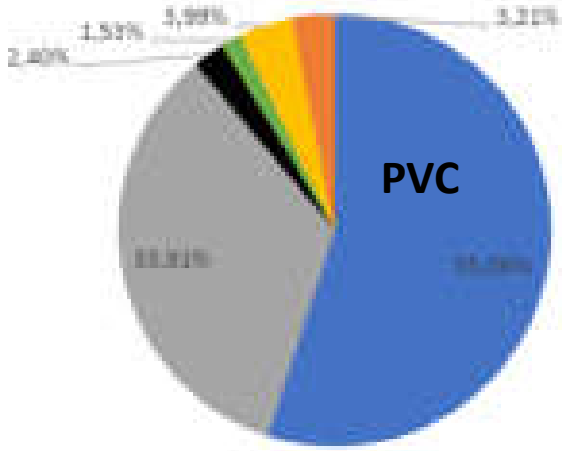


Study









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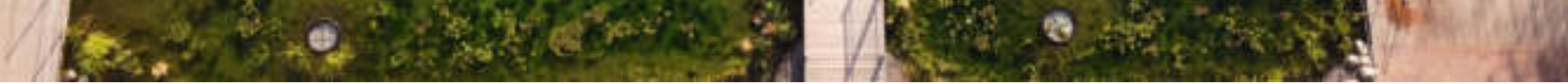

Study – Results – liner model

WK	PVC	EPDM	PP	PE
ADPf [MJ]	1,08E+02	1,34E+02	1,10E+02	1,12E+02
ADPe [kg Sb-Äq.]	1,13E-06	1,58E-06	6,08E-07	7,87E-07
AP [kg SO_2-Äq.]	7,03E-03	1,10E-02	5,58E-03	5,58E-03
EP [kg PO_4^{3-}Äq.]	1,44E-03	1,42E-03	8,44E-04	8,83E-04
GWP [kg CO_2-Äq.]	4,50E+00	5,19E+00	3,12E+00	3,32E+00
ODP [kg CFC11-Äq.]	1,47E-09	1,58E-09	6,15E-12	6,15E-12
POCP [Ethen-Äq.]	1,40E-03	8,45E-04	6,62E-04	5,17E-04
Pe-NRe [MJ]	1,13E+02	1,67E+02	1,15E+02	1,17E+02
Pe-Re [MJ]	9,12E+00	1,56E+02	5,88E+00	8,78E+00

Tabelle 7.: Kennindikatoren für die Umweltwirkungen nach DIN EN ISO 15804:2012+A1:2013 für PVC (11.), EPDM (2.), PP und PE

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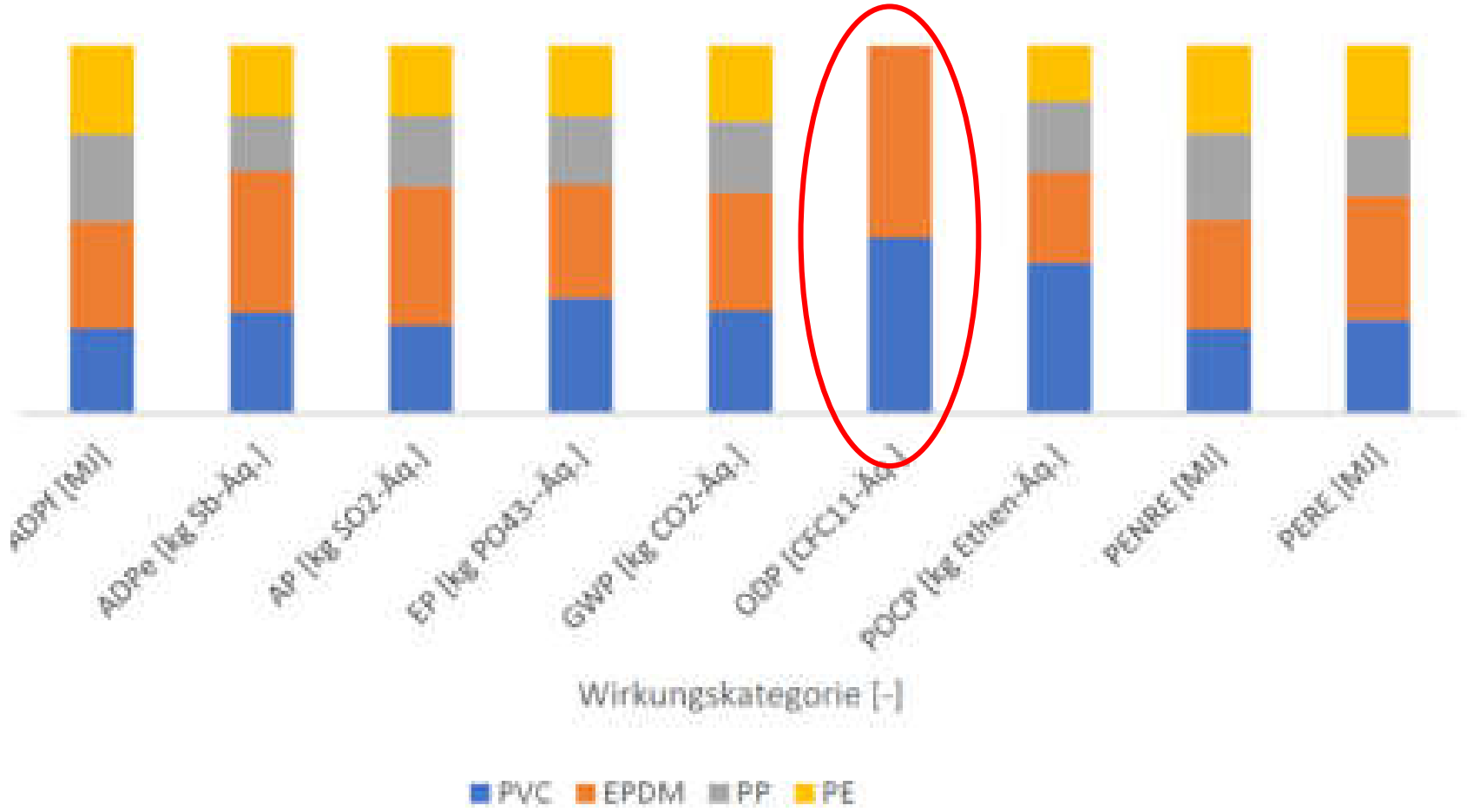
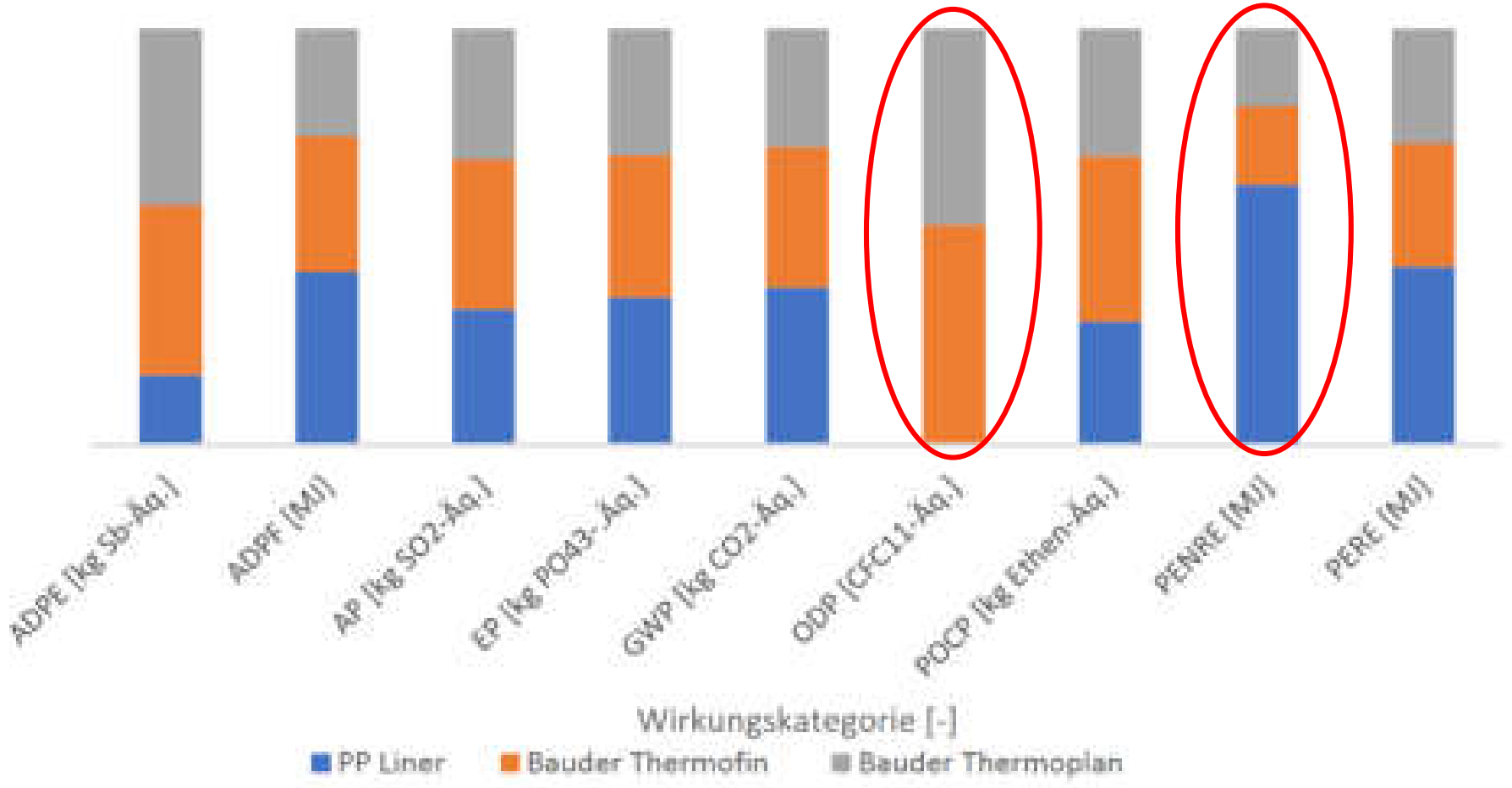
Study – Results – liner model



Study – Results – Comparison to EPDs



→ **Product stage**

Abbildung 23.: Vergleich der LCIA-Ergebnisse von je 1kg PP-basierter Abdichtungsfolien (A1-A3)

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Study - Results

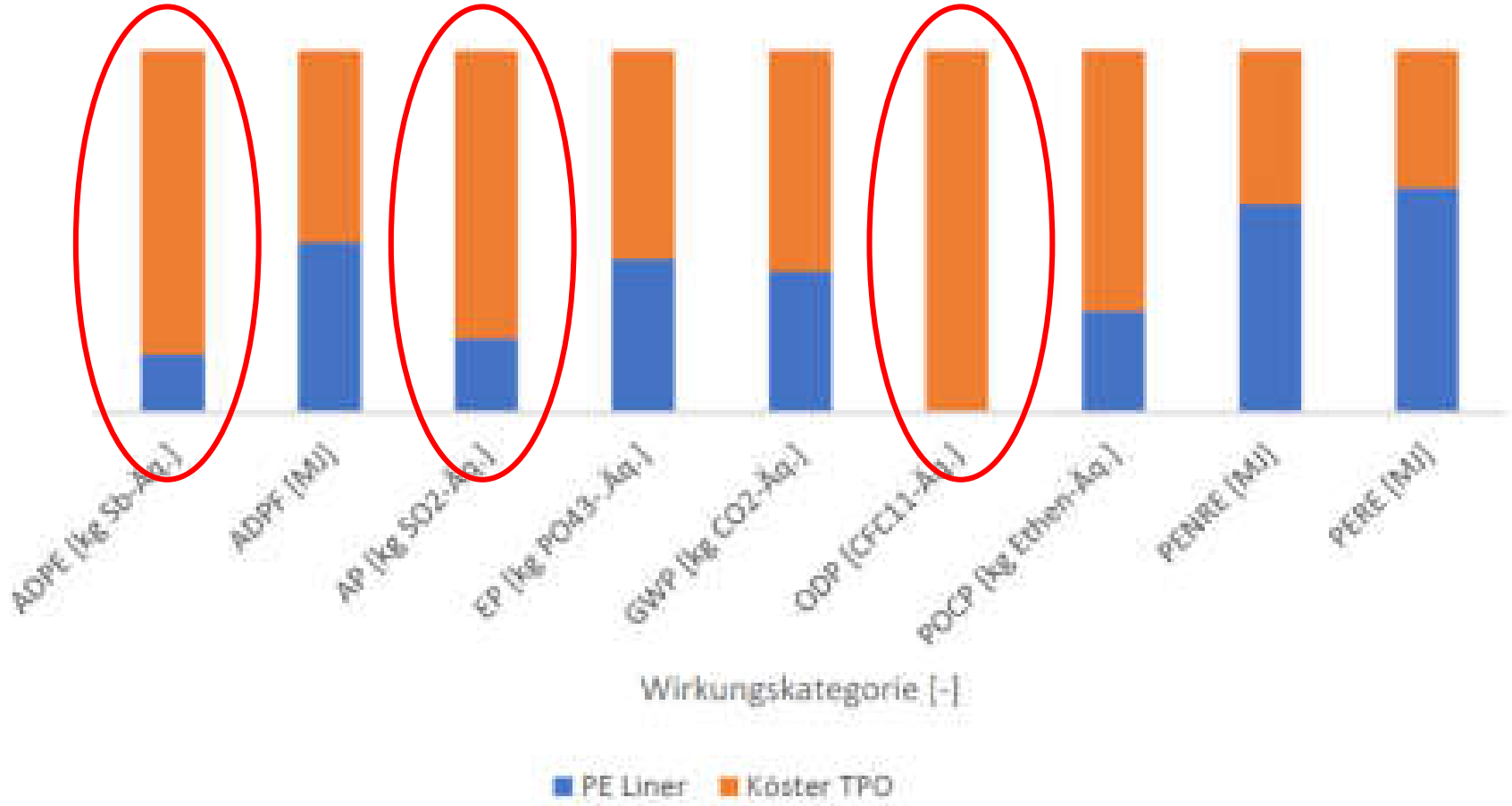

Abbildung 24.: Vergleich der LCIA-Ergebnisse von je 1kg PE-basierter Abdichtungsfolien (A1-A3)

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Study - Results

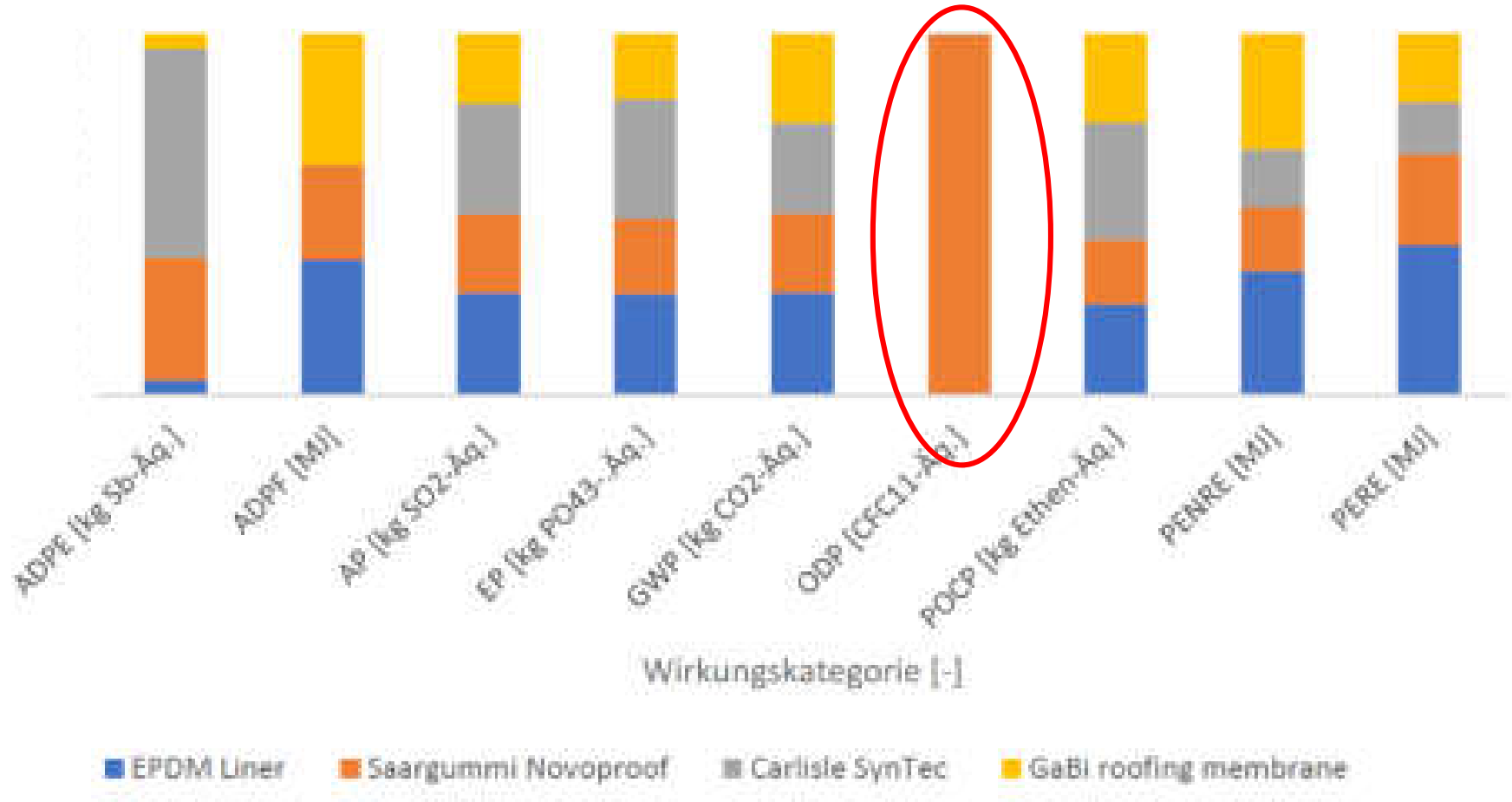

Abbildung 25.: Prozentualer Anteil der LCIA-Ergebnisse von je 1kg EPDM-basierter Abdichtungsfolien (A1-A3)

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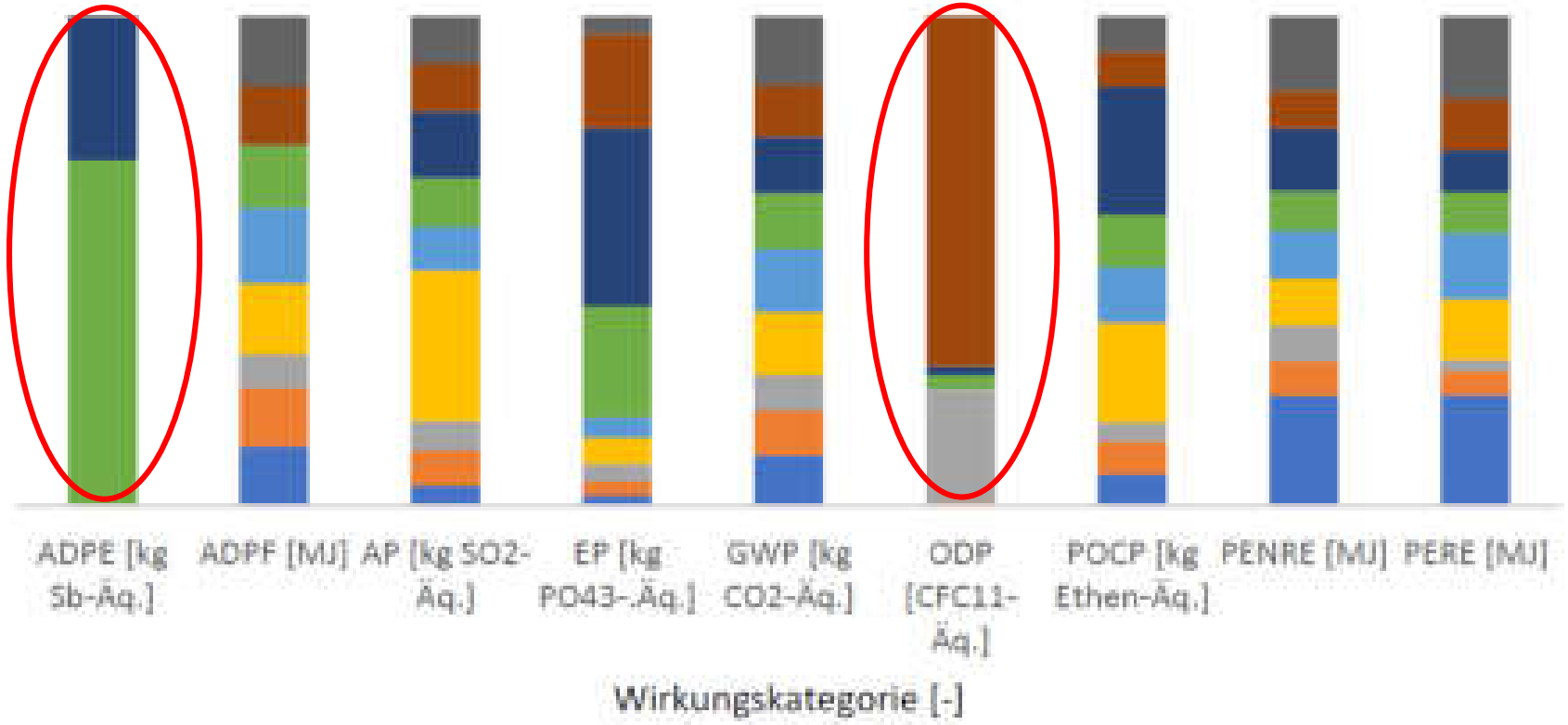
Study - Results



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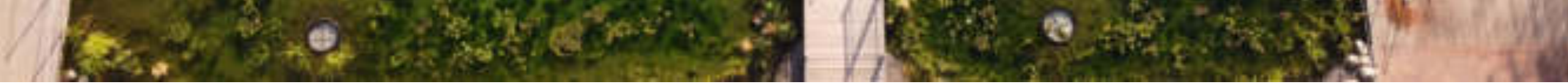
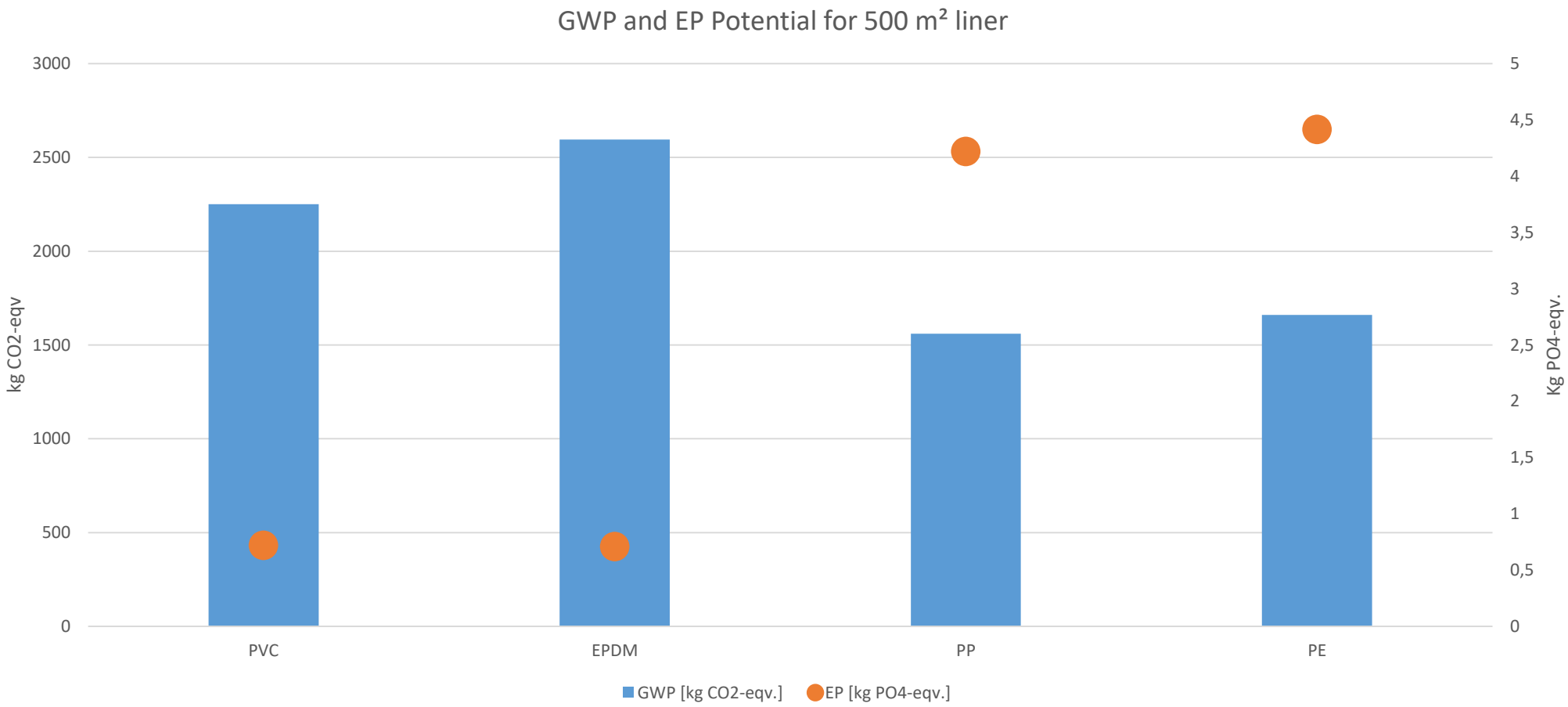
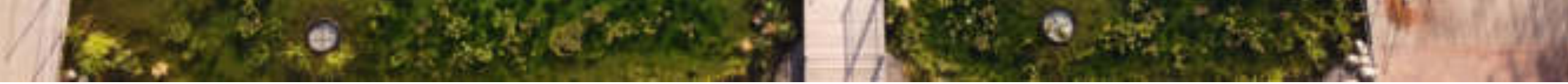


Study - Results





Study - Results

→ **The results of the Thesis and the literature review alongside indicate, that PP/PE Liner will result in lower emission potential (GWP Potential of EPDM = up to 1.66 * PP)**

→ **BUT**

Results are not weighted according to any evaluation scheme

Transport and recycling potential are not represented

Databases are still only partially developed

Repairs are not represented

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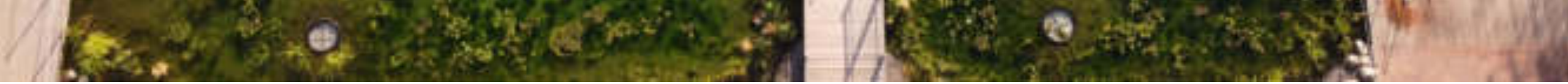
Thanks a lot for your attention



Study – Reference Unit

$$RF\ [kg] = FG\ \left[\frac{kg}{m^2}\right] * 1m^2 * \frac{30\ [a]}{RSL\ [a]} \qquad (1)$$

Polymerbasis	FG [kg/m²]	RSL [a]	RF [kg]
PE	1,5900	30	1,5900
PP	1,7280	32,5	1,5951
EPDM	1,7958	40	1,3469
PVC	1,8523	30	1,8523

Tabelle 4.: FG und RSL der Polymere

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