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TOWARDS SUSTAINABLE CHEMICAL INTENSITY

A global, inclusive goal for the sustainable use of chemicals is needed to safeguard both societal wellbeing and earth's life-sustaining capacity

Purpose of this Thought Starter

With this thought starter, the German Environment Agency (UBA) intends to spark further discussion and research on finding a chemicals intensity which respects societal wellbeing, human health, the functioning of ecosystems and related boundaries[1], at local to global levels.

Thus, we promote the idea of a global goal for sustainable chemical intensity, in view of the current critical situation and its extrapolation into the future, and present a possible pathway to delineating such a goal.

Baseline, extrapolation and synopsis

Globally increasing production, use, release, and dispersal of chemicals is an accumulating threat to human and planetary health unless urgent action is taken. Despite significant efforts and progress in the sound management of chemicals and waste, the global community has not met its Sustainable Development Goal (SDG) 12.4 of the 2030 Agenda[2]. Further to this, many other SDGs will likewise not be achieved if the release of chemicals to air, water and soil is not significantly reduced. On the contrary, the global situation will worsen and transformation to sustainability will become ever more difficult.

While some successful regulatory and other chemicals management regimes cater for limiting exposure to and releases of harmful chemicals, such regimes are far from being fully effective at global scale. A consequence to this situation is that just a few chemicals cause annually 2 million deaths worldwide and cost a minimum of 45 million healthy life years[3]. Pollution, including chemicals, continues to be an important driver for biodiversity loss[4]. In terms of greenhouse gas emissions from manufacturing industries, for example, the German chemical industry is the biggest consumer of primary energy in Germany and thus an important emitter[5].

The extent of the challenge is spelled out by the prospects that chemicals production capacity will globally increase by a factor of 2.3 per capita[6] from 1990-2030. At the same time, the number and complexity of chemicals as well as the diversity of chemicals uses are growing.

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[1] Currently, according to the planetary boundary concept as outlined by Rockström et al. and Diamond et al, chemicals are mostly assigned to "novel entities", which is not well described so far.
[2] https://sdgs.un.org/2030agenda in which Sustainable Development Goal (SDG) 12 reads "Ensure sustainable consumption and production patterns" and its target 12.4 "By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment" – note the 2020 timeline of this 2030 Agenda target and cf. GCO II (footnote 8) on missing the 12.4 "2020 goal of chemicals management"
[3] Further relevant estimates are provided by GAHP, see Sinai_Commission_on_Pollution_and_Health_Infographic_final_LETTERSIZE.pdf (gahp.net)
[4] UNEP 2020: Global Biodiversity Outlook 5 (target 8)
[5] https://www.umweltbundesamt.de/daten/umwelt-wirtschaft/industrie/branchenabhaengiger-energieverbrauch-des#primarenergienutzung-des-verarbeitenden-gewerbes
[6] UNEP 2019: Global Chemicals Outlook II (full report, cf. figure 3.1 + related text)

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Overall, exposure to harmful chemicals and chemical pollution is expected to increase in many parts of the world.

On the other hand, chemicals and their services provide solutions for almost all fundamental needs of societies, like housing, nutrition, water supply, clothing, healthcare, sanitation, mobility, energy supply, electronics, or communication. For this reason, the intensity of their use has to be balanced between their societal benefit and earth's life-sustaining capacity. To find this balance, new ways are required to determine how the use of chemicals can, throughout their life cycle, effectively minimise adverse impacts and maximise benefits for societal wellbeing and transformation towards sustainability. Moreover, the obvious need to move towards more circularity will reinforce voices requesting chemicals safety and sustainability.

Towards an inclusive chemicals goal

Overall, humankind's transition to sustainable development is inextricably linked to how chemicals are used. Global chemical intensification might therefore be recognized as an indicator for the urgency to embark on action to reach the sustainability goals. In particular, there is the need for a systematic preclusion of chemical threats, to abandon pollution, and to reduce negative impacts on resources and ecosystems. In order to bundle and strengthen efforts across sectors, the well-proven instruments of chemicals management urgently require science-based complementary qualitative and quantitative orientation since they are having limitations with respect to the sheer quantity and complexity of the subject[7].

A universal target defining a safe und just operating space, or corridor[8], for chemical intensity could enhance orientation and promote coherence of actions from global to local levels. Developing such a universal target for chemicals would support reflection on which chemical intensity is warranted in view of societal wellbeing, human health, and the functioning of ecosystems including preservation and restoring of biodiversity. Setting such a goal would urge to explore chemicals threats and counteract pollution, as well as to draw direct attention to other sustainability dimensions and keeping the impact of human activities within earth's life-sustaining capacity[9]. In essence, such goal would consequently orient the use of chemicals towards sustainability and safety: it would promote transformative measures with progressive

[7] The EU Green Deal reflects on the scientific evidence that pollution is the third global crisis (together with climate change and biodiversity losses) to be tackled for humankind's future-proof path towards sustainability.

[8] We decided to use the term "corridor", since terms like "limit" or "safe operating space" have their own connotation and might pre-empt discussions: While the term "limit" might too much suggest hard regulatory thresholds, the concept of a "safe operating space" initially coined 2017 by Kate Raworth has apparently neither been validated as such nor been shown to be applicable to chemicals, yet.

[9] See the SDGs and the principles of Sustainable Chemistry:

- Blum C, Bunke D, Hungsberg M, Roelofs E, Joas A, Joas R, Blepp M, Stolzenberg H C, 2017. The concept of sustainable chemistry: key drivers for the transition towards sustainable development. Sustain. Chem. Pharm. 5, 94–104. http://dx.doi.org/10.1016/j.scp.2017.01.001;
- Kümmerer, K., Clark, J., 2016. Green and sustainable chemistry. In: Heinrichs H, Wiek A, Martens P, Michelsen G (Eds.), Textbook on Sustainability Science. Springer, Berlin Heidelberg New York, pp. 43-60.
- Kümmerer K, Amsel A K, Bartkowiak D, Blum C, Cinquemani C: Key Characteristics of Sustainable Chemistry. Dialogue Paper by the International Sustainable Chemistry Collaborative Centre (ISC3), Bonn, Germany; https://www.isc3.org/en/activities/collaboration.html, aufgesucht am 15.03.2021
- https://sdgs.un.org/goals
- United Nations General Assembly, 2015 (A/RES/70/1): Transforming our world: the 2030 Agenda for Sustainable Development

reduction targets for chemicals use and for pollution where scientific evidence including precautionary considerations clearly suggest so.

Finding the right sustainable chemical intensity

Deriving an overall measure of the negative impact of chemicals on the carrying capacity of our planet, in analogy to the 1.5° goal for climate protection, has not yet been possible. Nevertheless, exploring a corridor of sustainable chemical intensity would help to focus on the consequences of human activities and to reflect on the different aspects of sustainability.

A corridor of sustainable chemicals intensity would stress the fact that more chemicals do not necessarily lead to societal benefits only, but can imperil planetary and human health. It would promote discussions about limits for chemical pollution and other aspects like environmental footprints of chemicals. At the same time, all sectors of societal demands would be orientated towards minimising chemical intensities required for a more sustainable satisfaction of needs. Result of these explorations might be a tenable chemical intensity which safeguards societal wellbeing, human health and the planet's life-sustaining capacity.

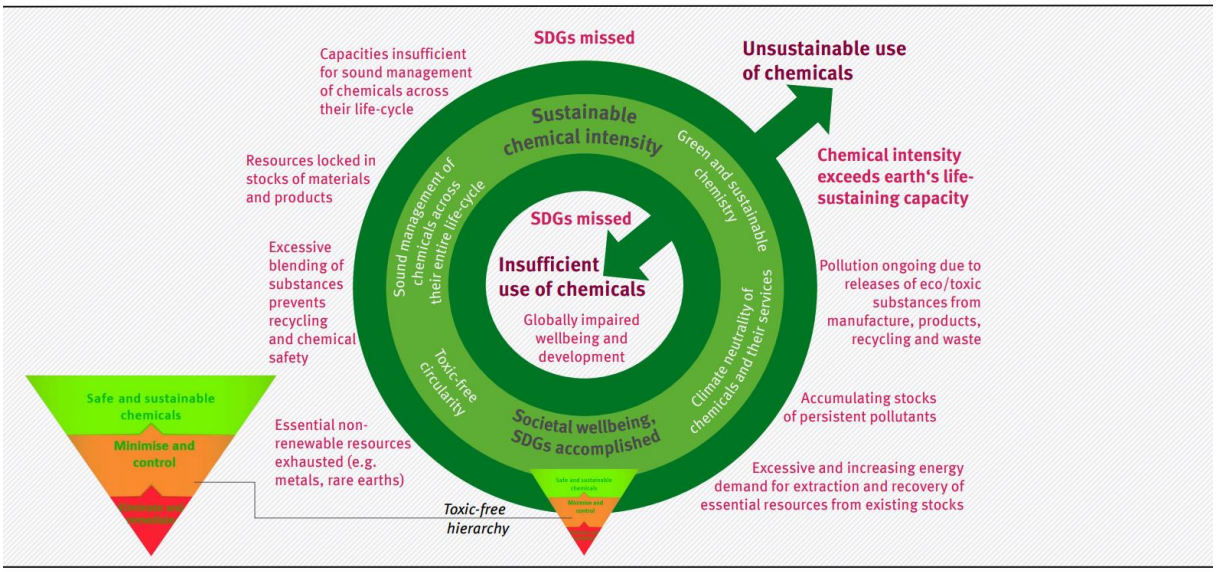

Figure: Sustainable chemical intensity as safe operating space for the use of chemicals. Inspired by Kate Raworth 2017: Doughnut Economy. Seven Ways to Think Like a 21st-Century Economist. Toxic-free hierarchy inserted from EU CSS[10]

This approach would have to explore figures for chemical intensities providing societal wellbeing under various conditions and to explore chemical intensities where evidence suggests exceedance of limits tolerable for human and environmental health. It will also require accounting for aspects such as (eco-)toxicity of certain substances, their origin and recyclability, their environmental dispersion, their overall diversity with resulting entropy extents, their material and energy resource demand, their environmental footprint (including greenhouse gas emissions), and possibly other resource, environmental and socioeconomic aspects related to the full life cycle of chemicals. In a concluding step, these explorations should be synthesised such that the unsustainable aspects of chemicals use are minimised while their benefits in relation to relevant sustainability dimensions are maximised.

[10] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0667&from=EN

More detailed suggestions for possible methodological approaches to derive a sustainable chemical intensity and connecting this to progressive pollution reduction as well as environmental footprint targets will be sketched out in a UBA Scientific Opinion Paper on this topic in the near future.

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