Recipient Organization: College of Maritime Transport and Technology

Project Title: Carbon Footprint Estimation and Reduction in the AASTMT Campus Towards developing a Model for Promoting Sustainable Development Goals (Green Campus)

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Table of Contents

1 Executive Summary

The GHG Emissions Report of the Abu Qir Campus of the Arab Academy for Science, Technology, and Maritime Transport (AASTMT) highlights the institute's commitment towards sustainable environmental management and greenhouse gas (GHG) emissions reduction. By calculating the carbon footprint of its activities, the campus provides valuable insights into the environmental impact of its operations and identifies areas where corrective or preventative actions are needed.

The research employs the GHG Protocol framework to classify emissions into three distinct scopes: Scope 1, encompassing direct emissions; Scope 2, encompassing indirect emissions resulting from electricity consumption; and Scope 3, encompassing other indirect emissions.

The report provides a comprehensive examination of various categories of emissions. It includes an in-depth analysis of Scope 1 emissions, which encompasses emissions from transportation and refrigerant leakage. Additionally, the report examines Scope 2 emissions, which are associated with purchased electricity. Furthermore, it addresses Scope 3 emissions, which encompass a range of activities such as waste disposal, paper consumption, water and wastewater management, transportation, electricity transmission and distribution losses, and accommodation. This report represents a pioneering endeavor for the Abu-Qir Campus, establishing a fundamental reference point for forthcoming investigations.

Between 2018 and 2021, the total carbon footprint of the Abu Qir Campus was found to be approximately 460,477,822 kg CO2 e. Over these four years, the highest emissions were reported in 2019 with 154,594,381 kg CO2 e, accounting for 34% of the total carbon footprint. On the other hand, the lowest emissions were observed in 2020, at 88,972,351.3 kg CO2 e, which constituted 19% of the total emissions during the reporting period.

One of the primary contributors to these emissions is paper consumption, accounting for the largest share of the total carbon footprint. Other significant contributors include transport fuel and purchased electricity. Measures such as replacing fluorescent lights with LEDs, installing energy-efficient VRF air conditioning systems, and implementing an electricity consumption monitoring program using smart meters have been initiated to curb these emissions. Additionally, a solar power station has been installed, further demonstrating the academy's commitment to reducing its carbon footprint.

The year 2020 marked a significant decline in the campus's emissions, largely due to the impacts of the COVID-19 pandemic. The implementation of social distancing, hybrid education systems, and distance learning resulted in reduced energy consumption on campus, thereby lowering its carbon footprint.

The campus's commitment to environmental sustainability was further demonstrated when, in October 2021, AASTMT signed up for the Race to Zero Campaign at the British Council in Cairo. As part of this initiative, the academy committed to being net-zero carbon by 2050 and achieving a 50% reduction in emissions by 2040. These ambitious targets underscore AASTMT's dedication to mitigating its environmental impact and contributing to global efforts to combat climate change.

However, the report acknowledges the challenges associated with data collection, particularly regarding solid hazardous waste, green areas, fertilizers, lighting, and distance learning. To ensure the accuracy of future reports and to identify all possible avenues for emissions reduction, continued efforts are needed to gather comprehensive data on these aspects.

The report highlights a continuous endeavor to diminish and streamline electricity consumption at the campus in relation to energy usage. Various measures have been implemented, such as the substitution of conventional lighting fixtures with energy-efficient LED lights, the installation of air conditioning systems that prioritize energy conservation, and the establishment of a solar power station. Notwithstanding these endeavors, the consumption of electricity continues to be a substantial factor in the carbon footprint of the campus.

The report serves as a crucial resource for comprehending the environmental impact of the Abu-Qir Campus and establishes the foundation for future enhancements in its sustainability initiatives. Continual monitoring and reporting of greenhouse gas (GHG) emissions by the Arab Academy for Science, Technology, and Maritime Transport (AASTMT) is of utmost importance in order to ascertain advancements towards a more environmentally friendly and sustainable campus.

In summary, the AASTMT Abu Qir Campus is proactively monitoring and managing its carbon footprint, with a clear focus on reducing GHG emissions. By committing to ambitious targets and implementing practical sustainability measures, the campus is playing an essential role in the global fight against climate change.

2 Background

In recent years, numerous academic investigations have been undertaken by diverse global institutions of higher education with the aim of comprehending their respective carbon footprints. Prominent academic institutions, including Harvard, Yale, and the University of California Berkeley, have established noteworthy standards by not only quantifying their carbon emissions but also implementing tangible strategies to mitigate them. These universities have demonstrated leadership in illustrating the feasibility and importance of engaging in such an endeavor, particularly given the current climate circumstances.

The initiative known as 'Sustainable Yale' represents an example of such endeavors. Since 2006, Harvard University has diligently monitored its greenhouse gas emissions, revealing that a significant proportion of 44% can be attributed to the operation of its heating and cooling systems. The University of California Berkeley has implemented a comprehensive program aimed at quantifying its carbon footprint, encompassing both direct and indirect sources. The organization has achieved success in effectively reducing their carbon emissions to levels equivalent to those recorded in 1990.

In a comparative analysis with AASTMT, the American University in Cairo (AUC) and Ain Shams University undertook a similar investigation in 2019 and 2021 respectively.

The case studies have furnished the AASTMT with valuable insights pertaining to the methodologies and optimal approaches for the computation of carbon footprints and the implementation of strategies aimed at reducing them. Furthermore, they have demonstrated the ability of higher education institutions to serve as role models by incorporating sustainability principles into their administrative practices and educational programs, as well as fostering community involvement in addressing these significant concerns.

Furthermore, prior research endeavors carried out at the Arab Academy for Science, Technology, and Maritime Transport (AASTMT) have established the foundation for the present evaluation of carbon footprint. The data and insights presented in this report are derived from extensive research conducted on energy consumption patterns, waste generation, disposal practices, and preliminary assessments of direct and indirect greenhouse gas emissions.

Therefore, this report should not be regarded as an independent endeavor, but rather as part of a broader pattern observed in universities across the globe, where they are assuming a proactive role in comprehending and addressing their impact on global greenhouse gas (GHG) emissions.

The Arab Academy for Science, Technology, and Maritime Transport (AASTMT) is an esteemed regional institution overseen by the Arab League, renowned for its exceptional educational benchmarks in the fields of science, technology, and maritime transport. The Abu-Qir Campus of the Arab Academy for Science, Technology, and Maritime Transport (AASTMT) located in Alexandria holds great importance within the institution and is widely recognized for its notable contributions in the realms of education and research.

The current worldwide discourse surrounding climate change has compelled organizations, including educational institutions, to quantify and comprehend their environmental impact. Specifically, the contribution of these entities to the release of greenhouse gases (GHGs) is regarded as a fundamental catalyst for the phenomenon of global warming and the subsequent alterations in climate patterns.

The Arab Academy for Science, Technology, and Maritime Transport (AASTMT), acknowledging its obligation towards environmental conservation, has undertaken the task of evaluating its carbon emissions impact at the Abu-Qir Campus. This report is a manifestation of the organization's dedication, as it presents a comprehensive and organized analysis of greenhouse gas (GHG) emissions by employing the GHG Protocol. The international accounting framework categorizes greenhouse gas (GHG) emissions into three distinct scopes. Scope 1 encompasses direct emissions, Scope 2 includes indirect emissions from purchased electricity, and Scope 3 encompasses other indirect emissions resulting from the activities of the organization but originating from sources not owned or controlled by the organization.

The temporal scope of this study encompasses the years 2018 to 2021. The assessment encompasses greenhouse gas (GHG) emissions resulting from various activities conducted within the campus premises. These activities include transportation, refrigeration, purchased electricity usage, waste disposal, paper consumption, water and wastewater treatment, electricity transmission and distribution losses, as well as accommodations.

Furthermore, within this timeframe, the campus experienced a substantial transformation in its functioning as a result of the worldwide COVID-19 pandemic. This scenario provided a distinct vantage point on the correlation between alterations in the campus's functioning and their impact on its ecological footprint.

The study additionally examines the strategies implemented by the campus to effectively manage and mitigate its energy consumption and emissions. These strategies include the adoption of LED lights, the utilization of energy-efficient air conditioning systems, and the establishment of a solar power station.

The Arab Academy for Science, Technology, and Maritime Transport (AASTMT) has long demonstrated a commitment to sustainability and environmental responsibility. This commitment was further solidified on 6th October 2021 when the AASTMT signed up for the Race to Zero Campaign at the British Council in Cairo.

The Race to Zero is a global campaign committed to rallying leadership and support from businesses, cities, regions, and investors for a healthy, resilient, zero-carbon recovery that prevents future threats, creates decent jobs, and unlocks inclusive, sustainable growth. By joining this initiative, the AASTMT has committed to achieving net-zero carbon emissions by 2050, alongside an intermediate target of a 50% reduction in emissions by 2040.

These targets represent a significant and ambitious commitment to reducing the Academy's carbon footprint and environmental impact. They are a key driver behind the AASTMT's ongoing efforts to measure and reduce its greenhouse gas emissions across all scopes of its operations, from transport fuel and purchased electricity to water and paper consumption.

This report outlines the AASTMT's carbon footprint for the period from 2018 to 2021, based on available data. The report also offers recommendations for how the Academy can further reduce its emissions in line with its Race to Zero commitments. It serves as a key tool in the AASTMT's continued drive towards sustainability and carbon neutrality.

3 Project Objectives

Main Objective: A carbon footprint offers a means to identify carbon emission sources and evaluate progress in reducing these emissions. In AASTMT's case, a principal objective of the study is to calculate a transparent CFP of AASTMT's Abu Kir campus from 2018 to 2021 together with identify the role of COVID-19 on CFP of AASTMT and develop information that can be used to mitigate climate change by reducing AASTMT's greenhouse gas emissions. A second important objective is to strengthen the university's finances for the long term by permanently reducing its appetite for carbon-based energy sources like natural gas, electricity, gasoline, and diesel fuel that must be purchased from third parties. Finally, our footprint study is designed to provide a replicable model and methods that other higher education institutions can adopt in the MENA region to calculate and evaluate their own carbon emissions.

Specific Objectives:

1- To calculate and reduce the AASTMT Alexandria campus carbon footprint based on the following academic years 2018/2019, 2019/2020, and 2020/2021.
2- To raise the environmental awareness of individuals, institutions and promote the use of green environmental practices.
3- To report the needed items to improve the AASTMT Alexandria campus climatic and sustainability options.

4 Description of Activities Performed

The activities conducted throughout the duration of this project were methodical and well-coordinated, with the primary objective of accurately quantifying AASTMT's carbon footprint and devising efficient strategies for its reduction. The authors incorporated:

1- Data Collection: The project commenced with an extensive data collection phase, encompassing the acquisition of pertinent information pertaining to energy consumption, encompassing electricity, natural gas, diesel, and gasoline, waste generation, paper consumption, and travel activities for the Abu Kir campus during the academic years spanning from 2018 to 2021.
2- Calculation of Carbon Footprint: After gathering the necessary data, the carbon footprint for the designated time periods and campuses was computed. The calculation was conducted using established and widely-accepted methodologies, such as the Greenhouse Gas Protocol, to ensure adherence to global standards.
3- Analysis of the Impact of COVID-19: Subsequently, the research team conducted an examination of the effects of the COVID-19 pandemic on the carbon footprint. This analysis involved a

comparison of carbon emissions during the pandemic year to those of previous years, taking into consideration alterations in campus operations and activities resulting from the pandemic.

4- Formulation of Carbon Emission Reduction Strategies: In light of the carbon footprint calculation and impact analysis, strategies were formulated to mitigate carbon emissions. The strategies considered the unique circumstances of the Abu Kir campus, with a particular emphasis on areas characterized by high emissions and opportunities for enhancement.
5- The project placed significant emphasis on the promotion of environmental awareness among both individuals and institutions. A range of activities were implemented with the aim of achieving this objective, encompassing workshops, training sessions, and the dissemination of informational materials.
6- Formulation of Sustainability Recommendations: The team has successfully identified and presented a set of measures that have the potential to enhance the climatic and sustainability aspects of AASTMT's Abu Kir campus. The recommendations were derived from the findings of the project and were in accordance with the overarching sustainability objectives of the university.
7- Development of a Replicable Model: In conclusion, the project has successfully devised a model that can be replicated by other higher education institutions in the MENA region for the purpose of calculating and assessing their individual carbon emissions. The model utilized in this study was developed using the project's methodology and findings, with a focus on adapting it to the unique circumstances of higher education institutions within the region.

5 Area of Study and Methodology

5.1 Area of Study:

The study area for this project, specifically the Abu Kir Campus, is located in the city of Alexandria, one of Egypt's largest and most historic cities. This campus is part of the Arab Academy for Science, Technology, and Maritime Transport (AASTMT), an institution recognized regionally and globally for its high academic standards and specialized programs.

The Abu Kir Campus is a prominent campus of the Arab Academy for Science, Technology, and Maritime Transport (AASTMT), accommodating a substantial proportion of the institution's student body and faculty. The campus has gained recognition for its academic offerings in the fields of maritime studies and technology, which have proven to be highly appealing to a wide range of students hailing from diverse backgrounds and geographical locations.

Geographically, the campus is located in close proximity to the coastline, providing a distinctive natural setting that seamlessly integrates the urban characteristics of the city with the scenic coastal landscapes of the Mediterranean Sea. The carbon footprint analysis considered the environmental challenges and opportunities that are inherent to this coastal location.

The infrastructure of the campus is comprehensive, comprising a diverse range of buildings and facilities. The aforementioned facilities encompass administrative and academic structures, advanced research laboratories, comprehensive library resources, and a wide range of recreational amenities. In addition, the campus is equipped with residential facilities that cater to the accommodation needs of students, thereby fostering a holistic educational experience as shown in figure 1 and table 1.

The Abu Kir Campus, due to its expansive size, diverse composition, and strategic coastal positioning, serves as a crucial subject of analysis in comprehending the comprehensive carbon footprint of the Arab Academy for Science, Technology, and Maritime Transport (AASTMT). The anticipated outcomes of this study conducted at our institution are poised to make a substantial contribution to the wider comprehension of carbon emissions in higher education institutions across the MENA region.

Table 1. Abu Kir Campus General information

Item	Area km^2
Parking	15134
Stadiums	27555
Roads	32290
Green Areas	12310
Hotels	30290
Restaurants	3175
Colleges	20308
Swimming pools	2900
Administrative buildings	12280
others	80542
Total Area	236784

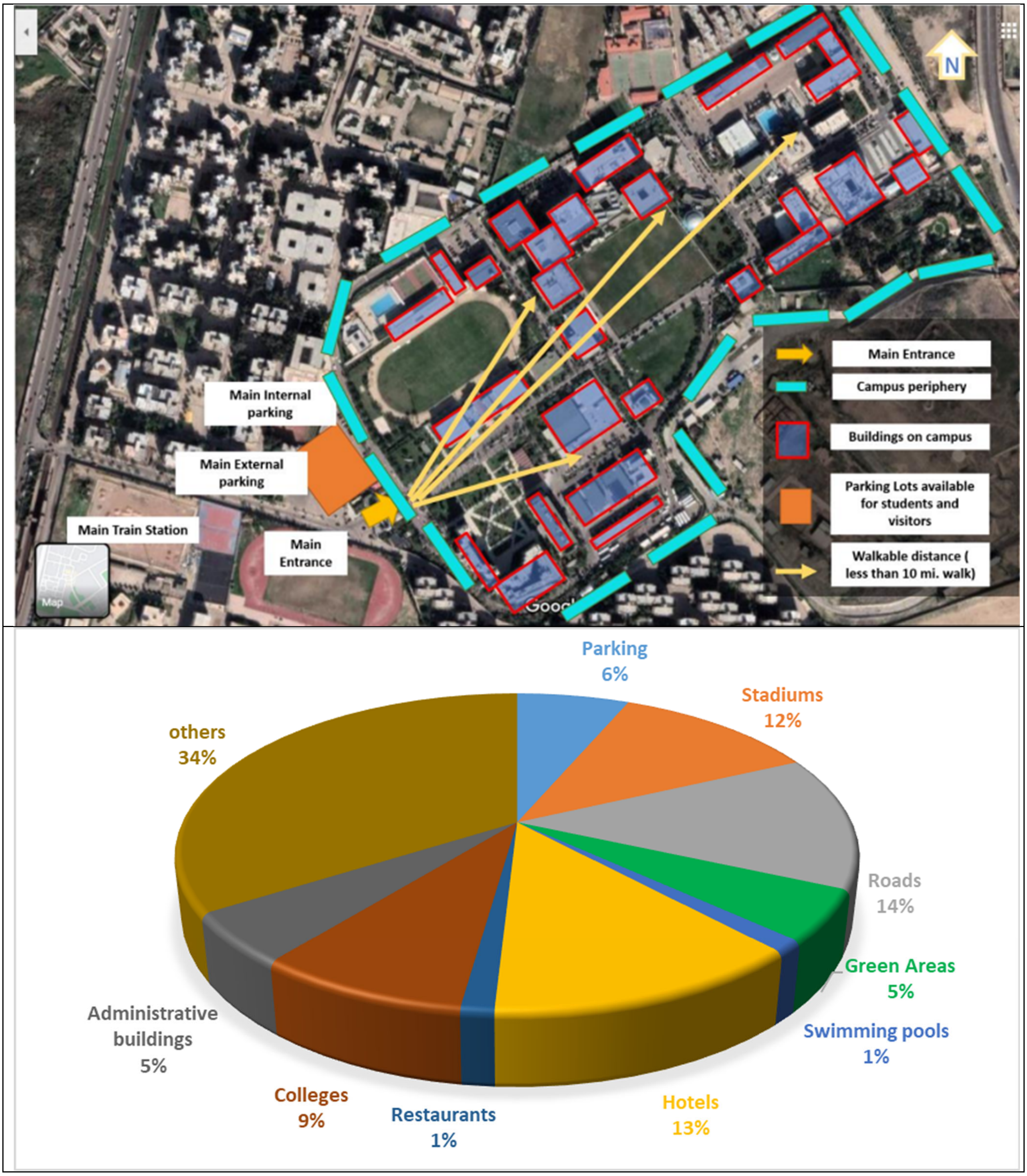

Figure 1: Abu Kir Campus overview

5.2 Methodology:

GHG protocol separates emissions into three scopes:

Scope 1: direct emissions from activities owned or controlled by the organization (e.g., own vehicle fuel, possible GHG leakage from cooling systems).

Scope 2: indirect emissions associated with purchased electricity.

Scope 3: indirect emissions from Centre activities that occur at sources outside its control and are not classified as scope 2 (e.g., transport, business travel, hotel stay, material consumption, and waste).

There are a few emission categories that consider mandatory to include in the CO2 calculation for each university: electricity, heat, employee commuting, paper and employee travel, including emissions of student commuting, waste, water, other on-campus stationary sources, water, and direct transportation (Sprangers 2011).

Greenhouse Gas Protocol (GHGP) provides a number of steps to assess the carbon foot print:

1. Identify GHG emissions sources.
2. Select a GHG emissions calculation approach.
3. Collect activity data and choose emission factors.
4. Apply calculation tools.
5. Roll-up GHG emissions data to reach the overall level.

Emission sources must be identified, categorized into scope 1, scope 2 and scope 3 emissions. Combustion of fuel in boilers and furnaces can be included in the assessment (in scope 1 or 3, depending on the organization that is the owner of the boilers and furnaces). In scope 1, business travel and commuting in company-owned vehicles is included. Scope 3 also includes "incineration of office waste or decomposition in a landfill when the facilities are not owned by the reporting organization" and emissions of outsourced activities as shown in figure 2. After the identification of emission sources, a calculation method should be chosen. Calculation methods can range from using direct monitoring to using generic emission factors. Each organization should determine what is most appropriate for them. Activity data has to be collected, and emission factors have to be selected by the organization. (Sprangers, 2011).

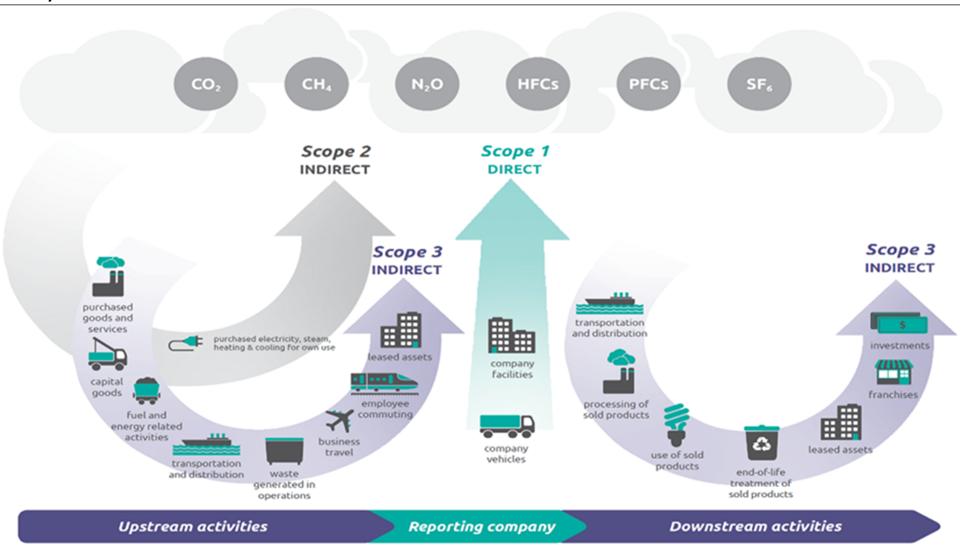

Figure 2: Overview of the scopes and emissions under the GHG Protocol across the value chain
Source: GHG Protocol – Technical Guidance for Calculating Scope 3 Emissions

GHG Protocol publishes the world's most widely used greenhouse gas accounting standards. These standards are often the basis for accounting resources designed by organizations or consultancies, such as sector-specific guidance, calculation tools, and reporting programs. The "Built on GHG Protocol" mark is a way for GHG Protocol to recognize products that have been developed in conformance with a GHG Protocol standard. Those that acquire the mark will benefit from the GHG Protocol's reputation as the gold standard for GHG accounting. GHG accounting and reporting should be based on the following principles: Consistency, Completeness, and Relevance.

The key steps in calculating an organizational carbon footprint are shown in Figure 3:

1. Defining organizational boundaries: It is necessary to set clear, explicit boundaries on which parts of the organization are included in the organizational carbon footprint. Meanwhile, an organization may comprise one or more facilities, which usually apply control and equity share approaches to consolidate facility-level GHG emissions and removals at the organization level.
2. Establishing operational boundaries: The operational boundary determines which emission sources will be quantified. It should include the full range of emissions from activities under operational control. All material Scope 1 and 2 emissions should be included, but Scope 3 emissions can be chosen to include. (Scopes 1, 2 and 3 are shown in Figure 2).
3. Calculating carbon footprint: The footprint's accuracy relies on collating consumption data for all of the emission sources within the established boundary. It is essential to clarify any gaps in the data and list any assumptions that have been made in calculating the footprint. The carbon footprint is typically calculated using activity data collated multiplied by standard emissions factors. However, there are other calculation methods, such as calculation of the use of models or measurement.
4. Reporting and verifying: Organizations should prepare a report to facilitate inventory verification, participation in a GHG program, or inform external or internal users. Meanwhile, third-party verification of carbon footprint was suggested to be carried out to add credibility and confidence to carbon reporting for public disclosure.

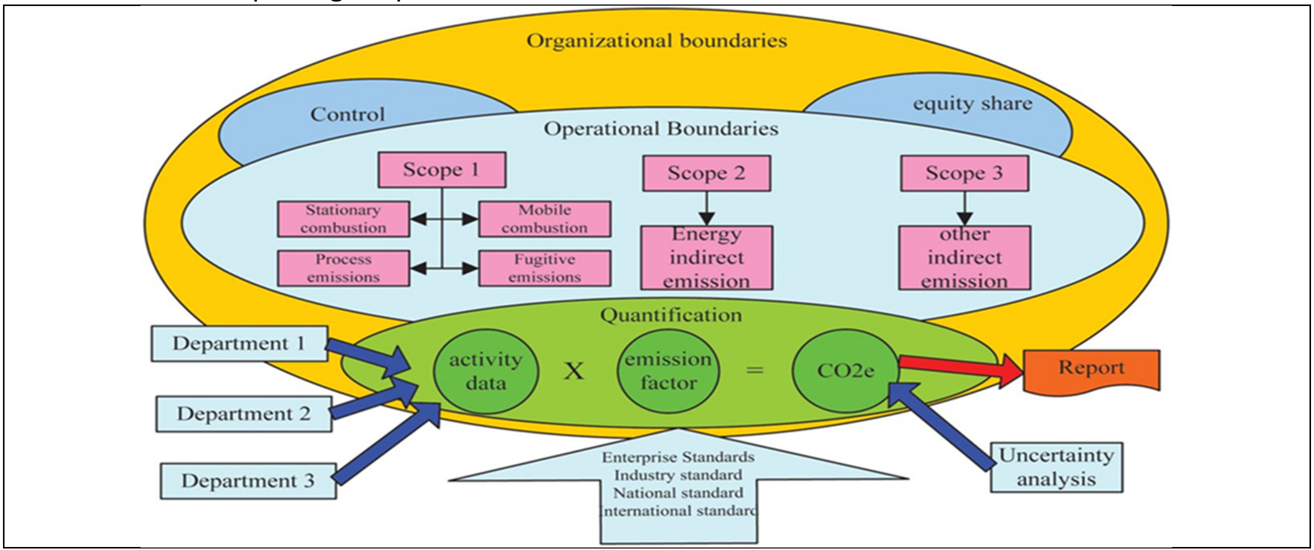

Figure 3: The evaluation methodologies employed for determining the carbon footprint of an organization.

Source: (Gao et al., 2014)

Listed In the table 2. Below the main activities contributing to the Abu Qir's AASTMT Campus Carbon Footprint classified according to the relevant scope.

Table 2. Activities contributing to the Abu Qir's AASTMT Campus Carbon Footprint

Scopes	Sources	Units	Data Resolution
Scope 1	Transportation Owned Vehicles	L	Fuel consumption/ year
	Refrigerants leakage	kg	Freon in Kg / branch
Scope 2	Purchased Electricity	kWh	Consumption per year/ branch
Scope 3	Waste Disposal	t	Waste / year / branch
	Paper Consumption	t	paper consumption per year/ branch
	Water & Wastewater	m^3	Consumption per month/ branch Wastewater treatment plants
	Transportation	L Km	Fuel consumption Distance travelled/ month/ Passenger
	Transmission and distribution losses for electricity consumption	kWh	Consumption per year/ branch
	Accommodation Working from home	Room/ night	People/rooms/night People electrical use with/without heating

6 Results

6.1 Emissions from transport fuel (Scope 1):

Scope 1 emissions of AASTMT's carbon footprint encompass direct greenhouse gas emissions from sources owned or controlled by the university, focusing specifically on emissions from transport fuel. This involves the combustion of fuel in university-owned vehicles, such as buses and other maintenance vehicles.

To calculate the Scope 1 transport fuel emissions, fuel consumption from these vehicles was monitored across four academic years (2018, 2019, 2020, and 2021). The data collected included the type and amount of fuel used, classified into two major types: kerosene and petrol. Emissions were then calculated using the formula $E = Q \times F$, where E represents the emissions from the source in kg CO2-equivalent per year, Q represents the quantity of fuel used, and F denotes the emission factors. Table 3 below summarizes the calculated emissions from transport fuel across the years studied:

Table 3 Calculated emissions from transport fuel across the years studied.

Year	Kerosene Consumption	Petrol Consumption	Total Fuel Consumption	Total kg CO_2-e/y	Percentage %
2018	337,111	102,896	440,007	1,244,230.5	24%
2019	374,413	96,630	485,583	1,374,252.42	27%
2020	249,946	96,630	346,576	972,551.04	19%
2021	431,454	119,296	550,750	1,561,942.92	30%

The total kg CO_2 equivalent emissions from transport fuel over the four years amounts to 5,152,976.88.

The analysis of this data offers a clear perspective on the impact of transportation on AASTMT's carbon footprint, pointing towards areas where improvements and reductions can be made. Moreover, the data from 2020 (Figure 4), a year significantly affected by the COVID-19 pandemic and subsequent lockdown measures, shows a marked reduction in fuel consumption and related emissions. This indicates the potential for future emissions reductions through remote learning strategies or other means of reducing transportation needs.

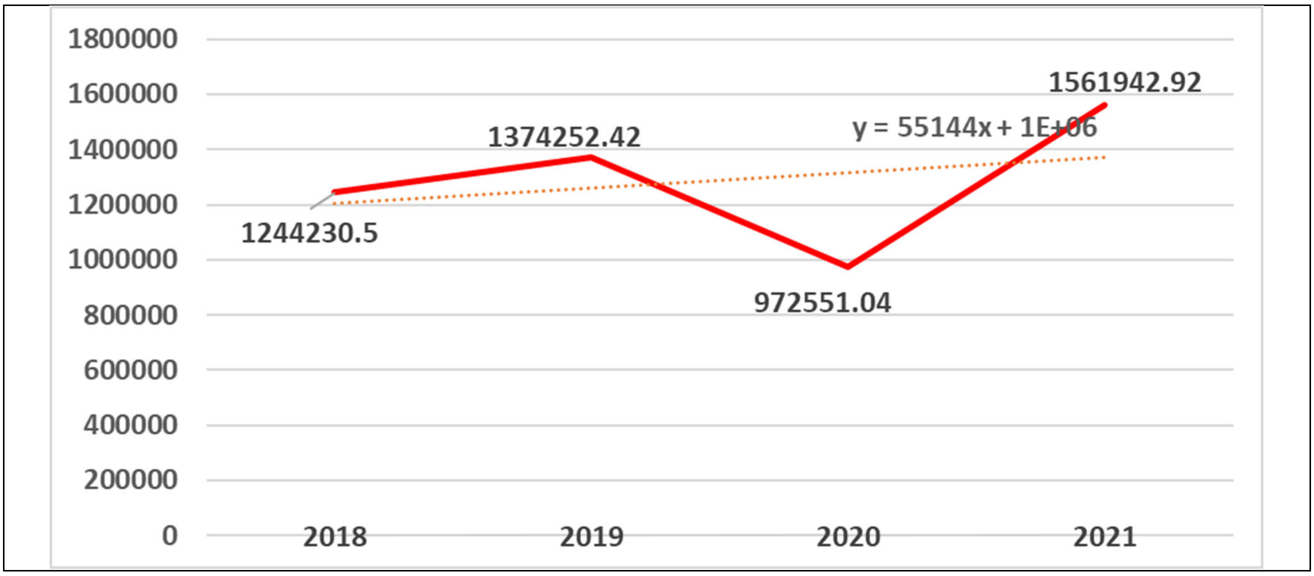

Figure 4: Calculated Emissions (kg CO_2 e/y) from transport fuel in 2021

The substantial increase in carbon dioxide equivalent emissions from transport fuel in the year 2021 warrants further examination. This rise is primarily attributed to the operational logistics involving the transportation of staff and students from the Abu Qir Campus to the El-Alamein new campus. The distance between these two locations is approximately 400 km, and the journey is made daily using a fleet of cars, buses, and other university-owned vehicles.

It's noteworthy that this activity significantly boosts fuel consumption and consequently increases greenhouse gas emissions. As AASTMT strives for sustainability, this finding emphasizes the need for innovative strategies to reduce emissions associated with inter-campus transportation. Such strategies may include optimizing bus schedules and routes, encouraging carpooling, or exploring options for remote working and learning.

Moreover, it highlights the potential impact of campus location and spatial distribution on a university's carbon footprint. It underscores the need for strategic planning in higher education institutions that takes into account environmental considerations, especially when campuses are located at significant distances from one another.

6.2 Emissions from Purchased Electricity (Scope 2):

The emissions from purchased electricity were calculated using the equation $E = Q \times F$, where E represents the emissions from the source in kg CO_2-equivalent per year, Q stands for the quantity of electricity used (in kWh), and F denotes the emission factors. Table 4 below demonstrates the emissions from purchased electricity for the years 2018 to 2021.

Table 4: The emissions from purchased electricity for the years 2018 to 2021.

Year	Electricity Consumption (kWh/year)	Emissions (kg CO_2-e/year)	Percentage (%)
2018	10,335,721	1,240,286.5	29
2019	9,594,010	1,151,281.2	27
2020	7,245,592	869,471.36	20
2021	8,402,135	1,008,256.2	24

The total kg CO2-e per year from purchased electricity for the given period equals 4,269,295.3. As seen in Figure 5, there was a significant decrease in the amount of carbon dioxide equivalent emissions from purchased electricity in the year 2020. This reduction was primarily due to the COVID-19 pandemic, during which AASTMT implemented social distancing protocols and reduced campus occupancy through the use of hybrid education systems and distance learning, resulting in lower electricity consumption.

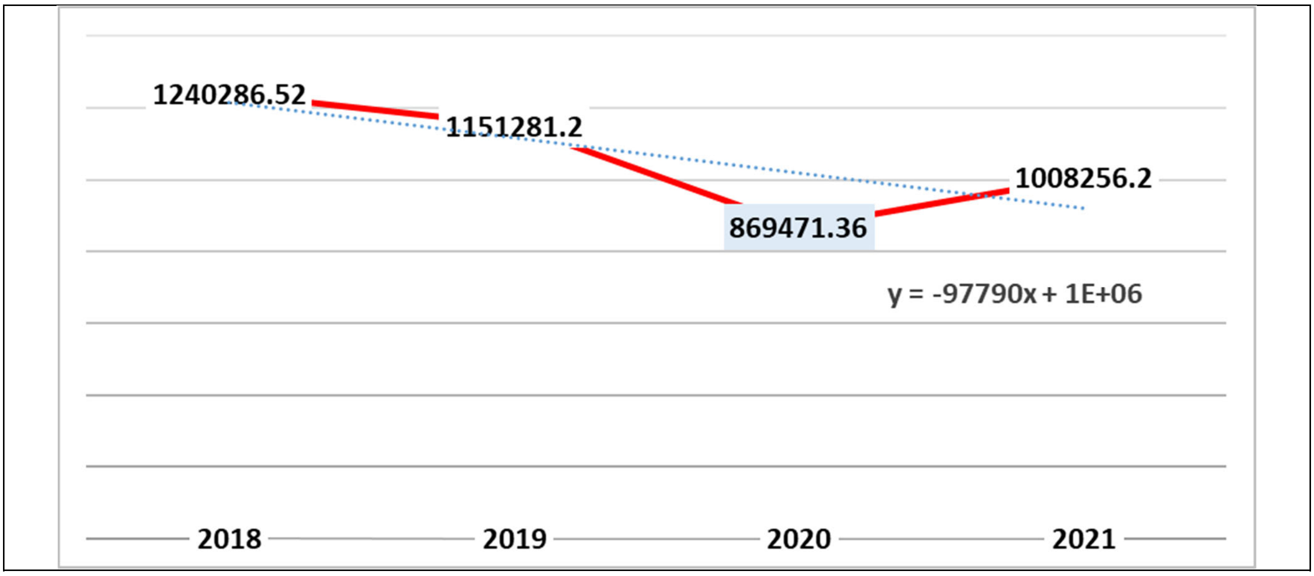

Figure 5: The amount of carbon dioxide equivalent emissions from purchased electricity

Further calculations were made to understand the Energy Usage Intensity, computed as the total energy use divided by the total area. The results are presented in Table 5 below.

Table 5: Energy Usage Intensity.

Total Area (km^2): 236,784	2018	2019	2020	2021
Energy Use (kwh)	10,335,721	9,594,010	7,245,592	8,402,135
Energy Usage Intensity	43.7	40.5	30.6	35.5

The kg CO2-e/m[2] was calculated as (energy consumption x CO_2-e emission factor) divided by Gross Internal Area (GIA), which is the total floor area inside the building in m2. The results of these calculations are presented in Table 6.

Table 6: Calculated Emissions (kg CO2 e/ m^2) from energy use.

Year	kg CO2-e/year	Gross Internal Area (m2)	kg CO2e/m2
2018	1,240,286.5	236,784	5.24
2019	1,151,281.2		4.86
2020	869,471.36		3.67
2021	1,008,256.2		4.26

Figure 6 demonstrates the emissions (kg CO_2-e) per square meter. Similar to the trend observed in Figure 5, there was a decrease in kg CO_2-e/m2 in 2020 due to the impacts of the COVID-19 pandemic.

To combat high energy usage, AASTMT's Energy Committee put forward several strategies to reduce and rationalize electrical consumption, including:

- Replacing the light bulbs, spotlights located on the roofs of buildings and in the roads with energy-saving LED lighting
- Replacing (100) spotlights for all electric poles and modifying the number of 17 triple poles for LED lighting in front of the entrances of the marine buildings, and the bus station.
- Air conditioning systems have been installed energy efficient VRF system.
- A solar power station with a capacity of 50 kilowatts has been installed in the seventh engineering building.
- Solar heaters have been installed to replace the electric heaters in the College of Pharmacy.

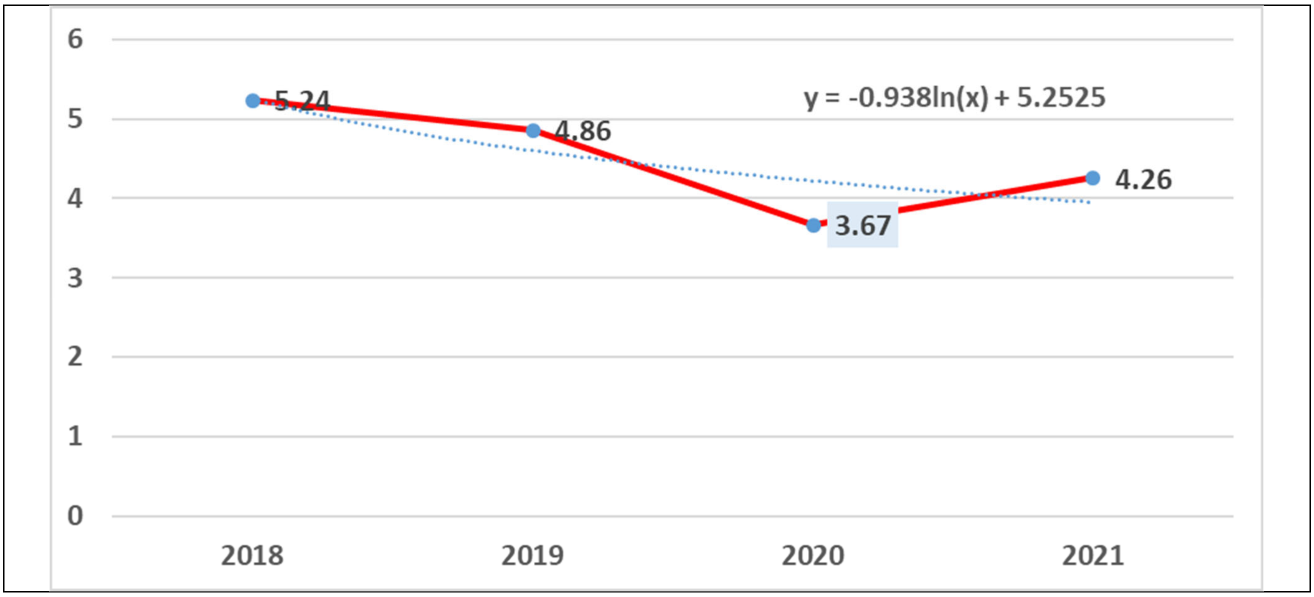

Figure 6: Shows emissions (kg CO_2 e) per square meter

Table 7 shows the percentage of savings in the energy consumption cost in LE (Egyptian pound) per year.

Table 7: Percentage of savings in the energy consumption cost (LE) / Year.

<table>
<tr><td>Year</td><td>2018</td><td>2019</td><td>2020</td><td>2021</td></tr>
<tr><td>Consumption Cost</td><td>12,008,668</td><td>13,286,093</td><td>10,559,151</td><td>12,000,295</td></tr>
<tr><td rowspan="3">Savings (%)</td><td colspan="2">7.71%</td><td></td><td></td></tr>
<tr><td></td><td colspan="2">20.5%</td><td></td></tr>
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These measures resulted in significant energy cost savings, underscoring the economic as well as environmental benefits of such initiatives.

6.3 Emissions from Water Consumption (Scope 3):

Emissions from water consumption were evaluated utilizing the formula $E = Q \times F$, where 'E' signifies emissions from the source in kg CO_2-e per year, 'Q' is the quantity of water consumed (in m^3 or per capita for persons using the water supply), and 'F' denotes the emission factors.

Table 8 below shows the calculated emissions in kg CO_2-e per year from water consumption for the years 2018 to 2021.

Table 8: Calculated kg CO_2 e/y from water consumption.

Year	Water Consumption (m^3/year)	Emission Factor	Emissions (kg CO_2-e/year)	Percentage (%)
2018	595,800	0.031	18,469.8	25.8
2019	624,251	0.031	19,351.8	27
2020	590,813	0.031	18,315.2	25.6
2021	499,152	0.031	15,473.7	21.6

The total emissions from water consumption over these four years amounted to 71,610.5 kg CO_2-e. As shown in Figure 8, the volume of water consumption fluctuated throughout the years, with the highest water consumption observed in 2019 and 2020. These higher rates correspond with the establishment of the College of Pharmacy and expansions at the Gas Hotel, both of which increased the demand for water.

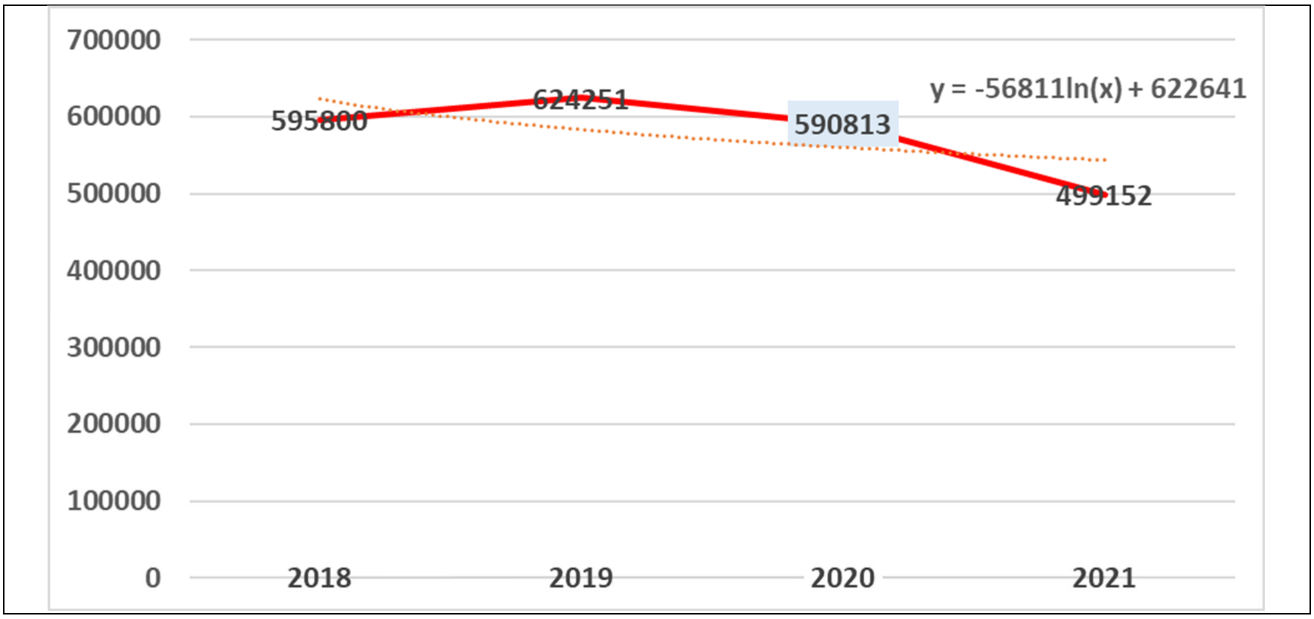

Figure 8. Amount of Water Consumption m^3 /y

Figures 9 to 16 visualize the monthly water consumption and resulting emissions for each year individually. The graphs exhibit variations in water consumption and emissions throughout the year, which can be attributed to various factors such as the academic calendar, weather, and specific events or activities on campus.

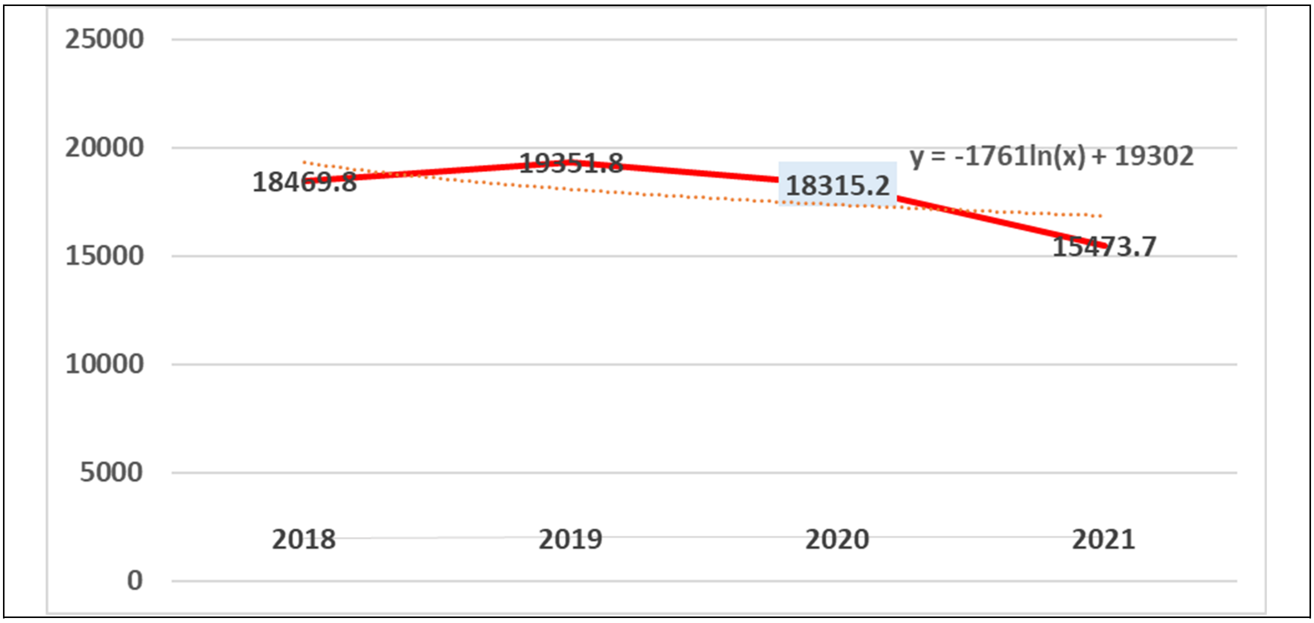

Figure 9: Calculated Emissions (kg CO_2 e/y) from water consumption

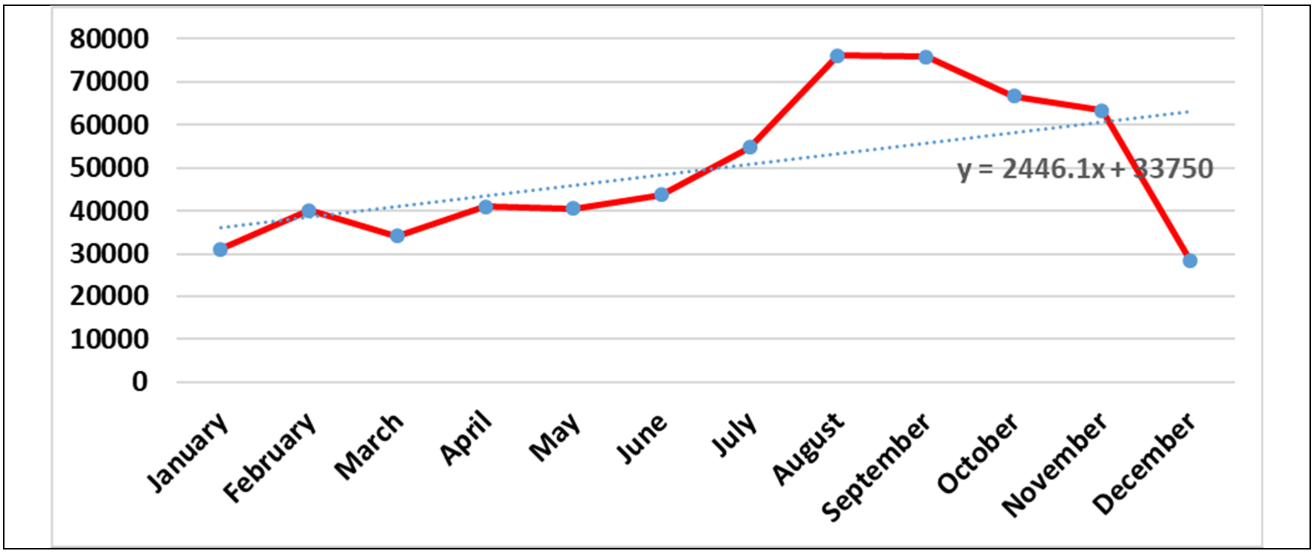

Figure 10: Amount of Water Consumption m^3/month in 2018

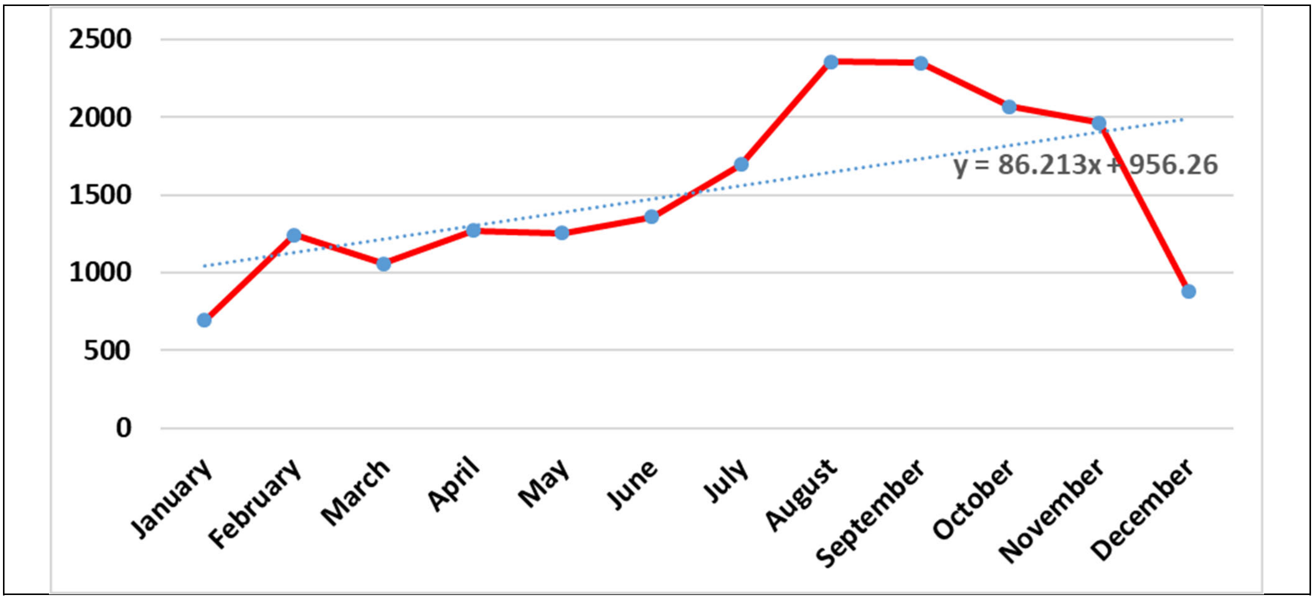

Figure 11: Calculated Emissions (kg CO_2 e/y) from water consumption in 2018

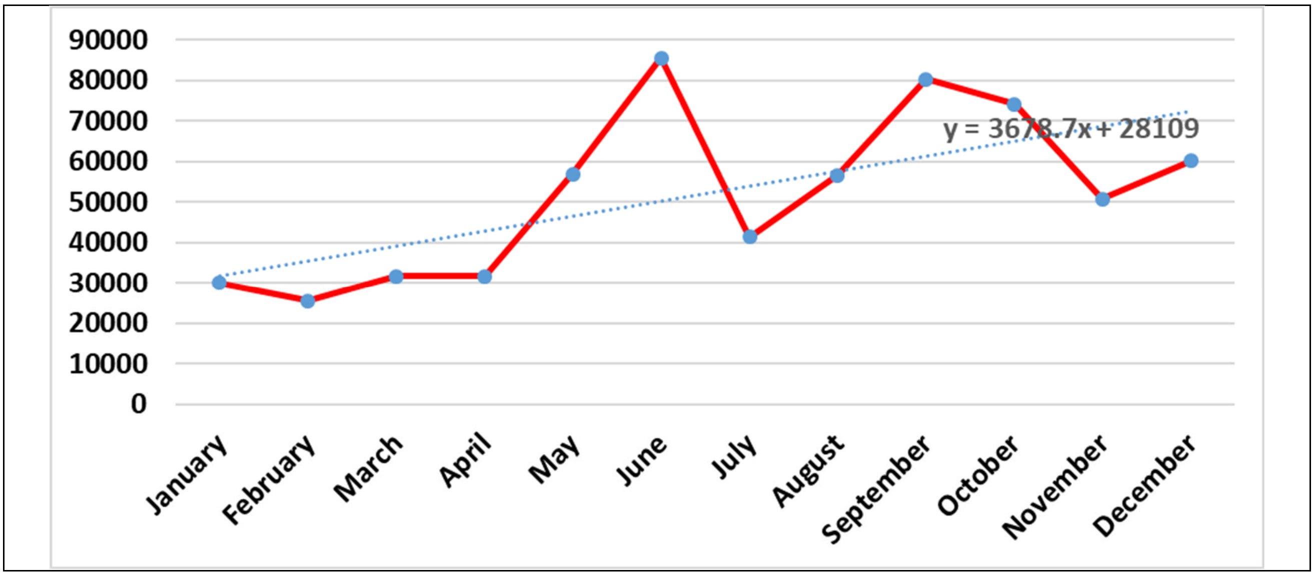

Figure 12: Amount of Water Consumption m[3]/month in 2019

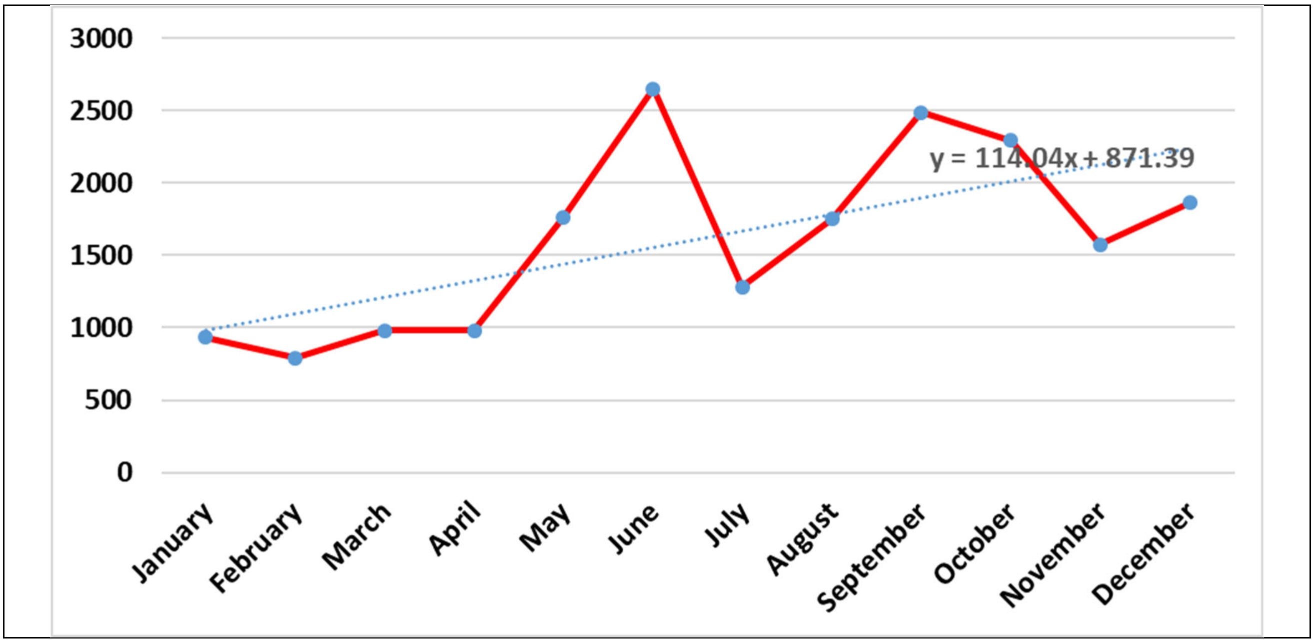

Figure 13: Calculated Emissions kg CO_2 e/y from water consumption in 2019

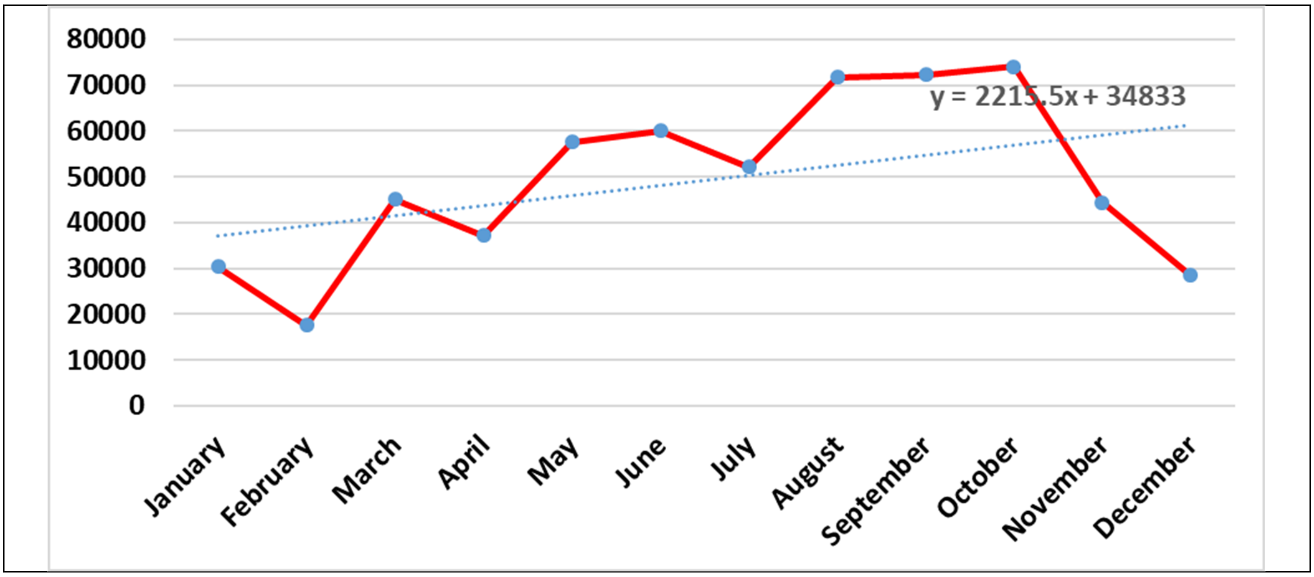

Figure 14: Amount of Water Consumption m^3/month in 2020

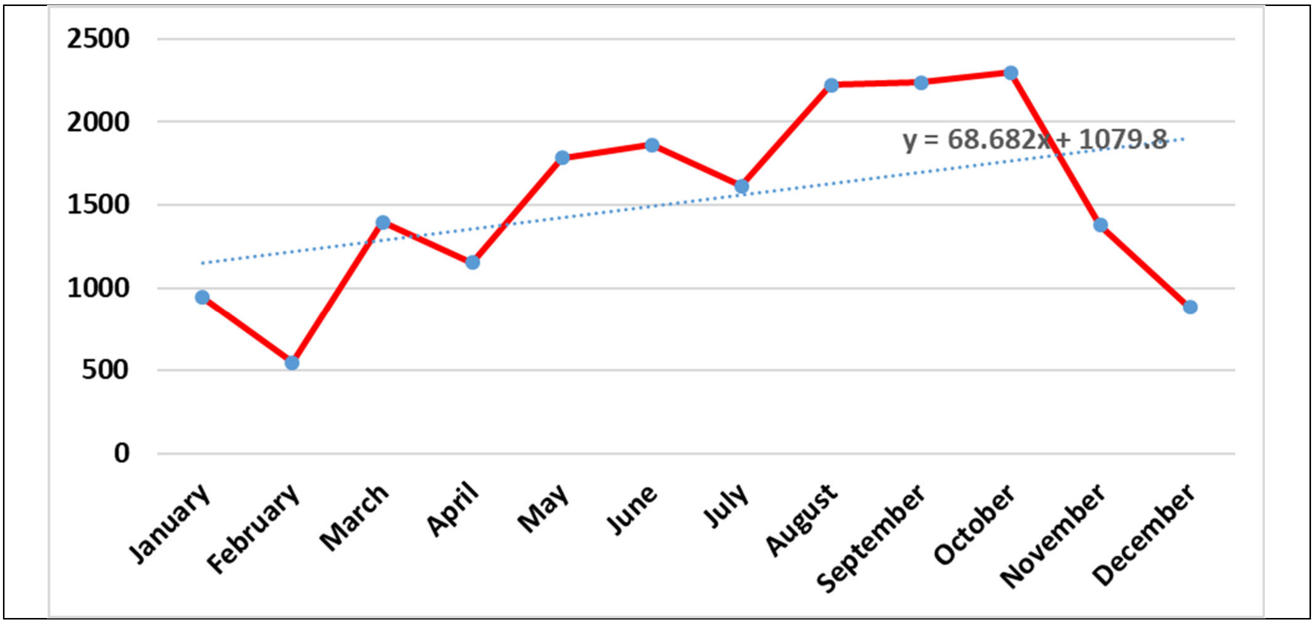

Figure 15: Calculated Emissions (kg CO_2 e/y) from water consumption in 2020

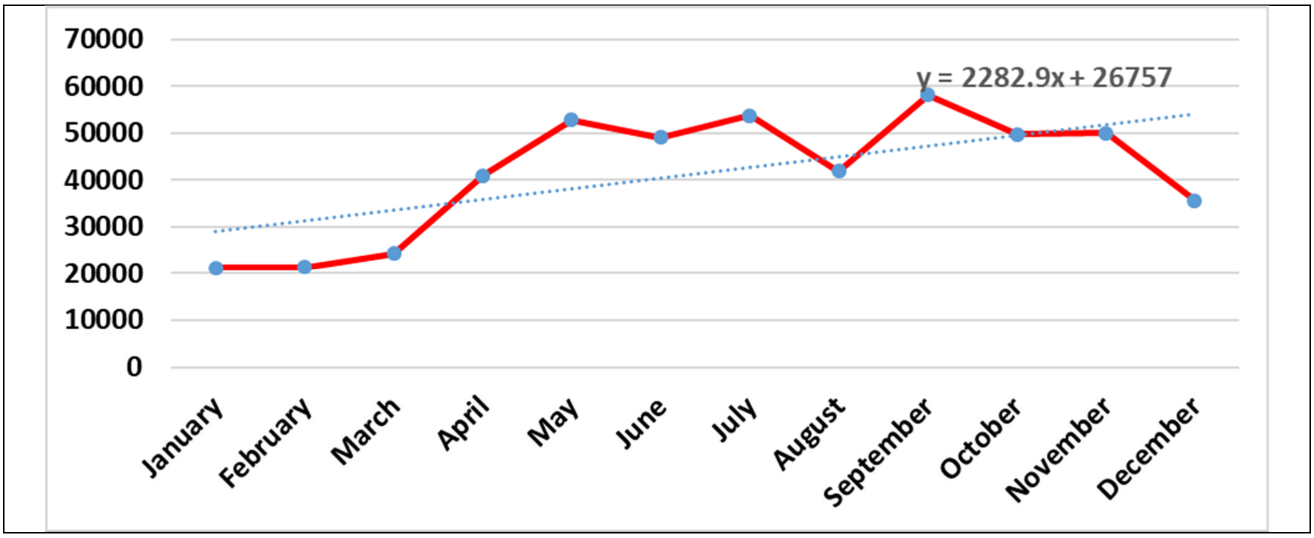

Figure 16: Amount of Water Consumption m^3/month in 2021

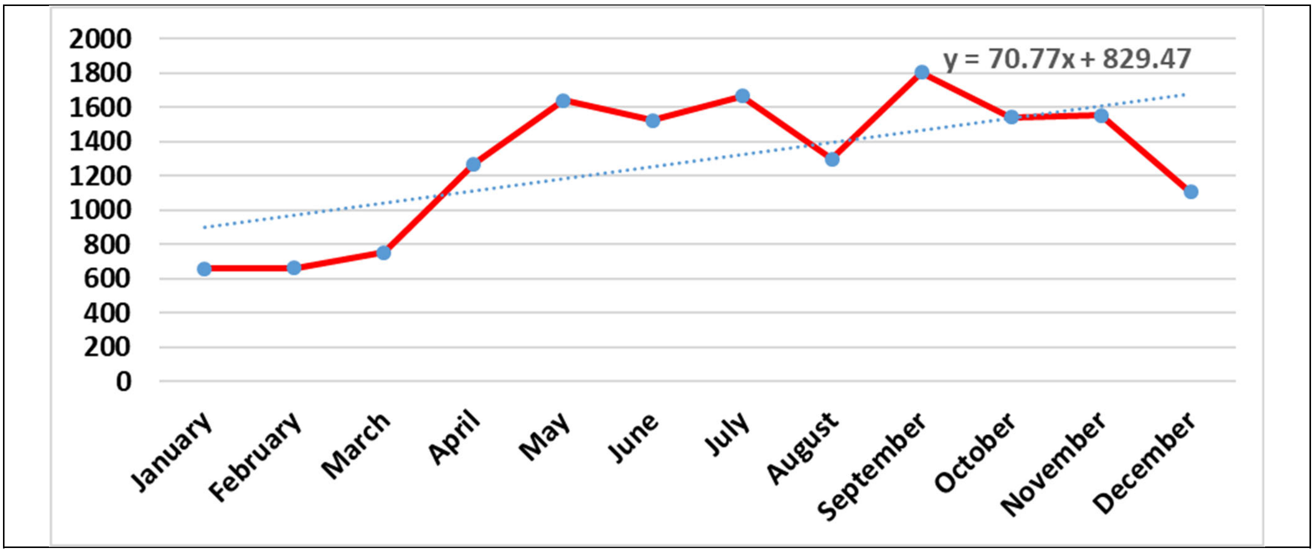

Figure 16: Calculated Emissions (kg CO_2 e/y) from water consumption in 2021

In summary, water usage and the resulting carbon emissions form a significant part of AASTMT's environmental impact. Future efforts to manage this impact may include water conservation initiatives, use of water-efficient appliances and fixtures, and efforts to raise awareness about water conservation among students, staff, and faculty.

6.4 Emissions from Transmission & Distribution Losses for Purchased Electricity (Scope 3):

Emissions from transmission and distribution losses for purchased electricity were calculated using the formula E = Q × F. In this formula, 'E' represents emissions from the source in kg CO_2-e per year, 'Q' refers to the quantity of electricity used (in kWh), and 'F' signifies the emission factors.

Table 9 below presents the calculated emissions in kg CO_2-e per year from transmission and distribution losses for the years 2018 to 2021.

Table 9: Calculated kg CO_2-e/y from transmission & distribution losses for purchased electricity.

Year	Electricity Consumption (kWh/year)	Emissions (kg CO_2-e/year)	Percentage (%)
2018	10,335,721	113,909.981	29
2019	9,594,010	105,735.584	27
2020	7,245,592	79,853.67	20
2021	8,402,135	92,599.93	24

The total emissions from transmission and distribution losses over these four years summed up to 392,099.165 kg CO_2-e.

As shown in Figure 17, the emissions from transmission and distribution losses varied from year to year, largely due to the annual fluctuations in electricity consumption. The lower emissions in 2020 can be attributed to the reduced electricity usage amid the COVID-19 pandemic, as a result of the university implementing social distancing measures and shifting to a hybrid education system.

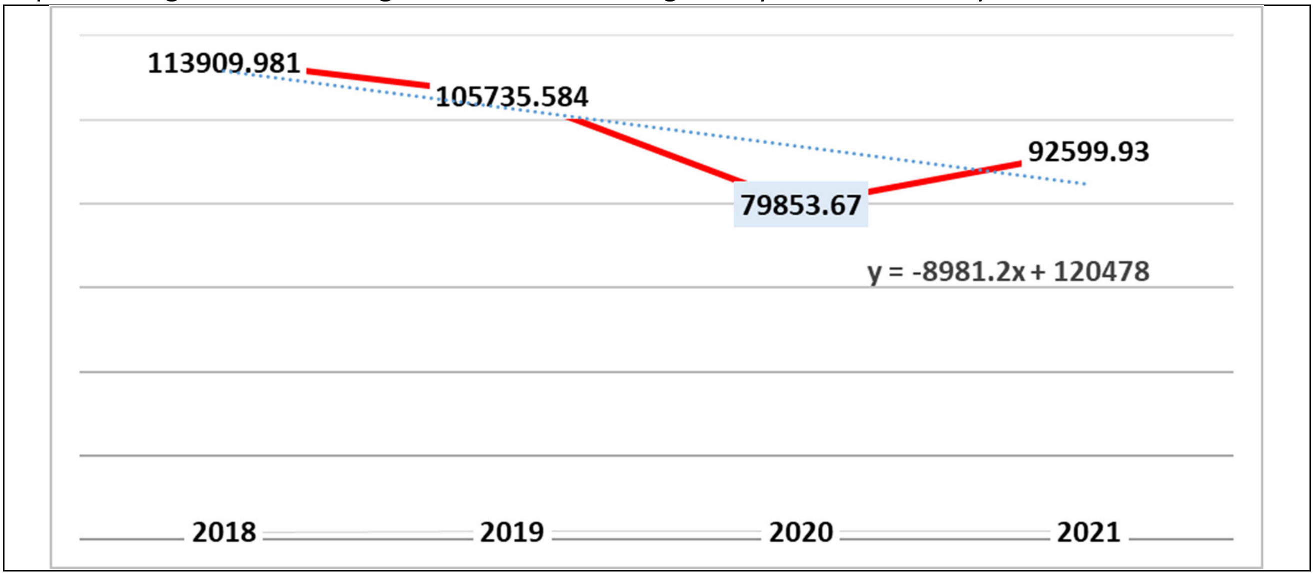

Figure 17. Calculated Emissions (kg CO_2 e/y) from transmission and distribution losses for purchased electricity

In conclusion, managing transmission and distribution losses for purchased electricity can significantly contribute to AASTMT's carbon emissions reduction efforts. These may include regular maintenance of electrical systems, adoption of energy-efficient appliances and equipment, and raising awareness about energy conservation among the university community.

6.5 Emissions from Paper Consumption (Scope 3):

Emissions from paper consumption are calculated by the equation $E = Q \times F$, where 'E' stands for emissions from the emissions source in kg CO_2-e per year, 'Q' is the quantity of paper used, and 'F' represents the emission factors.

Table 10 presents the calculated emissions in kg CO_2-e per year from paper consumption for the years 2018 to 2021.

Table 10: Calculated Emissions (kg CO_2 -e /y) from Paper Consumption.

Year	Packets/year	Weight (kg/year)	Emission Factor	Emissions (kg CO_2-e/year)	Percentage (%)
2018	14,454	36,135,000	2.736	98,865,360	22
2019	22,214	55,535,000	2.736	151,943,760	34
2020	12,724	31,810,000	2.736	87,032,160	19
2021	16,484	41,210,000	2.736	112,750,560	25

The total emissions from paper consumption over these four years summed up to 450,591,840 kg CO_2-e.

As shown in Figure 18, the emissions from paper consumption decreased in 2020, which can be attributed to the COVID-19 pandemic. During this period, the AASTMT Campus adopted precautionary measures that included social distancing, reducing the number of people on campus, and transitioning to a hybrid education system and distance learning. This shift to online platforms resulted in a significant reduction in paper consumption compared to previous years.

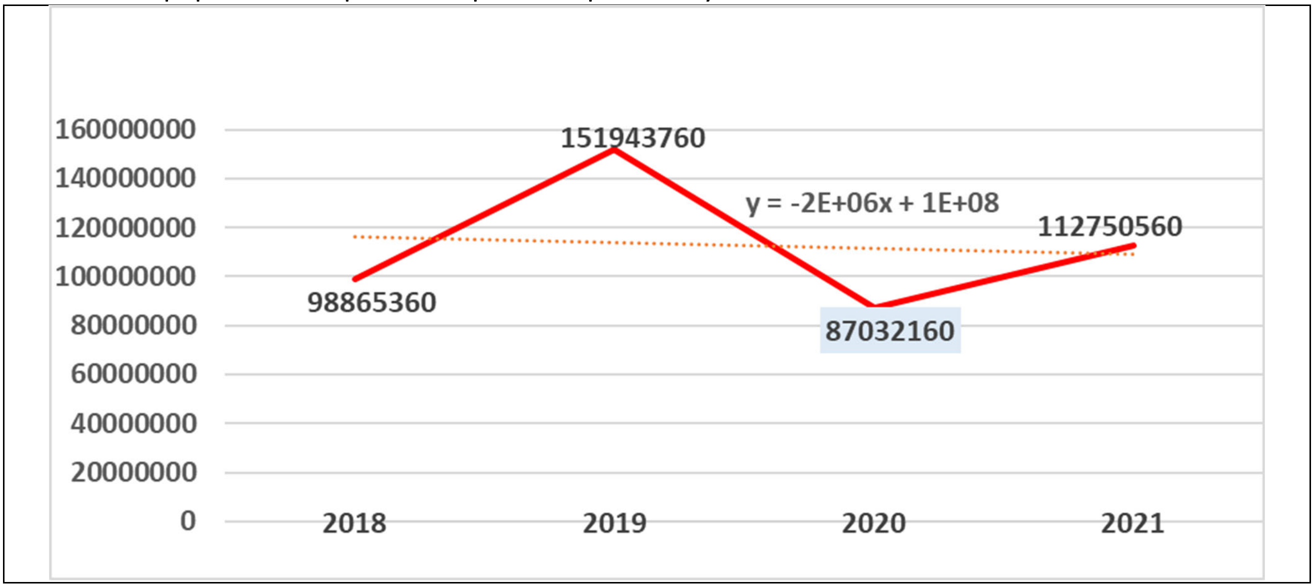

Figure 18: Calculated Emissions (kg CO_2 e/y) from paper consumption.

This experience shows the potential for reducing paper usage, and thus its associated emissions, in the future. Implementing policies such as digitalization of administrative procedures, encouraging online submissions of assignments, and increasing use of digital resources for teaching and learning could further reduce paper consumption and contribute to the university's sustainability goals.

6.6 GHG Emissions Report:

The Greenhouse Gas (GHG) Emissions Report provides an overview of the carbon footprint for the Abu Qir Campus of the Arab Academy for Science, Technology & Maritime Transport (AASTMT). The carbon footprint is calculated as the total amount of greenhouse gases produced, measured in equivalent units of carbon dioxide (CO_2 e).

Table 11 presents the GHG Emissions for the years 2018 to 2021, breaking down the environmental aspects contributing to the total emissions.

Table11: GHG Emissions Report.

Environmental Aspects	(kg CO_2 e)				
	2018	2019	2020	2021	Total/Aspect
Transport fuel	1,244,230.5	1,374,252.42	972,551.04	1,561,942.92	5,152,976.88
Purchased electricity	1,240,286.52	1,151,281.2	869,471.36	1,008,256.2	4,269,295.28
Water consumption	18,469.8	19,351.8	18,315.2	15,473.7	71,610.5
Paper Consumption	98,865,360	151,943,760	87,032,160	112,750,560	450,591,840
Transmission & distribution losses for electricity	113,909.981	105,735.584	79,853.67	92,599.93	392,099.165
Total Aspects /year	101,482,257	154,594,381	88,972,351.3	115,428,833	460,477,822

The total carbon footprint for the Abu Qir Campus (AASTMT) over these four years was calculated to be 460,477,822 kg CO_2 e. Table 12 shows the contribution percentage of each year to the total carbon footprint.

Table 12: Total Carbon Footprint.

Year	kg CO_2 e	% of contribution
2018	101,482,257	22%
2019	154,594,381	34%
2020	88,972,351.3	19%
2021	115,428,833	25%

Figures 19 and 20 visually represent the carbon footprint and the contribution percentage of the carbon footprint for the reporting period, respectively.

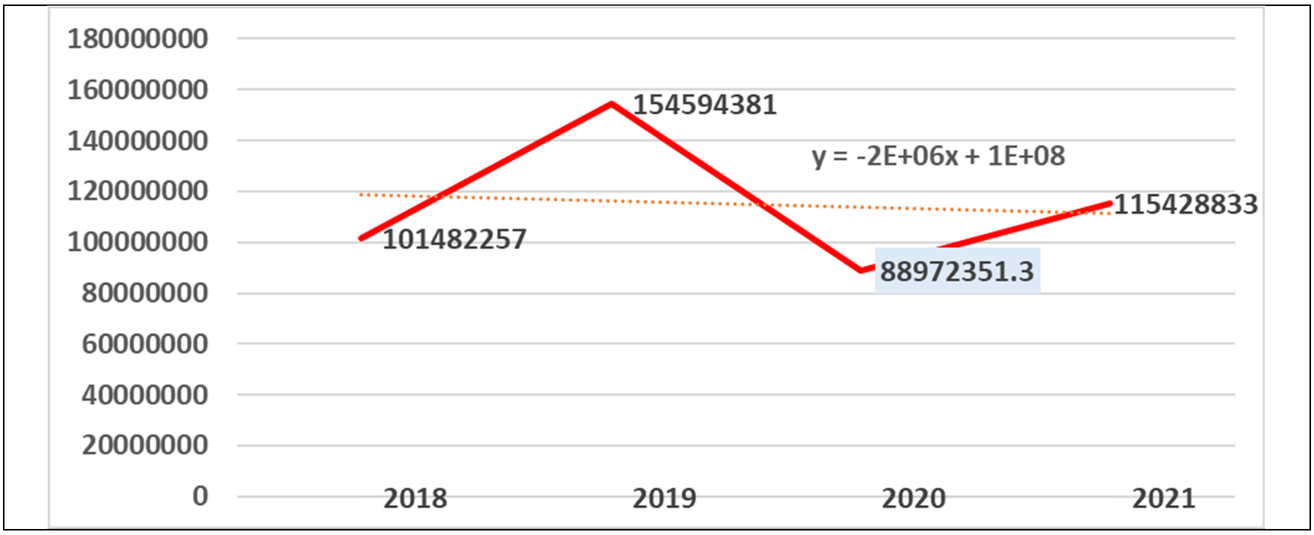

Figure 19: Shows the carbon footprint for the reporting period

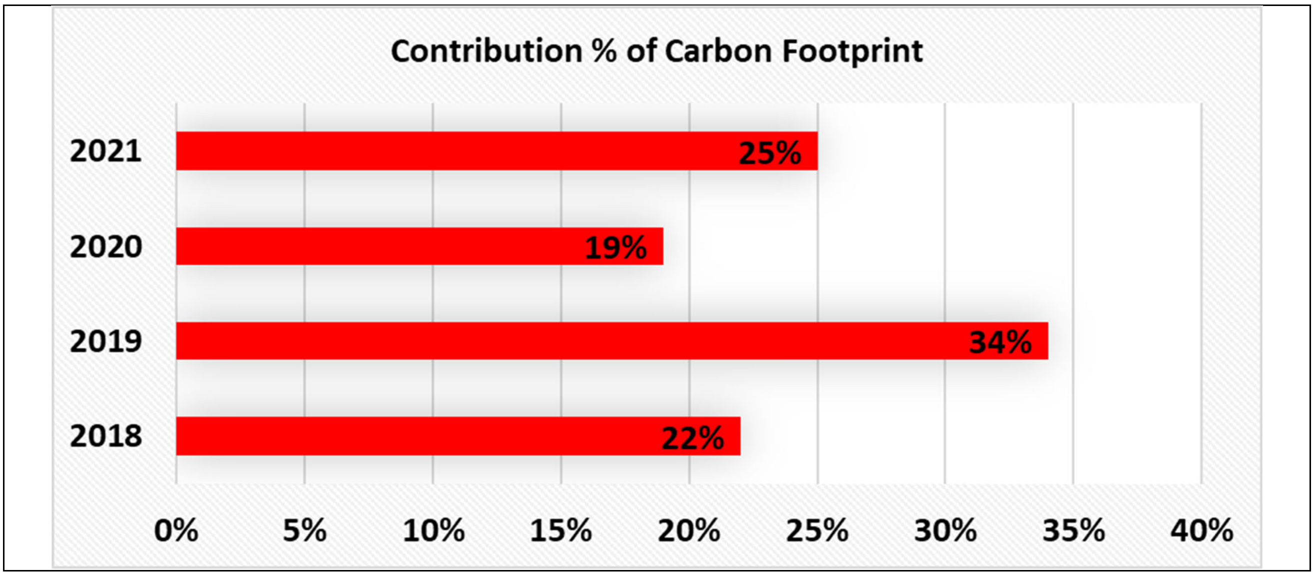

Figure 20: Shows the contribution % of carbon footprint for the reporting period

Table 13 presents a breakdown of the Abu Qir Campus's greenhouse gas (GHG) emissions, categorized according to Scopes 1, 2, and 3, for the years 2018 to 2021.

Scope 1 emissions are direct GHG emissions that occur from sources that are owned or controlled by the institute, such as emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc. Scope 2 emissions are the indirect GHG emissions from the consumption of purchased electricity, heat, or steam, while Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly impacts in its value chain.

For Scope 1 emissions, the Abu Qir Campus saw a general increase over the four years, with the total emissions across the four years amounting to 5,152,976.88 kg CO2 e. The highest emissions were recorded in 2021 with 1,561,942.92 kg CO2 e, while the lowest were in 2020 with 972,551.04 kg CO2 e.

Scope 2 emissions, which stem from purchased electricity, heat, or steam, had a total of 4,269,295.28 kg CO2 e over the four years. The largest contributor was in 2018, with 1,240,286.52 kg CO2 e, and the lowest in 2020, with 869,471.36 kg CO2 e.

Finally, Scope 3 emissions, which result from activities outside the organization's direct control, were the most significant contributors to the total carbon footprint. The total Scope 3 emissions over the four years were a staggering 451,055,549.67 kg CO2 e. The highest emissions in this category were in 2019, amounting to 152,068,847.38 kg CO2 e, and the lowest in 2020, at 87,130,328.87 kg CO2 e. This highlights that activities in the value chain, such as paper consumption, water consumption, and transmission & distribution losses for purchased electricity, have the most substantial impact on the campus's total carbon emissions.

In summary, while Scope 1 and Scope 2 emissions remained relatively consistent across the four years, Scope 3 emissions varied significantly, primarily driving the total carbon footprint. This underscores the importance of implementing sustainable strategies not only within the campus but also in managing external factors associated with its activities.

Table 13: Greenhouse Gas Emissions by Scope for Abu Qir Campus (2018-2021)

(kg CO2 e)					
Scope	2018	2019	2020	2021	Total/Aspect
Scope 1	1,244,230.50	1,374,252.42	972,551.04	1,561,942.92	5,152,976.88
Scope 2	1,240,286.52	1,151,281.20	869,471.36	1,008,256.20	4,269,295.28
Scope 3	98,997,739.78	152,068,847.38	87,130,328.87	112,858,633.63	451,055,549.67

Table 14 breaks down the contribution of each scope to the total carbon footprint. Scope 1 refers to direct emissions, Scope 2 to indirect emissions from the generation of purchased energy, and Scope 3 to other indirect emissions.

Table 14: Carbon Footprint Percentage (%) of contribution / Scope.

Scope	2018	2019	2020	2021
Scope 1	1%	0.9%	1%	1%
Scope 2	1%	0.7%	1%	1%
Scope 3	98%	98.4%	98%	98%

As shown, Scope 3 emissions, which include factors such as transport fuel, water consumption, paper consumption, and transmission & distribution losses for purchased electricity, contribute the most to the carbon footprint for all the years. This highlights the need to focus on these areas for effective greenhouse gas reduction strategies.

7 Conclusions and Recommendations

7.1 Conclusion:

The study of greenhouse gas emissions for the Abu Qir Campus of the Arab Academy for Science, Technology & Maritime Transport (AASTMT) for the years 2018-2021 revealed several trends and sources of emissions that are critical for planning sustainable practices. The total carbon footprint for the period under investigation was determined to be 460,477,822 kg CO_2-e.

The emissions sources, including transport fuel, purchased electricity, water consumption, paper consumption, and transmission & distribution losses for purchased electricity, all contribute significantly to the carbon footprint. The highest emissions source is paper consumption, followed by transport fuel and purchased electricity. There was a noticeable decrease in emissions in 2020, likely due to the Covid-19 pandemic and the measures implemented in response, including distance learning and a hybrid education system.

Scope 3 emissions, which include all indirect emissions not included in Scope 2, constitute the vast majority of the total emissions. This category encompasses several sources and hence highlights the importance of an inclusive and expansive view when examining carbon footprints.

This carbon footprint assessment of the Abu Qir Campus of the Arab Academy for Science, Technology & Maritime Transport (AASTMT) offers significant insights into the key emission sources and the campus's overall environmental impact. The study presents a comprehensive and structured approach to measuring and understanding greenhouse gas (GHG) emissions associated with the campus's activities.

One of the key observations from this assessment is the influence of indirect emissions, primarily from paper consumption, which account for a large portion of the campus's total carbon footprint. Other significant contributors include emissions from purchased electricity, transport fuel, and transmission and distribution losses for purchased electricity.

The impact of the COVID-19 pandemic on the campus's carbon footprint was also evident, leading to reductions in electricity usage, paper consumption, and water consumption. This highlights the role of external factors in affecting an institution's GHG emissions.

While this assessment provides a robust understanding of the campus's carbon footprint, it's acknowledged that certain elements, in accordance with the GHG Protocol, were not included in the current study due to the difficulty of data collection. These elements include refrigerant leakage under Scope 1 and waste disposal, accommodation, and working from home under Scope 3. The exclusion of these components from the current study points to potential areas of improvement in future carbon footprint assessments.

In the continuous follow-up of the carbon footprint for the AASTMT campus, it is anticipated that these missed elements will be incorporated. Data collection methods and strategies will be improved and expanded to include these aspects, thus providing a more holistic and comprehensive overview of the campus's carbon footprint.

The lessons learned from this assessment, the recommendations provided, and the intended improvements all contribute to a continued commitment to sustainability. They form an integral part of AASTMT's ongoing efforts to reduce its environmental impact, promote sustainable practices, and contribute to global efforts to combat climate change. This report serves as a stepping-stone towards a more sustainable future for the AASTMT campus, guiding its path to becoming a more environmentally responsible institution.

7.2 Recommendations:

The AASTMT's commitment to the Race to Zero initiative and its pledge to be net-zero carbon by 2050, with a 50% reduction in emissions by 2040, present a clear and ambitious roadmap for the Academy's future sustainability efforts. The findings of this carbon footprint assessment underscore the necessity and urgency of implementing targeted strategies to meet these commitments. In light of this, the following recommendations are proposed:

1. Enhanced Data Collection: Improvements in data collection practices will enable the AASTMT to more accurately track its carbon footprint, including currently unmeasured aspects such as refrigerant leakage, waste disposal, accommodation, and working from home. Incorporating these elements will provide a more holistic view of the campus's environmental impact.
2. Energy Efficiency: Continue the trend of transitioning towards energy-efficient technologies. This includes expanding the use of LED lighting, optimizing air conditioning systems, and further exploring renewable energy sources, such as solar power.
3. Sustainable Transport: Encourage sustainable transportation methods to reduce emissions from transport fuel. This could involve promoting public transportation, carpooling, cycling, or walking, where possible.
4. Water Conservation: Implement more water-saving practices, particularly given the significant role of water consumption in the campus's overall emissions.
5. Paper Reduction: Promote digital methods of communication and record-keeping to reduce paper consumption. Digital transformation efforts can substantially decrease the campus's reliance on paper and subsequently its associated carbon emissions.
6. Sustainability Awareness and Education: Foster a culture of sustainability within the AASTMT community. This could involve educational initiatives, awareness campaigns, and integrating sustainability concepts into academic and administrative practices.
7. Carbon Offsetting: Explore opportunities for carbon offsetting to counterbalance the campus's carbon emissions. This could involve supporting renewable energy projects, tree planting initiatives, or other carbon reduction programs.

By implementing these strategies and maintaining a continued focus on sustainability, the AASTMT can play a significant role in mitigating climate change and contribute to global sustainability goals. Achieving its commitments to the Race to Zero initiative and net-zero carbon emissions by 2050 will require sustained effort, ongoing monitoring, and continual adaptation to emerging technologies and best practices. This carbon footprint assessment serves as a valuable foundation for these future efforts.

8 Lessons Learned

This assessment of the carbon footprint of the Abu Qir Campus of the Arab Academy for Science, Technology & Maritime Transport (AASTMT) has provided several valuable insights. The following are some key lessons learned from this study:

1. Holistic Approach to Sustainability: Sustainability efforts must encompass all facets of campus operations. It is not sufficient to focus solely on apparent factors like energy use. Our analysis revealed that paper consumption was the most significant contributor to the campus's greenhouse gas emissions, highlighting the need for a comprehensive view of sustainability.

2. Significance of Indirect Emissions (Scope 3): While direct emissions are often the focal point of carbon footprint assessments, our study underscored the importance of considering indirect emissions. Scope 3 emissions were overwhelmingly the largest contributor to the total carbon footprint, demonstrating the need to consider all emission sources, not just those directly controlled by the campus.
3. Impact of Global Events: The Covid-19 pandemic had a noticeable impact on the campus's carbon footprint due to the shift to remote learning and reduced campus operations. This experience illustrated how global events can have significant, unexpected effects on sustainability efforts and the importance of adaptability in our approach to reducing emissions.
4. Value of Regular Reporting: Regularly tracking and reporting greenhouse gas emissions is vital for monitoring progress, understanding the effectiveness of implemented measures, and identifying areas where further reductions can be achieved. The trends visible through annual comparisons in our report demonstrate the value of this practice.
5. Importance of Sustainable Practices: The study underscores the importance of adopting sustainable practices in daily operations. Simple actions, such as reducing paper consumption and promoting energy-efficient practices, can lead to significant reductions in greenhouse gas emissions.
6. Role of Community Engagement: The commitment and engagement of the entire campus community—students, faculty, staff, and administrators—are crucial for the success of sustainability initiatives. Raising awareness and promoting a culture of sustainability can motivate individuals to adopt behaviors that reduce the campus's overall carbon footprint.

The experience and knowledge gained from this study serve as a valuable foundation for future sustainability efforts at the AASTMT and beyond. By applying these lessons, institutions can progress more effectively towards their sustainability goals and contribute positively to the global fight against climate change.