GREENHOUSE GAS BALANCE OF THE UNIVERISITY OF SIENA

The University of Siena (Italy) has deliberated the monitoring of its greenhouse gas (GHG) emissions through the elaboration of GHG inventories in accordance with the Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 2006, 2019) and the Italian Network of Sustainable Universities Procedure (RUS, 2023). The GHG inventories of the Siena Athenaeum include the direct emissions and removals (Scope 1), as well as the indirect emissions due to the energy imported from the national grid (Scope 2) (ISO 14064:2019). The consumption of fossil fuels and electricity, needed for all the academic activities and buildings, are considered for the period 2018-2021 and converted in tons of carbon dioxide equivalent (t CO_2eq). The carbon dioxide (CO_2) uptake due to parks, flowerbeds, and gardens (trees, shrubs, and perennial agricultural crops), is also accounted for, in order to obtain GHG balances (net emission given by gross emissions *minus* uptake). The average results of the period 2018-2021 have been proposed as a baseline (or reference value), since the Covid pandemics made results less reliable. The selection of a baseline is crucial to define the sustainability target of the University and therefore minimize the GHG impacts, both through emissions reduction measures and adoption of offsetting instruments/solutions.

Table 1 shows the GHG balances of the Siena Athenaeum for the period 2018-2021, highlighting the amount of gross emissions (5,442 t CO_2eq for the baseline), compensated by the local uptake (-17 t CO_2eq, only accounting for 0.3%).

Table 1. GHG balance of the University of Siena for the period 2018-2021 and baseline value.

ACADEMIC ACTIVITY	2018	2019	2020	2021	AVERAGE VALUE (2018-2021) *BASELINE*
	t CO_2eq	t CO_2eq	t CO_2eq	t CO_2eq	t CO_2eq
DIRECT EMISSIONS (SCOPE 1)	2,634.04	2,531.28	2,362.34	2,386.03	2,478.42
OWNED VEHICLES	*51.84*	*51.84*	*51.84*	*39.78*	*48.82*
NATURAL GAS (Heating)	*2,582.21*	*2,479.44*	*2,310.50*	*2,346.25*	*2,429.60*
INDIRECT EMISSIONS FROM IMPORTED ELECTRICITY AND HEAT (SCOPE 2)	3,447.96	3,037.10	2,671.17	2,696.72	2,963.24
ELECTRICITY (Emission Factor of the national grid)	*3,447.96*	*3,037.10*	*2,671.17*	*2,696.72*	*2,963.24*
GROSS EMISSIONS (SCOPE 1 + SCOPE 2)	6,082.01	5,568.38	5,033.51	5,082.75	5,441.66
INDIRECT EMISSIONS (SCOPE 3) Attempt at estimation (ERASMUS and business trips; water and paper consumption)	*737.44*	\	\	\	\
UPTAKE (SCOPE 1)	-16.77	-16.77	-16.77	-16.77	-16.77
PARKS (Including botanical garden)	*-9.32*	*-9.32*	*-9.32*	*-9.32*	*-9.32*
FLOWERBEDS	*-0.25*	*-0.25*	*-0.25*	*-0.25*	*-0.25*
GARDENS	*-7.19*	*-7.19*	*-7.19*	*-7.19*	*-7.19*
NET EMISSIONS (uptake + gross emissions)	6,065.24	5,551.62	5,016.74	5,065.99	5,424.90
% ABATEMENT	0.3%	0.3%	0.3%	0.3%	0.3%

The main hotspot is the consumption of electricity imported from the national grid (54% of the total), followed by the natural gas for heating buildings (45% of the total).

The slight emissions reduction, recorded in the period 2018-2021 (-16%), is due to the COVID-19 pandemic (mainly in 2020) and mitigation policies implemented by the Athenaeum managers (e.g., lower winter temperature in buildings and tests on heating boilers).

For the baseline, the GHG emission per person is 257 kg (Figure 1). This value is in line with those of other Italian universities, which are characterized by the same number of students and a similar academic structure (i.e., historic buildings and not a modern campus) (Montebugnoli, 2020).

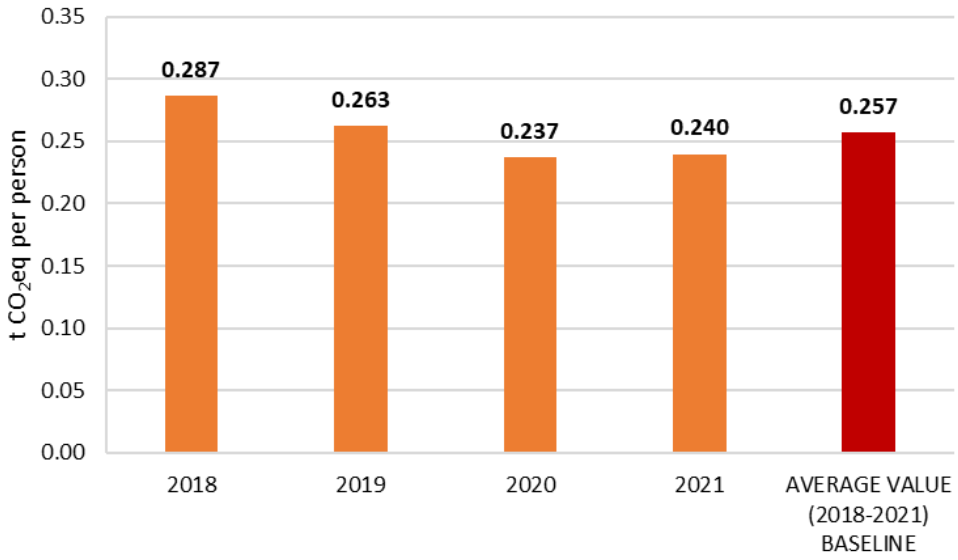

Figure 1. GHG emissions per capita for the period 2018-2021 and baseline value.

The results presented in this Summary Report have been elaborated for the year 2018 in the context of a Master thesis in "Ecotoxticology and Environmental Sustainability" at the University of Siena (Montebugnoli, 2020). Since then the GHG inventories are summarized in the Sustainability Report, produced yearly by the Athenaeum (UNISI, 2020).

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