Sustainable chemistry labs bottom-up and top-down – a case study

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Laboratories consume five to ten times more energy than office buildings of the same size, consuming large amounts of energy and water, and producing hazardous waste.[1-3] For example, single use plastics from research contributes about 2% of global plastic waste (5.5 million tons annually).[4] Similarly, global research and development (R&D) contributed in 2022 an estimated 385 megatons of CO2e emissions, which is more than the annual emissions of for example the UK or the Netherlands.[5,6] Faced with significant and urgent global challenges, we scientists need to do our part to promote more sustainable practices and contribute to solve technological and societal challenges not only through our research findings, but also through how we conduct our science from day to day. In this presentation, we will cover our recent work on sustainable lab practices at the University of Groningen.[1,7] Starting with an overview of the state of matters, we will then give a hands-on workshop on what easy steps each of us can take to lessen the impact of our research practices in chemistry laboratories and beyond the next day.

[1] T. Freese, N. Elzinga, M. Heinemann, M. M. Lerch, B. L. Feringa, The relevance of sustainable laboratory practices. *RSC Sustainability*, **2024**, *2*, 1300-1336.

[2] EPA, K. Murray, W. Lintner, N. Carlisle, D. Sartor, "Laboratories for the 21st Century: An Introduction to Low-Energy Design" (2008). *https://doi.org/10.2172/907998*

[3] Royal Society of Chemistry, "Sustainable laboratories: A community-wide movement toward sustainable laboratory practices" (Cambridge, 2022); https://www.rsc.org/policy-evidence-campaigns/environmental-sustainability/sustainability-reports-surveys-and-campaigns/sustainable-laboratories/.

[4] M. A. Urbina, A. J. R. Watts, E. E. Reardon, Labs should cut plastic waste too. *Nature*, **2015**, *528*, 479–479.

[5] R&D: total global spending 2022, Statista. https://www.statista.com/statistics/1105959/total-research-and-development-spending-worldwide-ppp-usd/.

[6] Supply Chain Greenhouse Gas Emission Factors v1.3 by NAICS-6 - Catalog. https://catalog.data.gov/dataset/supply-chain-greenhouse-gas-emission-factors-v1-3-by-naics-6.

[7] T. Freese et al., A guidebook for sustainability in laboratories, V4, **2024**, *ChemRxiv*, *https://doi.org/10.26434/chemrxiv-2023-g3lmq-v4*.