A solution by
DB E&C

BIM4LCA

Model-based lifecycle assessment

Green design and construction of railway infrastructure

Climate neutral by 2040

Protect the climate.
Preserve the environment.
Deutsche Bahn.

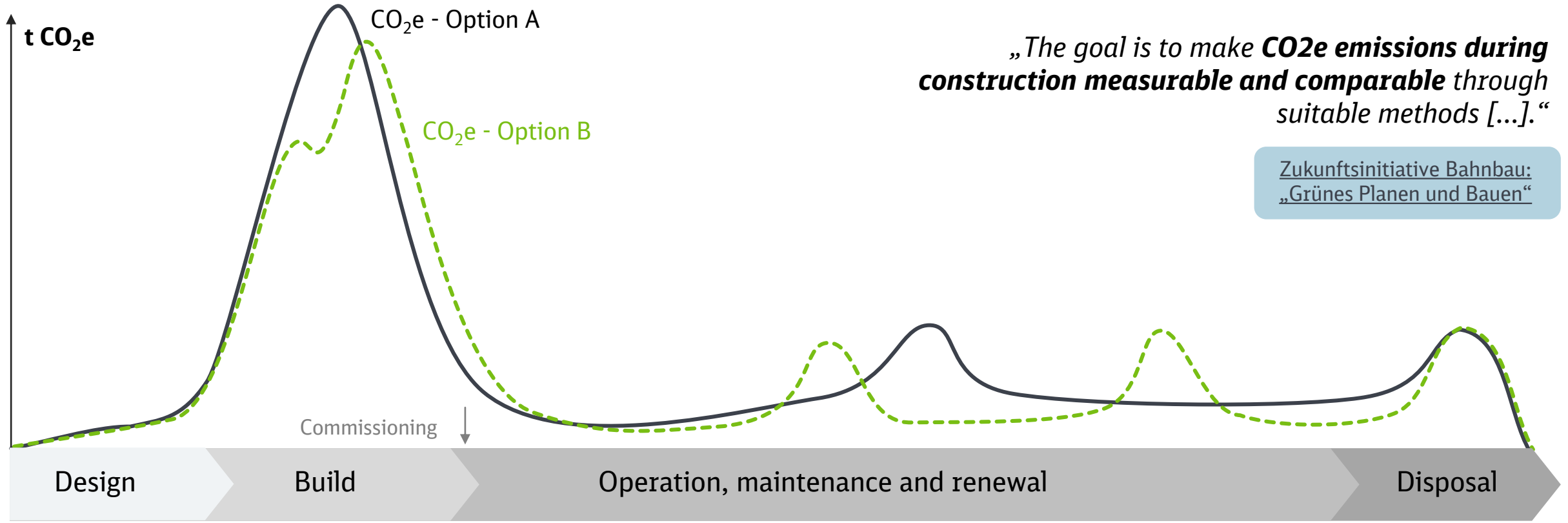
From road.
To rail.
Green construction logistics.

A good climate.
Good for the climate.
Green buildings.

BIM model-based lifecycle assessment of infrastructure

Anchor sustainability as a **decision-making criterion** in infrastructure design.
Lifecycle assessment makes **emissions measurable** in the design.

Lifecycle assessment according to DIN EN ISO 14040 and ISO 14044



*„The goal is to make **CO2e emissions during construction measurable and comparable** through suitable methods […].“*

Zukunftsinitiative Bahnbau: „Grünes Planen und Bauen“

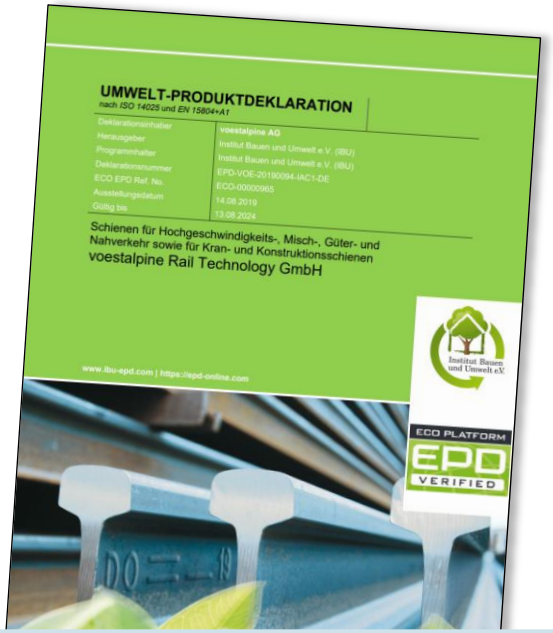
Vision – Determine emissions and costs over the entire lifecycle and use them as a criterion for well-founded, holistic decisions in the design.

Environmental Product Declarations (EPD)

The basis for a lifecycle assessment are so-called
Environmental Product Declarations (EPDs).
Standards: ISO 14025 and EN 15804

The evaluation is carried out on the basis of indicators such as
Global warming potential, eutrophication potential *or* ***hazardous waste generation to landfill.***

The quantification of the indicators is carried out according to the
lifecycle phases A-D.



„carbon footprint “ →

LCA Results – Environmental influences

Indicator		Unit	A1-A3*	C3*	C4*	D*
GWP	Global warming potential	kg CO_2 Eq	2.626E+03	0.000E+00	2.423E+00	-1.284E+03
ODP	Depletion potential of the stratospheric ozone layer	kg CFC11 Eq	7.183E-09	0.000E+00	6.338E-13	7.119E-06
POCP	Formation potential of tropospheric ozone	kg Ethen Eq	1.168E+00	0.000E+00	5.987E-04	-5.894E-01
AP	Acidification potential of soil and water	kg SO_2 Eq	6.734E+00	0.000E+00	6.738E-03	-2.506E+00
EP	Eutrophication potential	kg $(PO_4)^3$ Eq	7.957E-01	0.000E+00	8.538E-04	-1.872E-01
ADPE	Abiotic depletion potential for non fossil resources	kg Sb Eq	2.889E-02	0.000E+00	5.111E-07	-3.689E-03
ADPF	Abiotic depletion potential for fossil resources	MJ	2.135E+04	0.000E+00	3.469E+01	-1.239E+04

*A1: Raw material supply
A2: Transport
A3: Manufacturing/production

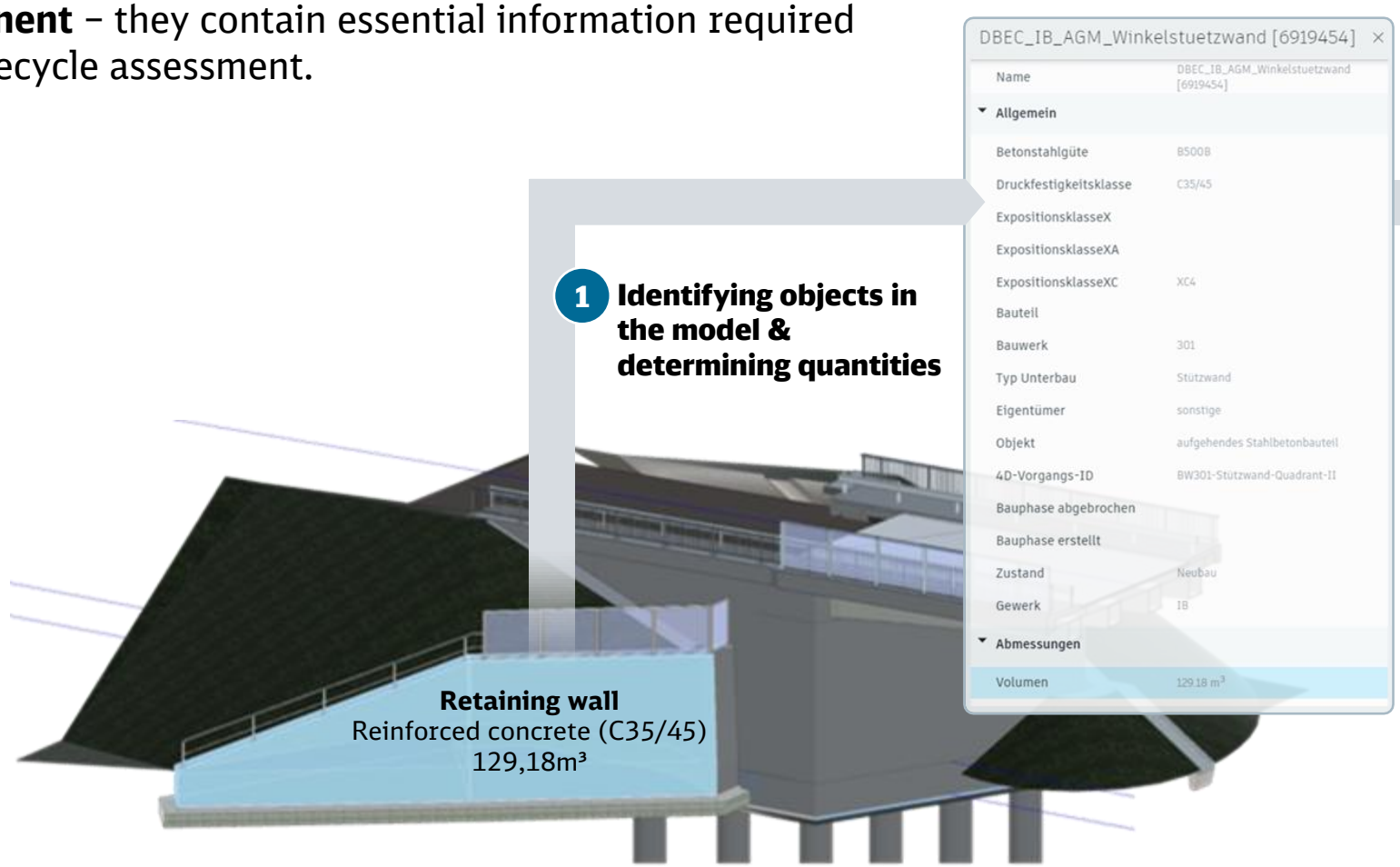
*C3: Waste treatment
C4: Disposal

*D: Reuse, recovery & recycling

Source: OEKOBAU.DAT

Lifecycle assessment as a BIM use case

At DB E&C, **BIM models** are an **essential design component** – they contain essential information required for a lifecycle assessment.



1 Identifying objects in the model & determining quantities

2 Assign EPD

EPD
1m³ Unreinforced structural concrete C35/45 (Source: epd-online.com)

Indicator	Unit	A1-A3
GWP	kg CO_2 Eq	244,00
ODP	kg CFC11 Eq	6,81E-8
POCP	kg Ethen Eq	2,98E-2
AP	kg SO_2 Eq	3,48E-1
EP	kg $(PO_4)^3$ Eq	6,55E-2
ADPE	kg Sb Eq	8,22E-4
ADPF	MJ	1080,00

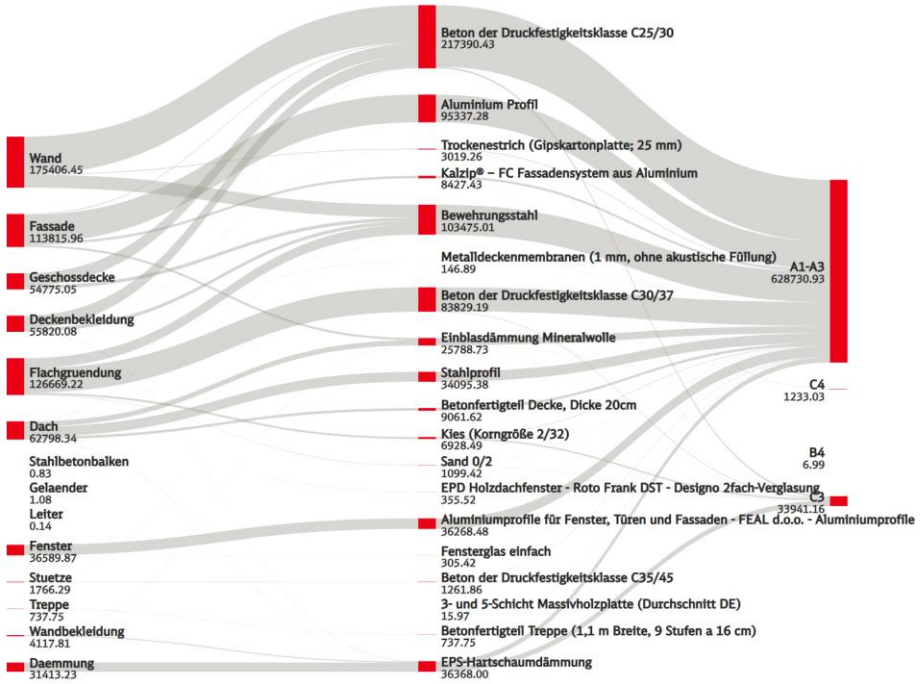
3 Calculate emissions

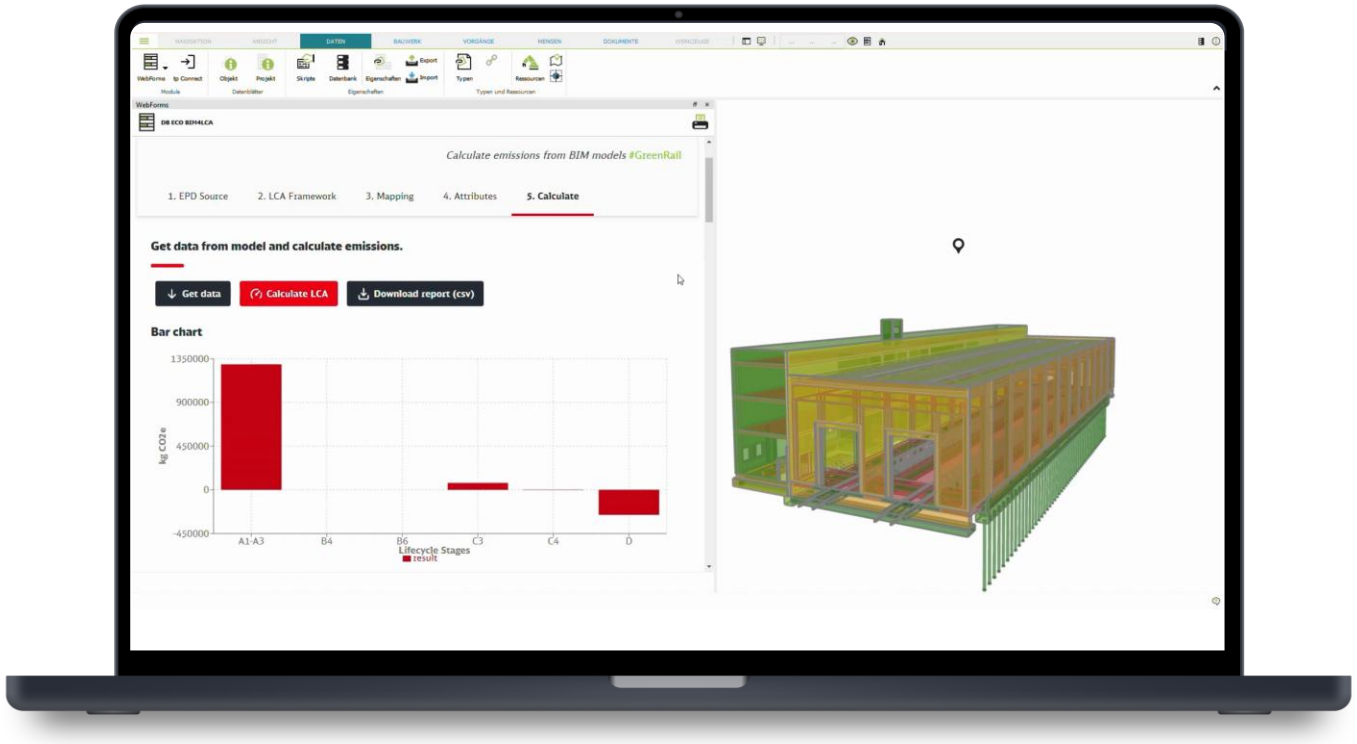
$GWP_{Gew,A1-A3}$ = 129,18 m³ x 244 kgCO2e/m³
= 31,5 tCO2e

4 Rate results

BIM4LCA for Dynamic LCA Adjustment in Response to Design Changes

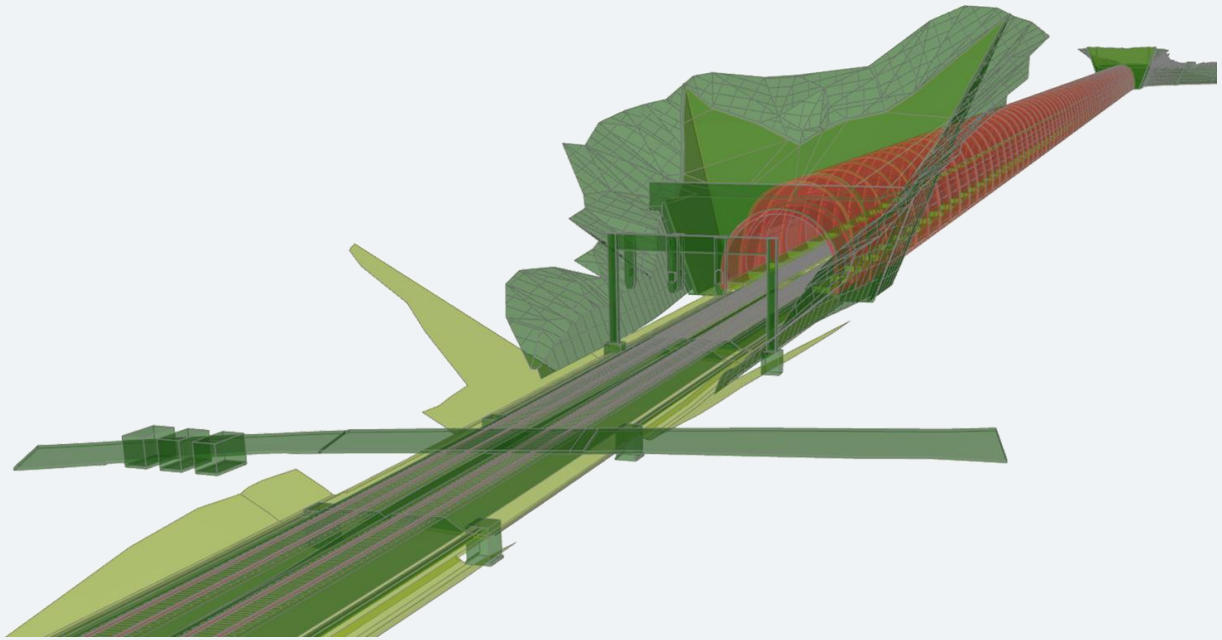
The **BIM4LCA tool**, developed by DB E&C, enables the direct calculation and visualization of emissions within the BIM model using a fully model-based approach. Its high level of automation allows for fast **LCA iterations**, while the life cycle assessment is carried out alongside the **planning process**.





Advantages of lifecycle analysis using BIM4LCA

BIM4LCA as a green component for the digital and sustainable design of tomorrow's railway infrastructure.



Determining emission and cost hotspots
Consultation on design alternatives in early stages

Speed through automation
Quick LCA iterations along the entire design process

Lifecycle Analysis
BIM4LCA addresses the whole infrastructure lifecycle

Making sustainability measurable
Quantifying emissions as a decision criterion

Quick comparison of design variants
LCA data can support the decision for a preferred design

High degree of standardization
Lifecycle assessment according to ISO 14040 & ISO 14044

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