

**2019 Accounting Report on Carbon  
Emission Consumption for International  
Campus, Zhejiang University**

**January 2020**

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## **1 Preface**

International Campus, Zhejiang University is always committed into pilot tasks to lead the green campus construction in China. In 2019, the Library and the Learning and Teaching Building North A of the International Campus had been awarded the LEED O+M platinum certification. This means that the International Campus, Zhejiang University, has become the first university in the world that have passed the LEED v4.1 ARC platinum certification. Moreover, it has obtained the ECO-CAMPUS gold certification, becoming the first university in China that certified as ECO-CAMPUS. This report will directly show International Campus carbon emission and carbon intensity through accounting on both direct and indirect greenhouse gas emissions and energy consumption to encourage more teachers and students to pay attention to climate change, and to join this green campaign.

## **2 Introduction of International Campus, Zhejiang University**

International Campus, Zhejiang University (International Campus for short) located in Haining, Zhejiang Province, with covering area of 666,667m<sup>2</sup> (1000mu) and building area of 399,300m<sup>2</sup>. It was officially opening in November 2016, and by December of 2019, it has 498 faculties and staff and 1087 full-time students (181 international students), including 804 undergraduate students, 193 graduate students and 90 doctoral students.

## **3 Report Year & Period**

This report is for 2019, from January to December.

## **4 Accounting Boundaries**

Campus carbon emissions accounting is based on two boundaries, organizational boundaries and operational boundaries. The organizational boundaries on International Campus are consistent with its geographical boundaries; the operational boundaries include making estimates to direct or indirect carbon emissions about International Campus. Explanations are as follows:

- Scope 1  
It accounts for direct greenhouse gas (GHG) emissions from sources that are owed or controlled by International Campus, principally the result of production of heat by boilers.
- Scope 2  
It accounts for indirect GHG emissions associated with generation of purchased electricity caused by activities such as teaching and academic research.
- Scope 3

It allows for the treatment of other indirect GHG emissions that are a consequence of activities of International Campus but occur from sources not owned or controlled by the campus, such as materials purchasing, employee commuting, business travel and so on.

This report will not calculate GHG emissions of hydrofluorocarbons (HFCs) of scope 1 and scope 3, because of inadequate equipment and incomplete statistics approaches. GHG emissions identification form is as below:

**GHG Emission Sources Identification Form 4-1**

Operational Boundaries	Emission Source Types	Main Emission Sources	Energy Consumption	GHG	Accounting
Scope 1: direct GHG emissions	Stationary combustion sources	Boiler	Natural gas	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Yes
	Stationary combustion sources	Canteen	Natural gas	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Yes
	non-stationary combustion sources	Shuttle Buses	Diesel	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Yes
	non-stationary combustion sources	Official business vehicle	gasoline	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Yes
		Air-conditioning and extinguisher	Refrigerant	HFCs	No
Scope 2: indirect GHG emissions	Purchased electricity	Lighting, air-conditioning and related facilities	Power	CO <sub>2</sub>	Yes
Scope 3: other indirect GHG emissions	non-stationary combustion sources	On and off campus commuting transportation excluding shuttle bus and official business vehicle	gasoline	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	No
	non-stationary combustion sources	Airplane, train, bus and ship (business travel)	Gasoline, diesel and power	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	No

## 5 Energy Consumption Activity Level Calculation

Calculation range: all buildings of the campus construction.

### 5.1 Emission Sources and Energy Consumption Activity Level Calculation

### 2019 International Campus Main Emission Sources Calculation Form 5-1

Operational Boundaries	Main Emission Sources	Types of Energy	Unit	Consumption Amount	Record Approach
Scope 1: direct GHG emissions	Boiler	Natural gas	NM <sup>3</sup>	181,800	Gauge table
	Canteen	Natural gas	NM <sup>3</sup>	38,800	Gauge table
	Shuttle bus	Diesel	L	13,300	Recorded by the supplier
	Shuttle bus	Gasoline	L	27,100	Recorded by the supplier
Scope 2: indirect GHG emissions	Lighting, air-conditioning and related facilities	Power	kWh	11,432,400	Gauge table

## 5.2 Main Emission Sources and Energy Consumption in Key Buildings

In this report, we will calculate carbon emissions in detail on the following buildings to provide a strong data gist for the future measures in lowering carbon emissions.

### 2019 International Campus Energy Consumption Activity Level Calculation on Major Functional Buildings Form 5-2

No.	Building	Function	Area (m <sup>2</sup> )	Power (kWh/a)	Natural Gas (m <sup>3</sup> /a)
1	No.1 Residential College	Student accommodation	27,408	1,406,745	---
2	Academic Exchange Center	Hotel	25,296	1,174,564	---
3	Laboratory Building	Science and research	19,779	416,836	---
4	Gymnasium	Sports	14,669	350,133	4,808
5	Student Center	Canteen	12,748	1,188,160	41,468
6	Learning and Teaching Building North B	Teaching	10,750	314,599	34,968
7	Arts and Science Building	Administration	10,648	276,378	34,636
8	Learning and Teaching Building North A	Teaching	10,440	454,101	33,960
9	Library	Library	9,840	469,076	32,008
10	ZJU-UoE Institute	Science and research	8,174	992,869	---
11	ZJU-UIUC Institute	Science and research	7,238	211,209	---
12	Serviced Apartment	Faculty accommodation	5,824	195,696	---
13	Hospital	Clinic	2,130	68,116	---

## 6 Emission Factor (EF), Global Warming Potential (GWP), CO<sub>2</sub>

### Equivalent Method (CO<sub>2</sub>e)

#### 6.1 Emission Factor (EF)

Emission factor is used in greenhouse gas inventories to estimate emissions from materials in a certain measurement, which links the activity level data with GHG emissions. Power EF is based on *Announcement of Emission Factor for China's Regional Power Grid Baseline in 2015* by Climate Change Department subordinated to National Development and Reform Commission; coal EF is based on *Evaluation Guide Rules of Recycle Energy Buildings Model Application Projects*; other EF data are guided by energy heat values from the page 283 of *China Energy Statistical Yearbook of 2008* and calculation values from GHG default emission coefficient of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2.

**Typical Emission Factors and Related Introduction Form 6-6-1**

Type	EF			Guideline
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	
Power	81,120 tCO <sub>2</sub> / (kWh)	--	--	EF value form re Regional Power Grid Power EF in East China in the Page 4 of <i>Announcement of Emission Factor for China's Regional Power Grid Baseline in 2015</i> by Climate Change Department subordinated to National Development and Reform Commission
Coal	2.47 tCO <sub>2</sub> /t	--	--	<i>Evaluation Guide Rules of Recycle Energy Buildings Model Application Projects</i>
Natural gas	209,000 tCO <sub>2</sub> /m <sup>3</sup>	$3.73 \times 10^{-4}$ tCH <sub>4</sub> /ten thousand m <sup>3</sup>	$3.73 \times 10^{-5}$ tN <sub>2</sub> O /ten thousand m <sup>3</sup>	Chapter 3 of GHG default emission coefficient of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2
Vehicle gas	226,000 tCO <sub>2</sub> /L	$8.16 \times 10^{-3}$ tCH <sub>4</sub> /ten thousand L	$2.61 \times 10^{-3}$ tN <sub>2</sub> O /ten thousand L	GHG default emission coefficient of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2
Vehicle diesel	273,000 tCO <sub>2</sub> /L	$1.44 \times 10^{-3}$ tCH <sub>4</sub> /ten thousand L	$1.44 \times 10^{-3}$ tN <sub>2</sub> O /ten thousand L	GHG default emission coefficient of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2
Liquefied petroleum gas (stationary)	175,000 tCO <sub>2</sub> /L	0.278 tCH <sub>4</sub> /ten thousand L	0.0278 tN <sub>2</sub> O /ten thousand L	GHG default emission coefficient of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2

Vehicle	$3.641 \times 10^{-5}$ tCO <sub>2</sub> /km	--	--	2010 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting: Annex 6 Passenger Transport Conversion Tables:22 of 35,Table 6k
Train	$3.641 \times 10^{-5}$ tCO <sub>2</sub> /km	--	--	2010 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting: Annex 6 Passenger Transport Conversion Tables:22 of 35,Table 6k
Airplane	$2.052 \times 10^{-4}$ tCO <sub>2</sub> /km	--	--	2010 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting: Annex 6 Passenger Transport Conversion Tables:22 of 35,Table 6l

## 6.2 Global Warming Potential (GWP)

Global warming potential (GWP) is a measure of how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon, relative to CO<sub>2</sub>. The GWP of CO<sub>2</sub> is 1. The GWP in this report is from *2007 IPCC Guidelines for National Greenhouse Gas Inventories*.

**Global Warming Potential Form 6-2**

GHG	Molecular Formula	GWP
Carbon dioxide	CO <sub>2</sub>	1
Methane	CH <sub>4</sub>	25
Nitrous oxide	N <sub>2</sub> O	298

Data from the 4<sup>th</sup> 2007 IPCC Evaluation Report

## 6.3 Carbon Dioxide Equivalence (CO<sub>2</sub>e)

CO<sub>2</sub>e is an abbreviation of 'carbon dioxide equivalence' and is the internationally recognized measure of greenhouse emissions.

International Campus CO<sub>2</sub>e equation:  $CO_2e = GHG_i \times GWP_i$

GHG<sub>i</sub> means the emission amount of greenhouse gas type i and the measurement unit is ton;

GWP<sub>i</sub> means the GWP of greenhouse gas type i.

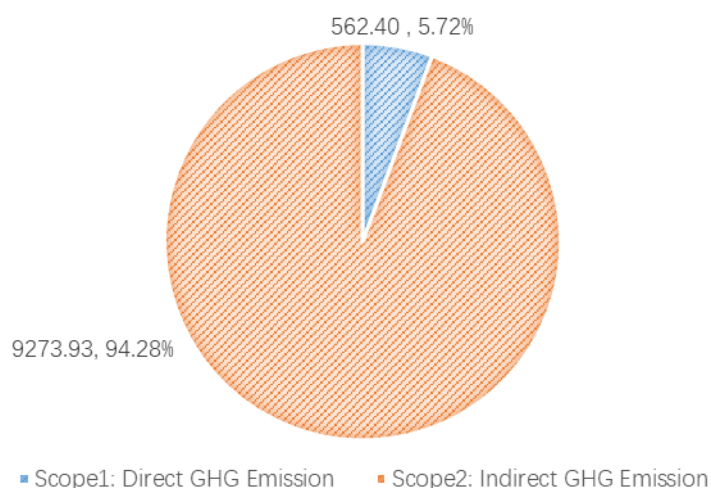
# 7 Campus Carbon Emissions (Greenhouse Gas Emissions) List

## 7.1 Campus Carbon Emissions (Greenhouse Gas Emissions) List

### 1 Total Campus Carbon Emissions (Greenhouse Gas Emissions)

GHG emissions on International Campus in 2019: CO<sub>2</sub> 9,832.60 tons, CH<sub>4</sub> 0.0323 tons, N<sub>2</sub>O 0.0098 tons, equivalent to CO<sub>2</sub>e 9,832.64 tons. The direct GHG CO<sub>2</sub>e is 562.40 tons, including sources such as natural gas of canteen and heat for teaching, learning and academic buildings in winter, diesel of shuttle bus and oil of official business vehicles; the indirect GHG CO<sub>2</sub>e is mainly from purchased electricity, about 9,273.93 tons.

Details are listed as the below forms:



**International Campus GHG Emission Graph 7-1**

**International Campus GHG Emission Form 7-1**

Operational Boundaries	Sources	Type	Unit	Annual Consumption Reported	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
Scope 1 Direct GHG Emission	Boiler	Natural gas	NM <sup>3</sup>	181,800	3,800,600	68	7
	Canteen	Natural gas	NM <sup>3</sup>	38,800	810,600	14	1
	Shuttle bus, official business vehicles	Diesel	L	13,300	362,800	19	19
	Shuttle bus, official business vehicles	Oil	L	27,100	612,500	221	71
Scope 2 Indirect GHG Emission	Lighting, air-conditioning and related facilities	Purchased electricity	kWh	11,432,400	92,739,300	0	0

**International Campus GHG Emission List Form 7-2 (Scope)**

Emission Scope	Scope 1 Direct GHG Emission	Scope 2 Indirect GHG Emission	Total Emission
Amount (t)	562.40	9,273.93	9,836.33
Percentage %	5.72	94.28	100

**International Campus GHG Emission List Form 7-3**

Emission	GHG			Total Emission
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	



Emission (t)	9,832.60	0.0323	0.0098	--
GWP	1	25	298	--
CO <sub>2</sub> e (t)	9,832.60	0.8065	2.9236	9,836.33
Percentage %	99.96	0.01	0.03	100

## 2 International Campus Carbon Emission Intensity

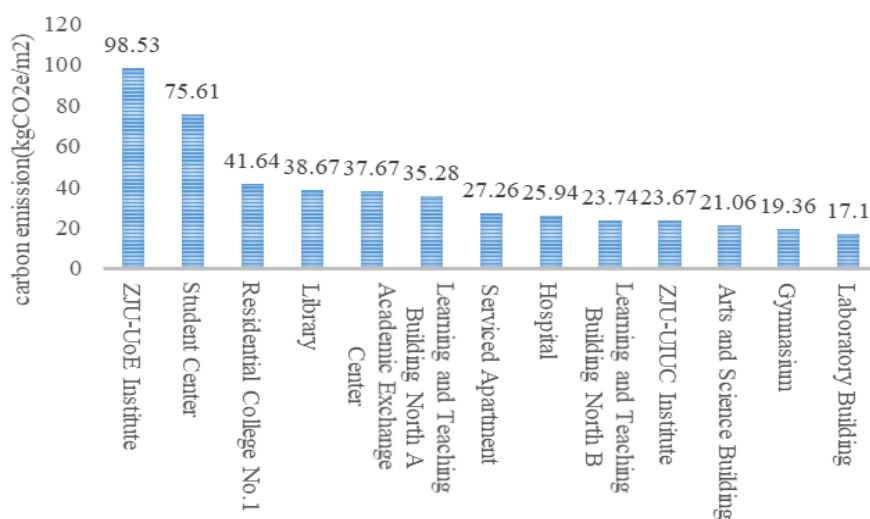
In 2019, the average CO<sub>2</sub>e is 9.05t accounted on students, 6.20t on faculty and students, 24.62kg per square meter of campus construction and 11.49kg per square meter of floor area. Details are as below:

**International Campus GHG Emission List Form 7-4 (per unit)**

Emission	GHG			Total Emission
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	
CO <sub>2</sub> e Emission (t)	9,832.60	0.8065	2.9236	9,836.33
Student's average CO <sub>2</sub> e (t)	9.05	0.0000	0.0000	9.05
CO <sub>2</sub> e (t) on faculty and students	6.20	0.0000	0.0000	6.20
CO <sub>2</sub> e (t) /m <sup>2</sup> of campus construction	33.14	0.0020	0.0073	24.63
CO <sub>2</sub> e /m <sup>2</sup> of floor area	14.75	0.0009	0.0034	11.49

## 7.2 Greenhouse Gas Emissions List of Key Buildings

Buildings contributed most to total energy consumption and average carbon emission of campus construction has been reported. Key accounting construction area is 164,944m<sup>2</sup>, which includes 41.31% of construction area that put in use and 68.48% of total carbon emission. The maximum average carbon emission intensity of campus construction is from ZJU-UoE Institute, about 98.53kg CO<sub>2</sub>e/m<sup>2</sup>. Detail forms are as below:



**Key Buildings' Average Carbon Emission Bar Graph 7-2**

**2019 Carbon Emission List of Key Buildings on International Campus Form 7-5**

No.	Building	Construction Area (m <sup>2</sup> )	Power (kWh/a)	Total CO <sub>2</sub> Emission (t)	Per Construction Area (kg CO <sub>2e</sub> /m <sup>2</sup> )
1	ZJU-UoE Institute	8,174	992,869	805.42	98.53
2	Student Center	12,748	1,188,160	963.84	75.61
3	Residential College No.1	27,408	1,406,745	1,141.15	41.64
4	Library	9,840	469,076	380.51	38.67
5	Academic Exchange Center	25,296	1,174,564	952.81	37.67
6	Learning and Teaching Building North A	10,440	454,101	368.37	35.28
7	Serviced Apartment	5,824	195,696	158.75	27.26
8	Hospital	2,130	68,116	55.26	25.94
9	Learning and Teaching Building North B	10,750	314,599	255.20	23.74
10	ZJU-UIUC Institute	7,238	211,209	171.33	23.67
11	Arts and Science Building	10,648	276,378	224.20	21.06
12	Gymnasium	14,669	350,133	284.03	19.36
13	Laboratory Building	19,779	416,836	338.14	17.10
	Total	164,944	7,518,482	6,098.99	36.98