

GC Greenhouse Gas Report (Y2020)



**PTT Global Chemical Public Company Limited
(6 May 2021)**

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GHG REPORT FOR GC GROUP IN Y2020

1. General

1.1. Background

PTT Global Chemical Public Company Limited (GC) has developed a corporate Greenhouse Gas (GHG) management program as a proactive initiative to respond to international and domestic pressures and to help the world in combating climate change.

1.2. Standards for GHG Inventory Preparation

GC prepared a GHG inventory that takes account of the international standards based on international GHG estimation standards such as, ISO 14064-1:2006, Greenhouse Gas Protocol (developed by WBCSD/ WRI, 2004), Compendium of Greenhouse Gas Emission Methodologies for the Oil and Natural Gas Industry (developed by API, 2009), IPCC Guidelines for National Greenhouse Gas Inventories (developed by IPCC, 2006) and Thailand Greenhouse Gas Management Organization (Public Organization).

1.3 Responsible for GHG Inventory

- 1) Corporate GHG accounting team responsible to consolidate GHG data provided by the facilities will want to explore.
- 2) Facility staff responsible for reporting facility-level data to corporate should read the following sections.

1.4 Reporting Period

This inventory report contains information related to GC GHG emissions the period 1st January to 31st December 2020 the total GHG emissions by scope, within our organizational boundary.

2. Organizational boundary

2.1. General

GC consists of a number of companies with differentiated business activities. Therefore, there is need in a standardized and systematic procedure for compiling GHG emission data for the GC group that can be sustained over the long term and that will improve data quality for the group.

GC Greenhouse Gas Emission Accounting and Reporting Manual is an all-encompassing organizational GHG accounting manual for reference by all facilities under GC corporate GHG management program.

2.2. Setting the organizational boundary

GC Manual uses the Operational Control approach for GHG accounting. Under the Operational Control approach, an organization accounts for GHG emissions from operations

where it has full control over (all or nothing). The Operational Control gets by:

- 1) GC owns 100 % in equity share of the Company; or
 - 2) GC is the majority shareholder.
- Joint Venture as well as oversea facilities are not covered.

For the purpose of reporting up to the Global Reporting Initiative (GRI), Dow Jones Sustainability Index (DJSI), Carbon Disclosure Project (CDP) and GC using the Operational Control approach.

2.3. Greenhouse Gas Selection

Under the Kyoto Protocol, six greenhouse gases have been selected based on the significant estimated volume in the atmosphere due to anthropogenic activities, and the significant potential for reduction. Countries which ratified the Protocol have committed to reduce the “basket-of-six” greenhouse gases, which include; Carbon dioxide (CO₂), Methane (CH₄), Nitrous oxide (N₂O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF₆).

At the time of this report no official decision had been made yet by IPCC on what source of global warming potentials (GWP) values should be used in the second commitment period. This manual adopts the American Petroleum Institute (API 2009, p.3-6) guidance on GWP selection. The API (2009) prescribes the use of IPCC Second Assessment Report (SAR) until the end of the Kyoto Protocol 1st Commitment Period (31st December 2012), and the use of IPCC AR4 GWP values beyond 2012.

This report accounts for GHGs considered under the Kyoto Protocol, and the following Non-Kyoto GHG: Hydrofluorocarbons (HFCs) and CFC use in refrigeration. These compounds are to be phased out under the Montreal Protocol, and GC will account for its use and report any reduction initiatives. However, GWP of these GHGs will not be accounted for in the GHG Inventory.

3. GHG Inventory Component and List of Facility

3.1 General

In line with ISO 14064-1, the organization shall document the following, where quantified, separately at facility and organization levels:

- Direct GHG emissions for each GHG;
- GHG removals;
- Energy indirect GHG emissions;
- Other indirect GHG emissions; and
- Direct CO₂ emissions from the combustion of biomass (biogenic emissions).

The organization should document separately at facility and organization levels other categories of GHG emissions and removals as appropriate.

3.2 Identification and Categorization of GHG Sources and Sinks

The organization shall, as appropriate, categorize the identified GHG sources following the categorization published by the GHG Protocol / ISO 14064:1 as follows:

3.2.1 Scope 1: Direct GHG Emissions

- Any fossil fuel combustion activity at stationary sources (captive power plants, process heaters, engines, turbines, flares, incinerators, oxidizers). This is normally for the generation of energy – e.g. Electricity, heat or steam;
- Process and vented emissions (process vents, equipment vents, maintenance /turnaround activities, non-routine activities).
- Any fossil fuel combustion of fuels in company owned or controlled vehicles (transportation of raw materials/products/waste; company owned vehicles);
- Fugitive emissions from pressurized equipment – e.g. Refrigeration chillers and SF₆ containing electrical switchgears, wastewater treatment etc.); and
- Accidental releases of GHG from equipment failure including those attributed to acts of nature or sabotage.

3.2.2 Scope 2: Energy Indirect GHG Emissions

- Consumption of purchased electricity, heat or steam supplied to the group by an external entity outside of the Organizational Boundary.

3.2.3 Scope 3: Other Indirect GHG Emissions

- Scope 3 emissions are any type of emissions which occur outside of the Organizational Boundary of GC.
- GC refer calculated to the Scope 3 Standard for requirements and guidance related to Technical Guidance for Calculating Scope 3 Emissions by GHG Protocol.

3.3 List of Facility

No.	Name	Business Unit	Location
1	GC 1 (RO)	Office building	59, Ratniyom Road, Noenphra, Mueang Rayong, Rayong 21150, Thailand.
2	GC 2 (I-1)	Olefins	14, I-1 Road, Tambol Maptaphut, Amphur Mueang Rayong, Rayong 21150, Thailand.
3	GC 2 (UT)	Utilities	
4	GC 2 (HDPE)	Polymers	
5	GC 3 (I-4)	Olefins	9, I-4 Road, Map Ta Phut Industrial Estate, Map Ta Phut, Mueang Rayong, Rayong 21150, Thailand.
6	GC 4 (ARO 1)	Aromatics	4, I-2 Road, Map Ta Phut Industrial Estate, Map Ta Phut, Mueang Rayong, Rayong 21150, Thailand.
7	GC 5 (ARO 2)	Aromatics	98/9, Rayong High way 3191, RIL Industrial Estate, Maptaphut District, Rayong 21150, Thailand.
8	GC 6 (REF)	Refinery	8, I-8 Road, Map Ta Phut Industrial Estate, Map Ta Phut, Mueang Rayong, Rayong 21150, Thailand.
9	GC 7 (BTF)	Jetty & Buffer Tank Farm	19 Rong Pui Road, Map Ta Phut, Mueang Rayong, Rayong 21150, Thailand.
10	GC 8 (ATF1)	Tank Farm	11, I-4 Road, Map Ta Phut Industrial Estate, Map Ta Phut, Mueang Rayong, Rayong

No.	Name	Business Unit	Location
			21150, Thailand.
11	GC 9 (LAB)	Lab Center	24/9, Pakorn Songkrorat Road, Map Ta Phut, Mueang Rayong, Rayong 21150, Thailand
12	GC 10	Office building	555/1 Energy Complex, Building A, 3rd , 10th Floor, Vibhavadi Rangsit Road, Chatuchak, Chatuchak, Bangkok 10900, Thailand
13	GC 11 (PE)	Olefins	8 Padaeng Road, Maptaphut Amphur Mueng Rayong, Rayong 21150, Thailand.
14	GC 11 (LDPE)	Polymers	
15	GC 11 (LLDPE I)	Polymers	
16	GC 11 (LLDPE II)	Polymers	
17	GC 12 (BPE)	Polymers	8, I-10 Road, Map Ta Phut Industrial Estate, Map Ta Phut, Muang Rayong, Rayong 21150, Thailand.
18	GC 13 (INNO)	Innovation building	83/9-10 Moo 5, Tambon Thap Ma, Muang Rayong, Rayong 21000 Thailand.
19	GC14 (Maintenance)	Office building	32 Rong Pui Road, Map Ta Phut, Mueang Rayong, Rayong 21150 Thailand.
20	GC Glycol (EO/EG)	EO-Based	9 Soi G-12 Pakorn Songkhraorat Road, Tambon Map Ta Phut Amphur Muang Rayong, Rayong 21150, Thailand.
21	GC Glycol (EA)	EO-Based	
22	GGC (Plant I)	Green Chemicals	8, Pakornsongkhorat Road, Map Ta Phut, Muang Rayong, Rayong 21150, Thailand.
23	GGC (Plant II)	Green Chemicals	199/1 Moo 2, Khao Sok, Nong Yai, Chon Buri 20190, Thailand
24	TTT	Jetty & Buffer Tank Farm	19 I-1 Road, Map Ta Phut, Muang Rayong, Rayong Province 21150, Thailand.
25	GCME	Office building	22/2 Pakornsongkoraj Rd. T.Maptaput, A.Mueang, Rayong 21150, Thailand.
26	NPC S&E	Office building	20/9 Pakorn Songkhraorat Road, Tambon Map Ta Phut Amphur Muang Rayong, Rayong 21150, Thailand.
27	NPCSG	Office building	20/9 Pakorn Songkhraorat Road, Tambon Map Ta Phut Amphur Muang Rayong, Rayong 21150, Thailand
28	GCS (GC Stryrenics)	Polymers	7 I-1 Rd., Map Ta Phut Industrial Estate, Map Ta Phut, Muang Rayong, Rayong 21150, Thailand.
29	ENCO (Head Office)	Office building	555/1 Energy Complex, Building A, 14th-18th Floor, Vibhavadi Rangsit Road, Chatuchak, Chatuchak, Bangkok 10900, Thailand.
30	GCPC (Phenol I & II)	Phenol	9 Soi G9 Hemaraj eastern Industrail Eastern Pakornsongkrohraj,Rd Map Ta Phut Rayong 21150, Thailand.
31	GCPC (BPA)	Phenol	
32	GCL (GC Logistics)	Polymer Logistics	<u>Head Office</u> 555/1, A Building, Energy Complex, 8 Fl., Vibhavadi Rangsit Rd., Chatuchak, Bangkok 10900, Thailand. <u>International Distribution Center</u>

No.	Name	Business Unit	Location
			48 Rongpui Rd., Maptaphut, Muang, Rayong 21150, Thailand.
33	GCM (GC Marketing)	Office building	555/1 Energy Complex, Building A, 9th Floor, Vibhavadi Rangsit Road, Chatuchak, Chatuchak, Bangkok 10900 Thailand 10900
34	PTTAC	High Value Specialty	8 Phangmuang Chapoh 3-1 Road, Huaypong Sub-district, Muang District, Rayong 21150 Thailand.
35	PTTMCC	Bio-plastics	3/1 moo 2 Asia Industrial
36	HMC (PDH)	Polymers	Hemaraj Eastern Industrial Estate, 19 Soi G-12, Pakorn Songkro Radh Rd. Map Ta Phut, Muang Rayong 21150, Thailand
37	HMC (PP)	Propylene	Map Ta Phut Industrial Estate, 6 Moo 8, I-1 Road, Map Ta Phut, Muang Rayong 21150, Thailand
38	GCMTPA	Polymers	8 Pakorn Songkhraorat Road, Tambon Map Ta Phut Amphur Muang Rayong, Rayong 21150, Thailand
39	TPRC	Polymers	18, Soi G-2 Pakorn Songkhraorat Road, Tambon Map Ta Phut Amphur Muang Rayong, Rayong 21150, Thailand
40	GC Corporate	Corporate	Bangkok and Rayong

4. GHG Reporting and Accounting

4.1. General

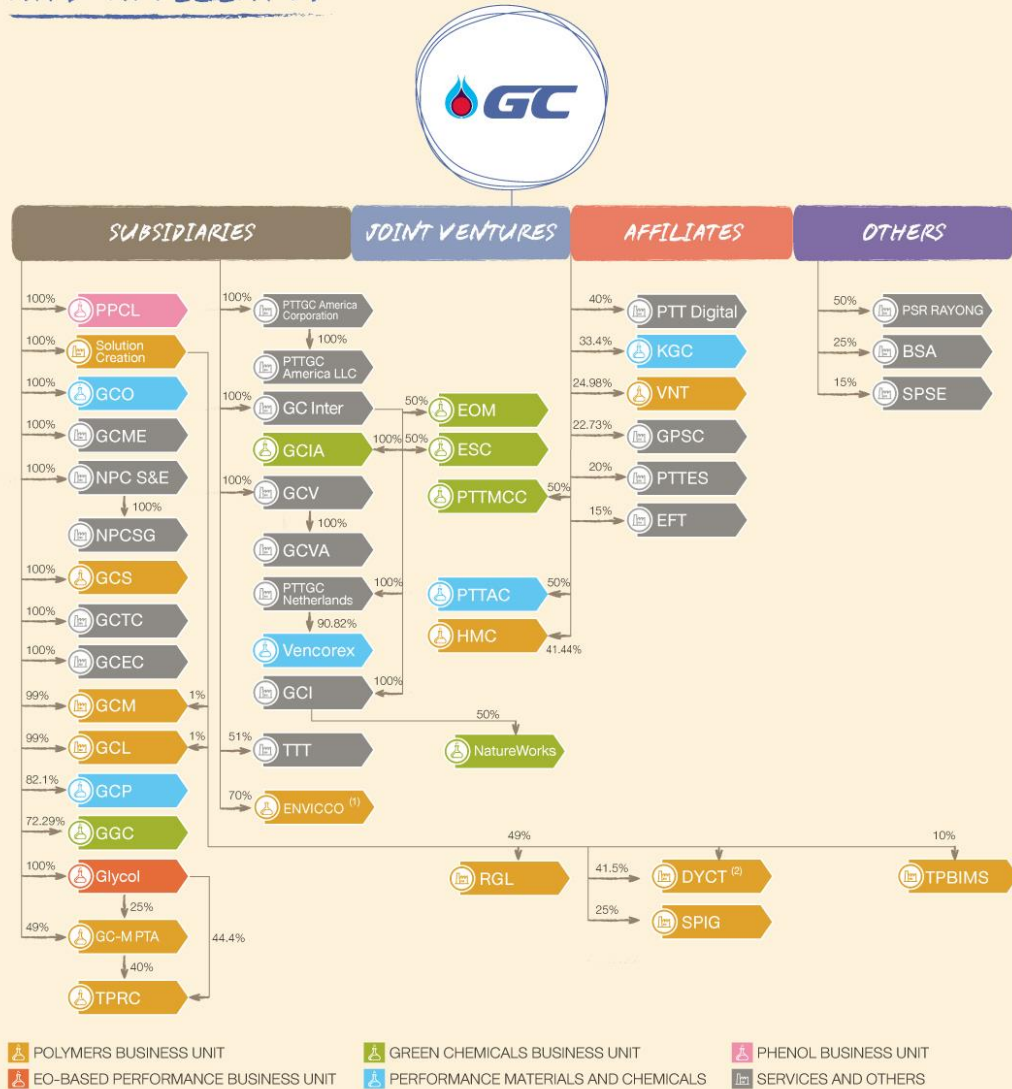
GC uses the Operational Control approach for GHG accounting. Under the Operational Control approach, an organization accounts for GHG emissions from operations where it has full control over (all or nothing). For GHG accounting will be reported the site location within Thailand only. The Operational Control gets by:

- 1) GC owns 100% in equity share of the Company; or
- 2) GC is the majority shareholder.

For GPSC, combined GHG Emission in the PTT, Not including in operational control approach for GHG accounting in GC Group.

For GGC owns 100% in equity share of the TEX Company. It's not including in operational control approach for GHG accounting in GC Group.

SHAREHOLDING STRUCTURE IN SUBSIDIARIES AND AFFILIATES

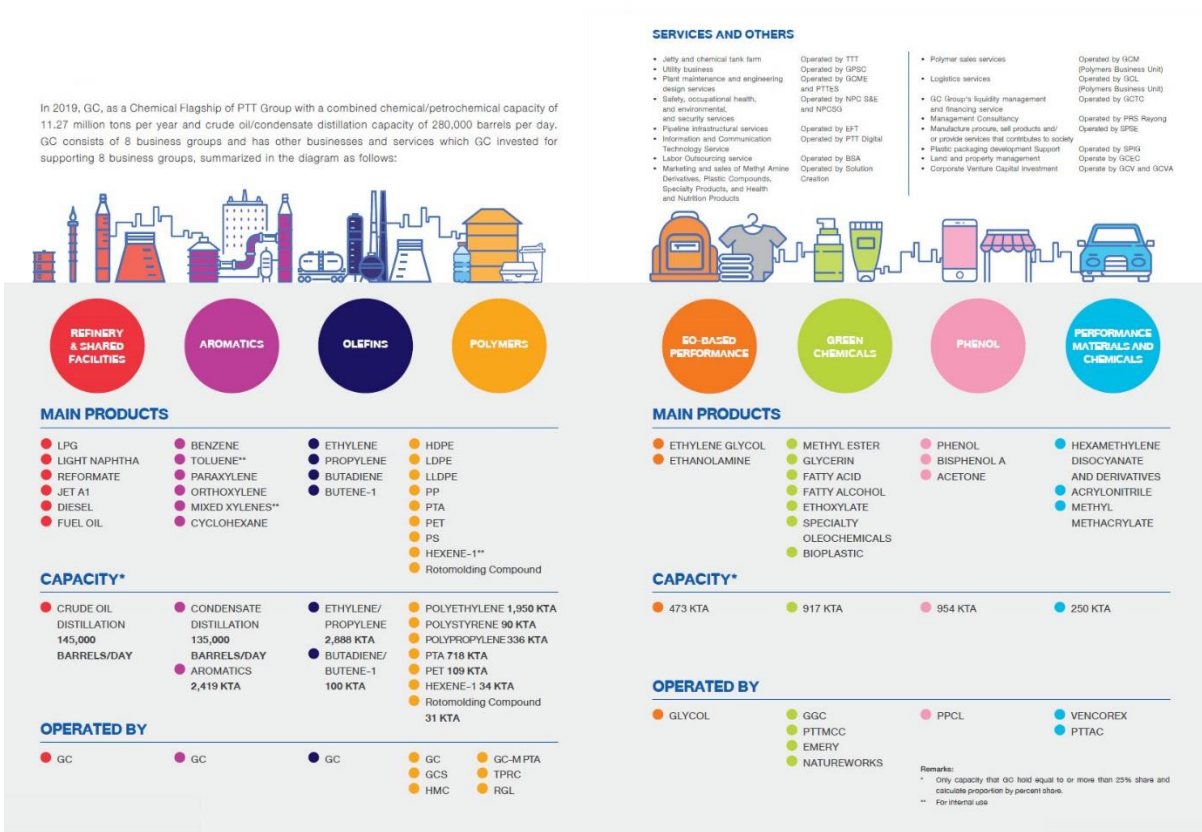


Remarks: Significant change in the shareholding structure in subsidiaries and affiliates from 1 January 2020 to 15 February 2021

1. February 3rd, 2020: ENVICCO was established, as a result GC held 70% shares in ENVICCO.

2. July 31st, 2020: The company invested in DYCT through Solution Creation, as a result holding 41.5%

Organizational Structure of GHG Reporting and Accounting



Structure Business of GC Group

4.2. De Minimis of GHG Sources

GC applies the following De Minimis provision:

- De Minimis represents GHG emitting activities which in aggregate forms less than 5% of the company's total aggregated GHG emissions. De Minimis emissions may be quantified once at the start of the GHG accounting exercise and the value may be used for GHG reporting in subsequent years. A recalculation of the GHG emissions for these De Minimis sources should be repeated at least once in 7 years, or when changes to the system which significantly affects the GHG emitting characteristics of the activity is implemented.
- GC De Minimis includes the GHG emitting activities that required huge effort and insignificant impact to GHG emission as follows:
 - Welding and cutting in Workshop area:** Welding and cutting activity is occasionally taken place in workshop area, approximately 0.0001% of total GHG emission. Electricity consumption in Workshop is already included in scope 2 (Energy indirect greenhouse gas emission), while the use of acetylene is omitted.

- **Afforestation & Reforestation:** GHG reduction approach due to afforestation and reforestation activity is now being reviewed and will be evaluated as soon as possible.
- **Fertilizer used:** Fertilizer is mainly used for plantation in factories within GC group. However, the group gardening is serviced by external contractors, as well as fertilizing is controlled in their scopes of work, approximately 0.0002% of total GHG emission.
- **CH₄ Generated from toilet:** CH₄ generated from toilet is not practically measurable. Though, approximately 0.0001% of total GHG emission could be calculated following: 6.2.2 Domestic wastewater, Chapter 6, IPCC 2006 Vol 5. The quantification shows very slightly significant impact to the total GHG.
- **LPG using to start-up flare:** Flare system commonly uses LPG for starting up the system, after that natural gas and flare gas are continuously consumed for pilot flare. Thus, LPG used to start-up flare is ignored since very less consumption, approximately 0.0001% of total GHG emission.

4.3. Biogenic CO₂ Emissions

Biogenic emissions are direct CO₂ emissions from biologically sequestered carbon (e.g., CO₂ from burning biomass/biofuels). These emissions shall be quantified and reported separately from the Scopes. Biogenic emissions occur in all types of biomass, biofuels, and biogas. Biogenic CO₂ should only contain that part of the fuel that relates to the quantities of biofuel and not to the total volume of liquids into which the biofuels are blended (if blended).

5. GHG Emissions Sources

5.1. General

GC Group estimated the GHG emissions based on direct GHG emissions, energy indirect GHG emissions, and other indirect GHG emissions as the operational boundaries.

- **Direct GHG emissions (Scope 1)** refer to the GHG generated from the emission sources possessed or controlled by GC Group. They include emissions from
 - **Process and vented emissions** from: CO₂ Separation, Ethylene production, Other process and Vent emission.
 - **Fugitive emission** from: Use of HFCs and SF₆, Wastewater Treatment Plant and Other facilities.
 - **Emission from combustion**: Flare combustion, Coke combustion, Mobile fuel combustion and Stationary fuel combustion.

- **Energy indirect GHG emissions (Scope 2)** refer to the amount emitted as a result of GC Group activities, although their emission sources are possessed or controlled by other companies. Generally, they include emissions from
 - Electricity purchased
 - Steam purchased
- **Other indirect GHG emissions (Scope 3)** refer to the amount indirect emissions which are a consequence of the activities of the GC Group, but occur from sources that are neither owned nor controlled. The identified categories of scope 3 GHG emissions to related with business are (Refer to Technical Guidance for Calculating Scope 3 Emissions (version 1.0) by GHG Protocol):
 - Categories 1- Purchased goods and service: Emissions of main raw material and Water withdrawal
 - Categories 4- Upstream transportation and distribution: Main raw material pipeline transportation and Electric power transmission and distribution losses
 - Categories 5- Waste generated in operations: End-of-Life Waste Treatment (Landfill & Incineration & Wastewater treatment)
 - Categories 6- Business travel: Employee air travel
 - Categories 9- Downstream transportation and distribution: Polymer products
 - Categories 10- Processing of sold products: Polymer products
 - Categories 11- Use of sold product: Sold product for (Diesel, LPG, Jet Fuel, Marine Fuel oil, Kerosene, Propane, Butane) and Biodiesel (B100)
 - Categories 12- End-of-life treatment of sold product: Polymer products

5.2 Break down of GHG emissions

1) Break down of GHG emissions by facility

Facility Name	Scope 1 (t-CO ₂ eq)	Scope 2 (Location based) (t-CO ₂ eq)	Scope 2 (Market based) (t-CO ₂ eq)	Scope 3 (t-CO ₂ eq)	Total (t-CO ₂ eq)
GC 1 (RO)	1,931	2,755	0	0	4,686
GC 2 (I-1)	400,011	0	0.00	0	400,011
GC 2 (UT)	1,421,667	5	10,384	0	1,432,057
GC 2 (HDPE)	87	0	0	0	87
GC 3 (I-4)	765,326	0	130,417	0	895,743
GC 4 (ARO 1)	337,133	0	197,438	0	534,572
GC 5 (ARO 2)	679,153	0	275,822	0	954,975
GC 6 (REF)	947,024	2,354	0	0	949,378
GC 7 (BTF)	2,194	0	0	0	2,194
GC 8 (ATF)	17,719	0	197	0	17,916
GC 9 (LAB)	10	0	3,242	0	3,253
GC 11 (PE)	801,633	0	153,338	0	954,971
GC 11 (LDPE)	6,292	0	98,756	0	105,048

Facility Name	Scope 1 (t-CO ₂ eq)	Scope 2 (Location based) (t-CO ₂ eq)	Scope 2 (Market based) (t-CO ₂ eq)	Scope 3 (t-CO ₂ eq)	Total (t-CO ₂ eq)
GC 11 (LLDPE)	10,113	0	104,664	0	114,776
GC 12 (BPE)	1,438	1,368	21,632	0	24,438
GC 13 (INNO 2)	0	138	0	0	138
GC Glycol (EO/EG)	45,855	0	104,601	0	150,456
GC Glycol (EA)	0	0	8,207	0	8,207
GGC Plant I	193	0	65,607	0	65,801
GGC Plant II	27,523	4,913	0	0	32,436
TTT	2,622	0	0	0	2,622
PTTME	814	509	0	0	1,323
NPC S&E	400	301	0	0	701
GCS (TSCL)	3,625	0	0	0	3,625
ENCO (Head Office)	0	332	0	0	332
GCPC (Phenol)	11,243	0	317,124	0	328,367
GCPC (BPA)	3	0	132,245	0	132,249
GC Logistics (PTTPL)	2,235	395	7,735	0	10,364
GC 13	0	138	0	0	138
GC Corporate & Scope 3	2,925	0	0	31,932,632	2,925
HMC (PDH)	71,537	0	211,298	0	282,835
HMC (PP)	24,573	0	0	0	24,573
PTT AC	123,523	20	26,301	0	149,844
PTT MCC	7,370	6,007	0	0	13,377
GC 14	0	138	0	0	138
GCM-PTA	142,975	0	94,634	0	237,609
TPRC	23,329	0	15,729	0	39,058
GC Group	5,882,480	19,234	1,979,371	31,932,632	7,881,085

2) Break down GHG emissions by Activity

Activity	GHG Emissions (t-CO ₂ eq)	%
Scope 1		
CO ₂ Separation	114,321	2.46%
Ethylene Production	286,124	4.86%
Other Process and Vented Emissions	842	0.01%
Fugitive emissions of SF ₆ and HFCs	4,454	0.08%
Fugitive Emissions from Waste Water Treatment Plants	0	0.00%
Fugitive Emissions from Facilities	2,173	0.04%
Flare Combustion	138,136	2.35%
Mobile Fuel Combustion	6,979	0.12%
Stationary Fuel Combustion	5,293,504	89.99%
Coke Combustion	5,947	0.10%
Total Scope 1	5,882,480	100.00%
Scope 2		
Location-based	19,234	0.96%
Market-based	1,979,371	99.04%
Total Scope 2	1,998,605	100.00%
Scope 3		
Categories 1- Purchased goods and service: Emissions of main raw material and Water withdrawal	4,561,799	14.22%

Activity	GHG Emissions (t-CO ₂ eq)	%
Categories 4- Upstream transportation and distribution: Main raw material pipeline transportation and Electric power transmission and distribution losses	146,509	0.46%
Categories 5- Waste generated in operations: End-of-Life Waste Treatment (Landfill & Incineration & Wastewater treatment)	31,805	0.10%
Categories 6- Business travel: Employee air travel	1,391	0.004%
Categories 9- Downstream transportation and distribution: Polymer products	31,900	0.10%
Categories 10- Processing of sold products: Polymer products	1,632,836	5.09%
Categories 11- Use of sold product: Sold product for (Diesel, LPG, Jet Fuel, Marine Fuel oil, Kerosene, Propane, Butane) and Biodiesel (B100)	25,083,219	78.19%
Categories 12- End-of-life treatment of sold product: Polymer products	589,289	1.84%
Total Scope 3	32,078,748	100.00%

5.3 GHG Emissions Summary

GC Group's total Scope 1 GHG Emission including GHG emitted within the organizational boundary is **5,882,480 tCO₂eq**, accounted for **14.7%** of the company's total emissions.

For GC Group's total Scope 2 GHG Emission are GHG emitted in the course of purchasing electricity and steam to GC Group is **1,998,605 tCO₂eq**, accounted for **5.0%** of the company's total emissions.

For GC Group's total Scope 3 GHG Emission excluding GHG emitted from activities accounted as Scope 1 & 2 emissions in other companies within the GC Group is **32,078,748 tCO₂eq**, accounted for **82.3%** of the company's total emissions.

For CO₂ emissions from the combustion of biomass are **1,285.98 tons CO₂ equivalent**.

6. Base year

Year 2012 is nominated as a fixed base year, as it is the year where sufficiently reliable GHG data for GC is available verification. This baseline is used to compare a current year's GHG emissions. GC may decide to participate in may have a definition on what is considered significant change to the GHG inventory which trigger base year recalculation.

7. Data Quality Management Procedure

A data quality management program is essential to ensure that a GHG accounting and reporting system meet the five principles of the GHG accounting manual. In order to maintain the quality of the GC GHG Inventory, the following considerations shall be implemented in the GC GHG accounting and reporting program:

7.1 Organizational Structure

A GHG reporting organizational structure shall be developed and communicated to all employees involved in the program. All involved shall understand which department/ individual are responsible for which task, and who shall the results/ data be communicated to. The organizational structure shall include owners (department/ individual) for all activities within this program which includes but not limited to data collection, verification, consolidation, and reporting.

7.2 Data management Procedures

The four key items necessary to ensure quality of data are:

- 1) Data collection;
- 2) Data recording and retention system;
- 3) QA/QC procedure; and
- 4) Emergency procedures

The procedures for the above four items shall be outlined in more detail in each company's customized data management manual. Companies may reference ISO 14001 in developing its Data Management Manual.

7.3 Uncertainty Analysis

Uncertainty investigations can be part of a broader learning and quality feedback process. They can support a company's efforts to understand the causes of uncertainty and help identify ways of improving inventory quality. These investigations establish lines of communication and feedback with data suppliers to identify specific opportunities to improve the quality of the data and methods used.

Estimation uncertainty arises any time greenhouse gas emissions are quantified. Therefore all emission or removal estimates are associated with estimation uncertainty. Estimation uncertainty can be further classified into two types: model uncertainty and parameter uncertainty.

Model uncertainty relates to any type of modeling conducted to estimate any amount of release, for example accidental release, fugitive emissions etc. Manual estimation using professional judgment also counts within this category. If an accidental release occurred, and the site engineer estimated the release the amount by considering the time when the release occurred, stopped and flow rate, then the accuracy of the estimated time and flow of release shall be considered.

Parameter uncertainty relates to meter and/or measurement accuracy. If a flow rate meter has an accuracy of $\pm 5\%$, then data read from it will have uncertainty of $\pm 5\%$. GC may combine its parameter uncertainty information using either of the following approaches by order of preference:

First Preference: a Full Quantitative Approach

Second Preference: Simplified Quantitative Approach; and

Third Preference: a Qualitative Approach.

7.4 Emergency Procedure

An emergency procedure is related to data collection issues with respect to metering failure or human error. Procedures should be applied, in line with ISO 14001 requirement to eliminate or reduce the risk of data loss/ incomplete data collection. Compliance to ISO 14001 procedural methods is encouraged, but not mandatory.

8. GC Greenhouse Gas Statement 2020

GC here by confirms that our 2020 GHG emissions calculations have been conducted as per the GC GHG accounting and reporting manual using the corresponding GHG accounting tool version 1. Any diversions to the manual or exclusions are outlined in this assertion. This has been prepared according to ISO 14064-1:2006.

We assert that for the period 1st January to 31st December 2020 the total GHG emissions by scope, within our organizational boundary are as follows:

Scope (as defined within ISO 14064.1:2006)	GHG emissions (tons CO ₂ equivalent)				
	2012 (recalculated)	2017* (recalculated)	2018* (recalculated)	2019* (recalculated)	2020*
Direct GHG Emissions	5,744,027	6,366,353	6,083,074	6,096,523	5,882,480
Energy Indirect GHG Emissions (Market-based)	2,724,738	2,016,689	1,919,259	2,142,910	1,979,371
Energy Indirect GHG Emissions (Location-based)	27,993	8,999	9,918	13,267	19,234
Other indirect GHG emissions	2,684,944	34,342,205	34,305,808	31,003,836	32,078,748

Remarks: * In Y2017-2020, Scope 3 was added to 8 from 5 categories in Y2012.

Other indirect GHG emissions (Scope 3) included Water withdrawal, Main raw material emissions and pipeline transportation, End-of-Life Waste Treatment (Landfill & Incineration & Wastewater treatment), Employee air travel, Polymer product transportation, Fuel combustion for Diesel, LPG, Jet Fuel, Marine Fuel oil, Kerosene, Propane, Butane and Biodiesel (B100), Processing and End-of-life treatment (Polymer Product) and Electric power transmission and distribution losses.

For CO₂ emissions from the combustion of biomass are **1,285.98** tons CO₂ equivalent.

Due to the calculation of GHG in 2020 has updated in several areas such as boundary, GHG quantification methodologies. Therefore, GHG recalculation of the base year of 2012 has been recalculated as follows:

- 1) Quantification methodologies updated, change the Emission Factor from Glow supplier then calculation approach updated for GC 3, GC 4, GC 8, GCM-PTA, and TPRC.
- 2) Quantification methodologies updated, change the heating value of steam method, then calculation approach updated for GC 11 (PE).
- 3) Quantification methodologies updated, change the calculation of wastewater treatment flare to biogenic emission, then calculation approach updated for GGC (Plant I).
- 4) Quantification methodologies updated, the changing of emission factor from Glow supplier then Upstream transportation and distribution: Main raw material pipeline transportation and Electric power transmission and distribution losses (Cat 4) updated for GC 3, GC 4, GC 8, GCM-PTA, and TPRC.

In 2020, variety of activities on energy saving as follows:

- electrical measures i.e. reduce power consumption, LED lighting replacement, and modification of discharge
- heating measures i.e. steam reduction, unit optimization, and pinch technology

leading to the GHG reduction of 82,575 tons CO₂ equivalent with 172 million Thai Baht investment and 396 million Thai Baht cost saving (estimate).

GC has set target of GHG emissions reduction (Greenhouse gas emission reduction) : 1) greenhouse gas emissions intensity reduction (scope 1 and 2) by 52 percent, based on Science Based Target initiative, within 2050 compared to base year (2012), and 2) greenhouse gas emission reduction (scope 1 and 2) by 20 percent, based on BAUs, within 2030 compared to base year (2012).

In 2020, which represents are emit greenhouse gases emission (scope 1 and 2) by 7.9 million tons CO₂ equivalent and its achieve the target, and emit greenhouse gases emission intensity (scope 1 and 2) by 306 kgCO₂ equivalent per ton productions, reduce greenhouse gas emission intensity by 5.8 percent, compared to previous year.

GC ensures the selection of appropriate methodology use for data collection. The outcomes of all submitted information are in accordance with the global standard, which is also reviewed internally by senior management and externally reviewed by credible third party to ensure that applied approach is rigorous and transparent.