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Executive Summary

GHG Accounting of a University of Vienna Laboratory Building

Background

In 2024, the University of Vienna partnered with Fraunhofer Austria to build internal greenhouse gas (GHG) accounting expertise, motivated by the growing recognition that Scope 3 emissions dominate institutional footprints (75–94% at comparable universities) and are not fully covered in ClimCalc[1], the existing GHG accounting framework for higher-education sector. The University of Vienna Biology Building (UBB) was selected as a pilot case study for reporting year 2023 due to its complexity as a laboratory building and its comparatively good data availability as a newly constructed site (2021).

Methodology

- Three knowledge-transfer workshops led by Fraunhofer Austria trained staff from relevant units (Scientific Staff, Facility & Resources Management, Finance & Controlling, Central IT Services, Sustainability Office) in GHG accounting principles and jointly with the University management defined project objectives and a roadmap.
- System boundaries were set to UBB for 2023, covering Scope 1 and 2 fully, plus the six of fifteen GHG Protocol Scope 3 categories judged relevant (purchased goods & services, capital goods, fuel- and energy-related activities, waste, business travel/study abroad, commuting).
- A value stream mapping workshop identified and grouped emission sources across departments, with small teams assigned to data collection per category.
- Given fragmented and inconsistently structured primary data, a spend-based approach (expenditure × emission factors from databases such as climatiq, Ecoinvent, and Labos1.5) was used for most purchased goods/services, supplemented by activity-based data where available (energy use, waste records, staff mobility/IT-usage surveys).
- For laboratory purchases, all spend-based data was manually sorted into categories defined by the working group. Emission factors for each category were assigned from a publication (De Paepe et al. 2024)[2]. A Python script was developed to clean the data and assign the identified emission factors to the individual booking lines.

[1] https://nachhaltigeuniversitaeten.at/arbeitsgruppen/co2-neutrale-universitaeten/

[2] https://doi.org/10.1371/journal.pstr.0000116

- A data-quality confidence scoring system and emission-factor uncertainty ranges were applied to compute conservative upper-bound emission estimates, per the GHG Protocol's conservativeness principle.
- These results were subsequently compared to a GHG footprint of UBB calculated using the ClimCalc accounting tool.

Results

- Total UBB emissions for 2023: 4,973.11 tCO_2eq (lower bound), rising to 6,346.75 tCO_2eq when accounting for data and emission-factor uncertainties.
- Scope 1: 72.23 tCO_2eq (1.5% of total), up to 88.13 tCO_2eq with uncertainty.
- Scope 2: 1,342.33 tCO_2eq (27%), up to 1,355.49 tCO_2eq with uncertainty.
- Scope 3: 3,558.55 tCO_2eq (71.56%) – the dominant category, and the one most affected by uncertainty, reaching up to 4,903.13 tCO_2eq.

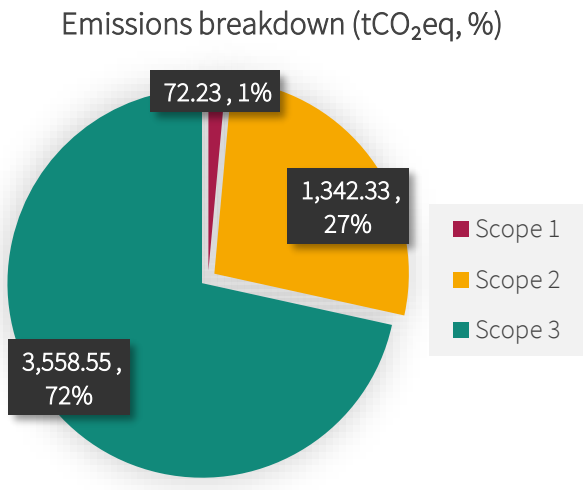

Figure 1: Percentage of Scope 1-3 emissions as part of total UBB emissions

- ClimCalc comparison: the University's standard tool estimated only 3,099.59 tCO_2eq total for UBB – an underestimate of at least 38% versus the full analysis. Scope 1 (72.23) and Scope 2 (1,342.22 tCO_2eq) matched closely, but ClimCalc captured only 47% of Scope 3 emissions (1,685.14 tCO_2eq), causing it to over-represent the relative share of Scope 1 (2.3%) and Scope 2 (43.3%) and under-represent Scope 3 (54.4%).

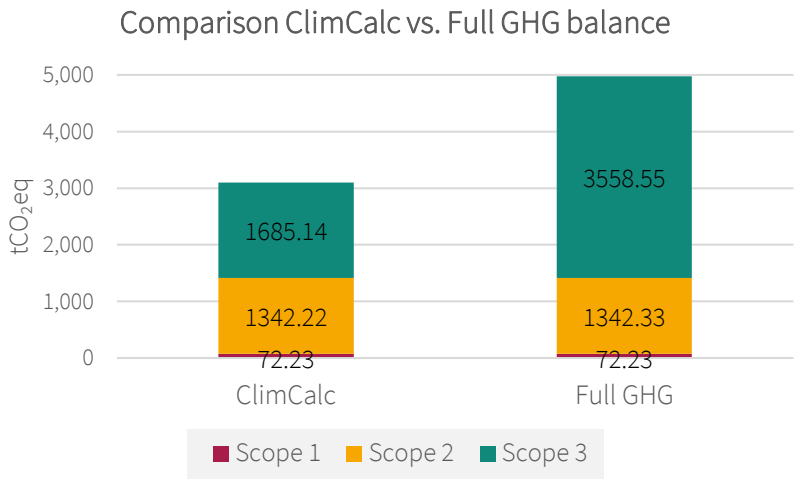

Figure 2: Comparison of GHG emissions accounting with ClimCalc vs. full GHG accounting

- Laboratory purchases (chemicals, consumables, equipment, research services) were identified as a major and highly granular Scope 3 contributor, calculated via averaged, subgroup-specific spend-based emission factors sourced from the Labos1.5 database.

Conclusion

The pilot confirms that Scope 3 emissions dominate the UBB carbon footprint and that the University's current ClimCalc-based accounting substantially underestimates total emissions by omitting relevant Scope 3 categories. The Python script and the identified average spend-based emission factors for the defined categories may be useful for similar life science research buildings in Austria to roughly estimate Scope 3 emissions not accounted for by ClimCalc. The findings underscore an urgent need for improved, structured data collection and management systems across university departments to increase the accuracy and scope of future GHG balances, and to support the development of meaningful emission-reduction plans on the path to the University of Vienna's climate neutrality goal.