Center
of Excellence
for Sustainability

GREEN HOUSE GAS (GhG) INVENTORY COVERING SCOPE 1/2/3 EMISSIONS FOR 2016-2017 FISCAL YEAR

SUMMARY

The American College of Greece conducted a Green House Gas Inventory with the following aims:

- Quantify current GhG emissions in relation to Scope1, Scope 2 and Scope 3
- Establish a baseline for the monitoring of GhG emissions.

The results presented in this report follow the philosophy and guidelines of the European Investment Bank namely:

- **Completeness:** All relevant information should be included in the quantification of a project's GHG emissions and in the aggregation to the total induced GhG footprint. This is to ensure that there are no material omissions from the data and information that would substantively influence the assessments and decisions of the users of the emissions data and information.
- **Consistency:** The credible quantification of GhG emissions requires that methods and procedures are always applied to a project and its components in the same manner, that the same criteria and assumptions are used to evaluate significance and relevance, and that any data collected and reported allow meaningful comparisons over time.
- **Transparency:** Clear and sufficient information should be provided to allow for assessment of the credibility and reliability of reported GhG emissions. Specific exclusions or inclusions should be clearly identified and assumptions should be explained. Appropriate references should be provided for both data and assumptions. Information relating to the project boundary, the explanation of baseline choice, and the estimation of baseline emissions should be sufficient to replicate results and understand the conclusions drawn.
- **Conservativeness:** Conservative assumptions, values, and procedures should be used. Conservative values and assumptions are those that are more likely to overestimate absolute emissions and underestimate negative relative emissions.
- **Balance:** Balance means that the data set should reflect both the positive and negative aspects of GHG emissions performance to enable users to make a reasoned assessment of overall performance.
- **Accuracy:** Uncertainties with respect to GhG measurements, estimates, or calculations should be reduced as far as is practical, and measurement and estimation methods should avoid bias. Where

accuracy is sacrificed, data and estimates used to quantify GHG reductions (relative emissions) should be conservative.

This report follows the Green House Gas (GhG) protocol for activity data. Excel files provided by the GHG were used for Scope 1 emissions calculation. Whenever more than one recent emission factors were found in the literature, conservative values and assumptions that are more likely to overestimate absolute emissions were applied. Assumptions for uncertainty assessment and measurements were to follow the GHG protocol standard which can be found at http://www.ghgprotocol.org/sites/default/files/ghgp/ghg-uncertainty.pdf

RESULTS

SCOPE 1 EMMISIONS 2017 INVENTORY

Table 1 provides GWPs for different refrigerants as a reference.
Table 2 provides default lifetimes, assembly leak rates, annual leak rates, and disposal recovery factors from IPCC Good Practice.

Clearly state in the final report if different values than the default factors are used, including their source.

Cell color code:
Mandatory user entry:
Optional user entry:
Default value:
Auto calculated value:

Step 1: Determine Annual Net HFC and PFC Emissions from Assembly/Installation of Refrigeration/AC Equipment

Step 1.1	Step 1.2	Step 1.3	Step 1.4	Step 1.5	Step 1.6		Step 1.7
A	B	C	D	E	F	G	H
Refrigeration/Air-Conditioner Equipment Name	**Number of Units**	**Type of Refrigerant**	**GWP of Refrigerant**	**Original Refrigerant Charge in Each Unit (kilograms)**	**Assembly/Installation Emission Factor**	**Conversion Factor (tonnes/kilograms)**	**Assembly Emissions (tonnes of CO2 equivalent/yr)**
Optional		Optional	See Table 1	See Table 2	See Table 2		B x D x E x F x G
Heat Pumps	12	R-410A	2088	17.00	1%	1.00E-03	4
Central Chiller unit	11	R-410A	2088	17.00	1%	1.00E-03	4
Air Handing unit	32	R-410A	2088	4.00	1%	1.00E-03	3
Central Dehumidifier unit	1	R-410A	2088	17.00	1%	1.00E-03	0
VRV	30	R-410A	2088	7.00	1%	1.00E-03	4
Split	129	R-410A	2088	2.30	1%	1.00E-03	3
Total							19

Please insert more rows as necessary.

Please insert more rows for equipment types as necessary.

Step 2: Determine Net Gross HFC and PFC Emissions from Operation of Refrigeration/AC Equipment

Step 2.1	Step 2.2	Step 2.3	Step 2.4	Step 2.5	Step 2.6		Step 2.7
A	B	C	D	E	F	G	H
Refrigeration/Air-Conditioner Equipment Name	**Number of Units**	**Type of Refrigerant**	**GWP of Refrigerant**	**Refrigerant Charge (kilograms)**	**Annual Leakage Rate (%)**	**Conversion Factor (tonnes/kilograms)**	**Operation Emissions (tonnes of CO2 equivalent/yr)**
Optional		Optional	See Table 1	See Table 2	See Table 2		B x D x E x F x G
Heat Pumps	12	R-410A	2088	17.00	3%	1.00E-03	13
Central Chiller unit	11	R-410A	2088	17.00	7%	1.00E-03	27
Air Handing unit	32	R-410A	2088	4.00	3%	1.00E-03	8
Central Dehumidifier unit	1	R-410A	2088	17.00	3%	1.00E-03	1
VRV	30	R-410A	2088	7.00	3%	1.00E-03	13
Split	129	R-410A	2088	2.30	3%	1.00E-03	19
Total							81

Please insert more rows as necessary.

Step 3: Determine Annual Net HFC and PFC Emissions from Disposal of Refrigeration/AC Equipment

Step 3.1	Step 3.2	Step 3.3	Step 3.4	Step 3.5	Step 3.6	Step 3.7	Step 3.8	Step 3.9		Step 3.10
A	B	C	D	E	F	G	H	I	J	K
Refrigeration/Air-Conditioner Equipment Name	**Number of Units**	**Type of Refrigerant**	**GWP of Refrigerant**	**Original Refrigerant Charge (kilograms)**	**Annual Leakage Rate (%)**	**Time since last recharge (years)**	**Recycling Efficiency (%)**	**Destruction (kilograms)**	**Conversion Factor (tonnes/kilograms)**	**Disposal Emissions (tonnes of CO2 equivalent/yr)**
Optional			See Table 1	See Table 2	See Table 2		See Table 2			((B x E) x (1 - (F * G)) x (1 - H)-I)* D * J
Heat Pumps	12	R-410A	2088	17.00	3%	7.00	70%	8.50	1.00E-03	87.68
Central Chiller unit	11	R410A	2088	17.00	7%	7.00	80%	8.50	1.00E-03	22.08
Air Handing unit	32	R-410A	2088	4.00	3%	7.00	70%	2.00	1.00E-03	61.97
Central Dehumidifier unit	1	R-410A	2088	17.00	3%	7.00	70%	8.50	1.00E-03	(8.96)
VRV	30	R-410A	2088	7.00	3%	7.00	70%	3.50	1.00E-03	101.22
Split	129	R-410A	2088	2.30	3%	7.00	70%	1.15	1.00E-03	150.93
Total										414.91

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Step 4: Determine Annual Net HFC and PFC Emissions

Step 4.1	Step 4.2	Step 4.3	Step 4.4
A	B	C	D
Assembly Emissions	**Operation Emissions**	**Disposal Emissions**	**Total Emissions (tonnes of CO2 Equivalent)**
Result of Step 1	Result of Step 2	Result of Step 3	A + B + C
19	81	414.91	515

	2016-2017	**Base Line Year 2014-2015**
Gross Scope 1 GhG emissions from stationary combustion	515.0 Mg CO_2 Equivalent	552.0 Mg CO_2 Equivalent

SCOPE 2 EMMISIONS 2017 INVENTORY

Scope 2 Emissions incorporate date from electricity consumption and from the consumption of Natural Gas

3888.12 MWh (this value was provided by ACG for the base year 2016-2017) x 0.876 $KgCO_2$ -e/KWh = 3888.12 x103 KWh x 0.876 Kg CO_2 -e/KWh = 3405993.12 Kg CO_2 -e = 3405.9931 metric tons CO_2 -e.

3057.22 MWh (this value was provided by ACG for the base year 2016-2017) x 0.2019598 Kg CO_2 -e/KWh = 3057.22 x103 KWh x 0.2019598 Kg CO_2 -e/KWh=617435.5397 Kg CO_2 -e = 617.4355 metric tons CO_2 -e.

	2016-2017	**Base Line Year 2014-2015**
Gross Scope 2 GHG emissions from purchased electricity	3,405.99	3,465.88
Gross Scope 2 GHG emissions from other sources	617.455	425.68
Total Scope 2 Emmisiions	4,023.44 Mg CO_2 Equivalent	3,891.56 Mg CO_2 Equivalent

Calculation of aggregate uncertainty for Scope 2 emissions according: (a) indirect uncertainty (+/- 20%), (b) direct uncertainty (+/- 2%). We assume a low direct uncertainty due to the fact that ACG has the technology to measure electricity consumption directly in KWh as opposed to measuring KWh indirectly through electricity bills.

SCOPE 3 EMISSIONS 2017 INVENTORY

BUISNESS TRAVEL

For air travel emissions, based on the air ticket booking data provided by ACG and ALBA and assuming an emission factor of 0.21937f Kg $CO_{2\ -e}$ per passenger Km, which is the average of the emissions for a short haul airliner such as the Boeing 737 and a larger one such as the Airbus A300. Based on these assumptions we find for the year 2015-2016 for air travel:

Air travel emissions Deere-Pierce campus	12.797
Air travel emissions ALBA	10.073
Total Business travel Scope 3 Emissions	22.87 Mg CO_2 Equivalent

To compensate for taking the average value, we assume uncertainty +/- 20%. It is usually the case that air travel emissions do not vary significantly between years as long as the number of employees remains relatively the same. Thus, we can assume the same air travel emissions for the year 2016-2017.

COMMUTING

Total Buses	892.248
Total Cars	380.041
Grand Total Vehicles	1,272.289 Mg CO_2 Equivalent

Data Sourses: Source for diesel-powered transportation: Bureau of Transportation, National Transportation Statistics for 2000. Source for CNG-powered transportation: Multiplies diesel (urban) emissions per unit by 56/73.9, the ratio of CO_2 emissions per terrajoule, natural gas to diesel. Emission factors are based on lower heating values. They are sourced from Revised IPCC, 1996, Vol. 2, Table 1-2.