Tel Aviv University

2019 Carbon Footprint

EcoTraders
Energy & Environment

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Executive summary

This report analyzes the carbon footprint of Tel Aviv University, identifying the key emission sources and serving as a basis for the identification and implementation of abatement measures, in line with the university's initiative to be carbon neutral by 2030.

The analysis was conducted according to the GHG Protocol guidelines – the world's most widely used greenhouse gas accounting standard – and relates to the carbon footprint of the Tel Aviv University campus in Tel Aviv and associated activities, including dormitories (Brushim and Einstein) and all cafeterias present in the campus. Anu Museum of the Jewish People, Park Atidim and other off-campus facilities are not included.

The carbon footprint includes direct emissions at the University (associated to the fuel consumption in vehicles and buildings, and the use of refrigerants within the HVAC system) as well as indirect emissions from electricity and water consumption, waste treatment, business travels, staff and students commuting, and emissions associated to the manufacture, transport and provision of key goods and services, including construction and renovation work.

Finally, the base year chosen was 2019, as it represents the most recent year for which data was available and which was not impacted by the COVID-19 pandemic, which dramatically altered university operations.

To the best of our knowledge this study is the first comprehensive carbon footprint performed for a university campus in Israel, accounting not only for direct emissions and indirect emissions from energy consumption, but also for upstream and downstream emissions from other goods and services.

Results

1. The total emissions of Tel Aviv University in 2019 amounted to 70,037 tCO2e, which is equivalent[i] to:

the burning of around 30,000 tons of coal	80,400 round-trip flights Tel Aviv - New York	0.089% of Israel's total emissions (2019)	1.5% of Tel Aviv's scope 1 and 2 emissions (2017)

[i] References of equivalence:
- Coal: 2.31 tCO2e / ton coal (emission factor, CBS)
- Round trip Tel Aviv – New York: 0.871 tCO2e / passenger ((International Civil Aviation Organization (ICAO), no date)
- Israel total emissions in 2019: 79,044,644 tCO2e (CBS, 2021)
- Tel Aviv scope 1 and 2 emissions: 4,654,482 tCO2e (CDP, 2017)

Indirect emissions from electricity consumption (scope 2), and other indirect emissions (scope 3) were the main emissions sources of the University, representing 42% and 50.2% of total emissions respectively.

Figure 1: Greenhouse gas emissions breakdown per scope (tCO_2e)

2. Electricity consumption was the main emissions source (42% of the total), followed by waste (11.3%) and student and staff commuting. Fugitive emissions was the fourth largest source, representing 7.1% of the total emissions, while direct food purchases and cafeterias combined were responsible of 8%. On the other hand, new construction represented only 4.4% and was the 7th largest source.

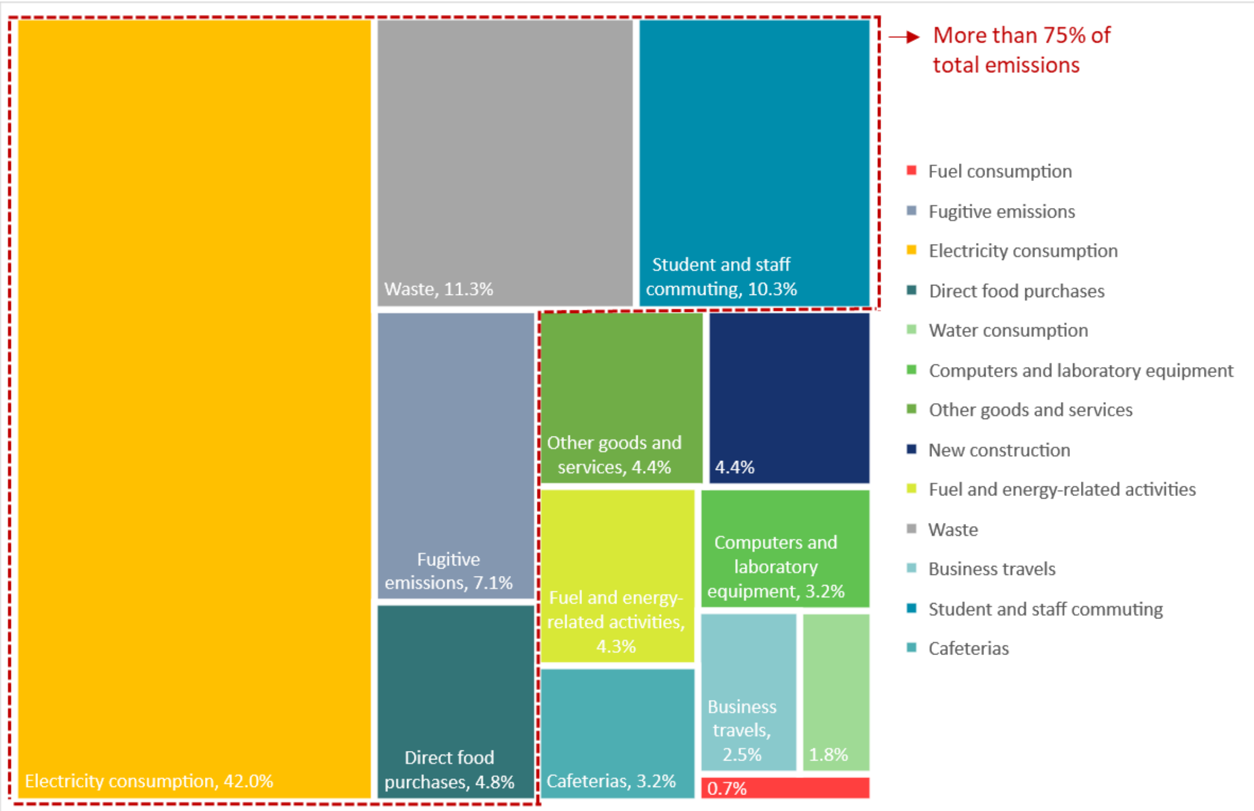


Figure 2: Summary of main emissions source of Tel Aviv University

3. The identification of the main emission sources allows a first estimation on potential focus for emission reductions measures. Results confirmed that the propositions included in Tel Aviv University 2030 carbon neutral initiative relate to the most significant sources of emissions. Mainly, measures to optimize energy consumption and generate renewable energy will help reduce emissions from electricity consumption, while promoting recycling is crucial to reduce emissions from municipal solid

waste management, as most of the waste is non-separated waste, much of which is landfilled. Promoting public transportation for students is another key measure that could reduce emissions from student commuting (more than half of the emissions from student commuting is due to car use).

4. Further analysis of specific activities of the University is required, notably regarding:

    a. Direct food purchases to detail more the causes of the associated emissions (no differentiation was made between meat /dairy /other products).
    b. Investments of the University into funds or companies to estimate the exact emissions reduction potential of divesting from fossil fuels and identify the most high-impact environmental companies or funds associated.

5. When comparing the University carbon footprint with 21 other international universities, for which data is publicly available, Tel Aviv University is ranked 12th best in emissions per capita, and 9th best in emissions per built area.

Analysis overview

Objectives and work process

The main objectives of the carbon footprint study for Tel Aviv University were:

1. Calculation of the direct and indirect emissions of Tel Aviv University (2019)
2. Identification of key emission sources as a basis for potential emission reduction measures
3. Comparability with other international universities

This study was mandated and overseen by the following Steering Committee:

- Ofer Lugassi
- Prof. Marcelo Sternberg
- Dr. Vered Blass
- Prof. Abraham Kribus
- Dr. Tomer Goodovitch, responsible of the data collection process.

The data collection was conducted through the review of the University's reports and documentation (Financial Report, Energy Survey, Student Commuting Survey, TAU Carbon Neutral Initiative 2030, TAU Master Plan), as well as through direct data collection in conjunction with several personnel from the University, most notably:

- Avi Weiss, Supply Department Director
- Nir Aziza, Licensing department Director
- Israel Friedman, Cafeterias and Events Coordinator
- Nissan Yakovi, Energy Survey Coordinator

In addition, all cafeterias present on campus were surveyed on their electricity and water consumption as well as on their purchases of cutlery, packaging and so forth.

Selected standard – GHG Protocol

The carbon footprint of Tel Aviv University was conducted following the principles and requirements of the GHG Protocol Corporate Accounting and Reporting Standard (The Greenhouse Gas Protocol, 2011, 2015), which is the world's most widely-used greenhouse gas accounting standard[ii].

The GHG Protocol standard takes into account emissions across the value chain of an organization, a project or a product.

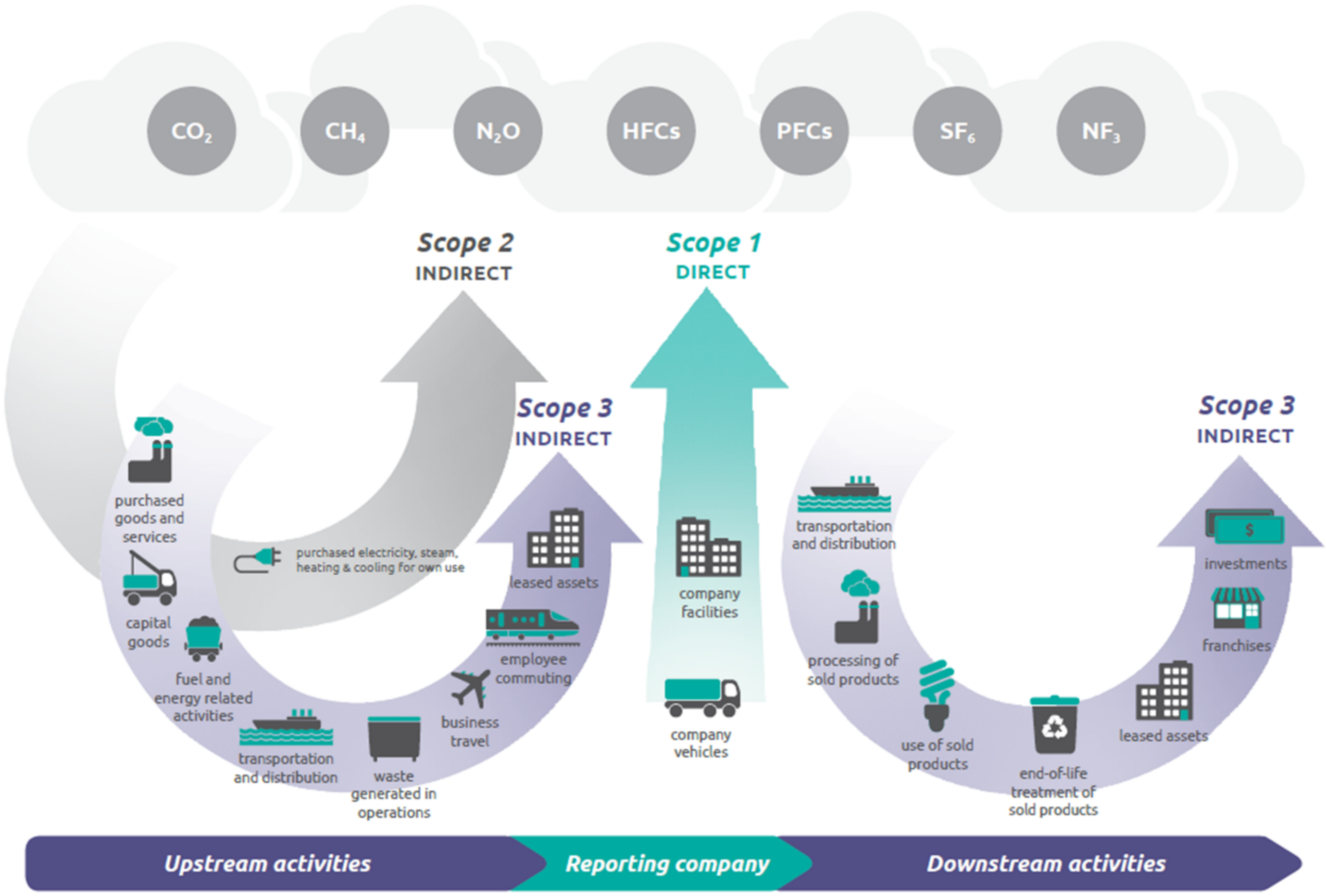


Figure 3: Overview of GHG Protocol scopes and emissions across the value chain (Source: GHG Protocol)

Direct and indirect emissions are categorized into three scopes:

- Scope 1 = Direct GHG emissions

  Direct GHG emissions are emissions from sources that are owned or controlled by the organization and include emissions due to fuel consumption (in vehicles, heating equipment or other), and fugitive emissions due to the use of refrigerants in HVAC.
- Scope 2 and 3 = Indirect GHG emissions

[ii] The Greenhouse Gas Protocol (GHG Protocol) is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). Launched in 1998, the mission of the GHG Protocol is to develop internationally accepted greenhouse gas (GHG) accounting and reporting standards and tools, and to promote their adoption in order to achieve a low emissions economy worldwide. https://ghgprotocol.org/

Indirect GHG emissions are emissions that are a consequence of the activities of the organization but occur at sources owned or controlled by another organization. Indirect emissions are divided into two scopes:

- Scope 2 = Indirect emissions from energy (electricity) consumption
- Scope 3 = Other indirect emissions (separated into 15 different categories, such as Goods and Services, Waste treatment, Business travel, Students and staff commuting, etc.). Detailed descriptions of each category are provided annex 1.

Boundaries of the analysis

The carbon footprint was performed for the Tel Aviv University main campus in Tel Aviv. The first step in performing the carbon footprint is setting the boundaries of the analysis, both in terms of the organizational boundaries, as well as the operational boundaries, as detailed below.

Setting organizational boundaries

In addition to the direct operations of the University, the Tel Aviv campus itself hosts activities by external organizations in its facilities, both on a regular (such as vendors) and an ad-hoc basis, as well as some buildings that are fully owned and operated by external organizations. Setting the organizational boundaries essentially determines which activities at the Tel Aviv campus "belong" to Tel Aviv University, and which do not.

In setting organizational boundaries, an approach is selected for consolidating GHG emissions. This approach is then consistently applied to define those buildings and operations that constitute the university for the purpose of accounting and reporting GHG emissions.

The operational control approach for Tel Aviv's University's carbon footprint was selected as the consolidation approach: the analysis included emissions from operations over which the University has operational control, meaning if it has the full authority to introduce and implement its operating policies at the operation. As opposed to financial control, this approach did not account for GHG emissions from operations in which the University owns a financial interest, but does not have operational control; conversely, it includes activities for which the University has operational control despite having no direct financial interest.

Most importantly, this means that emissions associated with activities by external organizations conducted on-campus in the University facilities, such as organizational meetings and events, are included in the University's organizational boundaries, as it is the University itself that has operational control over these facilities. However, on-campus facilities and activities that are not owned and operated by the University are either fully excluded from the analysis, or, to the extent that they provide services to the University, included as indirect emission (scope 3 – for more detail see operational boundaries below).

Consequently, the boundaries of the analysis considered the following buildings:

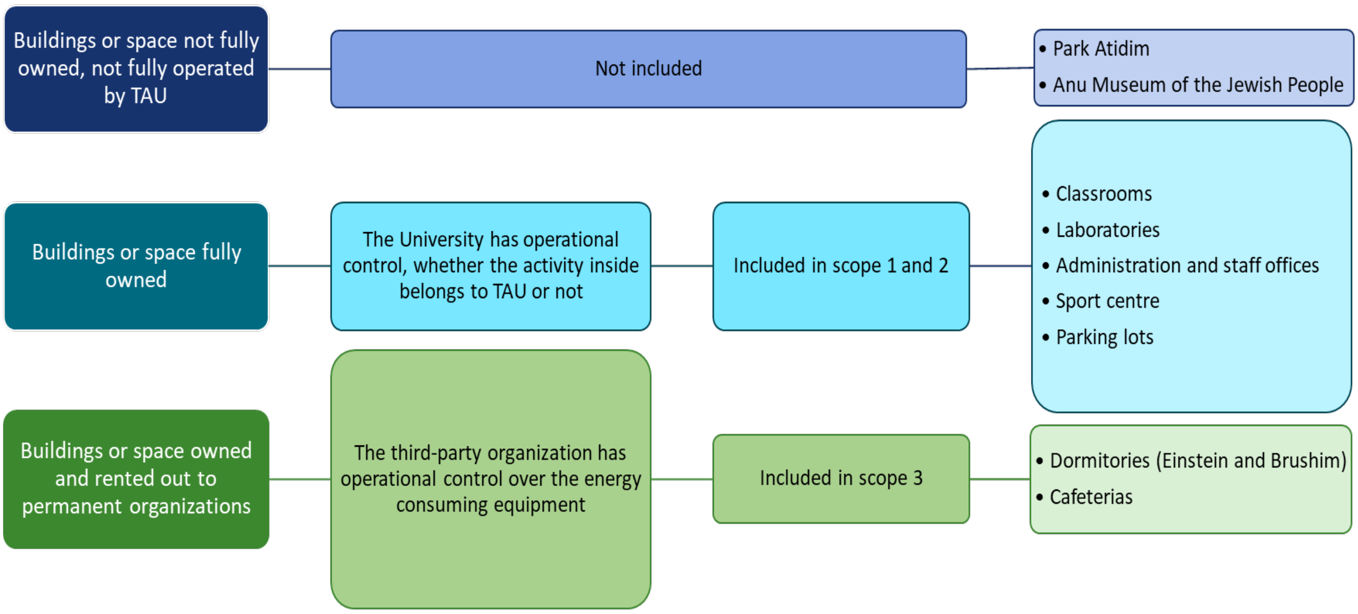


Figure 4: Definition of the analysis' organizational boundaries

Setting operational boundaries

After an organization has determined its organizational boundaries in terms of the operations that it owns or controls, it then sets its operational boundaries. This involves identifying emissions associated with its operations, categorizing them as direct and indirect emissions, and choosing the scope of accounting and reporting for indirect emissions.

What is classified as direct and indirect emissions is dependent on the consolidation approach selected previously for setting the organizational boundary.

Consequently, the following emissions sources were included in the analysis:

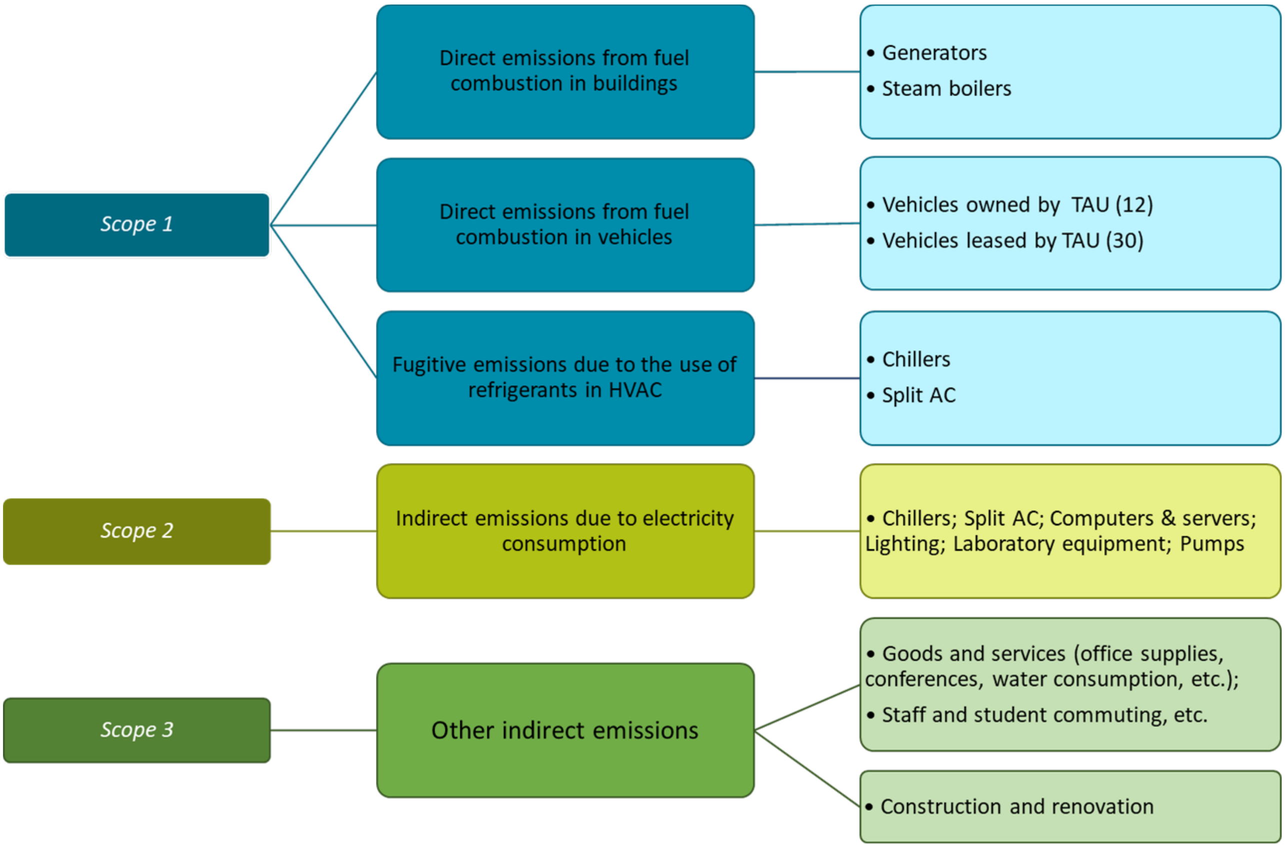


Figure 5: Summary of emissions sources included in the analysis

Finally, the base year chosen was 2019, as it represents the most recent year for which data was available and was not impacted by the COVID-19 pandemic, which dramatically altered university operations.

Methodologies and data used

Scope 1 and 2

In general, high-quality activity data was available at the University level for scope 1 and 2, and the associated emissions factors were University- and Israel-specific.
Therefore, for these scopes, the carbon footprint was conducted using the University's activity-specific data, as follows:

Scope	Methodologies	University activity data	Emission factors (EF) and other parameters used
Scope 1			
→ Fuel consumption in buildings	Application of documented emission factors per quantity of fuel	• Fuel consumption in generators and steam boilers (2019 Energy Survey (Gadir Engineering Ltd., 2019))	Coefficients of 2019, Israel Voluntary CO2 Emissions Reporting Mechanism of the Ministry of Environmental Protection
→ Fuel consumption in vehicles	Application of documented emission factors per quantity of fuel	• Fuel consumption from vehicles (owned or leased by the University)	Coefficients of 2019, Israel Voluntary CO2 Emissions Reporting Mechanism of the Ministry of Environmental Protection
→ Used of refrigerants in HVAC system	Application of documented emission factors per quantity of gas	• Quantities of gas used in the HVAC system (global). Gases included are R22, R134 and R404.	IPCC Emission Factor (IPCC's Working Group I, 2007)
Scope 2			
→ Electricity consumption: Emissions from the **combustion** of fuels to generate electricity[iii]	Market-based: electricity purchased to one supplier (Dalia Energy)	• Electricity consumption (2019 Energy Survey (Gadir Engineering Ltd., 2019)) • Electricity generated by solar PV	Combustion emission factor associated to Dalia. (Neeman Institute et al., 2017) This emission factor does not include the upstream emissions from production and transmission of the fossil fuels to the power plant, or the emissions related to T&D losses.

[iii] Do not include the upstream emissions or the emissions related to T&D losses; such emissions are calculated in scope 3 – category "Fuel- and Energy-Related Activities".

Scope 3

As mentioned previously, Scope 3 can be divided into 15 categories. However, categories might not all be relevant and GHG Protocol Scope 3 standard gives flexibility in whether and how to account for scope 3 emissions.

Identification of the applicable categories

The following categories were included in the carbon footprint under scope 3, as there are relevant to the University's activities: Categories 1- Purchased goods and services, 2 – Capital goods, 3 – Fuel and energy-related activities, 5 – Waste generated in operations, 6 – Business travels and 7 – Staff and students commuting.

Although relevant, categories 13 - Downstream leased assets and 15 – Investments were not included in the final analysis for the following reasons:

- In the case of Tel Aviv University and according to the standard requirements, Category 13 (downstream leased assets) shall include scope 1 and 2 emissions of leased buildings, namely dormitories and cafeterias. However, fuel consumption and refrigerants data were not fully available. Further, whilst they are downstream leased assets, dormitories and cafeterias also provided a service to the University. Therefore, in order to avoid double counting:
    - → Emissions from dormitories' electricity consumption (data available) were included in category 3 (Fuel- and energy- related activities) as "electricity purchased and sold" by the University.
    - → Emissions from cafeterias' electricity consumption were included in the total emissions of cafeterias (defined as a service in category 1) along with the emissions of the cafeterias' water consumption, purchases and waste generation.
- Due to the complexity of obtaining detailed data regarding investments, the corresponding category (category 15) was not included in this analysis. However, this category should not be overlooked and efforts to include it in future carbon footprint analyses should be undertaken.
  Indeed, in order to illustrate the importance of this category, the following graph presents the emissions associated with every 100,000 USD of revenue associated with the University's equity investment in a company[iv].
  This estimation was conducted using the GHG Protocol "Scope 3 evaluator" online tool[v] which combines financial data with an Environmentally Extended Input Output (EEIO) analysis.

[iv] A revenue associated with the University's equity investment in a company is equal to the annual revenue for the equity companies normalized by the equity share of the investment in the company. As an example, if the University owns 1% of the equity of a company that earned 10 million USD, the revenue of the University is 100,000 USD since the university has 1% equity share.
[v] https://ghgprotocol.org/scope-3-evaluator

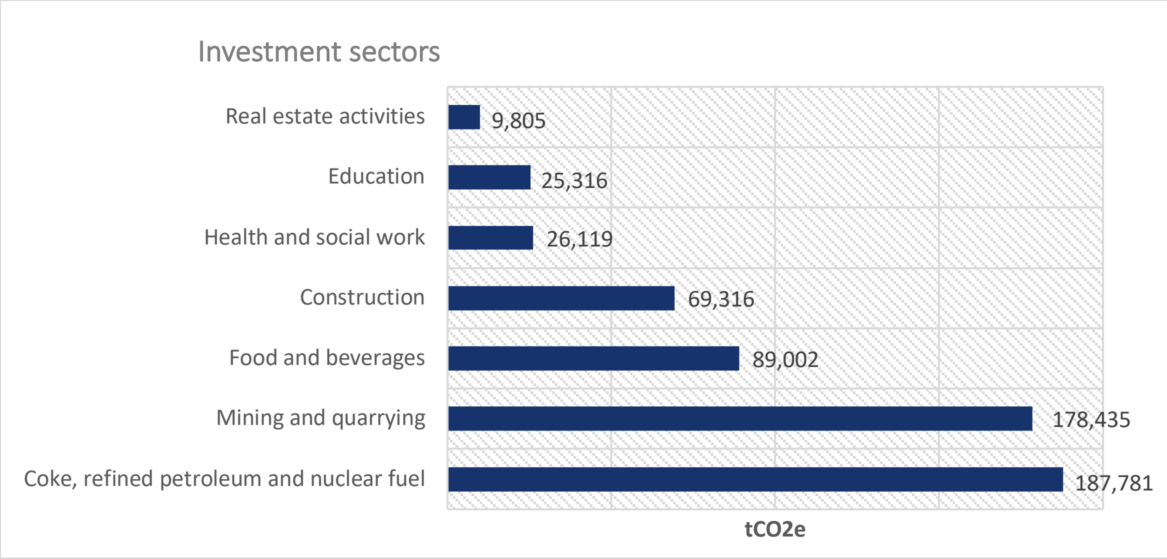


Figure 6: Emissions estimated for a 100,000 USD revenue associated with the University's equity investment in a company according to investment sectors (in tCO2e)

The impact of every 100,000 dollars revenue associated with the University's equity investment in a company, ranges from 9,800 tCO2e (if all of the investment is made towards real estate activities) to 187,781 tCO2e (if all of the investment is made towards fossil and nuclear fuel activities). This represents between 0.13 to 2.5 times the total emissions of TAU present carbon footprint (75,717 tCO2e).
Considering that the University invested NIS 3 billion in 2018 – as indicated in the University's 2018 financial report ('Tel Aviv University - Financial report', 2018) – the potential contribution to the revenue made from its investment can be significant, depending on the sector where the investment was made.

Other categories were considered as not applicable.[vi]

<u>As a result, categories included in the analysis are the following</u>:

[vi] Non-applicable categories include: 4. Upstream transportation and distribution, 8. upstream leased assets, 9. Downstream transportation and distribution, 10. Processing of sold products, 11. Use of sold products, 12. End-of-life treatment of sold products, 14. Franchises.

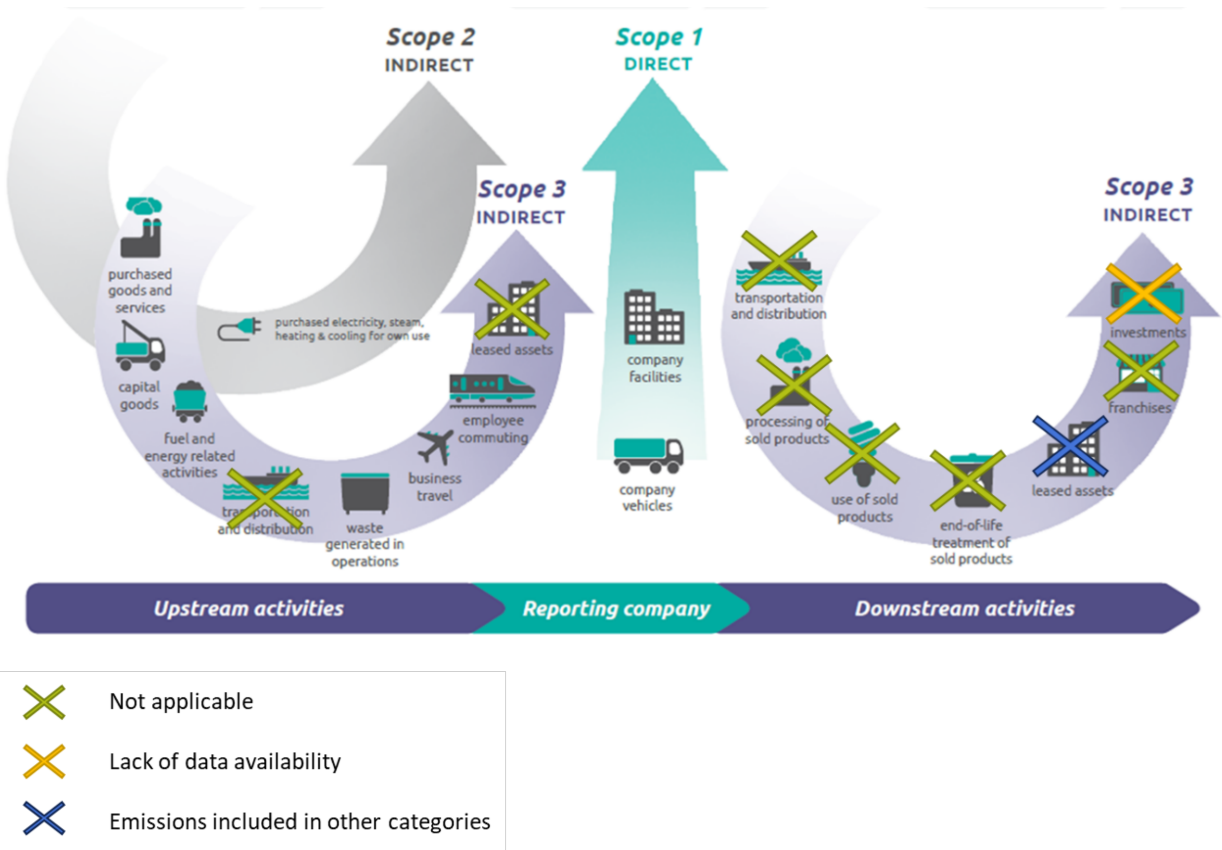


Figure 7: Summary of scope 3 categories included in Tel Aviv University's carbon footprint.

Prioritization of data collection

Data collection efforts were prioritized on specific scope 3 activities. Collecting higher quality data for priority activities allows to focus resources on the most significant GHG emissions in the value chain, more effectively set reduction targets, and track and demonstrate GHG reductions over time.

A combination of approaches and criteria to identify priority activities was used. Broadly speaking, higher quality data was sought for all:

i. *Activities that are significant in size.*
   In order to determine which scope 3 activities are expected to be most significant in size, the GHG Protocol "Scope 3 evaluator" online tool was used(The Greenhouse Gas Protocol and Quantis-suite, no date). Combining expenses data of the University with an Environmentally Extended Input Output (EEIO) analysis, this step provides an initial rough estimation of the emissions and ranking of each of the relevant scope 3 categories.
ii. *Activities where more accurate data can be easily obtained*.
iii. *Activities where the university can potentially reduce emissions*, to correspond to the university's goal to be carbon neutral by 2030
iv. *Activities that were deemed critical by the Steering Committee*, such as the use of single-use plastic tableware.
v. *Activities that were included in other universities' carbon footprint*, in order to be able to compare the results between one another. Key activities included in other universities'

carbon footprints are student and staff commuting, business travels, waste generation, and purchases of office supply and detergents (see Chapter "Comparison with other universities").

For activities that were expected to have insignificant emissions or where accurate data was not available in a timely manner, broader, less site-specific approaches were used to estimate emissions. Consequently, methodological decisions were taken for each category based on the following decision tree:

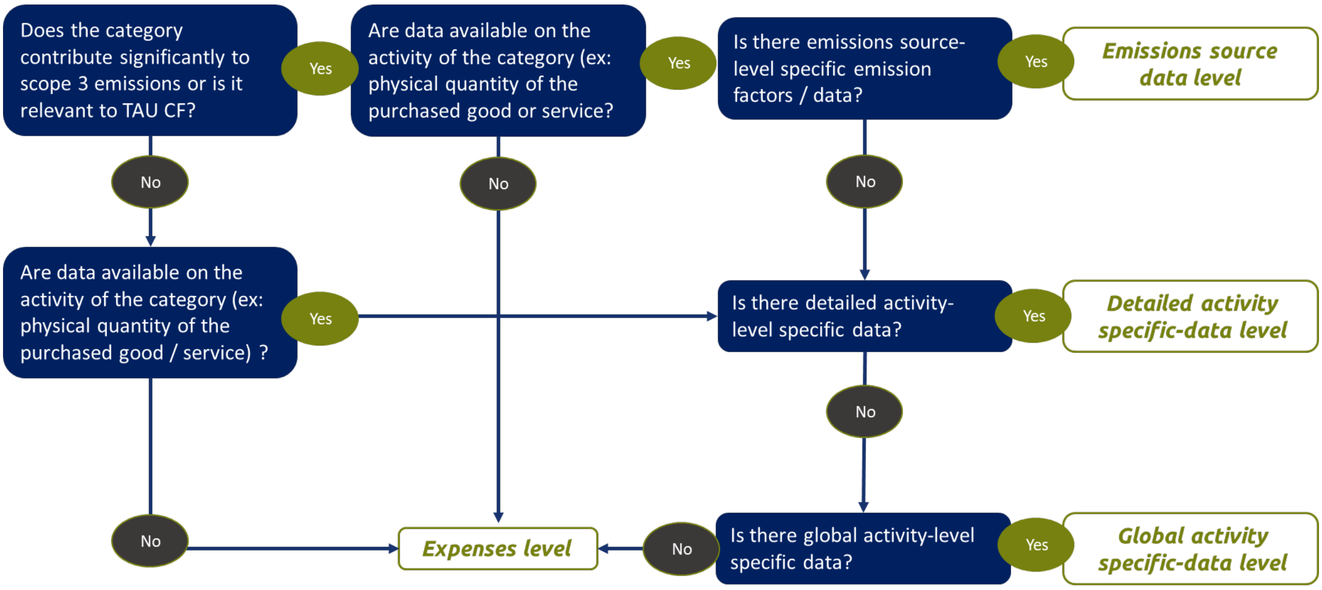


Figure 8: Methodological decision tree.

The specific methods applied under each level are as follows, in order of how site-specific the resulting emissions calculation is:

- **Emissions source data level**, which requires collection of emissions factors directly from the emissions source. Depending on the category, it can correspond to the following method:
  - *Supplier-specific method.* This method collects product-level cradle-to-gate GHG inventory data from goods or services suppliers or fuel providers.
- **Detailed activity specific level**, which requires collection detailed activity data from the University. Specific methods associated with this level are:
  - *Average-data method*. This method was applied to some sub-categories of "Goods and services purchases", "Capital goods" and "Fuel- and Energy-Related Activities" categories. It estimates emissions for goods and services by collecting data on relevant physical units of goods or services purchased (e.g. kilograms, liter) and multiplying by the relevant secondary (e.g., industry average) emission factors.
  - *Waste-type specific method*. As the name indicates, this method applies to the waste category and involves using emission factors for specific waste types and waste treatment methods.
  - *Distance-based method*. Relevant for "Business travels" and "Students commuting", this method involves determining the distance and mode of business trips, or the students commuting patterns (e.g., distance travelled and mode used for commuting) and applying appropriate emission factors for the modes used.

- **General activity-specific level**, which requires data relevant to the University's activities but based on national-level data. This level was only used for staff commuting – and is based on the "*average-data method*" using national commuting patterns.
- **Expenses level,** based on the *spend-based method*, emissions are estimated by collecting data on the economic value of goods and services purchased and multiplying it by relevant secondary emission factors. This method is relevant only to "Goods and services purchases", "Capital goods" and "Business travel" categories.

More than half of the total scope 3 emissions were estimated based on detailed activity-specific data, and a further 9% (corresponding to the campus water consumption and the cafeterias and dormitories electricity consumption), were estimated based on the highest level of data specificity, i.e. collecting data at the emissions source level.
Only 26% were estimated based on the University's expenses, the lowest level of data specificity.

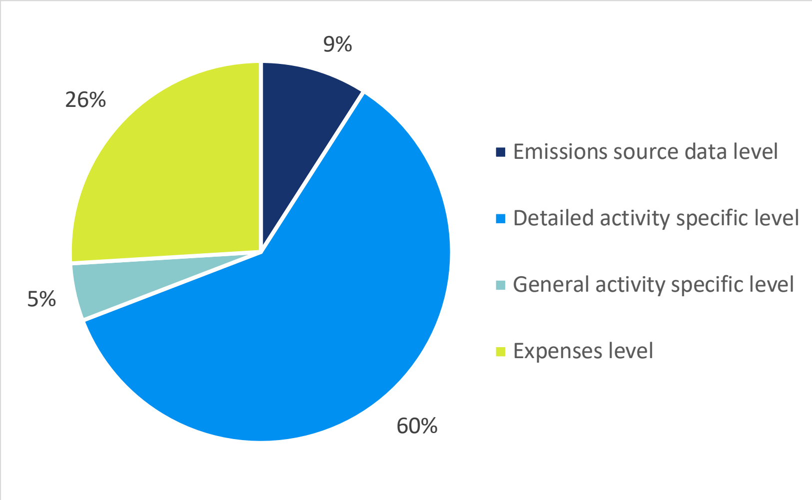


Figure 9: Share of scope 3 emissions according to the data-specificity level.

Detailed methodologies and data description related to scope 3 are provided in the following table.

Scope and category	Description of the methodology used to calculate emissions	Description of the activity-data collected from the University	Main assumptions used to calculate emissions	Data sources of the emission factors (EF) and other essential parameters used
Scope 3 emissions				
Category 1: Purchased goods and services				
→ Water consumption	Supplier-specific method	Include quantity of water consumed on campus, in the dormitories, and in the sport center	-	• Israeli-specific LCA study on the water supply system (Meron, Blass and Thoma, 2020)
→ Cafeterias	Hybrid method: • Detailed activity-specific data method for scope 2 (electricity consumption) • Spend-based method for food purchases and other packaging and cleaning products • Water consumption: Supplier-specific method • Waste: see category 5 (below)	The term “Cafeterias” include eateries (“בתי אוכל”), franchised restaurants (such as Mc Donald’s, Fabiano, etc.), and food trucks (“עגלות מזון”). The following parameters were collected: • Electricity consumption in NIS (not accounted in scope 2) • Water consumption in NIS (not accounted in the total water consumption) • Purchases of food and packaging and cleaning products in NIS • Waste quantity per type of waste (in ton or liter)	• Considering that there is no stationary fuel consumption and the lack of data regarding fuel consumption in vehicles and use of refrigerants, scope 1 emissions of cafeterias are not included. • Average price of 1 kWH in 2019 = 0.4 NIS (Energy survey, 2020) • Average price of 1 m^3 = 11 NIS (University’s data) • The Environmentally-Extended Input-Output used is specific to the US, updated in 2020 with 2019 USD prices. Nevertheless, it was the more recent and detailed database that was available.	• Electricity: combustion emission factor associated to Dalia (Neeman Institute *et al.*, 2017) • Water: Israeli-specific LCA study (Meron, Blass and Thoma, 2020) • Purchases: United States Environmentally-Extended Input-Output (USEEIO)(U.S. Environmental Protection Agency, 2020) • Waste: see category 5 (below)

→ All other categories	Spend-based method	Expenses in NIS of the most important purchases, aggregating them into subcategories (e.g., direct food purchases, detergents and cleaning products, paper, office supply, etc.).	Total expenses summed to around 136 million NIS. 65% of it was successfully subcategorized, and the associated emissions were estimated. The remainder (47 million NIS) was spent on a variety of goods and services that could not been sub-categorized. The emissions related to these 47 million NIS were thus not included in the present analysis.	• United States Environmentally-Extended Input-Output (USEEIO) (U.S. Environmental Protection Agency, 2020)
Category 2: Capital goods				
→ Construction / renovation	Average-data method using: • Quantity (estimation) of construction/renovation materials that emit the most GHG emissions (steel and cement) and other most common and relevant materials used. Not supplier-specific emissions factor	**Estimation** of the quantity of the main material used in construction and renovation works, i.e.: steel, concrete, flooring (porcelain granite), gypsum boards (including aluminum profile), aluminum and glass (aluminum and double-glazed profile windows) and acoustic ceilings (including aluminum profile and gypsum tiles / compressed cardboard / tin).	• According to literature, concrete emissions are almost exclusively due to cement production (Irfan, 2011), thus the emissions related to concrete are calculated taking into account only the production of cement, and do not include the other materials / activities (such as water, mineral additives, etc.). • The estimated quantity of steel and concrete in renovation was given as a proportion relative to the estimated quantity in new construction, aggregating steel and concrete together. • Regarding the emission factor for steel: various sources indicated different import countries (mainly Italy and China according to the	• Cement: Nesher's specific EF (Nesher, 2017) • Steel: global emission factor, average of 94 steel companies (World Steel Association, 2020) • Other materials: emission factor based on the total "global warming potential" related to the product stage, indicated in one representative Environmental Product Declarations (EPD). (Vetrotech, 2019; Gypsum Association, 2020; Merkongebonden, 2020; Seranit, 2020; Knauf Ceiling Solutions, 2021)

			World Bank[vii] versus Turkey, China and Russia according to the Observatory of Economic Complexity[viii]), so in view of this uncertainty it was decided to take a global value. • It was assumed that for each square meter of gypsum board or acoustic ceiling used, two meters of aluminum profiles are used. • According to TAU, fuel consumption on sites is not significant and was not included in the analysis.	
→ Laboratory equipment and computers	Spend-based method	Expenses in NIS	-	• United States Environmentally-Extended Input-Output (USEEIO) (U.S. Environmental Protection Agency, 2020)
Category 3: Fuel- and energy-related activities (not included in scope 1 or scope 2)				
→ Upstream emissions[ix] of purchased fuels and purchased electricity	Average-data method based on quantity of fuels and electricity consumption	• Data collected for scope 1 and 2 on electricity and fuel consumed by the University • In addition, it includes dormitories' electricity	Assumption that only natural gas is used to generate the electricity purchased	• Emission factor from CDM projects (United Nations. Framework Convention on Climate Change, 2014)

[vii] https://wits.worldbank.org/trade/comtrade/en/country/ISR/year/2019/tradeflow/Imports/partner/ALL/product/731450%202019
[viii] https://oec.world/en/profile/bilateral-product/iron-and-steel/reporter/isr
[ix] Emissions related to the extraction, production, and transportation of fuels purchased directly by the University or of fuels consumed in the generation of electricity that is purchased by the University, Emissions from fuels combustion to generate the electricity are accounted in scope 2.

		consumption (electricity purchased by the University)		
→ Transmission and distribution (T&D) losses[x]	Average-data method estimating emissions by using national average on T&D loss rate	• Data collected for scope 2 on electricity consumed and purchased by the University.	-	• National average on T&D loss rate (6% - conventional power) (Ministry of Environmental Protection, 2021)
→ Power that is purchased and sold (only combustion emissions)	• Supplier-specific method: electricity purchased to one supplier (Dalia Energy)	• Electricity consumption of dormitories (Einstein and Brushim)	• Include only electricity sold to dormitories • Does not include electricity sold to cafeterias (accounted in category 1) • Include the emissions from the combustion of fuels to generate electricity, upstream emissions are included in its specific category	• Combustion emission factor associated to Dalia (Neeman Institute *et al.*, 2017)
Category 5: Waste generated in operations				
	Waste-type specific method, using emission factors for specific waste types and waste treatment methods. In addition, in order to determine the final waste quantity going to landfill, recycling rates were applied to each collected waste stream (organic, paper, plastic, cardboard, garden waste, etc.)	• **Estimation** of collected waste quantity per type of waste (mixed waste, garden waste, paper and cardboard, electronic waste, biological waste and carcasses), based on the number of collected containers or trucks collecting the waste.	• Landfilling was assumed to be the main treatment method for the non-recycling part of the waste. • Composting was also included in the analysis. • Emissions from the treatment of the waste stream "biological waste and carcasses" were assumed not significant and were not included in the analysis.	• IPCC landfill emissions model per type of waste (Intergovernmental Panel on Climate Change (IPCC). National Greenhouse gas inventories programme., 2006) • Characteristics of Israel waste composition (Ministry of Environmental Protection, 2014) • National recycling rate per waste stream (CBS, 2017)

[x] Emissions related to generation (upstream activities and combustion) of electricity reported by the University

	separated at the source or sorted out from municipal solid waste, applying the national recycling rate as published by the CBS.		• Emissions from recycling of part of the inert waste (electronic, plastic, glass, metals and others) were assumed not significant and were not included in the analysis	
Category 6: Business travel				
→ Plane travels	Distance-based method	• Number of travels per destination (country)	• Assumption that the city of arrival is the capital city of the destination country • For the USA, assumption that half of the travels were to the east coast (New York), and half to the west coast (San Francisco) • Assumptions were made on the layover city when no direct flights were available.	• ICAO (International Civil Aviation Organization, a UN organization) Carbon Emissions Calculator (based on the cabin class, number of passengers, city of departure and city of arrival) (International Civil Aviation Organization (ICAO), no date)
→ Bus travels, taxi	Spend-based method	Expenses in NIS	-	• United States Environmentally-Extended Input-Output (USEEIO) (U.S. Environmental Protection Agency, 2020)
Category 7: Employee commuting				
→ Students	Distance-based method, using average data on students commuting patterns	• Commuting patterns according living city and transport mode (Tomer Goodovitch, 2018)	• Estimation on total vkm needed to commute to each town of residence (using google maps) • Estimation on number of academic days (Tel Aviv University, 2018)	• Fuel efficiency and load factor per transport mode (Ministry of Environmental Protection, EcoTraders Ltd., and Ricardo Energy & Environment, 2015)

→ Staff	Average-data method, using average national data on employees commuting patterns. National data include the following transport modes: car, shuttle, bus, train and bicycle /by foot. Percentage of workers per transport mode was recalculated considering the following: 1. There is no shuttle organized by TAU 2. People taking the train are living are at least 10 km from the University, with the average distance being 20 km.		• Estimation on number of working days	• National data on workers' commute (Haim Bleikh, 2018) • Fuel efficiency and load factor per transport mode (Ministry of Environmental Protection, EcoTraders Ltd., and Ricardo Energy & Environment, 2015)

Summary of methodological decisions

Main decisions impacting the analysis are summarized in the following table:

Parameters	Methodological decisions taken
Chosen consolidation approach	Operational Control
Description of the operations included in the company's organizational boundary	• All buildings on campus were included within the analysis' boundaries. • All emissions sources related to buildings rented out to permanent organizations (dormitories and cafeterias) were included in scope 3. • Park Atidim and Anu Museum of the Jewish People were not included.
Reporting period covered	2019. Also chosen as the base year since it represents activities as they were pre COVID-19
Scope 3 activities (other indirect emissions) included in the analysis	1- Purchased goods and services, 2 – Capital goods, 3 – Fuel and energy-related activities, 5 – Waste generated in operations, 6 – Business travels and 7 – Staff and students commuting
Scope 1, scope 2, and scope 3 activities excluded from the analysis with justification for their exclusion	• All scope 1 and 2 activities were included in the analysis • Non-applicable scope 3 categories include: 4. Upstream transportation and distribution, 8. upstream leased assets, 9. Downstream transportation and distribution, 10. Processing of sold products, 11. Use of sold products, 12. End-of-life treatment of sold products, 14. Franchises • Scope 3 category 15 - Investments was not included due to data availability. • Scope 3 Category 13 (downstream leased assets, namely cafeterias and dormitories) are included in other categories (1 and 3).

Data confidence:

Data were ranked according three levels of confidence:

- High-confidence: activity data monitored and site/supplier-specific emission factor
- Medium confidence: activity data monitored, but the emission factor applied was not site/supplier-specific, or the activity data was estimated but the emission factor was site/supplier-specific
- Low confidence: activity data estimated and non-site/supplier specific emission factor.

62% of total emissions were estimated based on a high-confidence data, which includes:

1. The entire scope 1 and 2: activity data were sourced through the Energy Survey or through bills (refrigerants), while emission factors are specific to each refrigerant (R22, R134 and R404) or each fuel;
2. Water consumption in scope 3;
3. Student commuting in scope 3, where activity data was based on the student commuting survey conducted in 2018 for the University.

17% of total emissions were estimated based on a low-confidence data, and included:

1. Construction and renovation related emissions, based on a quantity estimate of the most emitting or the most common materials together with representative but not supplier-specific emission factors.
2. Waste: activity data were estimated based on the number of containers collected, while emissions factors used were from the IPCC model with a conservative methane collection rate of 5%.

The remainder of scope 3 categories (representing 21% of the emissions) had a medium confidence.

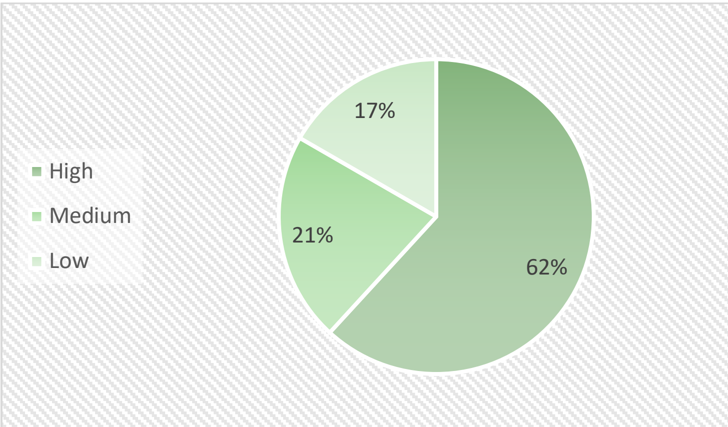


Figure 10: Share of emissions according to the data-confidence level.

<u>Results confidence</u>:

Emissions were calculating via an Excel tool and subject to a dual QA/QC process:

- One technical, conducted by a fellow project manager who reviewed all the formulas, data relations, conversions, etc.
- One from a final results point of view, conducted by the team manager who reviewed the logic of the results in terms of scale, or comparison with similar projects.

Results

Total emissions

In 2019, Tel Aviv University emitted a total of 70,037 tCO2e.

Indirect emissions from electricity consumption (scope 2), and other indirect emissions (scope 3) were the main emissions sources, representing 42% and 50.2% of total emissions from the University, respectively. Direct emissions due to fuel consumption and the use of refrigerants in the HVAC system constituted only 7.8% of total emissions.

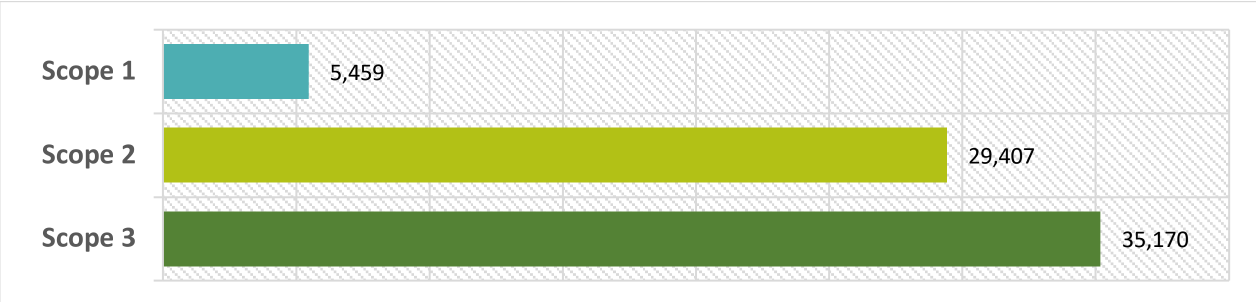


Figure 11: 2019 emissions breakdown per scope (tCO2e)

With 32,000 students and 1,700 staff members (faculty and administrators) the emissions amounted to 2.08 tCO_2e / capita.

When considering the total gross constructed buildings' area, equal to 407,337 m^2, the University emitted 0.172 tCO_2 per square meter.

Scope 1 – Direct emissions

Scope 1 emissions = 5,459 tCO2e, representing 7.8% of total emissions

Direct emissions were mainly due to the use of refrigerants in the University's HVAC systems (gas used for the air-conditioning of the buildings – R22, R134 and R404). Emissions from lab hoods were not taken into account since the data related to **greenhouse** gases used in laboratories was not available.

Emissions from fuel consumption in buildings (almost entirely in steam boilers) and in vehicles owned and leased by the University (42 vehicles in total) represented less than 10% of direct emissions.

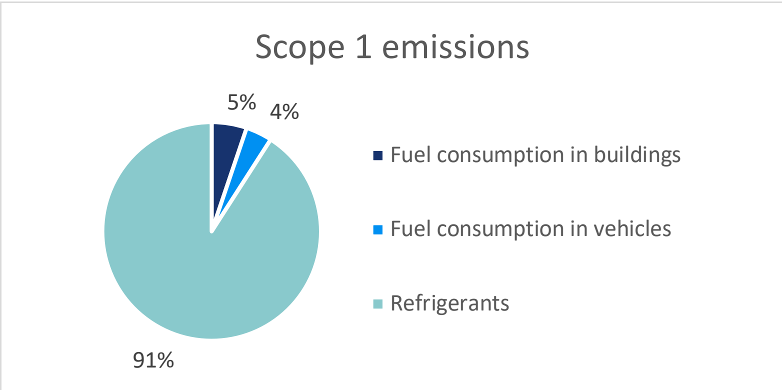
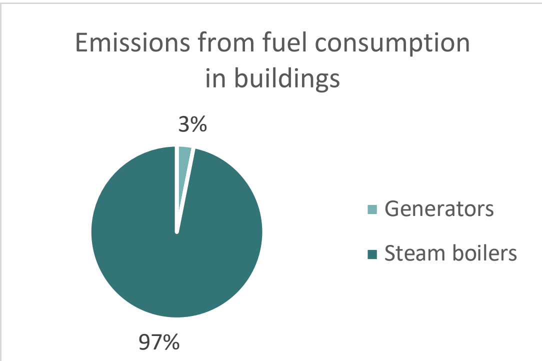


Figure 12: Scope 1 emissions by source



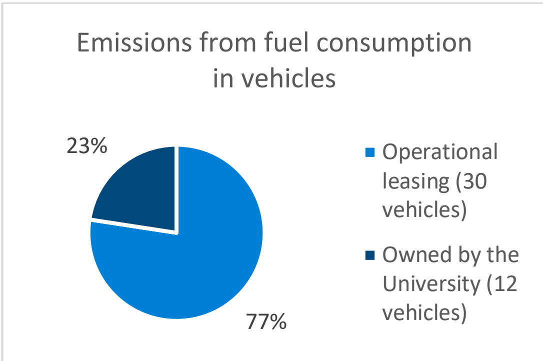


Figure 13: Scope 1 emissions breakdown for fuel consumption in buildings and in vehicles

Scope 2 – Indirect emissions from electricity consumption

Scope 2 emissions = 29,407 tCO2e, representing 42% of total emissions

According to the breakdown of electricity consumption by equipment category, included in the University's energy survey (2019), the primary source of emissions due to electricity consumption was the use of air conditioning (44%), followed by computers and servers (23%), and lighting (19%).

It should be noted that data from the energy survey benefits from a high-confidence level, since data is collected through meters and a series of measurements at the level of the main energy consumer points.

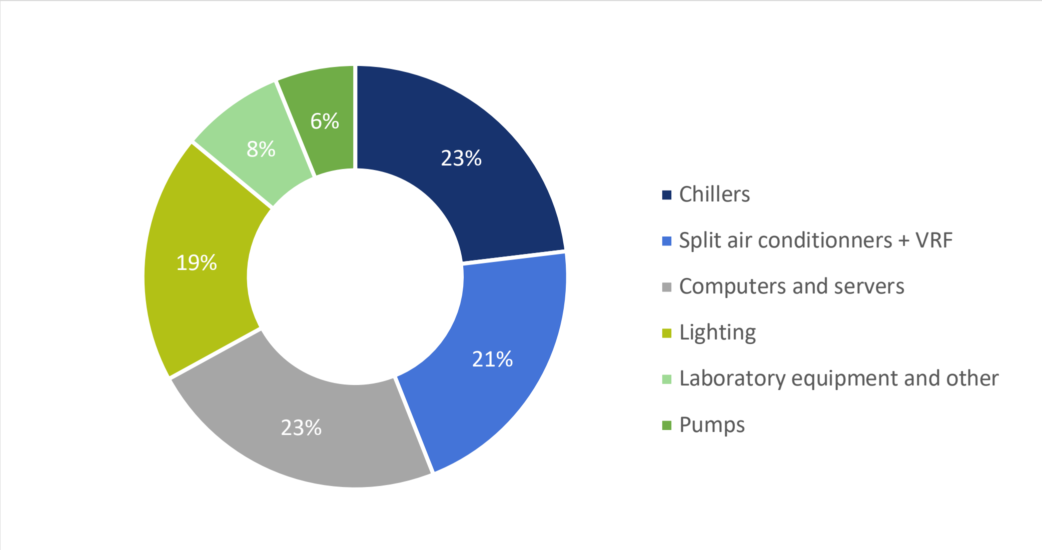


Figure 14: Scope 2 emissions per equipment

The 175kW capacity of solar panels installed on the Central Library, and 150 kW on the Mexico Building (installed mid-2019) generated an estimated 437,500 kWh[11] in 2019. Assuming that the electricity would have been otherwise generated by the same electricity provider of the University (Dalia, a conventional gas power station), this corresponds to an emission reduction of 176 tCO_2e (less than 1% of the University's total scope 2 emissions).

[11] Electricity produced in kWh was calculated based on the installed capacity and the capacity factor corresponding to Israel characteristics (1750).

Scope 3 – Other indirect emissions

Scope 3 emissions = 35,170 tCO_2e, representing 50.2% of total emissions

Aside from electricity consumption, the University's purchase of goods and services is the main indirect emissions source. Mobility, taking into account both emissions from student and staff commuting as well as business travels, is second, followed by waste generation.

Category	Emissions estimation ($tCO2_e$)	% within scope 3	% of total emissions
1. Purchase of goods and services	9,344	27%	13%
2. Capital goods - building contruction and renovation, laboratory equipment, computers	5,983	17%	9%
3 - Fuel and energy-related activities	2,989	8%	4%
5 - Waste generated in operations	7,949	23%	11%
6 - Business travels	1,718	5%	2%
7 - Student and staff commuting	7,188	20%	10%

Figure 15: Scope 3 emissions per category

Purchase of goods and services

Represents 13% of total emissions.

The breakdown of emissions from the purchase of goods and services by category is presented in the graph below. Direct food purchases were responsible for 36% of the emissions in this category, followed by cafeteria activities (24%), water consumption (13%), and laboratory gases (8%).

The 13 remaining categories represent less than 5% of emissions from the purchase of "goods and services" each.

All categories apart from "water consumption" and "cafeterias" were calculated using the spend-based method. The expenses related to these categories totaled 54.6 million NIS.

It should be noted that an additional 47 million NIS were spent on a variety of goods and services that could not been sub-categorized further. Consequently, the emissions related to these additional purchases were not included in the present analysis.

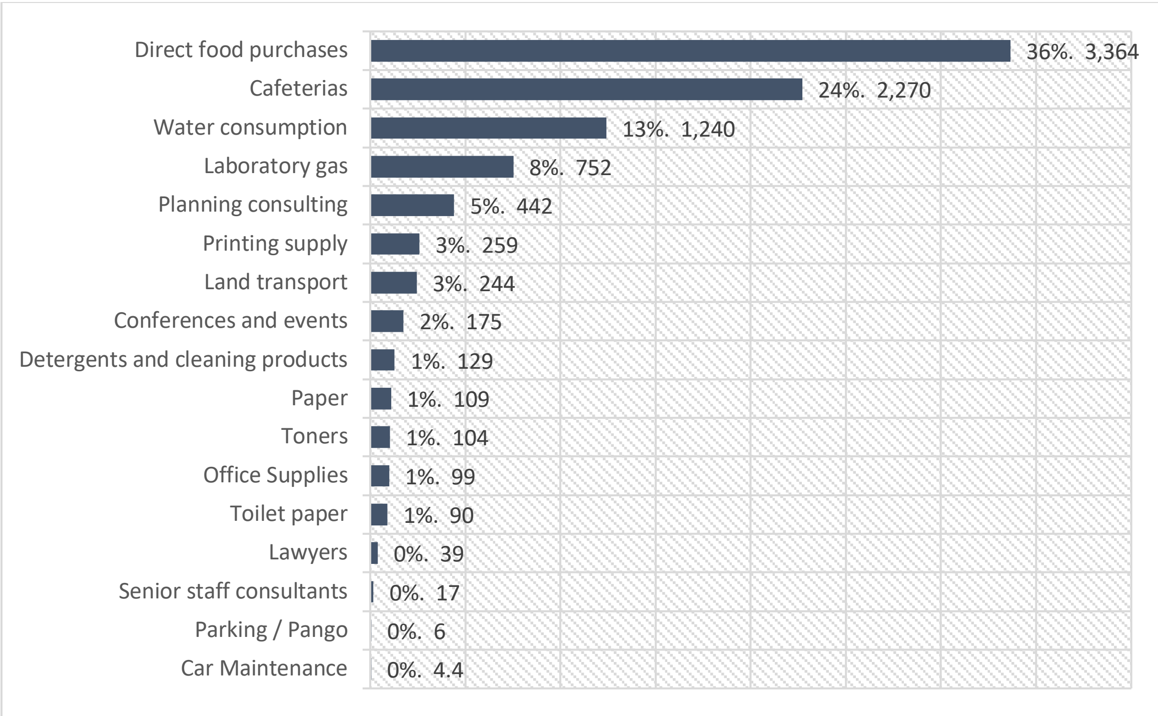


Figure 16: Emissions due to the purchase of goods and services by the University in 2019 (in $tCO2_e$)

Based on data collected through a survey of all cafeterias present on campus, the primary source of emissions from cafeterias is purchases (46%), followed by electricity consumption (40%), and waste generation (13%).

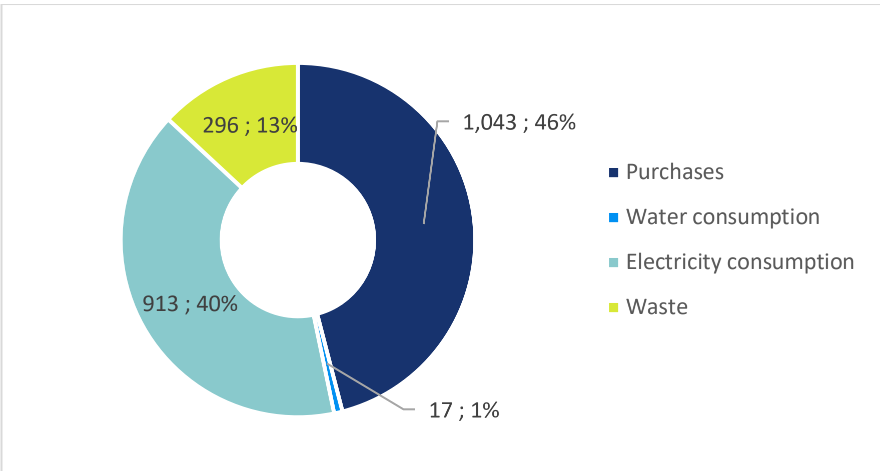


Figure 17: Cafeterias emissions by source (tCO_2e, percentage within the cafeterias' total emissions)

Mobility – Student and staff commuting & Business travels

Represent 12.7% of total emissions

Student commuting represents the major source of emissions in this category (almost three quarters). Only 23% of the 32,000 students arrive by car. However, taking into account that on average, a student arriving by car emits around 3.5 times as much as a student arriving by bus or by train, they emit more than 60% of the emissions associated with student commuting emissions and 46% of total emissions associated with mobility.

International business trips are the second source of emissions in the mobility category, accounting for 17% of emissions in this category, and are mainly due to flights.

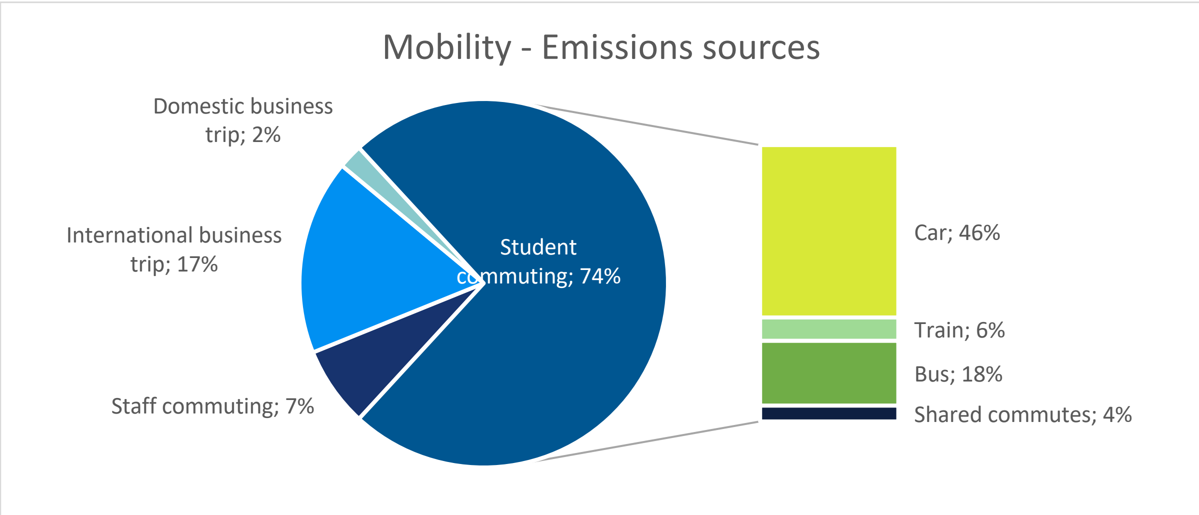


Figure 18: Mobility-related emissions by source

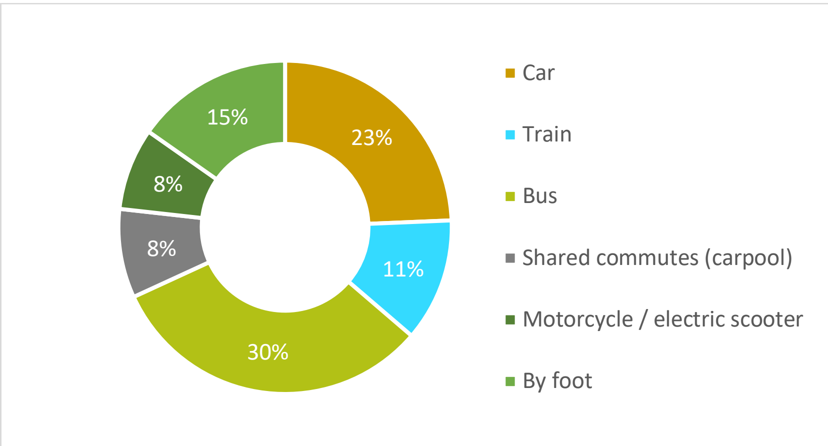


Figure 19: Breakdown of students' arrival means

Waste

Represent 11.3 % of total emissions

Waste emissions are virtually all due to the landfilling of mixed waste. Indeed, 93% of the total waste generated on campus is non-sorted mixed waste, of which 40% is degradable waste going to landfill, around 35% is recycled and the remaining is inert waste going to landfill (with zero emissions).

It should be noted that emissions included in the analysis are only related to landfilling and composting, as other treatment methods (including recycling of inert waste) have been assumed not significant in terms of greenhouse gas emissions.

In order to determine the final quantity landfilled (presented in the table below), the following stages were applied:

1. National municipal solid waste composition was applied to the mixed waste to determine the fraction of each waste stream (organic, paper, plastic, cardboard, garden waste, etc.) (Ministry of Environmental Protection, 2014);
2. National CBS recycling rates were then applied to each collected waste stream that are sorted out from municipal solid waste or separated at the source.

Waste type	Quantity estimated (t/year)	*Recycling rate of the waste separated at source and waste not separated at source (CBS, 2017)*	Final landfilled waste quantity (after sorting and recycling) (t / year)
MSW	11,606		
Organic waste	3,250	*36%*	2,080
Paper	1,625	*19%*	1,316
plastic	1,509	*NA (inert waste)*	NA (inert waste)
Cardboard	1,277	*45%*	702
Garden waste	812	*33%*	542
Other (glass, metals and other)	3,134	*NA (inert waste)*	NA (inert waste)
Waste separated at the source			
Garden waste	200	*33%*	133
Paper and cardboard (in m^3)	626 (m^3/year)		
Paper (in tons)[12]	353	*19%*	82
Cardboard (in tons)	272	*45%*	9

Note: To avoid double counting, waste from cafeterias is not included here but within the total emissions related to cafeterias as a service (category 1).

[12] Conversion from cubic meter to tons was based on the composition of MSW according to volume (Ministry of Environmental Protection, 2014) and volume-to-weight conversion factors of paper and cardboard (US EPA, 1997).

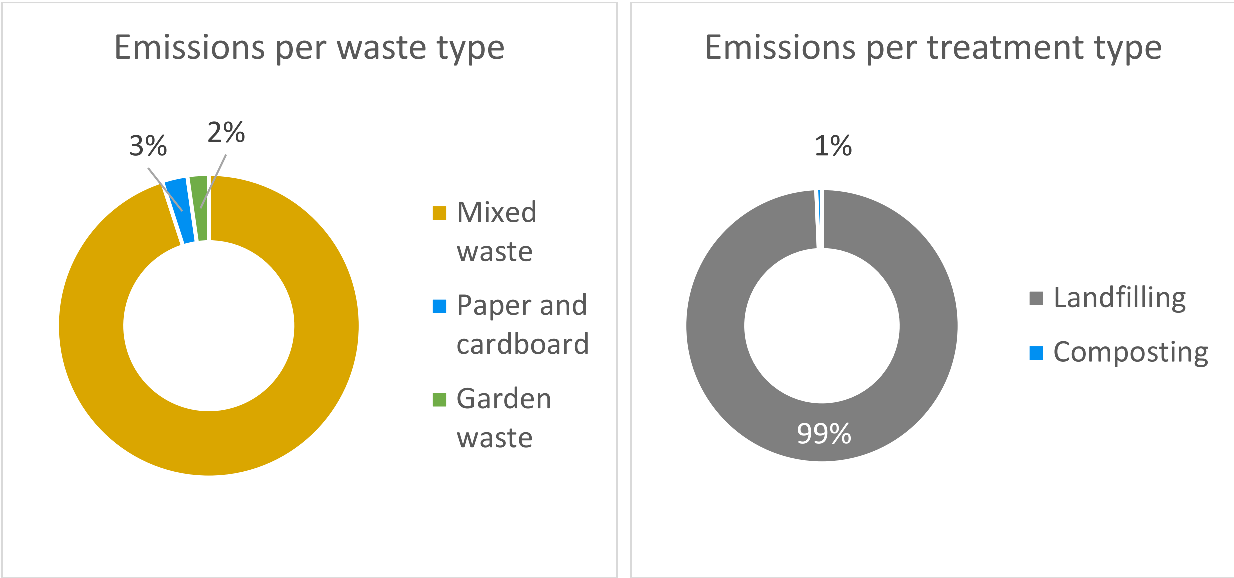


Figure 20: Waste-related emissions

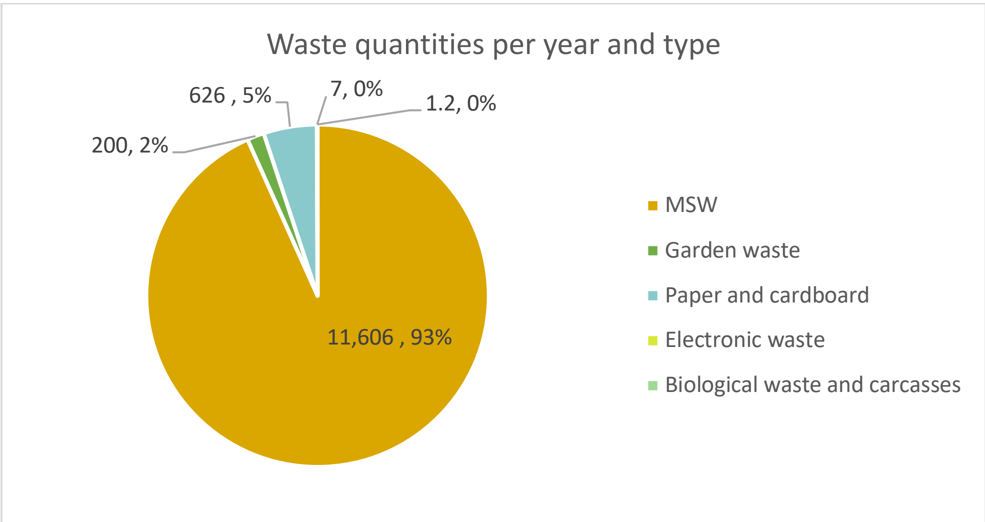


Figure 21: Breakdown of waste quantities per type of waste

Capital goods

Represent 8.5% of total emissions

In 2019, 10,400 m^2 of new construction was carried out, along with 6,200 m^2 of renovations. The emissions due to new construction represented 48% of the capital goods emissions, while renovation represented only 11%. This can be explained by the fact that renovation uses much less steel and concrete, which are the most emission-intensive of the construction materials included in the analysis, than new construction does.

It should be noted that data used for construction and renovation have a low confidence level since the activity data was based on estimated quantity of the most emitting or common materials, while applying representative but not supplier-specific emission factors.

Combined, laboratory equipment and computers represent around 38% of capital goods emissions.

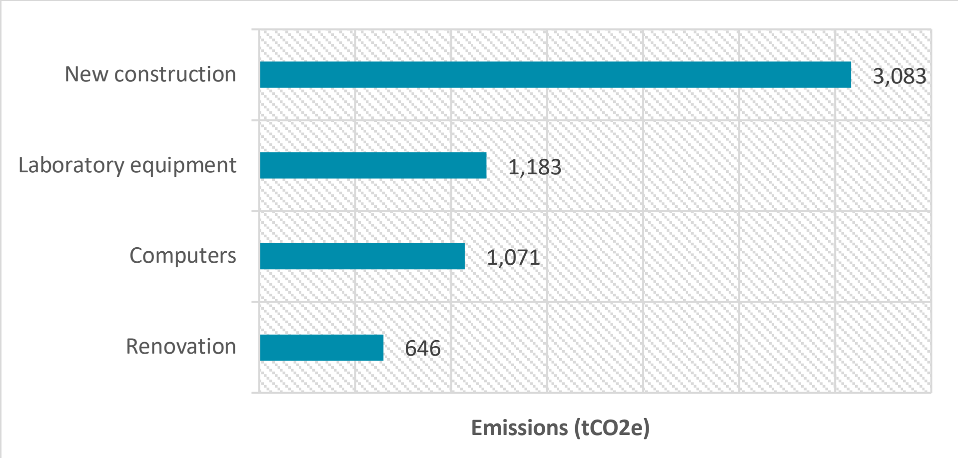


Figure 22: Capital goods emissions by source (tCO2e)

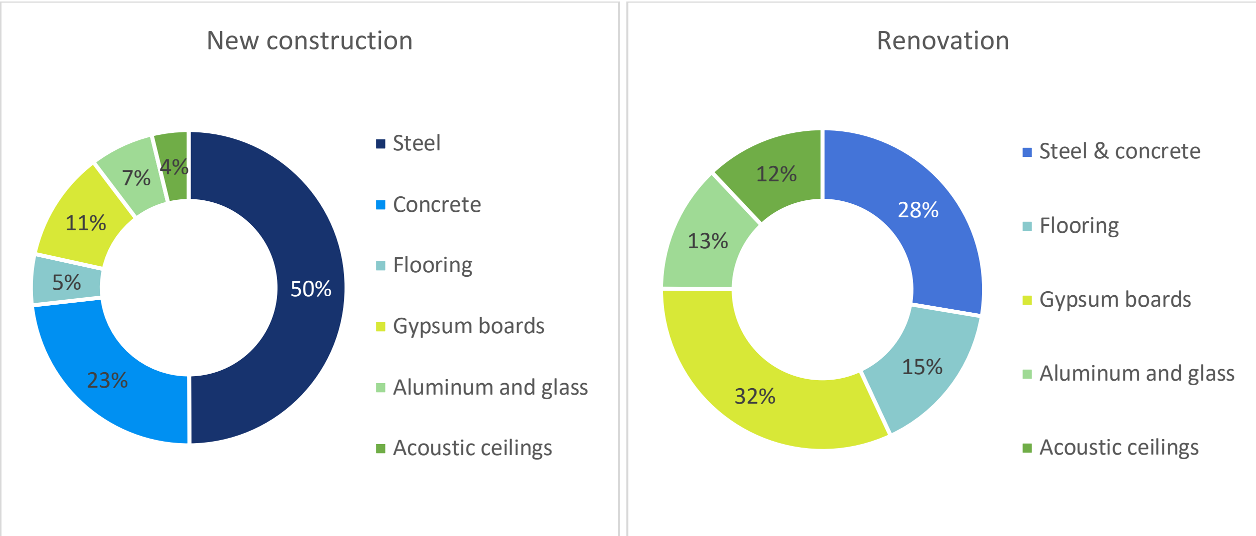


Figure 23: Emissions breakdown by type of construction materials in new construction (left) and in renovation (right)

Fuel and energy-related activities

Represent 4.3% of total emissions

Fuel and energy-related activities emissions (not included in scope 1 or scope 2) encompass the emissions related to the production of fuels and energy purchased and consumed by the University.

These emissions are divided into four sub-categories. Electricity transmission and distribution losses are the main source (61%), followed by emissions due to the power that is purchased and sold – namely the electricity consumption of dormitories (34%).

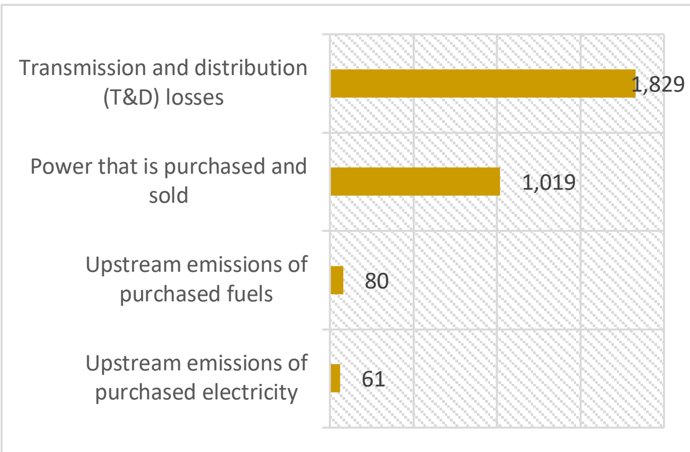


Figure 24: Fuel and energy-related activities emissions (tCO_2e)

Comparison with other universities

Comparability

The carbon footprint of Tel Aviv University was compared to other universities based on a study by Helmers et al. (2021), which surveyed available information on the carbon footprint of 21 universities across the world.(Helmers, Chang and Dauwels, 2021)
It should be noted that carbon footprints cannot be compared across universities on the basis of scopes 1, 2 and 3. For example, large universities sometimes run their own power plants, shifting the emissions related to electricity consumption from scope 2 to scope 1. And each university does not include the same categories in their scope 3, as this scope encompasses a great variety of emissions sources.

Consequently, the comparison was performed on "impact" categories instead of scopes, taking into account those impact categories that were included in the analyses for other universities:

- Energy, which includes emissions related to electricity and heat
- Mobility, which includes emissions related to transport, campus vehicles, staff and student commuting, business trips (domestic and international).
- Further impacts, which include emissions related to fresh and wastewater, office supplies, chemicals and detergents, waste.

Taking into account ***only*** these impact categories, the following comparison considered an "adjusted" carbon footprint of Tel Aviv University, which totaled 52,439 tCO_2e. This means that 75% of the total emissions from Tel Aviv (70,037 tCO2e) were included in the comparability analysis, the rest being out of the scope of the other universities' carbon footprint analyses.

Results

Ranking of Tel Aviv University

In view of the differences between universities – for example, in terms of number of students and personnel – the comparison between universities was based on the impact categories' total emissions per constructed area and per capita.
Tel Aviv University's 2019 emissions – again, adjusted to exclude categories not accounted for by other universities – were 1.56 tCO_2e / capita, and 129 $kgCO_2$ / m^2.

That ranks the University 12th best when considering the emissions per capita (TAU emits 113% more than the lowest emissions per capita – which is achieved by the University of Luneburg, Germany), and 9th best when considering the emissions per constructed area (TAU emits 174% more than the lowest emissions per m^2 – which is achieved by the ETH of Zurich, Switzerland).

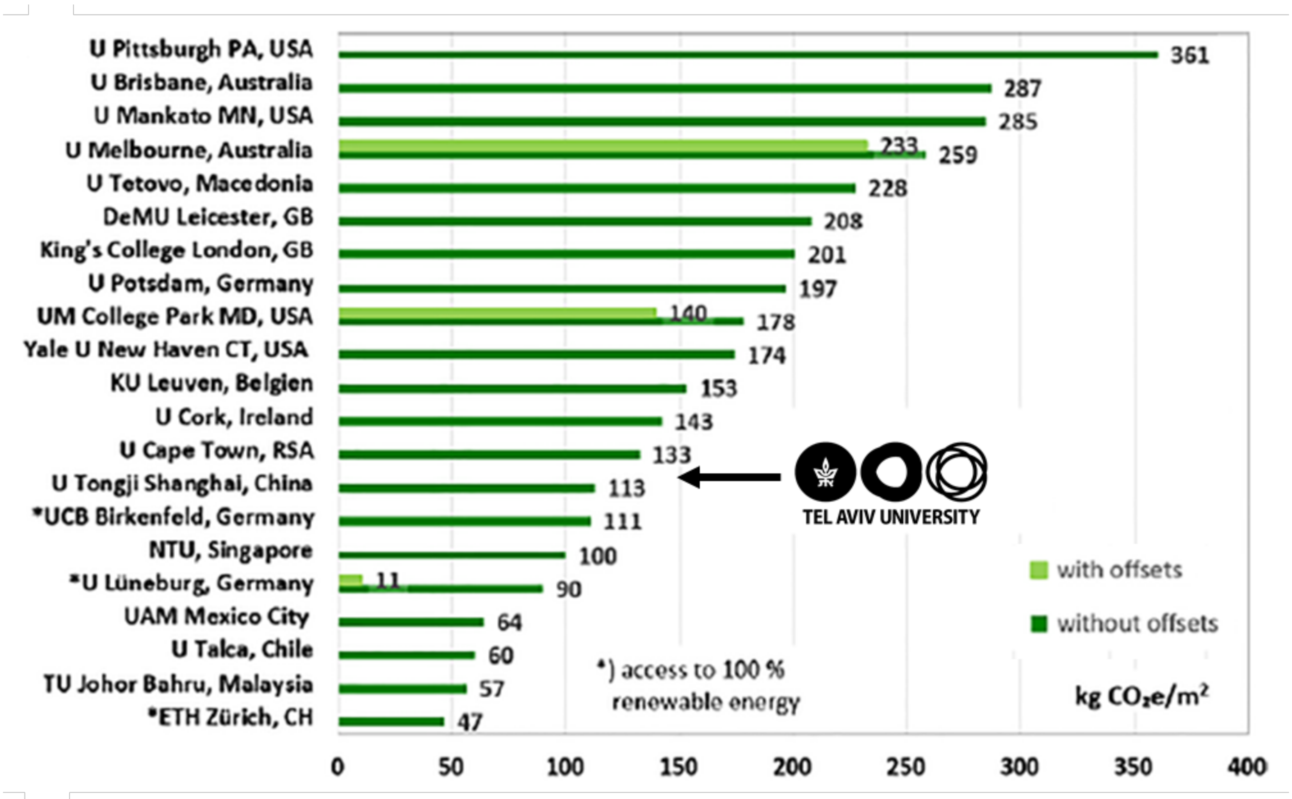


Figure 25: Universities ranking – Emissions per constructed area (tCO_2e / m^2)

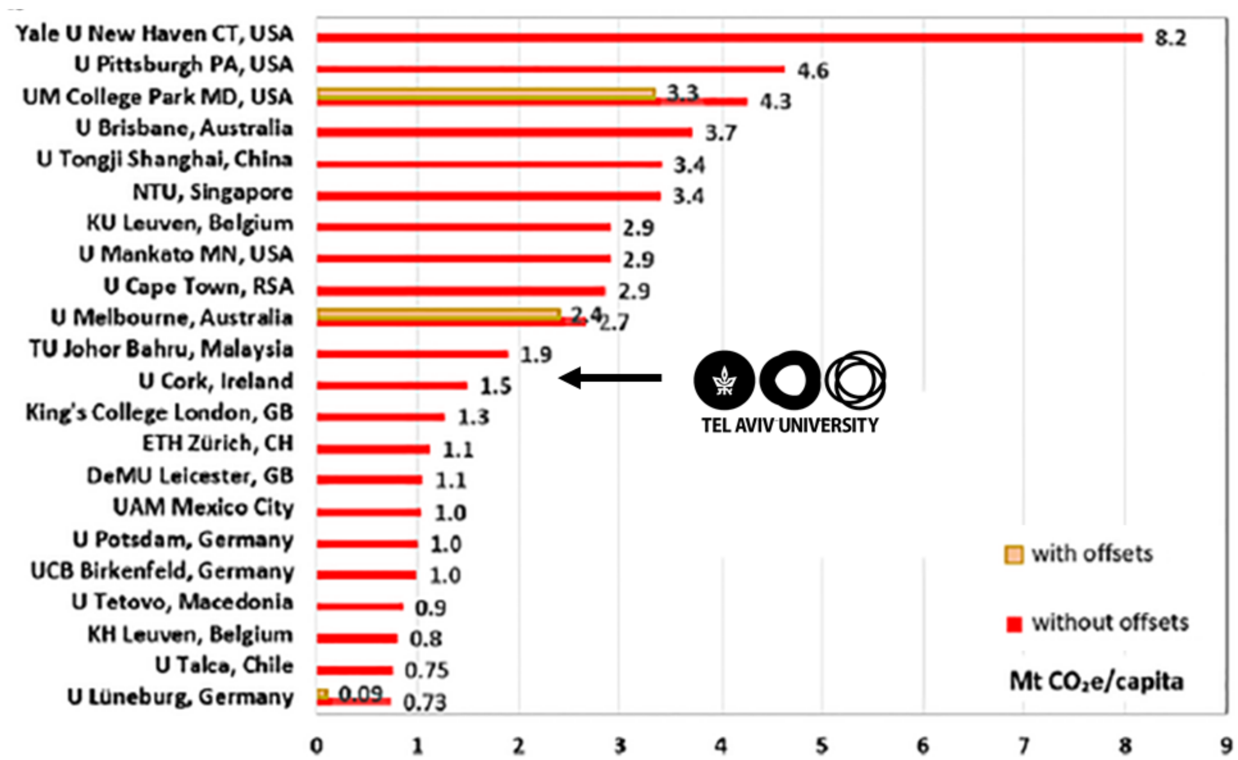


Figure 26: Universities ranking – Emissions per capita (tCO_2e / capita)

Distribution patterns of GHG emissions

- Emissions from energy constitute 62% of total emissions, which is similar to most of the universities included in the comparison (10out of 18 universities[13] have an energy share above 60%). Three out of the seven universities with an energy share below 36%, benefit from 100% renewable electricity production. Further analysis would be required to understand the reasons behind the low share of energy-related emissions in the other four.
- Emissions from mobility constitute the lowest emission share (17%) of all included universities. It is difficult to identify the specific reasons behind this due to a lack of detailed data, however, emissions from both international business trips as well as emissions from student and staff commuting are relatively low compared to other universities. One potential reason for the latter could be the fact that the campus is situated in the city (limiting somewhat the student and staff commuting distance, while shifting more students to public transport).
- Emissions due to waste generation (indicated in "further impacts" which accounts for 20% of total emissions) seems much more significant than in other universities. This might be explained by the fact that the other universities are all located in developed countries where landfilling is not the main waste treatment method, and in some cases is not used at all (indeed, landfilling of mixed waste is prohibited in most European countries).

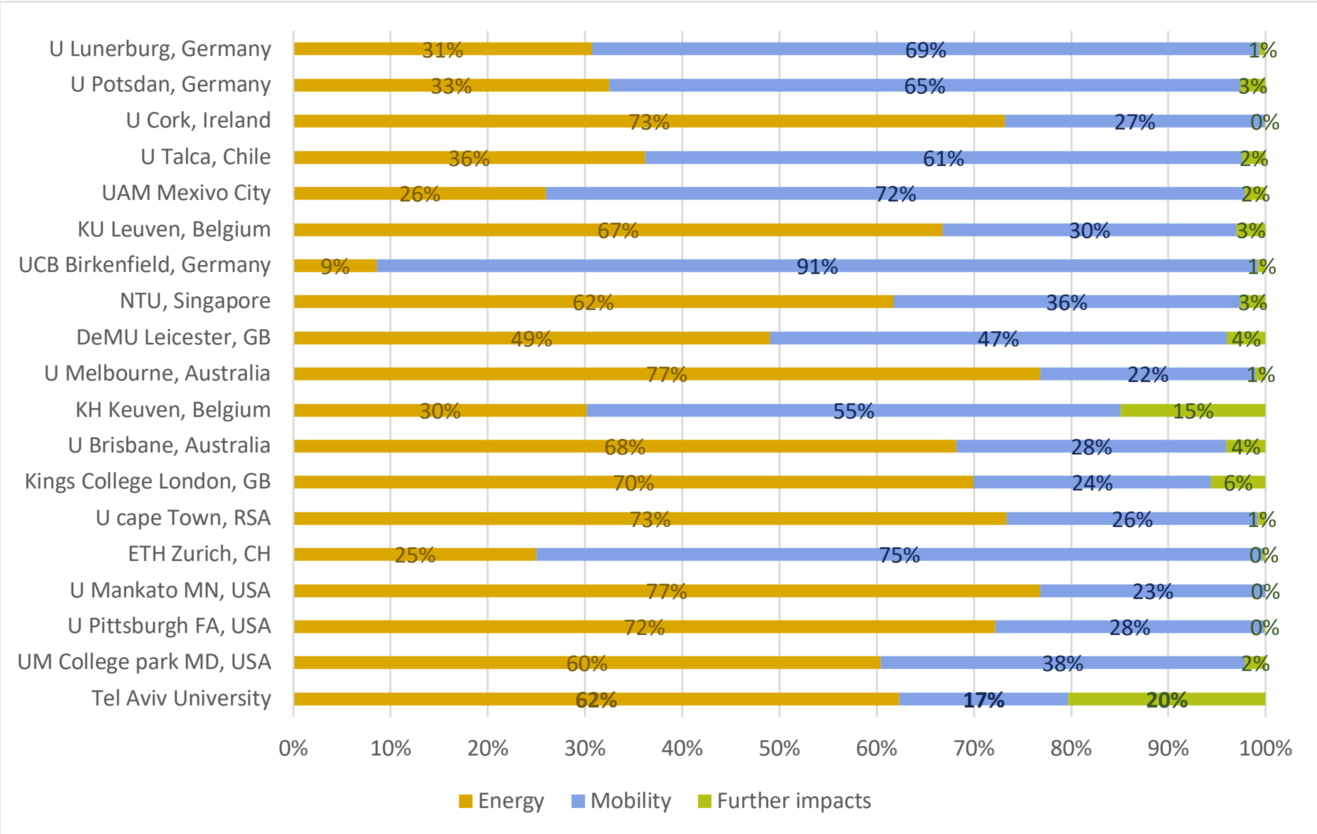


Figure 27: Distribution pattern of impact categories emissions across universities

[13] Only 18 universities out of the 21 mentioned in the article had detailed information to evaluate their carbon footprint according to the impact categories.

Conclusions

The total 2019 emissions of Tel Aviv University amounted to 70,037 tCO2e, which is equivalent[14] to:

the burning of around 30,000 tons of coal

80,400 round-trip flights Tel Aviv - New York

0.089% of Israel's total emissions (2019)

1.6% of Tel Aviv's scope 1 and 2 emissions (2017)

Electricity consumption was the main emissions source (42% of the total), followed by waste (11.3%) and student and staff commuting. Fugitive emissions was the fourth largest source, representing 7.1% of the total emissions, while direct food purchases and cafeterias combined were responsible of 8%. On the other hand, new construction represented only 4.4% and was the 7th largest source.

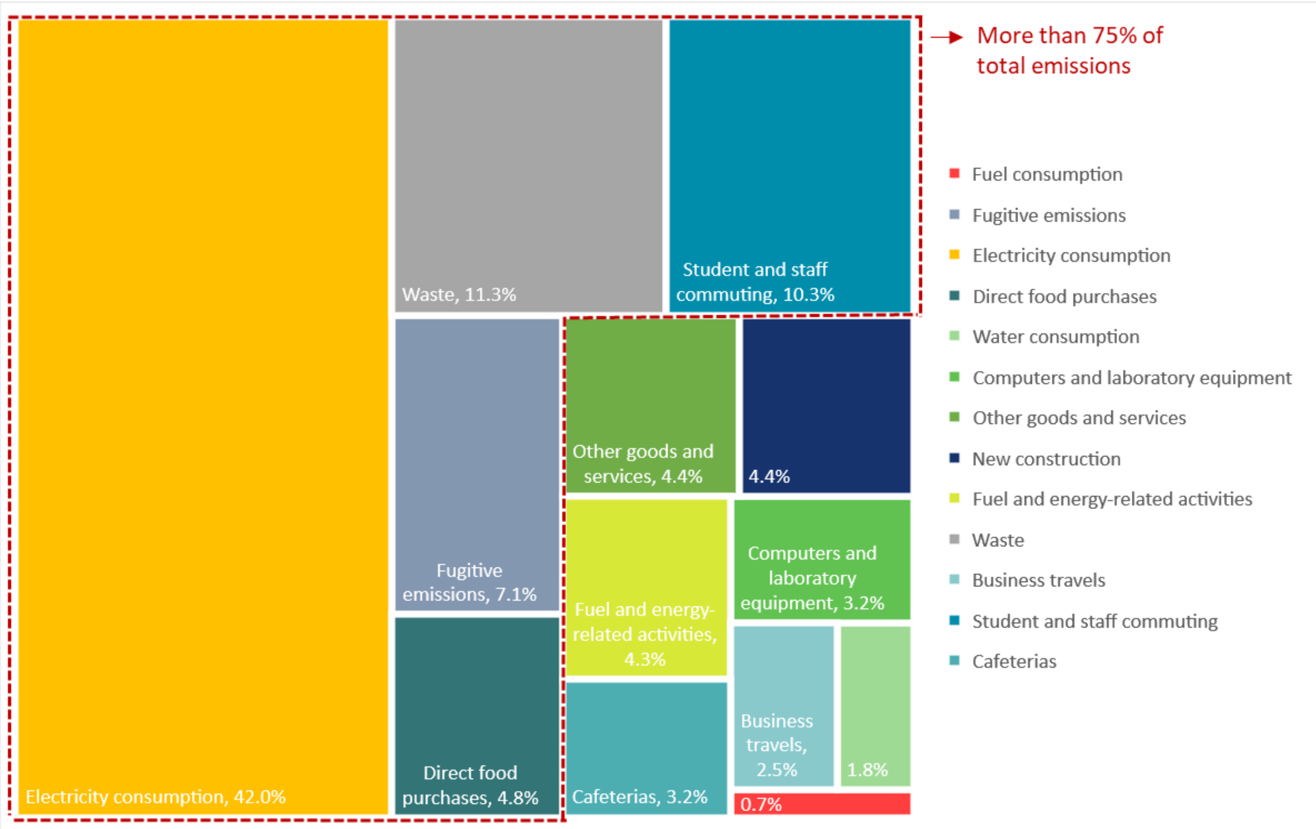


Figure 28: Summary of main emissions source of Tel Aviv University

[14] References of equivalence:
- Coal: 2.31 tCO2e / ton coal (emission factor, CBS)
- Round trip Tel Aviv – New York: 0.871 tCO2e / passenger ((International Civil Aviation Organization (ICAO), no date)
- Israel total emissions in 2019: 79,044,644 tCO2e (CBS, 2021)
- Tel Aviv scope 1 and 2 emissions: 4,654,482 tCO2e (CDP, 2017)

The identification of the main emissions sources provides a basis on which to focus future efforts to reduce GHG emissions. The initial propositions in Tel Aviv University's 2030 carbon neutral initiative are largely in sync with the main identified emissions sources. Indeed, the following mitigation measures deal with those sources that account for more than 75% of the university emissions:

- Measures to optimize and save energy (which can be partly realized through the construction of Green Buildings) as well as the generation of renewable energy via solar PV or biogas would be essential to reduce electricity consumption and its associated emissions.
- Promoting recycling is undoubtably a crucial measure to reduce emissions from waste management, as most of the waste is non-separated waste going to landfill sites.
- Promoting public transportation for students could potentially reduce part of the emissions due to their commuting (60% of student commuting emissions is due to car use).
- Further analysis is required regarding emissions due to direct food purchases – which was evaluated on a spend-based method using global values – to evaluate if the prevention of beef consumption and the promotion of vegetarian and low-carbon food is sufficient to tackle this emissions source.

Other measures in the 2030 carbon neutral initiative include the reduction of international business travels and the implementation of water conservation measures, which would impact the total GHG emissions to a lesser extent, as these sources represent only 2.5% and 1.8% of total emissions, respectively.

Finally, it is worth noting that although the emissions due to the University's investments were not estimated due to a lack of detailed data availability, the significance of the proposition to divest from high-environmental impact companies should not be overlooked, as it would position Tel Aviv University in line with a key global abatement effort. Indeed, divesting has gained momentum in recent years – as of mid-2021, more than 1,300 institutional investors and institutions worth nearly USD 15 trillion had committed to divest partially or fully from fossil fuel-related assets, up 36% from USD 11 trillion in 2019.
In order to fully assess the impact of this proposition and give it more credibility, we strongly suggest to include the *Investment* category in the future carbon footprint of the University.

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Annex 1. Scope 3 categories' description

Upstream scope 3 emissions

Category	*Category description*
1. Purchased goods and services	• Extraction, production, and transportation of goods and services purchased or acquired by the reporting company in the reporting year, not otherwise included in Categories 2 - 8
2. Capital goods	• Extraction, production, and transportation of capital goods purchased or acquired by the reporting company in the reporting year
3. Fuel- and energy-related activities (not included in scope 1 or scope 2)	• Extraction, production, and transportation of fuels and energy purchased or acquired by the reporting company in the reporting year, not already accounted for in scope 1 or scope 2, including: a. Upstream emissions of purchased fuels (extraction, production, and transportation of fuels consumed by the reporting company) b. Upstream emissions of purchased electricity (extraction, production, and transportation of fuels consumed in the generation of electricity, steam, heating, and cooling consumed by the reporting company) c. Transmission and distribution (T&D) losses (generation of electricity, steam, heating and cooling that is consumed (i.e., lost) in a T&D system) – reported by end user d. Generation of purchased electricity that is sold to end users (generation of electricity, steam, heating, and cooling that is purchased by the reporting company and sold to end users) – reported by utility company or energy retailer only

Upstream scope 3 emissions

Category	*Category description*
4. Upstream transportation and distribution	• Transportation and distribution of products purchased by the reporting company in the reporting year between a company's tier 1 suppliers and its own operations (in vehicles and facilities not owned or controlled by the reporting company) • Transportation and distribution services purchased by the reporting company in the reporting year, including inbound logistics, outbound logistics (e.g., of sold products), and transportation and distribution between a company's own facilities (in vehicles and facilities not owned or controlled by the reporting company)
5. Waste generated in operations	• Disposal and treatment of waste generated in the reporting company's operations in the reporting year (in facilities not owned or controlled by the reporting company)
6. Business travel	• Transportation of employees for business-related activities during the reporting year (in vehicles not owned or operated by the reporting company)
7. Employee commuting	• Transportation of employees between their homes and their worksites during the reporting year (in vehicles not owned or operated by the reporting company)
8. Upstream leased assets	• Operation of assets leased by the reporting company (lessee) in the reporting year and not included in scope 1 and scope 2 – reported by lessee

Downstream scope 3 emissions

Category	Category description
9. Downstream transportation and distribution	• Transportation and distribution of products sold by the reporting company in the reporting year between the reporting company's operations and the end consumer (if not paid for by the reporting company), including retail and storage (in vehicles and facilities not owned or controlled by the reporting company)
10. Processing of sold products	• Processing of intermediate products sold in the reporting year by downstream companies (e.g., manufacturers)
11. Use of sold products	• End use of goods and services sold by the reporting company in the reporting year
12. End-of-life treatment of sold products	• Waste disposal and treatment of products sold by the reporting company (in the reporting year) at the end of their life
13. Downstream leased assets	• Operation of assets owned by the reporting company (lessor) and leased to other entities in the reporting year, not included in scope 1 and scope 2 – reported by lessor

Category	Category description
14. Franchises	• Operation of franchises in the reporting year, not included in scope 1 and scope 2 – reported by franchisor
15. Investments	• Operation of investments (including equity and debt investments and project finance) in the reporting year, not included in scope 1 or scope 2