The Legislative Council Complex
Greenhouse Gas Accounting Report
For the Period 1 April 2018 - 31 March 2019

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1. EXECUTIVE SUMMARY

1.1 Key findings from the GHG accounting project

i. The reported greenhouse gas (GHG) emissions of the Legislative Council (the LegCo) Complex (the Complex) during the period from 1 April 2018 to 31 March 2019 totaled 8,409.76 tonnes CO_2 equivalent (CO_2-e), with Scope 2 emissions contributing to 96.89% through purchased energy. Scope 1 direct GHG emissions which include fuel combustions by vehicles, generators, Towngas equipment and fugitive emissions from refrigerant and fire suppression system made up 1.75% while Scope 3 other indirect emissions, including fresh water processing, sewage processing, waste paper and general waste sent to landfill, accounted for 1.36% of reported emissions.

ii. The GHG emission intensity of the Complex was calculated at 159.48 kg CO_2-e/m^2, based on the included construction floor area at 52,731 m^2, and 9.95 tonnes CO_2-e/person based on 845 building users.

iii. Absolute GHG emissions showed a 2.02% increase compared with the base year (1April 2013 - 31 March 2014), and a 0.56% increase compared with the previous year (1 April 2017 - 31 March 2018). The GHG performance in terms of construction floor area presented a 1.19% increase compared with the base year, as well as an increase at 0.55% compared with the previous year.

iv. Scope 1 and Scope 2 GHG emissions increased by 0.46% and 2.56% respectively compared with the base year, while Scope 3 presented a 24.86% decrement. The decrease in Scope 3 GHG emissions was mainly due to the reduction of waste paper disposal at landfill.

v. Electricity consumption was the most significant source of Scope 2 GHG emissions. While actual electricity consumption dropped slightly compared to 2017-2018 (by approximately 0.9%), the production of greenhouse gas emissions increased due to a revision of the electricity emission factor from 0.79 kg CO_2-e/kWh (2017) to 0.80 kg CO_2-e/kWh (2018).

1.2 Recommendations on carbon reduction and information management

i. The application of automated air conditioning control systems in the Complex is recommended, which can reduce redundant energy use by turning off the air conditioners when no occupants are using the facilities.

ii. Review of illumination levels, employment of two-level lighting control system is recommended to allow efficient energy use.

iii. A feasibility study on the application of anti-UV films on windows for reduced excessive heat gain through windows, increased comfort and energy saving can be carried out.

iv. Green procurement procedure is recommended to extend to water saving utilities.

v. To reduce the energy consumption of escalators, glass fibre material and non-metallic

materials for power transmission chains can be used.

vi. Installing more solar panels on available open space is also recommended.

vii. Setting up smart monitoring system to monitor real-time energy consumption is recommended.

viii. Carbon Road Map: It is recommended that the Commission engage different stakeholders to develop its reduction targets in the short, medium and long term based on a review of internal capacity and current performance.

ix. Communication and engagement: The Complex is the center of public attention. It can play a leadership role in championing the cause of combating climate change in carbon management.

- Engaging suppliers: The Commission may also lead and influence its service providers to take actions for the environment, which could provide strong support to the Commission for introducing more innovative and efficient carbon reduction measures;
- Engaging employees and users: More engagement exercises, such as incentive programmes, Green Day Events and carbon reduction competitions would encourage greater stakeholder involvement.

2. BACKGROUND

2.1 Name of the reporting entity

The Legislative Council Commission (the Commission)

2.2 Description of the reporting entity

The Commission is a statutory body established under The Legislative Council Commission Ordinance (Cap. 443).

2.3 Reporting period

1 April 2018 - 31 March 2019[1], and this is the sixth consecutive GHG reporting period for the Legislative Council Complex (the Complex).

2.4 Scope of physical boundary

(a) Location of the building

1 Legislative Council Road, Central, Hong Kong

(b) Description of the purpose of the building

The Complex is the first purpose-built building to house the Legislature of Hong Kong.

(c) Description of physical boundary with detailed information

The GHG accounting is compiled from an assessment of facilities under operational control as qualified by the Commission. The construction floor area of the Complex is 52,955 m^2 in the reporting period, comprising the Council Block, the Office Block, and the adjacent open space area, namely, the LegCo Square and the LegCo Garden. The Cafeteria, with an area of 224 m^2, is operated by an outsourced contractor. The Complex, one of the buildings of the Tamar Development Project, has achieved the Platinum rating under the Hong Kong Building Environment Assessment Method (HK-BEAM).

(d) Description of areas excluded from the GHG accounting

The contractor's operation of the Cafeteria (floor area: 224 m^2) is not under control of the Commission and therefore the Cafeteria is excluded from this GHG

[1] 1 April 2013 – 31 March 2014 has been set as the base year for the Legislative Council Complex's GHG accounting in order to compare the GHG emissions over time.

accounting report. The total floor area of the Complex covered by the GHG accounting is 52,731 m^2.

2.5 Scope of operational boundary

(a) Scope 1 - Direct GHG emissions from:

- Combustion of fuels in stationary sources – diesel used in electricity generators
- Combustion of fuels in stationary sources – Towngas used in boilers and room kit
- Combustion of fuels in mobile sources – petrol used in vehicles owned by the Commission
- Unintentional GHG release from equipment and system (fugitive emissions from fire suppression system and refrigeration/air conditioning equipment)

(b) Scope 2 - Energy indirect GHG emissions from:

- Electricity purchased from The Hongkong Electric Company Limited
- Towngas purchased from The Hong Kong and China Gas Company Limited

(c) Scope 3 - Other indirect GHG emissions from:

- Methane gas generation at landfill in Hong Kong due to disposal of paper waste
- GHG emissions due to electricity used for fresh water processing by Water Supplies Department (WSD)
- GHG emission due to electricity used for sewage processing by Drainage Services Department (DSD)
- Methane gas generation at landfill in Hong Kong due to general waste disposal

2.6 Methodologies for quantifying GHG emissions

The accounting process follows the "*Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings (Commercial, Residential or Institutional Purposes) in Hong Kong (2010)*" (EPD-EMSD Guidelines) in data collection, classification of emission source, quantification methods and the reporting format. The GHG emissions are quantified in terms of CO_2-e, and the types of GHG covered in this report are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluoro-carbons (HFCs), perfluoro-carbons (PFCs) and sulphur hexafluoride (SF_6).

(a) List of activities where simplified methodologies and conversion factors in the Guidelines are used for quantification:

- Direct emissions from stationary combustion (Scope 1)
  Emission (CO_2) = Σ Amount of fuel consumed × Emission factor of CO_2

Emission (CH_4 / N_2O) =Σ Amount of fuel consumed × Emission factor of (CH_4 / N_2O) × Relative Global Warming Potential (GWP)
where
Emission is summed over all types of fuel used by all generators and Towngas consuming devices; and
Amount of diesel consumed is in terms of litre and amount of Towngas consumed is in terms of unit.

- Direct emissions from mobile combustion (Scope 1)
  Emission (CO_2) = Σ Amount of fuel consumed × Emission factor of CO_2
  Emission (CH_4 / N_2O) =Σ Amount of fuel consumed × Emission factor of (CH_4 / N_2O) × GWP
  where
  Emission is summed over petrol used by all vehicles owned by the Commission; and
  Amount of fuel consumed is in terms of litre.

- Indirect emissions from electricity / Towngas purchased (Scope 2)
  Emission (CO_2-e) = Quantity of purchased electricity / Towngas × Emission factor
  where
  Purchased electricity is measured in kilowatt-hours (kWh); and
  Purchased Towngas is measured in unit.

- Other indirect emissions due to electricity used for processing fresh water by WSD (Scope 3)
  Emission (CO_2-e) = Quantity of fresh water consumed × Emission factor
  where
  Water consumed is measured in cubic metre (m^3).

- Other indirect emissions due to electricity used for processing sewage water by DSD (Scope 3)
  Emission (CO_2-e) = Quantity of sewage discharged × Emission factor
  where
  Sewage discharged is measured in cubic metre (m^3).

- Other indirect emissions from paper disposed at landfills (Scope 3)
  In order to simplify the calculations, the default emission factor assumes that the total raw amount of CH_4 emitted throughout the entire decomposition process of the paper waste disposed at landfills will go into the atmosphere within the same reporting period when the paper waste is collected.

  Emission (CO_2-e) = (P_s + P_i – P_r – P_e) × Emission factor (estimated at 4.8 kg CO_2-e/kg)
  where
  P_s = Paper inventory at the beginning of the reporting period (in storage) (kg)

P_i = Paper added to the inventory during the reporting period (kg)
P_r = Paper collected for recycling purpose (kg)
P_e = Paper inventory at the end of the reporting period (in storage) (kg)

(b) Details (including necessary reference) of other methodologies and conversion factors used for quantification:

- Fugitive emissions from fire suppression system – portable extinguishers (Scope 1)
  "*2006 IPCC Guidelines for National Greenhouse Gas Inventories*" [2] is referred, as below:
  Emissions (CO_2-e) = Σ Amount of extinguishing agent leakage × GWP of extinguishing agent
  where
  Amount of extinguishing agent leakage = Amount of extinguishing agent × leakage rate
  The IPCC default leakage rate is 4% ± 2% and midpoint of the interval, 4%, is adopted.

- Fugitive emissions from fire suppression system – FM 200 system (Scope 1)
  "2006 IPCC Guidelines for National Greenhouse Gas Inventories" is referred, as below:
  Emissions (CO_2-e) = Σ Amount of HFC-227ea[3] leakage × $GWP_{HFC-227ea}$
  where
  Amount of extinguishing agent leakage = Amount of HFC-227ea × leakage rate

  The IPCC default leakage rate is 2% ± 1%. Considering the periodical pressure tests conducted during the reporting period, the lower value 1% is selected.

- Fugitive emissions from refrigeration / air conditioning systems – refrigerators / air conditioning equipment (Scope 1)
  "2006 IPCC Guidelines for National Greenhouse Gas Inventories" is referred, as below:
  Emissions (CO_2-e) = Σ Amount of refrigerant leakage × GWP of refrigerant
  where
  Amount of refrigerant leakage = Amount of refrigerant charge × operation emission factor

  The IPCC default operation emission factor for domestic refrigeration is 0.1% - 0.5% of initial charge per year and for chiller is 2% - 15% of initial charge per year. The lower end of the emission factors is intended to specify the status in developed region, thus, 0.1% and 2% are selected accordingly.

- Other indirect GHG emissions from general waste disposal (Scope 3)
  "*The Guidelines of Carbon Audit Toolkit for Small and Medium Enterprises in Hong Kong*" is referred, as below:

[2] Source: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_7_Ch7_ODS_Substitutes.pdf
[3] HFC-227ea is the fire suppression agent used in FM 200 system.

The general waste sent to landfill will be decomposed through anaerobic digestion and CH_4 will be emitted. Estimating that anaerobic digestion of one kg of the general waste is equivalent to 1.5 kg CO_2-e, then
Emission (CO_2-e) =Amount of general waste disposal × Emission factor (estimated at 1.5 kg CO_2-e/kg).

(c) Details of any changes in methodologies and conversion factors since the last GHG report by the reporting entity:

- The grid-electricity emission factor[4] of electricity purchased within Scope 2 has been revised from 0.79 kg CO_2-e/kWh (2017) to 0.80 kg CO_2-e/kWh (2018) according to the "*HK Electric Investments Sustainability Report 2018*".

- The GHG Emission Factor of Towngas[4] purchased within Scope 2 has been revised from 0.592 kg CO_2-e/unit (2017) to 0.564 kg CO_2-e/unit (2018) according to the "*Towngas Sustainability Report 2018*".

- The GHG Emission Factor for Sewage Processing[5] by DSD within Scope 3 has been revised from 0.202 kg CO_2-e/m^3 (2017) to 0.219 kg CO_2-e/m^3 (2018) according to the recent "*DSD Sustainability Report 2017-2018*".

- The GHG Emission Factor for Fresh Water Processing[5] by WSD within Scope 3 has been revised from 0.403 kg CO_2-e/m^3 (2017) to 0.404 kg CO_2-e/m^3 (2018) according to the recent "*WSD Annual Report 2017/18*"

(d) Details on any re-calculation of previously reported emissions and removals because of changes in methodologies and conversion factors
Not applicable.

2.7 Contact person of the reporting entity

The Administration Division, Legislative Council Secretariat (the Secretariat)

2.8 References

The following guidelines are taken as references in this *Report*:

[4]The indirect GHG emission factors of grid-electricity and Towngas are associated with electricity generation by HKEI and Towngas generation by Towngas, which are dependent on the composition of the energy sources used to generate electricity, e.g. coal, natural gas, naphtha, landfill gases and renewable energies. The GHG emissions from indirect energy consumptions will slightly increase or decrease subject to the operations of HK Electric Investments and Towngas.

[5] The indirect GHG emission factors of fresh water and sewage are associated with electricity used for processing fresh water by WSD and sewage by DSD. The GHG emissions from other indirect energy consumptions will slightly increase or decrease subject to the operations of WSD and DSD.

- *"Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings (Commercial, Residential or Institutional Purposes) in Hong Kong (2010)".* Environmental Protection Department and Electrical and Mechanical Services Department of the Government of the Hong Kong Special Administrative Region

- *"ISO14064-1 (2006): International Standard on Greenhouse Gases - Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*", ISO

- *"2006 IPCC Guidelines for National Greenhouse Gas Inventories - Chapter 7: Emissions of Fluorinated Substitutes for Ozone Depleting Substances",* IPCC

- *"Carbon Audit Toolkit for Small and Medium Enterprises in Hong Kong (2010)"*, published in February 2010 by The University of Hong Kong

- Other references, where appropriate (e.g. emission factors), have also been taken into consideration and are quoted in corresponding sections of this report.

3. GHG EMISSIONS DATA

3.1 Information on GHG emissions and removals

Summary of Results

Scope 1 Emissions:	147.00	tonnes of CO_2-e
Scope 1 Removals:	Nil	tonnes of CO_2-e
Scope 2 Emissions:	8,148.49	tonnes of CO_2-e
Scope 3 Emissions:	114.27	tonnes of CO_2-e
Other GHG Offsets / Removals:	Nil	tonnes of CO_2-e
Accounted GHG Emissions in total:	8,409.76	**tonnes of CO_2-e**

In terms of absolute GHG emission, the reported emissions of the Complex in the reporting period had a 0.56% increase compared with 8,363.30 tonnes CO_2-e in 2017-2018 (the previous year), by 46.46 tonnes CO_2-e; which corresponded to a 2.02% increase versus 8,243.16[6] tonnes CO_2-e in 2013-2014 (the base year), by 166.60 tonnes CO_2-e.

GHG Performance in Ratio Indicator:

Based on the included construction floor area of 52,731 m^2, the GHG emission intensity of the Complex in terms of construction floor area was 159.48 kg CO_2-e/m^2, also indicating a 0.55% increase compared with the previous year and a 1.19% growth compared with the base year's 157.60 kg CO_2-e/m^2.

Based on 845 building users, the GHG emission intensity of the Complex in terms of number of building users was 9.95 tonnes CO_2-e/person, also indicating a 3.11% increase compared with previous year and a 3.77% reduction compared with the base year's 10.34 tonnes CO_2-e/person.

3.2 Total and breakdown of the GHG emissions

The GHG emissions of the Complex accounted for the reporting period from 1 April 2018 to 31 March 2019 were 8,409.76 tonnes CO_2-e. Table 1 summarizes the GHG emissions of the Complex from different emission sources. The summary of activity data and calculation details are shown in APPENDIX 1 and APPENDIX 3 respectively. The GHG emissions summary for the base year is attached in APPENDIX 4.

[6] This figure in "*The Legislative Council Complex Greenhouse Gas Accounting Report for the Period 1 April 2013 - 31 March 2014*" was 8,243.17, which was later revised to 8,243.16 in accordance with the rules for rounding off in the reporting period.

Table 1: Summary of GHG emissions of the Complex during the reporting period

Emission source	in tonnes of CO_2-e						
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Sub-total
Scope 1 Direct Emissions							
Combustion of fuels in stationary sources – diesel used in generators	0.61	0.0001	0.0005	N/A	N/A	N/A	0.61
Combustion of fuels in stationary sources – Towngas consumption	11.00	0.004	0.013	N/A	N/A	N/A	11.02
Combustion of fuels in mobile sources – petrol used in vehicles owned by the Commission	15.31	0.035	2.23	N/A	N/A	N/A	17.58
Unintentional GHG release from equipment and system	0.05	N/A	N/A	117.74	N/A	N/A	117.79
Scope 2 Energy Indirect Emissions (To be reported in general without being classified into specific gas type)							
Electricity purchased from The Hongkong Electric Company Limited							8,146.06
Towngas purchased from The Hong Kong and China Gas Company Limited							2.43
Scope 3 Other Indirect Emissions (GHG emission from fresh water processing and sewage discharge disposal to be reported in general without being classified into specific gas type)							
Methane gas generation at landfill in Hong Kong due to disposal of paper waste	N/A	29.25	N/A	N/A	N/A	N/A	29.25
GHG emissions due to electricity for fresh water processing by WSD[7]							5.67
GHG emissions due to electricity used for sewage processing by DSD							3.02
Methane gas generation at landfill in Hong Kong due to general waste disposal	N/A	76.33	N/A	N/A	N/A	N/A	76.33

[7] The fresh water usage includes plants watering, floor washing, fountain, kitchen, pantry operation and toilets.

3.3 Data collection

i. Scope 1 - Stationary fuel combustion

The data of diesel consumption for three generators controlled by the Complex are extracted from the monthly maintenance records.

Towngas consumption is based on the bills issued by The Hong Kong and China Gas Company Limited.

ii. Scope 1 - Mobile fuel combustion

The vehicle type of the three cars owned by the Commission is specified as "Private Car" on their licenses. Fuel consumption records are summarized from the invoices issued by the suppliers. The type of fuel used is petrol, and the quantities for each of these vehicles are listed.

iii. Scope 1 - Fugitive emissions

The quantities and specifications of the CO_2 portable and FM-200 extinguishers are provided by the Secretariat. The types and amounts of refrigerant used in the refrigerators and the air conditioning equipment solely managed by the Complex are also provided. The quantity of the refrigerant used in the central chiller plant (CCP), which is shared with the Chief Executive's Office and Central Government Offices, was excluded from this report.

iv. Scope 2 - Electricity

The electricity used by the Complex is measured by two meters. One meter records the electricity consumption of the building services installation solely controlled by the Complex, such as the lighting system and the fresh water pumping system. The other meter records the electricity consumption of the shared facilities in the Complex, the Chief Executive's Office and the Central Government Offices, including CCP and the seawater pump house (SWP). The electricity consumed by the Complex in air conditioning is calculated by measuring the water consumption of the CCP and SWP of each building.

v. Scope 3 - Water

The fresh water consumption of the Complex is based on the readings from five freshwater meters as recorded by the Secretariat and the Water Supplies Department (WSD) on a monthly basis. The sewage generated is calculated on the basis of the default conversion from fresh water amount, as specified in the EPD-EMSD Guidelines.

vi. Scope 3 - Paper

The paper consumption data for the Complex operation includes the paper procured by the Secretariat and the LegCo Members' offices. The paper consumption data of the Secretariat is determined by making reference to the monthly inventory and the

procurement records. The paper consumption data of the LegCo Members' Offices is estimated according to the response submitted by the Council Members' Offices in a general survey.

As the current practice of paper collection and recycling in the Complex covers both newspaper and office paper (including recyclable confidential paper), the quantity of paper recycling of the Complex per year is estimated based on sampling conducted on a quarterly basis. As newspapers do not form part of the Complex's operation, their quantity has not been included in the calculation.

vii. Scope 3 - General waste

Owing to the fact that the Complex does not maintain weight measurement records of general waste disposals, the Secretariat agrees that the quantity of its general waste disposal during the reporting period is to be estimated based on projection of sample data. Such sampling process and projection method for both newspapers and the general waste have been adopted consistently since the base-year study.

3.4 Data analysis

i. GHG emissions breakdown

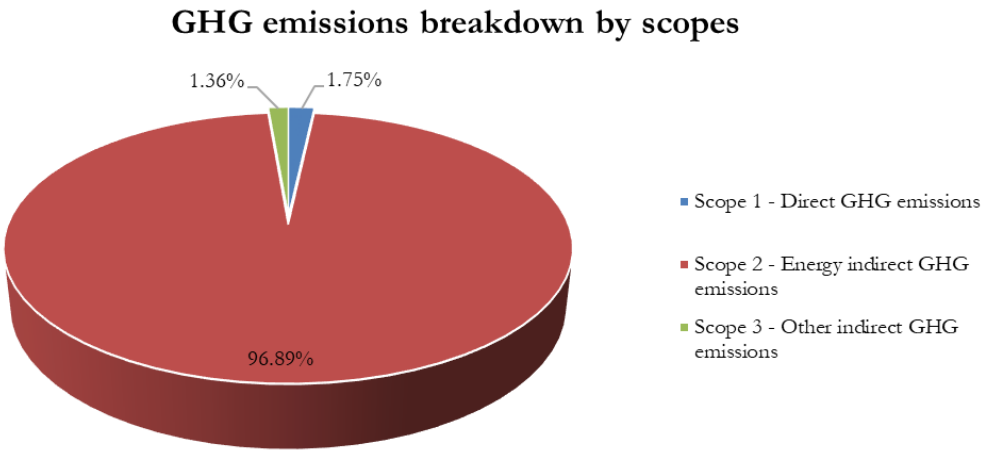


Figure 1. 2018-2019 GHG emissions profile by scope

Figure 1 summarizes the 2018-2019 GHG emissions profile of the Complex. Scope 2, representing the indirect GHG emissions from purchased energy, constituted 96.89% (8,148.49 tonnes) of the total GHG emissions (8,409.76 tonnes). Scope 1 and Scope 3, representing the direct GHG emissions and other indirect GHG emissions, accounted for 1.75% (147.00 tonnes) and 1.36% (114.27 tonnes) of the total GHG emissions respectively.

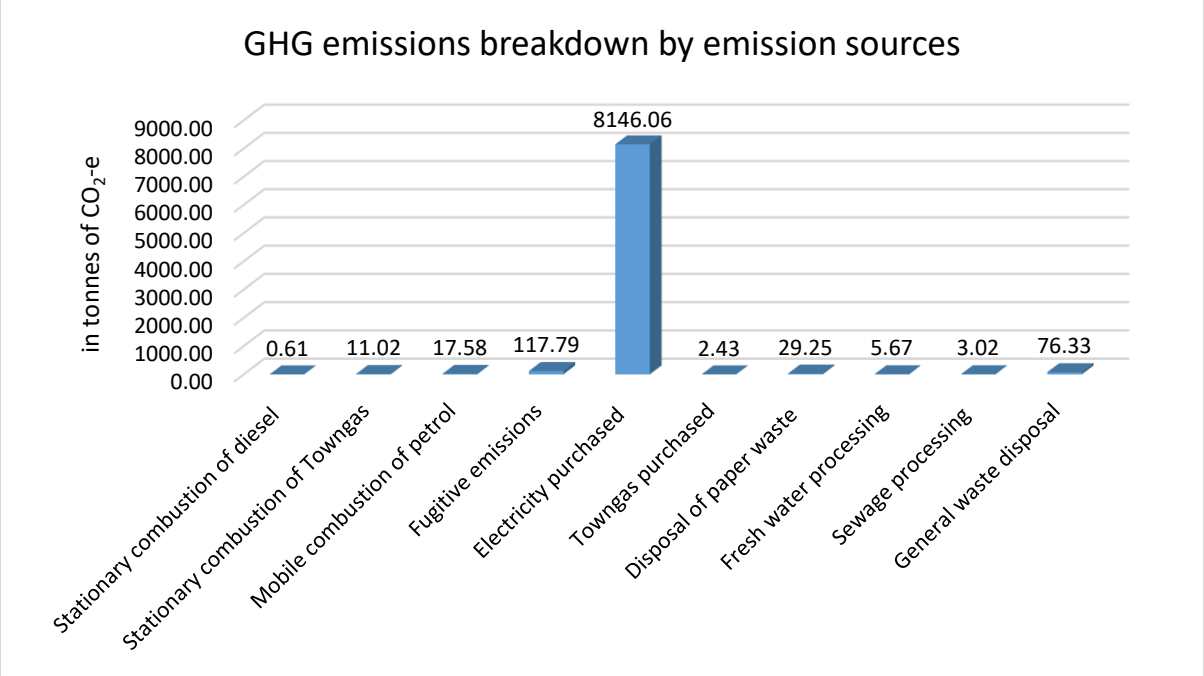


Figure 2. 2018-2019 GHG emissions profile by emission source

Figure 2 presents the distribution of the GHG emissions from different emission sources. Electricity consumption was the dominant carbon emissions source of the Complex, accounting for 8,146.06 tonnes CO_2-e (96.86% of the reported emissions), followed by fugitive emissions (117.79 tonnes), general waste disposal (76.33 tonnes) and disposal of paper waste (29.25 tonnes). The rest represented 0.48% of the total emissions profile.

ii. **GHG emissions comparison with previous reporting years and the base year**

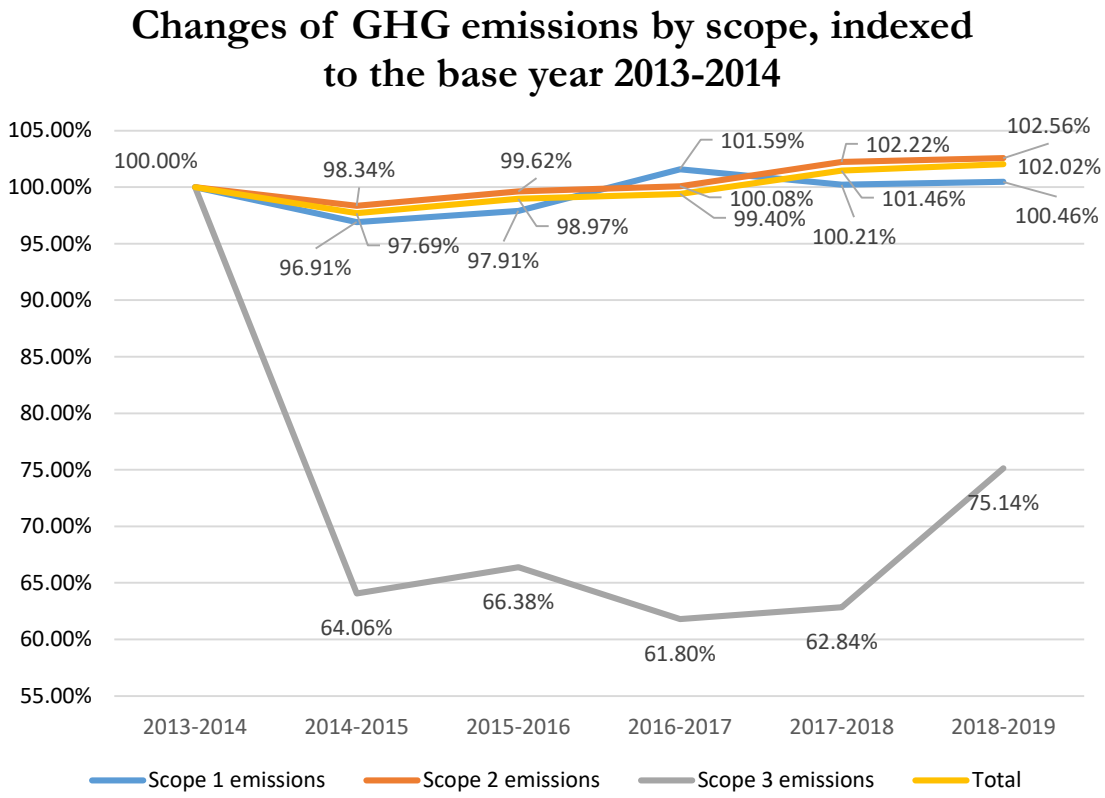


Figure 3. Changes of GHG emissions by scope and indexed to the base year 2013-2014

Figure 3 illustrates the overall trends of GHG emissions and annual changes for each scope: Scope 1 – direct GHG emissions, Scope 2 – energy indirect GHG emission and Scope 3 – other indirect GHG emissions. Scope 3 reflected significant decrease from 2013 to 2015 and fluctuated in the range of 60% to 75% over the past five years. Scope 1 had a mild decrement in 2014-2015 (96.91%) and 2015-2016 (97.91%) but reached a noticeable increase in 2016-2017 (101.59%), fell back slightly in 2017-2018 (100.21%) and had slight increment in 2018-2019 (100.46%). The elevated diesel consumption as recorded in 2016-2017 is due to the periodic inspection, testing and certification for the fixed electrical installations in which the backup electricity was provided for the operation of the essential equipment of the Complex. Meanwhile, Scope 2, dominated by electricity consumption, showed a slight increment (102.56%) when compared with the base year.

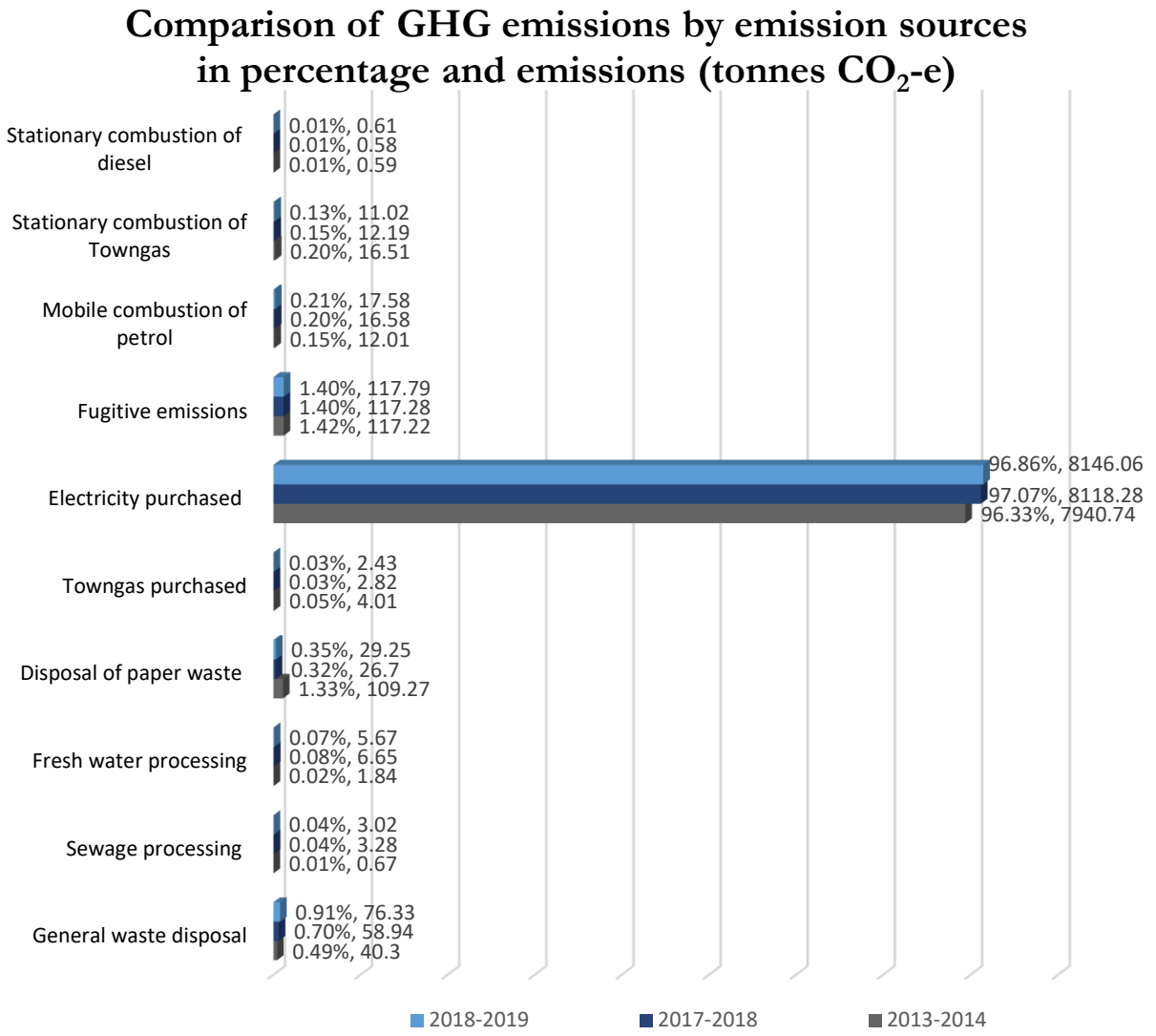


Figure 4. Comparison of GHG emissions among 2018-2019, 2017-2018 and 2013-2014

Figure 4 compares the distribution of different emission sources in tonnes of CO_2-e and in percentage terms among the reporting year (2018-2019), the previous reporting year (2017-2018) and the base year (2013-2014). Electricity consumption has been the largest contributor to the total GHG emissions of the Complex, which made up 96.86%, 97.07%, and 96.33% of the total GHG emissions in the reporting period, the previous year, and the base year, representing 8,146.06, 8,118.28 and 7,940.74 tonnes CO_2-e respectively. The percentage of the electricity purchased contributing to the total carbon emissions increased mildly during the three reporting periods.

Table 2: Summary of GHG emissions differences among 2018-2019, 2017-2018, and 2013-2014

Emission Source	Accounted GHG emissions in tonnes of CO_2-e			Differences in tonnes of CO_2-e	
	2018-2019	2017-2018	2013-2014	2018-2019 versus 2017-2018	2018-2019 versus 2013-2014
Scope 1 Direct Emissions	**147.00**	**146.63**	**146.33**	**+0.37 (+0.25%)**	**+0.67 (+0.46%)**
Combustion of fuels in stationary sources – diesel used in generators	0.61	0.58	0.59	+0.03	+0.02
Combustion of fuels in stationary sources – Towngas consumption	11.02	12.19	16.51	-1.17	-5.49
Combustion of fuels in mobile sources – petrol used in vehicles owned by the Commission	17.58	16.58	12.01[8]	+1.00	+5.57
Unintentional GHG release from equipment and system	117.79	117.28	117.22	+0.51	+0.57
Scope 2 Energy Indirect Emissions	**8,148.49**	**8,121.10**	**7,944.75**	**+27.39 (+0.34%)**	**+203.74 (+2.56%)**
Electricity purchased from The Hongkong Electric Company Limited	8,146.06	8,118.28	7,940.74	+27.78	+205.32
Towngas purchased from The Hong Kong and China Gas Company Limited	2.43	2.82	4.01	-0.39	-1.58
Scope 3 Other Indirect Emissions	**114.27**	**95.57**	**152.08**	**+18.70 (+19.57%)**	**-37.81 (-24.86%)**
Methane gas generation at landfill in Hong Kong due to disposal of paper waste	29.25	26.70	109.27	+2.55	-80.02

[8] This figure in "*The Legislative Council Complex Greenhouse Gas Accounting Report for the Period 1 April 2013 - 31 March 2014*" was 12.02, which was later revised to 12.01 in accordance with the rules for rounding off in the reporting period.

Emission Source	Accounted GHG emissions in tonnes of CO_2-e			Differences in tonnes of CO_2-e	
	2018-2019	2017-2018	2013-2014	2018-2019 versus 2017-2018	2018-2019 versus 2013-2014
GHG emissions due to electricity for fresh water processing by WSD	5.67	6.65	1.84[9]	-0.98	+3.83
GHG emissions due to electricity used for sewage processing by DSD	3.02	3.28	0.67	-0.26	+2.35
Methane gas generation at landfill in Hong Kong due to general waste disposal	76.33	58.94	40.30	+17.39	+36.03
Sum-total	**8,409.76**	**8,363.30**	**8,243.16**	**+46.46 (+0.56%)**	**+166.60 (+2.02%)**

i. Table 2 summarizes the difference of the accounted GHG emissions among the reporting period (2018-2019), the previous year (2017-2018) and the base year (2013-2014). When compared with the previous year, Scope 1 and Scope 2 presented slight increments while Scope 3 presented a noticeable increment. When compared with the base year, both Scope 1 and Scope 2 increased slightly, while Scope 3 presented a noticeable decrement. The decrease in Scope 3 GHG emission compared with base year was mainly due to the reduction of waste paper disposal as the LegCo proactively reduced paper usage and tracked recycled paper systematically. In terms of relative change of each emission source as compared with the previous year, it can be observed that except for emission sources related to stationary combustion of towngas and use of freshwater, all emission sources showed different levels of increase. The reason for the decrease in consumption of freshwater was that one water metre recording water consumption for floor washing was out of order. This led to exclusion of the water consumption for floor washing from the calculation in this year. The emission of electricity purchased in Scope 2 rose by 27.78 tonnes of CO_2-e compared with the previsous year. While actual electricity consumption dropped slightly compared to 2017-2018 (by approximately 0.9%), the production of greenhouse gas emissions increased due to a revision of the electricity emission factor from 0.79 kg CO_2-e/kWh (2017) to 0.80 kg CO_2-e/kWh (2018). Besides, the emission due to general waste disposal increased by 17.39 tonnes of CO_2-e compared with the previsous year.

[9] This figure in "The *Legislative Council Complex Greenhouse Gas Accounting Report for the Period 1 April 2013 - 31 March 2014*" was 1.83, which was later revised to 1.84 in accordance with the rules for rounding off in the reporting period.

Overall, the increase in GHG emissions from the previous year was largely due to general waste generation.

3.5 Activity data comparison

Activity data refer to the data on the magnitude of those activities at the Complex resulting in carbon emissions or carbon removals during a given period of time.

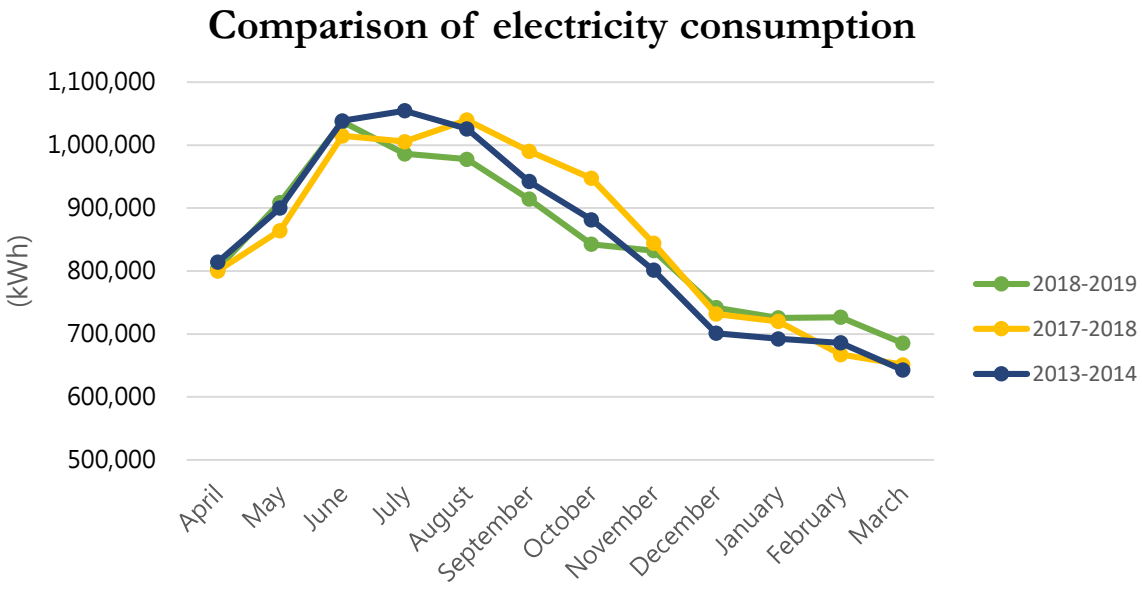


Figure 5. Comparison of electricity consumption among 2018-2019, 2017-2018, and 2013-2014

Figure 5 shows the monthly comparison of electricity consumption, the most significant emission source of the Complex. The electricity consumption of the Complex increased from the month of April and peaked in the month of June. It then declined from the month of July to March of the following year, reflecting the elevated energy consumption required for air conditioning during the summer season. The electricity consumption from April 2018 to June 2018 and from December 2018 to March 2019 was slightly higher than the same period in 2017-2018. One reason was that the outdoor temperature in these months were generally higher than that of the same period in 2017-2018, pointing to the higher demand of electricity.

Weather is one of the main factors which affect the electricity bills. According to the figures[10,11] of the Hong Kong Observatory, the total number of bright sunshine hours from August to October 2018 was lower than those in 2017. Total rainfall during the same

[10] Monthly extract of meteorological observations,2018 http://www.hko.gov.hk/cis/monthlyExtract_e.htm?y=2018
[11] Monthly extract of meteorological observations,2017 http://www.hko.gov.hk/cis/monthlyExtract_e.htm?y=2017

period in 2018 was higher than those in 2017. These may account for lower mean temperatures from August to October 2018 than those in 2017.

In hot days, air conditioners consume more electricity as the outdoor temperature is higher. It is because to maintain the same room temperature, the actual working hours for the compressor, which is controlled by the thermostat, are longer. In other words, although the daily operating hours of an air conditioning system are the same on days with different outdoor temperatures, higher outdoor temperature leads to higher electricity consumption[12].

3.6 Implementation of the GHG emission reduction measures

Since the base year, the GHG emissions reduction measures have been summarized in the dedicated document – "*Green Measures taken in the Complex*", which is reviewed and updated annually by the Secretariat. The details of the reduction measures include:

- Outer layer filters and inner layer filters of the air handling units of the air conditioning system are replaced quarterly and annually respectively. Air filters of fan coils are cleaned quarterly;
- Indoor temperature is set at 25.5°C as far as practicable;
- Maintenance of refrigeration and air conditioning systems are done in accordance with EMSD's maintenance manual;
- Continuously explore opportunities for the replacement of the existing lighting system with the more energy-efficient LED lighting when refurbishment works are taken[13];
- Use energy efficient electrical appliances and IT equipment with Grade 1 Energy Label issued by the EMSD or Energy Star;
- In the purchase of office and IT equipment, energy-efficient products are preferred;
- The installation of variable voltage variable frequency (VVVF) type lift power system, features with standby mode, and equipped with regenerative power devices;
- The installation of service-on-demand escalators;
- The installation of photo sensor at offices with daylight and corridors by the windows

[12] This information is from Hong Kong Electric Investments.
[13] When the Members' Activity Room was refurbished in December 2017, the lighting system was replaced with LED lighting.

- Conduct of Waste Audit in May and June 2019;
- Recycling bins for glass bottles are provided in designated locations to promote recycling;
- Issue useful tips for handling general waste and waste reduction to the Secretariat's staff and Members' offices;
- Staff are encouraged to use double-sided printing;
- Expanded the types of documents of which only soft copies are provided to LegCo Members. These documents include the Legislative Council Briefs provided by the Government, most of the minutes of open meetings, and the circulars issued by certain Divisions of the Secretariat, etc.;
- LegCo Members and Secretariat staff are encouraged to use soft copies instead of printed copies of documents. Some LegCo Members have opted to receive discussion papers for committee meetings in soft copy only;
- The amount of food for corporate functions is ordered on a need basis and surplus food is donated to the Foodlink Foundation to reduce the general wastes;
- Vending machines do not sell bottled drinks, Coffee Corner does not provide plastic cutlery and plastic straws.
- Suppliers are encouraged to take green measures

4. DISCUSSION AND RECOMMENDATIONS

4.1 Discussion

4.1.1 Scope 1 - Direct Emissions

The carbon emissions from Scope 1 which include the stationary and mobile combustion as well as fugitive emissions, were 147.00 tonnes CO_2-e, similar to the figure in the previous reporting year (146.63 tonnes CO_2-e). The total emissions from scope 1 was 1.75% of the total emission and therefore was not considered as significant source of emissions.

Emissions from stationary combustion sources showed a mild decrement when compared with previous reporting period mainly due to the fewer consumption of towngas. Whereas, emissions from mobile sources had a mild increment from previous reporting period due to higher consumption of petrol for vehicles. And the magnitude of carbon emissions from fugitive emissions was similar to that of previous reporting year.

4.1.2 Scope 2 – Indirect Emissions from Purchase of Energy

The carbon emissions from Scope 2 which include the procurement of electricity and Towngas, were 8,148.49 tonnes CO_2-e and recorded an increment as compared with the previous reporting year (8,121.10 tonnes CO_2-e).

The consumption of electricity and Towngas during the reporting period (Electricity: 10,182,572 kWh; Towngas: 4,361 units) decreased as compared with the previous reporting year (Electricity: 10,276,307 kWh; Towngas: 4,776 units). The increase in the total carbon emissions is due to the increase of grid-electricity emission factor[4] from 0.79 kg/kWh in 2017 to 0.80 kg/kWh in 2018 (Refer to Section 2.6).

On the other hand, it is worth mentioning that as the number of building users in the Complex dropped from 867 to 845, the GHG emission intensity of the Complex in terms of building users is 9.95 tonnes CO_2-e/person, indicating a 3.11% increase compared with the previous year.

4.1.3 Scope 3 – Other Indirect Emissions

The carbon emissions from Scope 3 which include the disposal of paper waste and general waste together with the energy used for the processing of fresh water and sewage treatment were 114.27 tonnes CO_2-e, showing a 19.57% increase when compared with the figure in the previous reporting year (95.57 tonnes CO_2-e).

Carbon emissions from the disposal of paper waste had decreased by 73.2% since the base year to 29.25 tonnes CO_2-e. In estimating paper recycling which is carried out using the same sampling methodology throughout the six years, the paper consumption of the Secretariat office was found to be fewer than the paper recycled. The reason may be that the amount of the recycled paper as collected in the Complex included paper not procured by the Secretariat. It may also be due to some random error of the statistical results obtained from the waste sampling conducted on quarterly basis. The indirect emissions from the paper consumption and recycling under the control of the Secretariat cannot be presented as negative values and the paper recycling cannot be offset for other emission sources, and therefore the value was adjusted to zero.

Carbon emissions caused by the energy used for fresh water processing were 5.67 tonnes CO_2-e, an decrease of 14.7% when comparing with previous year. On the other hand, the carbon emissions caused by the energy used for sewage treatment were 3.02 tonnes CO_2-e, an decrease of 7.9% when comparing with previous year. Such reduction was due to one water metre recording water consumption for floor washing being out of order. This led to exclusion of the water consumption for floor washing from the calculation in this year. Consequencely, the underestimated consumption of fresh water led to underestimated discharge of sewage recorded.

The amount of general waste generated in the reporting period was 76.33 tonnes CO_2-e, an increase of 29.5% compared with the previous reporting year. One probable reason was that the total waste disposal quantity was calculated based on the daily average waste quantity sampled in each quarter.

4.2 Recommendations

4.2.1 Operational Improvement

Air Conditioning System, Lighting System, Equipment, Lifts and Escalators

The operation of the air conditioning system, the lighting system and office equipment consumes the majority of electricity of the Complex. Apparently, some measures have been taken to improve energy efficiency in the Complex, including the adoption of seawater cooled chiller plants, the use of a natural light funnel, the use of lighting sensor, the use of lifts equipped with regenerative power devices, standby mode or variable voltage variable frequency (VVVF) type lift power system, the installation of service-on-demand escalators and switching to energy-efficient electrical appliances. However, to enhance carbon performance of the Complex, it is important to keep the existing practices in place as well as explore further improvement opportunities continuously.

Air conditioning system

It is recommended that the Secretariat should consider the application of automated air conditioning control systems in the Complex that can reduce redundant energy use by turning off the air conditioners when no occupants are using the facilities.

Lighting System

It is also recommended that the Secretariat should review and adjust the illumination levels according to the intended usage of working zones and remove reductant illumination. Two-level lighting control system could also be installed to allow users to adjust illumination level according to their needs.

In addition, a feasibility study on the application of anti-UV films on windows for reducing excessive heat gain through windows and achieving energy savings can be carried out.

Equipment

It is recommended that the Secretariat should extend the green procurement procedure to restrict procurement to cover other type of products in the future including plumbing fixtures and water-consuming devices with voluntary water efficiency labels.

Lifts and Escalators

To reduce the energy consumption of escalators, it is recommended to replace the existing heavy escalator steps by glass fibre material and replace the power transmission chains with non-metallic materials or plastic-based materials.

Solar Panel Installation

The government has announced a new feed-in tariff scheme[14]. The Commission may conduct a study to install more solar panels on available open space. The new feed-in tariff should allow a pay-back period of less than 10 years. If the Commission implements this scheme successfully, the installation can be included in public tours and serve as a showcase for educational purpose on renewable energy.

Smart Monitoring system

In order to better monitoring the energy consumption and detect wastage of energy, it is recommended to install energy information display system. The system displays real-time electricity consumption to allow users to adjust their usage so as to achieve energy conservation.

4.2.2 Carbon Roadmap Strategy Assessment

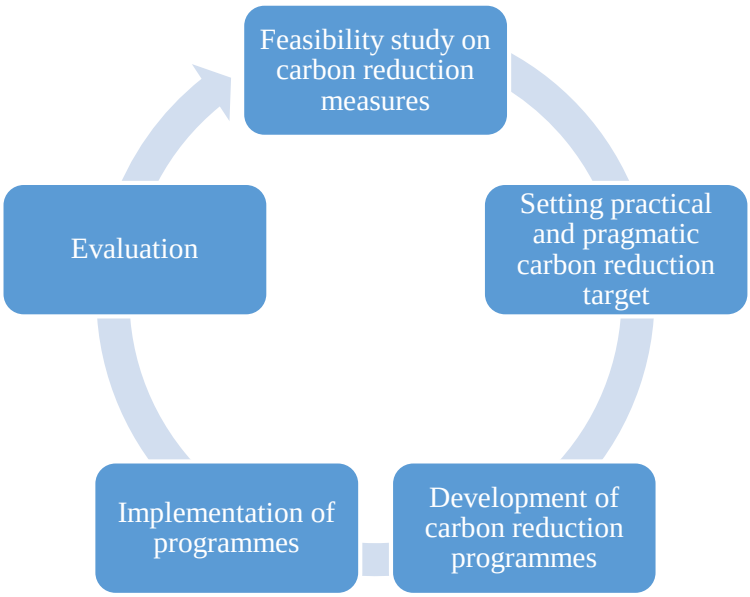


Figure 6. Carbon Roadmap Strategy Assessment

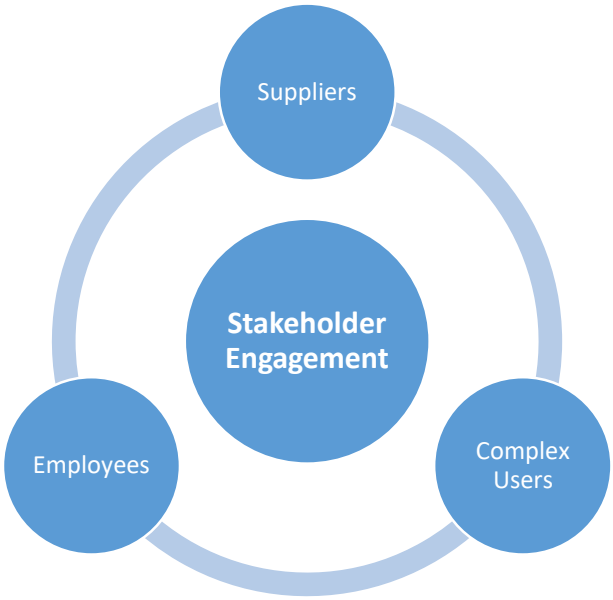
The Government has announced the *Hong Kong Climate Action Plan 2030+*, which outlines the Government's mid and long-term action in combating climate change. The plan sets out a carbon intensity reduction target of reducing 65% to 70% by 2030, using 2005 as the base[15]. This is equivalent to an absolute reduction of 26% to 36% in that period, resulting in per capita emissions of 3.3 to 3.8 tonnes by 2030. The Commission should engage

[14] HK RE Net, http://re.emsd.gov.hk/english/fit/int/fit_int.html
[15] http://www.policyaddress.gov.hk/2017/eng/pdf/Leaflet_Climate.pdf
http://gia.info.gov.hk/general/201701/20/P2017012000736_251945_1_1484911087018.pdf

different stakeholders to develop reduction targets in the short, medium and long term based on a review of the Complex's internal capacity and the current performance to ensure, at the minimum, they are in accordance with the government's targets for the territory as a whole.

4.2.3 Communication and Engagement

Programs for engaging internal and external stakeholders to support and implement GHG reduction actions should be carried out to promote sustainability awareness and support carbon friendly practices.



- *Engaging Suppliers:* The Commission should continue to encourage and influence its service providers to care for the environment. More engagement with the suppliers would mean stronger support to the Commission for introducing more innovative and effective carbon reduction measures.

- *Engaging Employees and Users:* In addition to the recommendations contained in the previous GHG accounting report, the Commission can explore further engagement programmes. Incentive programmes, for example, are new ways to encourage participation in energy efficiency and waste reduction projects. Green Day Events can be organized by internal or external party to engage the Complex users in exciting and thought-provoking activities such as workshops and sharing bazaar to promote the concept of low-carbon lifestyle and environmentally recycling. Carbon reduction competitions can also be organized to encourage green office practices amongst the Complex users. A self-assessment tool can be developed in terms of a checklist listing different aspects of office culture where carbon reduction practices can be integrated.

Monthly reports can be used to track, compare and benchmark the performance of participants. Awards will then be given to the best performing individual or department. A carbon innovation competition can also be held to encourage suggestions on carbon reduction solutions from Complex users, through giving out prizes or other forms of recognition. It is recommended that the Commission set up an internal communications platform to encourage the sharing of innovative ideas on sustainability and carbon reduction.

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APPENDIX 1: SUMMARY OF ACTIVITY DATA

Activity	Emission source	Activity data	Unit	Scope (1, 2, 3)
Stationary fuel combustion	Diesel	234.1	litre	1
Stationary fuel combustion	Towngas	4,316.0	unit	1
Mobile fuel combustion	Unleaded petrol (ULP)	6,488.3	litre	1
Fugitive emission – Portable extinguishers	CO_2	45.8	kg	1
Fugitive emission – FM 200 system	HFC-227ea	39.7	kg	1
Fugitive emission – Refrigerator	R-134a	0.403	kg	1
Fugitive emission – Air conditioning equipment	R-410A	1.2	kg	1
Electricity purchased	GHG emissions from the utility	10,182,572	kWh	2
Towngas purchased	GHG emissions from the utility	4,316	unit	2
Paper waste disposal	Methane gas generation at landfill	6093.8	kg	3
Fresh water processing	Electricity used for processing by WSD	14,015.0	m^3	3
Sewage discharge	Electricity used for processing by DSD	13,802.9	m^3	3
General waste disposal	Methane gas generation at landfill	50,883.4	kg	3

APPENDIX 2: CONVERSION FACTORS

A. Emission factors used

Scope	Emission source	Type	Unit	CO_2 (kg/unit)	CH_4 (g/unit)	N_2O (g/unit)	Data source
Scope 1	Stationary combustion	Diesel	litre	2.614	0.0239	0.0074	EPD-EMSD Guidelines
	Stationary combustion	Towngas	unit	2.549	0.0446	0.0099	EPD-EMSD Guidelines
	Mobile combustion	ULP – Passenger car	litre	2.360	0.253	1.105	EPD-EMSD Guidelines

Scope	Emission source	Unit	kg CO_2-e /unit	Data source
Scope 2	Electricity purchased from The Hongkong Electric Company Limited	kWh	0.80	HK Electric Investments Sustainability Report 2018
	Towngas purchased from The Hong Kong and China Gas Company Limited	unit	0.564	Towngas Sustainability Report 2018
Scope 3	Methane generation at landfill in Hong Kong due to disposal of paper waste	kg	4.8	EPD-EMSD Guidelines (2010)
	Electricity used for fresh water processing by WSD	m^3	0.404	WSD Annual Report 2017/18
	Electricity used for sewage processing by DSD	m^3	0.219	DSD Sustainability Report 2017-2018
	General waste disposal	kg	1.5	Carbon Audit Toolkit for Small and Medium Enterprises in Hong Kong

B. GWP values used

Gas or Blend	GWP	Information source
HFC-227ea	2,900	IPCC Second Assessment Report (1995)
R-134a	1,300	IPCC Second Assessment Report (1995)
R-410A	1,725	"World Resources Institute (2005), Calculating HFC and PFC Emissions from the Manufacturing, Installation, Operation and Disposal of Refrigeration & Air conditioning Equipment (Version 1.0) - Guide to calculation worksheets, World Business Council for Sustainable Development", in which the latter states that the source of reference is from ASHRAE Standard 34.

APPENDIX 3: DETAILED CALCULATION WORKSHEETS FOR GHG EMISSIONS

A. GHG emissions from stationary combustions

A	B	C	D	E	F	G	H	I
Source description	Amount of fuel used (litre/unit)	Fuel Type	CO_2 emission factor	CO_2 emissions in tonnes of CO_2-e ((B×D)/1000)	CH_4 emission factor	CH_4 emissions in tonnes of CO_2-e ((B × F)/(1000 × 1000) × GWP[Note 1])	N_2O emission factor	N_2O emissions in tonnes of CO_2-e ((B × H)/(1000 × 1000) × GWP[Note 1])
Generators	234.1	Diesel	2.614	0.610	0.0239	0.0001	0.0074	0.0005
Towngas consumption	4,316.0	Towngas	2.549	11.000	0.0446	0.0040	0.0099	0.0133
Total				11.610		0.004		0.014

Note 1: GWP of CH_4 is 21 while it is 310 for N_2O.

B. GHG emissions from mobile combustions

A	B	C	D	E	F	G	H	I
Source description	Amount of fuel used (litre/unit)	Fuel Type	CO_2 emission factor	CO_2 emissions in tonnes of CO_2-e ((B × D)/1000)	CH_4 emission factor	CH_4 emissions in tonnes of CO_2-e ((B × F)/(1000 × 1000) × GWP[Note 1])	N_2O emission factor	N_2O emissions in tonnes of CO_2-e ((B × H)/(1000 × 1000) × GWP[Note 1])
LC1	2,556.6	ULP	2.36	6.03	0.253	0.014	1.105	0.88
LC2	1,541.6	ULP	2.36	3.64	0.253	0.008	1.105	0.53
LC3	2,390.1	ULP	2.36	5.64	0.253	0.013	1.105	0.82
Total				15.310		0.035		2.230

Note 1: GWP of CH_4 is 21 while it is 310 for N_2O.

C. GHG emissions from fugitive emissions

A	B	C	D	E
Type of agent	Amount of the agent at the beginning of the reporting period (kg)	IPCC default leakage rate / operation emission factor	GWP of the agent	GHG emissions in tonnes of CO_2-e ((B × C × D) /1000)
CO_2 - portable extinguishers	1,144	4%	1	0.05
HFC-227ea – FM 200 system	3,971.7	1%	2,900	115.18
R-134a - refrigerators	403.2	0.1%	1,300	0.52
R-410A – air conditioning equipment	59	2%	1,725	2.04
			Total	117.79

D. GHG emissions from purchased energy

a) Electricity

A	B	C	D
Facility / source description	Amount of electricity purchased (kWh)	Emission factor (kg CO_2-e/kWh)	Indirect GHG emissions in tonnes of CO_2-e (B × C/1000)
The Complex solely controlled	7,617,156.00	0.8	6,093.73
Share usage CCP and SWP	2,565,416.25	0.8	2,052.33
		Total	8,146.06

b) Towngas

A	B	C	D
Facility / source description	Amount of Towngas purchased (unit)	Emission factor (kg CO_2-e/unit)	Indirect GHG emissions in tonnes of CO_2-e (B × C/1000)
Towngas consumption	4,316	0.564	2.43
		Total	2.43

E. GHG Emissions from paper waste disposal sent to landfill

A	B	C	D	E	F	G
Source description	Amount of paper in storage at the beginning of the reporting period (kg)	Amount of paper purchased during the reporting period (kg)	Amount of paper collected for recycling during the reporting period (kg)	Amount of paper in storage at the end of the reporting period (kg)	Emission factor (kg CO_2-e/kg)	Indirect emissions in tonnes of CO_2-e ((B+C-D-E) × F/1000)
Secretariat	6,279.50	26,052.39	41,069.00	4,390.54	4.8	0.00[Note 1]
Members' offices	1,686.20	6,013.8	0	1,606.18	4.8	29.25
					Total	29.25

Note 1: The indirect emissions calculated by the formula cannot be negative, since the paper recycling are not carbon offsetting for other emission sources. The minimal value is zero.

F. GHG emissions due to electricity used for fresh water processing by WSD

A	B	C	D
Source description	Amount of water consumed (m^3)	Emission factor (kg CO_2-e/m^3)	Emissions in tonnes of CO_2-e (B × C/1000)
Fresh water usage	14,015.0	0.404	5.67
		Total	5.67

G. GHG emissions due to electricity used for sewage processing by DSD

A	B	C	D
Source description	Amount of water consumed (m^3)	Default Emission Factor [Note 1] (kg CO_2-e/m^3)	Emissions in tonnes of CO_2-e (B × C /1000)
Sewage generation - General	13,308.0	0.219	2.91
Sewage generation - 1/F kitchen [Note 2]	707.0	0.153	0.11
		Total	3.02

Notes for GHG Emissions due to electricity used for sewage processing by DSD

Note 1: The default emission factor is determined according to the purpose of water used as follows:

Source description	Default emission factor (kg CO_2-e/m^3)
Restaurants and catering services	(0.7 × Emission factor) assuming 70% of the fresh water consumed will enter the sewage system.
Other commercial, residential and institutional purposes	(1.0 × Emission factor) assuming 100% of the fresh water consumed will enter the sewage system.

Note 2: "Restaurants and catering services" category is applied to the sewage generation in 1/F kitchen.

H. GHG emissions from general waste disposal

A	B	C	D
Source description	Amount of general waste sent to landfill (kg)	Emission factor (kg CO_2-e/kg)	Emissions in tonnes of CO_2-e (B × C /1000)
General waste disposal	50,883.4	1.5	76.33
		Total	76.33

APPENDIX 4: GHG EMISSIONS SUMMARY IN THE BASE YEAR

Summary of GHG emissions accounted for the Complex from 1 April 2013 to 31 March 2014

Emission source	in tonnes of CO_2-e						
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Sub-total
Scope 1 Direct Emissions							
Combustion of fuels in stationary sources – diesel used in generators	0.59	0.00	0.00	N/A	N/A	N/A	0.59
Combustion of fuels in stationary sources – Towngas consumption	16.48	0.01	0.02	N/A	N/A	N/A	16.51
Combustion of fuels in mobile sources – petrol used in the Commission owned vehicles	10.47	0.02	1.52	N/A	N/A	N/A	12.01
Unintentional GHG release from equipment and system	0.05	N/A	N/A	117.17	N/A	N/A	117.22
Scope 2 Energy Indirect Emissions (To be reported in general without being classified into specific gas type)							
Electricity purchased from The Hongkong Electric Company Limited							7,940.74
Towngas purchased from The Hong Kong and China Gas Company Limited							4.01
Scope 3 Other Indirect Emissions (GHG emission from fresh water processing and sewage discharge disposal to be reported in general without being classified into specific gas type)							
Methane gas generation at landfill in Hong Kong due to disposal of paper waste	N/A	109.27	N/A	N/A	N/A	N/A	109.27
GHG emissions due to electricity for fresh water processing by WSD							1.84
GHG emissions due to electricity used for sewage processing by DSD							0.67
Methane gas generation at landfill in Hong Kong due to general waste disposal	N/A	40.30	N/A	N/A	N/A	N/A	40.30