Master carbon accounting: PCF, LCA, and EPD explained Webinar

23/10/2025

High-Level

Key topics:

Building your scope 3 footprint and transitioning to supplier-specific data

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What questions to ask to get the right data

The differences between PCF, LCA, and EPD

When to use each and the essentials to answer customer questions

Why it matters

Why it matters:

- Investors expect it
- Legislation guides you
- Make choices with impact
- Create brand value
- Impact risk in your value chain

Which question is answered:

- Refine your Scope 3
- Optimize your product
- Differentiate yourself
- Make a product claim
- Compare Suppliers
- Procure Sustainably

What solution you need:

- Product Carbon Footprint (PCF)
- Life Cycle Assessment (LCA)
- Environmental Product Declaration (EPD)
- Environmental Cost Indicator (ECI)

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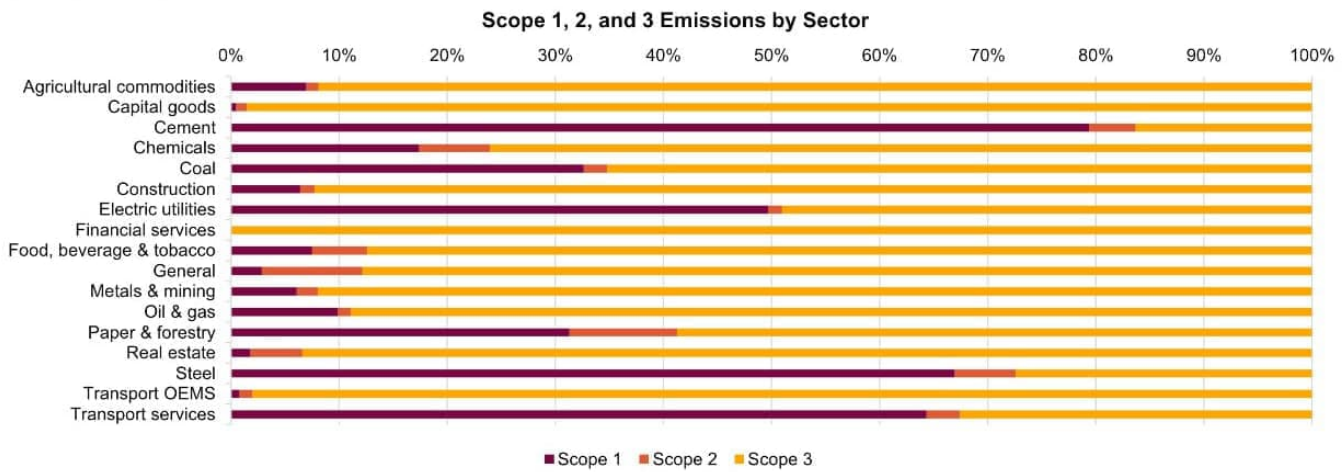

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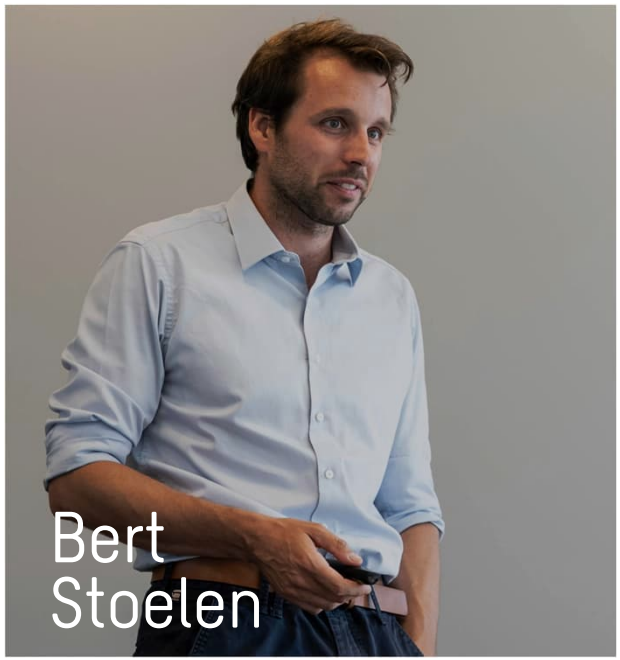
Experts in sustainability management



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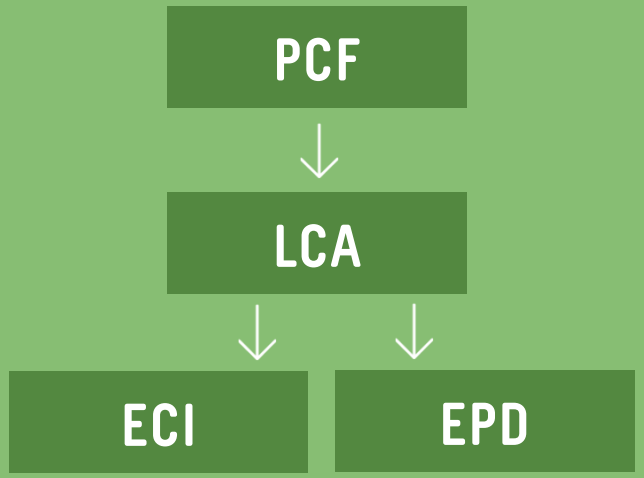
Concepts

Understanding PCF, LCA and EPD

OVERVIEW

Complexity / Maturity ↓



Concepts

01
Product Carbon Footprint

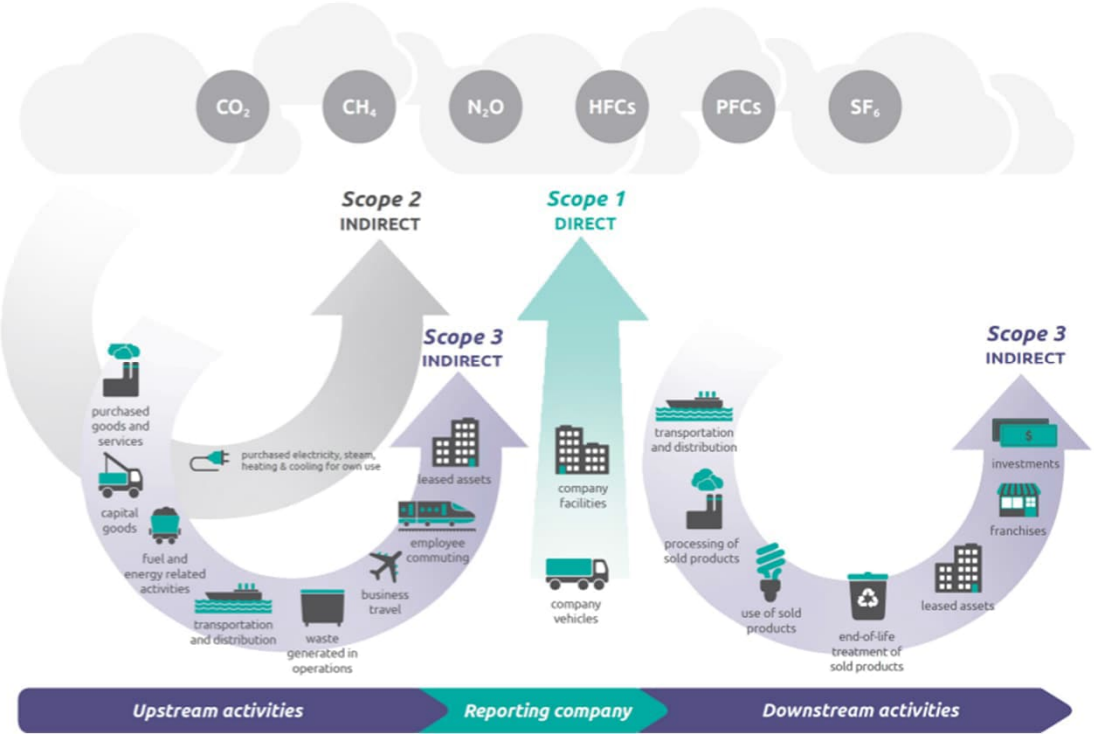
02
Life Cycle Assessment

03
Environmental Product Declaration

04
Environmental Cost Indicator

Corporate carbon footprint (CCF)

- Top down
- Carbon Accounting for total company's activities
- E.g. CCF Chemical Company = 1 000 000 ton CO2eq / year



Corporate carbon footprint (CCF)

- Top down
- Carbon Accounting for total company's activities
- E.g. CCF Chemical Company = 1 000 000 ton CO2eq / year

Product carbon footprint (PCF)

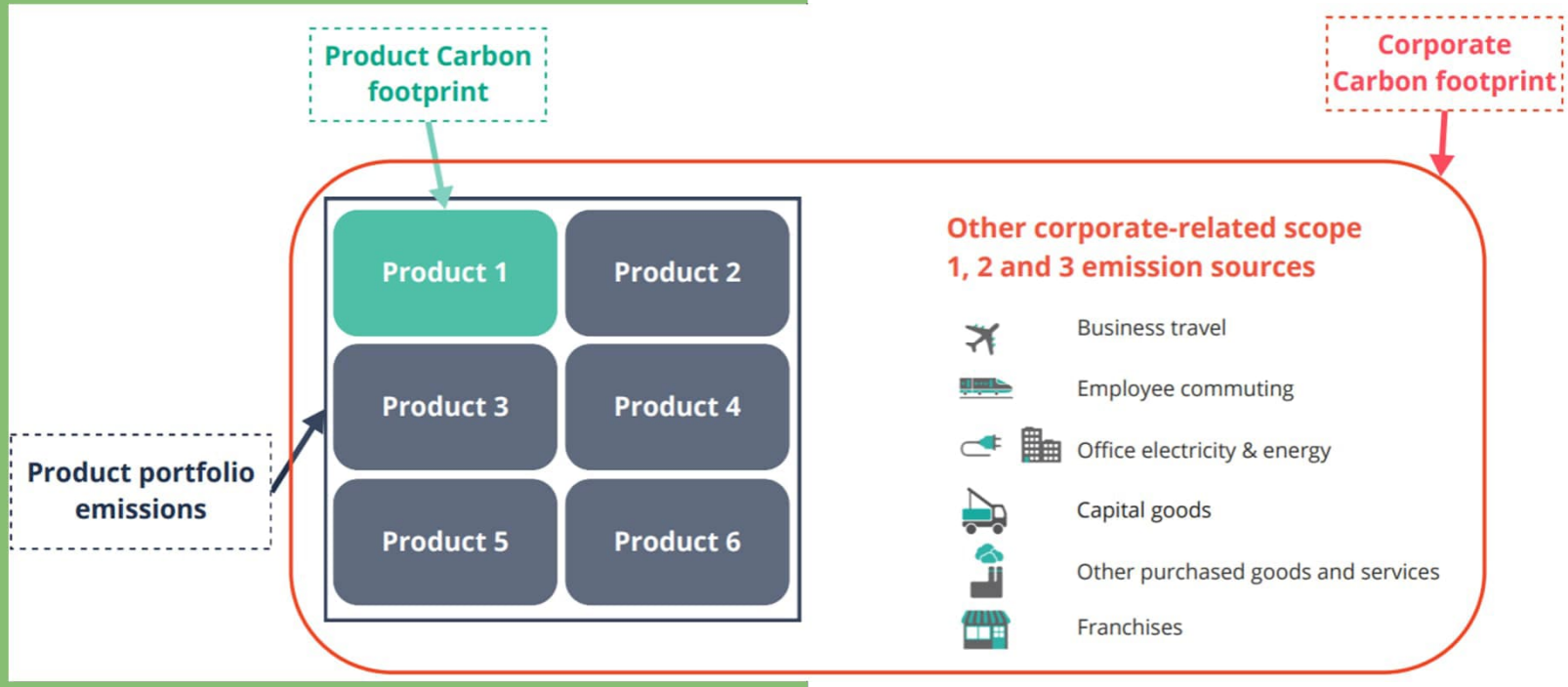
- Bottom up
- Product-specific over its total lifecycle
- E.g. PCF Polypropylene = 2 kg CO2eq / kg PP

Emission Factor (EF)

Corporate carbon footprint (CCF)

Product carbon footprint (PCF)

Base case



- Portfolio emissions = 800 000 ton CO2eq / year
- Production of Polypropylene = 400 000 ton / year
- ➔ PCF = 2 kg CO2eq / kg PP

Product carbon footprint (PCF)

Best case

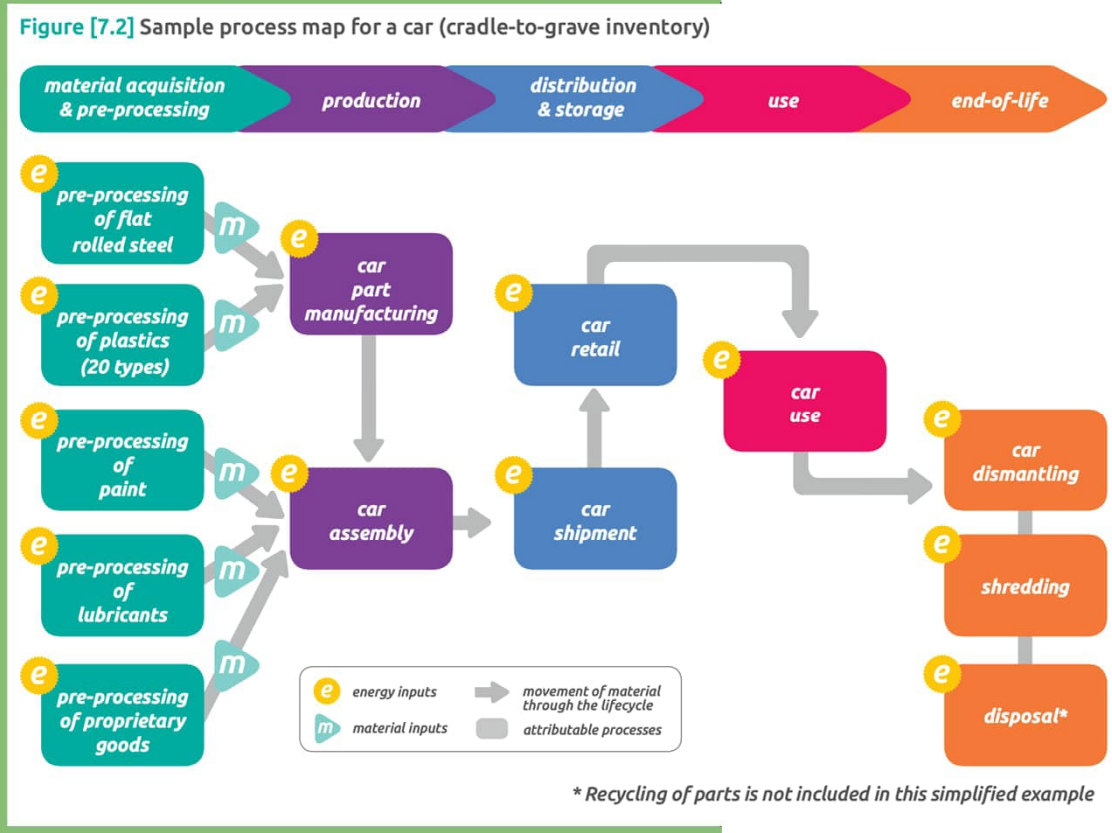


Figure [7.2] Sample process map for a car (cradle-to-grave inventory)

Inputs:

- Energy
- Material inputs
- Transport
- Waste

Product carbon footprint (PCF)

Result:

- Product emissions (intensity)
  - Per Lifecycle step
  - Per GHG-protocol category

Results

0.580 kg CO2e / kg			Scope 1	1.76%
			Scope 2	0.41%
			Scope 3	97.82%

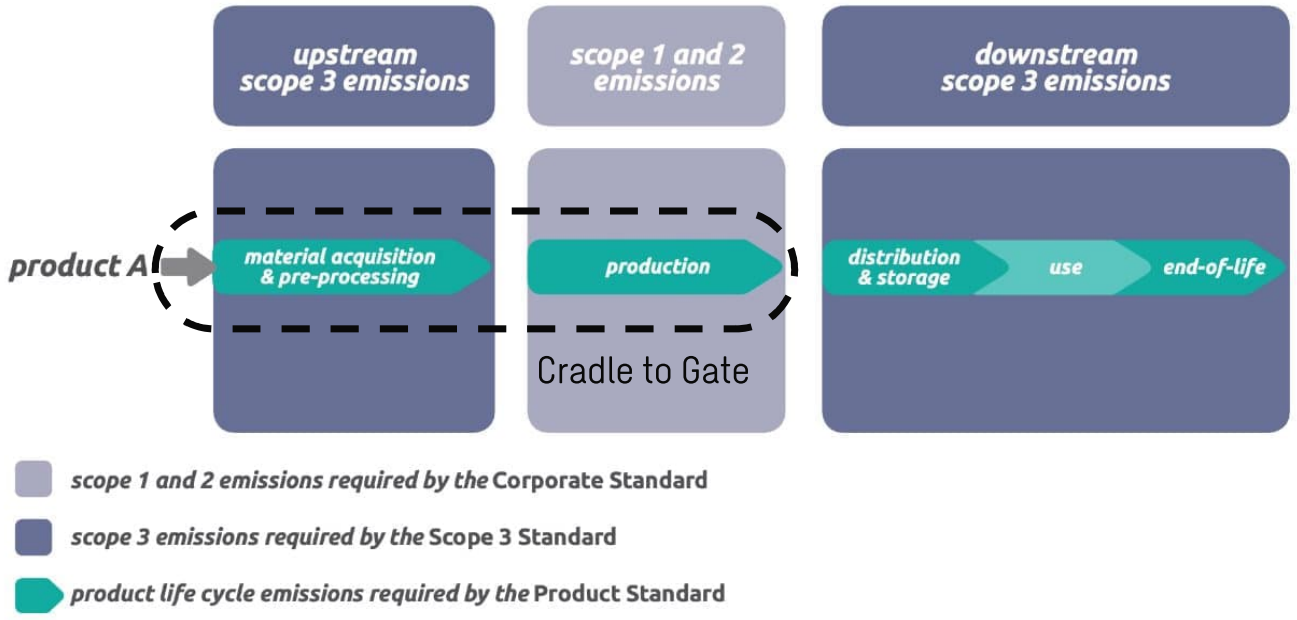
Inventory results per life cycle step	kg CO2e / kg		% of total
Material acquisition and preprocessing		0.562	96.99%
Production		0.017	3.01%

Inventory results per GHG-protocol category	kg CO2e / kg		% of total
Company facilities		0.010	1.76%
Purchased electricity		0.002	0.41%
Purchased goods & services		0.546	94.20%
Energy related activities		0.002	0.34%
Upstream transportation & distribution		0.016	2.79%
Waste		0.003	0.49%
Totaal		**0.580**	

Corporate carbon footprint (CCF)

Product carbon footprint (PCF)

Figure [1.1] The relationship between the *Corporate, Scope 3, and Product Standards* for a company manufacturing product A



Concepts

01
Product
Carbon
Footprint

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LCA: a holistic and quantitative approach to environmental impact

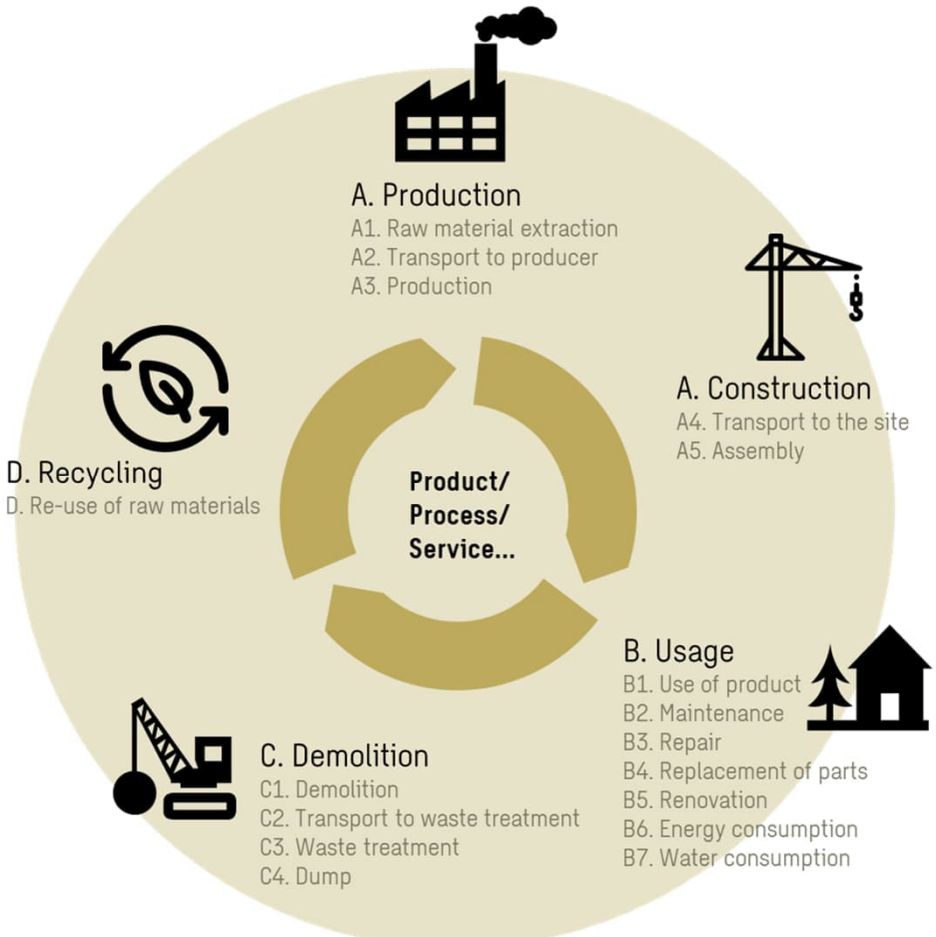
A life-cycle assessment (LCA) is an evaluation of the effects that a product/process/service... has on the environment over the entire period of its life.

QUANTITATIVE

- Based on numbers of inputs (raw materials, energy, water) and outputs (waste, products, emissions..)

HOLISTIC

- Over the whole life span
- Multiple environmental impacts



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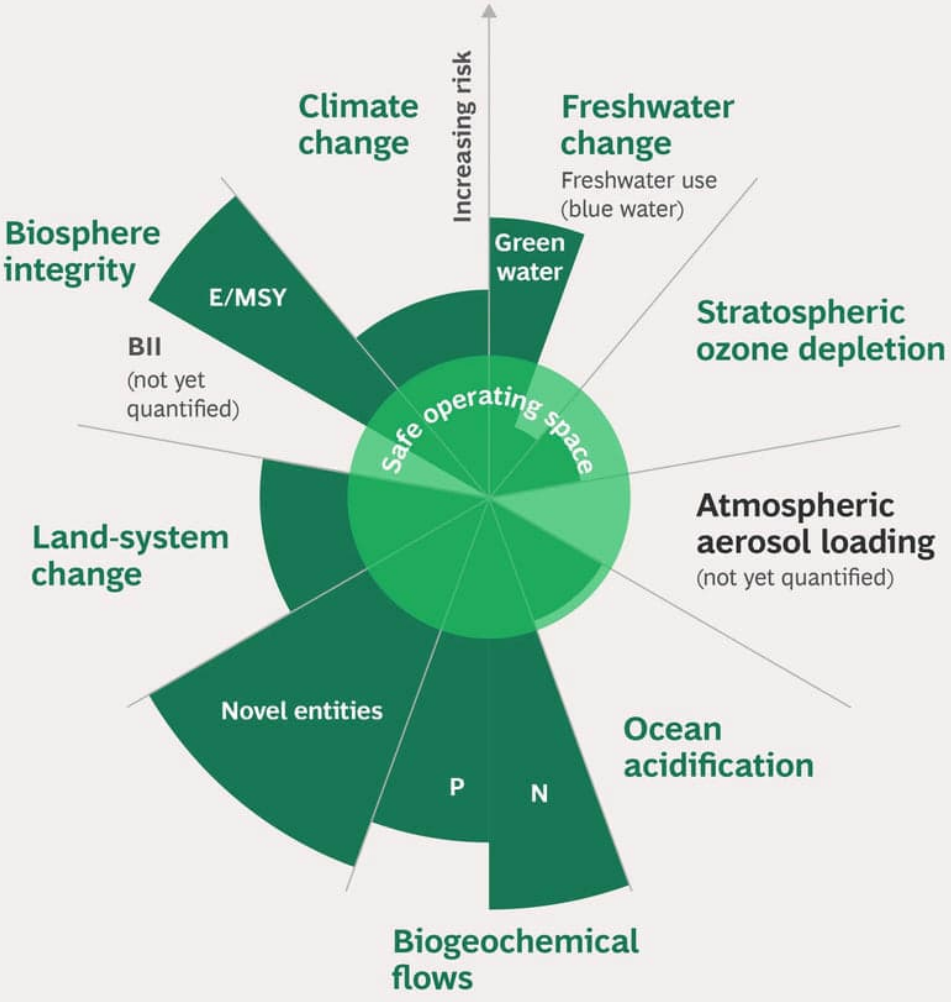
Impacts assessed by LCA

- Global warming potential
  - Fossil fuels
  - Biogenic
  - LULUCF
- Ozone depletion potential
- Acidification potential
- Eutrophication potential
- Photochemical ozone formation
- Abiotic depletion potential
  - Fossil
  - Non-fossil
- Ecotoxicity freshwater
- Human toxicity
  - Carcinogetic
  - Non-carcinogetic
- Particulate matter
- Soil quality index
- Water depletion potential
- Use of resources (energy, ...)
- Generation of waste streams
- Environmental Cost Indicator
  - MKI (€)
  - PEF (points)

The Nine Planetary Boundaries



Standard: ISO 14044 and ISO 14040

1 2 3 4

Goal and scope

e.g. LCA of a car of typology X, assuming a use for Y years, produced in country Z, ect.

LCI - Life Cycle Inventory

For each stage of a product life cycle (e.g. resource extraction, manufacturing, use, etc.) data on **emissions into the environment** (e.g. CO_2, benzene, organic chemicals) and **resources used** (e.g. metals, crude oil) are collected in an inventory.

Each emission in the environment and resource used are then characterised in term of potential impact in the LCIA, covering a number of impact categories.

LCIA - Life Cycle Impact Assessment

CLIMATE CHANGE

EUTROPHICATION

LAND USE

RESOURCE DEPLETION

ACIDIFICATION

OZONE DEPLETION

ECOTOXICITY

IONISING RADIATION

PHOTOCHEMICAL OZONE FORMATION

WATER DEPLETION

HUMAN TOXICITY

Areas of protection

- Human health
- Ecosystem health
- Natural resources

Interpretation

Concepts

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LCA for a specific product of a certain size or mass

- e.g. 1 ton of sand

High level of standardisation

- Claim of environmental impact
- Comparibility with other EPDs

National and international databases

- Public accessibility on external platforms
- Environdec, B-EPD, NMD

3rd party verification process to ensure credibility

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EPD process in a nutshell

1 → 2 → 3 → 4 → 5

START Select or develop PCR	Conduct LCA according PCR	Transfer LCA into EPD format	LCA/EPD verification	EPD registration and publication
• Product Category Rules • Standard/Norm • Eg: EN15804 (construction products)			• By independent party	• Not mandatory • Higher credibility • Registration fee

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Registered EPD benefits

- The data will be part of an open (inter)national **database**
- The product **can be found more easily**
- The product **can be compared more easily** based on ecological impact
- The producer proves **transparancy** on sustainability to stakeholder

Databases

- EPD International
- B-EPD
- Nationale Milieudatabase

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Environmental Impacts

Environmental indicators	PRODUCT STAGE	CONSTRUCTION STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE LIFE CYCLE
	A1 / A2 / A3	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
Climate Change [kg CO2 eq.]	1.41E+01	3.62E-01	1.40E+00	0	0	0	0	0	0	0	4.47E-03	5.06E-02	0.00E+00	2.06E-01	-3.44E-02
Climate Change (fossil) [kg CO2 eq.]	1.51E+01	3.58E-01	3.31E-01	0	0	0	0	0	0	0	4.47E-03	5.00E-02	0.00E+00	2.06E-01	-3.47E-02
Climate Change (biogenic) [kg CO2 eq.]	-1.06E+00	9.48E-04	1.07E+00	0	0	0	0	0	0	0	5.63E-07	1.34E-04	0.00E+00	0.00E+00	3.70E-04
Climate Change (land use change) [kg CO2 eq.]	4.61E-03	3.36E-03	1.27E-04	0	0	0	0	0	0	0	5.03E-07	4.61E-04	0.00E+00	6.49E-04	-1.72E-05
Ozone depletion [kg CFC-11 eq.]	1.09E-05	3.18E-14	2.18E-07	0	0	0	0	0	0	0	7.10E-11	6.47E-15	0.00E+00	5.31E-13	-2.78E-10
Acidification terrestrial and freshwater [Mole of H+ eq.]	2.79E-02	4.12E-04	6.18E-04	0	0	0	0	0	0	0	4.14E-05	6.33E-05	0.00E+00	1.48E-03	-1.34E-04
Eutrophication freshwater [kg P eq.]	3.91E-04	1.32E-06	8.87E-06	0	0	0	0	0	0	0	1.37E-07	1.82E-07	0.00E+00	4.20E-07	-6.39E-06
Eutrophication marine [kg N eq.]	6.94E-03	1.41E-04	1.85E-04	0	0	0	0	0	0	0	1.92E-05	2.22E-05	0.00E+00	3.83E-04	-2.06E-05
Eutrophication terrestrial [Mole of N eq.]	9.79E-02	1.66E-03	2.15E-03	0	0	0	0	0	0	0	2.09E-04	2.59E-04	0.00E+00	4.21E-03	-2.40E-04
Photochemical ozone formation - human health [kg NMVOC eq.]	2.16E-02	3.58E-04	4.90E-04	0	0	0	0	0	0	0	6.18E-05	5.55E-05	0.00E+00	1.15E-03	-1.53E-04
Resource use, mineral and metals [kg Sb eq.][1]	1.09E-05	2.36E-08	2.44E-07	0	0	0	0	0	0	0	1.56E-09	3.30E-09	0.00E+00	9.65E-09	-8.94E-08
Resource use, energy carriers [MJ][1]	2.22E+02	4.94E+00	4.61E+00	0	0	0	0	0	0	0	5.83E-02	6.78E-01	0.00E+00	2.78E+00	-1.30E+00
Water deprivation potential [m³ world equiv.][1]	2.34E+00	4.19E-03	5.03E-02	0	0	0	0	0	0	0	1.97E-04	6.01E-04	0.00E+00	2.29E-02	-1.98E-02

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Environmental Cost Indicator (ECI)

Single score to indicate the environmental impact, based on **LCA outcome**

MKI (milieukostindicator)

- Expressed in **Euro**
- **Shadow cost:** what would be the societal cost to restore the environmental impact of this product
- Implementation in Nationale Milieu Database (**NMD**, **database** with ECI of various products and materials) and **DuboCalc** (**calculation tool** to calculate an integrated ECI of a project based on materials and components in NMD database)
- Mainly used in the **Netherlands**

PEF (product environmental footprint) weighting

- Expressed in **mPt**
- Used in **TOTEM calculation tool** (~ Belgian DuboCalc, based on B-EPD)

Environmental impact indicator	Weight factors	Unit	Result
Abiotic depletion, non fuel (AD)	0,16	kg Sb eq	€ 0,00
Abiotic depletion, fuel (AD)	0,16	kg Sb eq	€ 0,16
Global warming (GWP)	0,05	kg CO2 eq	€ 7,43
Ozone layer depletion (ODP)	30	kg CFC-11 eq	€ 0,00
Photochemical oxidation (POCP)	2	kg C2H4	€ 0,15
Acidification (AP)	4	kg SO2 eq	€ 2,06
Eutrophication (EP)	9	kg PO4--- eq	€ 0,93
Human toxicity (HT)	0,09	kg 1,4-DB eq	€ 3,37
Ecotoxicity, fresh water (FAETP)	0,03	kg 1,4-DB eq	€ 0,04
Ecotoxcity, marine water (MAETP)	0,0001	kg 1,4-DB eq	€ 0,33
Ecotoxicity, terrestric (TETP)	0,06	kg 1,4-DB eq	€ 0,10
Total ECI			**€14,57**

Concepts

When to use which methodology

Use cases for PCF, LCA, EPD & ECI

Sustainability & Compliance → Refine your Scope 3 emissions

Product development/ R&D → Make the product more sustainable

Supply chain management → Compare your suppliers

Marketing & Sales → Differentiate yourself, make a product claim

Companies

Executive / Strategic planning → *Incorporate sustainability in businesses*

Policy making → *Make substantiated decisions on environmental policy*

Governments

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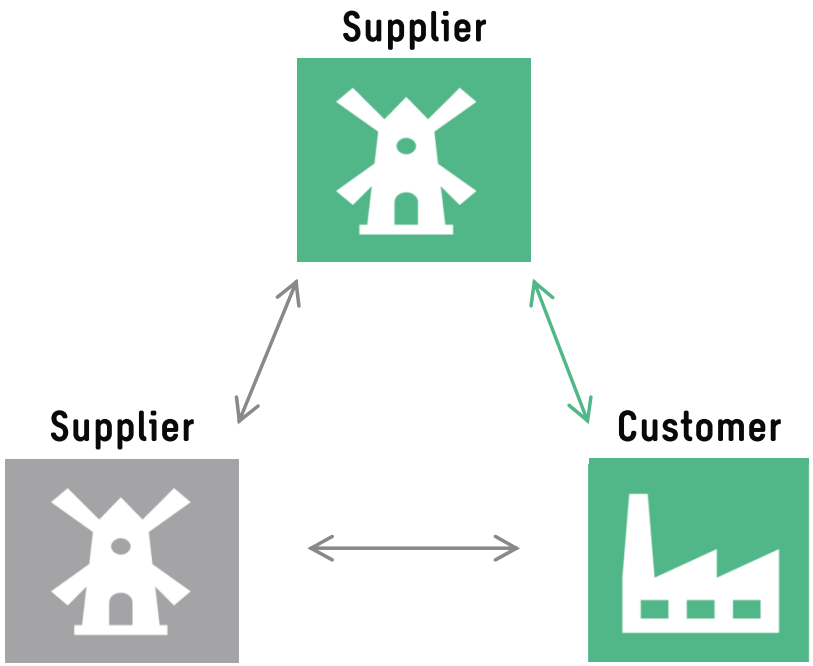
Example Situation for **Scope 3 Calculation**



Sustainability & Compliance
Refine your Scope 3 emissions

GOAL

- Get **more accurate** information on your indirect emissions
- Engage with suppliers on emission reduction

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Example Situation for **Scope 3 Calculation**

ecoinvent

defra
Department for Environment Food and Rural Affairs

AGRIBALYSE

ADEME
AGENCE DE LA TRANSITION ÉCOLOGIQUE

CarbonCloud

Supplier

Supplier-Specific (SS) Product
Emissions: 3.5 **kg CO2eq/kg product**

Customer

Average **Upstream Scope 3**
e.g. 1.000 kg bought **x 5 kg CO2eq/kg product**
= 5.000 kg CO2eq

Upstream Scope 3 of your Supplier
e.g. 1.000 kg bought **x 3.5 kg CO2eq/kg product (DB)**
= 3.500 kg CO2eq

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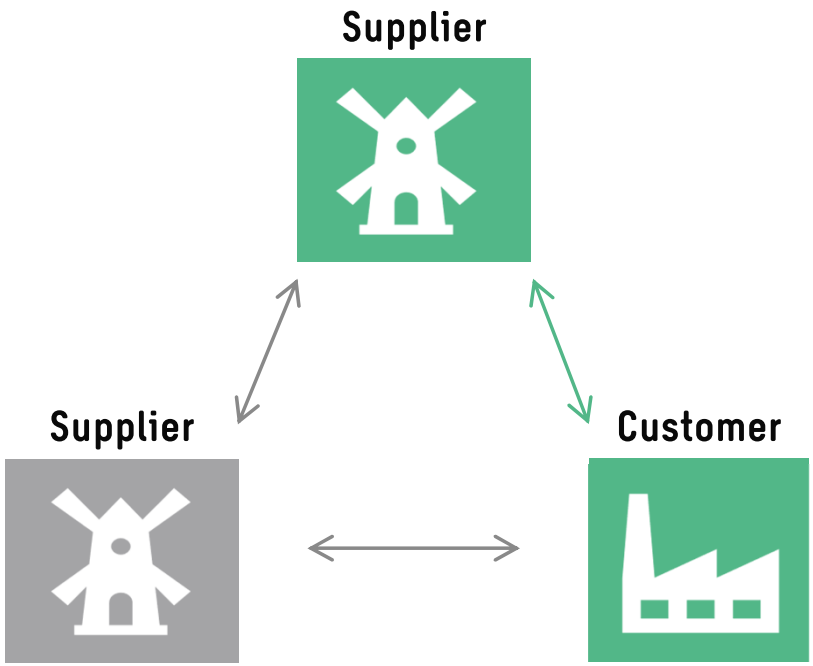
Example Situation for **Scope 3 Calculation**



Sustainability & Compliance
Refine your Scope 3 emissions

GOAL

- Get **more accurate** information on your indirect emissions
- Engage with suppliers on emission reduction

METHODOLOGY

- PCF
- LCA
- EPD

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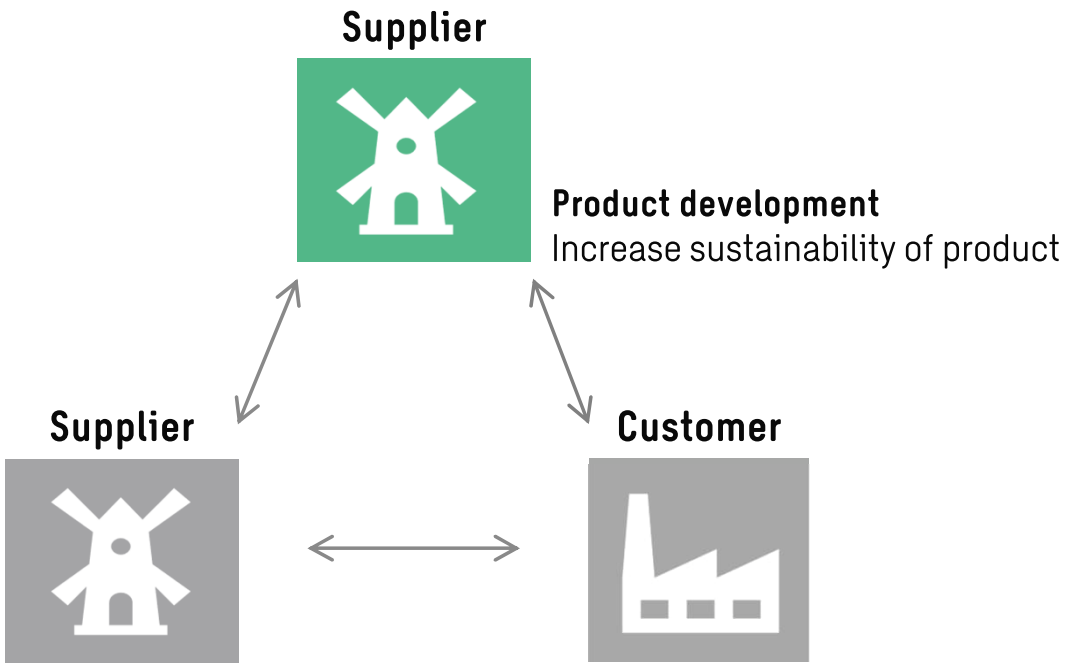
Example Situation for Optimization & Hotspot/Portfolio Analysis



GOAL

- **Internal improvement**:
  which product/ life cycle stage / input was most impactful?

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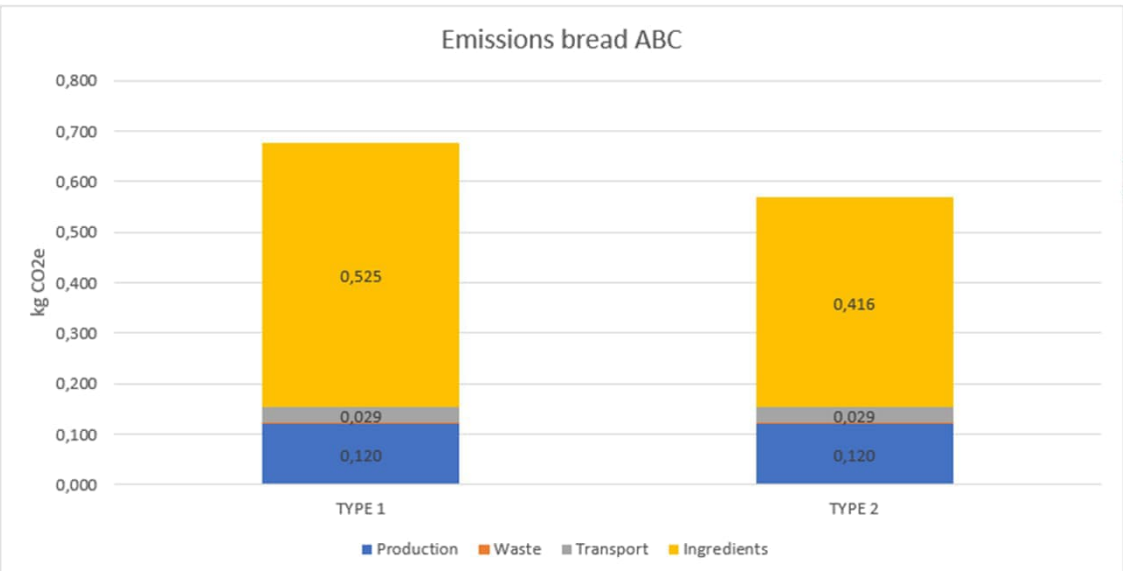
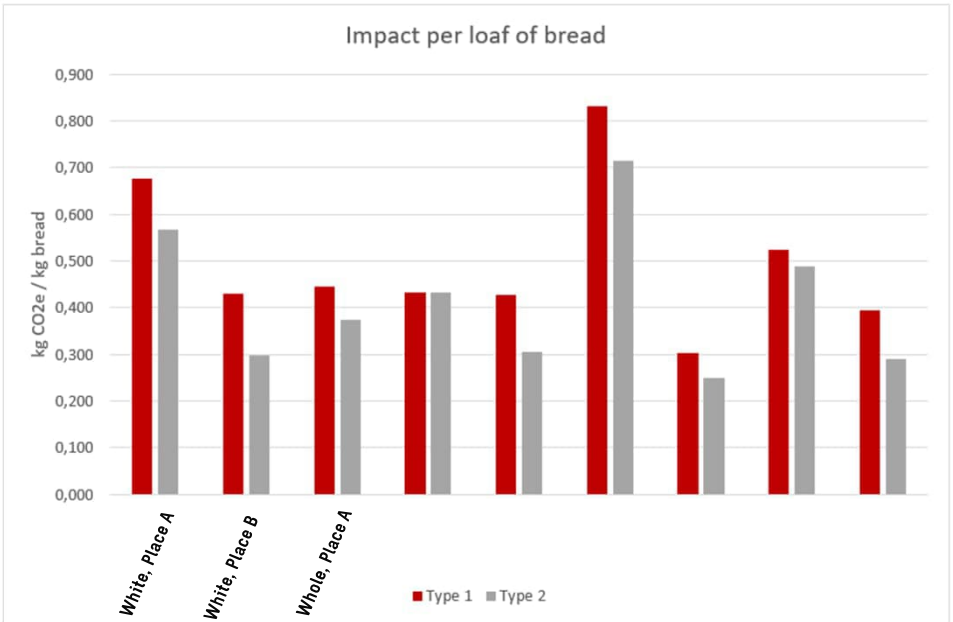
Example Situation for Optimization & Hotspot/Portfolio Analysis





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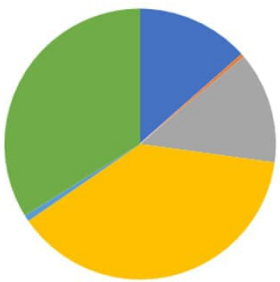
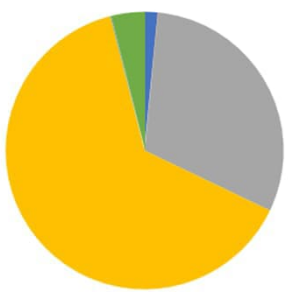
Example Situation for Optimization & Hotspot/Portfolio Analysis

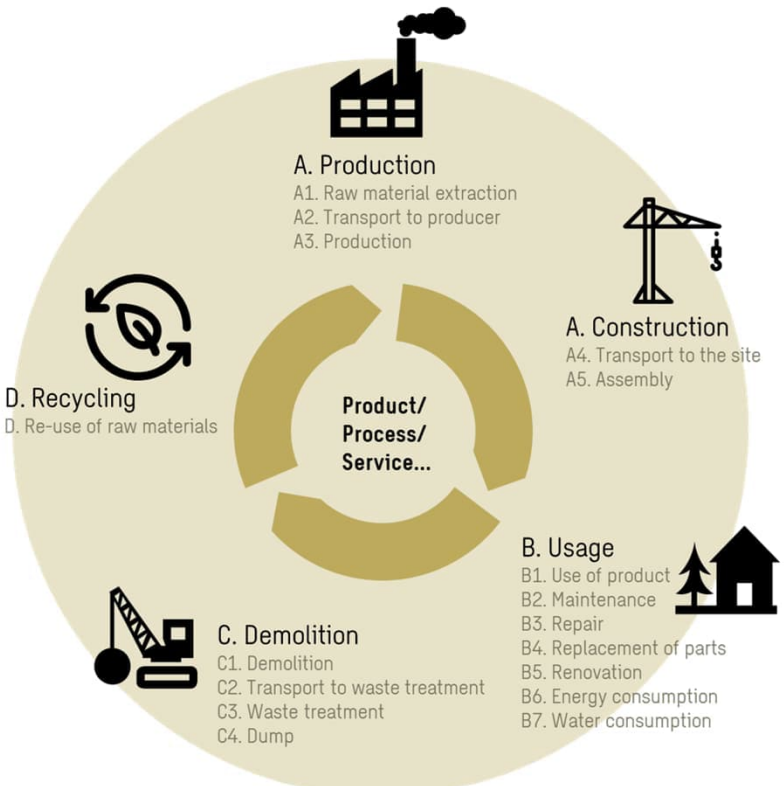
Climate change (kg CO2-eq)



ECI (€)



- C1 – Demolition
- C2 – Transport to waste treatment
- C3 – Waste treatment
- A1 – Raw material acquisition
- A2 – Transport to producer
- A3 – Production



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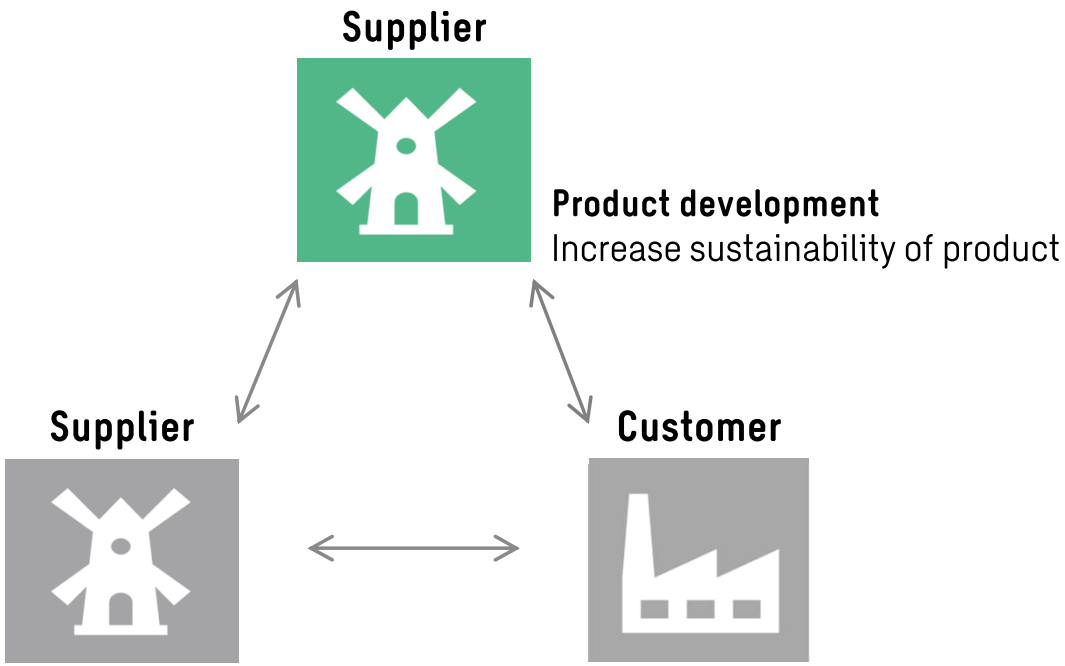

GOAL

- **Internal improvement**:
  which product/ life cycle stage / input was most impactful?

METHODOLOGY

- LCA
- PCF
- EPD

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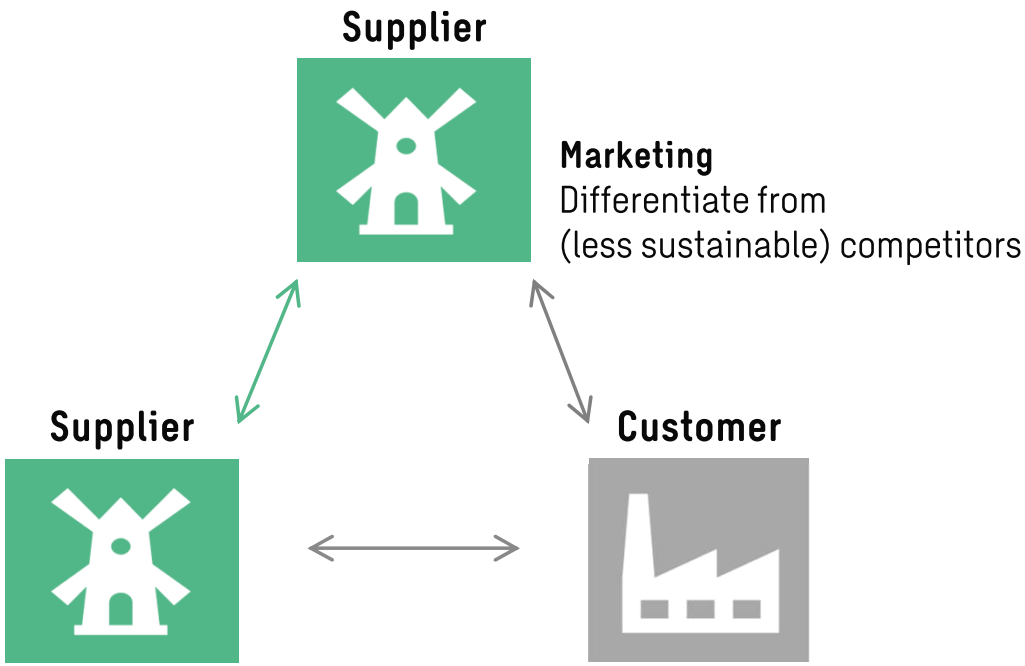
Example Situation for **Market Differentiation**



GOAL

- **Claim;** can be compared with other PCFs or EPDs within it's database

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Market Differentiation

Company Challenges:

- Explicit need for an EPD due to competition pressure

Actions:

- Modelling of impacts with specialized software (SimaPro, GaBi, Oneclick)

Results:

- Resulting impacts of the product are provided for each life cycle stage
- Comparison possible within same standards, ensuring comparability by external partner

Environmental Impacts

Environmental indicators	PRODUCT STAGE	CONSTRUCTION STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE LIFE CYCLE
	A1 / A2 / A3	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling
Climate Change [kg CO2 eq.]	1.41E+01	3.62E-01	1.40E+00	0	0	0	0	0	0	0	4.47E-03	5.06E-02	0.00E+00	2.06E-01	-3.44E-02
Climate Change (fossil) [kg CO2 eq.]	1.51E+01	3.58E-01	3.31E-01	0	0	0	0	0	0	0	4.47E-03	5.00E-02	0.00E+00	2.06E-01	-3.47E-02
Climate Change (biogenic) [kg CO2 eq.]	-1.06E+00	9.48E-04	1.07E+00	0	0	0	0	0	0	0	5.63E-07	1.34E-04	0.00E+00	0.00E+00	3.70E-04
Climate Change (land use change) [kg CO2 eq.]	4.61E-03	3.36E-03	1.27E-04	0	0	0	0	0	0	0	5.03E-07	4.61E-04	0.00E+00	6.49E-04	-1.72E-05
Ozone depletion [kg CFC-11 eq.]	1.09E-05	3.18E-14	2.18E-07	0	0	0	0	0	0	0	7.10E-11	6.47E-15	0.00E+00	5.31E-13	-2.78E-10
Acidification terrestrial and freshwater [Mole of H+ eq.]	2.79E-02	4.12E-04	6.18E-04	0	0	0	0	0	0	0	4.14E-05	6.33E-05	0.00E+00	1.48E-03	-1.34E-04
Eutrophication freshwater [kg P eq.]	3.91E-04	1.32E-06	8.87E-06	0	0	0	0	0	0	0	1.37E-07	1.82E-07	0.00E+00	4.20E-07	-6.39E-06
Eutrophication marine [kg N eq.]	6.94E-03	1.41E-04	1.85E-04	0	0	0	0	0	0	0	1.92E-05	2.22E-05	0.00E+00	3.83E-04	-2.06E-05
Eutrophication terrestrial [Mole of N eq.]	9.79E-02	1.66E-03	2.15E-03	0	0	0	0	0	0	0	2.09E-04	2.59E-04	0.00E+00	4.21E-03	-2.40E-04
Photochemical ozone formation - human health [kg NMVOC eq.]	2.16E-02	3.58E-04	4.90E-04	0	0	0	0	0	0	0	6.18E-05	5.55E-05	0.00E+00	1.15E-03	-1.53E-04
Resource use, mineral and metals [kg Sb eq.][1]	1.09E-05	2.36E-08	2.44E-07	0	0	0	0	0	0	0	1.56E-09	3.30E-09	0.00E+00	9.65E-09	-8.94E-08
Resource use, energy carriers [MJ][1]	2.22E+02	4.94E+00	4.61E+00	0	0	0	0	0	0	0	5.83E-02	6.78E-01	0.00E+00	2.78E+00	-1.30E+00
Water deprivation potential [m³ world equiv.][1]	2.34E+00	4.19E-03	5.03E-02	0	0	0	0	0	0	0	1.97E-04	6.01E-04	0.00E+00	2.29E-02	-1.98E-02

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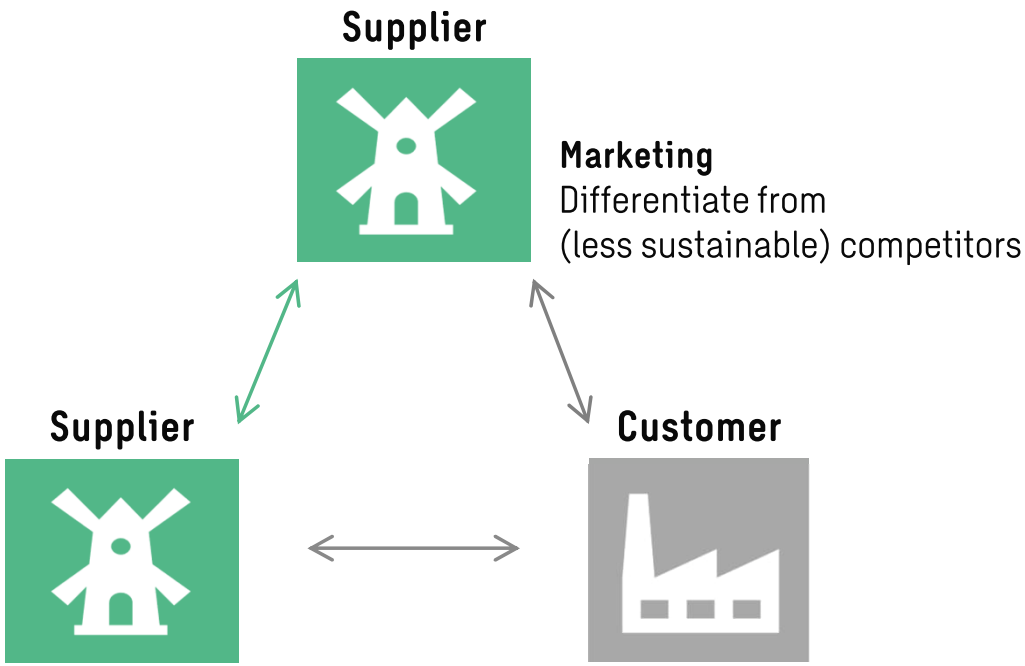
Example Situation for **Market Differentiation**



GOAL

- **Claim;** can be compared with other PCFs or EPDs within it's database

METHODOLOGY

- EPD
- LCA*
- PCF*

* if same standard and third party verified.
This is by default the case for EPD

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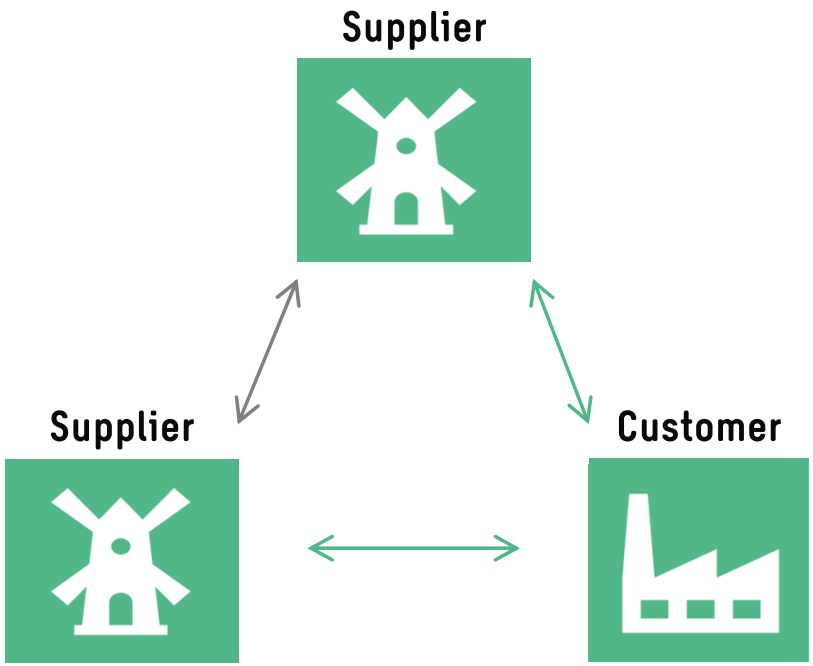
Example Situation for **Comparing Suppliers**



GOAL

- **Comparing two products:** which product has a lower impact?

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Comparing suppliers

Scope

- Water sanitation (specifically, PFAS treatment)
- 1 m^3 of water treated

Goal: compare different techniques

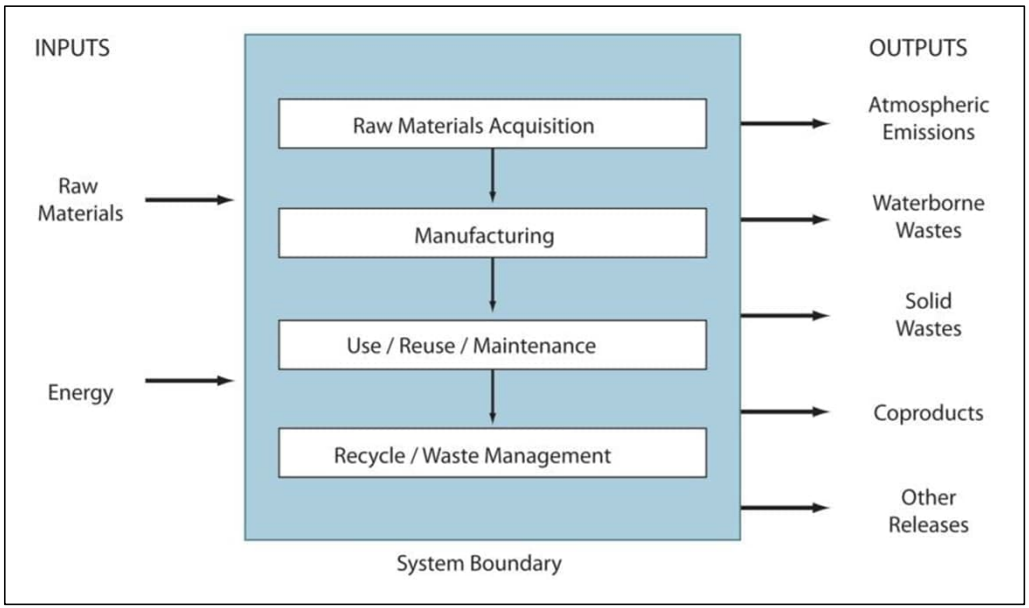
- Company A treats the water with activated carbon
- Company B uses membrane technology and a mix of chemicals
- Company C uses resins and chemicals
- Company D uses a photochemical technique (high energy use)

Method

- Standard - PCR UNCPC94413 Site Remediation
- Inventory of all inputs and outputs requested for each company

Interpretation

- Resulting impacts of each technique
- Comparison on impacts to aid procurement



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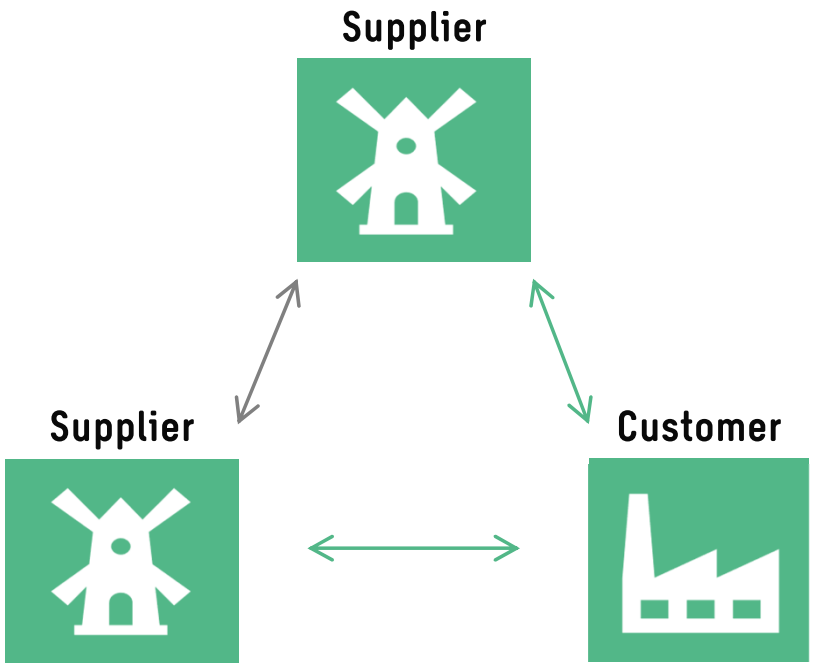
Example Situation for **Comparing Suppliers**



GOAL

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- LCA*
- PCF*

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This is by default the case for EPD

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Conclusion

Recap & pitfalls

Conclusion - Recap / Pitfalls (!)

- No Silver Bullet
- Be aware of the shortcomings of the multiple methods, compare apples with apples
  - When receiving a PCF/*LCA*: ask about boundary; categories included/excluded; standard ; (third party) verification
- Be pragmatic, consider your company and sector context
- Communicate with your external stakeholders on their exact needs

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Bonus Use Case

Zeelandia

Zeelandia: Market Pressure with 5k+ products

Company Profile:

- Producer of baking goods (bread mixes, pastries and fillings)
- Operating world-wide in 23 countries with 3.200 employees and HQ in Zierikzee, NL
- 5000+ types of raw materials, 5000+ different products

Company Challenges:

- Scope 3 Corporate Carbon Footprint calculation
- Market pressure from customers → Product emissions are needed urgently

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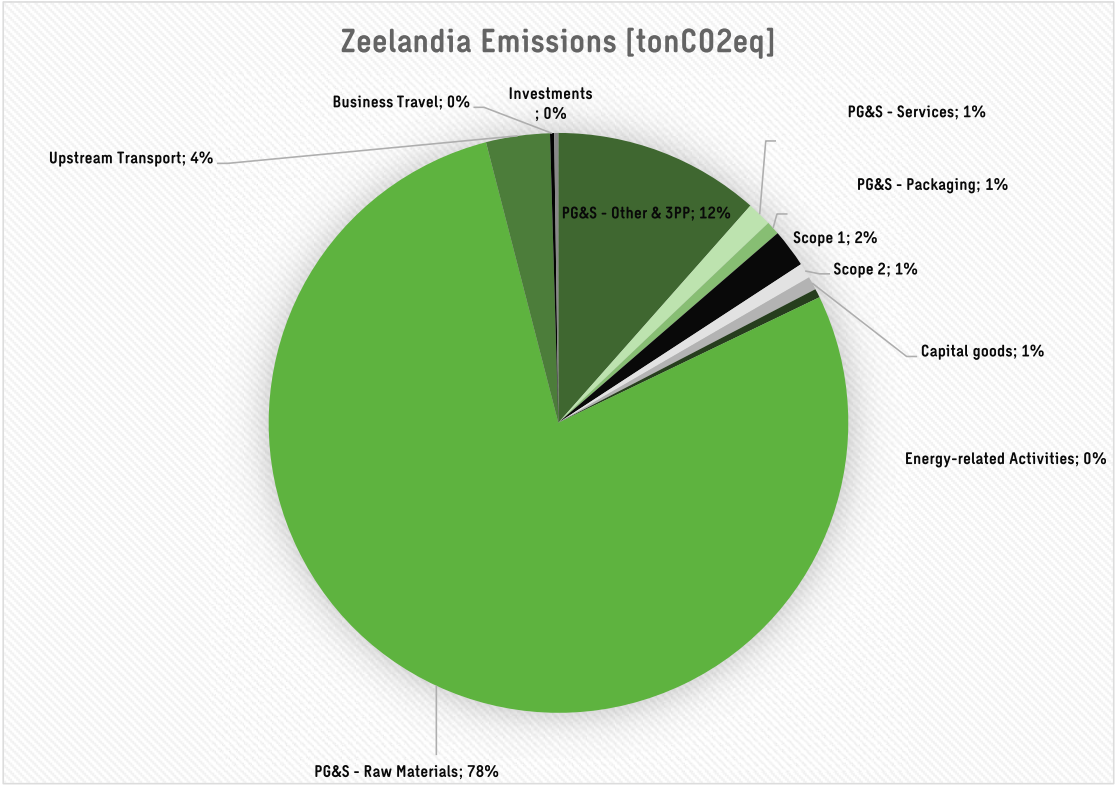

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Company Challenges:

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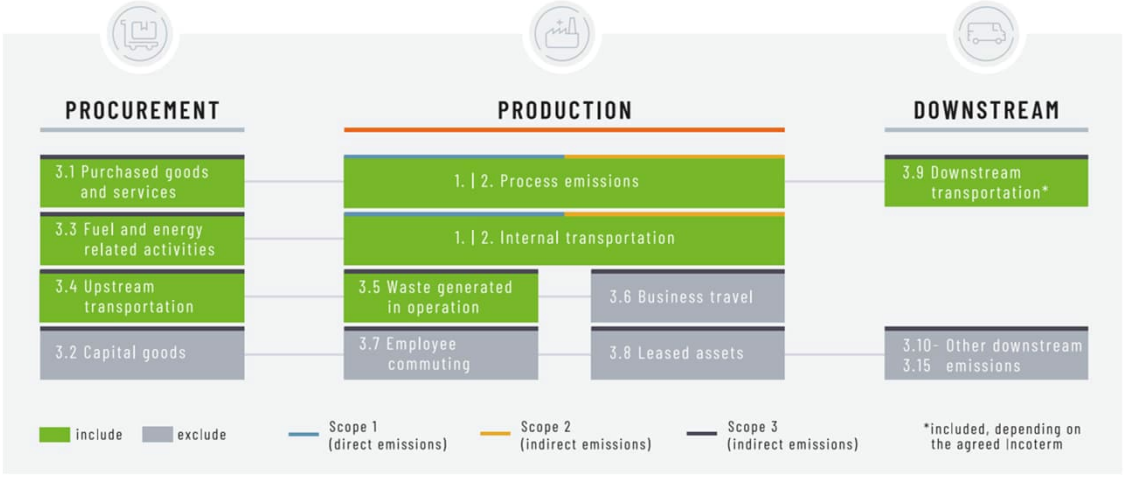
- **Market pressure from customers → Product emissions are needed urgently**

> I need to have your **CO2** calculation within a year, **otherwise we will go to another supplier. Your competitor already has this calculated**"

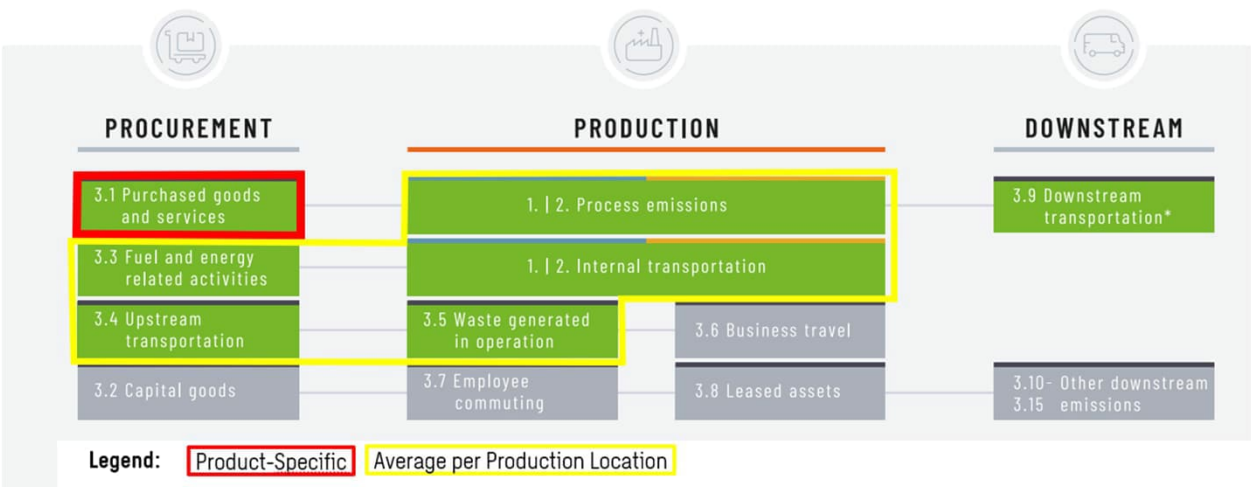


Zeelandia: Market Pressure with 5k+ products

Zeelandia

Short-Term Solution

1. **PCF** XLS Calculator focussing on the raw materials / ingredients
    1. **Scoping & Boundary**
    2. Granularity level → Selection of 120 representative EF's
    3. Compliant GHGP Report, Dashboarding



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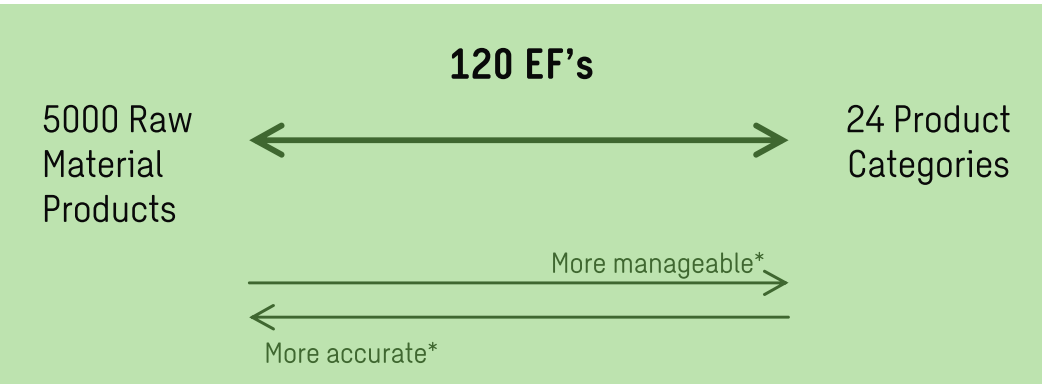

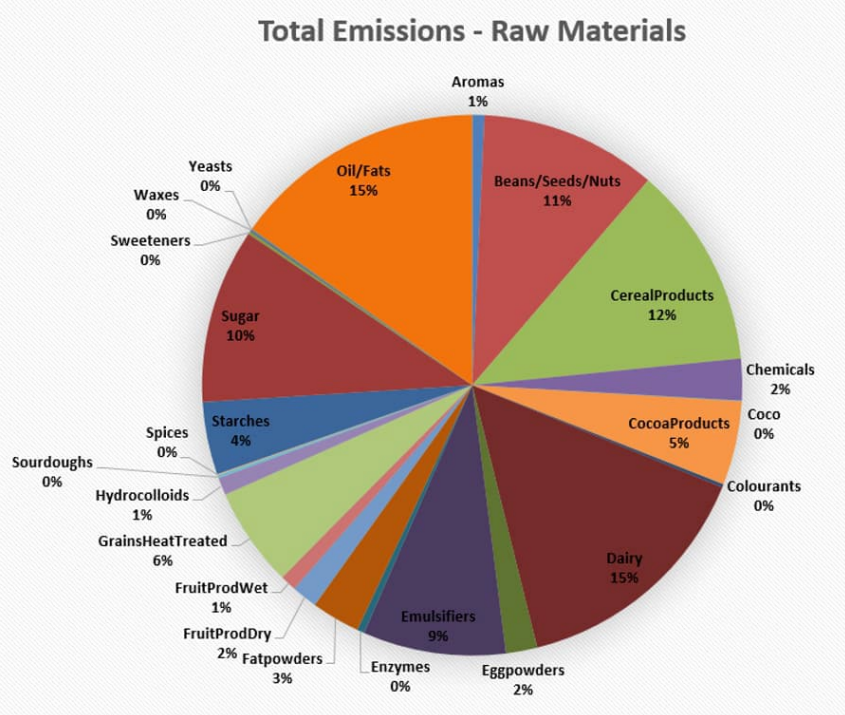

Zeelandia: Market Pressure with 5k+ products

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1. **PCF** XLS Calculator focussing on the raw materials / ingredients
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A. Enter Ingredients & Match on EF

	Total Volume Produced [KGs]		KGs
Quantity of Raw Material Used [KGs]	SELECT_Product_Group	SELECT_Product_Type	SELECT_EF_Code
	Enzymes	Enzymes	EF_Food_
	Beans/Seeds/Nuts	Seeds - Sesame	EF_Seed_
	Emulsifiers	Nutrisoft van BASF	EF_Mono
	Oil, fats	Other - General Oils	EF_Comb oils)_
	Starches	Corn Starch	EF_Corn_
	Sugar	Saccharose	EF_Beet_
	Chemicals	Salt	EF_Salt_
	Aromas	Aromas	EF_Food_
	Cereal products	Gluten	EF_Glute
	Cereal products	Barley	EF_Barle
	Grains heat treated	Grain corn	EF_Grain ditional_
	Cereal products	Rye (rogge)	EF_Rye_r
	Beans/Seeds/Nuts	Seeds - Sunflower	EF_Seed_
	Oil, fats	Other - General Oils	EF_Comb oils)_
	Yeasts	Yeasts	EF_Nutrit
	Other	Other	EF_Zeela
	Cereal products	Spelt	EF_spelt_
NA	Packaging	Bags	Bags_Piece_NL02

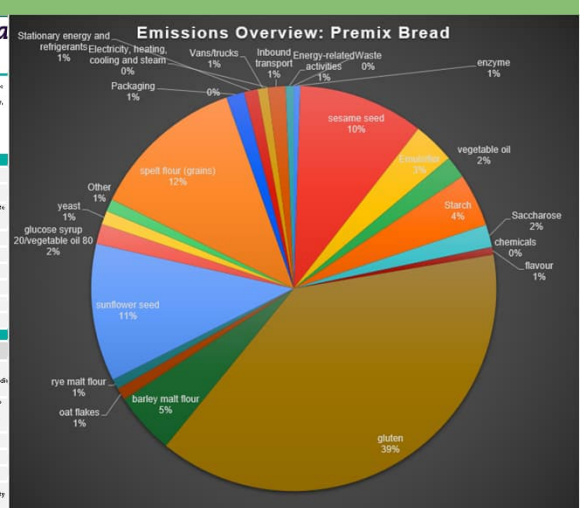
B. Results: official report documentation + Dashboard

Zeelandia

Product carbon footprint Premix Bread

This carbon footprint was calculated by Futureproofed following the reporting requirements of the Product Standard of Greenhouse Gas Protocol.
The study was performed based on the key accounting principles of Greenhouse Gas Protocol, with attention for relevance, accuracy, completeness, consistency and transparency.
Please contact us if any relevant information is missing or if more insights are required on how this assessment was completed.

General information and scope	
Contact information	Zeelandia, Jolita Oomz - jolita.oomz@zeelandia.com
Studied product name	Premix Bread
Studied product description	Premix Bread produced on the site of Netherlands: ZNLD and sold from the site of Zeelandia Belgium- Wommelgem Intermediate Product
Unit of analysis	1 kg of Premix Bread
Reference flow	Equal to unit of analysis
Type of inventory	Cradle to gate inventory
Inventory date	Inventory finalized in 2025 using data for 2024
Version	Version 1
Disclaimer	The results of this calculation are specific to Premix Bread produced at Netherlands: ZNLD and sold from Zeelandia Belgium- Wommelgem
Boundary setting	
Life cycle stage	Brief description of the boundary of each life cycle stage.
Material acquisition and preprocessing	All upstream emissions and removals related to raw materials and packaging materials purchased and used in the production process of Premix Bread, excluding the transportation of these materials from tier 1 suppliers to Zeelandia and between sites of Zeelandia.
Production	All emissions generated on site from combustion of fossil fuels and related to purchased electricity (location based). No other fugitive emissions. No removals. Incl Energy-related Activities category. Incl all emissions related to operational waste processing from production at the producing site.
Distribution and storage	Not included (cradle-to-gate calculation)
Use	Not included (cradle-to-gate calculation)
End-of-life	Not included (cradle-to-gate calculation)
Process map	A process map was created to access all relevant attributional material and energy flows. This map is however not publicly disclosed due to confidentiality reasons. Given the wide variation of products created by Zeelandia, 2 general process maps were created based on the type of product.



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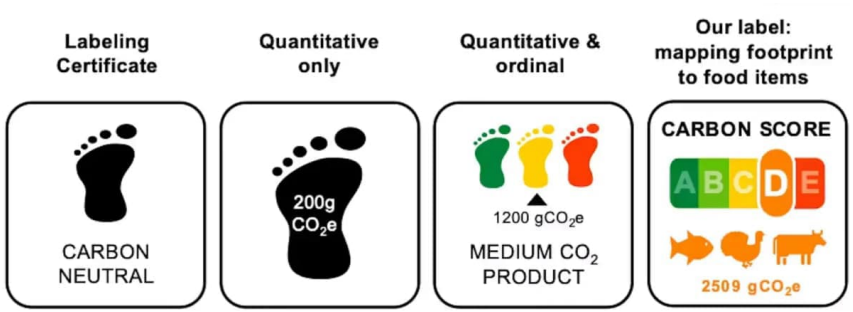
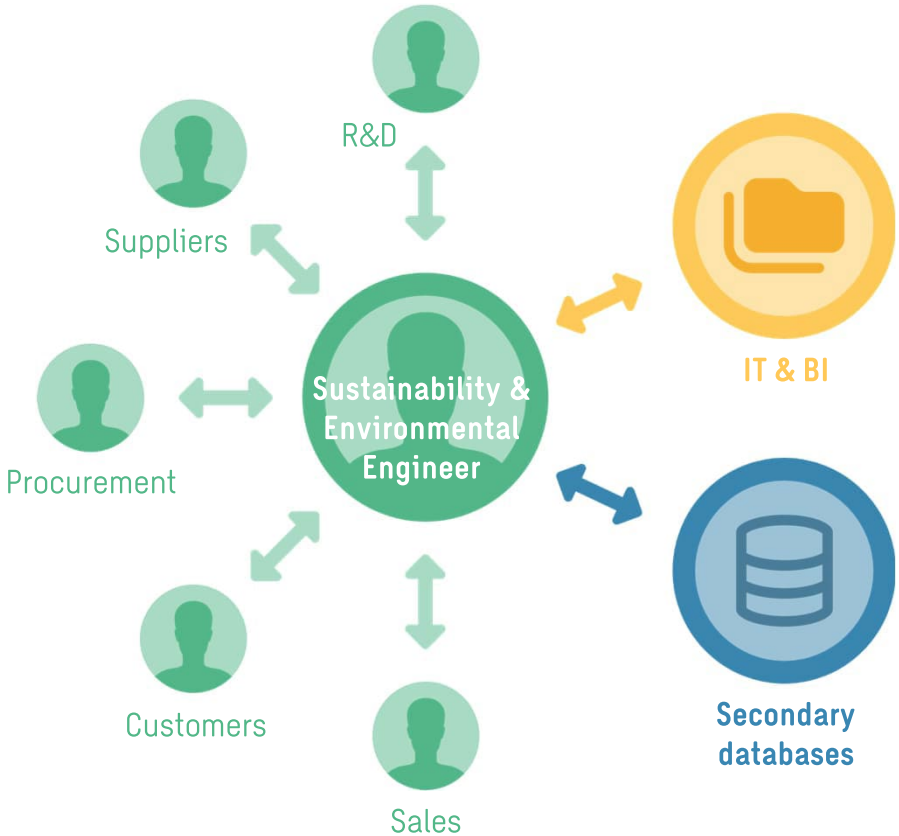
Zeelandia: Market Pressure with 5k+ products

Zeelandia

Next Steps

1. **Learning from PCF examples**
2. **Supplier-specific** Emission Factors & more accurate information
3. **Automation & Integration**





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Stijn Verdoodt

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Plan a meeting

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