



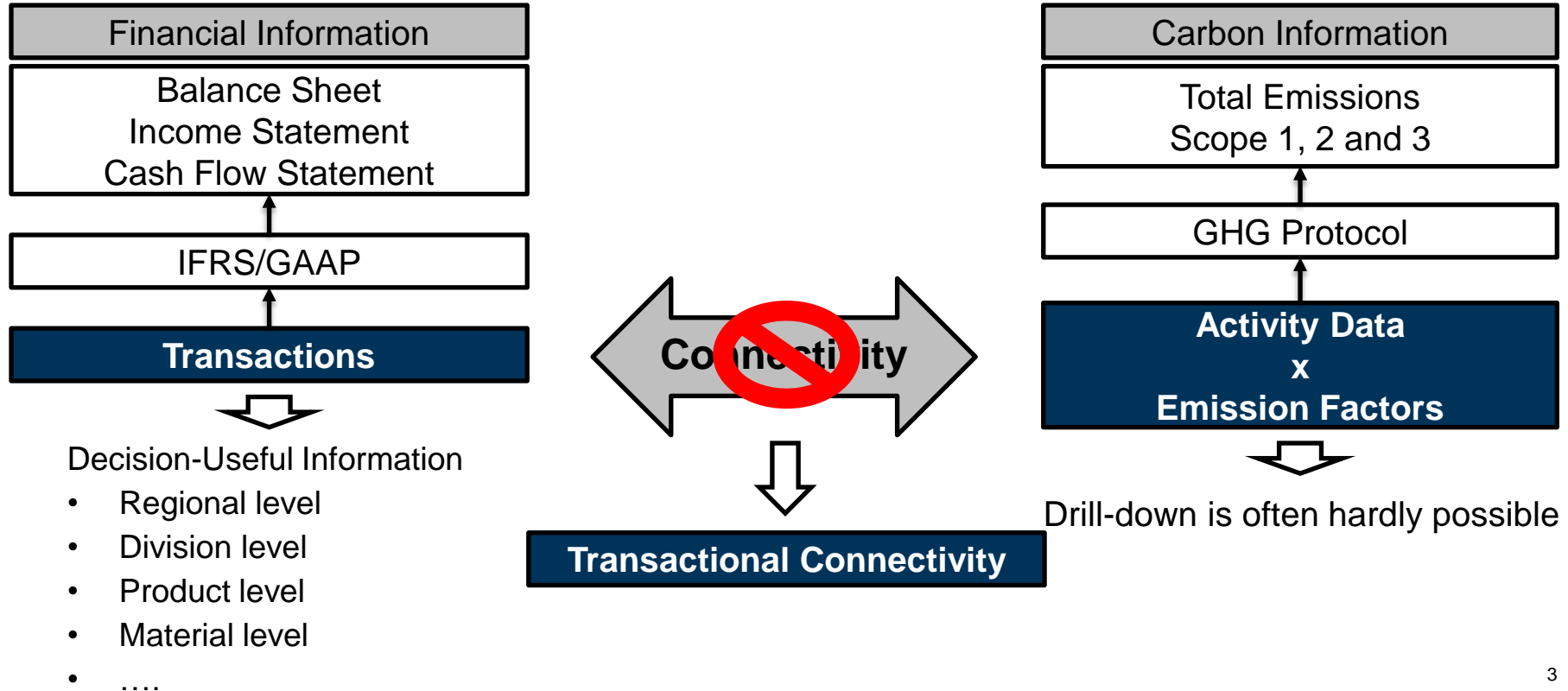
Incorporating Carbon Emissions into Decision-Making - The Case of Transactional Connectivity

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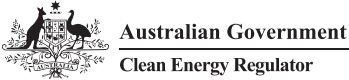
Connecting carbon and financial information for decision-making is often not possible because of the different granularity of data.



Most current regulations on carbon reporting follow or even require the application of the Greenhouse Gas (GHG) Protocol.



CSRD (Corporate Sustainability Reporting Directive)
ESRS (European Sustainability Reporting Standards)



NGER (National Greenhouse and Energy Reporting Scheme)



Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021



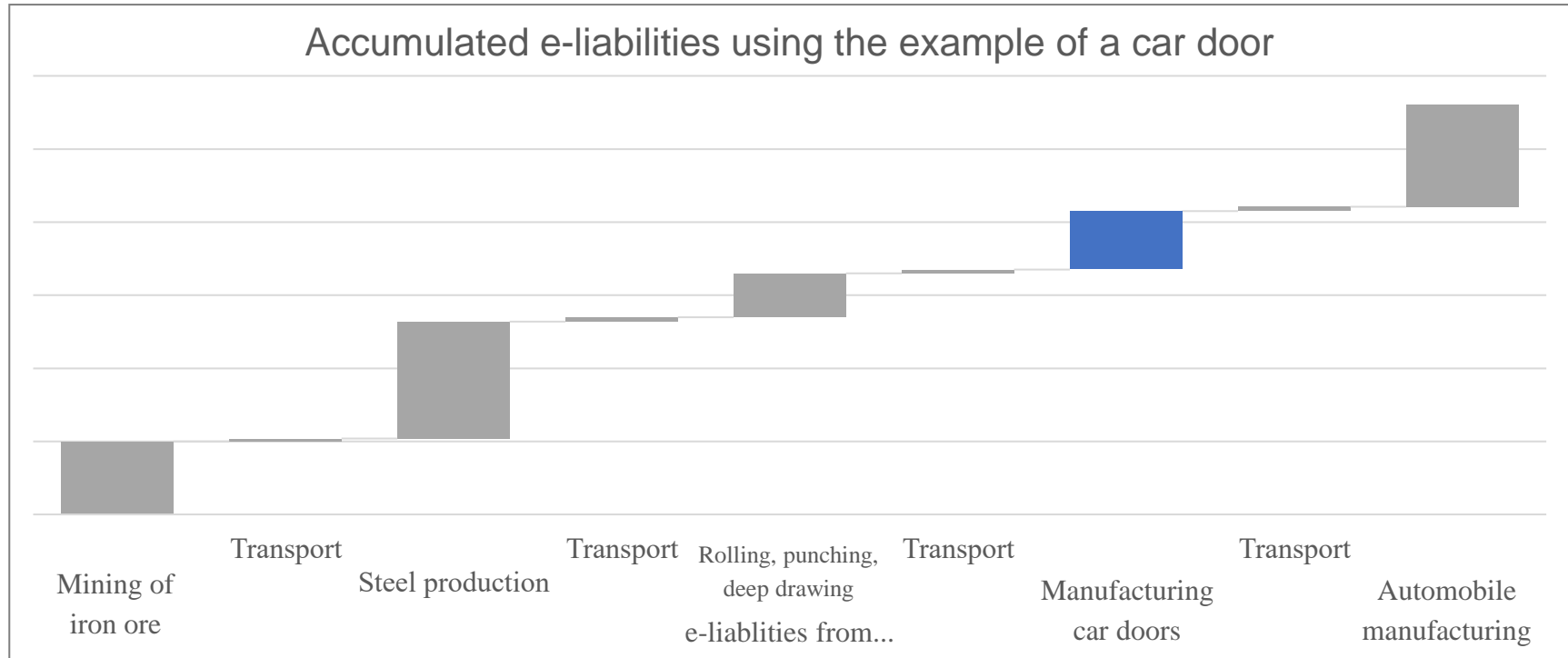
Rules to Enhance and Standardize Climate-Related Disclosures for Investors



IFRS Sustainability Disclosure Standards (specifically IFRS S2)



The E-Liability approach applies the concept of cost accounting* to carbon accounting to solve the issues of scope 3 emissions.



* The **E-liabilities** proposal is modeled on **activity-based costing**

Reichelstein (2024) extends the E-Liability approach to a carbon accounting system with a carbon balance sheet as outcome.

CE in Assets		CE in Liabilities and Equity	
Buildings	BB_{BLD}	BB_{ETI}	Emissions Transferred In
Machinery & Equipment	BB_{MAC}	BB_{DE}	Direct Emissions
Raw Materials	BB_{MAT}	(BB_{DR})	Direct Removals
Work-in Process	BB_{WIP}	BB_{EQ}	Equity
Finished Goods	BB_{FG}		

- This approach applies double entry bookkeeping to carbon emissions to generate a carbon balance sheet and carbon flow statement, which are separated from their financial counterparts.
- **Carbon emissions (CE) transferred to the customer = CE from supplier(s) + own CE**

Our approach of transactional carbon accounting adds the dimension of carbon emissions to existing accounts in an ERP system.

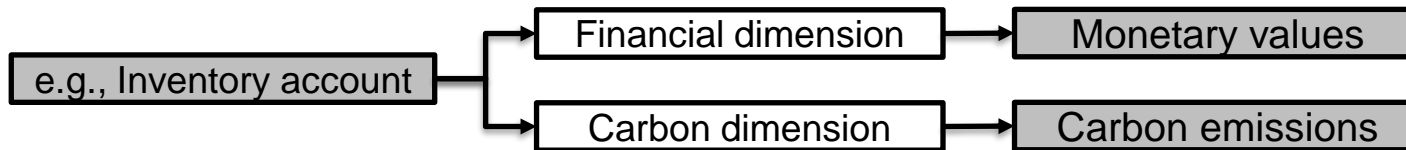
Our approach of **transactional carbon accounting** views carbon accounting from a **transactional perspective** (input)



Bringing carbon information on the same transactional level as financial information



Adding carbon emission quantities to existing accounts in an ERP system



Transactional connectivity

This paper contributes to the literature on connectivity and carbon accounting, highlighting substantial practical implications.

Connectivity

We contribute to the literature on the connectivity of financial and sustainability-related financial information by introducing transactional connectivity as a new dimension of connectivity.

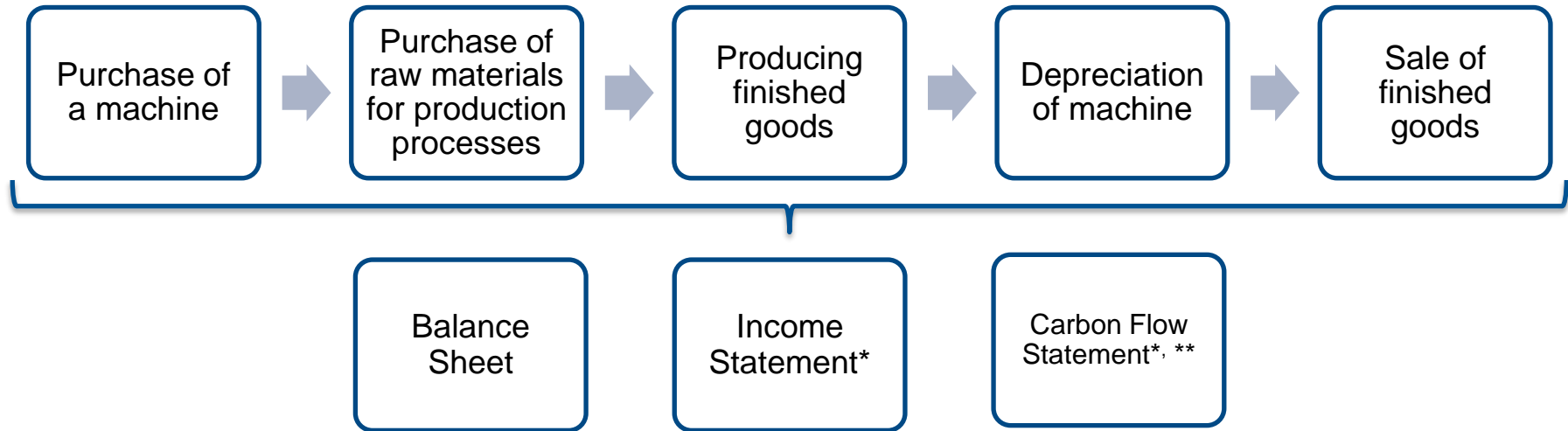
Carbon accounting

We extend the existing literature on carbon accounting by examining carbon accounting through transactions (inputs) rather than reports (outputs), thereby integrating carbon emissions into individual transactions within the general ledger

Practical implication

Transactional carbon accounting enables integrated thinking and supports data-based decision-making. With relatively low implementation effort, it has the potential to significantly transform carbon accounting practices, offering substantial practical benefits for firms, auditors, and investors.

Case study transactional carbon accounting.



* Not covered in this presentation. See submitted paper for details.

** Includes carbon-only information (not connected with the cash flow statement). Follows a structure comparable with the direct-method cash flow statement.

Concept of transactional carbon accounting.

Table 1 Balance sheet at the beginning of the period

Assets	[CU]	Total tCO₂e	Liabilities and equity	[CU]	Total tCO₂e
Cash and cash equivalents	30,000	0	Trade payables	0	0
Trade receivables	0	0	Current provisions	1,000	0
Inventories	0	0	Total current liabilities	1,000	0
Total current assets	30,000	0	Provisions	11,500	0
			Total non-current liabilities	11,500	0
Intangible assets	500	0	Issued capital	15,000	0
Property, plant and equipment	0	0	Capital reserve	3,000	0
Total non-current assets	500	0	Retained earnings	0	0
			Net income	0	0
			Total equity	18,000	0
Total assets	30,500	0	Total liabilities and equity	30,500	0

Concept of transactional carbon accounting.

- 1) Purchase of a production machine for 1,200 CU with a 30-day payment term.
Embedded carbon emissions are 120 tCO₂e.

Dr. PPE	1,200 [CU]		120 [tCO ₂ e]	
Cr. Trade payables		1,200 [CU]		120 [tCO ₂ e]

- 2) Purchase of raw materials for 100 CU and embedded carbon emissions of 1 tCO₂e.

Dr. Inventories (raw materials)	100 [CU]		1 [tCO ₂ e]	
Cr. Trade payables		100 [CU]		1 [tCO ₂ e]

Concept of transactional carbon accounting.

- 3) Assembly of final products using raw materials valued at 50 CU and with embedded carbon emissions of 0.5 tCO₂e.

Dr. Inventories (finished goods)	50 [CU]		0.5 [tCO ₂ e]	
Cr. Inventories (raw materials)		50 [CU]		0.5 [tCO ₂ e]

Concept of transactional carbon accounting.

- 4) Monthly depreciation of the purchased machine from transaction (1) with a useful life of 10 years. The monthly depreciation is 10 CU (1200/10/12) and 1 tCO₂e (120/10/12).

Dr. Depreciation	10 [CU]		1 [tCO ₂ e]	
Cr. PPE		10 [CU]		1 [tCO ₂ e]

Dr. Inventories (finished goods)	10 [CU]		1 [tCO ₂ e]	
Cr. Depreciation		10 [CU]		1 [tCO ₂ e]

Concept of transactional carbon accounting.

5) Sale of finished goods: Revenue of 60 CU; Cost of sales of 40 CU.

Dr. Cost of sales	40 [CU]		1 [tCO ₂ e]	
Cr. Inventories (finished goods)		40 [CU]		1 [tCO ₂ e]

Dr. Trade receivables	60 [CU]		1 [tCO ₂ e]	
Cr. Revenue		60 [CU]		1 [tCO ₂ e]

Concept of transactional carbon accounting.

- 6) Payment of trade payables (machine and raw materials); and cash receipt from the sale.

Dr. Trade payables	1,300 [CU]		121 [tCO ₂ e]	
Cr. Cash		1,300 [CU]		121 [tCO ₂ e]

Dr. Cash	60 [CU]		1 [tCO ₂ e]	
Cr. Trade receivables		60 [CU]		1 [tCO ₂ e]

Concept of transactional carbon accounting.

Table 2 Balance sheet at the end of the period

Assets	[CU]	Total tCO₂e	Liabilities and equity	[CU]	Total tCO₂e
Cash and cash equivalents	28,760	-120	Trade payables	0	0
Trade receivables	0	0	Current provisions	1,000	0
Inventories	70	1	Total current liabilities	1,000	0
Total current assets	28,830	-119	Provisions	11,500	0
			Total non-current liabilities	11,500	0
Intangible assets	500	0	Issued capital	15,000	0
Property, plant and equipment	1,190	119	Capital reserve	3,000	0
Total non-current assets	1,690	119	Retained earnings	0	0
			Net income	20	0
			Total equity	18,020	0
Total assets	30,520	0	Total liabilities and equity	30,520	0

Transactional carbon accounting has multiple advantages.

Connectivity

Links financial and carbon information at the transactional level.

Integrated Thinking

Provides granular connected data for decision-making at all levels.

Investor Benefits

Enhances reporting quality and decision-useful information.

Auditing

Facilitates established auditing procedures for carbon data.

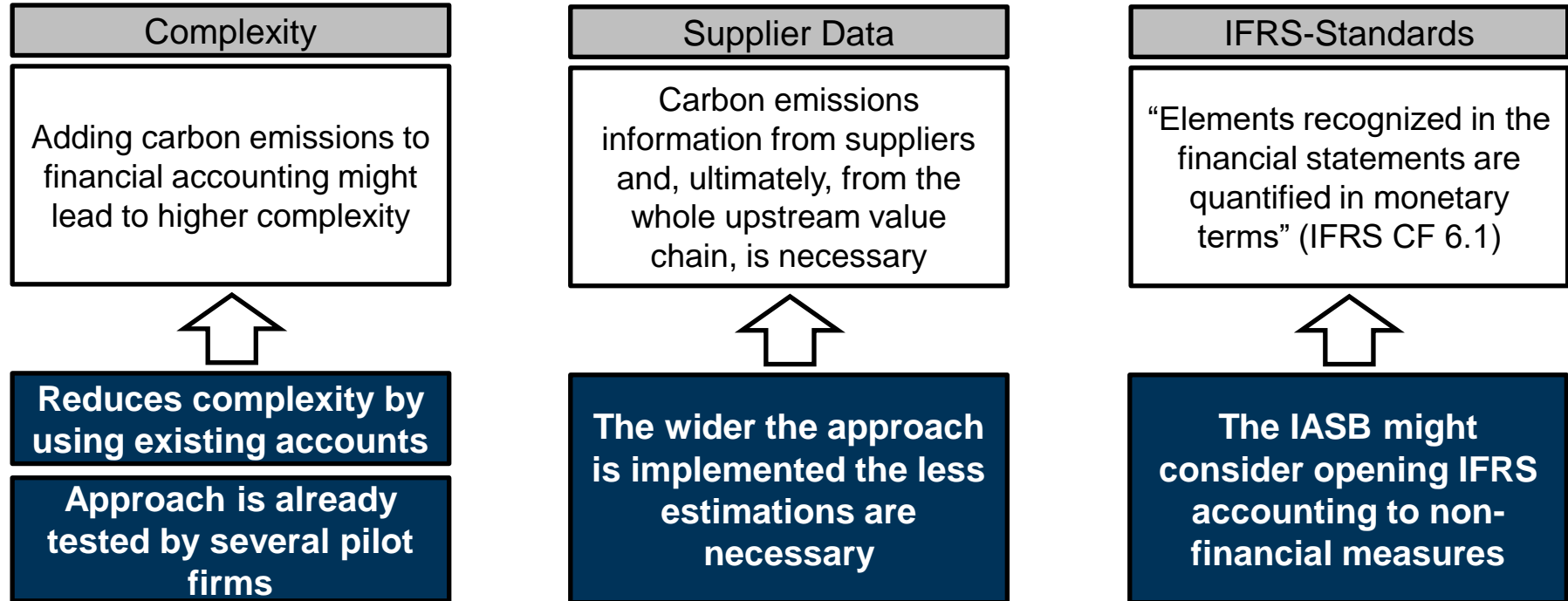
Implementation

Low effort compared to other carbon accounting concepts.

Timeliness

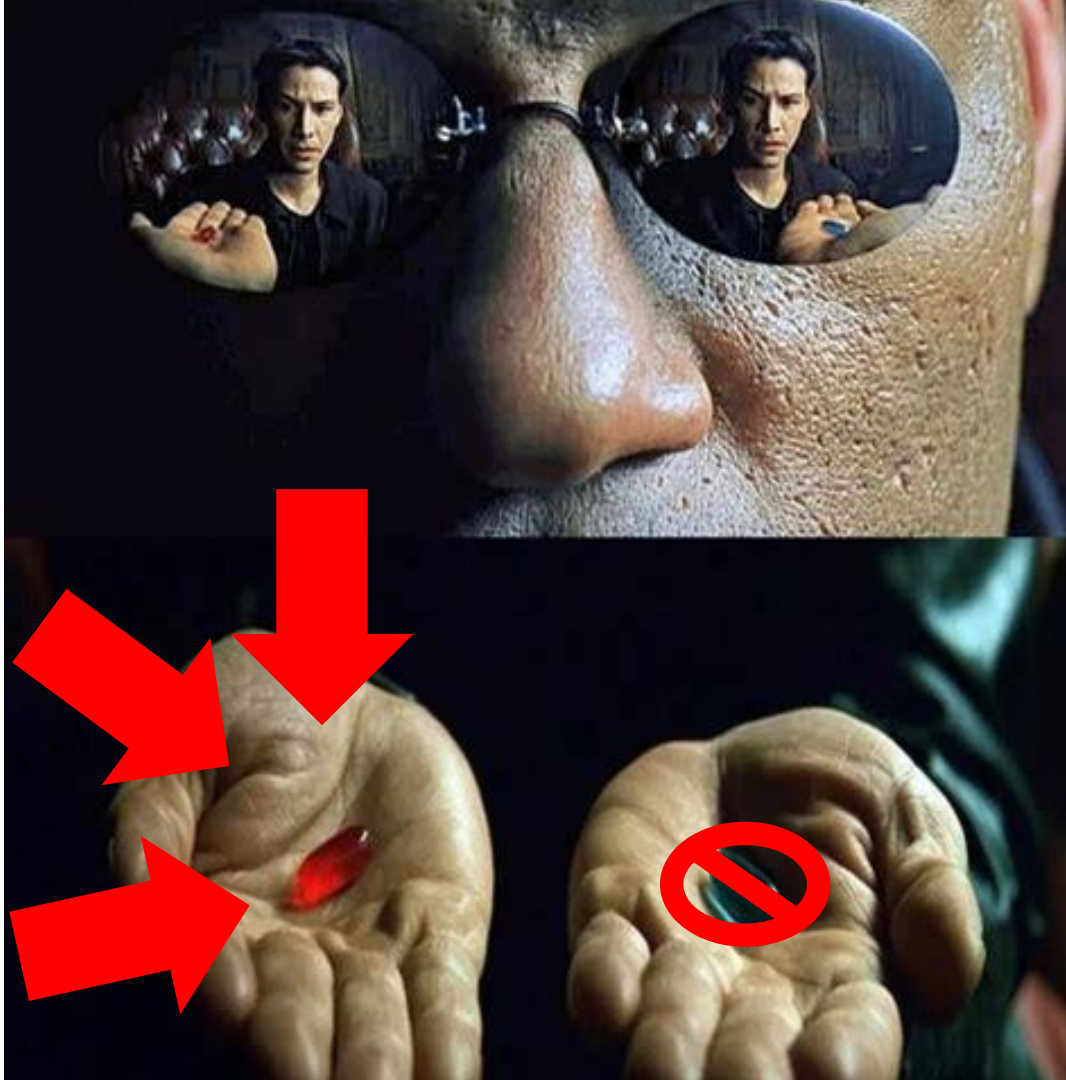
Enhances the prompt availability of carbon information.

Transactional carbon accounting comes with several drawbacks. However, these drawbacks can be addressed.



Conclusion

- Transactional carbon accounting brings carbon information in the same granular level as financial information.
- This allows to consider both financial and carbon emission data equally in decision making and, thus, allows integrated thinking.
- We extend existing approaches to carbon accounting by focusing on transactions and connectivity.
- There are already several pilot firms that are implementing our approach of transactional carbon accounting within the SAP Green Ledger





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Back up

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Income statement and carbon flow statement

Table 3 Income statement

	[CU]	Total tCO ₂ e
Revenue	60	1
Cost of Sales	40	1
Gross Profit	20	0
Selling and general administrative expenses	0	0
Net income	20	0

Table 4 Carbon flow statement

	Total tCO ₂ e
Start of period - overall carbon within firm	0
Additions	121
Exit	1
End of period - overall carbon within firm	120
Not allocated to an asset	0
Closing balance - carbon in assets	120

Purchase of a production machine using a carbon-only account.

- 1) Purchase of a production machine for 1,200 CU with a 30-day payment term.
Embedded carbon emissions are 120 tCO₂e.

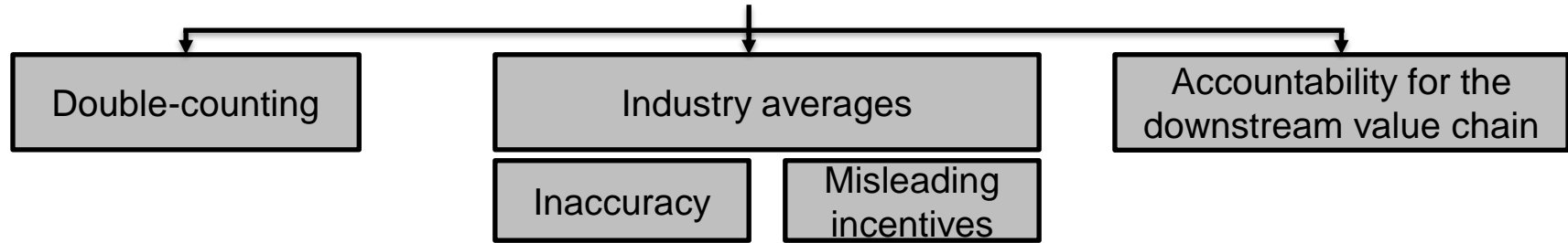
Dr. PPE	1,200 [CU]		120 [tCO ₂ e]	
Cr. Trade payables		1,200 [CU]		
Cr. Carbon Emissions				120 [tCO ₂ e]

Balance sheet at the end of the period for a modification of transactional carbon accounting

Table 6 Balance sheet at the end of the period for a modification of transactional carbon accounting

Assets	[CU]	Total tCO _{2e}	Liabilities and equity	[CU]	Total tCO _{2e}
Cash and cash equivalents	28,760	0	Trade payables	0	0
Trade receivables	0	0	Current provisions	1,000	0
Inventories	70	1	Total current liabilities	1,000	0
Total current assets	28,830	1	Provisions	11,500	0
			Total non-current liabilities	11,500	0
Intangible assets	500	0	Issued capital	15,000	0
Property, plant and equipment	1,190	119	Capital reserve	3,000	0
Total non-current assets	1,690	119	Retained earnings	0	0
			Net income	20	0
			Carbon emissions	120	120
			Total equity	18,020	120
Total assets	30,520	120	Total liabilities and equity	30,520	120

The GHG Protocol, especially regarding scope 3 emissions, shows several weaknesses that are addressed by the E-Liability approach.



Issues are addressed by the E-Liability approach of Kaplan/Ramanna (2021)

References

- Kaplan, R. S., and Ramanna, K. (2021), 'Accounting for Climate Change', Harvard Business Review, Vol. 99, No. 6, pp. 120–131.
- Reichelstein, S. (2024), 'Corporate carbon accounting: balance sheets and flow statements', Review of Accounting Studies, Vol. 29, No. 3, pp. 2125–2156.