

## Table of Contents

<b>1- EXECUTIVE SUMMARY</b> .....	2
<b>2- INTRODUCTION</b> .....	4
<b>3- TECHNICAL APPROACH</b> .....	5
<b>3.1- Methodology</b> .....	5
<b>3.2- Organizational and Operational Boundaries</b> .....	5
<b>3.2.1- Organizational Boundaries</b> .....	5
<b>3.2.2- Operational Boundaries</b> .....	6
<b>3.3- Reporting Period</b> .....	8
<b>3.4- Data Analysis</b> .....	8
<b>3.4.1- Data of Emission Sources</b> .....	8
<b>3.4.2- Emission Factors</b> .....	9
<b>3.4.3- Calculation of Greenhouse Gas Emissions</b> .....	10
<b>3.4.4- Data Integrity and Quality</b> .....	10
<b>3.5- Greenhouse Gas Emission Sinks</b> .....	11
<b>4- CARBON FOOTPRINT OF TOBB ETU</b> .....	12
<b>4.1- Greenhouse Gas Emissions by Scope</b> .....	12
<b>4.1.1- Scope 1: Direct greenhouse gas emissions</b> .....	13
<b>4.1.2 - Scope 2: Energy indirect greenhouse gas emissions</b> .....	13
<b>4.1.3 - Scope 3: Other indirect greenhouse gas emissions</b> .....	14
<b>4.2- Emission Intensity</b> .....	14
<b>5- RECOMMENDATIONS AND TARGETS</b> .....	16
<b>5.1- Recommendations for Scope Extension and Enhancing Data Quality</b> .....	16
<b>5.2- Recommendations for Reducing Greenhouse Gas Emissions</b> .....	17
<b>5.3- Targets for Reducing Greenhouse Gas Emissions</b> .....	18
<b>6- ANNEXES</b> .....	18
<b>6.1 Preliminary Feasibility Study on TOBB ETU Rooftop Solar Power Plant</b> .....	18

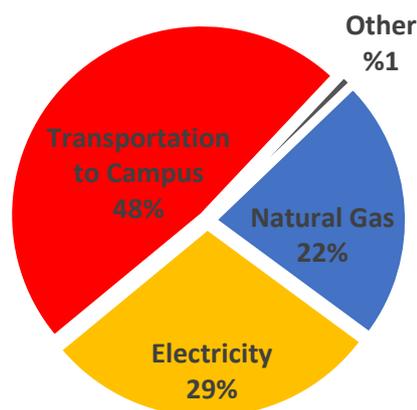
## 1- EXECUTIVE SUMMARY

	2016 (tCO <sub>2</sub> e)	2017 (tCO <sub>2</sub> e)	CHANGE (%)
Total Emissions	16,803.94	16,934.21	0.78%
Amount of Emission per Capita	2.37	2.28	-3.78%

This study is prepared with the aim of creating a sustainable campus for TOBB University of Economics and Technology (TOBB ETU) by analyzing its environmental effects that could cause climate change and by determining its potential to reduce greenhouse gas emissions. First of all, greenhouse gas emissions were calculated for the year 2016 to form a reference dataset. Afterwards, greenhouse gas emissions for 2017 were added to the inventory to analyze the most recent changes in activities that cause formation of greenhouse gases. In the light of the findings obtained, even though the carbon footprint of TOBB ETU had increased by 0.78% in 2017 compared to 2016, the amount of per capita emissions was decreased by 3.78% due to a 4.7% increase in the number of academic staff, administrative staff and students.

Within the context of the inventory, greenhouse gas emissions originating from natural gas consumption, purchased electricity, transportation to campus, paper consumption, water consumption, and rental and TOBB ETU-owned vehicles were calculated, and it was determined that the main emission load was due to natural gas consumption, purchased electricity, and campus transportation activities.

Figure 1- Emission Sources



Based on these determinations, emission reduction suggestions were made, and a pre-feasibility study including technical and financial details for installation of a rooftop solar power plant was prepared in order to reduce greenhouse gas emissions due to electricity consumption. In addition, monitoring proposals were made for the following years to enlarge the scope of the greenhouse gas emissions inventory.

Finally, emission reduction targets were determined in line with the climate strategies identified by the European Commission, considering the views of the stakeholder representatives.

## 2- INTRODUCTION

TOBB ETU was founded by the Turkey Chambers and Commodity Exchanges Educational and Cultural Foundation (TOBEV) on July 1, 2003. Our university started its education activities in 2004-2005 Academic Year with 3 faculties, 6 departments, and 270 students, 145 of which were scholarship students. In addition to the TOBB ETU campus in Söğütözü district, which consists of administrative units and education and training blocks, social facilities building was included the following year, and Foreign Language Building in 2009, Technology Center in 2013, and the Faculty of Medicine Morphology Laboratory in 2014.

TOBB ETU was founded with the mission of contributing to the needs of the country and society, and to the economic and social development of the country, with its research and development activities. In accordance with its mission, TOBB ETU chose not to be indifferent to climate change problem, which is one of the major problems of our earth. It had been decided that the first of the studies on climate change to be carried out on the preparation of our university's greenhouse gas emission inventory. Accordingly, our university's greenhouse gas emission inventory was prepared within the scope of "Increasing Climate Change Awareness at TOBB ETU" project supported by the European Union. Within the scope of this project, the emission values were shared with our students, academicians, and administrative staff, training was provided in this regard, and emission reduction recommendations were gathered. This report is not only a text containing the results of the greenhouse gas inventory analysis, but also a roadmap containing the recommendations of TOBB ETU members. We especially thank Rifat HISARCIKLIOGLU, our chairman of the board of trustees, who sincerely supports all activities of our university, and our president and teacher Prof., Dr. Adem SAHIN, who supported our team throughout the project, our Technology Transfer Office, and our students and academic and administrative staff.

Süleyman TURGUT

Project Coordinator

TOBB ETU 2014-2015 Graduate

TOBB ETU Technology Transfer Office

Project Management Unit, Assistant Specialist

## 3- TECHNICAL APPROACH

### 3.1- Methodology

Carbon footprint analysis of TOBB ETU has been prepared in accordance with the GHG Protocol defined by the World Resources Institute (WRI) and the ISO 14064-1 standard defined by the International Organization for Standardization. These two standards are designed to be compatible with each other and to complement each other in the monitoring and reporting of carbon footprints of organizations. In addition, the GHG Protocol is the world's most widely used international greenhouse gas emission calculation tool.

### 3.2- Organizational and Operational Boundaries

#### 3.2.1- Organizational Boundaries

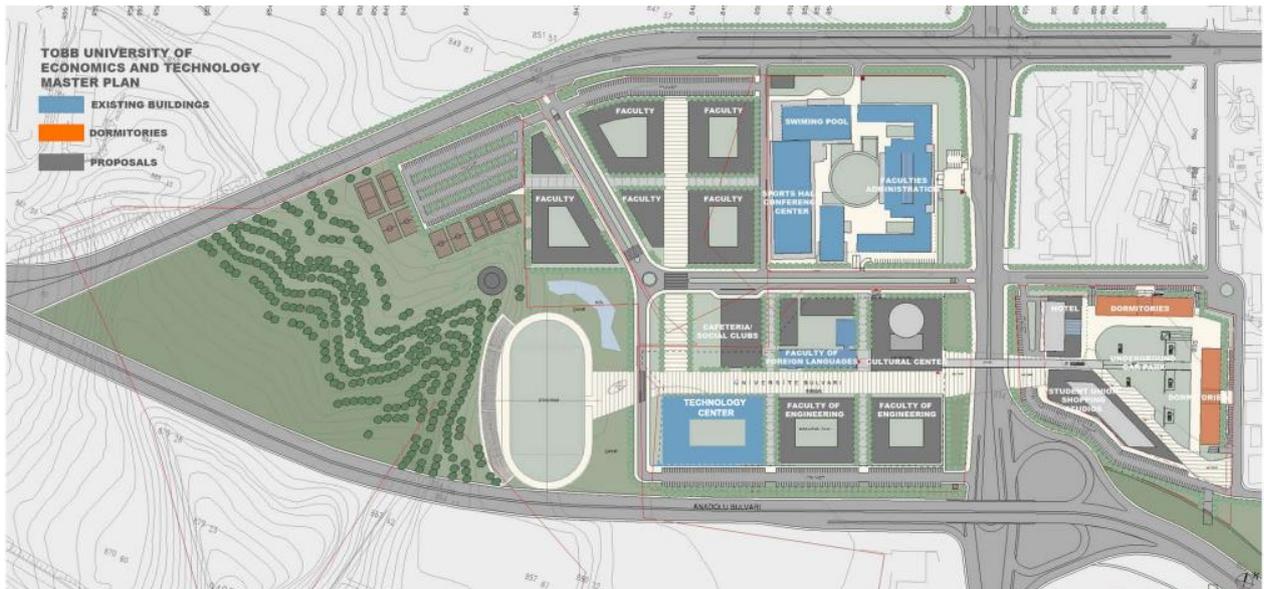
Organizational boundaries determined for the purpose of calculating greenhouse gas emissions refer to the boundaries in which an organization performs its activities and operations. In this context, organizations may prefer to report the emissions caused by the facilities in its own financial or operational control according to (1) the control approach or the emissions caused by the shared facilities according to (2) the equity share approach.

Operational control approach was preferred for calculating the carbon footprint of TOBB ETU. In this context, greenhouse gas emissions resulting from activities carried out and managed in buildings and facilities in three different areas within the TOBB ETU campus have been calculated. These areas are:

- 1) Central Area where faculties, institutes, and administrative units are located
- 2) YBD Area where Foreign Language Department and Technology Center Building are located
- 3) Student Residence Area where student dormitories are located

TOBB ETU Private Hospital affiliated to TOBB ETU in 2016 has not been included in the calculation because its operational control is not in TOBB ETU. Besides, the field belonging to the Ataturk Forest Farm, which is found west of TOBB ETU and allocated to TOBB ETU for forestation, maintenance, and recreation purposes, is excluded from this report, since there is no activity in the field. In addition, since the operation of the sports center found at the Central Area is made by a private company, it is considered as out of organizational boundaries.

#### **Figure 2- TOBB ETU Master Plan**



### 3.2.2- Operational Boundaries

Determining operational boundaries involves identifying greenhouse gas emissions and discharges associated with the activities of the organization, and classifying greenhouse gas emissions and discharges as *direct greenhouse gas emissions*, *energy indirect greenhouse gas emissions* and *other indirect greenhouse gas emissions*. Determination of operational boundaries also includes selecting which of the other indirect emissions will be calculated and reported.

For this purpose, the following definitions are used:

#### **Scope 1: Direct greenhouse gas emissions**

Although definition of this scope presents minor differences in ISO 14064-1 and GHG Protocol guidelines, we can deduce that they describe the same boundaries, considering that these two standards are complementary.

In ISO 14064 guideline, this content is described as "*direct greenhouse gas emissions and discharges originating from facilities within the boundaries of the organization*", while in the GHG Protocol manual, it is described as "*greenhouse gas emissions originating from sources that belong to the organization or are controlled by the organization*".

#### **Scope 2: Indirect energy greenhouse gas emissions**

Describes emissions of greenhouse gases generated during the production of electricity, heat, or steam consumed by the organization by importing (by purchasing).

#### **Scope 3: Other indirect greenhouse gas emissions**

Other than energy indirect greenhouse gas emission, this refers to greenhouse gas emissions generated due to activities of an organization, but originating from greenhouse gas sources owned by or controlled by other organizations.

16 activities leading to other indirect greenhouse gas emissions have been defined in detail in the guide for the implementation of ISO 14064-1.

In the light of these definitions, the operational boundaries determined for reporting TOBB ETU's carbon footprint are as follows:

**Scope 1:**

- 1.1. Natural gas burnt in boilers for heating the buildings in the TOBB ETU campus and for hot water use,
- 1.2. Fuel used by transportation vehicles belonging to TOBB ETU,
- 1.3. Greenhouse gas emissions originating from the reduction of R410A gas used in air conditioners.

**Scope 2:**

- 2.1. Mains electricity purchased for use in illumination, air conditioning systems, and elevators, etc.

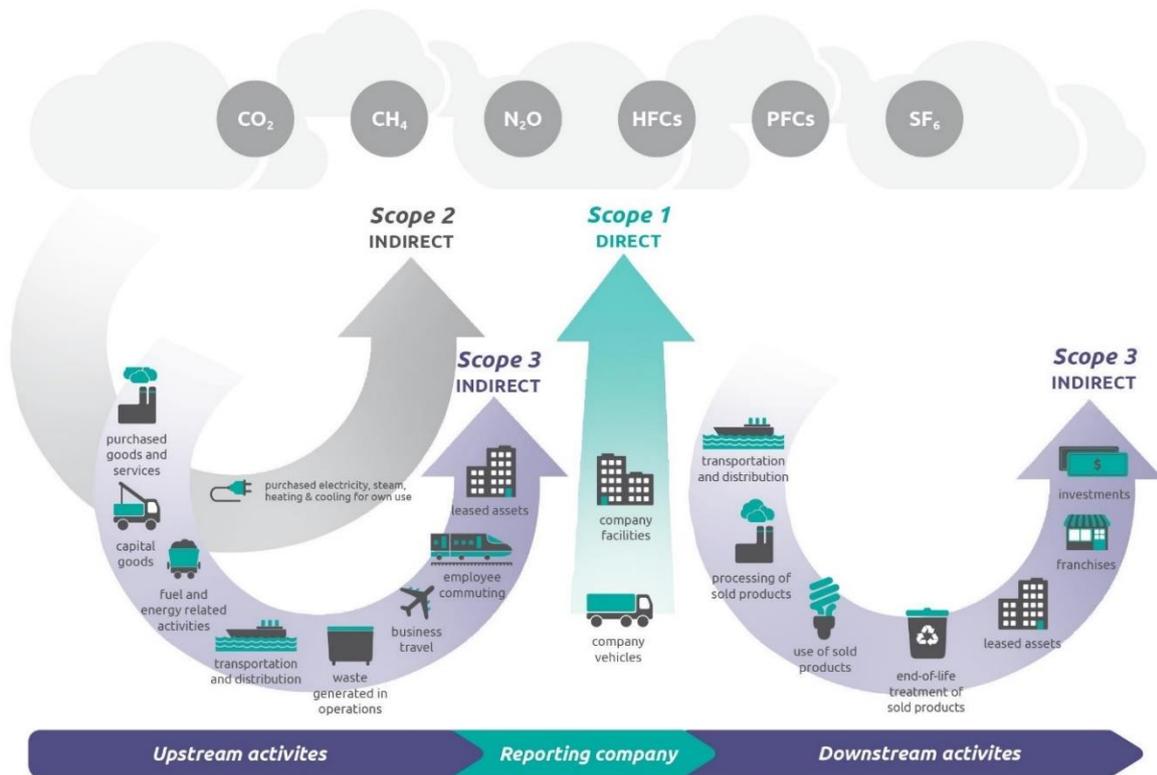
**Scope 3:**

- 3.1. Fuel consumption of rental vehicles,
- 3.2. Consumption of paper that is purchased from outside and used for office work,
- 3.3. Water consumption,
- 3.4. Distance covered by vehicles, which are procured from outside and used in transportation services of the staff and students to TOBB ETU,
- 3.5. Distance covered by the staff and students by public transportation to reach TOBB ETU,
- 3.6. Distance covered by private vehicles of the staff and students to reach TOBB ETU,

While preparing greenhouse gas emission inventory, all the emission sources are defined in detail, but especially some activities that are considered to be within the boundaries of Scope 3 could not be included in the inventory since there is not enough data. Main sources of emissions excluded from inventory are from wastes, international and intercity trips, and accommodation activities. The following sections provide detailed explanations about the collected data and applied emission factors.

TOBB ETU aims to monitor emissions originating from its own activities in more detail in order to make use of opportunities to reduce its carbon footprint, and especially aims to focus on emission sources in the context of scope 3 boundaries. Efforts will be made in the coming years to also include emissions originating especially from business trips and accommodations. In addition, it is planned to monitor and record activities that cause greenhouse gas emissions more frequently so that more detailed analysis of emission sources and emission reduction measures can be taken more effectively.

**Figure 3- GHG Protocol Operational Boundary Diagram**



### 3.3- Reporting Period

This report covers two consecutive periods:

1. Period: January 1, 2016 - December 31, 2016 (Base year)
2. Period: January 1, 2017 - December 31, 2017

### 3.4- Data Analysis

#### 3.4.1- Data of Emission Sources

The sources, units, and monitoring frequencies of data collected from emission sources are provided in detail in the below given table. These data are mainly obtained from information and documents provided by the TOBB ETU administrative staff as the primary source.

**Table 1- TOBB ETU Emission Sources Data**

SCOPE	EMISSION SOURCE	UNIT	MONITORING FREQUENCY
Scope 1	Natural Gas Consumption	m <sup>3</sup>	Yearly

	(Heating and Hot Water)		
	Fuel Consumption of School Vehicles (Diesel Oil)	Litre	Monthly
	Fugitive Emissions (Air Conditioner – R410 A)	kg	Yearly
<b>Scope 2</b>	Purchased Electricity	kWh	Monthly
<b>Scope 3</b>	Fuel Consumption of Rental Vehicles (Diesel Oil)	Litre	Monthly
	Paper Consumption	Amount-kg	Yearly
	Water Consumption	m <sup>3</sup>	Yearly
	School Bus and Shuttle Bus Services (Distance covered)	km	Yearly
	Public Transportation to and from TOBB ETU	km	Yearly
	Transportation to and from TOBB ETU using Personal Vehicles	km	Yearly

### 3.4.2- Emission Factors

**Emission factor** is the coefficient that indicates the average amount of greenhouse gas emission caused by the unit raw material, unit fuel, unit volume, unit time, or unit area of emission sources. However, on the other hand, the effects of the six greenhouse gases defined in Kyoto Protocol (Carbon dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>), Nitrous Oxide (N<sub>2</sub>O), Hydrofluoride carbons (HFCs), Perfluoro carbons (PFCs), Sulphurhexafluoride (SF<sub>6</sub>)) on global warming are different from each other. Some greenhouse gases remain longer in the atmosphere. Therefore carbon dioxide equivalent (CO<sub>2</sub>e) unit is used to denote the effect of greenhouse gases on global warming caused by emission sources with a single unit. The coefficient used to convert greenhouse gases to carbon dioxide equivalent is called **global warming potential (GWP)**.

**Table 2- Annual Change in Emission Factors**

SCOPE	EMISSION SOURCE	EMISSION FACTOR (2016-BASE YEAR)	EMISSION FACTOR (2017)	CHANGE COMPARED TO THE BASIC YEAR	SOURCE
<b>Scope 1</b>	Natural Gas Consumption	<b>2.028</b> kgCO <sub>2</sub> e/m <sup>3</sup>	<b>2.097</b> kgCO <sub>2</sub> e/m <sup>3</sup>	<b>+ 3.4%</b>	Defra

	(Heating and Hot Water)				
	Fuel Consumption of School Vehicles (Diesel Oil)	<b>2.676</b> kgCO <sub>2</sub> e/litre	<b>2.672</b> kgCO <sub>2</sub> e/liter	<b>-0.2%</b>	Defra
	Fugitive Emissions (Air Conditioner – R410 A)	<b>2088.000</b> kgCO <sub>2</sub> e/kg	<b>2088.000</b> kgCO <sub>2</sub> e/kg	---	Defra
<b>Scope 2</b>	Purchased Electricity	<b>0.478</b> kgCO <sub>2</sub> /kWh	<b>0.478</b> kgCO <sub>2</sub> /kWh	---	IEA
<b>Scope 3</b>	Fuel Consumption of Rental Vehicles (Diesel Oil)	<b>2.676</b> kgCO <sub>2</sub> e/liter	<b>2.672</b> kgCO <sub>2</sub> e/liter	<b>-0.2%</b>	Defra
	Paper Consumption	<b>939.000</b> kgCO <sub>2</sub> e/ton	<b>928.600</b> kgCO <sub>2</sub> e/ton	<b>-1.1%</b>	Defra
	Water Consumption	<b>0.344</b> kgCO <sub>2</sub> e/m <sup>3</sup>	<b>0.344</b> kgCO <sub>2</sub> e/m <sup>3</sup>	---	Defra
	School Bus and Shuttle Bus Services (Distance covered)	<b>0.120</b> kgCO <sub>2</sub> e/(passenger.k m)	<b>0.123</b> kgCO <sub>2</sub> e/(passenger.k m)	<b>2.3%</b>	Defra
	Public Transportation to and from TOBB ETU	<b>0.120</b> kgCO <sub>2</sub> e/km	<b>0.120</b> kgCO <sub>2</sub> e/km	<b>2.3%</b>	Defra
	Transportation to and from TOBB ETU using Personal Vehicles	<b>0.189</b> kgCO <sub>2</sub> e/km	<b>0.184</b> kgCO <sub>2</sub> e/km	<b>-2.5%</b>	Defra

### 3.4.3- Calculation of Greenhouse Gas Emissions

TOBB ETU's absolute greenhouse gas emission inventory was calculated using the data provided by the TOBB ETU administrative staff and service contractors (School and Shuttle Bus Services) and the relevant emission factors derived from international sources. For calculation of the amount of emissions per capita, the number of University members consisting of the sum of academicians, students, and administrative staff was used.

### 3.4.4- Data Integrity and Quality

#### TABLE 3- Data Source Analysis

SCOPE	EMISSION SOURCE	ACTIVITY DATA	SOURCE
Scope 1	Natural Gas Consumption (Heating and Hot Water)	Primary Data	TOBB ETU Administrative Staff
	Fuel Consumption of School Vehicles (Diesel Oil)	Primary Data	TOBB ETU Administrative Staff
	Fugitive Emissions (Air Conditioner – R410 A)	Primary Data	TOBB ETU Administrative Staff
Scope 2	Purchased Electricity	Primary Data	TOBB ETU Administrative Staff
Scope 3	Fuel Consumption of Rental Vehicles (Diesel Oil)	Primary Data	TOBB ETU Administrative Staff
	Paper Consumption	Primary Data	TOBB ETU Administrative Staff
	Water Consumption	Primary Data	TOBB ETU Administrative Staff
	School Bus and Shuttle Bus Services (Distance covered)	Secondary Data	Service Bus Company
	Public Transportation to and from TOBB ETU	Secondary Data	Survey
	Transportation to and from TOBB ETU using Personal Vehicles	Secondary Data	Survey

 Weak

 Can be improved

 Adequate

### 3.5- Greenhouse Gas Emission Sinks

It has been determined that there are about 2,000 trees, including fruit trees, ranging in age from 1 to 15 within the TOBB ETU campus. Even though TOBB ETU staff takes care of these trees, which are scattered in the campus, they are not added into the inventory as emission sinks, since it is not possible to perform the required methodological monitoring.

No other emission sink was detected.

## 4- CARBON FOOTPRINT OF TOBB ETU

### 4.1- Greenhouse Gas Emissions by Scope

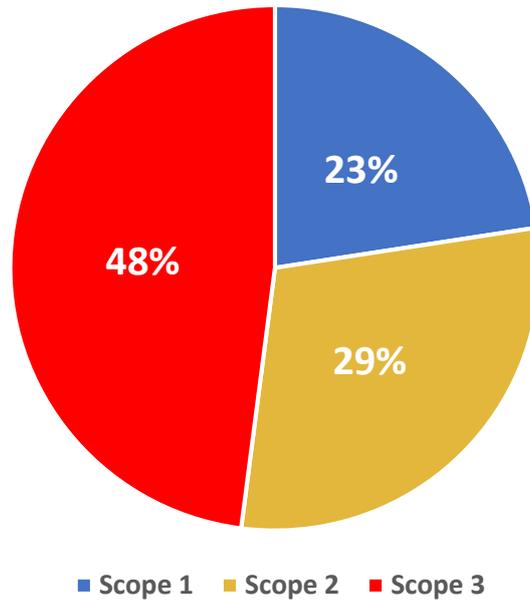
**Table 4- Greenhouse Gas Emissions by Scope**

SCOPE	EMISSION SOURCE	2016 (tCO <sub>2</sub> e)	2017 (tCO <sub>2</sub> e)	CHANGE (%)	
Scope 1	Natural gas	4010.11	3753.14	-6.41%	
	Vehicles Owned by TOBB ETU	70.89	66.15	-6.69%	
	Fugitive Emissions	0.00	0.00	0.00%	
Scope 2	Electricity	4830.54	4993.83	3.38%	
Scope 3	Rental Cars	16.68	20.06	20.26%	
	Paper	19.01	16.02	-15.76%	
	Water	28.48	34.26	20.29%	
	Transportation to Campus	Service	3189.67	3262.32	2.28%
		Public Transportation	1038.04	1111.91	7.12%
Automobile		3600.51	3676.52	2.11%	
Total	Scope 1 Total	4081.00	3819.28	-6.41%	
	Scope 2 Total	4830.54	4993.83	3.38%	
	Scope 3 Total	7892.39	8121.09	2.90%	
	General Total	16803.94	16934.21	0.78%	
Intensity	Number of People:	7081	7416	4.7%	
	Emission Per Capita	2.37	2.28	-3.78%	

Total greenhouse gas emissions for 2017 amounted to 16,934.21 tCO<sub>2</sub>e. Total emission amount has increased by 130.27 tCO<sub>2</sub>e compared to the previous year emissions, which are considered as the base year. Proportionally, this increase is below 1%. Considering especially the 4.7% increase in the total number of people in TOBB ETU, improvement has been made in reducing greenhouse gas emissions.

When 2017 and 2016 emissions are compared based on the scopes, Scope 1 emissions were reduced by 261.72 tCO<sub>2</sub>e (6.41%), Scope 2 emissions were increased by 163.30 tCO<sub>2</sub>e (3.38%), and Scope 3 emissions were also increased by 228.70 tCO<sub>2</sub>e (2.90%).

Figure 4- Distribution of GHG Emissions by Scope



Focusing on 2017, approximately 48% of all greenhouse gas emissions were due to Scope 3 activities. In the forthcoming years, Scope 3 emissions are expected to surpass 50% upon inclusion of other emission sources that fall into Scope 3 (see, Section 5.1) into the inventory.

#### 4.1.1- Scope 1: Direct greenhouse gas emissions

**Natural gas:** Almost all of the Scope 1 emissions are due to natural gas consumption. The total share of other emission sources is less than 2%. Therefore, even though there was a 3.4% increase in the natural gas emission factor (see, Table 2), reduction of natural gas consumption by 9.5% had ensured that the total greenhouse gas emissions of 2017 remained at the same level with the total greenhouse gas emissions of 2016.

**Vehicles Owned by TOBB ETU:** The share of emissions caused by the vehicles owned by the school within Scope 1 is 1.7% for both 2017 and the base year, 2016. The amount of emissions caused by school vehicles in the year 2017 had decreased by 4.74 tCO<sub>2</sub>e, from 70.89 tCO<sub>2</sub>e to 66.15 tCO<sub>2</sub>e, when compared to the base year inventory.

**Fugitive Emissions:** The only measurable-monitorable fugitive emission source within the organizational and operational boundaries of TOBB ETU is the R410A gas which is used for air conditioners. No emission of R410A gas was monitored during the years of 2016 and 2107, covering the reporting periods.

#### 4.1.2 - Scope 2: Energy indirect greenhouse gas emissions

**Electricity:** Since vapour, heat, etc. are not purchased to be used within TOBB ETU organizational and operational boundaries, all of the Scope 2 emissions consist of emissions originating from electricity

consumption. Moreover, electricity consumption is the second largest source of emission, forming approximately 30% of total greenhouse gas emissions.

When compared to the year 2016, emissions from electricity consumption increased by 163.30 tCO<sub>2</sub>e, which is 3.38%. The amount of this increase is greater than the sum of all remaining emissions, excluding the two main emission sources in the inventory, natural gas and transportation to campus. Since there is no difference in the emission factors used for both 2016 and 2017, the only reason in increase of emissions due to electricity consumption is directly the increase in electricity consumption. Furthermore, TOBB ETU contains the world's largest water turbine test and design center with 3.0 MW consumption and 2.1 MW recovery capacity, and it is predicted to have significantly increased electricity consumption and thus greenhouse gas emissions when this facility starts operation with full capacity.

#### 4.1.3 - Scope 3: Other indirect greenhouse gas emissions

**Rental Vehicles:** Generally, rental vehicles are used for the needs that occur within the context of projects implemented in TOBB ETU. Among total greenhouse gas emissions, the share of greenhouse gas emissions caused by rental vehicles is 0.1%, which is negligible.

**Paper:** The amount of greenhouse gas emissions caused by paper consumption is almost as low as the emissions caused by rental vehicles. As a result these emissions are also negligible. The main reason for the reduction in greenhouse gases originating from paper use in 2017 compared to 2016 is due to the fact that Electronic Document Management System (EDMS) is completely put into use starting from 2017.

**Water:** Greenhouse gas emissions due to water consumption, which was 28.48 tCO<sub>2</sub>e in the base year had increased by 20.29% in 2017 to 34.26 tCO<sub>2</sub>e. As the emission factor remained constant between 2016 and 2017, the reason for the increase in these emissions is directly the 20.29% increase in water consumption. The ratio of greenhouse gas emissions due to water consumption to Scope 3 emissions is 0.4%, and the ratio to total emissions is 0.2%.

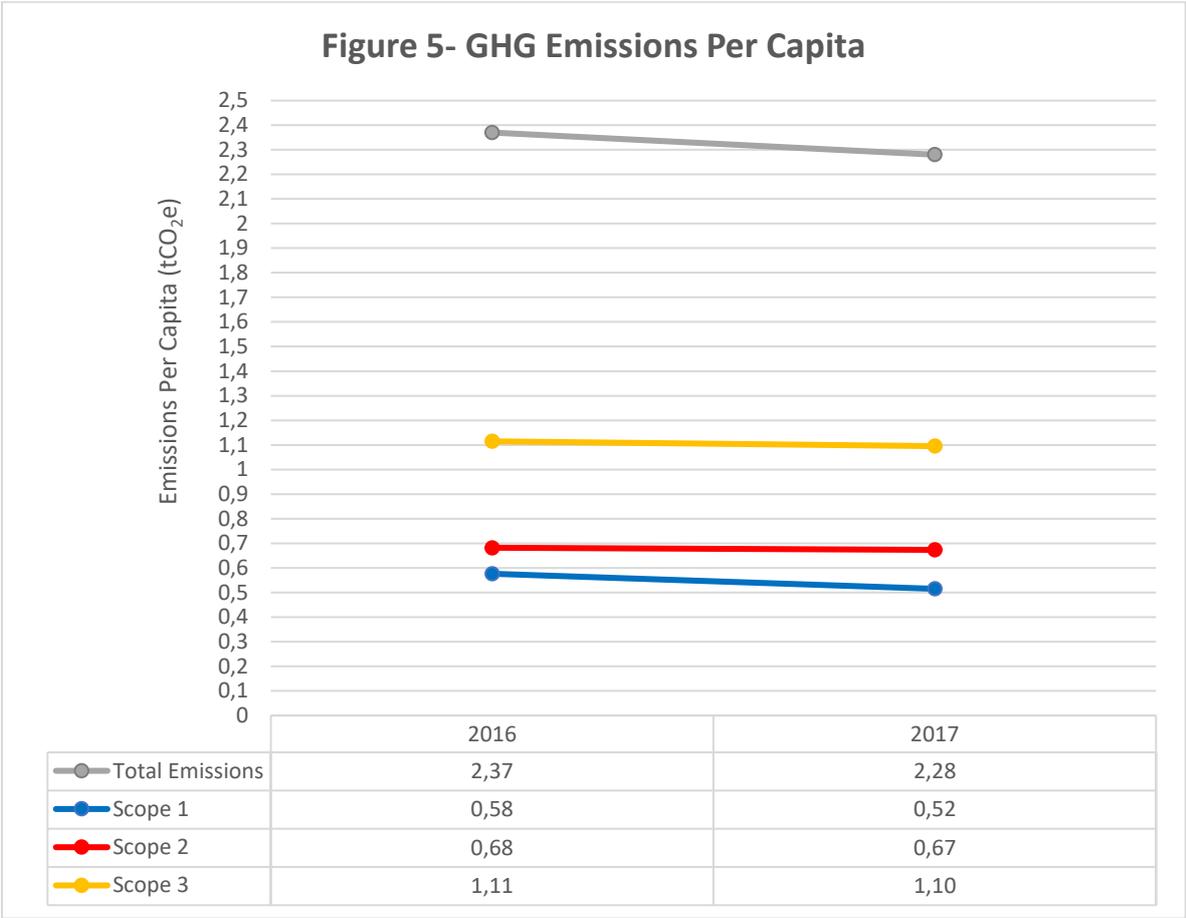
**Transportation to Campus:** It is the greenhouse gas emissions originating from transportation of TOBB ETU members using motor vehicles from their residences to the campus and vice versa. Total emissions for transportation to campus were 7828.22 tCO<sub>2</sub>e in 2016, which increased by 2.8% in 2017 to 8050.75 tCO<sub>2</sub>e. The greenhouse gas emissions originating from transportation to and from the campus account for 47.5% of the total emissions and 99% of the Scope 3 emissions. With these rates, it constitutes the largest source of emissions in total inventory. In this source of emission, which is analyzed under three sub-sections, the greatest emission is caused by automobile transportation, and service buses and public transportation come second and third. Vehicle preference of TOBB ETU members in transportation is also parallel with this order.

## 4.2- Emission Intensity

For each educational institution, activities that cause greenhouse gases are different from each other due to reasons such as their geographical location, scale, and the age of the institution. In addition, inventory scope and reporting methodologies may also vary. As a result, it is quite difficult to establish

a reference point for one-to-one comparison in terms of greenhouse gas emission performances of different institutions. In order to make the most objective assessment in this regard, a reference point should be established by considering the indicators within the institution.

TOBB ETU is a University that renews and develops itself every year. Within short periods of time, new academic units are added to the university, and as a result, the number of students, academicians, and administrative staff also increase. Accordingly, increase in greenhouse gas emissions is inevitable due to activities performed to meet the academic and social needs of the increasing population. For this reason, it would be appropriate to evaluate the increasing amount of emissions in direct proportion to the increasing population.



The term "emission intensity" refers to greenhouse gas emissions per capita. As can be seen in Figure 5, the per capita emissions of TOBB ETU have declined in both total emissions and in all scopes individually, when compared to the base year. While total emissions, Scope 2 emissions, and Scope 3 emissions increased by 0.78%, 3.38%, and 2.90%, respectively, and Scope 1 emissions decreased by 6.41%, the number of TOBB ETU members increased by 4.7%. As a result of these data, total per capita emissions decreased by 2.38% from 2.37 tCO<sub>2</sub>e to 2.28 tCO<sub>2</sub>e, while the per capita Scope 1 emissions decreased by 10.64% from 0.58 tCO<sub>2</sub>e to 0.52 tCO<sub>2</sub>e, per capita Scope 2 emissions decreased by 1.29% from 0.68 tCO<sub>2</sub>e to 0.67 tCO<sub>2</sub>e, and per capita Scope 3 emissions decreased by 1.75% from 1.11 tCO<sub>2</sub>e to 1.10 tCO<sub>2</sub>e.

## 5- RECOMMENDATIONS AND TARGETS

### 5.1- Recommendations for Scope Extension and Enhancing Data Quality

While examining carbon footprint inventory of TOBB ETU, it is seen that data on Scope 1 (natural gas, school vehicles, and fugitive emissions/air conditioning gases) and Scope 2 (electricity) activities were monitored regularly, and data quality was adequate. On the other hand, suggestions are given below for monitoring emission sources in future reporting periods in order to increase the number of activities included in Scope 3 and prepare a more comprehensive carbon footprint inventory, and to improve the quality of accessible data:

#### a) Emissions sources included in this report;

**Paper consumption:** Emissions from paper consumption are calculated using invoice data. However, such consumables used for office consumption may not be used completely within the year of purchase, and some of the consumables remain to be used the following year. It is recommended that this type of consumables should be delivered to the staff together with the storage output record so as to be able to see the year of consumption more clearly.

**Service Vehicles:** Fuel consumption of the service vehicles used by the TOBB ETU members to provide campus access, or the mileage of the vehicles must be obtained in writing from the company providing the service.

#### b) Emission sources not included in this report

**Waste:** Although a registration system has been established for generated hazardous wastes, these data could not be added to the inventory since they are recorded without any separation. In order to calculate the emissions of hazardous wastes, they should be classified and stored separately (e.g. oil, battery, plastic, etc.) and for liquid wastes, weight measurement unit should be used, as well.

Moreover, in order to allow addition of emissions originating from non-hazardous wastes to the inventory, the weights of the wastes sent to solid waste collection centers and recycling facilities are required to be recorded separately.

**Business trips and accommodation:** In order to be able to add this activity to the inventory, the trips made and accommodation used by the staff needs to be recorded taking into account the following aspects;

For business trips;

- Type of trip (airline, highway, or railway)
- Departure-arrival terminals or city information

For accommodation:

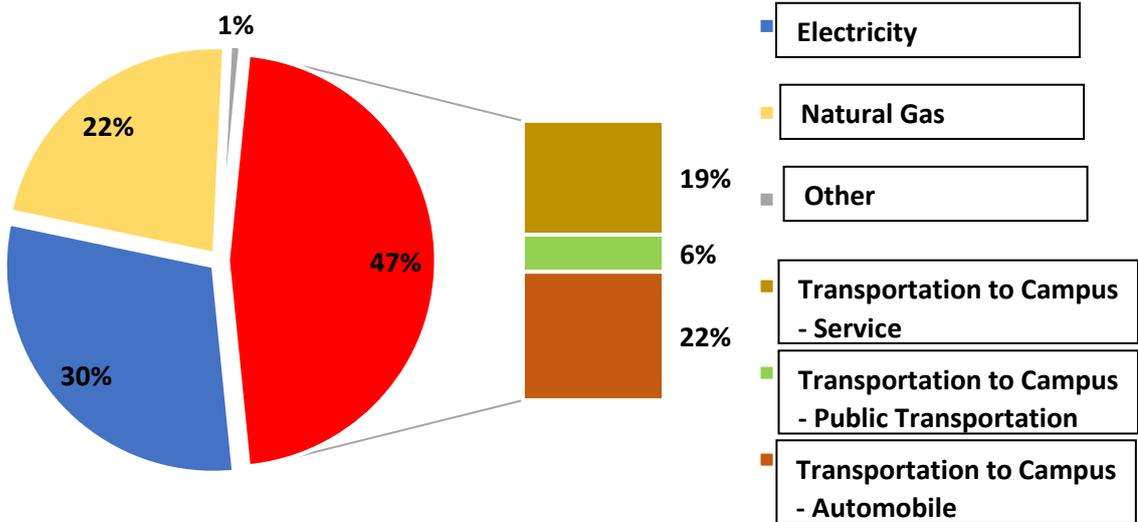
- Number of rooms used for accommodation
- Country information of the accommodation

**Courier:** The number of deliveries must be recorded and the average emission value per shipment must be requested from service provider companies.

## 5.2- Recommendations for Reducing Greenhouse Gas Emissions

When the greenhouse gas emission sources in the inventory are examined individually and independent from the scopes, it is seen that the main emission load of TOBB ETU originates from transportation to campus, electricity consumption, and natural gas consumption, respectively.

Figure 6- Main Emission Sources



As shown in Figure 6, these emission sources constitute 99% of the total emissions. Therefore, these emission sources should be focused on to achieve a scalable reduction in greenhouse gas emissions.

**Electricity:** Emissions from purchased electricity form 30% of total emissions. Raising awareness of TOBB ETU members about saving electricity and ensuring their autocontrol is quite important for reducing the emissions caused by electricity consumption.

Another method of reducing emissions originating from electricity consumption is to make use of renewable energy sources. As a result of the analyses based on data and observation, it is determined that the roofs of the buildings located within the TOBB ETU campus have a minimum area of 10.000 m<sup>2</sup>, which is suitable for production of electricity from solar energy. According to the pre-feasibility study made by Metosfer Enerji Mühendislik ve Meteoroloji Hizmetleri Ticaret Ltd. Şti., which provides consultancy services for meteorological measurement and renewable energy projects, a solar energy-based power generation plant with a production capacity of 1.5 MW can be established on this field. As a result of establishing such a facility, it is predicted that annual electricity generation would be 2021 MWh. As a result of supplying such amount of electricity from a renewable source, greenhouse gas emissions originating from electricity consumption will be reduced by 20%.

Preliminary feasibility studies including investment costs, ROI, and other technical information can be examined in detail in Section 6.1.

**Natural gas:** In order to reduce emissions due to natural gas, first of all, technical consultancy service must be received to assess the situation and boiler sealing should be checked. Apart from this, the habit of periodically using stack gas analyzer should be formed, and the boiler water temperature should not be kept higher than needed. Boiler water should be supplemented with discharged water and this water should be kept at a temperature as high as possible.

**Transportation to Campus:** These are the emissions that have the largest share in the greenhouse gas inventory of TOBB ETU. Students and staff must be encouraged to use service buses in order to ensure reduction in these emissions. Optimal service bus routes and numbers should be determined by conducting a mapping study especially for the regions where students live.

Necessary measures should also be taken in reducing paper and water consumption, even though they do not take up as much space as the main emission sources among total greenhouse gas emissions. It should be remembered that the raw materials of paper are among of the most significant instruments in the fight against climate change, trees, which have very high carbon-storing capacity. Water resources are the most significant and vital resources that are affected from the climate change.

### 5.3- Targets for Reducing Greenhouse Gas Emissions

In parallel with the climate strategies and targets set by the European Commission, until 2030, TOBB ETU aims to;

- Obtain 27% of the energy it consumes, from renewable energy sources, and
- Ensure 27% energy saving by energy efficiency applications.

Another fundamental target of the European Commission is to cut its greenhouse gas emissions by 40% by 2030, compared with 1990 levels. TOBB ETU had only started its education activities in 2004, and preparation of first GHG inventory was initiated with this report. Therefore, the required reference point to compare with the 1990 is not available. However, as a result of realizing the above mentioned targets and outcomes of the stakeholder meetings, TOBB ETU aims to reduce its GHG emissions by 20% by 2030, compared with 2016 levels. On the other hand, TOBB ETU aims to train students who have awareness of climate change and aims to create a wider impact on reduction of greenhouse gas emissions by indirectly raising this awareness also in the institutions where its graduates are involved.

Within the next 12 years, projects will be produced to achieve these goals and efforts will be made to access the financing required to realize these projects.

## 6- ANNEXES

### 6.1 Preliminary Feasibility Study on TOBB ETU Rooftop Solar Power Plant