RAILTECH EUROPE '24

Environmental impacts and sustainable tenderings in railways

Dr. Matthias Landgraf
CEO evias rail
matthias.landgraf@evias.at
www.evias.at

Sven Schirmer
Corporate Procurement Coordinator
Austrian Federal Railways ÖBB
sven.schirmer@oebb.at

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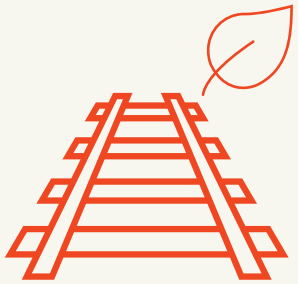
efficiency. railways. science.

ÖBB HOLDING



Environmental impacts railway infrastructure

Mitigation potential

Sustainable Tendering

Calculation of environmental impacts

Production process

Construction

Use phase

End-of-life

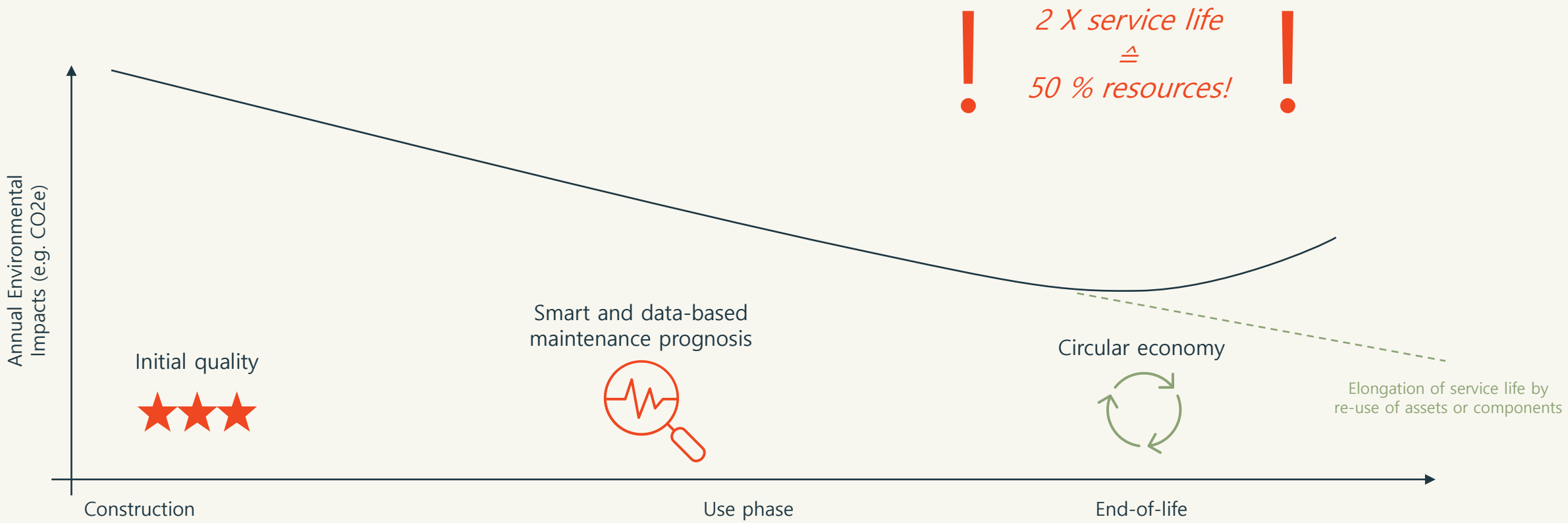
$$E_{LC,a} = \sum_{i=1}^{n} (M_{prod_i} * EF_i + ED_{prod_i} * EF_i) + \sum_{j=1}^{n} (M_{constr_j} * EF_j + ED_{constr_j} * EF_j) + \sum_{m=1}^{n} (ED_m * Pt_m * SL * EF_m + IH_m * EF_m) + \sum_{p=1}^{n} ED_{disp_p} * EF_p$$

Service Life

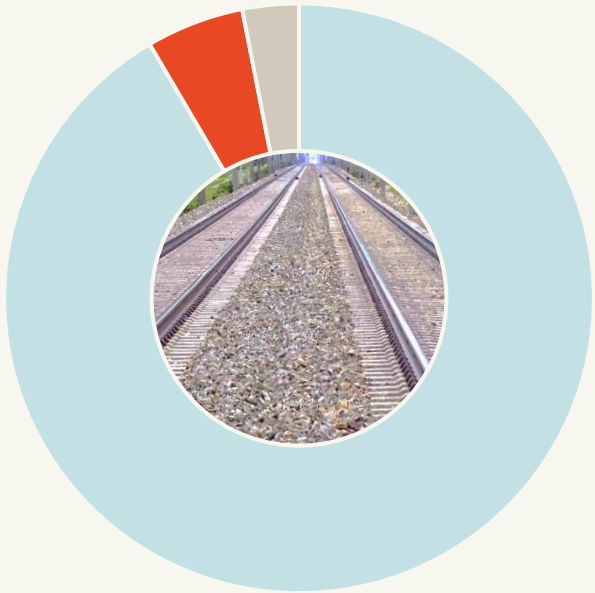
$E_{LC,a}$ … annual Emissions
M … Masses per material
EF … Emission factor
ED … Energy demand
Pt … Productive time of working process
SL … Service life

[Landgraf M., Horvath A. "Life cycle assessment of railway infrastructure: an Austrian case study", ERIS Environmental Research Infrastructure and Sustainability, IOP, DOI 10.1088/2634-4505/ac1242]

Service life | Asset management

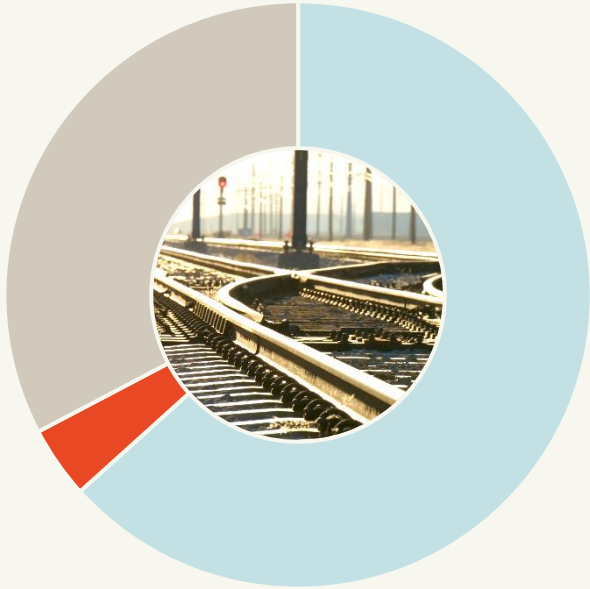


Open track vs. Turnouts (S&C)



Greenhouse gas emissions [%]

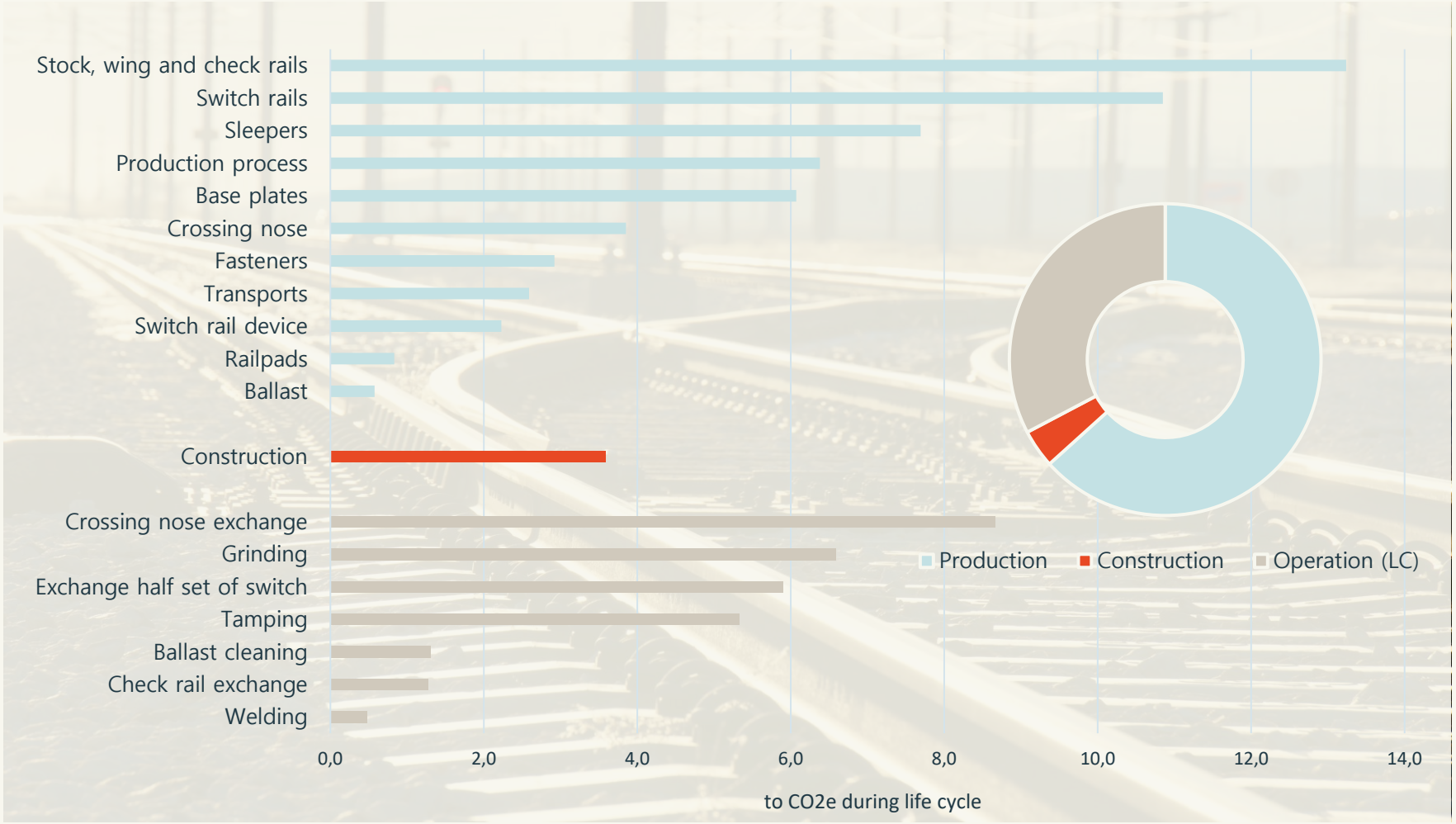
Production
Construction
Use Phase



Greenhouse gas emissions [%]

Turnouts are complex and maintenance-intensive which is why more emissions are associated to the use phase.

LCA Turnouts



Calculation of CO_2 emissions of the Austrian railway network in cooperation with ÖBB Infrastruktur AG.

Detailed calculation of components and processes – also aggregated at system level to evaluate and identify network-wide mitigation potentials.

Landgraf, Matthias, et al. "Environmental impacts and associated costs of railway turnouts based on Austrian data." Transportation Research Part D: Transport and Environment 103 (2022): 103168.

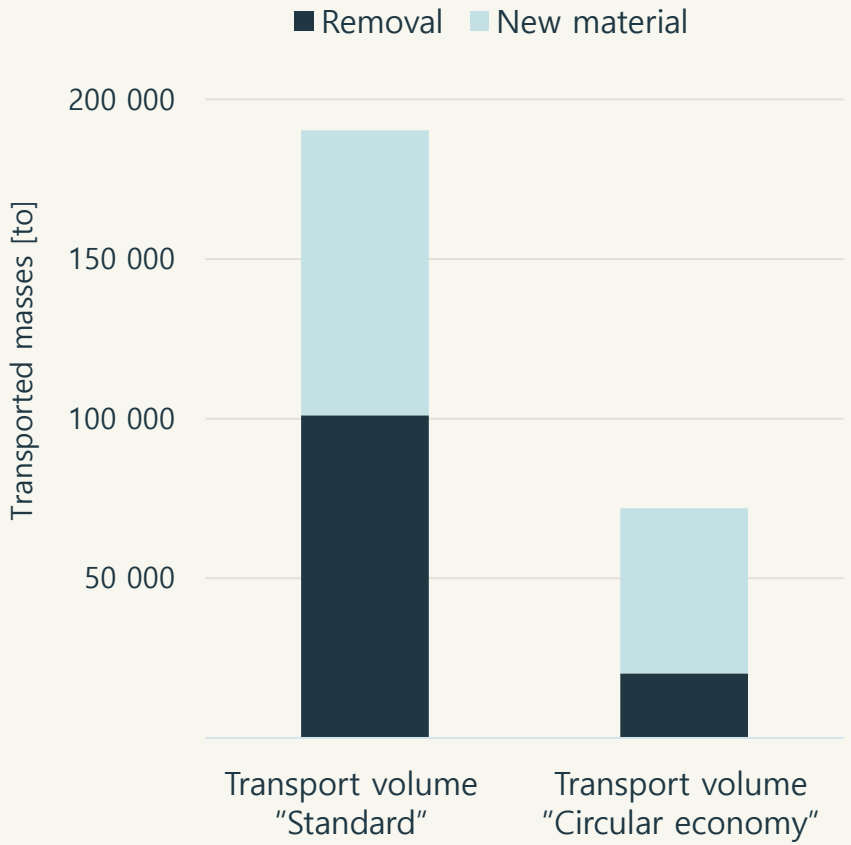
Further potential

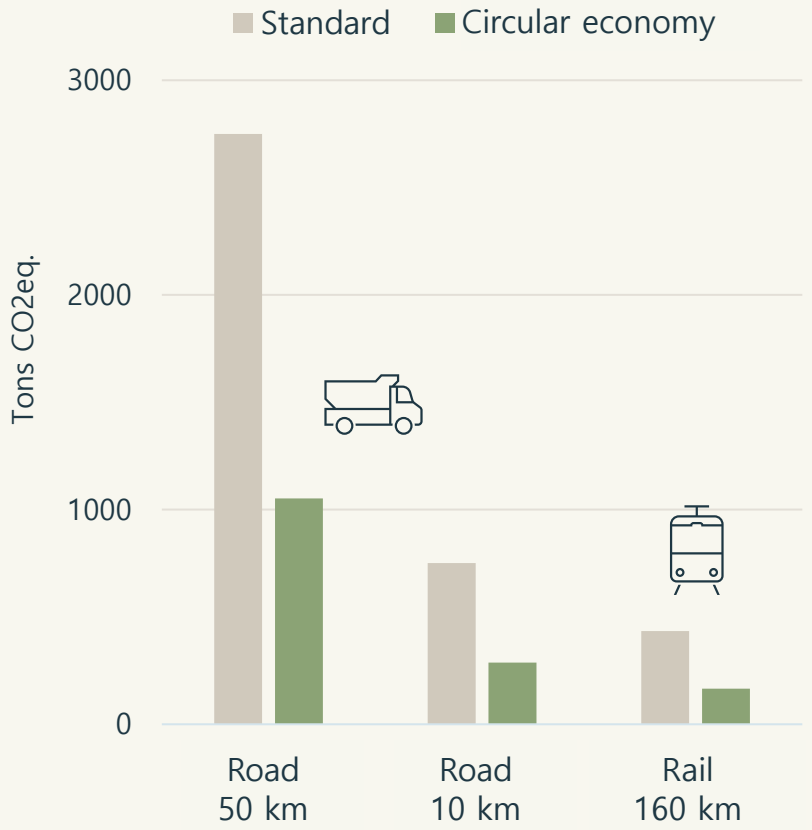
Circular economy

Savings potentials with implemented circular economy using the example of gravel and earth material in a station reconstruction.

By reusing the materials*, more than 60% of the masses to be transported can be saved and thus resources can be conserved.

This is also reflected in the CO2 emissions associated with the transports – especially when transported to and from the site by rail.



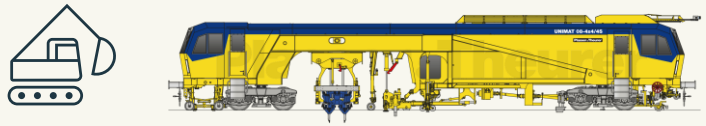


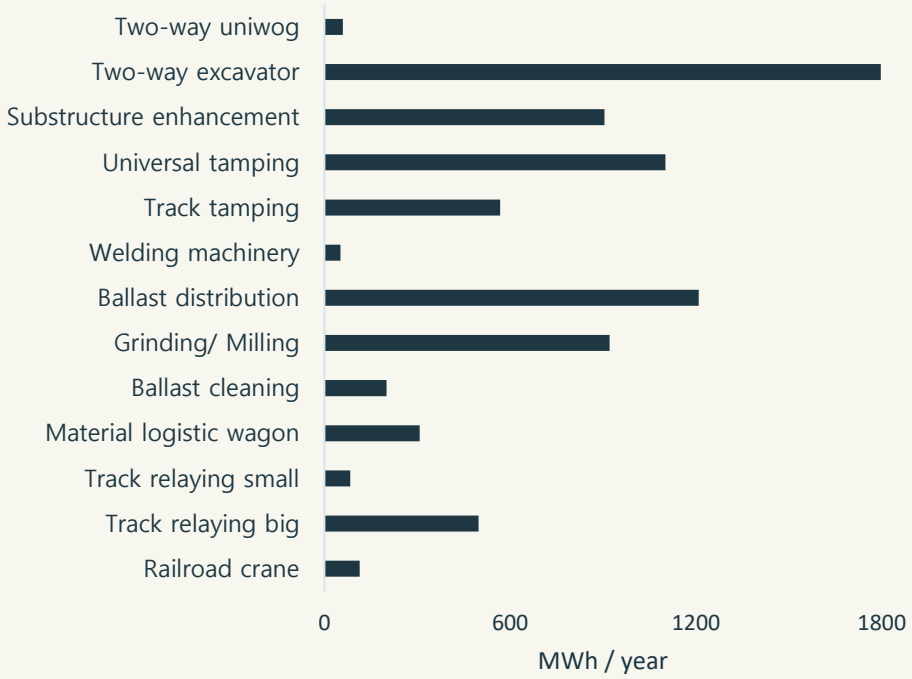
*Assumption: Re-use rate of 80%

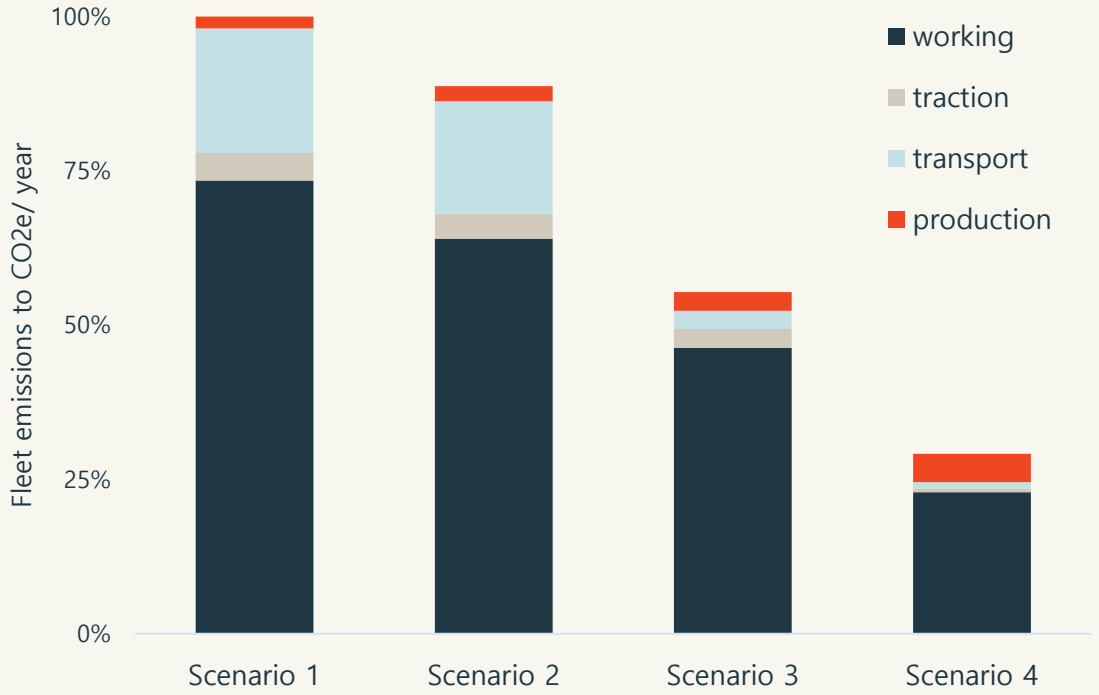
Landgraf, M., Ferreira, C. G., & Egger, J. (2023). Ökologische Einsparungspotenziale im Infrastrukturbau: Ökologische Planungsbegleitung am Beispiel eines Bahnhofsumbaus zur Einsparung von Treibhausgasemissionen und Implementierung von Kreislaufwirtschaft. *Der Eisenbahningenieur*

Further potential

Track work machinery







Analysis

Energy requirement for production, transport, transport to and from the site and use of track construction machines in kWh per year.

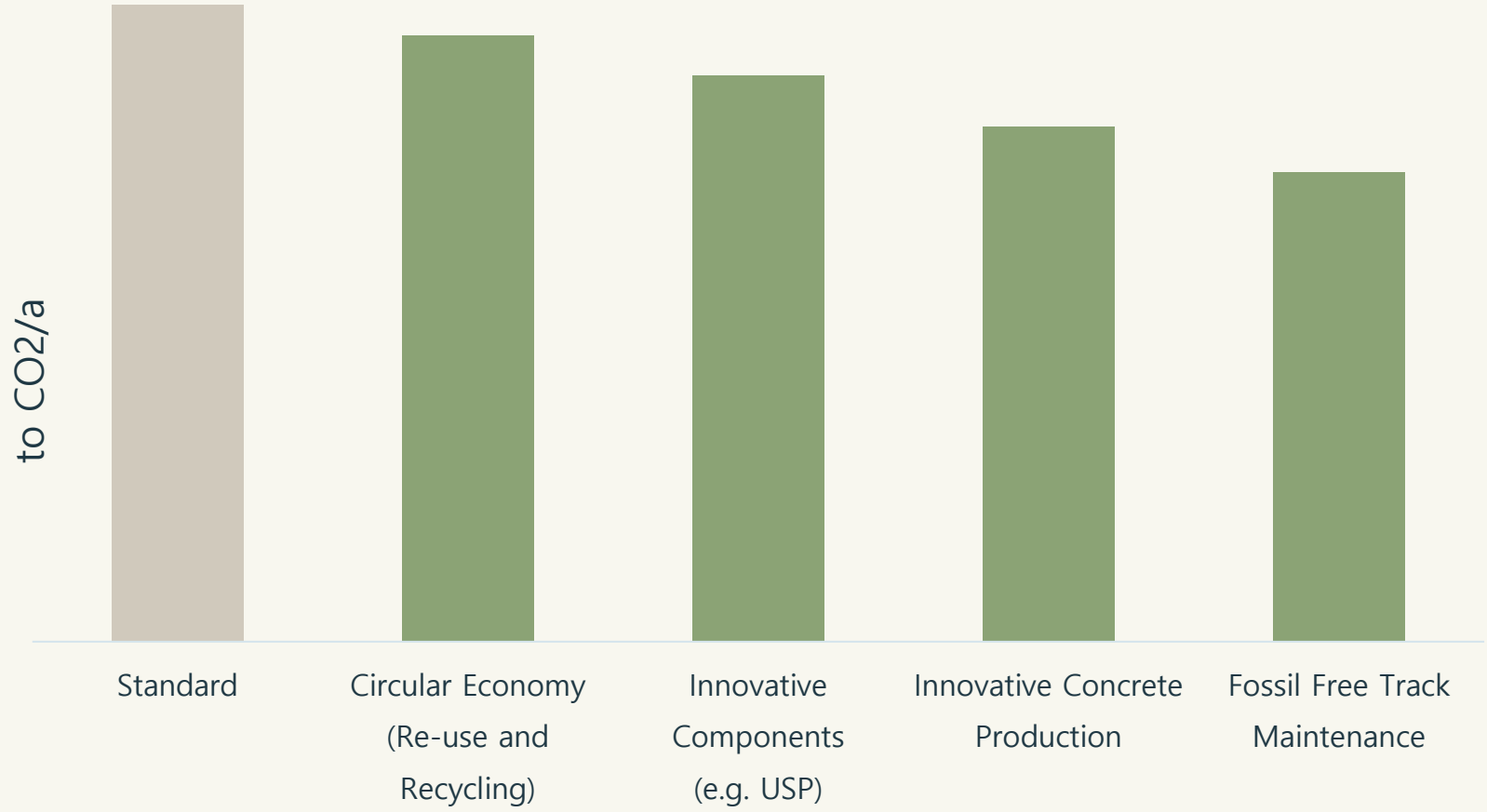
Strategy

Potential for reducing greenhouse gas emissions on the basis of a long-term migration strategy.

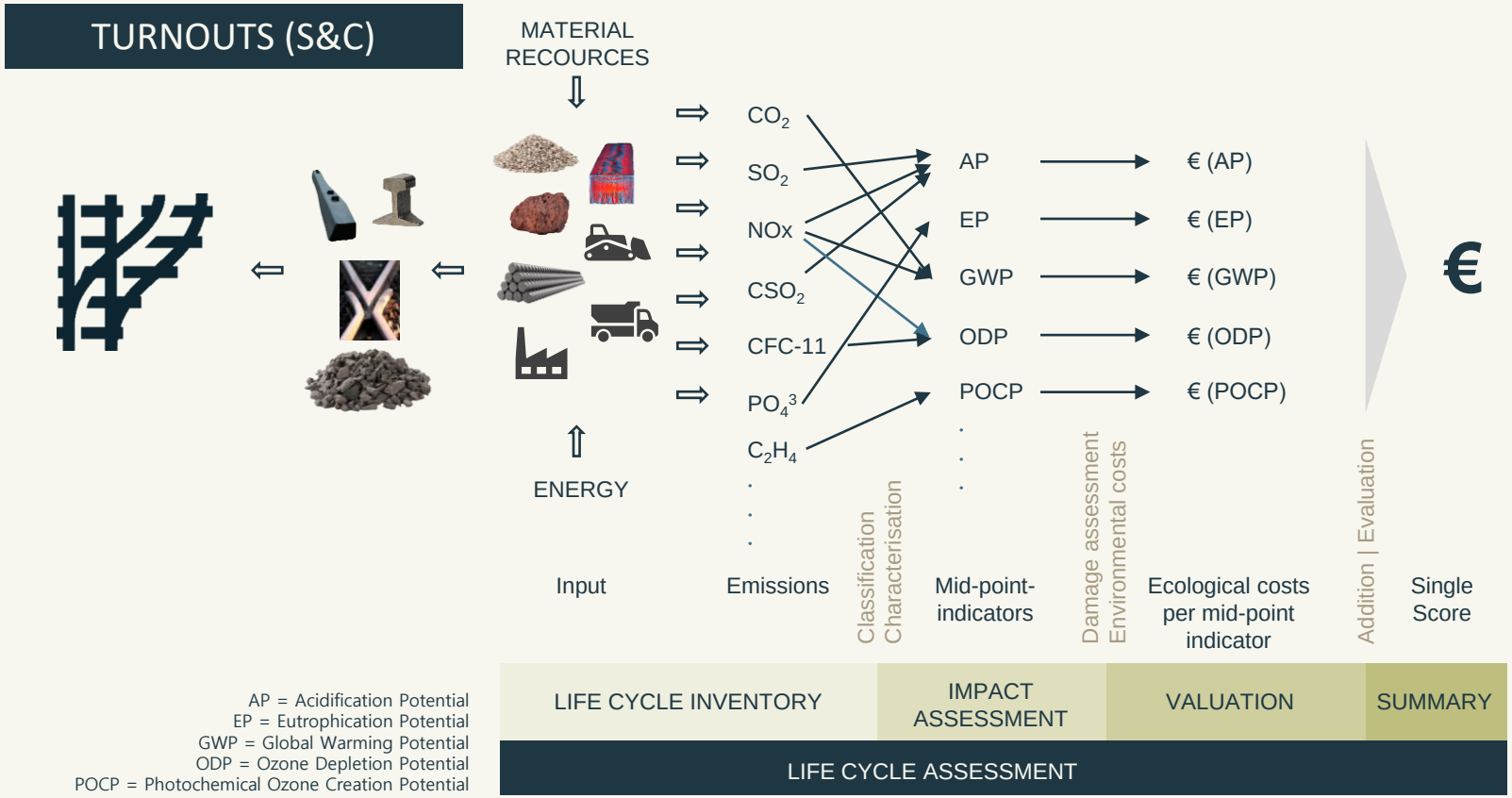
Landgraf, Matthias, et al. "Nachhaltigkeit im Gleisbau am Beispiel der Gleisbaumaschinenflotte in Österreich." ZEVrail 2023.11/12 (2023).

Mitigated environmental impacts

Innovative technologies as well as the implementation of circular economy show significant potential for reducing emissions.



Monetization of environmental impacts



The monetization of environmental impacts enables them to be integrated into cost-based decision-making processes (asset management, planning process, procurement).

If possible, this should be carried out on the basis of damage and avoidance costs in order to achieve the necessary steering effect.

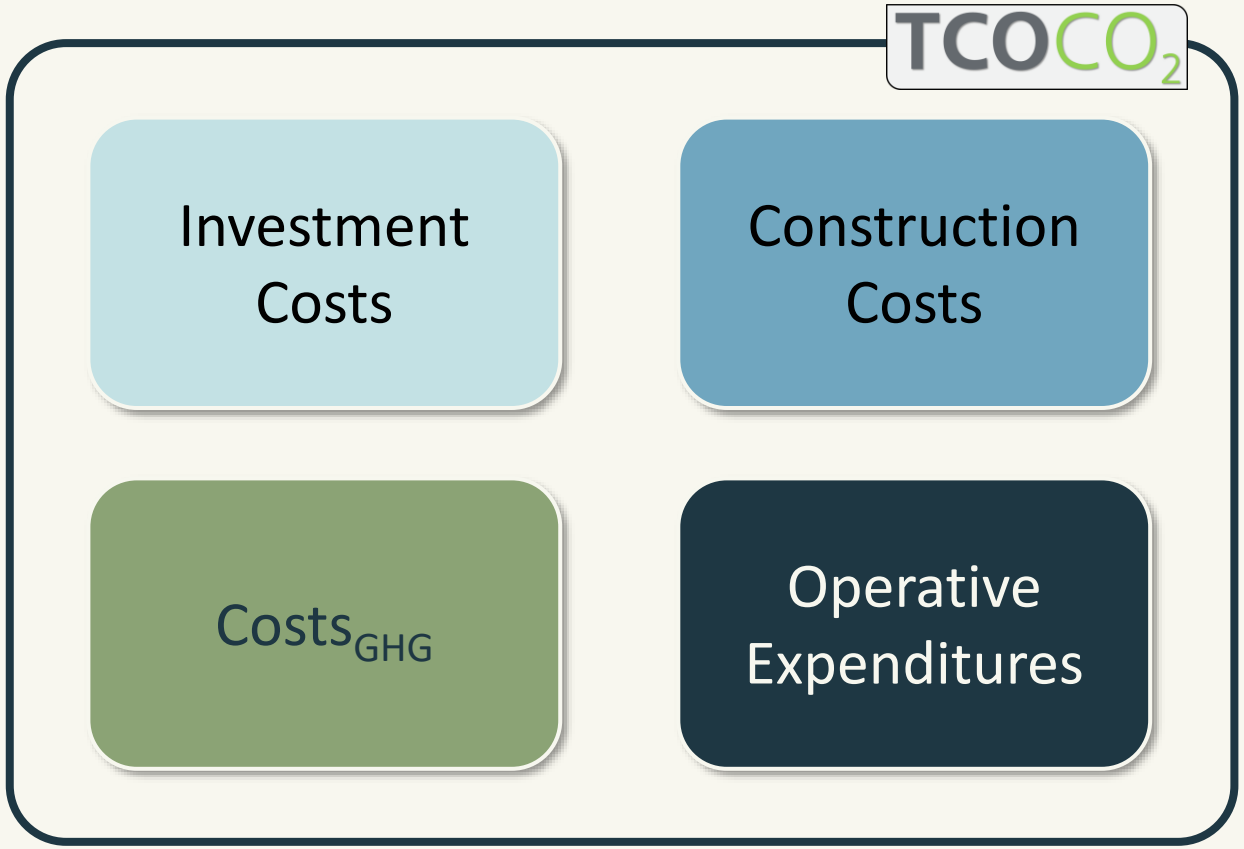
[Landgraf, M., Zeiner, M., Knabl, D. C., & Corman, F. (2022). Environmental impacts and associated costs of railway turnouts based on Austrian data. Transportation Research Part D: Transport and Environment, 103(103), https://doi.org/10.1016/j.trd.2021.103168]

Green Procurement

Extension of the TCO model to include environmental costs (monetized environmental impacts).

Methodology should be applicable to infrastructure, vehicles, IT and services.

Development of a calculation model for the determination of supply-specific environmental impacts.



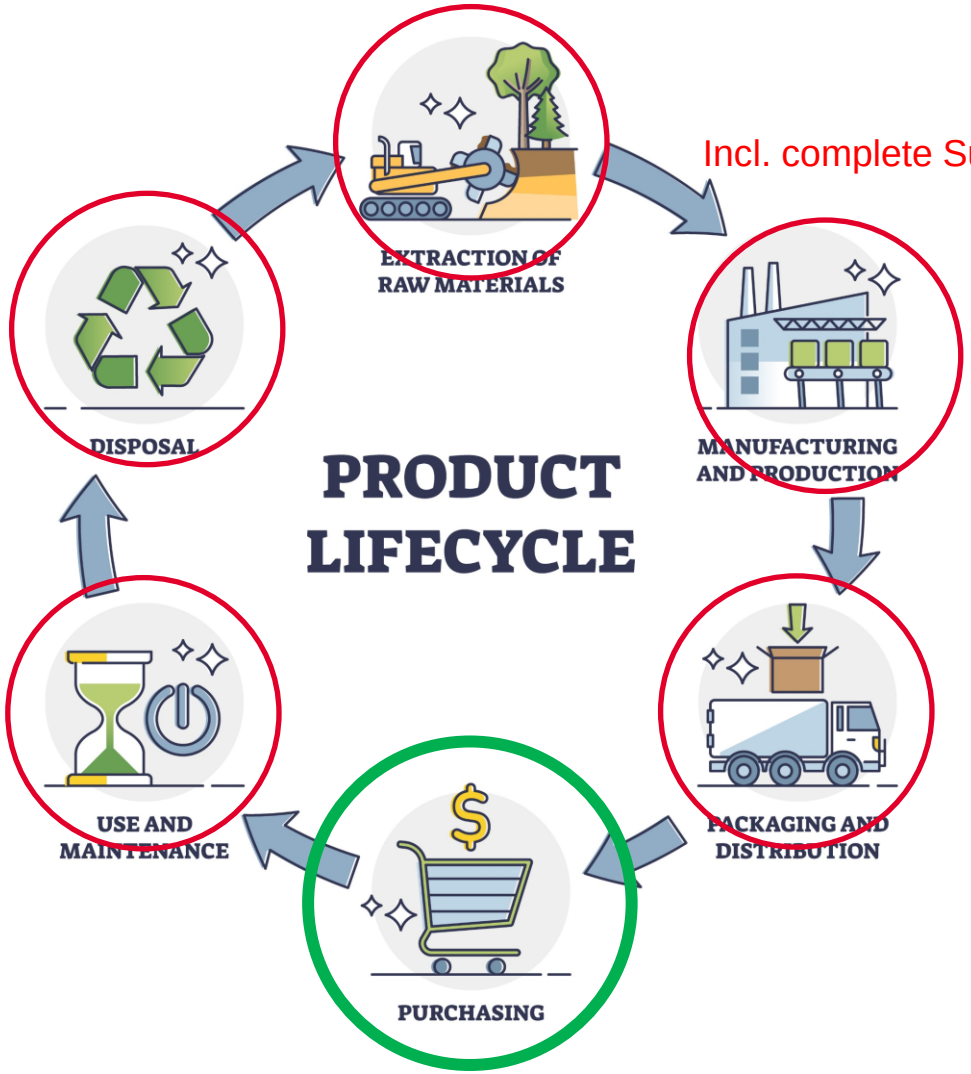
[Landgraf, Schirmer, *Implementation of environmental impacts within public procurement at ÖBB*, Global Railway Review]
[Landgraf, Schirmer, *Total Cost of Ownership mit ökologischer Bewertung*, Best in Procurement BiP]
[Landgraf, Marschnig, Schirmer, *Integration von Umweltwirkungen im öffentlichen Beschaffungsprozess am Beispiel der Eisenbahn*, ZEV Rail]
[Komer, Landgraf, Schirmer, *Nachhaltige Kostenmodelle im Vergaberecht*, ZVB Vergaberecht und Bauvertragsrecht, Manz]

Environmental impacts and sustainable tendering in railways

Part 2 – Implementation at ÖBB

HEUTE. FÜR MORGEN. FÜR UNS.

Product Lifecycle and its interfaces to Carbon in Tenders



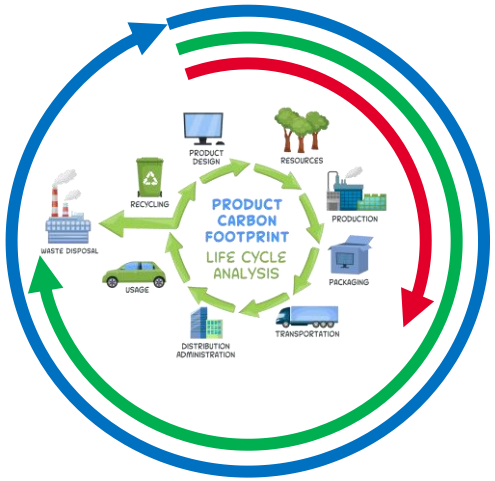
Incl. complete Supply Chain

Different phases of the product lifecycle should be considered, evaluated, the CO_2 emissions summarized, monetized and integrated in a tendering process

WHY?
→ Because only by doing this you can:

- Purchase the product with the lowest CO_2 in the lifecycle
- Reduce your CCF
- Formulate strategies and track them
- Motivate your suppliers to invest in decarbonization
- Boost the circularity approach with additional facts
- Reach the Green Deal
- Save Money in the long run

Calculation methodology in the Lifecycle



Cradle 2 Cradle

Cradle 2 Grave

Cradle 2 Gate

1: Production

- Raw material extraction
- Intermediate transport
- Intermediate processing
- Manufacture of the product

2: Transport & Assembly

- Transport Manufacturer → Customer
- Assembly/installation/ commissioning at the customer

3: Usage

- Maintenance
- Repairs
- Inspections
- Energy requirements

4: Recycling / Disposal

- Recycling (up/down)
- Waste disposal
- Sale
- Further use

$$CO_2 = (THG_{ent} + THG_{tr\_af} + THG_{nu} + THG_{rc})*m$$

Collecting necessary primary data in the PLC

Certificate

or

Energy

Material

Processes

from the

Supply Chain

EPD/ DPP/ PCF/ …

of Materials or/and components

Energy consumption

Energy mix

Material 1

2 3 4 5 6 7 8 9 10 …

Transports

Non electrical processes with CO_2 emission

Delegation Delegation Delegation …

Aggregation Aggregation Aggregation

TCO CO_2 – the new model and its usage

Data capture supply chain

- API integration
- Communication module
- Delegation module
- Reporting

Data capture Procurement / Bidder

- Tender management
- KPIs
- $TCOCO_2$ formulas
- Dashboards Procurement / Bidder
- Reporting
- Archives
- Delegation module

ESG Datahub

Output

ÖBB query

CO_2 data

ÖBB procurement DB

Internal/External databases

Modern web-based tool, with the ability to go down the supply chain and capture primary data and/or certificates.
Saves the CO_2 data of successful bids into an ESG database for further usage throughout the company for strategy creation and tracking, for the sustainability reporting and for different internal KPIs

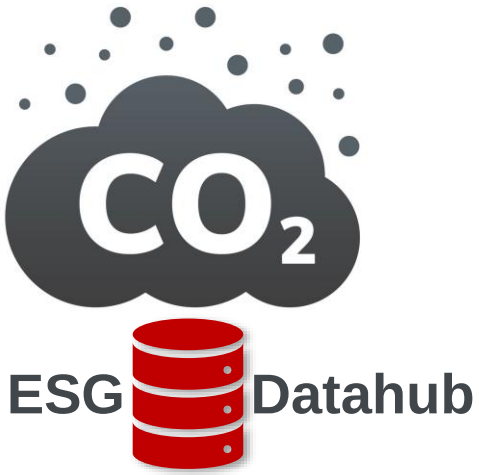
Benefits of captured CO_2/ESG Data

Informed Decision Making

Enhanced Sustainability

Regulatory Compliance and Reporting

Innovation and Efficiency



Risk Management

Support for Corporate Sustainability Goals

Market Competitiveness

Improved Reputation and Stakeholder Relations

Cost Reduction

Summary / Contact data

Dr. Matthias Landgraf

CEO evias rail
www.evias.at

Graz, Austria

Expert sustainable railways and railway infrastructure asset management.

Open for exchange

matthias.landgraf@evias.at

SCAN ME

Sven Schirmer

Corporate Procurement Coordinator at ÖBB-Holding AG

Vienna, Austria

Expert for sustainable procurement, focus on Scope 3

Open for exchange

sven.Schirmer@oebb.at

SCAN ME