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TOXICITY RANKING OF EUROPEAN INDUSTRIAL FACILITIES
A LARGESCALE SOLUTION FOR THE EUROPEAN GREEN DEAL

INTRODUCTION

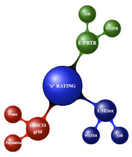
We present a methodology to improve environmental assessment of European facilities, companies, industries and regions by linking the European Pollutant Release and Transfer Register (EPRTR) and USEtox, a consensus model for characterizing human toxicity and biodiversity impacts of chemicals. The key advantage of our methodology is that it can be used to measure progress towards the UN's Sustainable Development Goals and towards the environmental objectives in the EU Taxonomy regulation on the company facility level and regionally.

The key novelty of our research is that we constitute methods to broaden the scope of environmental assessment to non-listed companies in the European Union (EU).

Investors, consumers, regulators, banks and other financial intermediaries increasingly need ESG information to make decisions. We present results on the company facility level, and further statistics on various pollutants
and major industries across EU regions.

Emissions (E) of substances (i) in the EPRTR are multiplied by their USEtox 2.12 midpoint human-& ecotoxicity characterization factors (CFs) and aggregated across all substances and release media (j), Eq (1).

$$Impactpotential = \sum E_{ijk} \times CF_{ijk} \qquad (1)$$



RESULTS

Pollutant releases by industrial facilities impact on humans and the environment. The seriousness of health and ecological consequences can be underestimated if only the quantity of pollutants is used. The health consequences at the societal level depend also on the release media, length of exposure and population density. Our results are presented here in terms of human toxicity and ecotoxicity impact potentials of point source emissions in Europe by major pollutants in the E-PRTR regulation, by industries and across regions. Impact potentials are measured in Comparative Toxic Units for human health (CTUh) and ecotoxicity (CTUe), respectively.

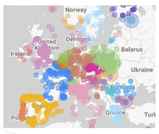
Companies in the electricity production sector are estimated to have the largest human toxicity (52% of total) in the EU and facilities in the sewerage sector the largest ecotoxicity potential (41%).

Table 1: Facilities with the largest human toxicity impact in the EU

No	Facility	NACE	Country
1	PGE Bełchat.	Electr. prod.	PL
2	RWE AG	Electr. prod.	DE
3	Enefit	Electr. prod.	EE
4	U.S.Steel	Manuf. iron	SK
5	TAMEH	Air cond. sply	PL

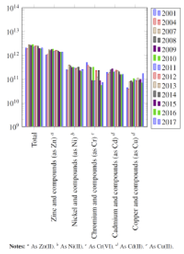
There are clusters of toxicity in the most industrialized regions of North-England, North-Italy, the German Ruhr-area, South-Poland, in the Benelux states, and in coastal areas of Spain, Portugal and Nordic countries.

Figure 3: Human toxicity of substances from largest European sources to air, water in 2017.



Human toxicity almost halved from 2001 to 2017, although the trend reversed in 2016. Ecotoxicity increased by 20% in the same period

Figure 1: Trend of contribution from substances with the largest contribution to ecotoxicity (CTUe)



Notes: [1] As Zn(II). [2] As Ni(II). [3] As Cr(VI). [4] As Cd(II). [5] As Cu(II).

CONCLUSIONS

Our study aims at broadening the coverage of company and facility level environmental impact measurement. Earlier methodologies assessed only CO2 and climate change risk.
- Human toxicity impacts: mostly by Hg compounds in the EU, accounting for 71% of total in 2017.
- The facility with the largest contribution to human toxicity is PGE Górn. Bełchatów, a coal-fired station in PL.
- The pollutant with the largest contribution to ecotoxicity: Zn in 2017 (55% of the total) .

The seriousness of health and ecological consequences can not be evaluated if only the quantity of pollutants are used.
- Sewerage (41%) is the industry with the largest estimated ecotoxicity footprint.
- Largest human toxicity footprint was estimated for Production of electricity (52%) .
- Our results are significantly important due to the fact that USEtox subcompartment level toxicity characterization factors are used for the EU based facilities and matched with point source industrial pollutant releases on the basis of EUROSTAT GISCO population density and distance-to-coast grid data.

We decomposed the results similarly to an earlier study on Sweden, and found that non-cancer human toxicity dominated the aggregated human toxicity impact potentials in Europe.
- Chromium compounds and, Polycyclic aromatic hydrocarbons(PAHs), mercury compounds and PCDD + PCDF (dioxins + furans) have the largest cancer toxicity impact potential
- Results are relevant for the EU taxonomy(Obj. 5: pollution prevention) and Non-financial Reporting Directive

FUTURE RESEARCH

Broadening the scope of the chemical footprint analysis in terms of geographic coverage, pollutant list or indicators (e.g. waste) could be interesting research objectives.

The EPRTR data used in our research covers pollutants which enter the environment from point sources, for example from smokestacks or from discharge pipes of EU facilities. Nonpoint source pollution is more difficult to monitor and neither covered by the EPRTR database nor by our study. The additive toxicity calculation formula in our analysis does not take into account the large number of possible interactions. Especially, the investigation of toxicity consequences from zinc's and mercury's interactions with other pollutants could be a potential research directions.

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