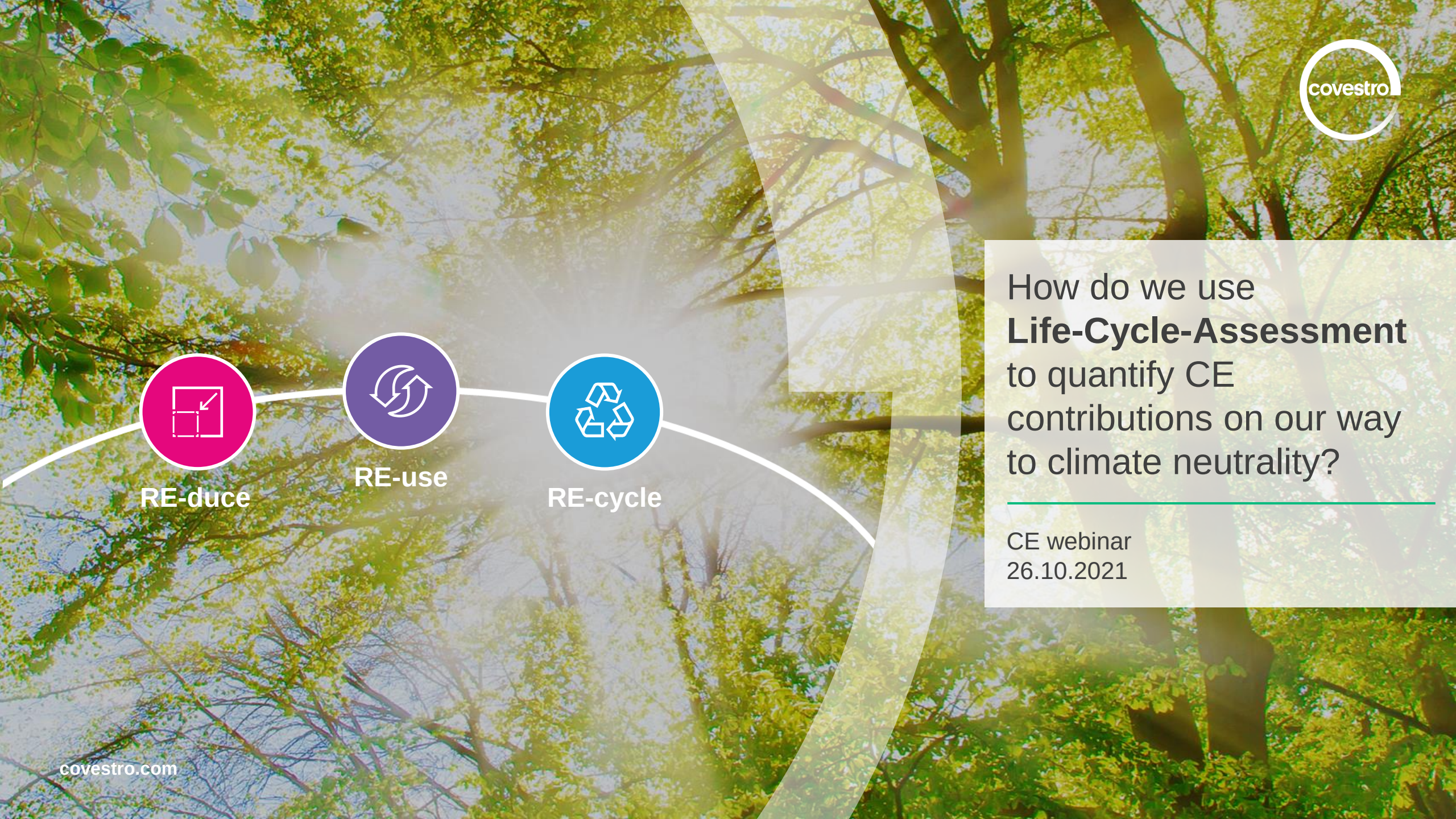


How do we use **Life-Cycle-Assessment** to quantify CE contributions on our way to climate neutrality?

CE webinar
26.10.2021

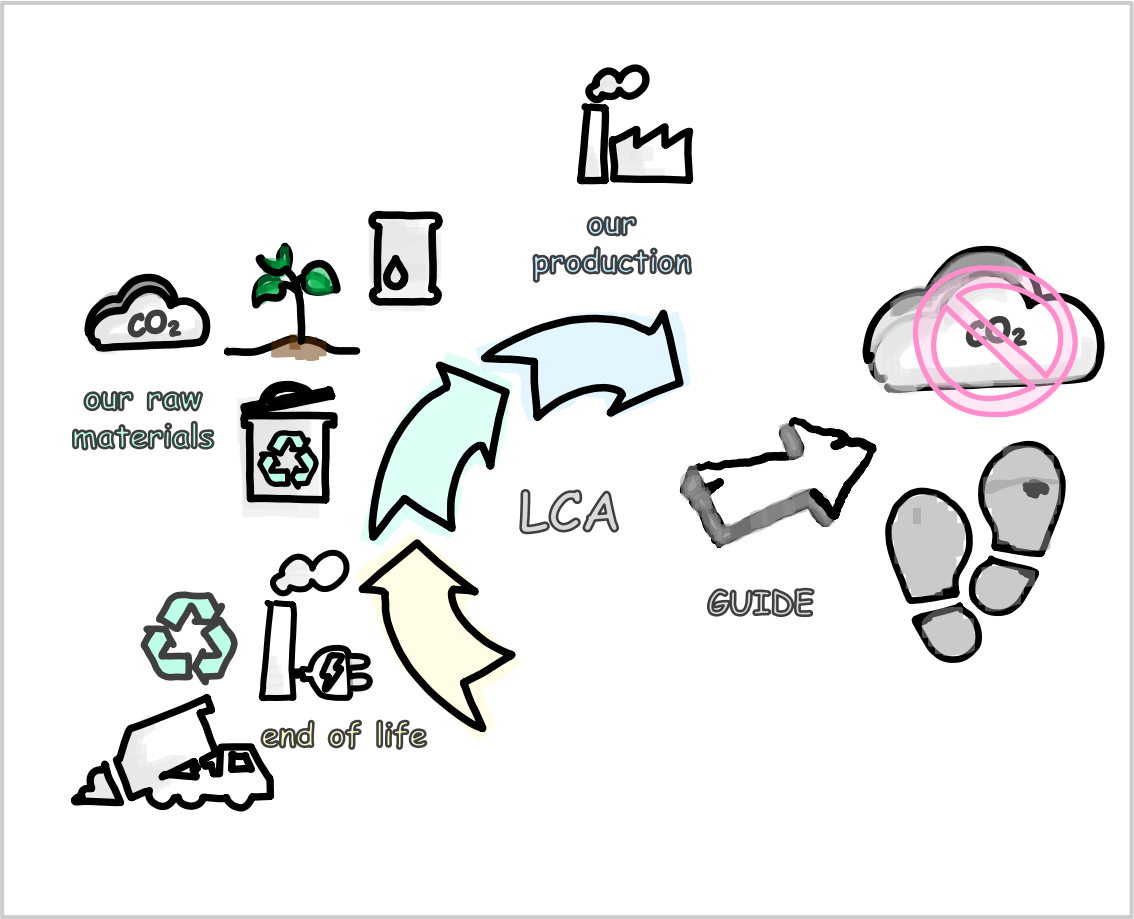
Who is presenting today?

Dr. Frank Buckel

Sustainability Solutions – Advocacy
Covestro

Agenda

01	Introduction
02	**LCA** - as standardized calculation method
03	The impact of **recycled content** on the Makrolon® carbon footprint
04	The contribution of **raw materials derived from mass-balanced bio-waste and residues** to carbon (footprint) neutral Makrolon®



01 INTRODUCTION

Introduction

Carbon (footprint) neutral is THE way to mitigate climate change

WHY: to stabilize the climate (a)

WHO: idea gets more and more followers (b)

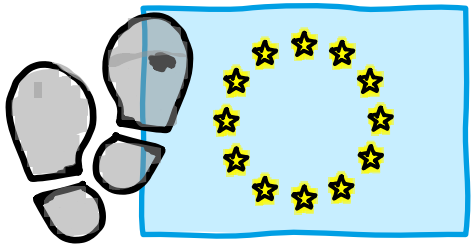
HOW: first studies quantify different levers (c)

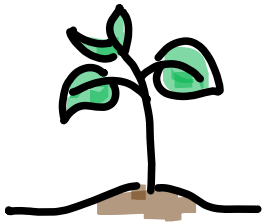
(a) Press_release_wgi_ar6_website-final (ipcc.ch); (b) Factsheets on the European Green Deal | European Commission (europa.eu); Carbon Pricing Dashboard | Up-to-date overview of carbon pricing initiatives (worldbank.org);
(c) Studie_Treibhausgas_engl_v1.indd (vci.de)

Introduction

Guidance is needed to reduce as fast as possible the carbon footprint of our activities

6,7t CO_2
per person in 2019 (a)



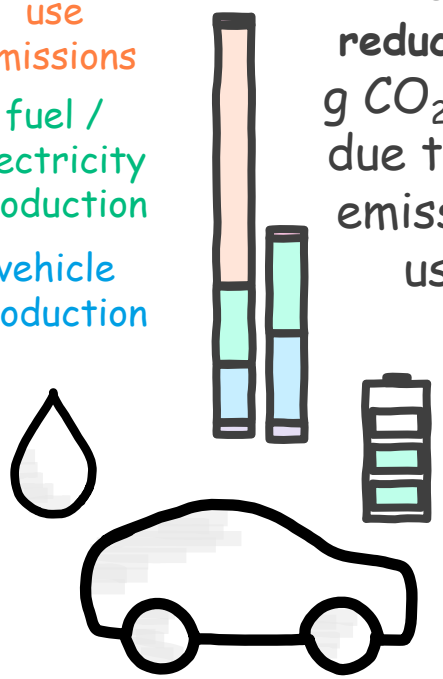


equal to **111 tree seedlings** grown for **10 years** (b)

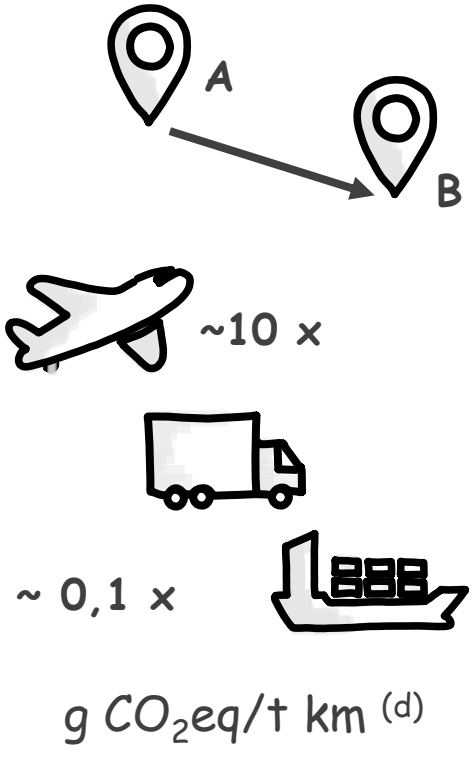
use emissions

fuel / electricity production

vehicle production



55% reduction of g CO_2eq/vkm due to saved emissions in use (c)



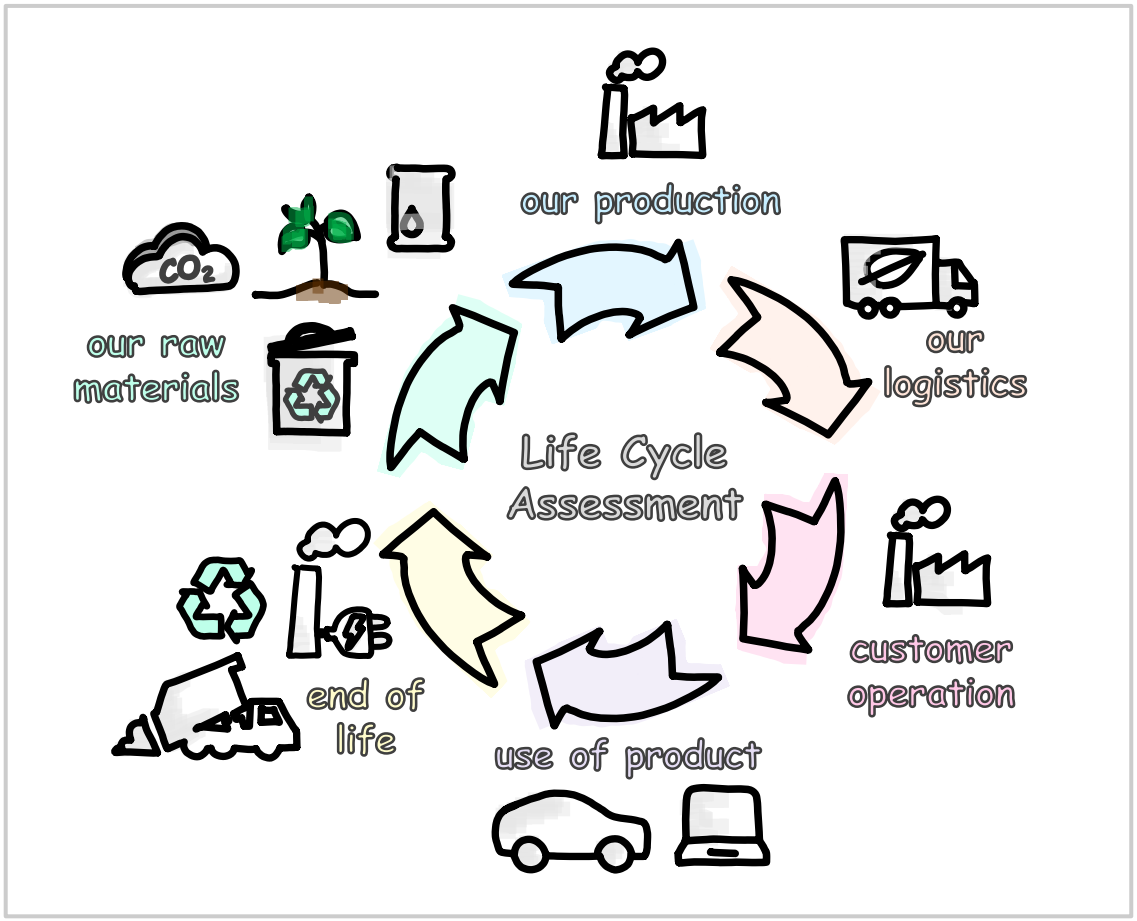
g CO_2eq/t km (d)

(a) Greenhouse gas emission statistics - carbon footprints - Statistics Explained (europa.eu); (b) Greenhouse Gas Equivalencies Calculator | US EPA; (c) Determining the environmental impacts of conventional and alternatively fueled vehicles through LCA - Publications Office of the EU (europa.eu); (d) MeasuringAndManagingCO2EmissionOfEuropeanTransport-McKinnon-24.01.2011-REPORT_TRANSPORT_AND_LOGISTICS.pdf (cefic.org)

02 LCA - AS STANDARDIZED CALCULATION METHOD

LCA – as standardized calculation method

Life cycle assessment is defined in ISO standards and provides this guidance

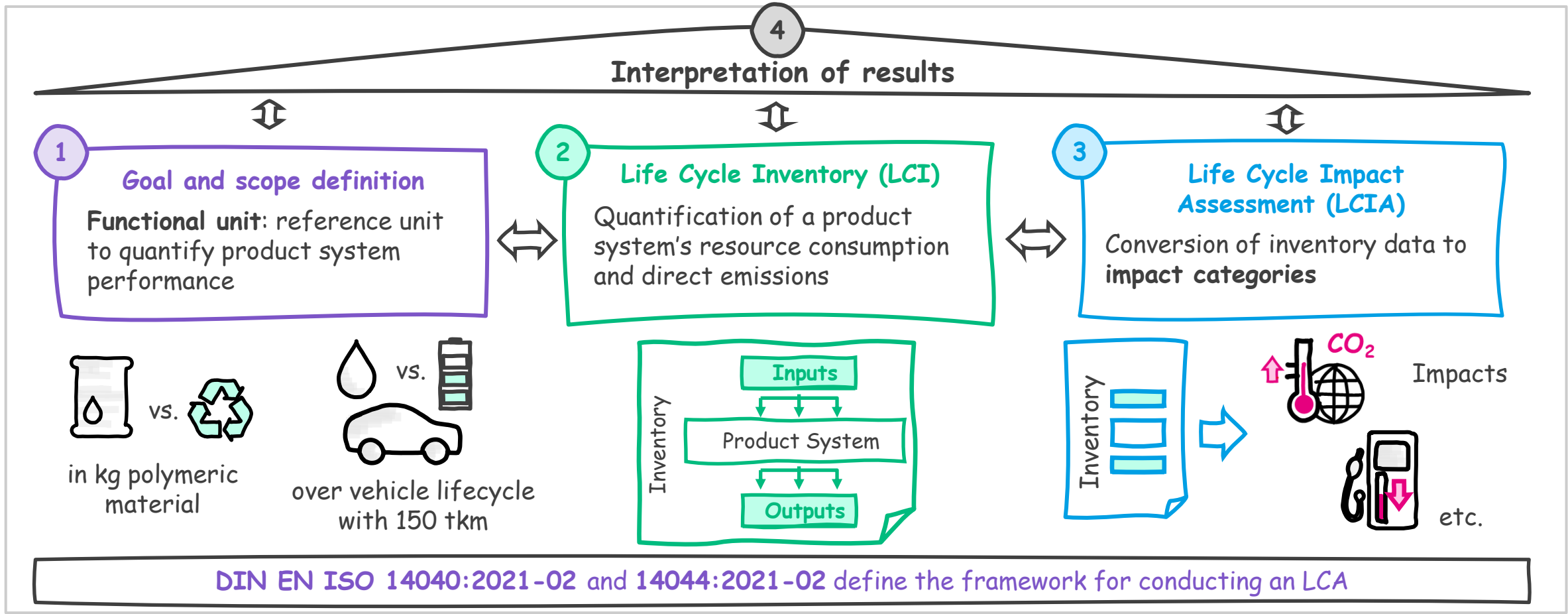


DIN EN ISO 14040:2021-02 /
DIN EN ISO 14044:2021-02

- Life Cycle Assessment (LCA) is a technique to assess the potential environmental impacts of products or processes throughout their entire life cycle – including raw material acquisition, production, use and end of life.
- A life cycle is defined as “consecutive and interlinked stages from raw material acquisition or generation of natural resources to the final disposal”

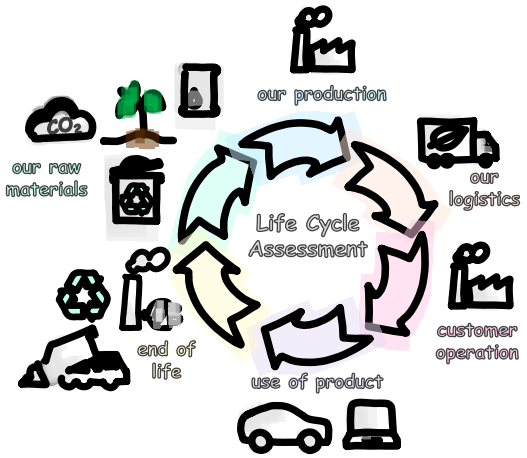
LCA – as standardized calculation method

Elements and relevant terminology of life cycle assessments according to ISO



LCA – as standardized calculation method

System boundaries – a product carbon footprint (cradle to gate) or the full life cycle



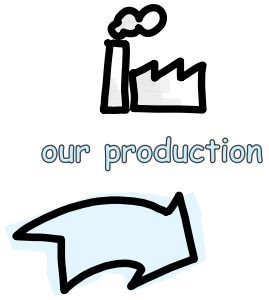
cradle-to-grave
(LCA from raw material extraction ('cradle') to use phase and end of life ('grave'))

EXAMPLE:
environmental impact of
1 laptop A-cover
(functional unit)
from **cradle-to-grave** *(system boundaries)* made of Maezio® or MgAl Alloy

cradle-to-gate
(from raw material extraction to factory gate)

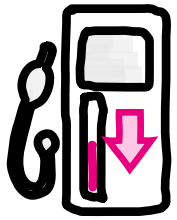
EXAMPLE:
environmental impact of the production of
1 kg Makrolon®
(functional unit)

gate-to-gate
(one value-added-process in the entire production chain)

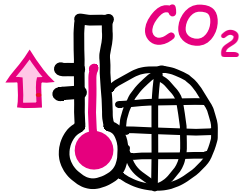


LCA – as standardized calculation method

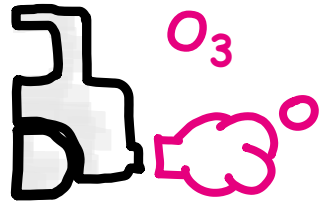
Impact categories – carbon footprint is only one environmental impact (a)



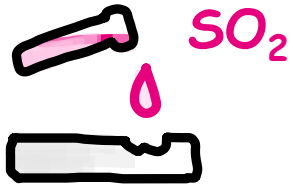
Fossil Resource Depletion
Abiotic Resource Depletion Potential – fossil **(ADPf)**
Unit: **MJ**



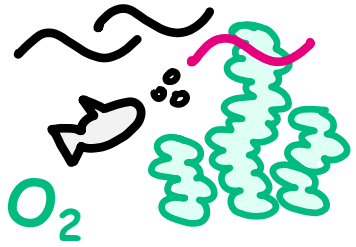
Climate Change
Global Warming Potential **(GWP)**
Unit: **kg CO_2-eq**



Summer Smog
Photochemical Ozone Creation Potential **(POCP)**
Unit: **kg ethene-eq**



Acidification
Acidification Potential **(AP)**
Unit: **kg SO_2-eq**



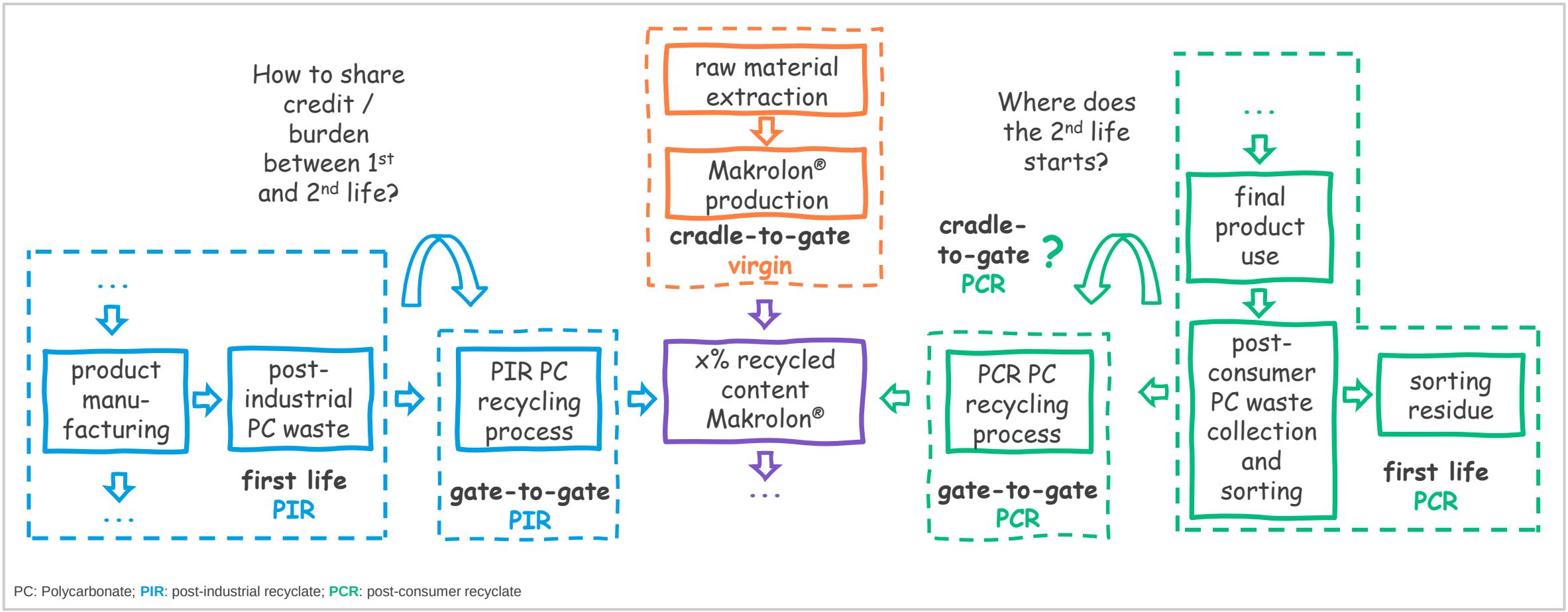
Aquatic Oxygen Depletion
Eutrophication Potential **(EP)**
Unit: **kg PO_4^{3-}-eq**

(a) the selected impact categories here represent the most relevant impacts with reliable methods and high data quality and are mandatory impacts currently assessed at Covestro. Other impact categories are e.g., land use, water, particulate matter, or toxicity

03 THE IMPACT OF RECYCLED CONTENT ON THE MAKROLON® CARBON FOOTPRINT

The impact of recycled content on the carbon footprint

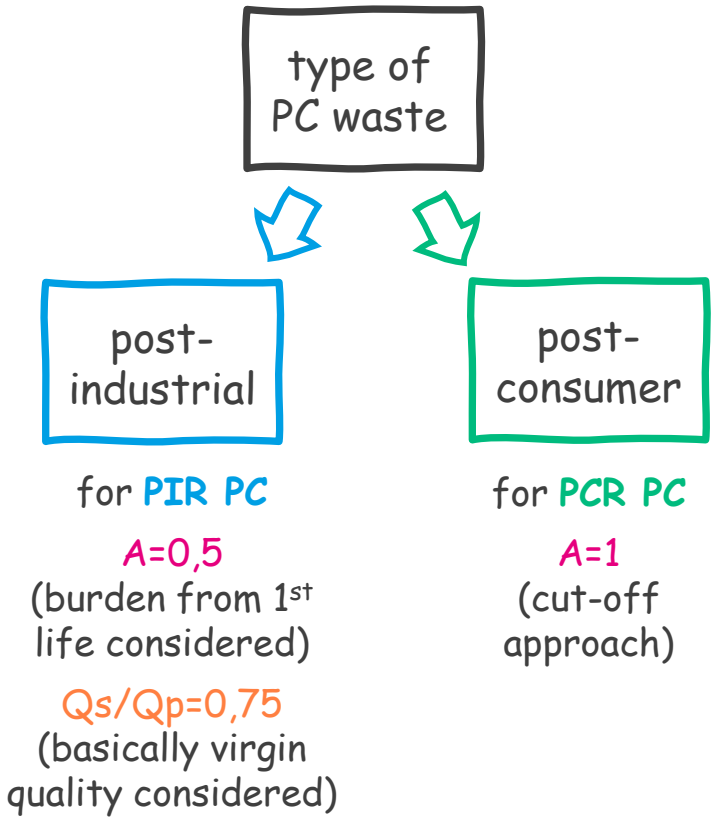
Production chart including system boundaries



PC: Polycarbonate; **PIR**: post-industrial recycle; **PCR**: post-consumer recycle

The impact of recycled content on the carbon footprint

The Circular Footprint Formula from Product Environmental Footprint Category Rules (a)



Circular Footprint Formula (CFF):

$$CFF = f(A; Qs/Qp; \ldots)$$

with **A**: the **allocation factor**,

where **A = 1** means no burden from 1st life (equivalent to a cut-off approach)

where **A = 0,5** means equilibrium between offer and demand (focus on both recyclability and recycled content)

with **Qs/Qp**: the **quality ratio** between secondary and primary material;

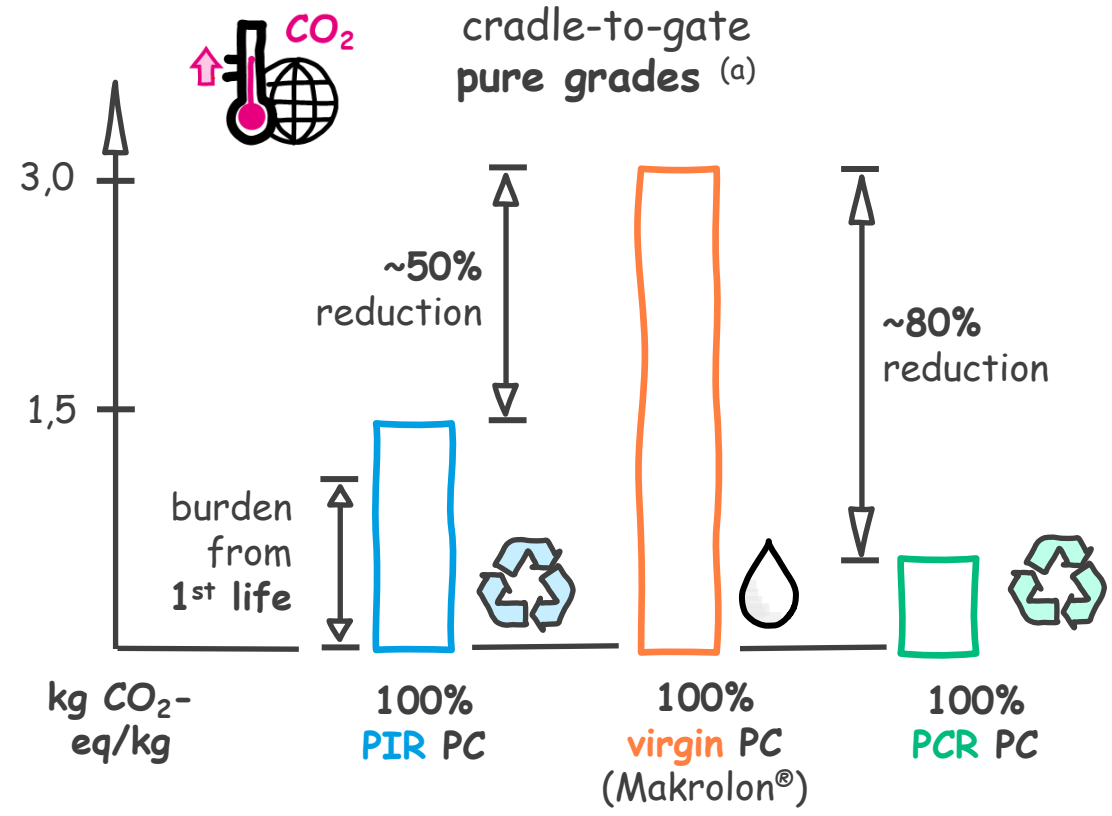
where **Qs/Qp = 1** means recyclate has virgin quality

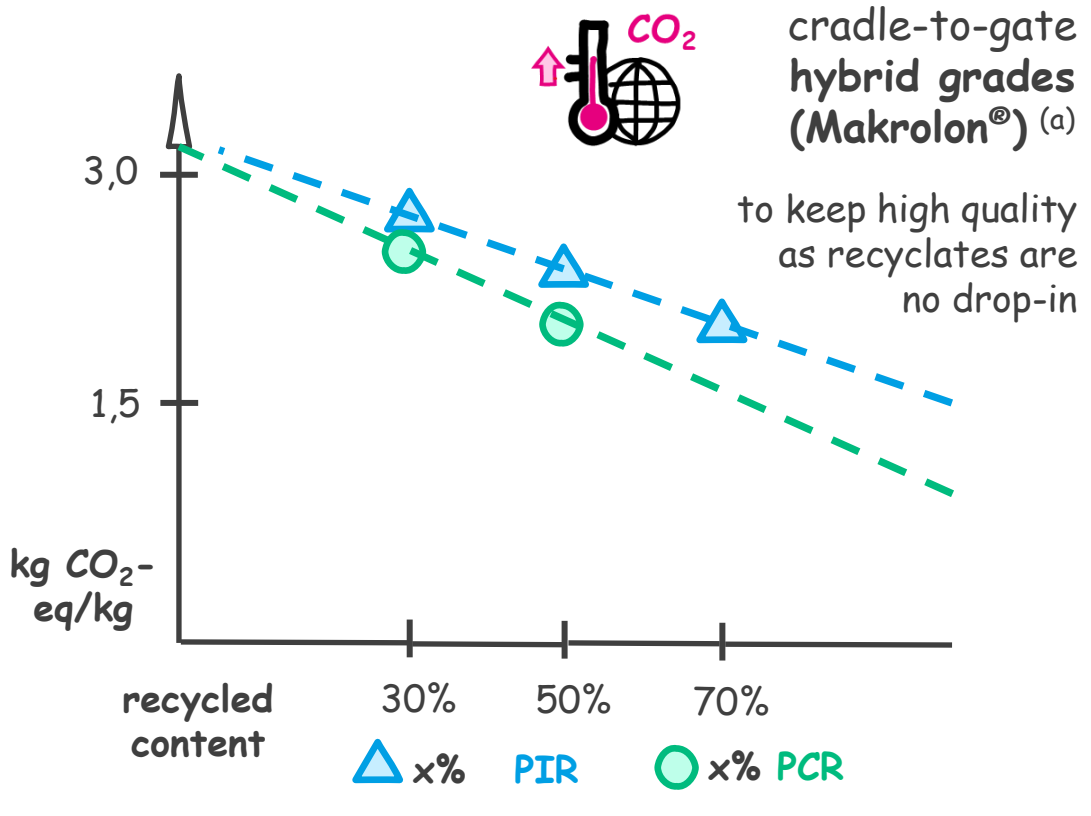
where **Qs/Qp = 0,75** means virgin quality except loss of characteristics for food, medical, etc.

(a) PEFCR_guidance_v6.3.pdf (europa.eu)

The impact of recycled content on the carbon footprint

Calculation results and carbon footprint reduction potential



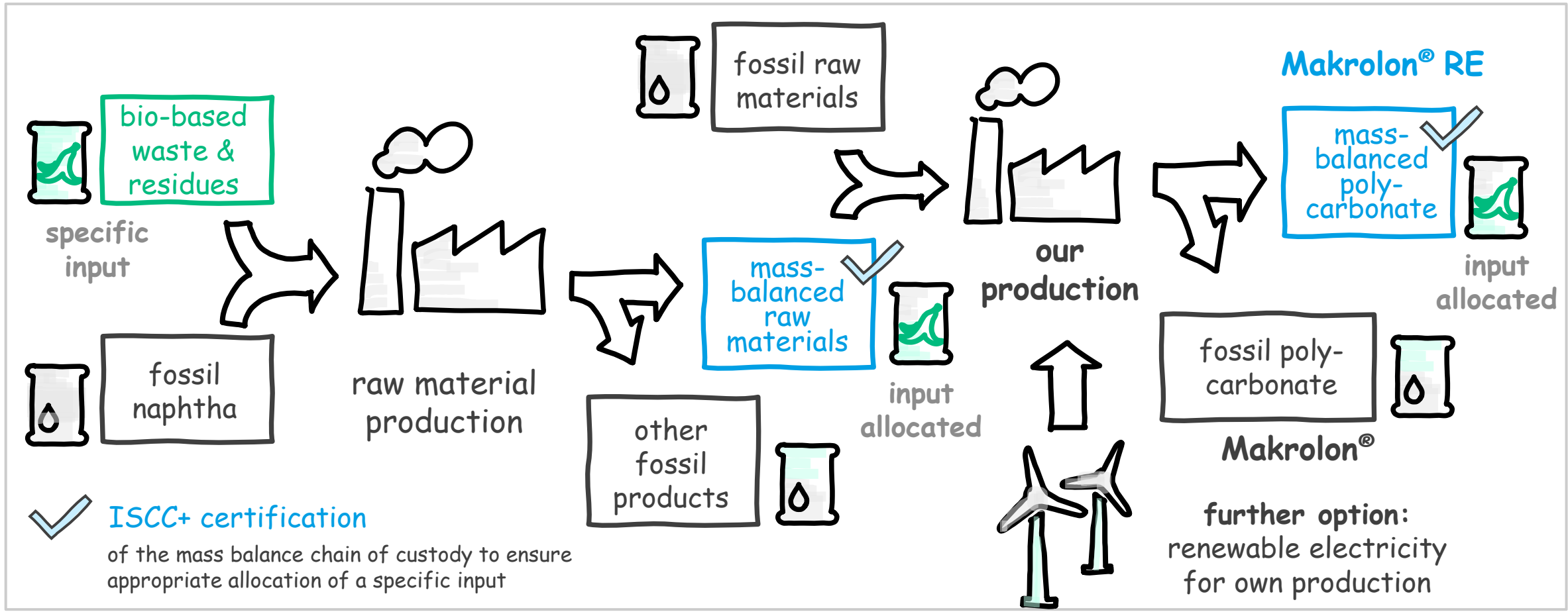


(a) based on the methodology of international standards DIN EN ISO 14040:2021-02 / DIN EN ISO 14044:2021-02; for the calculation GaBi database version 10.0 were used wherever possible for background data; impact assessment according to CML 2001 – Aug 2016; **critical review performed by TÜV Rheinland;**

04 THE CONTRIBUTION OF RAW MATERIALS DERIVED FROM MASS-BALANCED BIO-WASTE AND RESIDUES TO CARBON NEUTRAL MAKROLON®

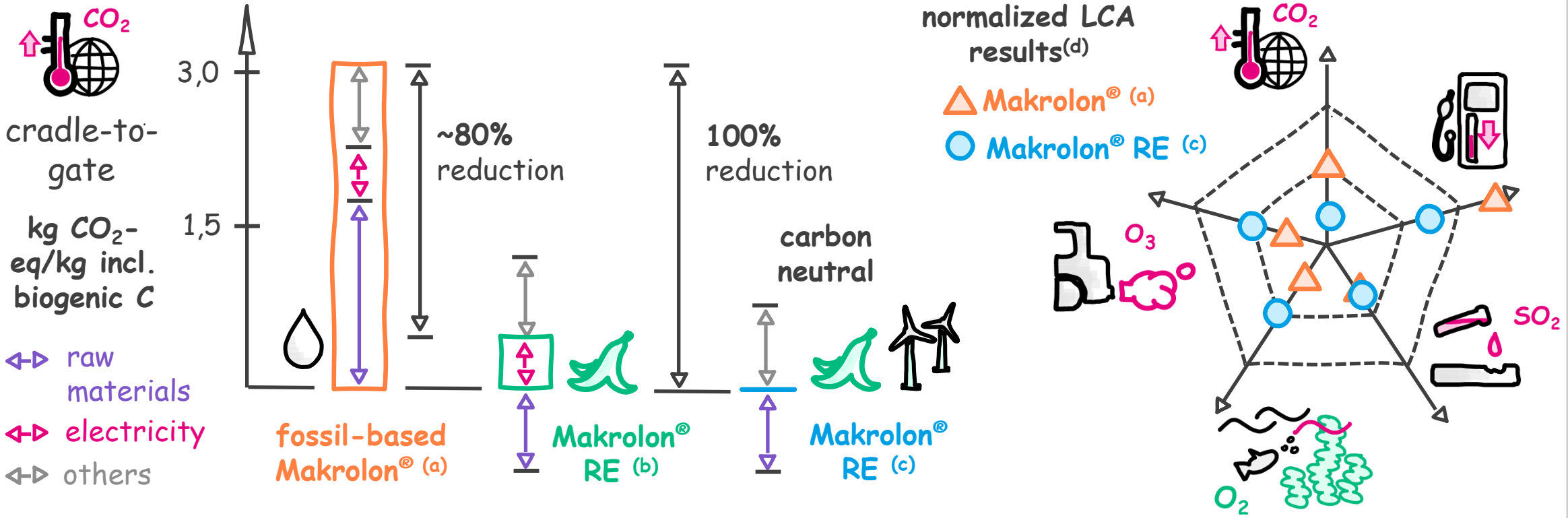
The way to carbon (footprint) neutral Makrolon®

Production chart with raw materials derived from mass-balanced bio-waste and residues



The way to carbon (footprint) neutral Makrolon®

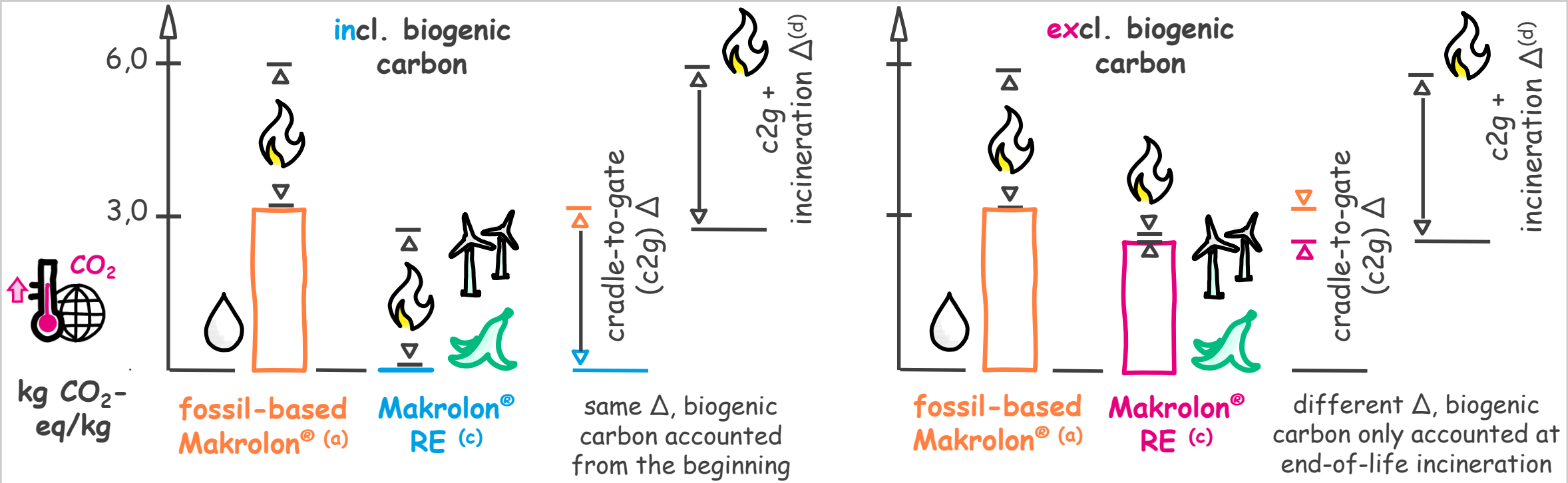
Calculation results for bio-circular raw materials & renewable energy in own production



(a) based on the methodology of international standards DIN EN ISO 14040:2021-02 / DIN EN ISO 14044:2021-02; for the calculation GaBi database version 10.0 were used wherever possible for background data; impact assessment according to CML 2001 – Aug 2016; (b) replacing key raw materials with mass balanced bio-circular ones according to ISCC+; (c) replacing electricity grid mix with renewable electricity for Covestro processes; **critical review performed by TÜV Rheinland; results presented at LCM conference 2021**; (d) normalization via CML Normalization (World) in GaBi

The way to carbon (footprint) neutral Makrolon®

Biogenic carbon accounted from the beginning to make it visible for the value chain

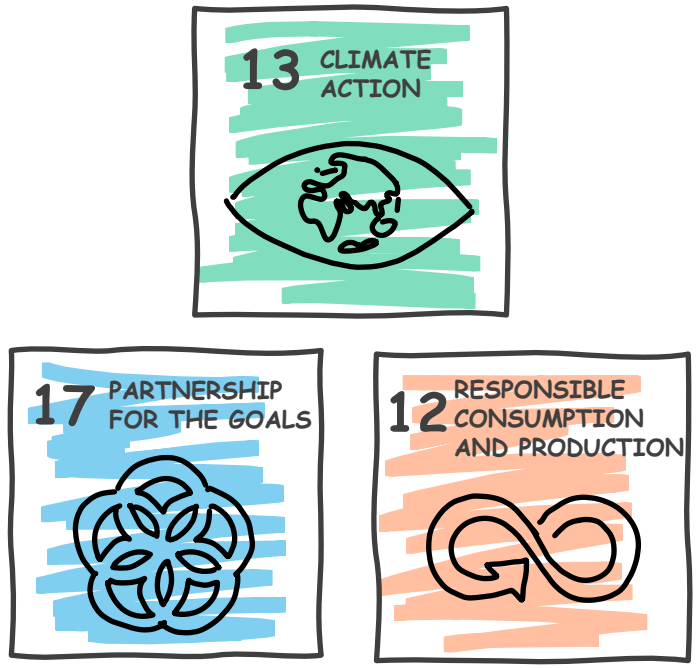


To foster the **transition away from fossil-based raw materials** it is important to **account biogenic carbon from the beginning to make the benefit visible in the decision phase** (material production).

(a) and (c) see slide 18; (d) overall Δ between fossil-based and mass-balanced bio-circular raw materials is the same incl. or excl. biogenic carbon

Summary

Key takeaways



- **Life Cycle Assessment (LCA)**
  is the tool to **calculate our impact** – not only, but especially on climate change – **guiding us** on our road to get carbon neutral.

- **Makrolon® hybrid grades**
  using **mechanically recycled plastic waste** and calculating its impact via the **Circular Footprint Formula (CFF)** – allows together with virgin **to balance quality and footprint reduction potential.**

- **Makrolon® RE drop-in solutions**
  using **mass-balanced renewable raw materials** derived from bio-waste and residues and **including biogenic carbon** in the LCA cradle to gate (c2g) calculation, together with **renewable electricity** for our production – enables a **carbon neutral product on par with virgin quality.**

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Thank you
for your attention

Dr. Frank Buckel

Sustainability
Solutions - Advocacy

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