Integrated Corporate Carbon Accounting

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Assessing Corporate CO_2 Emissions

Two fundamental questions:

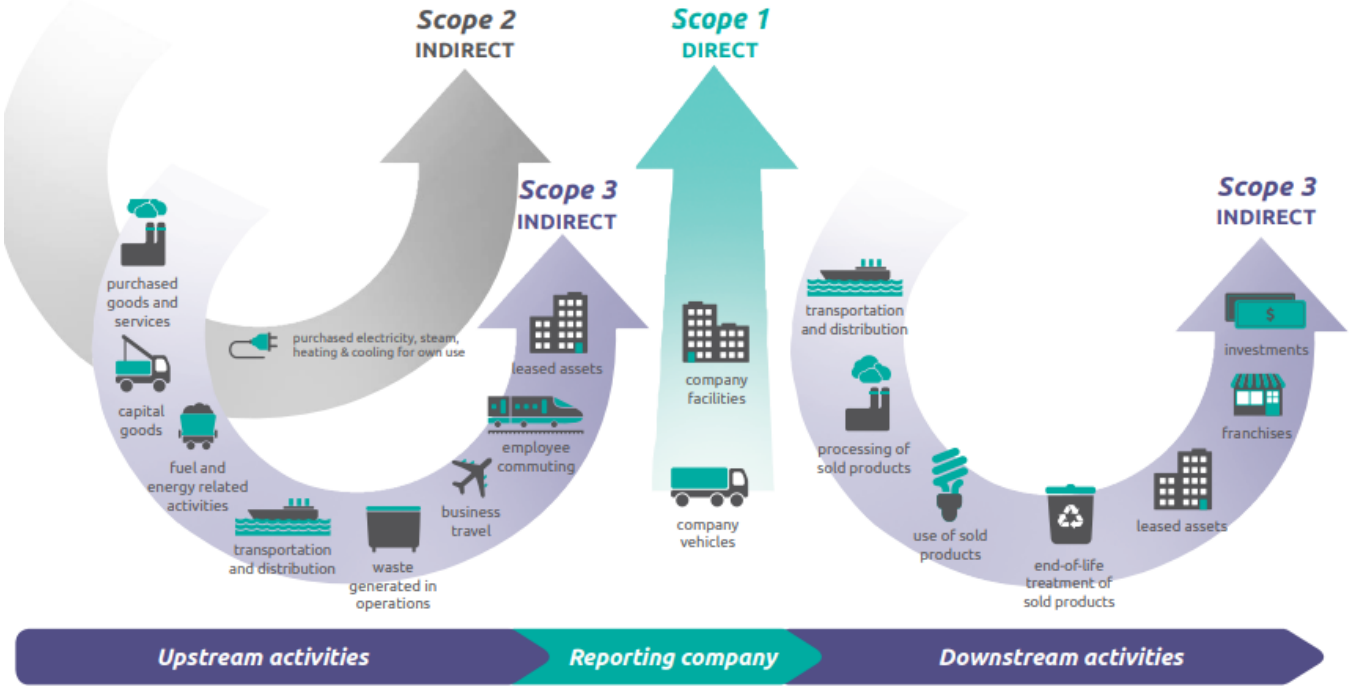
First:

What is the scope of carbon emissions a company is responsible for?

Second:

Do companies need an in-house carbon accounting system to assess their Corporate Carbon Footprint (CCF)?

Greenhouse Gas (GHG) Protocol



Source: WBCSD

Frequently Voiced Concerns:

Implementation uneven, inconsistent and incomplete in practice

No proper distinction between stock and flow variables

Reliance on secondary rather than primary data reflecting actual emissions

Demand for Integrated Corporate Carbon Accounting

Reporting mandates for CO_2 emissions in multiple jurisdictions:

- Britain: Companies Act of 2013
  → Directors' Report to include Scope 1 & 2 emissions
- EU: CSRD→ Scope 1, 2 & 3 emissions (to be phased in)
- California: SB 253/261→ Scope 1, 2 & 3 emissions (to be finalized)

Policy support tied to assessed carbon intensity of products

- EU: Carbon Border Adjustment Mechanism→ in 2026
- U.S. IRA: Production Tax Credits for low carbon products
  → Example: Hydrogen

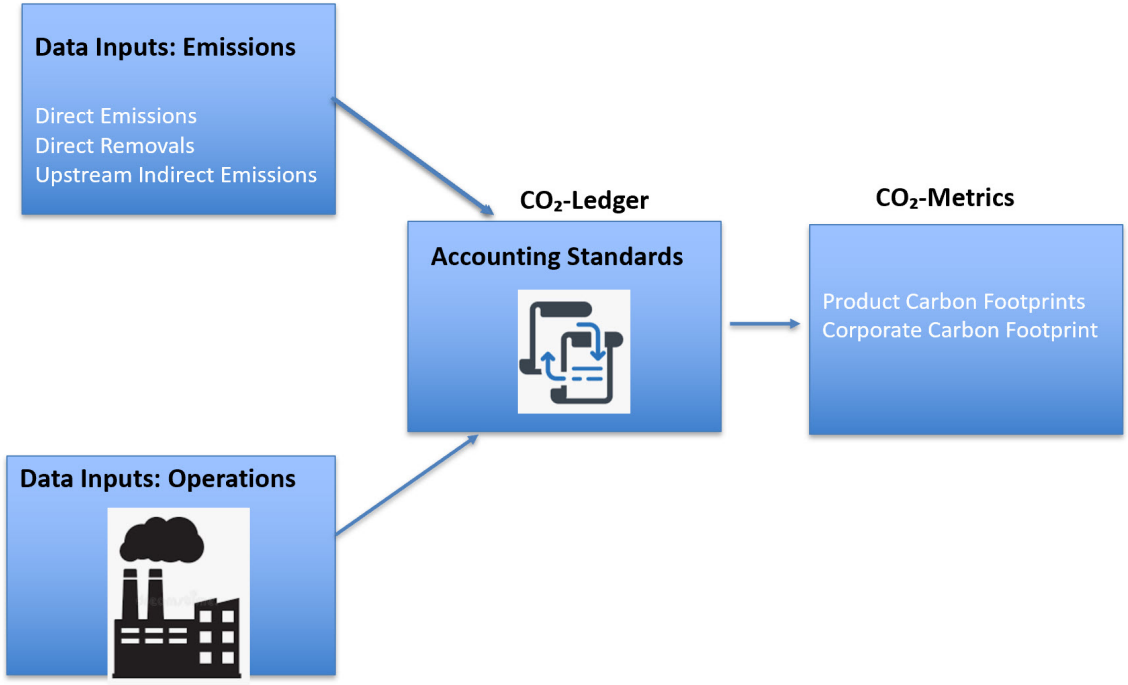
Demand for Integrated Corporate Carbon Accounting

Voluntary carbon disclosures:

- Most Fortune 500 companies have issued "Net-zero by 20xx" pledges
  FAQ: What's the metric? Is the company on track to meet its pledge? At least meet certain interim milestone targets?
- Consumers and corporate customers increasingly demand reliable emissions information at the product level
  → Continuing concerns about "Greenwashing"

Internal reporting: Carbon accounting as a management tool for steering corporate decarbonization efforts

Integrated Corporate Carbon Accounting



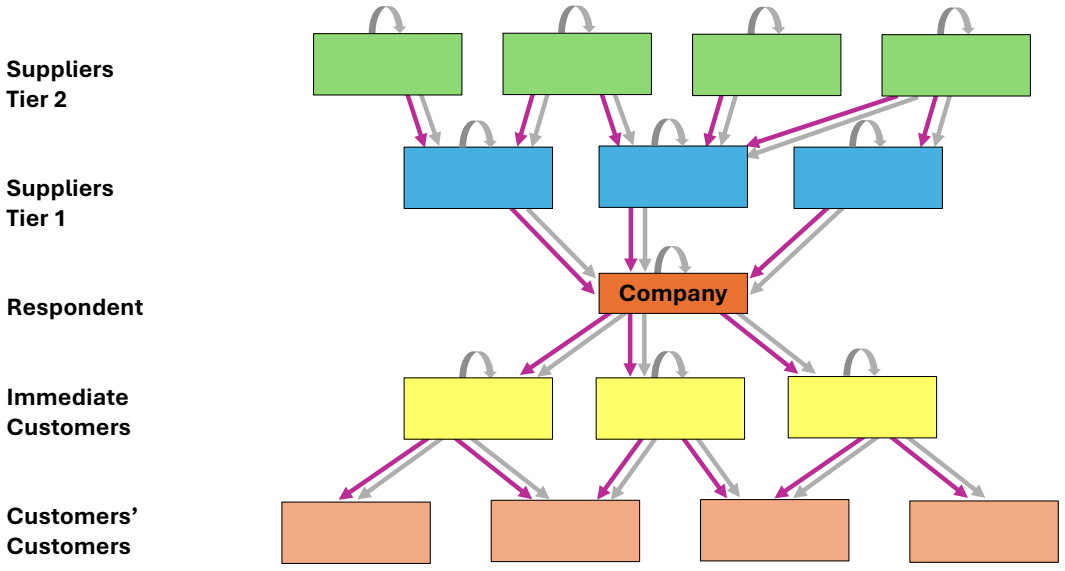
Source: Reichelstein et al. (2025)

Integration Criteria:

i) CCF and PCFs determined from the same data sources and according to one consistent set of accounting standards.

ii) CCF metric to include the direct and indirect emissions incurred in order to deliver the entity's products and services in the current period

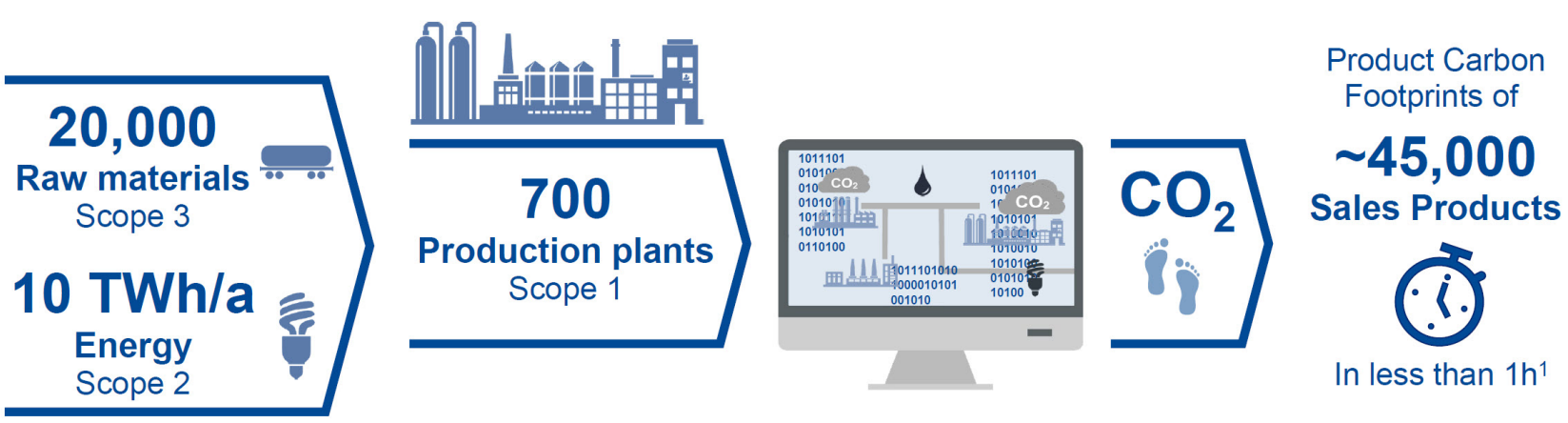
Product Carbon Accounting: Cradle-to-Gate PCFs



Purple arrows: Flow of goods and services
Grey arrows: "Carbon Tags" representing PCFs
Grey loops: Periodic Scope 1 emissions

- Possibly supplement cradle-to-gate PCFs with estimates of use-phase emission of products

Strategic CO_2 Transparency Tool (SCOTT) at BASF



Source: BASF (2021)

- Currently a minority of BASF's suppliers base their PCF calculation for inputs supplied to BASF on primary data
- Driven by customer demand for reliable PCF measures

Cradle-to-Gate PCFs

- As more companies adopt their own PCF measurement systems, the resulting cradle-to-gate PCFs will increasingly reflect:
  - an allocated share of each company's actual direct emissions
  - an allocated share of the actual direct emissions incurred by its *Tier 1* suppliers
  - an allocated share of the actual direct emissions incurred by its *Tier 2* suppliers
  - ... and so forth, up the *tiers of the supply chain*
- Increasing use of measurements based on primary data
- No double-counting at the product level!
- **Real incentives to reduce direct and indirect emissions**
- Reports for which **reasonable assurance** seems achievable

Corporate Carbon Footprint (CCF)

$PCF_1 \cdot s_1$	=	CO_2 in Current Sale of Product *1*
$PCF_2 \cdot s_2$	=	CO_2 in Current Sale of Product *2*
.	=	.
.	=	.
.	=	.
$PCF_n \cdot s_n$	=	CO_2 in Current Sale of Product *n*
$\sum PCF_i \cdot s_i$	=	**Carbon Emissions in Goods Sold (CEGS)**
Y	=	General & Administrative CO_2 Emissions
Less		
X	=	Current Direct CO_2 Removals
$\sum PCF_i \cdot s_i + Y - X$	=	**CO_2-Gains & Losses**

CO_2-Gains & Losses $\rightarrow$ Corporate Carbon Footprint (CCF)Metric

Direct and upstream indirect emissions incurred in order to deliver an entity's products and services in the current period

Double Entry System: CO_2-Balance Sheets

Example:

Buildings					**103**
Year	prior to 2023	2023	2024	2025	
	120	*-10*	*-10*	*3*	
Machinery & Equipment					**165**
Year	prior to 2023	2023	2024	2025	
	180	*-15*	*-15*	*15*	
Materials					**1,040**
Year	prior to 2023	2023	2024	2025	
	0	*0*	*600*	*440*	
Work-in-Process Goods A					**0**
Year	prior to 2023	2023	2024	2025	
	0	*0*	*0*	*0*	
Work-in-Process Goods B					**0**
Year	prior to 2023	2023	2024	2025	
	0	*0*	*0*	*0*	
Finished Goods A					**540**
Year	prior to 2023	2023	2024	2025	
	80	*-80*	*620*	*-80*	
Finished Goods B					**98**
Year	prior to 2023	2023	2024	2025	
	40	*-40*	*80*	*18*	
Total	***420***	***-145***	***1,275***	***396***	**1,946**

Indirect Emissions Transferred In					**24,018**
Year	prior to 2023	2023	2024	2025	
Scope 2	*10,500*	*600*	*850*	*508*	
Scope 3.1	*7,280*	*1,440*	*1,550*	*1,290*	
Direct Emissions					**1,757**
Year	prior to 2023	2023	2024	2025	
	1,400	*125*	*187*	*45*	
Direct Removals					**-27**
Year	prior to 2023	2023	2024	2025	
	0	*-10*	*-12*	*-5*	
Legacy Emissions					**-23,802**
Year	prior to 2023	2023	2024	2025	
	-18,760	*-2,300*	*-1,300*	*-1,442*	
Total	***420***	***-145***	***1,275***	***396***	**1,946**

$$\mathbf{CO_2 \text{ in Assets} \equiv CO_2 \text{ Liabilities} + \text{Legacy } CO_2}$$

CO_2-Statement Analysis

Entity-Level Analysis

- Is the business decarbonizing its own operations?
  - *Current Net Direct Emissions* $\downarrow$?
- Are we reducing our total direct and upstream indirect emissions?
  - CCF $\downarrow$? If so, how rapidly?
  - Aggregate carbon intensity: $\frac{CEGS}{COGS} \downarrow$?
- Is the business (segment) staying within a *carbon budget*?
  - Legacy Emissions $\leq$ Budget?

Product-Level Analysis

- Is the business lowering the carbon intensity of select products?
  - $PCF_i \downarrow$?
- Greenwashing select products?
  - $\rightarrow$ Statement of CO_2 Gains & Losses
- What does the i-th product line contribute to the overall CCF?
  - $\rightarrow$ The ratio $\frac{s_i \cdot PCF_i}{CEGS}$

For Further Discussion

- Specific accounting rules to be adopted for:
  - Product PCF boundaries
  - Allocations of "overhead" emissions
  - Recognition and allocation of carbon credits (removals)
- Industry associations like Catena-X (automotive) and TfS (chemicals) have issued industry-specific "rulebooks"
- Software integration of carbon accounting into ERP systems
- Facilitate the task of assurance providers

Our ambition

To be the preferred chemical company to enable our customers' green transformation.

DBT – AK Internes Rechungswesen und Controlling

Product Carbon Footprints bei BASF – Unterstützung der Kunden bei ihrer grünen Transformation

Janine Möller, BASF SE
Head of Sustainability Reporting, Analytics & Performance Management

September 24th , 2025

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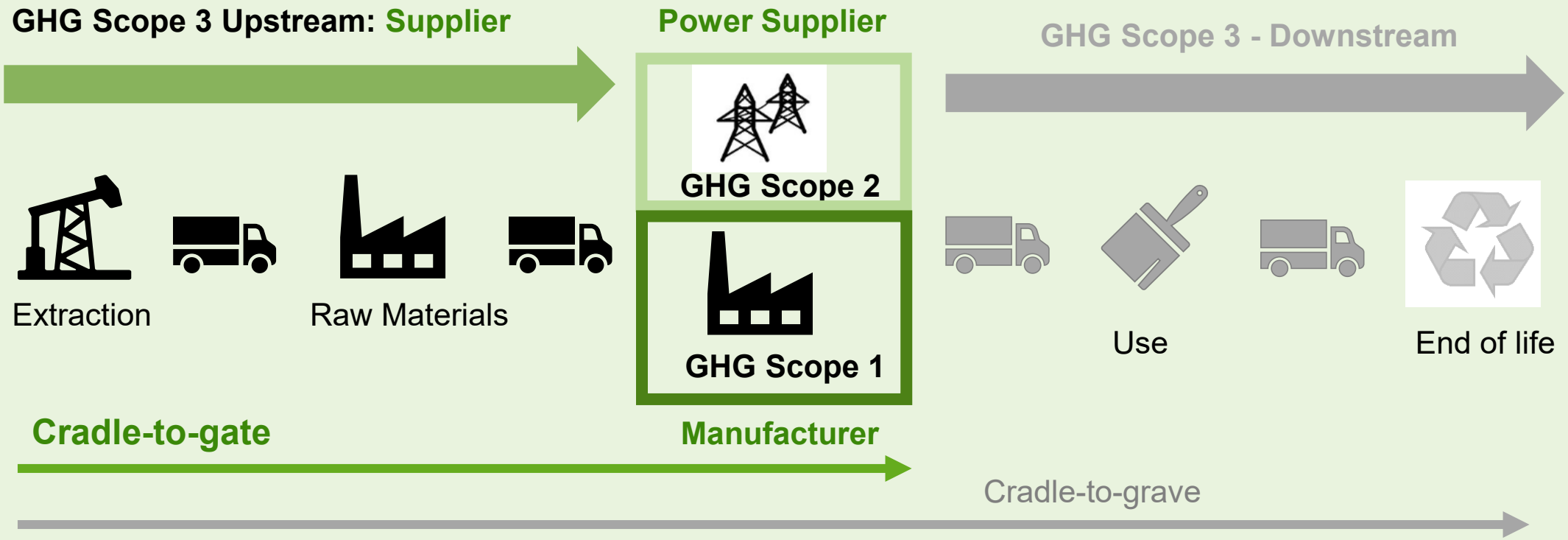
Agenda

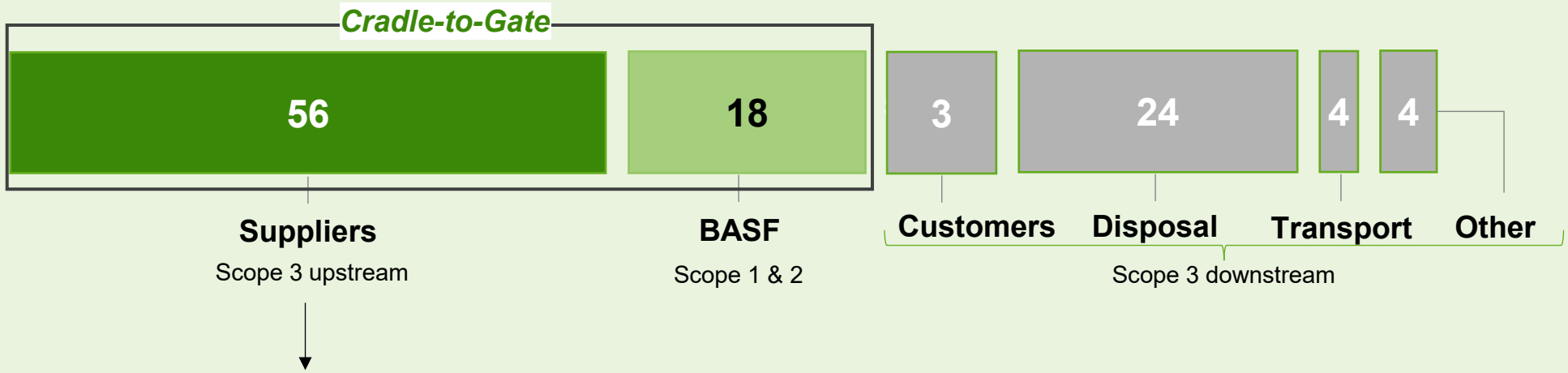
1. Company Carbon Footprint & Product Carbon Footprint
2. Business Enablement via PCF Transparency
3. Market oriented green transformation
4. Next steps & Conclusions

Cradle-to-gate **Product carbon footprint (PCF) & CCF**



ISO 14067:2018

Relevant upstream emissions for PCF calculation



[mt CO_2eq]
BASF Corporate Carbon Footprint

Scope	Category	CO2eq	%
3.1	Purchased raw materials	52	93%
3.2 & 3.3a	Purchased services & capital goods	4	7%

PCF of consumer products requires data owned by actors along global value chains

TIER N

PCF_{Tn}

Scope 1+2

TIER 2

PCF_{T2}

Scope 3 upstream

Scope 1+2

TIER 1

PCF_{T1}

Scope 3 upstream

Scope 1+2

OEM

PCF_{OEM}

Scope 3 upstream

Scope 1+2

SCOTT - Strategic CO_2 Transparency Tool to calculate PCFs

Primary data
Secondary data

20,000
Raw materials
Scope 3

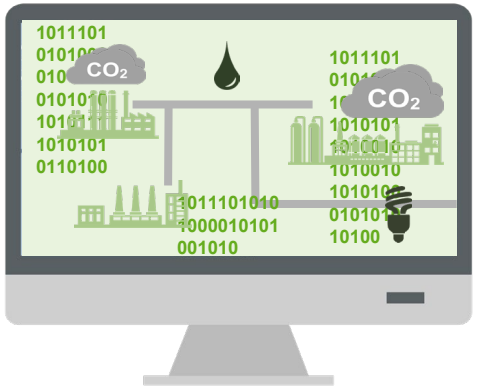
10 TWh/a
Energy
Scope 2

Mainly primary data

700
Production plants
Scope 1

Primary data via global collection tool

ERP data:
BOM, product costing data



CO_2

Product Carbon Footprints of

~45,000
Sales Products

In less than 1h

CEFIC
Resp.Care Award

VCI
Resp. Care Award

Peter Horváth / ICV Green Controlling Award

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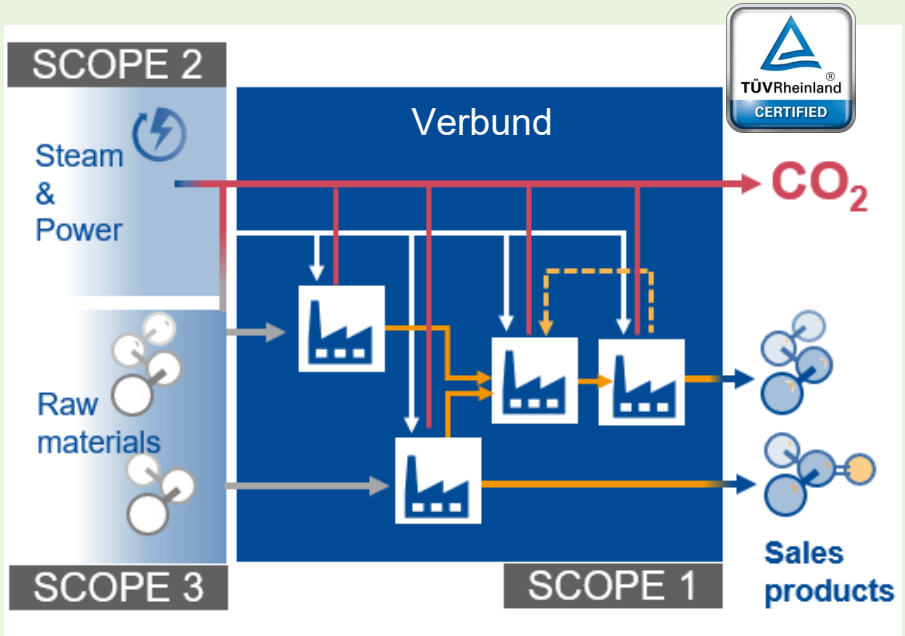
PCF transparency using product costing know how & tools

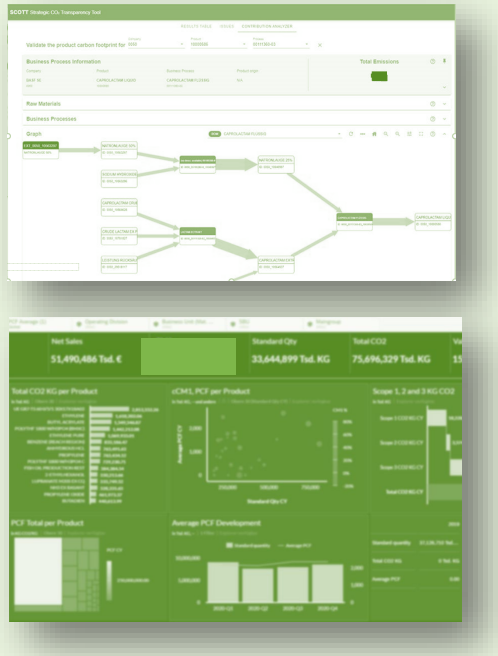
Harmonized data extraction

- Plant emissions
- Bill of materials
- Utility consumptions
- Raw material purchases and PCFs[1]

Data consolidation and proper, **ISO compliant**, CO_2 **allocation on product level** along the typically non-linear chemical manufacturing network



Transparency to **all stakeholders** of the organization, with insights on emission drivers for subject experts and dashboards for sales&marketing



Note: 1 preferably primary data calculated by the respective supplier; if not available, secondary data will be used

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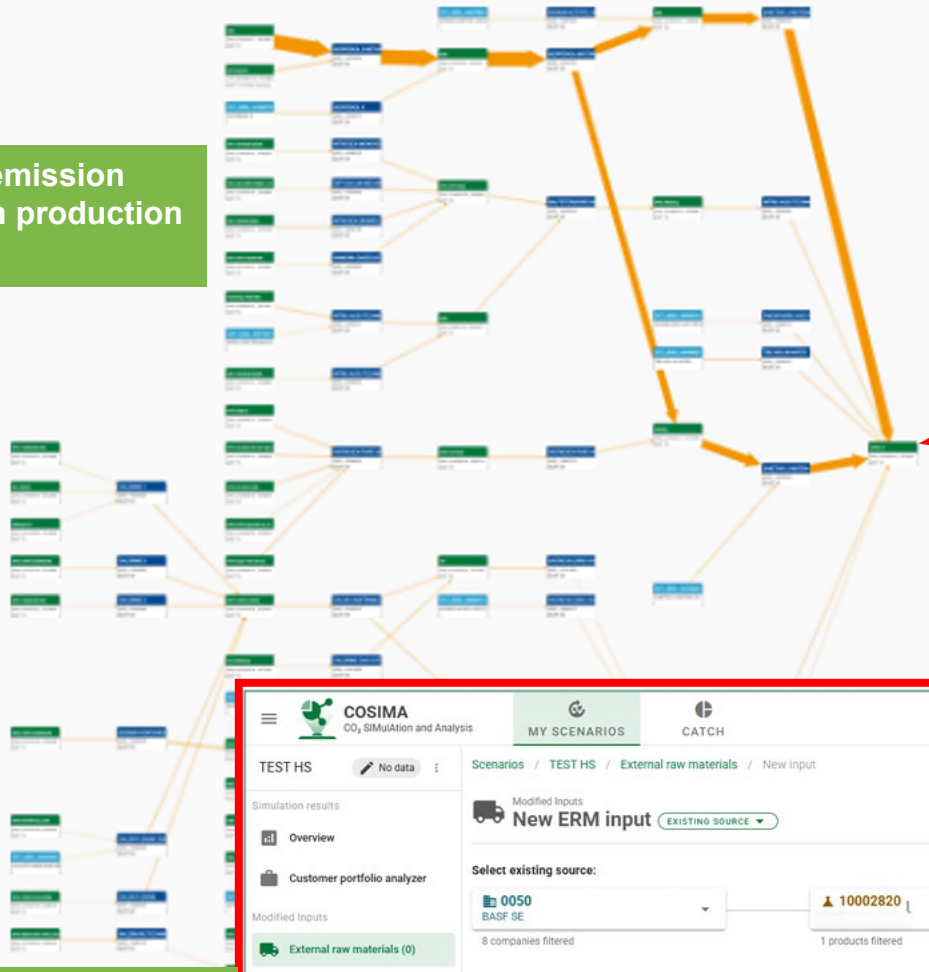
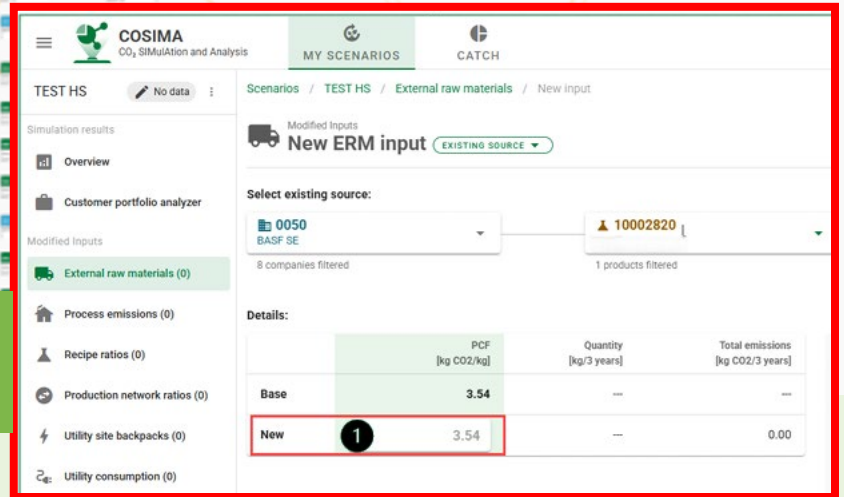
SCOTT – some impressions

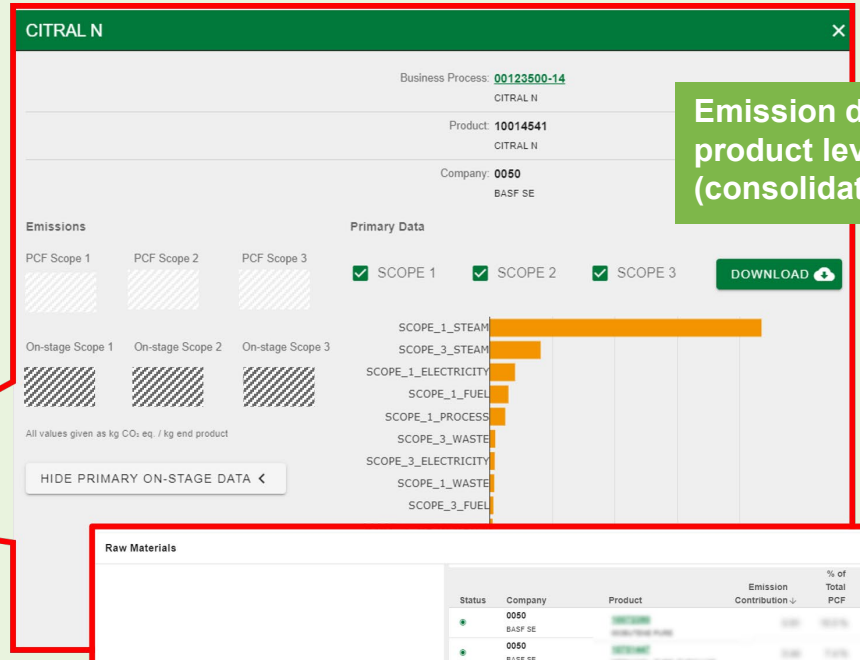
Identify emission drivers in production footprint



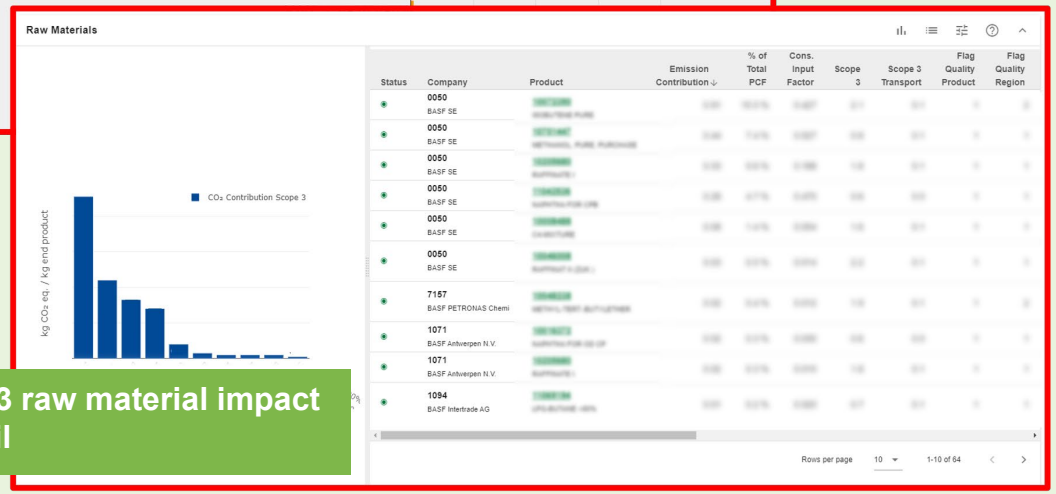
Simulate scenarios how to reduce PCF



Emission details at product level (consolidated & on stage)



Scope 3 raw material impact in detail



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100% of relevant “cradle-to-gate” emissions are allocated to PCFs

Data collection processes

Scope 1

Scope 2

Audited under reasonable assurance

Scope 3 (3.1, 3.3, 3.4, 3.5)

Scope 3 others

SCOTT solution

PCF‘s

[kg CO_{2e} / kg sales product]

∑ Sold product volumes * PCF

BASF Corporate Reporting “Periodic Emissions”

[mt CO_2eq]

Solution to steer on all levels of the business organization

Market-oriented: Emissions of Sales

[mt CO_2eq]

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Carbon Accounting Statements

	over total period	Calender year view
Corporate cradle-to-gate emissions = sum of PCFs of all **produced** products	**yes**	**yes**
Corporate cradle-to-gate emissions = sum of PCFs of all **sold** products	**yes**	**no**

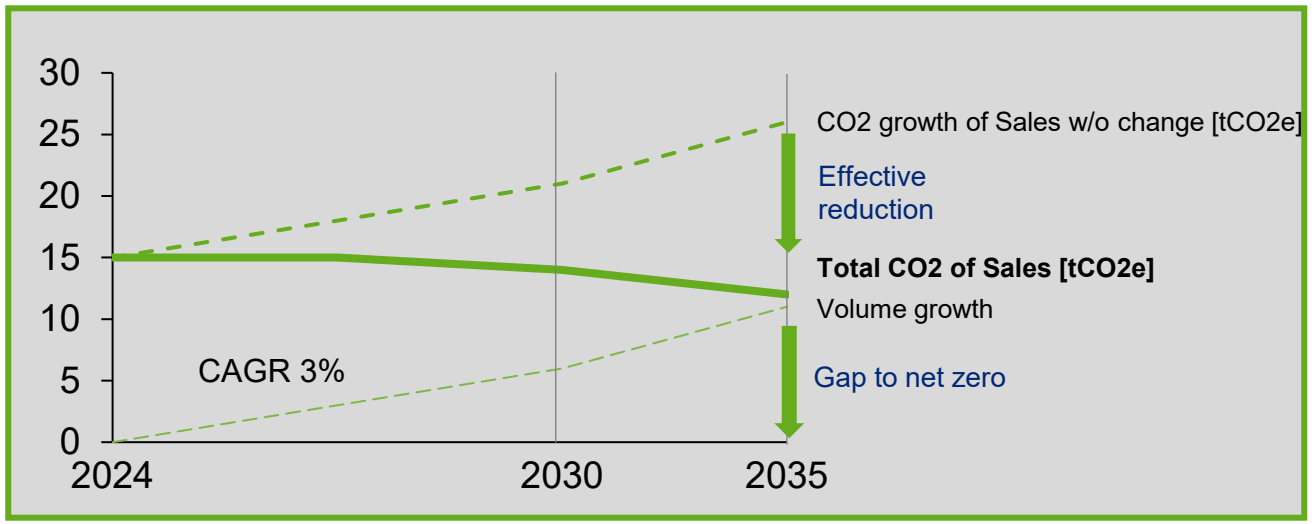
Reasons:

- Inventory changes
- Time gap (e.g. PCF of calendar year 2023 was applied from mid 2024 til mid 2025)

Certification by TÜV Rheinland focuses on **completeness** of the data and that the **automized system** works as described according to a **standardized methodology** (for chemicals TfS).

Market oriented steering of CO_2 reduction

Transformation Trajectories for CO_2 emissions in Sales developed by all businesses - numbers illustrative only



Businesses in the driver seat considering

- Regulatory and customer requirements
- With different speed and magnitude in different industries and regions

In some markets the PCF “lives” as selling argument

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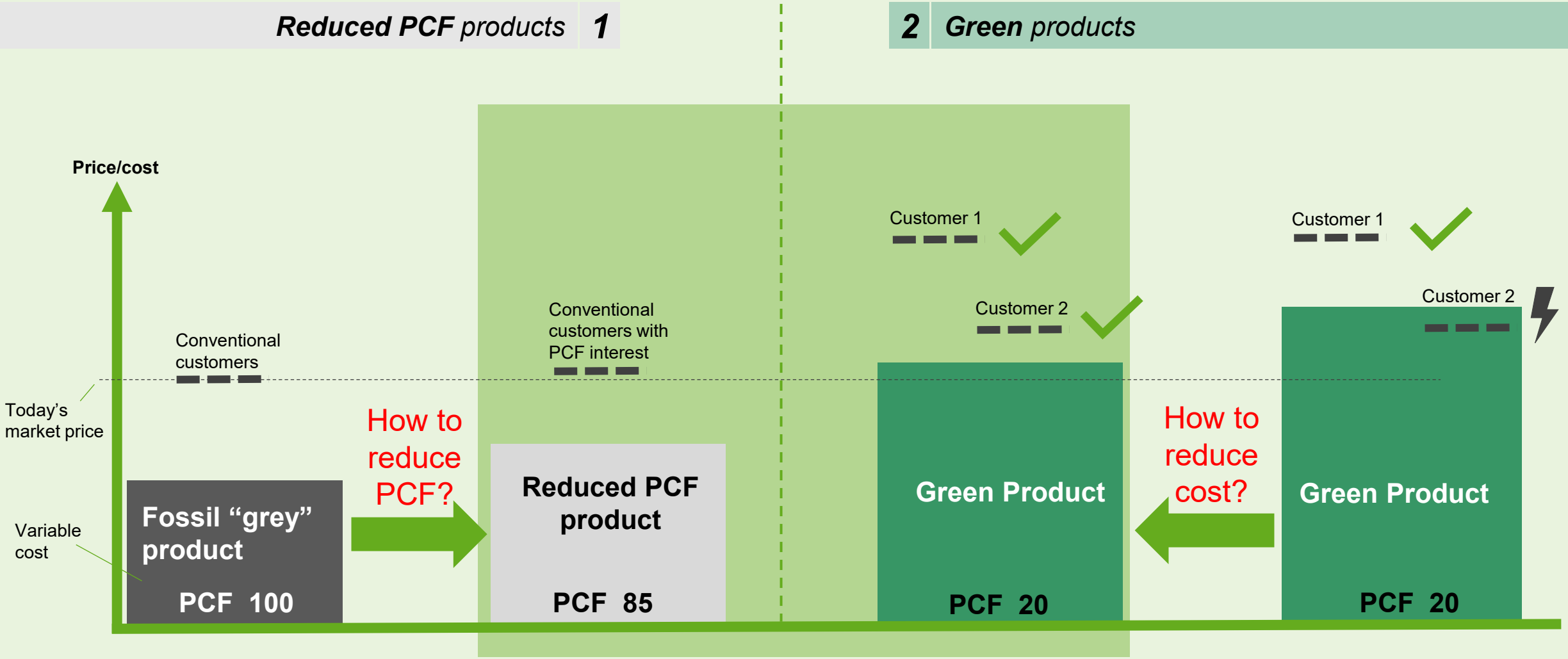
WE BOUGHT THIS BILLBOARD TO TELL YOU ABOUT THE CLIMATE FOOTPRINT NUMBERS WE'VE INCLUDED ON OUR PRODUCTS.
THE ORIGINAL
OAT
LY!
SEMI
OAT DRINK
0.47
kg CO2e/kg
0.47
1L
?
kg CO2e/kg
AND WE'RE DONATING THIS SIDE TO THE DAIRY INDUSTRY SO THEY CAN TELL YOU THEIR CLIMATE FOOTPRINT NUMBERS TOO.
Apply for this free ad space at oatly.com/DairyDeal

Business observations towards our customers



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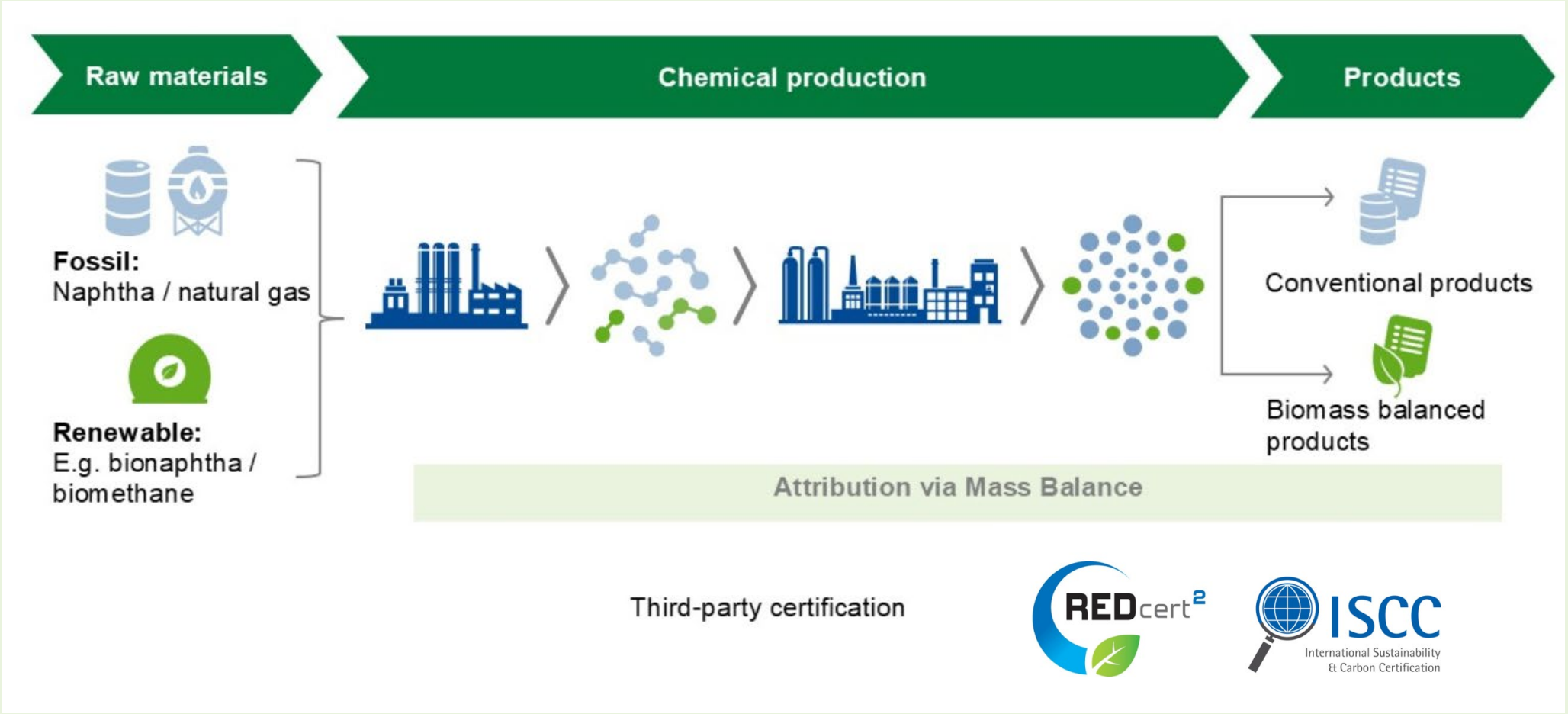
Mass Balance requires seggregated, certifiable Internal Accounting



Supplier carbon management program to tackle scope 3.1

Awareness

More than **1,900 suppliers** have been approached: **~80% of Scope 3.1 emissions**

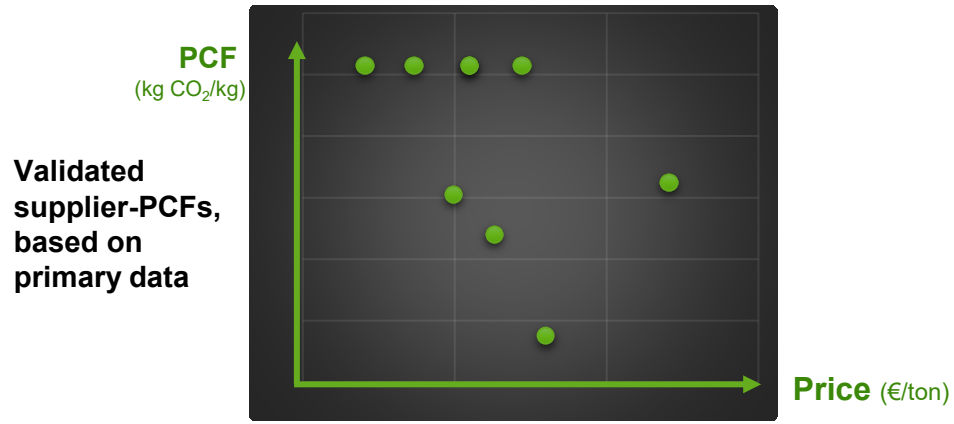
Transparency

1,700 validated PCFs for our raw materials: **~35% of our Scope 3.1 emissions**

Improvement

We make PCFs a buying criterion to reduce the PCFs of our sales products

e.g. Raw Material X from 8 suppliers



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Priorities for an impactful GHG Reporting along the Value Chain

1. **Accurate data collection of scope 1 and 2 emissions** based on robust (financial-like) processes through automated solutions.
2. **Standardization of a product carbon footprint methodology** for the specific industry
3. **Automated PCF calculation tool**, with 3rd party certification of the PCF calculation program's compliance.
4. **For scope 3.1, high coverage** of standardized and certified or verified **supplier-specific PCFs** instead of average secondary PCFs from databases.
5. **Interoperable digital exchange of certified or verified PCF data through platforms** along the value chains.
6. **Acceptance** of a **certified mass-balance approach**

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Standardization for the chemical industry

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SCOTT

Ecosystem of Partnerships

Software houses, data providers

AllocNow · Atos · iPoint · sphera · carbonminds

license, collaborate

Associations & Consortia

TfS · TOGETHER FOR SUSTAINABILITY · wbcsd · Catena-X Automotive Network

align, collaborate, educate

Consultants

(…)

educate, collaborate

Manufacturing companies from chemical and process industry

- Accelerate carbon steering
- Access to automated tool
- Leverage a common standard
- Generate PCF transparency