

A close-up photograph of clear water being poured from a glass pitcher into a glass. The water is captured in mid-pour, creating a dynamic, flowing stream that splashes into the glass below. The background is a solid, light blue color, which makes the clear water stand out. The lighting is bright, highlighting the transparency and movement of the liquid.

Carbon footprint at Islamic university of Gaza

*Submitted by
Environmental and Rural Research Center*

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1. Brief Background Facts ABOUT ISLAMIC UNIVERSITY OF GAZA

- Founded in 1978 by a group of notable public figures as the first university in Gaza to offer generations of young Palestinian's access to quality higher education inside Palestine.
- IUG is an independent academic institution supervised by the Ministry of Higher Education and managed by a board of trustees composed of experienced professionals in different fields.
- Started with only three faculties and now has 11 faculties offering BA. B.Sc., MA, M.Sc., PhD, Diploma and higher diploma in medicine, engineering, IT, health sciences, science, arts, education, nursing, business, Shari'a and law and Osool Deen.
- IUG offers around 172 academic programs in various levels PhD, masters, Bachelore and professional diploma
- IUG provides education in a well-equipped academic environment that facilitates higher education to 17,000 students (62% females) including physically, visually and hearing disabled students and community members.
- IUG offers lifelong and capacity building programs in many fields related to the local community needs.
- IUG has partnership with around 350 university and research center in 23 EU and 10 Asian countries.
- IUG is a member in 12 regional and international academic and research associations:
 1. [Anna-Linda Euro-Mediterranean foundation](#)
 2. [Association of Arab Universities \(AAU\)](#)
 3. [Community of Mediterranean Universities \(CMU\)](#)
 4. [Eurasian Universities Union \(EURAS\)](#)
 5. [Euro-Mediterranean Universities Consortium TETHYS](#)
 6. [Federation of the Universities of the Islamic world](#)
 7. [International Association of Universities \(IAU\)](#)
 8. [Mediterranean Universities Union \(UNIMED\)](#)
 9. [Réseau Méditerranéen des Ecoles d'Ingénieurs \(RMEI\)](#)
 10. [The Euro-Mediterranean University \(EMUNI\)](#)
 11. [Black Sea and Eastern Mediterranean Academic Network \(BSEMAN\)](#)

12. [Global University Network for Innovation \(GUNi\)](#)

- The Islamic University of Gaza (IUG) has three campuses namely the IUG Main Campus, IUG Medicine Campus and IUG South Campus (Khanyunis).
1. The IUG Main Campus was established in 1978 with an area of 81,600 m². It is widely considered as one of the largest and most attractive places in Gaza strip. It is located only two Kilometer from the Mediterranean Sea, and less than one kilometer from city center. It has a free spaces and green areas of about 61000 m². IUG Main Campus houses different buildings, including: Administration Building, Conferences Hall, Library Building, Community Service & Continuing Education Building, Student Activity Building, and other buildings for classrooms. Islamic University of Gaza is the focus of life for students, staff and visitors.
 2. IUG South Campus (Khanyunis) is located in the area of Khanyunis. It was established in 2003 to alleviate university students suffering during the Israeli occupation siege and checkpoints across the Gaza strip. It has an area of about 30000 m² from which 21330 m² are free spaces and green areas. It is located in extensive greenery planted areas with green crops. Besides IUG Main Campus, the South Campus provides education services to IUG students who are living in the south part of Gaza strip. The campus includes classrooms, scientific and computer labs.
 3. IUG Medical Faculty Campus includes Medicine Faculty and university hospital aiming at graduating a distinctive staff and participating in the rehabilitation of the medical staff in the Gaza Strip in the field of Medicine. The Medicine Faculty Building has an area of 950 m² while the university hospital's areas is 8500 m².

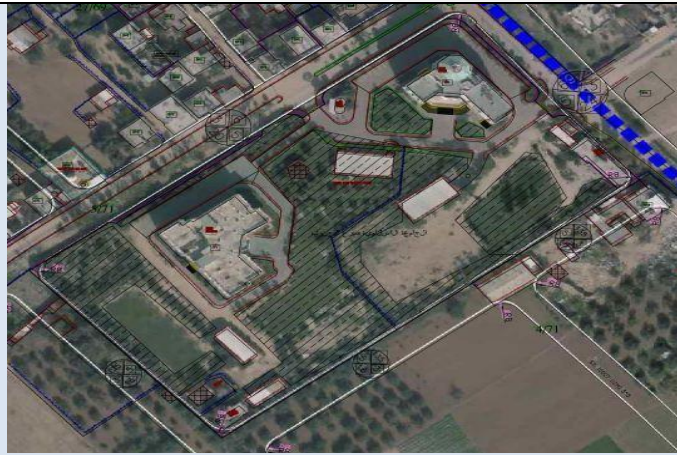


IUG Campuses

- Total area on campus covered in forest vegetation

No.	Campus	Area (m ²)
1	▪ Main campus	7,000
2	▪ South Campus	10,330
3	▪ Medical Faculty Campus	97,200
Total		114,530

- Total area: about 114,530 m²
- Total distance/circumference: $114,530/4,678=24.5$



Forest Vegetation Area

- Renewable Energy Sources in Campus

Recently, the Islamic University of Gaza put more effort in using renewable energy such as solar systems. Many solar systems have already been installed on many buildings roof inside the university such as Administration Building, Central Library, teaching halls buildings and others. The total generated energy per day is (2,900.62) kWh. The energy amount produced by the solar system represents (43%) of the total energy usage in the university. This ratio will be increased in the near future.



Example of Roof and Façade Mounted Solar Panels (Islamic University of Gaza)

2. INTRODUCTION

Due to growing concerns about climate change, there has been increasing attention given to assessing emissions and calculating carbon footprints as essential steps toward reducing individual impacts and ultimately achieving carbon neutrality. Presently, there exists a significant disparity between the natural carbon sinks' capacity for sequestration and the global emissions being released. Consequently, mitigating greenhouse gas (GHG) emissions is recognized as a critical aspect of climate change mitigation.

Numerous organizations, institutions, countries, and associations at national and international levels are actively engaged in reducing emissions and striving for carbon neutrality. The concept of the carbon footprint, which serves as a greenhouse gas emission inventory, offers a means to establish a starting point for higher education institutions aiming to achieve carbon neutrality.

In this context, the university's carbon footprint was calculated for a base year, representing the initial step towards carbon neutrality. The assessment encompassed a wide range of the university's activities and employed popular calculation methods while considering commonly chosen emission scopes. The ensuing results facilitate the identification of optimal mitigation measures and opportunities for attaining carbon neutrality on the campus, as well as highlighting encountered limitations and challenges.

The central question to explore is the valuable insights a university can gain from creating a greenhouse gas inventory, ultimately leading to the development of an emission reduction pathway.

2. SCOPES OF EMISSIONS

The Greenhouse Gas Protocol Corporate Standard is widely recognized as a popular regulatory framework and international guideline for calculating organizational carbon footprints. Among higher education institutions (HEI), it is the most commonly favored guideline used as a basis for calculations. Specifically, the GHG Protocol Corporate Standard provides clear requirements for including emissions in scopes 1 and 2. However, when it comes to scope 3

emissions, the framework is less stringent, allowing universities to selectively adopt individually chosen indirect, non-energy-related emissions at their discretion. Consequently, universities tend to make decisions based on their own experiences regarding which emissions to incorporate into their final carbon footprint.

3.APPROACHES AND TOOLS FOR CARBON FOOTPRINT CALCULATION

A commonly used method to calculate the carbon footprint of a university involves a hybrid model that combines two different methodologies for assessing environmental impacts. This approach considers both indirect, energy-related emissions and directly caused emissions, utilizing a methodological basis similar to Life Cycle Assessment (LCA). The calculation involves identifying activity data related to specific actions and then multiplying it by the appropriate Greenhouse Gas (GHG) emission factor (EF) to convert the activity data into GHG emissions.

- **CALCULATION APPROACH**

To calculate the carbon footprint of IUG (name of the university), a hybrid-model approach was followed. This approach included not only the mandatory Scopes 1 and 2 as defined in the Greenhouse Gas Protocol Corporate Standard but also selected Scope 3 categories for assessment. The Scope 3 categories considered were: business travels using various transportation modes and overnight stays, commuting of staff and students, restaurant services, procurement of equipment for education, research, and laboratories, waste handling, and building management on campus.

Scope 1: Direct Emissions: All emissions falling under Scope 1 were calculated using an LCA approach, involving the multiplication of activity data (ADS1) with the appropriate emission factors (EFs). The formula used for this calculation was: $EGHG = ADS1 \times EF$. The

direct emission sources considered were the university's vehicles and direct fuel combustion on campus.

- **UNIVERSITY'S CAR FLEET:** In 2022, the university's car fleet consisted of 13 transporter vans, 10 diesel-driven cars, and three plug-in gasoline vehicles. Emissions from the car fleet were determined based on the total kilometers driven in a year, multiplied by the EF corresponding to each car type, used fuel, and fabrication year. Information about the individual cars was obtained from the campus service. The transporter vans contributed approximately 207,360 km to the carbon footprint, while diesel cars accounted for about 53,800 km.
- **DIRECT FUEL COMBUSTION:** The university's campus operates a generator that burns diesel fuel, causing direct emissions. The impact of the generator was assessed by combining the yearly fuel consumption in MWh with the appropriate EF. The total yearly fuel consumption of the generator was 360 MWh.

Scope 2: Indirect, Energy-Related Emissions: Scope 2 encompasses the indirect emissions (EGHG) resulting from the use of district heating, cooling, water, and purchased electricity. The primary calculation method involved multiplying consumption data (CDS2) by appropriate EFs, which also considered local circumstances. The formula used for this calculation was: $EGHG = CDS2 \times EF$. Information for this section was mainly obtained from the university's property management company.

- **ELECTRICITY:** The university uses electricity entirely generated from renewable energy sources and fuel power plants. The EF used for electricity consumption from solar systems equals zero, resulting in no emissions being allocated to the university's carbon footprint. Both services assign an emission factor of 0.87 t CO₂e to diesel fuel and 0 tCO₂ to renewable energies and electricity generated via power plants. Only operational emissions, those caused during the generation of electricity, are considered, not the full life-cycle emissions of the employed power plants and fuels. The university consumed a total of 2800 MWh of electricity in 2022, distributed as follows: 1760 MWh from the general electricity power plant, 360 MWh from IUG generators, and 500 MWh from solar panel systems.

- **WATER CONSUMPTION:** The carbon footprint associated with water consumption on campus is based on the supply of clean water and the handling of wastewater. Due to the lack of specific information on the amount of wastewater, the same volume as the consumed clean water was assumed for the calculation. The amount of water in m³ was multiplied by the appropriate EF, representing both clean water and wastewater handling, to determine the emissions. The estimated yearly consumption for both types of water is 50,000 m³, respectively.

Scope 3: Indirect, Non-Energy-Related Emissions: Unlike the previous scopes, the calculation of indirect, non-energy-related emissions did not solely rely on an LCA approach. Several categories were assessed based on financial data, following an Environmentally Extended Input-Output Analysis (EEIOA) approach.

- **BUSINESS TRAVEL:** Business travel includes job-related travel by staff members of IUG University using buses and rental cars. The emissions (EGHG) were calculated based on booked travel distances (TD) for each mode of transport, using the formula: $EGHG = TD \times EF$. The traveled distances amounted to 320,000 km in 2022, as specific information about the type of rented vehicles was unavailable.
- **PROPERTY MAINTENANCE:** Building-related emissions include non-energy-related emissions allocated to maintenance, repairs, construction, and cleaning activities on the campus premises. The carbon footprint of constructions and repairs was directly reported by the property manager, while the impact of the cleaning service was calculated based on procurement costs of utilized cleaning supplies (CCS - around 100,000 \$ in 2022) and an EF in kg CO₂e/\$ using the following equation: $EGHG = CCS \times EF$.

- **General procurements.**

The category of general procurements includes an unspecified assortment of purchased laboratory equipment, furniture, educational materials, and office supplies, as well as large scale research equipment. The equation is displayed in the following:

$$EGHG = CP \times EF$$

- **IT-equipment.** The assessment of emissions related to laptops and desktop was carried out based on the number of purchased items (nIT) in 2022, their expected service life (a), and

annual cradle-to-grave life-cycle emission factors (EFLCA) per item retrieved from manufactures of the typically purchased products at the University. Those EFs were divided by the potential usage time of an item and then applied as an annual factor. IT equipment bought during the previous two years was added as well to the carbon footprint of 2022 based on the expected service life of 3 years. In 2022, 350 laptops and 50 desktop were acquired by the University.

$$EGHG = n_{IT} \times EFLCA$$

A

- Printing paper and printed books. Paper provided by the printing service on campus was accounted for based on the total weight of the utilized sheets of paper (n_P) and a cradle-to-grave EF for printing paper in kg CO₂e/kg of paper (Table A), therefore following an LCA approach. In 2022, 25,000 kg of paper was consumed at the Islamic University of Gaza . $EGHG = n_P \times EF$

- Waste management.

Emissions allocated to waste management encompass the GHG emissions caused by the transport and treatment of the waste. Considered waste fractions include biowaste, paperboard, scrap metal, glass, paper, and batteries, as well as mixed waste, wood, ewaste and hazardous waste. The treatment emissions were calculated based on the produced waste in tonnes per year (m) and a treatment emissions factor in kg CO₂e/t waste for each type of waste (EFTM), respectively. The impact of transportation was assessed following the number of waste collections (n_T), the amount of waste in tonnes (m), the transport distance in km (d) and the transportation EF in kg CO₂e/ton km (EFTP). Apart from carton and paper waste, the following equation is used:

$$EGHG = m \times EFTM + m \times d \times n_T \times EFTP$$

A total amount of 650 t of waste was produced on campus in 2022.

Restaurant services. The carbon footprint of restaurant services only refers to the impact of the food sold on campus, while energy consumption necessary for the restaurants' operations is part of scope 2. The required information was directly obtained from the restaurant operators. the calculation follows two different approaches. The first method relied on the number of sold meals (n_M), the number of sold cups of coffee (n_C) and EFs for different types of food

(EFM, meal with or without meat) the following equation is used:

$$EGHG = nM \times EFM + nC \times EFC$$

- **Commuting**

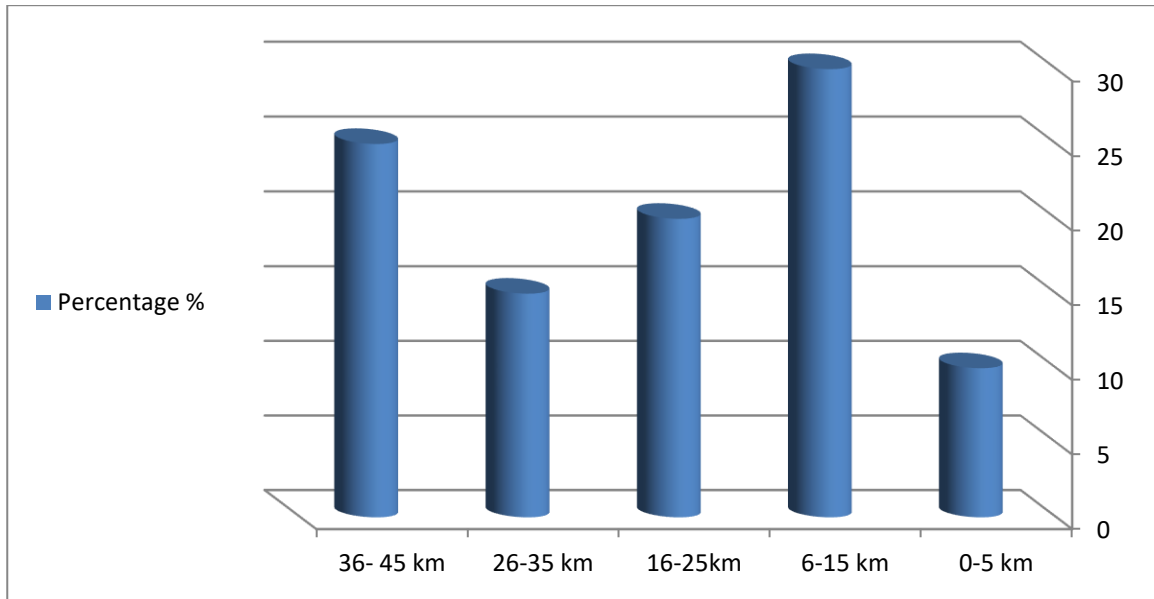
The commuting of staff and students was analyzed with the help of a survey, where people were asked to state their primary mode of transportation, their main workplace, as well as their one-way commuting distance and the usual number of days they commute to the campus.

Types and amounts of waste produced at the Islamic University of Gaza in 2022.

#	Type of waste	Amount of waste in tones
1	organic matter	58%
2	Glass	0.5%
3	plastic	15%
4	paper and cardboard	14%
5	iron	1.5%

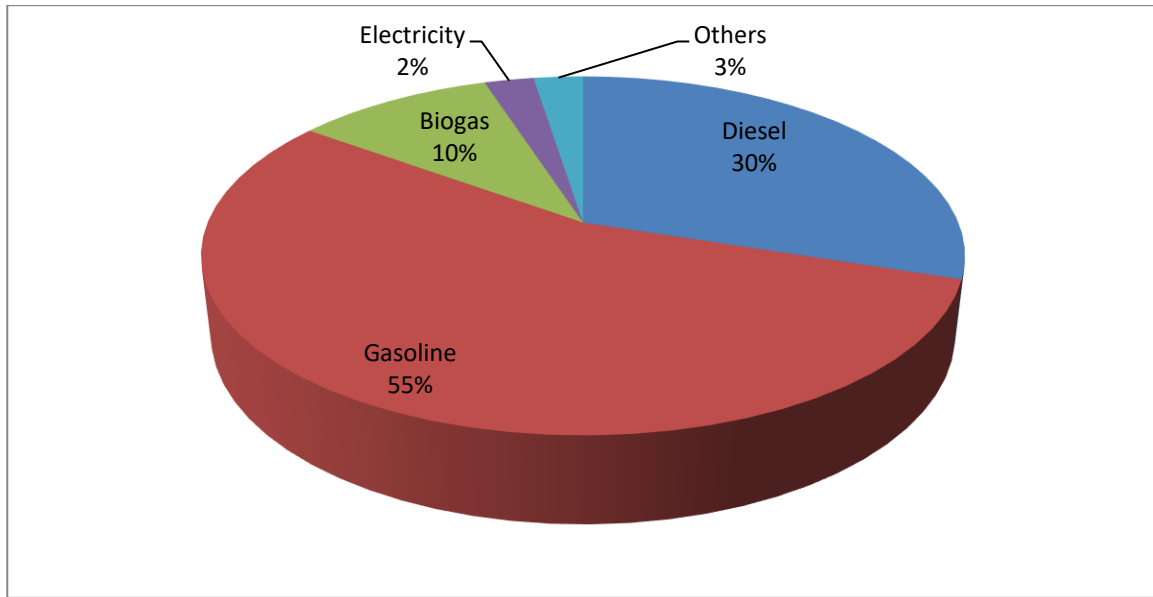
Shares of different commuting distances of staff and students at the IUG

#	distances of staff and students	Percentage %
1	0-5 km	10
2	6-15 km	30
3	16-25km	20
4	26-35 km	15
5	36- 45 km	25



Shares of different fuels used by staff and students at the University

#	different fuels used by staff and students	Percentage %
1	Diesel	30
2	Gasoline	55
3	Biogas	10
4	Electricity	2.5
5	Others	2.5



Results of the commuting survey conducted at the University of

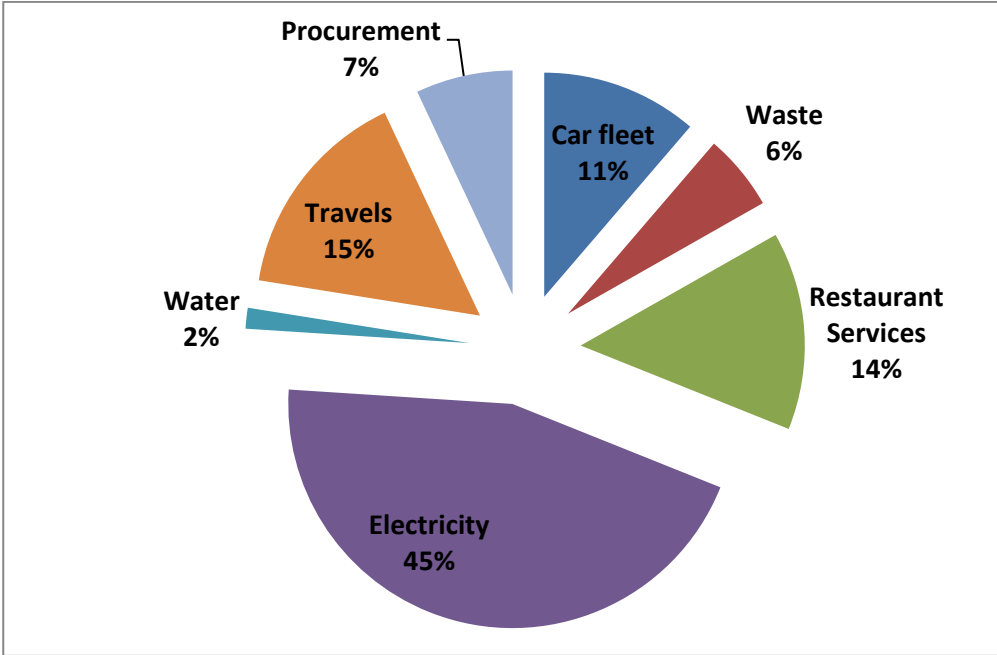
#	commuting	Commuting Mode of transportation	Share (%)
1	University's employees and students	Passenger vehicle	15
2		Public transport	55
3		Biking	10
4		Walking	20
5		Others	2.5

❖ **Carbon footprint of the Islamic University Of Gaza**

The Islamic University of Gaza recorded a total emission of 22,800 t CO₂e in 2022. This carbon footprint can also be represented as 1.29 t CO₂e per person, considering the student and staff count of 18,000. The visualization of the carbon footprint is depicted in Fig.2, while Table 5 provides a more detailed breakdown of the results. Presently, the highest contributing factor to emissions is the purchase of electricity, accounting for approximately 45% of the total carbon footprint. Following this is the impact of procurements, which has a significant difference, contributing to around... Business travel and restaurant services account for approximately 15.5% and 14.3% of the emissions, respectively. The commuting of staff and students, though lower than business travel, still holds a substantial share of around 7%.

Additionally, the construction and maintenance of properties contribute approximately 5% to the total emissions. The remaining categories, in comparison, are relatively small and seem to have almost negligible contributions. It is evident that the three main campus areas drive the majority of emissions, while smaller units have a minimal overall impact on greenhouse gas emissions.

#	Categories	Percentage %
1	Car fleet	11.3
2	Waste	5.5
3	Restaurant Services	14.3
4	Electricity	45
5	Water	1.5
6	Travels	15.5
7	Procurement	7.0



The carbon footprint of the Islamic University of Gaza in 2022

❖ **Mitigation measures**

The calculation of the carbon footprint provides an appropriate starting point for an HEI to start considering the reduction of environmental impacts and increase the sustainability of its operations. A declaration of emission reduction was seen to closely correlate with the plan to conduct annual carbon footprint calculations after the initial process. the largest source of emissions in this report is the electricity consumption on the three main campus areas. Energy-related emissions have therefore a considerable impact on the institution's carbon footprint. To solve the electricity problem at the IUG changed gradually to usage of 100% renewable energy sources, Other mitigation measures that could be introduced at the Islamic University of Gaza are, for example, incentives for more environmentally friendly commuting practices or updated travelling guidelines to reduce the impact of buses or rental cars. The feasibility of remote working or online conferences has been thoroughly tested during the ongoing pandemic and can be seen as one option for reducing greenhouse gas emissions of transportation. In order, the choice of an electricity sources and should also be possible for a different source of energy. If only renewable energy sources could be purchased, the institution's carbon footprint could be reduced by over than 50% of tCO₂e, lowering the share of Scope 2 emissions to near insignificance. In addition, it could be considered how the positive impact of a university's research can be accounted for when analyzing environmental and sustainability goals. Would it be legitimate to use approaches such as the carbon handprint to quantify potential emission reductions supported by research and education., the One of the important things and practices to reduce the environmental impact of greenhouse gas emissions is to increase the green cover in the university composes , to focus more on e-books, and to reduce paper publications to a minimum. These item reduce the carbon footprint to 17 .

