STRATEGIC CLIMATE METRICS

PRIORITISING KEY FACTORS FOR ENHANCED DECISION-MAKING

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Embedding Sustainability in Credit Risk Assessment
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STRATEGIC CLIMATE METRICS

PRIORITISING KEY FACTORS FOR ENHANCED DECISION-MAKING

1. CONTEXT AND RELEVANCE OF THE PROJECT
2. GHG PROTOCOL AND ITS THREE-SCOPE MODEL IS HEGEMONIC AS A CORPORATE STANDARD FOR MEASURING EMISSIONS
3. RESEARCH OBJETIVE
4. THEORETICAL FRAMEWORK
5. METHODOLOGY
6. ANALYSIS
7. LIMITATIONS AND FUTURE RESEARCH

CONTEXT AND RELEVANCE

The lack of information and its consistency for assessing corporate climate risks has been a challenge highlighted by numerous stakeholders in recent years.

"Currently, however, financial market participants face a lack of high-quality, reliable, and comparable data needed to efficiently price climate related risks and avoid greenwashing—spurious attempts by financial or non-financial companies to burnish their environmental credentials"

Achieving Net-Zero Emissions Requires Closing a Data Déficit
Charlotte Gardes-Landolfini , Fabio Natalucci, IMF, 2022

The Availability of Data with Which to Monitor and Assess Climate-Related Risks to Financial Stability (FSB, 2021)

Final Report on bridging data gaps (NGFS, 2022)

Climate data and net zero: Closing the gap on investors' data needs (UN PRI, 2023)

Narrowing the climate data gap – climate change-related indicators (ECB, 2023)

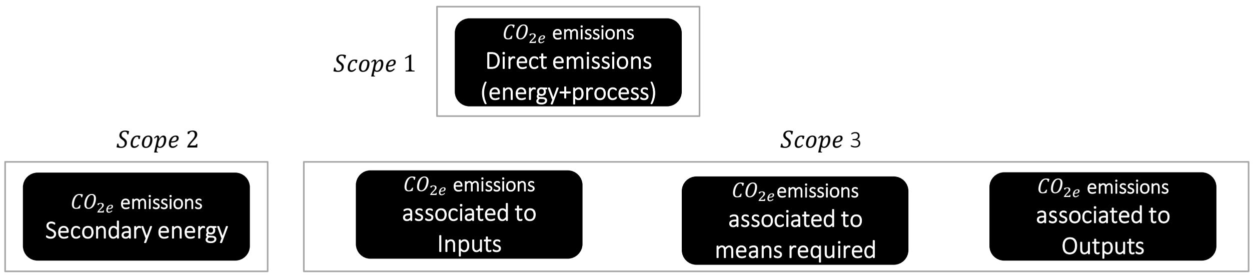
GHG PROTOCOL

This private protocol has proposed **since 2004** a three-scope approach, which has been successful as a reference for measuring greenhouse gas emissions worldwide.

The GHG Protocol is the most widely used framework to measure and manage **greenhouse gas** (GHG) emissions from private and public sector operations, value chains, and mitigation actions.

This protocol is based on a 20-year partnership between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). It is adopted by governments, industry associations, NGOs, businesses, and other organizations.

SCOPES RATIONALE (2004)



$$Scope\ FtCO2 = Business\ activity\ ft(x)\ x\ Emission\ Factor\ CO2/ft(x)$$

DISCLOSURES USING GHG PROTOCOL

EFRAG

ESRS E1
50,000 companies in Europe

IFRS S2
100-130,000 companies

TCFD

GRI

Source: WRI, 2024

GHG PROTOCOL

This private protocol has proposed since 2004 a three-scope approach, which has been successful as a reference for measuring greenhouse gas emissions worldwide.

A COST EFFECTIVENESS

Despite the efforts made, there is frustration among reporters and users of this information.

ESTIMATED COSTS

US SEC
$420,000 for small companies to $530,000 for large companies.

EFRAG
One-off cost of €287,000 and annual costs around €320,000 for reporting, including €173,000 for in-house expenses, equivalent to 2 to 2.5 full-time employees.

B COMPARABILITY LIMITATIONS

The Protocol contains numerous reporting options that hinder comparability.

1. Consolidation approaches,
2. Greenhouse gases considered,
3. Accounting rules for scope 2 emissions,
4. Estimation methods to calculate scope 3 emissions,
5. The use of different emission factors.

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❶ Consolidation approaches.

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❸ Accounting rules for scope 2 emissions.

❹ Methods to calculate scope 3 emissions.

❺ The use of different emission factors.

❶ The GHG Protocol requires companies to define their **organizational boundaries** to build the GHG inventory. It allows companies to choose between **operational** and **financial control** discretionarily → no consensus about the most appropriate consolidation method.

❷ The GHG Protocol addresses the gases listed in the Kyoto Protocol. However, previous research indicates that companies **report a limited and non-homogeneous selection of greenhouse gases** in their inventories.

❸ The calculation of scope 2 emissions relies on two methods: **location-** and **market-based methods**. Companies shall choose which method suits best for the company, but there are significant differences on emissions between both approaches.

❹ Two main approaches: Direct measurement (unfeasible) and calculation (i.e., estimating emissions). **Calculation** involves multiplying **activity data** by an **emission factor** (more than 80 databases).

❺ **Companies in the same sector with similar operations** can end up with very **different emission figures** due to the selection of different emission factor databases (IPCC, EPA, IEA, among others.)

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C CONTEXTUAL ACCURACY

Emissions are accounted without considering where they occur, limiting the ability to assess transition risks because:

1. It is not possible to identify transition risks that depend on local policies and regulations.
2. The current configuration of the protocol makes it impossible to harmonize with the countries' NDCs.

RESEARCH OBJECTIVE

PROPOSING AN EVOLUTION OF CURRENT CARBON ACCOUNTING AND REPORTING PRACTICES

Based on the use of information related to companies' emissions for calculating exposure to transition risk, this work **reviews and proposes an evolution of GHG emissions metrics based on the key drivers for decarbonization.**

Our argument is that the GHG Protocol fails to create a precise evaluation of climate-related risks required to address the green transition. In this context, it becomes crucial to pinpoint the drivers of decarbonization.

This work seeks to improve efficiency in the collection of climate information by focusing on **a critical aspects** that may influence the decisions of financial statement users.

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THEORETICAL FRAMEWORK

IMPACT = VOLUME x EFFICIENCY x INTENSITY

MATEMATICAL IDENTITIES
I=PAT AND KAYA IDENTITY

Developed by Yoichi Kaya, the identity is a specific application of the I = PAT identity, which relates human impact on the environment (I) to the product of population (P), affluence (A) and technology (T) based on Commoner, Ehrlich, Holdren early 70s.

The Kaya Identity is a mathematical formula that relates the total emission level of the greenhouse gas carbon dioxide to four factors: human population, GDP per capita, energy intensity (per unit of GDP), and carbon intensity (emissions per unit of energy consumed)

Background based on Ehrlich and Holdren, 1971

Impact = Population x Affluence x Technology

Kaya and Yokobori, 1997

$$\overset{\Delta}{\rightarrow} CO_{2e} = Population\ x \frac{GDP}{Population}\ x \frac{Energy}{GDP}\ x \frac{CO_{2e}}{Energy}$$

Proposed identity for Corporate emissions

$$\overset{\Delta}{\rightarrow} CO_{2e} = Activity\ x \frac{Production}{Activity}\ x \frac{Energy}{Production}\ x \frac{CO_{2e}}{Energy}$$

METHODOLOGY

KAYA IDENTITY ADAPTATION

ENTITY LEVEL

$$\overset{\Delta}{\rightarrow} CO_{2e} = Activity\ x\ \frac{Production}{Activity}\ x\ \frac{Energy}{Production}\ x\ \frac{CO_{2e}}{Energy}$$

VALUE CHAIN LEVEL

$$\overset{\Delta}{\rightarrow} CO_{2e} = f(output)\ \frac{Input}{Output}\ x\ f(rm, P, p)\ \frac{Energy}{Input}\ x\ \frac{CO_{2e}}{Energy}$$

Process efficiency factor *Emissions intensity factor*

- *rm: Materials/Raw materials input*
- *P: Process input*
- *p: Product input.*

PROCESS LEVEL

MATERIALS

$$f(rm)(\frac{Energy}{Input}\ x\ \frac{CO_{2e}}{Energy})$$

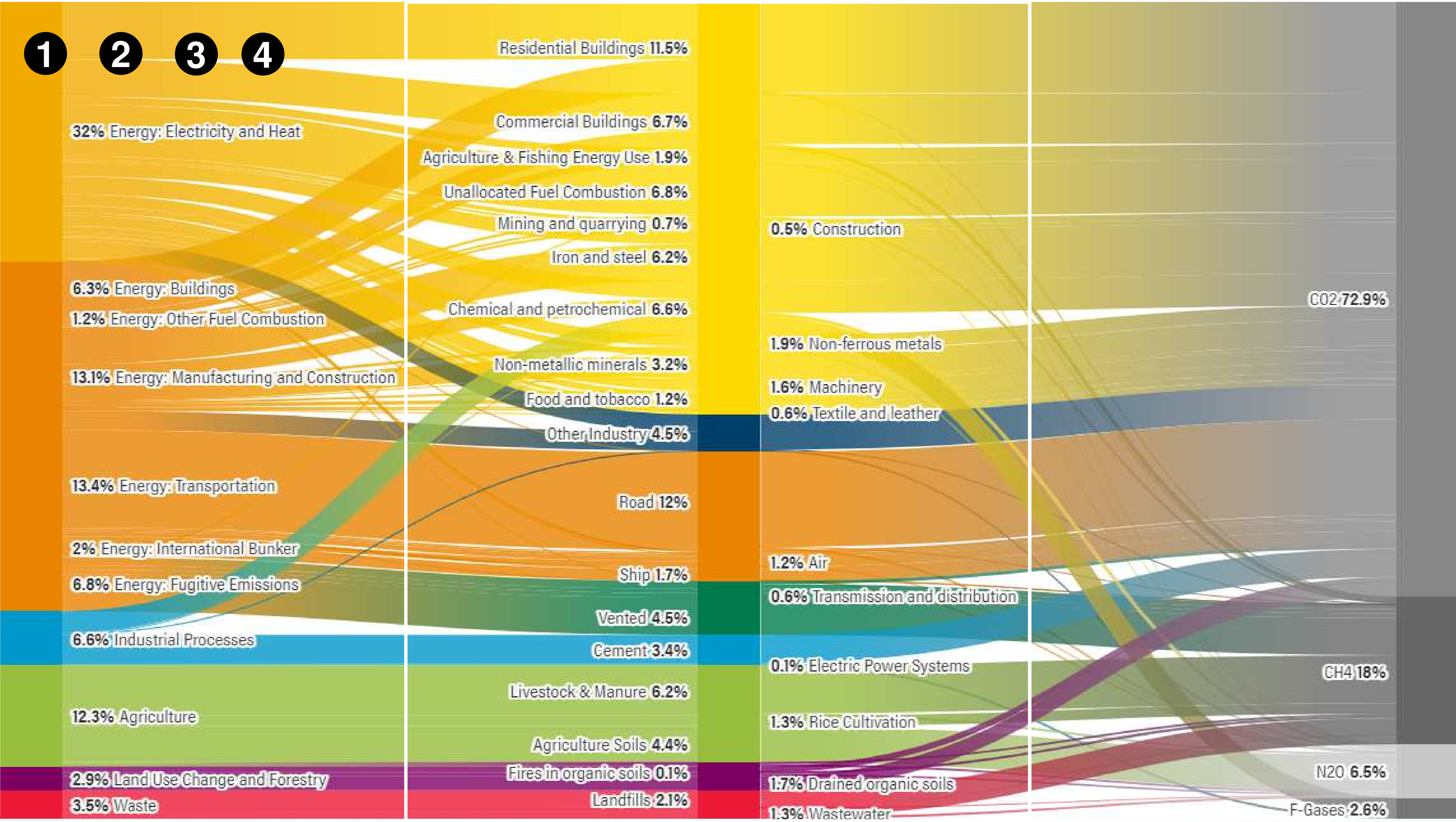
PROCESS RELATED EMISSIONS

$$F(Output)\ x\ \frac{Input}{Output}\ x\ f(P)(\frac{Energy}{Input}\ x\ \frac{CO_{2e}}{Energy})$$

PRODUCT EMISSIONS

$$f(p)(\frac{Energy}{Input}\ x\ \frac{CO_{2e}}{Energy})$$

- *Materials f(rm) depend on the energy per unit of raw materials and the carbon intensity of the energy produced.*
- *Process f(P): depends on the activity, efficiency, and the carbon intensity of the energy consumed.*
- *Product f(p): depends on the product efficiency and the carbon intensity of that energy.*



1
2
3
4
32% Energy: Electricity and Heat
6.3% Energy: Buildings
1.2% Energy: Other Fuel Combustion
13.1% Energy: Manufacturing and Construction
13.4% Energy: Transportation
2% Energy: International Bunker
6.8% Energy: Fugitive Emissions
6.6% Industrial Processes
12.3% Agriculture
2.9% Land Use Change and Forestry
3.5% Waste
Residential Buildings 11.5%
Commercial Buildings 6.7%
Agriculture & Fishing Energy Use 1.9%
Unallocated Fuel Combustion 6.8%
Mining and quarrying 0.7%
Iron and steel 6.2%
Chemical and petrochemical 6.6%
Non-metallic minerals 3.2%
Food and tobacco 1.2%
Other Industry 4.5%
Road 12%
Ship 1.7%
Vented 4.5%
Cement 3.4%
Livestock & Manure 6.2%
Agriculture Soils 4.4%
Fires in organic soils 0.1%
Landfills 2.1%
0.5% Construction
1.9% Non-ferrous metals
1.6% Machinery
0.6% Textile and leather
1.2% Air
0.6% Transmission and distribution
0.1% Electric Power Systems
1.3% Rice Cultivation
1.7% Drained organic soils
1.3% Wastewater
CO2 72.9%
CH4 18%
N2O 6.5%
F-Gases 2.6%

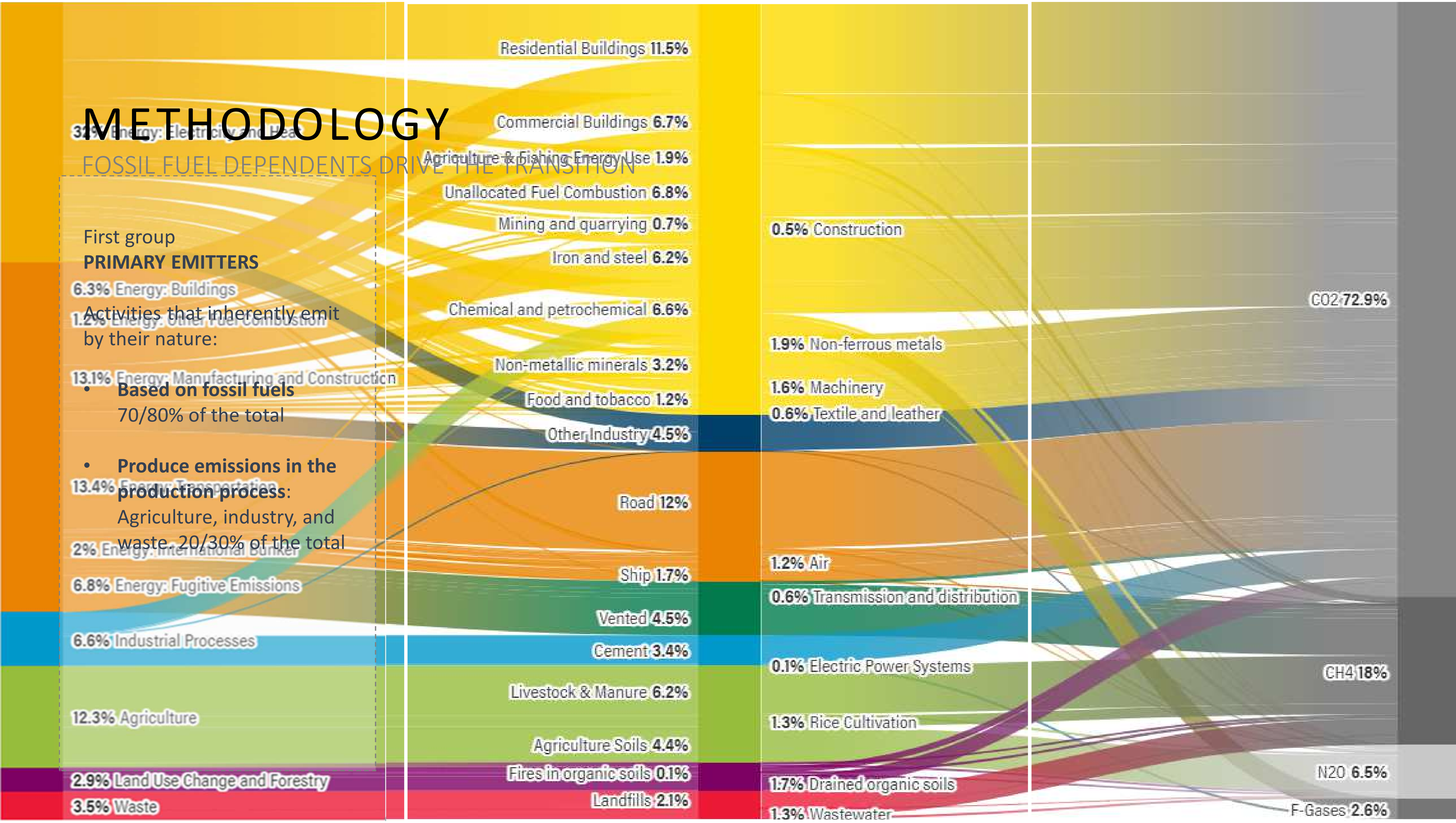
METHODOLOGY

FOSSIL FUEL DEPENDENTS DRIVE THE TRANSITION

First group
PRIMARY EMITTERS

Activities that inherently emit by their nature:

- **Based on fossil fuels** 70/80% of the total
- **Produce emissions in the production process**: Agriculture, industry, and waste. 20/30% of the total



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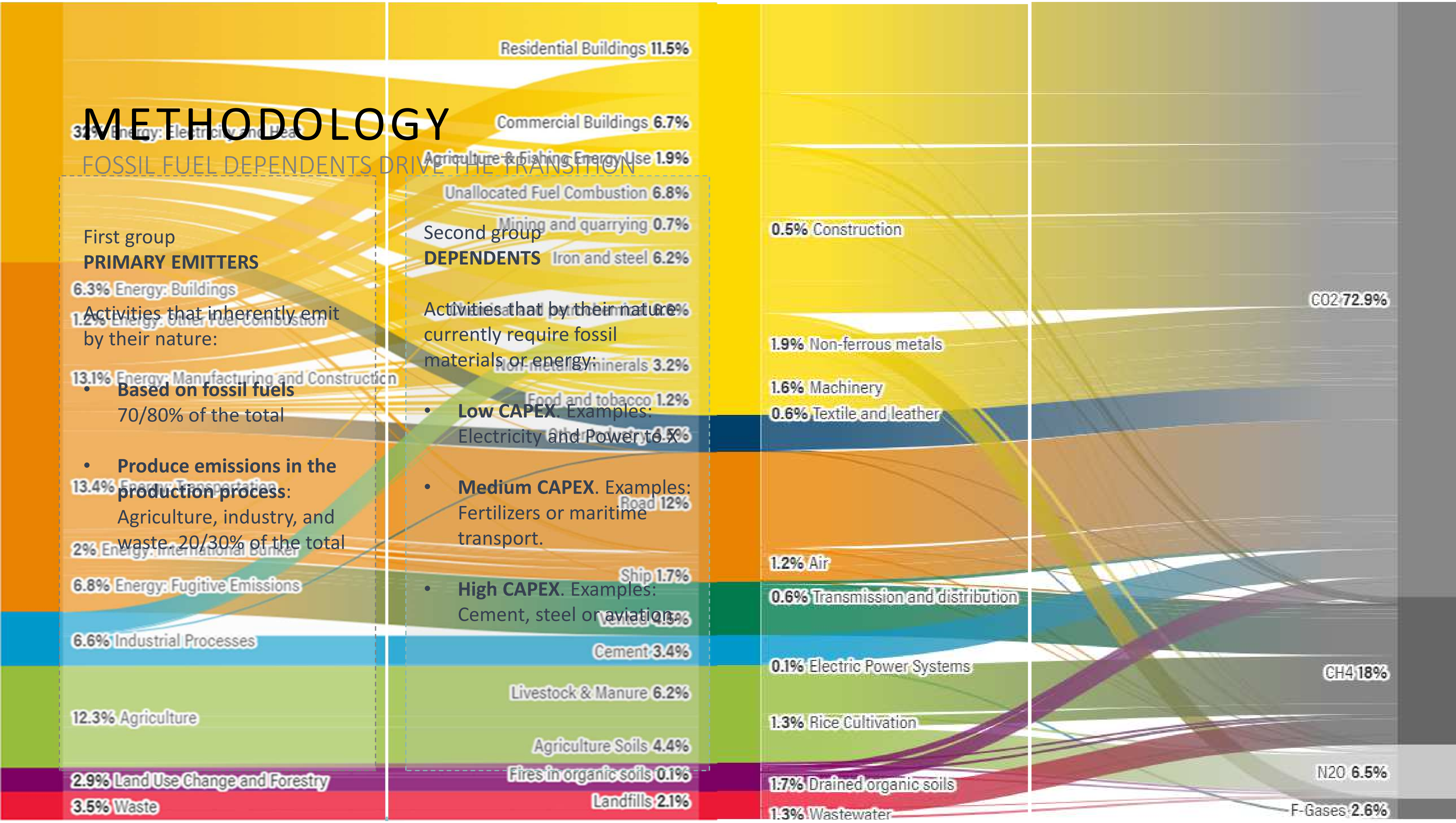
Second group
DEPENDENTS

Activities that by their nature currently require fossil materials or energy:

- **Low CAPEX**. Examples: Electricity and Power to X
- **Medium CAPEX**. Examples: Fertilizers or maritime transport.
- **High CAPEX**. Examples: Cement, steel or aviation.



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Third group
USERS

Activities that by their nature can have an impact **on demand**:

- Construction
- Food
- Retail
- Tourism
- Telco
- …

CDP data base 2018-2021

CEMENT	25 global companies
STEEL	21 global companies
AUTOMAKERS	20 global companies

The samples of the companies have been selected based on two criteria: contribution to emissions and the availability of complete series from 2018-2021. Both factors are according to the CDP database. Whenever CDP data has been handled, the original data available in the database has been considered and has not been subjected to any processing.

ANALYSIS AND RESULTS

MATERIAL FACTORS

$$\overset{\Delta}{\rightarrow} CO_{2e} = Activity\ x\ \frac{Production}{Activity}\ x\ \frac{Energy}{Production}\ x\ \frac{CO_{2e}}{Energy}$$

MATERIALS → PROCESS RELATED EMISSIONS → PRODUCT EMISSIONS

Industry	$f(rm)(\frac{Energy}{Input} x \frac{CO_{2e}}{Energy})$	$F(Output)\ x \frac{Input}{Output} x\ f(P)(\frac{Energy}{Input} x \frac{CO_{2e}}{Energy})$	$f(p)(\frac{Energy}{Input} x \frac{CO_{2e}}{Energy})$
AUTOMAKERS	$t\ steel\ \frac{CO2e}{t\ steel}$		$km\ \frac{CO_{2e}}{km}$
CEMENT		$F(cement) \frac{CO2a1}{Output}$	
STEEL		$F(steel) \left(\frac{Energy}{Input}\right) x \left(\frac{CO_{2e}}{Energy}\right)$	

ANALYSIS AND RESULTS

MATERIAL FACTORS

AUTOMAKERS

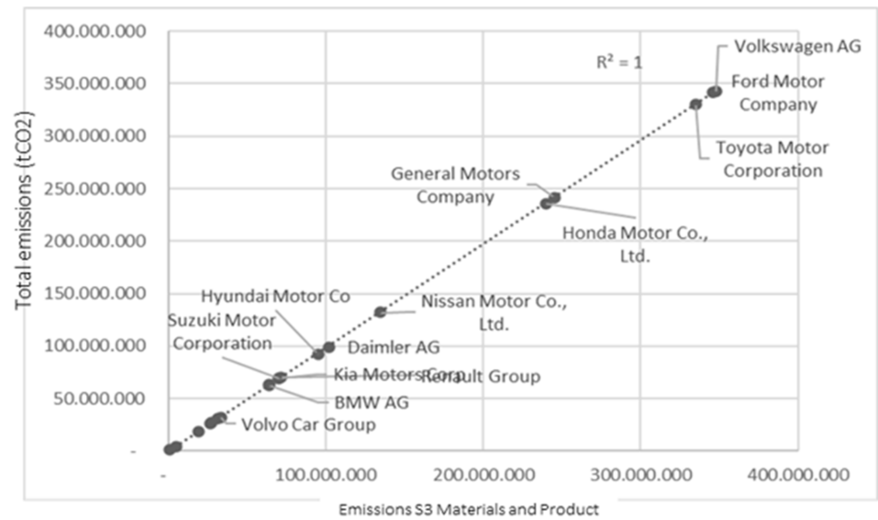
The emissions from cars, trucks, and other road transport vehicles account for about 75% of all carbon emissions from mobility, approximately 6GtCO_2 per year (15% of the total global CO_2 emissions) (Moller & Shaufuss, 2022).

98% of the reported emissions from the sampling come from Scope 3.

In this sector, the first decarbonized alternative is already on the market – BEV – These have half the emissions of combustion cars – 50% comes from the characteristics of the electricity they consume.

In the automotive industry these four factors perfectly correlate with global emissions, so we could say that these are the material factors.

Graph 1: Total emissions compared with the Purchased goods and Use of sold products emissions reported by NAuto (2021).



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$$F(vt) = t\ \text{steel}\ \frac{CO2e}{t\ steel}\ x\ kwh\ \frac{CO2e}{kwh}\ x\ Units\ km\ \frac{CO_{2e}}{km}\ x\ \boldsymbol{Energy}\ \frac{\boldsymbol{CO_{2e}}}{\boldsymbol{Energy}}$$

Structure | Battery footptint | WLTP | Local CO2 electricity intensity

*World Harmonized Light-duty Vehicle Test Procedure

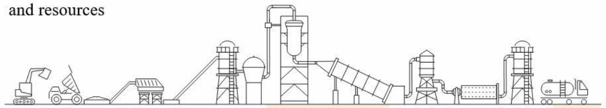
ANALYSIS AND RESULTS

MATERIAL FACTORS

CEMENT

The intensity of direct CO2 emissions from cement production has remained virtually stable over the past five years, and it is estimated to have increased slightly (by 1%) in 2022. However, annual reductions in CO2 intensity of 4% are required until 2030 for the sector to be on the path of the Net Zero Emissions by 2050 Scenario (NZE) (IEA, 2023).

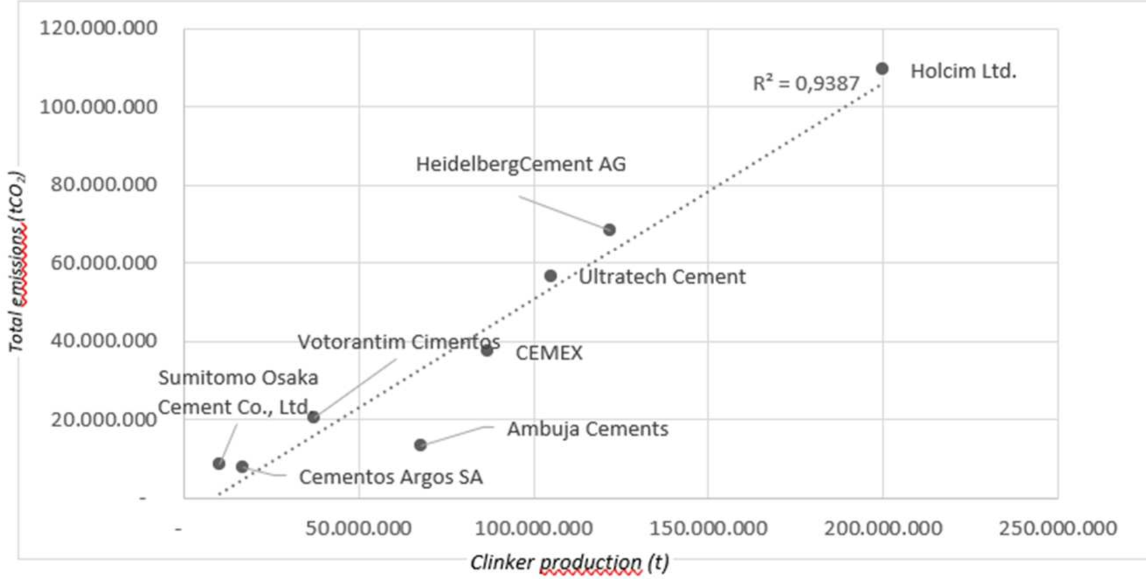
CO2 emissions (N25): 79% S1, 4% S2 and 18% S3



	Quarry	Crusher	Transport *	Raw mill	Kiln and preheater/ precalcinator §	Cooler †	Cement mill	Logistics ‡	Total
Energy (MJ/ton)	40	5	40	100	3,150	160	285	115	3,895
CO2 (KG/ton)	3	1	7	17	479 calcination process; 319 fossil fuels	28	49	22	925

* Assumed 1kWh/tonne/100m.
§ Assumed global average, data from Global Cement and Concrete Association (2017).
† Assumed reciprocating grate cooler with 5kWh/tonne clinker.
‡ Assumed average truck transportation of 200 km.
Source: Mckinsey data.

Graph 3: Total emissions (S1+S2+S3) vs Clinker production. NCem (2021).



1

$$Ft = F(cement)\frac{CO2a1}{Output} = \boxed{F(cement)\frac{Clinker}{Output}}$$

In the cement industry clinker production correlate with global emissions, so we could say that this is the material factor.

ANALYSIS AND RESULTS

MATERIAL FACTORS

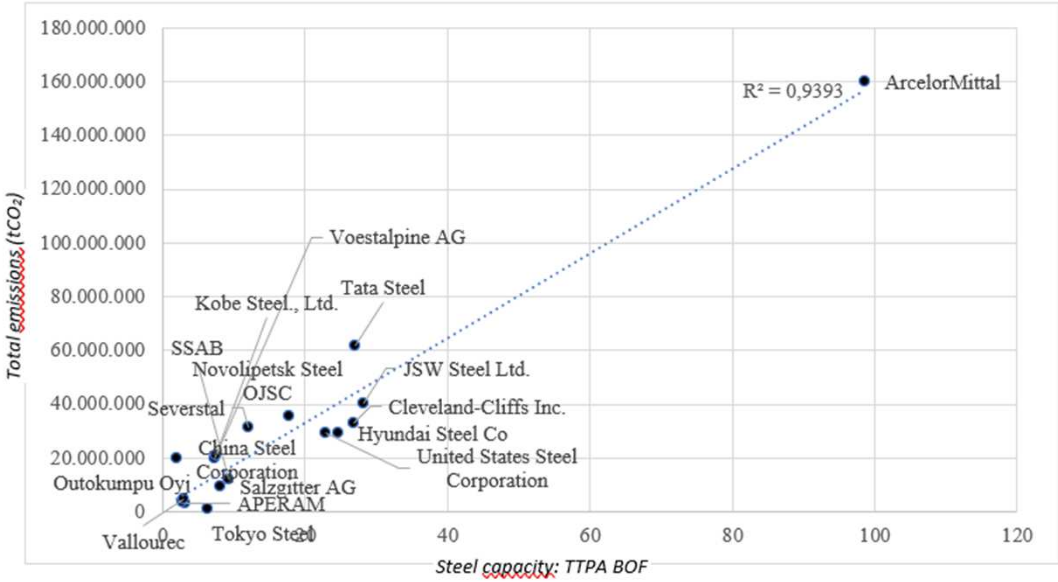
STEEL

Between 2002 and 2012, the volume of steel production increased by 72% worldwide, and emissions increased by 75%. (Xylia et al., 2018). It is a significant source of CO2 emissions, being responsible for 2.8 gigatonnes of annual CO2 emissions, which represents 8% of global emissions (IEA, 2023), accounting for approximately 25% of global industrial emissions.

Three main steel industrial processes (IEEFA, 2022):

	Direct CO2/t steel	Direct and indirect CO2/t steel	Energy(GJ/t)		Market share (%)
			IEA	*WorldSteel*	
BF-BOF	1.20	2.2	*21.4*	*22,7*	73.2
DRI-EAF	1.00	1.4	*17.1*	*21,8*	4.8
Scrap-EAF	0.04	0.3	*2.1*	*5,2*	21.5

Graph 5: Total emissions (S1+S2+S3) by company vs BOF Steel production (TTPA) by company NSteel (2021)



$$Ft = \mathrm{F}(steel)\ \left(\frac{Input}{CO_{2e}} x \frac{Output}{Input} x \frac{CO_{2e}}{Output}\right)$$

$$Ft = \mathrm{F}(steel)\left(\frac{Output}{Input} x \frac{CO_{2e}}{Output}\right) = \boxed{\mathrm{F(steel)}\left(\frac{Energy}{Input}\right) \mathrm{x} \left(\frac{CO_{2e}}{Energy}\right)} \quad (1)$$

In the steel industry Basic Oxygen Furnaces production and the source of energy for the rest of production process correlate with global emissions, so we could say that this is the material factor.

CONCLUSIONS AND RECOMMENDATIONS

PRACTICAL APPROACHES

The GHG Protocol, with its three-scope approach, has played An essential role in raising awareness among companies about their GHG emissions. However, it is having difficulties being applied to the professional uses needed today for the effective management of climate risks.

The limitations in the comparability of emissions observed over the past two decades do not seem to be resolved by the work of IFRS and EFRAG.

CONCLUSIONS

Focusing on those metrics that contribute material emissions in the value chain of companies simplifies the analysis, reduces costs, and directs action.

- To improve the comparability of emissions data, several key aspects of the GHG Protocol need to be revised, specifically:
  - General elements including the definition of consolidation boundaries, the selection of gases included in inventories, and the application of emission factors.
  - Considering that Scope 3 accounts the highest amount of emissions and offers the most calculation flexibility, it is relevant to segment these emissions by each phase of the value chain and to standardize the calculation methods.
- To strengthen its ability to report climate transition risks, emissions should be broken down by country, especially in Scopes 1 and 2, to adequately assess transition risks encompassed with the National Determined Contributions (NDCs).

CONCLUSIONS AND RECOMMENDATIONS

PRACTICAL APPROACHES

RECOMMENDATIONS

To evolve corporate climate metrics, *three initial drivers are proposed*:

- **GOVERNANCE**: The GHG Protocol or its future equivalent should have a multistakeholder structure and be under the auspices of a global public entity.
- **MATERIAL RISKS ORIENTED METRICS**: The identification of the accounting metrics by industry in setting net-zero commitments should be linked to the countries' Paris Agreement (NDCs) to become more efficient management tools.
- **TRANSITION PLANS**: Translation of the transition plans (forward looking information based on material emissions across the value chain) into mandatory corporate accounting statements/information so that they can be easily interpreted by financial risk assessment models.

LIMITATIONS AND FUTURE RESEARCH

LIMITATIONS

- The findings are preliminary and not as comprehensive as some other studies. Yet, the data collected enables identifying the decarbonization drivers in three crucial sectors.

- The study's quantitative approach has not yet engaged stakeholders, including companies, regulators, and financial institutions, in evaluating the effectiveness of these methodologies.

FUTURE RESEARCH

- Explore the application of strategic climate metrics in financial auditing and a more detailed approach in sectoral decarbonization planning.

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