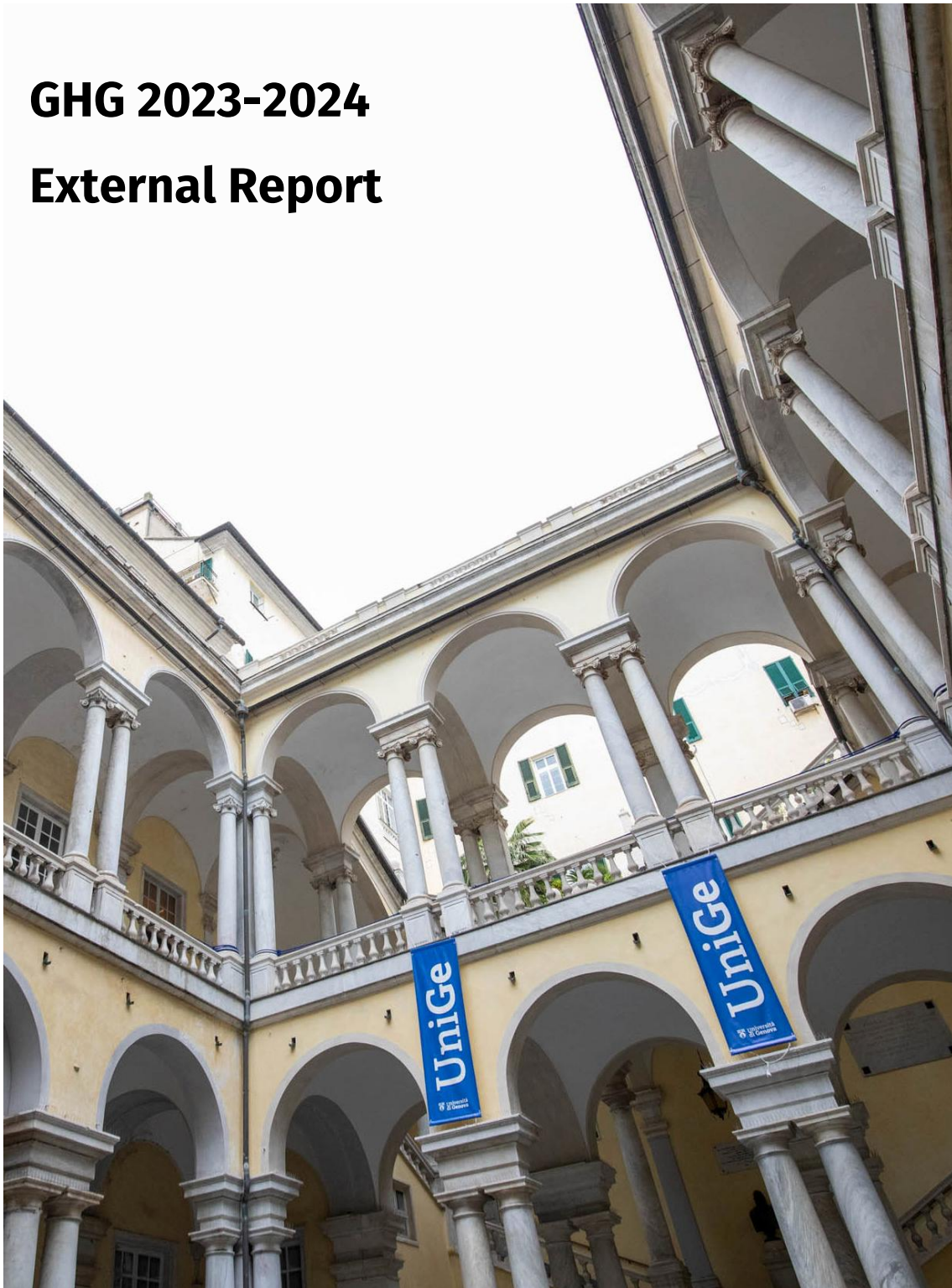


GHG 2023-2024 External Report



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Introduction

The University of Genoa (UniGe) has made a strong commitment against climate change, accounting and validating its carbon footprint since 2014, committing to being climate neutral by 2030, joining the United Nations global campaign Race To Zero for Universities and colleges, and systematically managing sustainability through the Environmental Sustainability Commission and the Unigesostenibile Working Group. In particular, in 2019 UniGe joined "The Sustainable Development Goals Accord", an initiative coordinated by the Youth and Education Alliance of the UN Environment, declaring the Climate Emergency and signing a letter of intent which lists 10 good practices and actions, including goal of achieving climate neutrality by 2030.

Since 2014, the University of Genoa (UniGe) has systematically integrated environmental sustainability into its governance, following a voluntary agreement with the Italian Ministry of the Environment to assess its carbon footprint. This marked the start of several key initiatives: the appointment of a Sustainability Coordinator, the creation of a permanent Rector's Committee on Environmental Sustainability, and UniGe's participation in both national (RUS) and international (UNFCCC) sustainability networks. In 2019, UniGe joined the "Sustainable Development Goals Accord," declaring a climate emergency and committing to carbon neutrality by 2030. The establishment of a Vice-Rectorate for Sustainability in 2020 further strengthened this commitment.

As a major public institution, UniGe recognizes its responsibility to reduce greenhouse gas (GHG) emissions and to foster environmental awareness among students, staff, and the broader community. Universities can play a critical role in addressing climate change both by reducing their direct emissions (e.g., from energy use) and by educating future leaders on sustainable practices. UniGe has committed to preparing a detailed GHG inventory following the UNI ISO 14064-1 standard. This process involves identifying emission sources, defining organizational

boundaries, quantifying emissions, and reporting them transparently. This document outlines the methodology used for calculating emissions in the years 2023 and 2024 and sets the basis for future monitoring and third-party certification. Sustainability is one of the strategic pillars of UniGe's 2021–2026 Strategic Plan, reflecting its ambition to act as a living lab for sustainable development and a key player in climate action.

Organizational Boundaries Analysis and Definition

According to ISO 14064-1, the first step in developing a GHG inventory is defining the organizational boundaries and identifying the facilities that make up the organization. In this study, the organization is the University of Genoa (UniGe), whose facilities are spread across multiple locations: Genoa, Santa Margherita, Ventimiglia, Savona, Imperia, and La Spezia. For clarity, reporting is grouped by province - Santa Margherita is included in the Genoa campus, while Ventimiglia falls under Imperia. The boundaries are defined based on the control approach, meaning that only emissions from sources under the direct control of the university are included in Categories 1 and 2. Indirect emissions (except those from purchased electricity) are classified under Categories 3 to 6. Both owned and rented buildings have been included, as long as UniGe has operational control over them. A detailed list of all included buildings and facilities is provided in Table 1 for both the main and satellite campuses.

Operational Boundaries Definition and Emission Significance Assessment

Following the definition of the organizational boundaries, the operational boundaries of the GHG inventory for the University of Genoa (UniGe) were established, in accordance with ISO 14064-1:2019. This standard requires organizations to classify GHG emissions and removals into three main categories: direct emissions, indirect emissions from energy consumption, and other indirect emissions. The operational boundaries determine which sources and sinks of GHGs are to be included, based on a multi-criteria assessment. The operational boundary definition process involved a preliminary identification of all potential emission sources and sinks related to the university's activities.

The establishment of criteria for selecting which of these sources should be included. The

application of these criteria to define the final scope, with emissions classified accordingly.

Based on ISO 14064-1:2019, emissions were grouped into six categories:

- **Category 1:** Direct GHG emissions and removals (e.g., fuel combustion, refrigeration systems, university fleet).
- **Category 2:** Indirect GHG emissions from electricity consumption.
- **Category 3:** Other indirect emissions from transportation (e.g., commuting, business travel, energy transmission losses).
- **Category 4:** Other indirect emissions from purchased products and services (e.g., water consumption, food services, cleaning, fuel production).
- **Category 5:** Indirect emissions from waste generated.
- **Category 6:** Other indirect emissions (e.g., teleworking, overnight stays).

These categories were analyzed across all UniGe campuses (Genoa, Savona, Imperia, La Spezia), and specific emission sources were mapped accordingly for each site.

For reporting purposes, emissions are summarized in Scope 1 (Category 1), Scope 2 (Category 2) and Scope 3 (Category 3, 4, 5 and 6).

To identify which indirect emissions should be included in the inventory, a significance assessment model was developed using five criteria, as per ISO 14064-1:

- **Magnitude:** Relative quantitative weight of the emission (score 0–5, based on estimated annual CO₂-eq).
- **Influence:** UniGe's ability to monitor or influence the emission (score: 0 or 1).
- **Importance:** Strategic or reputational relevance to UniGe (score: 0–2).
- **Data Availability:** Accessibility and reliability of data (score: 0–2).
- **Guidelines Compliance:** Inclusion of the source in national university guidelines (RUS Network, 2023) (score: 0 or 1).

An emission is deemed significant when the sum of its scores (S) is ≥ 6 .

The following indirect emissions were identified as significant and thus included in the GHG inventory:

- Commuting (S = 10)
- Business travel (S = 8)
- Fuel production and transportation (S = 6)

Other emission sources such as water use, cleaning services, teleworking, were included into the inventory as a calculation choice despite being below the significance threshold. This choice is due to the fact that the University of Genova has adopted a robust framework for the collection of such data and has the purpose of establishing a reference for their calculation.

Methodologies for GHG Emission Quantification

According to ISO 14064-1:2019 (§6.4), organizations must establish a historical base year for GHG emissions and removals to enable consistent comparison over time and to fulfill GHG program requirements. The University of Genoa (UniGe) selected 2019 as its baseline year, corresponding to the adoption of mitigation targets. This choice ensures temporal consistency in the GHG inventory, provided that organizational and operational boundaries are clearly defined and maintained. Future inventories will be compared against this baseline, and any changes in boundaries or quantification methods that significantly impact emission values may prompt a revision of past inventories, as specified in the standard. These include cases such as the transfer of ownership/control over emission sources or sinks and significant changes in quantification methodologies. A review of the 2019 base year was conducted due to such conditions occurring since then. This review, detailed in the annexed documents “Reassessment Procedure for Base Year (2019)” and “Annex A - UNIGE – GHG Inventory v3 2013-2022 rev.2.0 2024.04,” reflects a transition to the updated ISO classification. GHG emissions are expressed in tons of CO₂ equivalent (CO₂-eq). For direct emission sources, the gases considered are CO₂, CH₄, and N₂O. Exceptions include refrigerants used within the university, specifically R410A, R422D, and R407C. Based on operational boundaries, no other direct GHG emissions were identified. For all other activity data, emissions were calculated using emission factors expressed in CO₂-eq.

The quantification of GHG emissions followed a calculation-based approach, multiplying activity data (quantitative input data) by the corresponding GHG emission factors. These factors are aligned with the latest IPCC Sixth Assessment Report (AR6). The methodology was chosen to ensure accuracy, consistency, reproducibility, and to minimize calculation uncertainty. Activity data were sourced from billing records or direct measurements. In the absence of such data, a conservative estimation approach was applied. Emission/removal factors were derived from national and international literature and LCA studies, and selected based on recognized sources, consistency with the specific source or sink, temporal validity, and minimization of associated uncertainty.

The main data collected are:

- **Direct Fuel Consumption (Category 1):** The University used both natural gas and diesel fuel, primarily for heating buildings. Natural gas consumption was recorded for all campuses, while diesel use was residual and limited to the Via Balbi 6 site, where estimates were made for 2020–2021 due to missing data. Data were provided by Unigesostenibile and aggregated by the Sustainability Commission. At the Savona campus, a cogeneration plant with two natural gas microturbines provided both electricity and heat, fully consumed on-site and excluded from emissions calculations due to zero-emission self-consumption.
- **University Fleet (Category 1):** Vehicle data were collected per year and aggregated by type. Emissions were calculated based on annual mileage for each vehicle or group of vehicles (e.g., multiple Fiat Doblò vans). Some vehicles were electric or hybrid.
- **Refrigerant Gases (Category 1):** No maintenance or installation activities involving fluorinated gases were reported during 2020–2022. Where data were missing, annual gas losses were estimated based on surface area and specific loss rates from comparable buildings.
- **Electricity Consumption (Category 2):** Consumption data were collected for all campuses, including energy from the grid, photovoltaics, and microturbines (the latter two for Savona, used entirely on-site). Where data were unavailable, estimates were made based on specific consumption per square meter. Location-based emission factors were derived from ISPRA, adjusted for import/export with Ecoinvent data. Market-based emissions were calculated using residual mix data and Guarantees of Origin (GO) from CONSIP. GOs covered only certain campuses, mainly in Genoa, Savona, and Imperia, but not La Spezia.
- **Water Consumption (Category 4):** Water use data were recovered from billing data.
- **Waste Generation (Category 5):** Data on plastic, paper, and mixed waste were estimated based on per-student production. Waste management was handled in collaboration with local utilities, and historical data from the "Ateneo Meno Rifiuti" project (2015) supported emission factors. The waste treatment impacts were based on electricity and water consumption from 2016, the last year of available plant-specific data.

Overall, data acquisition was based on actual records when available, and estimations were applied using consistent and transparent methodologies where gaps existed.

The University of Genoa conducted an uncertainty assessment for greenhouse gas (GHG)

emissions and removals, considering uncertainty associated with emission and removal factors. The overall uncertainty for each emission category in the GHG inventory was evaluated using three qualitative criteria, each assigned a numerical score:

1. uncertainty of primary activity data,
2. uncertainty of available emission factors, and
3. the relative weight of the emission/removal category on total emissions.

The uncertainty of primary activity data was classified as low, medium, or high based on accuracy, consistency, and reproducibility. The uncertainty of emission factors was categorized similarly, with low uncertainty indicating a well-recognized and appropriate source for the GHG source or sink. The weight of each emission category relative to total emissions was also factored into the uncertainty evaluation. Each category's overall uncertainty was calculated by summing the scores across the three criteria, leading to classifications of **low**, **medium**, or **high** uncertainty. The uncertainty analysis identified several emission sources with significant impact on total emissions, including electricity consumption, natural gas, fuel oil, refrigerants, car usage, network losses, water consumption, and services such as cleaning and catering, all with low uncertainty. Categories like daily mobility, catering services, and cleaning services had medium uncertainty due to sampling methods used for data collection. Exclusions from the assessment were based on technical feasibility, estimated impact on total emissions, and economic feasibility of collecting primary data. Excluded sources included smartworking and the procurement of goods. All direct and indirect emissions sources (Categories 1 and 2) were included in the GHG inventory, along with significant emissions and those for which reliable data could be obtained, such as fuel production, commuting, business travel, network losses, water consumption, cleaning services, catering services, and waste transport and wastes.

Inventory Results

Table 1 and 2 and the following paragraphs show the total GHG inventory and divided by Scopes. The following tables report the results with the market-based approach, consequently, also the following indicators are reported by market-based approach.

Scopes	Emissions [t CO ₂ eq]	
	2023	2024
Scope 1	2,557.1	2,643.2
Scope 2	231.4	1,502.2
Scope 3	12,761.5	13,445.4
Total emissions	15,550.0	17,590.7

TAB. 1 - SUMMARY OF GHG EMISSIONS OF THE UNIVERSITY OF GENOA FOR THE YEARS 2023-2024 (MARKET-BASED APPROACH)

Two indicators, one qualitative and one control, have been defined and will be used to represent the results of the GHG inventory:

- **Qualitative indicator:** developed to quantify emissions with respect to students enrolled in each year. It is expressed in **t CO₂ eq/student enrolled**. This indicator is not used as a control because the number of students varies from year to year and cannot be compared with previous and subsequent inventories. Instead, it can be employed to compare different universities.
- **Control indicator:** developed to obtain a comparable figure between previous and subsequent years of the inventory. It is obtained from the ratio of GHG emissions to area and is expressed in **t CO₂ eq/m²**

Indicators	Data	Emissions
2023		
Qualitative Indicator	28,353 students	0.488 t CO ₂ eq. / student year
Control Indicator	364,430 m ²	0.043 t CO ₂ eq. / m ² year
2024		
Qualitative Indicator	28,935 students	0.552 t CO ₂ eq. / student year
Control Indicator	364,430 m ²	0.048 t CO ₂ eq. / m ² year

TAB. 2 - UNIVERSITY OF GENOA GHG EMISSIONS INDICATORS

Emissions contributions by scope are reported in Figure 1.

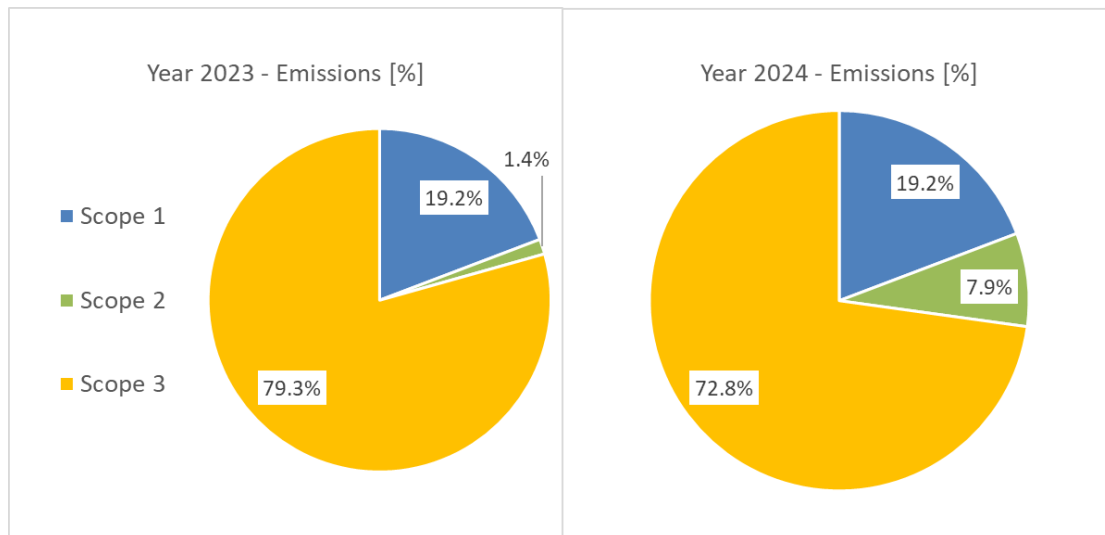


FIG. 1 - EMISSIONS CONTRIBUTIONS BY SCOPE IN THE YEARS 2023 AND 2024.

The emissions trend is driven by the change in the composition of Guarantess of Origin (GO) for the purchasing of green energy, shown in Fig. 2.

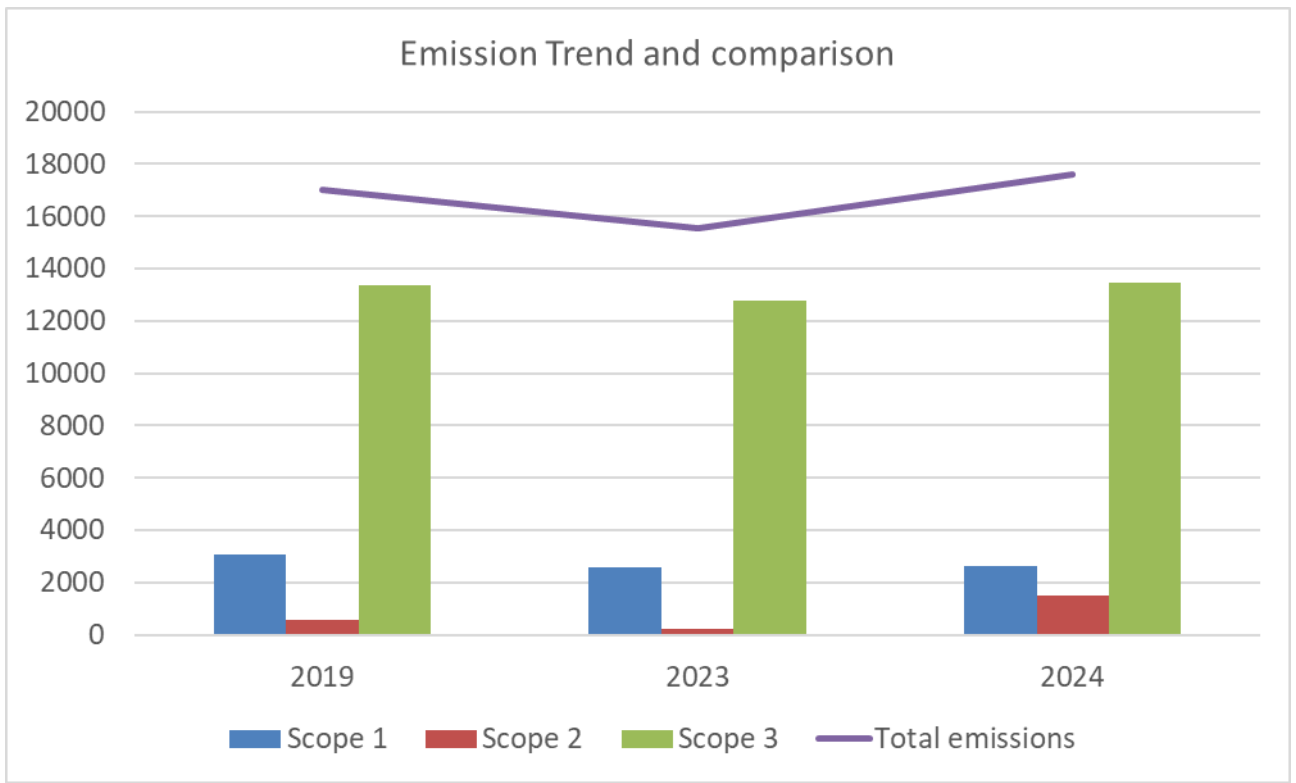


FIG. 2 - EMISSIONS TRENDS BY SCOPE IN THE YEARS 2023 AND 2024 AND COMPARISON WITH REFERENCE YEAR 2019.

Verification

Until 2022, the GHG inventory of the University of Genoa was subject to external third-party verification in compliance with ISO 14064-3, carried out by an accredited body (RINA Services).

While this practice represents best-in-class assurance, it has not yet become widespread among Italian universities, primarily due to the significant costs involved and the substantial administrative burden associated with the certification process. For these reasons, starting from the 2023 inventory cycle, the University of Genoa has decided not to pursue formal third-party certification. However, this choice does not imply any reduction in methodological rigor.

The GHG inventory continues to be developed in full compliance with ISO 14064-1:2019, under the scientific and technical responsibility of UniGe's Environmental Sustainability Commission and [Centro interuniversitario di ricerca per lo sviluppo della sostenibilità dei prodotti \(CESISP\)](#), which oversees the entire calculation process - from data collection and emission factor selection to uncertainty assessment and reporting. The transparency and reproducibility of the methodology, together with the institutional oversight of the bodies involved, ensure a level of quality and reliability consistent with the standards adopted in previous verified inventories.