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## **Corporate Greenhouse Gas Emissions: a micro-level environmental Kuznets curve evaluation**

Marine Kohler, Pascal da Costa, Peter Fox Penner, Natalia Costa I Coromina

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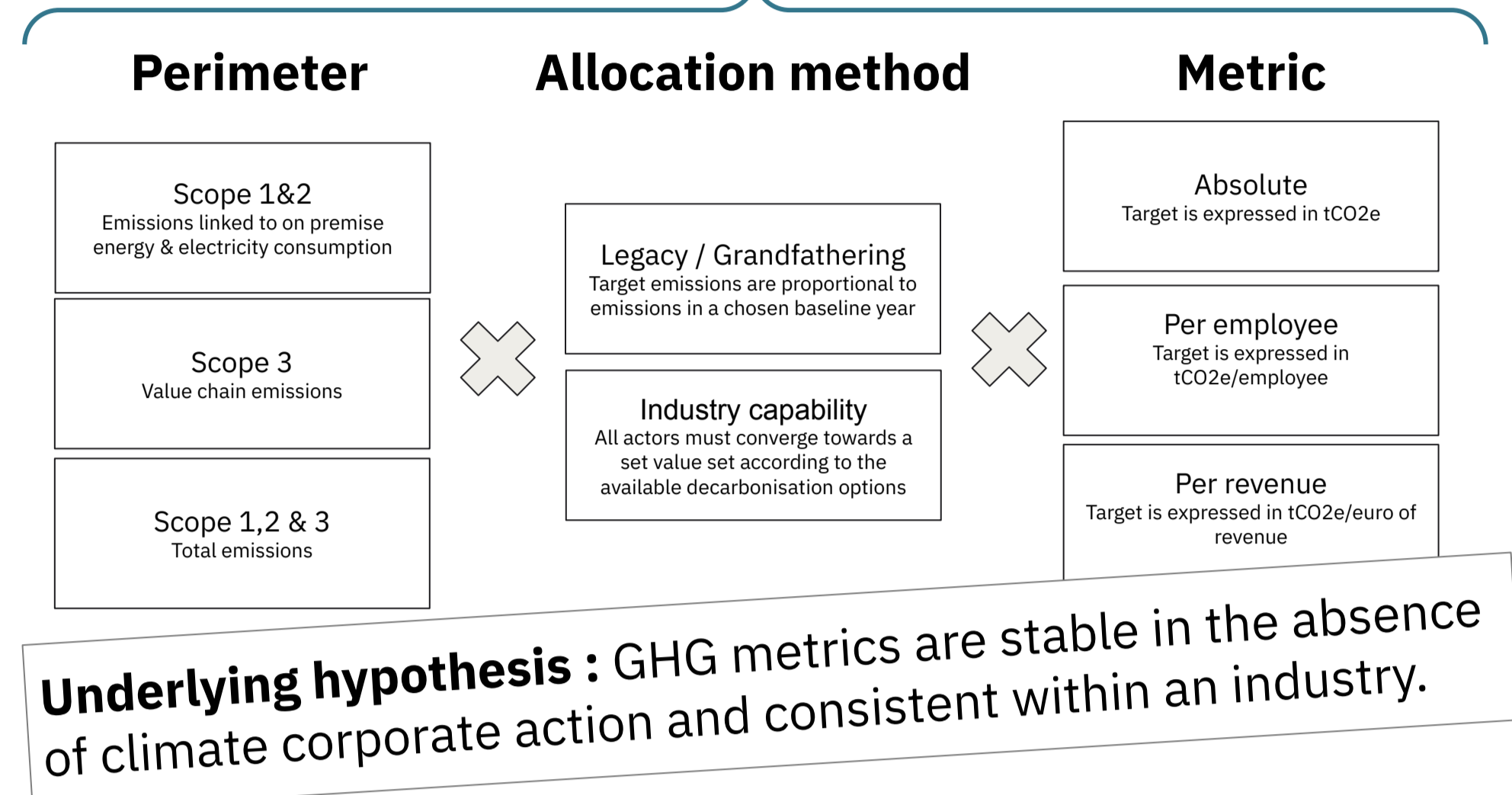
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## Current corporate GHG targets

In the absence of mandatory emission reduction objectives, NGO and private sector coalitions developed frameworks for companies to set Paris-Agreement compatible yet fair emissions reduction targets.



### Individual corporate target



## Method

### Focus

- How do GHG metrics behave **empirically pre climate action**?
- In particular, do they follow an **environmental Kuznets curve (EKC)**?
- Is there a **difference** in behavior **between metrics and perimeters**?

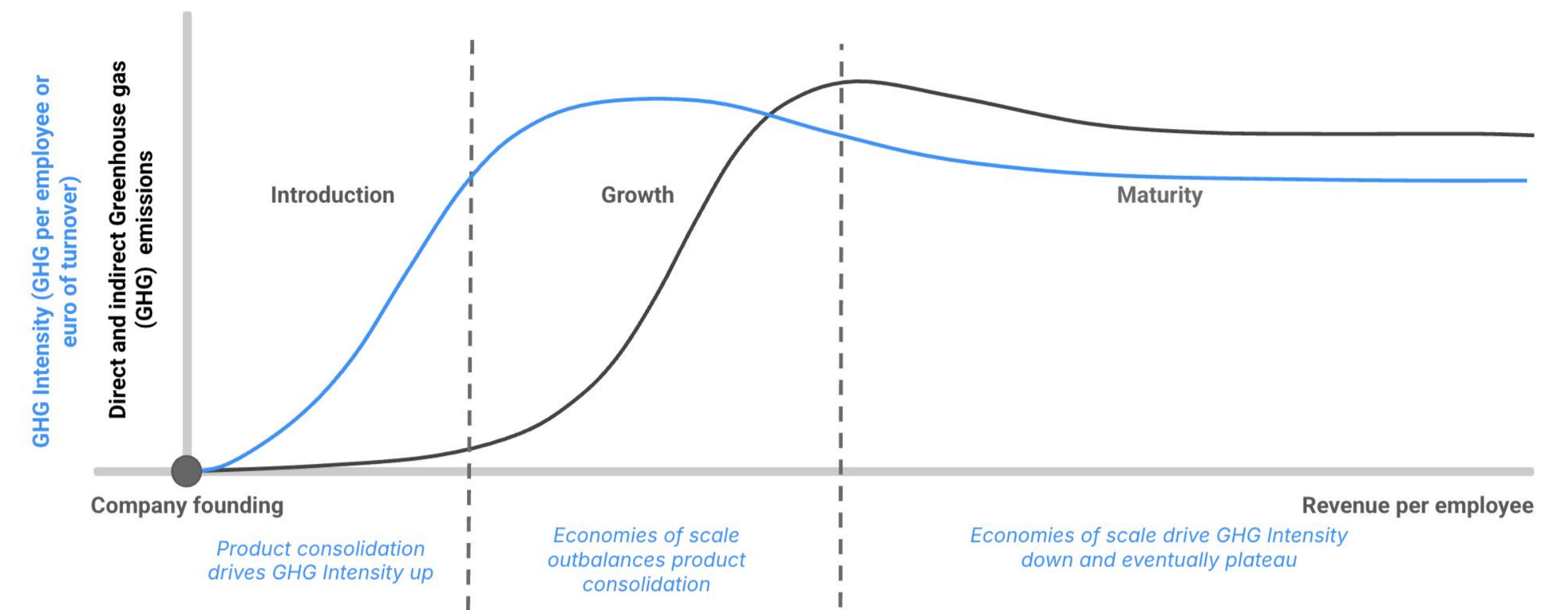


Figure 1 - Illustration of hypothesised corporate level EKC

## Dataset

<b>greenly</b>	<b>GREENHOUSE GAS PROTOCOL</b>	<b>1399</b> assessments	<b>1047</b> companies
<b>2019-2024</b>	<b>0 to 2 billions</b> 2015 euro of revenue	<b>2 to 4980</b> full time employees	<b>75%</b> Tech and services

## Tools

- Lasso** fixed effects selection to limit multicollinearity
- Competing **polynomial, panel piecewise & exponential saturation** regression models with **industry fixed effects** and **heteroscedasticity-consistent** standard errors
- Mixed-effects panel Granger** causality test

## Results

### Intra firm variability

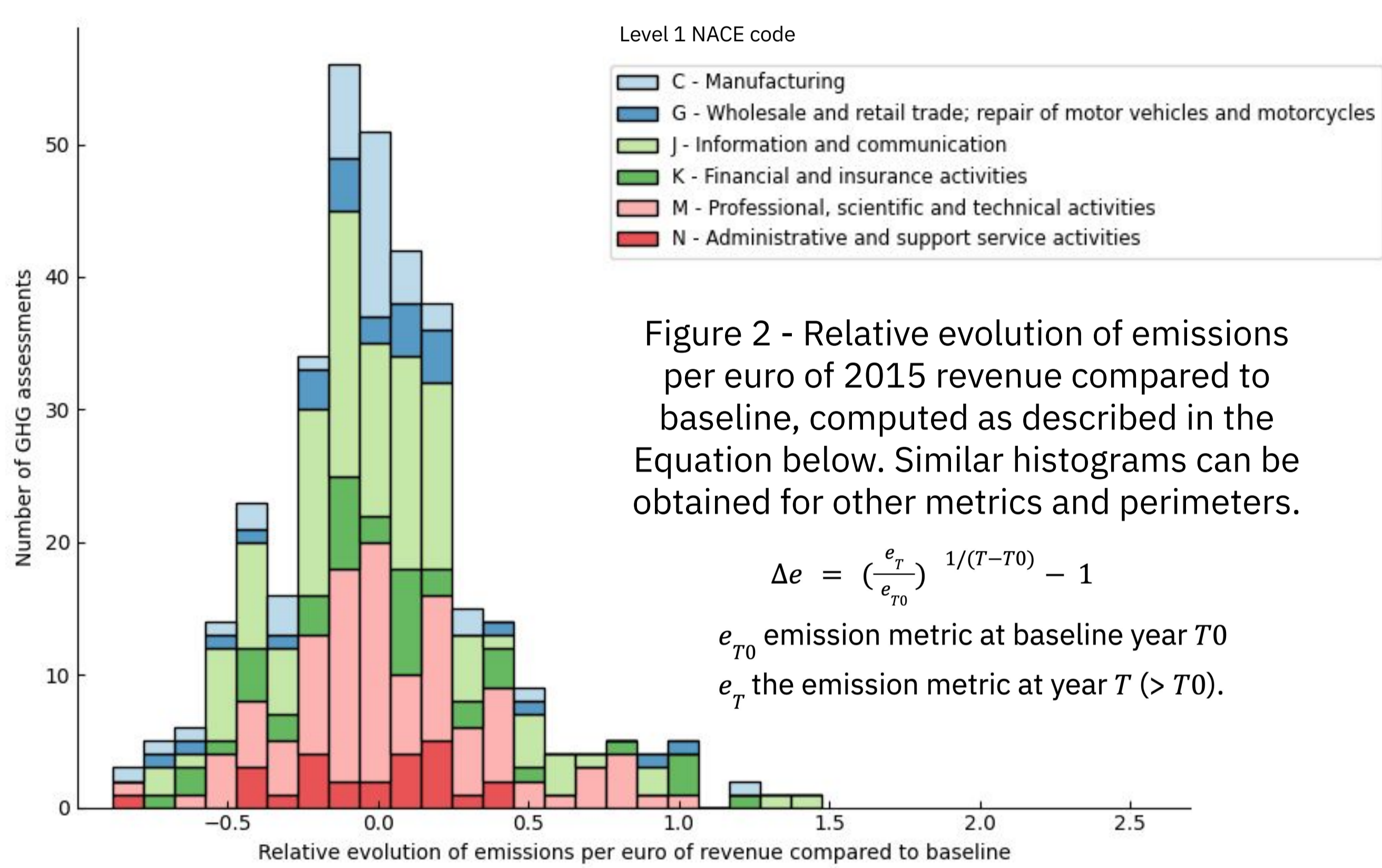
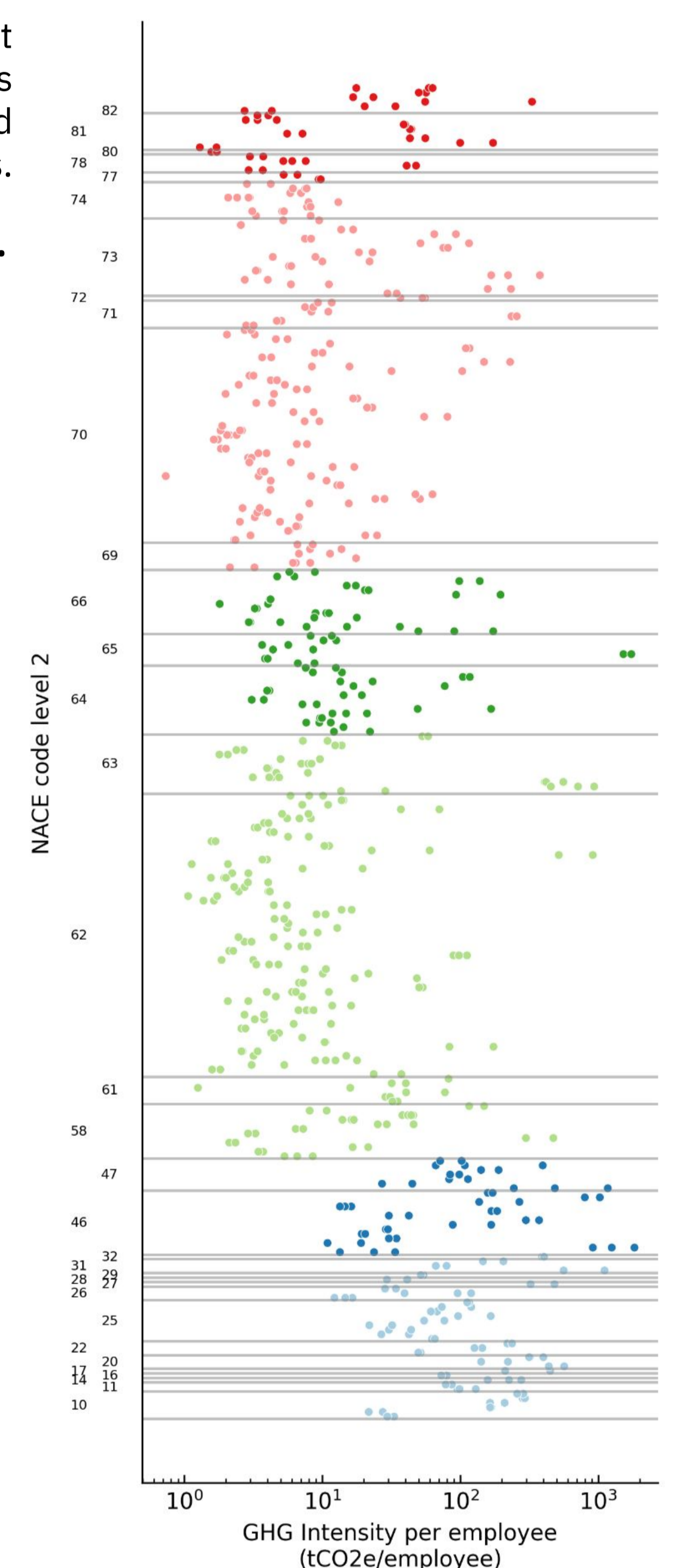


Figure 2 - Relative evolution of emissions per euro of 2015 revenue compared to baseline, computed as described in the Equation below. Similar histograms can be obtained for other metrics and perimeters.

### Inter & intra industry variability

Figure 3 - GHG intensities per full-time employee split among level 1 and level 2 NACE codes. Color legend is shared with Figure 1. Similar patterns can be observed for other metrics and perimeters.

- GHG data displays **significant year-on-year variability**. A qualitative outlier analysis shows year-on-year variability can be traced back to **methodology adjustments** (e.g. changes in computation approaches and accounting perimeters) and to **business decisions** (e.g. punctual raise in the use of subcontractors, moving upmarket, asset purchases and investments).
- While average GHG intensities in different NACE codes have **different orders of magnitude** (e.g. operations in manufacturing and wholesale and trade are roughly 10 times more carbon intensive than information and communication activities), each level 1 NACE code display **significant internal variability** and contains **outliers**. Part of this variability can be explained subdividing further industry into **level 2 NACE codes**.



## Evidence of micro-level EKC for emissions per employee and total emissions

We show **piecewise linear models are best suited** for predicting our data. **Absolute emissions and emissions per employee** typically **first rise** with revenue per employee before reaching a **plateau** (e.g. Figure 4a). On the contrary, emissions per euro of **revenue** typically **drop steeply, before decreasing slightly** as revenue per employee rises (e.g. Figure 4b).

Our **Granger causality** analysis suggest that evolutions in **scope 3** emissions and emissions per employee precede evolutions in revenue per employee, but changes in revenue per employee precede changes in emissions per revenue and **scope 1&2** emission per employee and total emissions.

Metric	Perimeter	Share of models including a tipping point	Average coefficient revenue per employee pre tipping point	Standard deviation of coefficient of revenue per employee pre tipping point	Average coefficient revenue per employee post tipping point	Standard deviation of coefficient of revenue per employee post tipping point
Emissions per employee	1&2	50%	2E+01	2E+01	-3E-02	1E-01
Emissions per revenue	1&2	29%	-2E+03	3E+03	-2E-01	5E-01
Total emissions	1&2	100%	1E+01	2E+01	4E-01	1E+00
Emissions per employee	3	29%	6E+00	9E+00	1E-01	3E-01
Emissions per revenue	3	43%	-6E+02	7E+02	9E-03	3E-01
Total emissions	3	71%	6E+00	9E+00	6E-03	2E-01
Emissions per employee	all	29%	6E+00	8E+00	1E-01	3E-01
Emissions per revenue	all	43%	-6E+02	7E+02	-3E-03	3E-01
Total emissions	all	83%	-3E-02	2E+01	6E-02	2E-01

Table 1 - Statistics on statistically significant to the 5% level piecewise linear model results across industries.

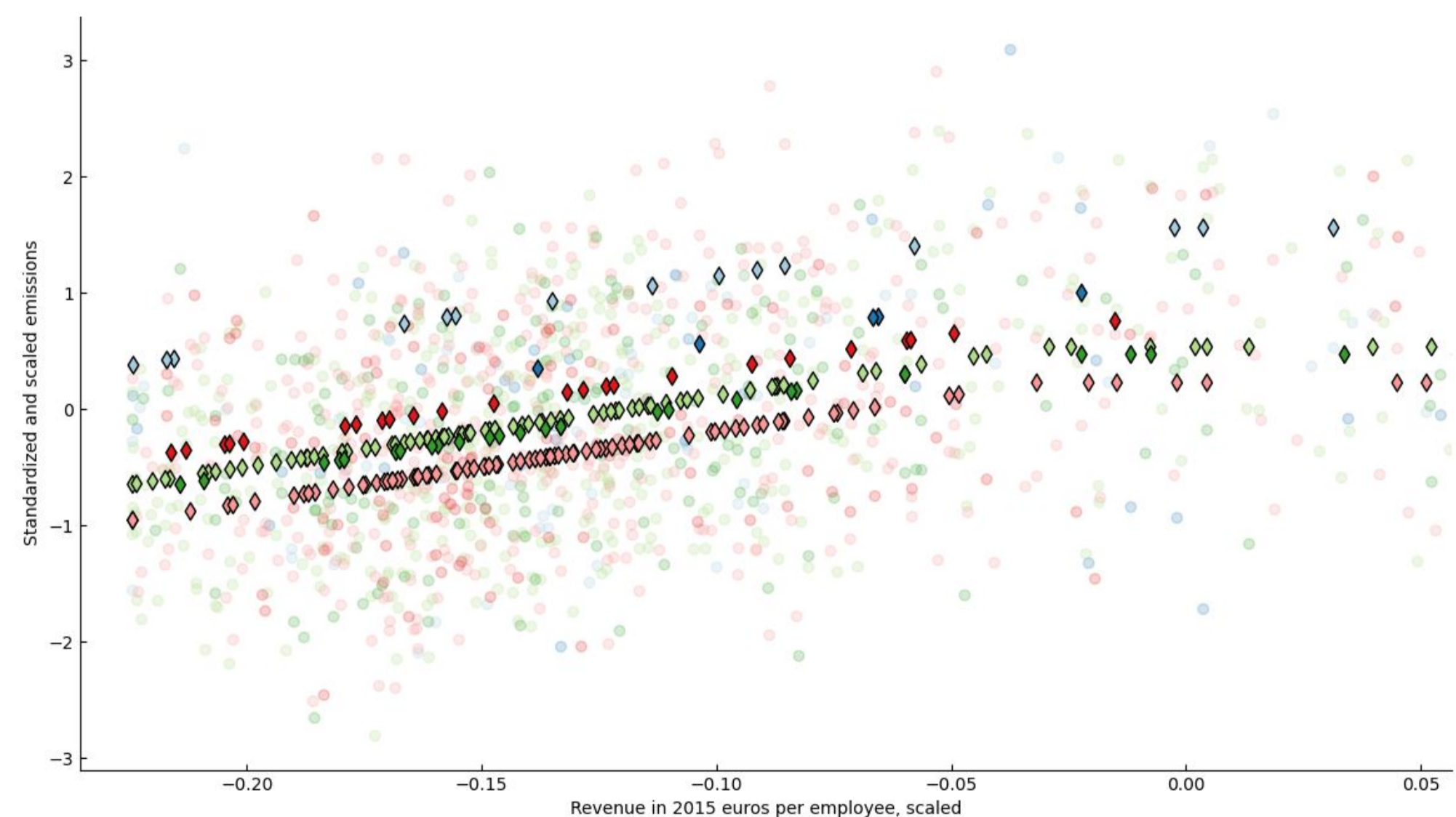
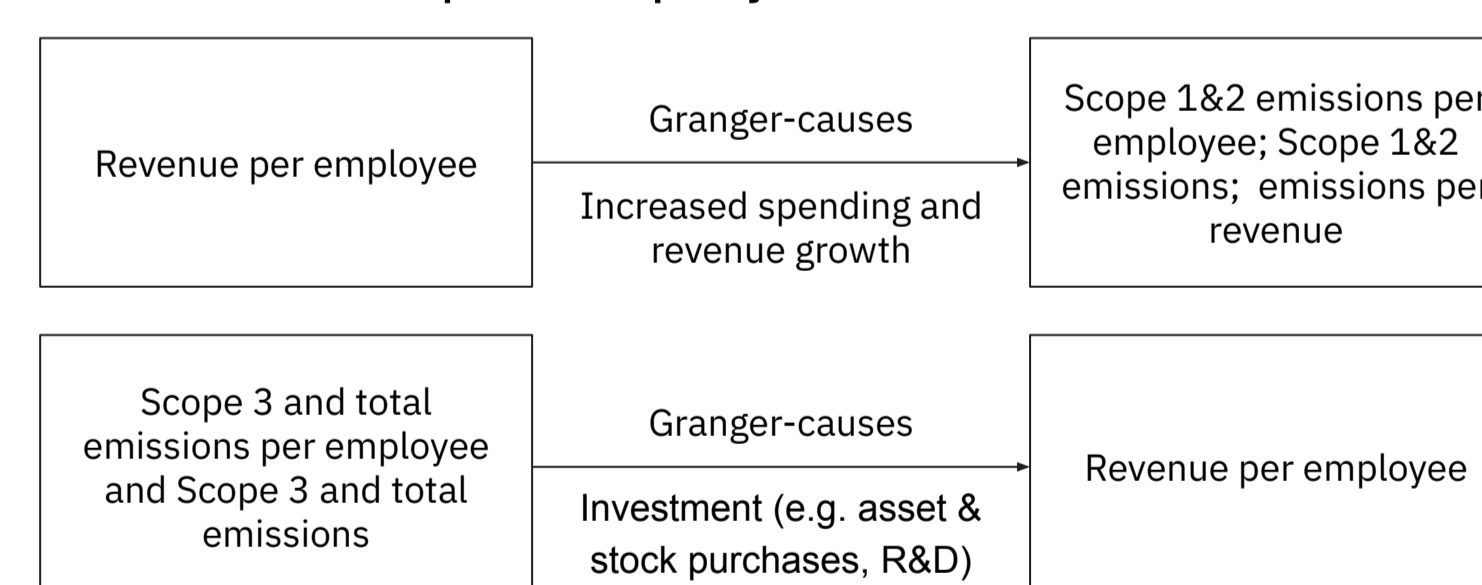


Figure 4a - Piecewise regression results for scope 1, 2 & 3 emissions across the full dataset. Color legend is shared with Figure 1, marker legend with Figure 4b.

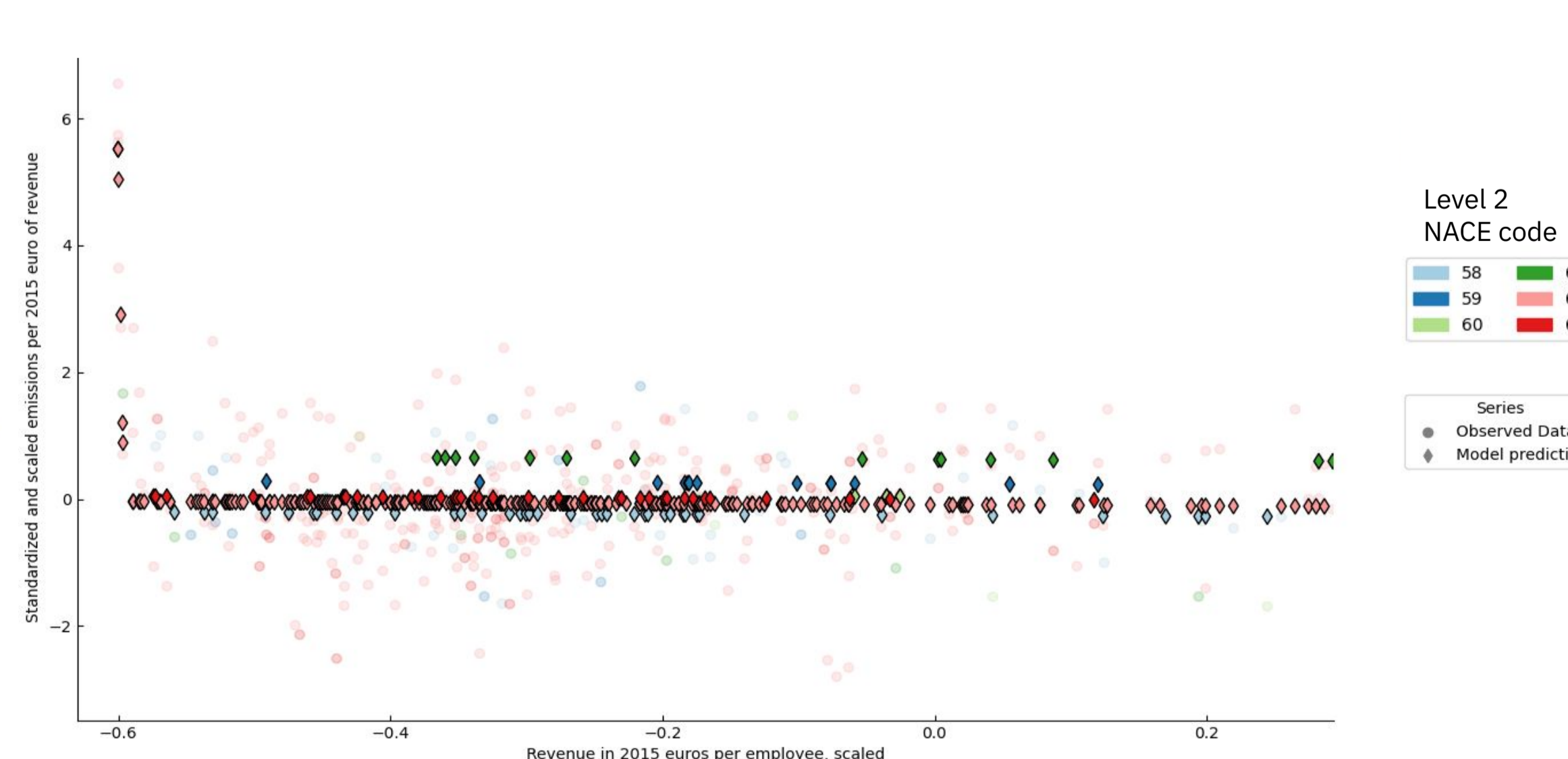


Figure 4b - Piecewise regression results for scope 1 & 2 emissions per euro of revenue for industry J - information and communication.

## Recommendations

- Mandate or encourage the **systematic disclosure of anonymous GHG datasets**,
- Review the **GHG Protocol standard** to enhance comparability
- When using grandfathering, **consider using the average** of a metric **over various years as the baseline**,
- Limit the use of grandfathering for SMEs that have not reached the emission plateau**,
- Limit the use of emissions per euro of revenue**.