



**ISO Greenhouse Gas & Carbon Audit
ISO/IEC 14064-1-2-3
Carbon Auditor & GHG Verifier**

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International Evaluator on ILAC & IAF

1

Different kinds of GHG professional

- **GHG Carbon auditor** – Carbon Auditing Firm or Freelance
- **GHG Carbon verifier** – GHG Validation & Verification Body
- **GHG Carbon validator** - GHG Validation & Verification Body
- **GHG Carbon assessor** – HKAS, ANAB & IAS
- **GHG Carbon evaluator** – Peer evaluator to an economy

2

Different kinds of GHG Accounting Methodology

- GHG Carbon auditor to **HK EMSD Guideline**
- **CIC HKGBC** to **ISO 14067** – Carbon footprint labelling for Steel, Cement & RMC
- GHG verification & validation to **ISO 14064-1, -2 & -3** – **GHG VVB** - SGS, Pricewater House.
- GHG accreditation assessment to **ISO 14065 & ISO 17029** – HKAS, ANAB & IAS
- GHG evaluator – **IAF MD Requirements**

3

**CIC - Hong Kong Green Building Council
Certified Carbon Auditor**

**“Cement” & “Ready Mixed Concrete”
“Reinforced Bar & Structural Steel”**



**Energy Institute UK
Certified Carbon Auditor**



Area No.	Description
1	Environmental Management System
2	Energy Management System
3	Occupational Health and Safety Management System
4	Information Security Management System
5	Quality Management System
6	Business Continuity Management System
7	Asset Management System
8	Human Resource Management System
9	Legal and Compliance Management System
10	Customer Satisfaction Management System
11	Supplier Management System
12	Internal Audit Management System
13	Management Review Management System
14	Document Control Management System
15	Record Control Management System
16	Information Management System
17	Contract Management System
18	Complaint Management System
19	Non-Conformance Management System
20	Corrective and Preventive Action Management System
21	Statistical Process Control Management System
22	Measurement Management System
23	Calibration Management System
24	Measurement Uncertainty Management System
25	Measurement Method Management System
26	Measurement Equipment Management System
27	Measurement Personnel Management System
28	Measurement Process Management System
29	Measurement System Management System
30	Measurement System Analysis Management System
31	Measurement System Validation Management System
32	Measurement System Verification Management System
33	Measurement System Control Management System
34	Measurement System Improvement Management System
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Carbon Offsetting & Neutrality

Definition of Carbon Offsetting and Neutrality

- Carbon Offsets - CO₂e savings equivalent to your footprint have been achieved by others

Carbon Neutrality the organisation does not emit any CO₂e or has offset all emissions

Figure 1: Carbon neutrality

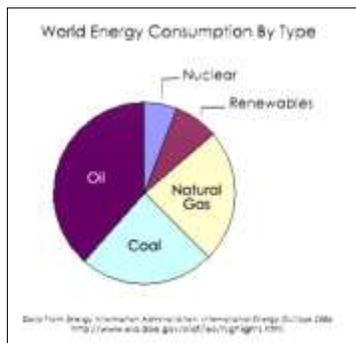
Consumption of Fossil Fuels

Fossil Fuel

- Burial of vegetation under successive layers of sedimentary sands & rocks; fossilized vegetation - physical compression & chemical decomposition lead to formation of coal.
- Decomposed marine life buried under ocean floor forms oil & natural gas
- Chemical reaction: carbohydrate -> hydrocarbon

$$C_6(H_2O)_n \xrightarrow[\text{absence of } O_2]{\text{pressure + heat}} C_nH_m$$

World Energy Consumptions



Consumption of Hydrocarbon

Hydrocarbon (C_nH_m)

- Natural gas - mostly methane (CH₄)
- Liquefied petroleum gas (LPG) - propane (C₃H₈) and butane (C₄H₁₀)
- Gasoline - octane (C₈H₁₈)
- Diesel - cetane (C₁₆H₃₄)
- Coal - very long-chain hydrocarbon

C: ● (red)
H: ● (blue)

Combustion of C_nH_m - Gasoline

Combustion of C_nH_m 

Chemical reaction for complete combustion of gasoline:

$$C_8H_{18} + 12.5O_2 + 12.5(3.76)N_2 \rightarrow 8CO_2 + 9H_2O + 47N_2$$

The exothermic reaction releases heat.

Carbon & Carbon Dioxide

Carbon & carbon dioxide 

Carbon dioxide is made up of 1 atom of carbon and 2 of oxygen (CO₂). The relative atomic mass of Oxygen (the bottom number on the periodic table) is 16 and Carbon 12. This means one molecule of CO₂ has a relative atomic mass of 16+16+12 (44).

Carbon + Oxygen = Carbon Dioxide

C	+	O ₂	=	CO ₂
12	+	16 x 2	=	44

Carbon is 12/44 of CO₂.

44 tonnes of CO₂ contains only 12 tonnes of Carbon!

So how many tonnes of carbon is there in 88 tonnes of CO₂?

Emissions of GHGs

Emissions 

Combustion of fossil fuels emits airborne pollutants.

Carbon dioxide (CO₂): major greenhouse gas (GHG) that causes climate change and global warming.

Sulfur dioxide (SO₂): may cause infant mortality, cardiovascular disease, viral diseases, respiratory tract, chronic bronchitis, asthma, lower respiratory, emphysema, kidney damage, anemia fatigue, bone changes, cancer.

Nitrogen oxides (NO_x): may cause cardiovascular disease, viral diseases, respiratory tract, chronic bronchitis, asthma, lower respiratory, emphysema, hypertension, visual disorders.

Carbon monoxide (CO): extremely toxic; cardiovascular disease and symptoms such as fatigue, rapid breathing, chest tightness, etc.

Volatile organic compounds (VOC): headaches, depression of central nerves, irritators of eyes, nose, & throat, carcinogenic.

Particulate matters: PM₁₀ (dia. ≤ 10 μm) and PM_{2.5} (dia. ≤ 2.5 μm) can be deposited in lungs and cause harm to our health.



Consequence of Global Warming – Climate Change

Consequences of Global Warming – Climate Change 

- Sea level rise
 - 15 – 100 cm in next century.
 - Potential coastal flooding.
- Intensification of hydrologic cycle
 - increasing evaporation will result in drier soil.
 - impact on regional water sources.
- Dramatic effects on ecosystems
 - forest, deserts, mountain regions, lakes, streams, wetlands etc.
- Health effect
 - disease such as malaria.
 - adverse heat strain.



Kyoto and Beyond – Paris COP 26 – Glasgow Nov 2021

Actions 

1990 UN Intergovernmental Panel on Climate Change (IPCC) First Assessment Report concludes and triggers UNFCCC process
– Second World Climate Conference
– UN General Assembly sets up group to negotiate United Nations Framework Convention on Climate Change (UNFCCC).

1992 UNFCCC concluded with weak targets.

1994 Alliance of Small Island States (AOSIS) submits Protocol proposal for 25% reduction by 2005 for CO₂.

1995 Conference of the Parties COP1, Berlin agrees to negotiate protocol urgently
– IPCC Second Assessment Report concluded under extreme pressure from industry and AOSIS.

1996 COP2 US surprises EU, Rattbergasts Japan and calls for legally binding tradeable targets.

1997 COP3 Adopts Kyoto Protocol with reduction targets.

2008 More than 180 nations have ratified the Kyoto Protocol.

2009 G8 pledged to support a global target to cut emissions by 50% by 2050 compared with 1990.

UNFCCC = United Nations Framework Convention on Climate Change
COP = Conference of the Parties

Kyoto and Beyond – Paris COP 26 – Glasgow Nov 2021 Climate Summit

Actions 

2008 G8 pledged to support a global target to cut emissions by 50% by 2050 compared with 1990.

2009 Copenhagen Accord - addressed climate change as one of the greatest modern challenges. Agreed that actions should be taken to keep the average temperature increase to below 2°C, but no legally binding commitments.

2010 New proposed 60% minimum reduction by 2050
Kyoto extended (2nd commitment period) until 2020.

2011 Durban COP16 laid the framework for post 2020. All member nations committed to a "comprehensive plan that would come closer over time to delivering the ultimate objective of the Climate Change Convention" to stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous interference with the climate system and at the same time will preserve the right to sustainable development.

2013 IPCC 5th assessment report states that warming of the climate system is unequivocal and asserts that "human influence on the climate system is clear".

2015 COP21 Warsaw: The goal was to develop a new legally binding international treaty to curb rising global emissions in order to limit the global average temperature increase to 2°C by the end of the century. This future agreement, to be signed in 2015, is set to enter into force in 2020, would replace the Kyoto Protocol (expires in 2020). Negotiations ended with a directive for all nations to establish and submit their emissions-reduction contributions by early 2015. Consensus was for nations to submit "contributions" rather than "commitments".

**Kyoto and Beyond – Paris
COP 26 – Glasgow Nov 2021 Climate Summit**

Kyoto Protocol

- Commit to meet target for greenhouse gas (GHG) emission reduction.
- Implement emission trading.

APEC Sydney Declaration on Climate Change

- Ensure energy supply for the needs.
- Address environmental issues and reduce GHG emission.

ISO 14064: GHG Emissions Inventories and Verification

- Quantify, report and verify GHG emissions.

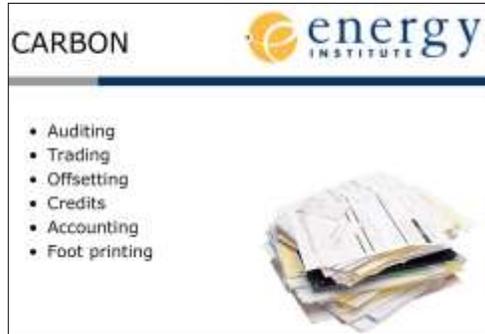
Copenhagen Conference

- Not too successful as no concrete agreement on the reduction

Paris United National Climate Change Conference 2015

- Agreement signed off among 170+ jurisdiction states for the reduction of GHG including developing countries
- In particular USA and China committed to mitigating the GHG and reduce the temperature rise to 1.5 degree C in the upcoming decade.

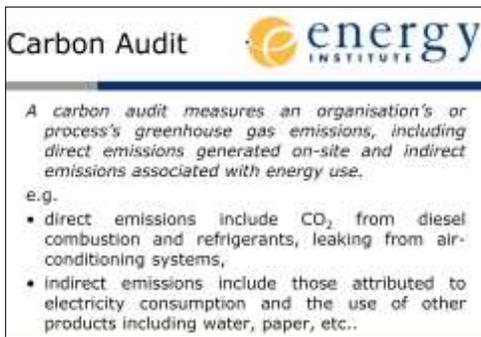
Carbon Management



CARBON energy INSTITUTE

- Auditing
- Trading
- Offsetting
- Credits
- Accounting
- Foot printing

Carbon Audit



Carbon Audit energy INSTITUTE

A carbon audit measures an organisation's or process's greenhouse gas emissions, including direct emissions generated on-site and indirect emissions associated with energy use.

e.g.

- direct emissions include CO₂ from diesel combustion and refrigerants, leaking from air-conditioning systems,
- indirect emissions include those attributed to electricity consumption and the use of other products including water, paper, etc..

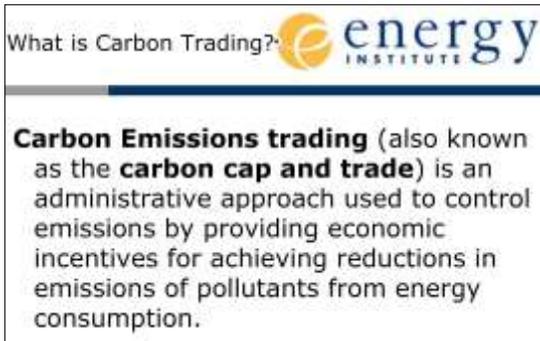
Carbon Audit References



Useful References energy INSTITUTE

- Intergovernmental Panel on Climate Change (IPCC)
- U.S. Environmental Protection Agency (U.S. EPA - AP42)
- European Environment Agency (EMEP/EEA air pollutant emission inventory guidebook)
- Census and Statistics Department (C&SD - Hong Kong Energy Statistics Annual Report)
- Electrical and Mechanical Services Department (EMSD - Hong Kong Energy End-use Data)

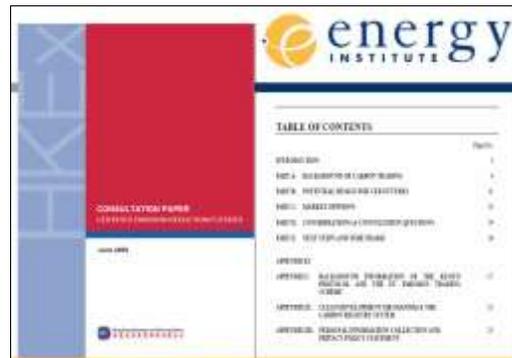
Carbon Emission Trading



What is Carbon Trading? energy INSTITUTE

Carbon Emissions trading (also known as the **carbon cap and trade**) is an administrative approach used to control emissions by providing economic incentives for achieving reductions in emissions of pollutants from energy consumption.

Carbon Emission Trading



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Carbon Emission Trading - Problems

Problems 

- Market price for Carbon (HK\$ 4 -150+)
- Supply and Demand
- Complex reporting methodologies
- Verification of emissions
- Voluntary v Compulsory

Carbon Dioxide Sequestration

Environmental 

Dioxide (CO₂) or Carbon Sequestration
 Carbon dioxide sequestration is the term given for locking up CO₂ somewhere other than the atmosphere .
 Also be called **carbon** sequestration because the carbon dioxide may be broken down into its component parts and the carbon stored away while the oxygen is released to the atmosphere.
 There are two kinds of sequestration:

- **Biological:** carbon is naturally sequestered in plants, soils, and in ocean life.
- **Geological:** is the storage of carbon dioxide directly in rocks or underwater.

Kyoto Protocol - GHGs

Kyoto Protocol Greenhouse Gases 

Greenhouse Gases (GHGs): A group of gases that absorb and re-radiate infrared radiation. These gases result from both natural and human-influenced processes.

Carbon Footprint

What is a Carbon Footprint 

The total greenhouse gas emissions caused directly and indirectly by an individual, organisation, event or product.
 Expressed in units of carbon dioxide equivalent (CO_{2e}).

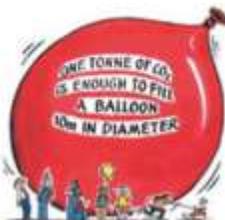
- Carbon Dioxide Equivalent (CO_{2e}): A measure used to compare and sum the impact from various greenhouse gases based upon their global warming potentials (GWP).
- The CO₂-equivalent for a gas is derived by multiplying the tonnes of the gas by the gas's associated Global Warming Potential (GWP).



Carbon Dioxide – its Size & Scale

Carbon Dioxide 

1 tonne of Carbon Dioxide is equivalent to a balloon **10 metres** in Diameter!



Kyoto Protocol – 6 Kinds of GHGs

Kyoto Protocol Greenhouse Gases (GHG) 

 Carbon Dioxide Fuels for Energy and Transport, Manufacturing Processes	Nitrous Oxide Chemical manufacture and agriculture
 Methane Waste (Landfills, natural activity)	HFCs (hydrofluorocarbons) Refrigerants, chemical manufacture, foams & aerosols
	PFCs Aluminium manufacture, electronics manufacture
	Sulphur hexafluoride Magnesium smelting, high voltage switchgear, electronics manufacturing

GHG – Global Warming Potential

Global Warming Potential



GHG	Global Warming Potential (GWP)
CO ₂	1
CH ₄	21
N ₂ O	310
HFCs	140 – 11,700
PFCs	6,500 – 9,200
SF ₆	23,900

Note: Taking into account the amount of worldwide emissions, CO₂ contributes about 50% to the total global warming effect.

Top Ten CO₂ Emitter

Top 10 2010 emitters

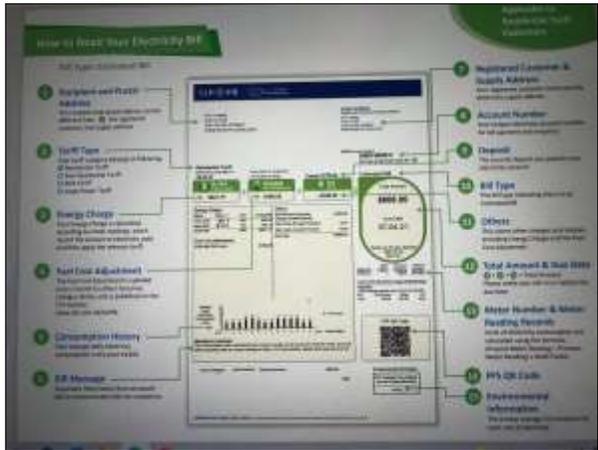


CO₂ Emissions from the Consumption of Energy
2010 Data (Mkton Metric Tons)

Country	Rank	Mkton Metric Tons	Tonnes per person
China	1	6,321	8
United States	2	6,810	18
India	3	1,898	1
Russia	4	1,628	1.2
Japan	5	1,168	9
Germany	6	744	10
Korea, South	7	579	12
Iran	8	568	7
Canada	9	549	16
United Kingdom	10	532	9
Australia	10	405	10

Global average is ~4/tonnes/person

Electricity Bill – China Light Power



Electricity Bill – HK Electric Co.

Gas Supply Bill – Towngas Co Ltd





Water Bill – Hong Kong WSD

The Carbon Auditing Process



Carbon Footprint Audit

GHG inventory / carbon footprint

■ The Fundamental Formula:

■ Emissions in terms of tons CO₂e =

$$AD_i \times EF_i \times GWP_i$$

■ The Footprint:

$$\text{Footprint} = \sum_i^n (AD_i \times EF_i \times GWP_i)$$

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Information gathering

- Types
- Sources
- Accuracy

Site Tour

- Preparation
- Responsibilities
- Equipment
- Time
- How far?

Information Analysis

- Observations
- Data collected
- History
- Benchmarks
- Future plans
- Capabilities

Reporting & Action Plans

- Reports
- Action Plans
- Implementation
- Closing the loop

Carbon Audit Process

Simple Auditing

First Principles

OTHERS

- Motors
- Water Heaters
- Office equipment
- Plant
- Process equipment
- Fugitive emissions
- Waste
- Transport

Audit steps

- Preliminary Contact
- Preparation
- Start up meeting
- Collecting Data
- Site Tour
- Visit closing meeting
- Analysis
- Report
- Post Survey briefing
- Implementation?

Detailed Carbon Audit

- Short period metering data
- Sub metering information
- Descriptions of operation
- Staffing levels, working hours and patterns
- Building and refurbishment history
- Information on building materials
- Future projects being planned
- Issues of current concern
- Discussions with relevant staff
- Waste Management
- Fleet management

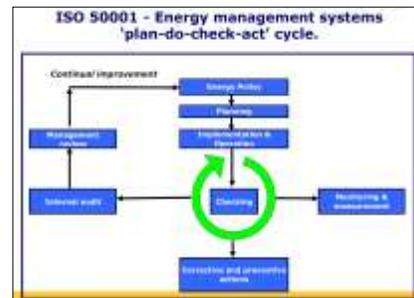
REPORTING

- Text
- Tabular
- Graphical or PowerPoint
- Action points and Recommendations

Remember the reader

- Is it a report or a resource to prompt decision and actions?
- Will it still make sense in 12 / 24 months time?
- Does it offer sufficient options?
- Does it recognise the needs and the ability of the organisation / individuals?
 - Can they afford it?
 - Are they motivated?
 - Are the main objectives met?

ISO 50001:2018 EnMS



Post ISO 50001 - EnMS

Suite of Standards

- **ISO 50002** - Energy Audits
- **ISO 50003** - Energy Management System Audits & Auditor competency
- **ISO 50004** - Guidance for implementing, Maintaining and Improving an EnMS
- **ISO 50006** - Energy Performance Indicators and baselines
- **ISO 50015** - Measurement & Verification of Organisational Energy Performance
- **ISO 17741** - General technical rules for Measurement, Calculation & Verification of energy savings of Projects
- **ISO 17742** - General calculation methods on energy efficiency and savings for Countries, regions and Cities
- **ISO 17743** - Definition of methodological framework applicable to the calculation and reporting of energy savings
- **PAS 2030** - Improving the energy efficiency of existing buildings. Specification for installation process, process management and service provision

ISO 14001:2015 EMS

Environmental "aspects"

- emissions to air
- releases to water
- releases to land
- use of raw materials and natural resources
- use of energy
- energy emitted, e.g. heat, radiation, vibration
- waste & by-products, and
- physical attributes, e.g. size, shape, colour, appearance

The range of renewable energy

- Wind
- Wave
- Hydroelectric
- Energy from waste
- Landfill gas
- Energy crops
- Agricultural and forestry residues
- Active solar (hot water panels & PV)
- Passive solar design
- Geothermal
- Ground, Air and water source cooling / (GSHP)

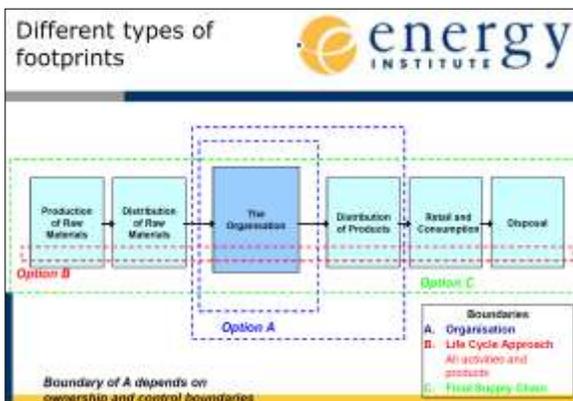
Recap of the CO2 Equivalent

The total greenhouse gas emissions caused directly and indirectly by an individual, organisation, event or product.

Expressed in units of carbon dioxide equivalent (CO₂e).

- Carbon Dioxide Equivalent (CO₂e): A measure used to compare and sum the impact from various greenhouse gases based upon their global warming potentials (GWP).
- The CO₂-equivalent for a gas is derived by multiplying the tonnes of the gas by the gas's associated Global Warming Potential (GWP).





Principles: accounting for and reporting GHG emissions



- **Relevance:** Boundaries, data, assumptions & methodologies must reflect the emission status of the building.
- **Completeness:** The reporting entity should account and report all GHG emissions & removals. Specific exclusions should be disclosed and justified.
- **Consistency:** The reporting entity should use consistent methodologies to allow meaningful comparisons in the GHG-related information including trends over time.
- **Accuracy:** The reporting entity should ensure that any bias & uncertainties in quantifying GHG emissions and removals are minimised, as far as practicable.
- **Transparency:** The reporting entity should disclose sufficient & appropriate information, assumptions and references to allow the users of the report to arrive at conclusions with a reasonable confidence.

Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings (Commercial, Residential or Institutional Projects) in Hong Kong

2010 Edition

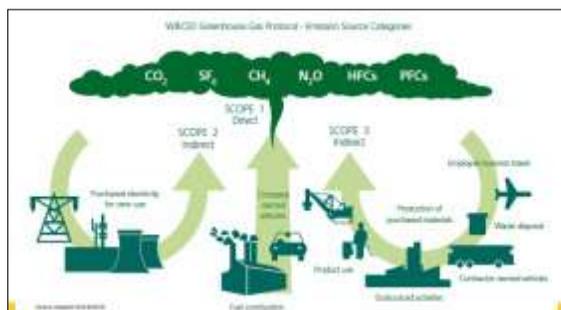
http://www.epd.gov.hk/epd/english/comm_chi_chi/this/Guideline_English_2010.pdf

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Relevance of the Guide

- Applicable to buildings used for residential or commercial purposes:
- Offices
 - Retail
 - Restaurants
 - Hotels
- Also most institutional buildings such as:
- Schools
 - Colleges
 - Universities
 - Community centres
 - Sports complexes
- but not industrial buildings because of other emitting processes

Emissions Scope



Reporting Scopes

- **Scope 1 operations** are on-site electricity generators, boilers, gas stoves, dedicated motor vehicle fleets, leakage from refrigeration systems, and additional trees planted on site.
- **Scope 2 operations** include production and transportation of electricity and Towngas consumed (purchased) by the buildings.
- **Examples of Scope 3 operations** are commuting and business travel by employees; transportation of products, materials, people or waste by third parties; outsourced activities;
 - GHG emissions arising from the production and distribution of energy products, other than those covered under Scope 2;
 - GHG emissions from production of purchased materials and products.

Emission factors
For stationary
sources

Emission Factors for Stationary Combustion Sources

Table 1-1 CO₂ Emission factor by fuel type (for stationary combustion sources)

Fuel Type	Emission Factor	Unit
Steam Oil	2.811	kg/ton
LPG	2.817	kg/ton
Kerosene	2.829	kg/ton
Coal (bit)	2.876	kg/ton
Travelp	2.877	kg/ton

Table 1-2 CH₄ Emission factor by fuel type (for stationary combustion sources)

Fuel Type	Emission Factor	Unit
Steam Oil	0.0299	g/ton
LPG	0.0320	g/ton
Kerosene	0.0341	g/ton
Coal (bit)	0.036	g/ton
Travelp	0.0366	g/ton

Table 1-3 N₂O Emission factor by fuel type (for stationary combustion sources)

Fuel Type	Emission Factor	Unit
Steam Oil	0.0034	g/ton
LPG	0.0036	g/ton
Kerosene	0.00376	g/ton
Coal (bit)	0.0039	g/ton
Travelp	0.00392	g/ton

Mobile combustion sources

- Road transport
- Air Transport
- Water Transport
- Emissions from all mobile sources which serve within the physical building boundary, and mobile sources dedicated to provide transportation services for the concerned building (e.g. shuttle bus services provided by the building) should be included

Mobile combustion sources

Table 2-1 GHG Emissions from the Mobile Sources

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
Vehicle description	Fuel description	CO ₂ emissions (kg)	CH ₄ emissions (kg)	N ₂ O emissions (kg)	CO ₂ emissions (kg)	CH ₄ emissions (kg)	N ₂ O emissions (kg)
(1) Different vehicle and fuel type	(2) Fuel type (kg/ton)	(3) CO ₂ emissions (kg/ton) x (4) (1000)	(5) CH ₄ emissions (kg/ton) x (6) (1000)	(7) N ₂ O emissions (kg/ton) x (8) (1000)	(9) CO ₂ emissions (kg/ton) x (10) (1000)	(11) CH ₄ emissions (kg/ton) x (12) (1000)	(13) N ₂ O emissions (kg/ton) x (14) (1000)
Road transport							
Maritime							
Air							

Please refer to the following notes:

Note 1: Refer to Table 2-1 for CO₂ emissions factor for different vehicle and fuel type.

Note 2: Refer to Table 2-2 for CH₄ emissions factor for different vehicle and fuel type.

Note 3: Refer to Table 2-3 for N₂O emissions factor for different vehicle and fuel type.

Note 4: Initial Masses Product (IMP) of CO₂, CH₄ and N₂O is 1000 kg.

Emission factors
For mobile
combustion
sources

Table 2-2 N₂O Emission factor (for mobile combustion sources)

Vehicle Type	Fuel Type	Emission Factor	Unit
Motorcycle	ULP	0.040	g/ton
Passenger Car	ULP	0.035	g/ton
	DO	0.038	g/ton
Private Van	ULP	0.040	g/ton
	DO	0.036	g/ton
	LPG	0.030	g/ton

Vehicle Type	Fuel Type	Emission Factor	Unit
Public Light Bus	DO	0.038	g/ton
	LPG	0.030	g/ton
Light Goods Vehicle	ULP	0.035	g/ton
	DO	0.038	g/ton
Heavy Goods Vehicle	DO	0.032	g/ton
Medium Goods Vehicle	DO	0.032	g/ton
Ship	Gas Oil	0.035	g/ton
Aircraft	Jet Kerosene	0.030	g/ton
Other Mobile Machinery	DO	0.037	g/ton
	LPG	0.030	g/ton
	Kerosene	0.0378	g/ton

Emission factors
For mobile
combustion
sources

Emission Factors for Mobile Combustion Sources

Table 2-1 CH₄ Emission factor (for mobile combustion sources)

Fuel Type	Emission Factor	Unit
Steam Oil (DO)	0.0299	kg/ton
Industrial Process (ULP)	0.0320	kg/ton
Coal (bit) (ULP)	0.0341	kg/ton
Travelp (ULP)	0.036	kg/ton

Table 2-2 CH₄ Emission factor (for mobile combustion sources)

Vehicle Type	Fuel Type	Emission Factor	Unit
Motorcycle	ULP	0.040	g/ton
Passenger Car	ULP	0.035	g/ton
	DO	0.038	g/ton
Private Van	ULP	0.040	g/ton
	DO	0.036	g/ton
	LPG	0.030	g/ton
Public Light Bus	DO	0.038	g/ton
	LPG	0.030	g/ton
Light Goods Vehicle	ULP	0.035	g/ton
	DO	0.038	g/ton
Heavy Goods Vehicle	DO	0.032	g/ton
Medium Goods Vehicle	DO	0.032	g/ton
Ship	Gas Oil	0.035	g/ton
Aircraft	Jet Kerosene	0.030	g/ton
Other Mobile Machinery	DO	0.037	g/ton
	LPG	0.030	g/ton
	Kerosene	0.0378	g/ton

Fugitive Emissions

HFC and PFC Emissions for Refrigeration / Air-conditioning

Emissions = Refrigerant inventory (added and disposed) x GWP

See next slide for the calculation

Table 6: GHG Emissions from Towngas Purchased from the Hong Kong and China Gas Company (Towngas)

Step 1 A	Step 2 B	Step 3 C	Step 4 D
Facility / source description (i.e. data facilitates the Towngas bill in reporting)	Amount of Towngas purchased (GJ or MWh)	Emission factor (kg / GJ or t / MWh)	Default GHG emissions in tonnes of CO ₂ equivalent (B x C x 1,000)
Total			

GHG Emission Factor (in kg CO₂e / Unit of Towngas purchased)

Year	2021	2020	2017
Emission Factor	0.732	0.681	0.582

Scope 2 – Indirect GHG from Towngas Company

Scope 3 – Other direct emissions

Scope 3 – Other indirect emissions (Optional for reporting purposes)

The reporting entity **may choose** to report other indirect GHG emissions that are relevant to their activities and goals.

- If the quantification methodologies and necessary activity data (input data) are well-defined and easily available.

While reporting such indirect emissions is optional, the reporting entity is encouraged to collect information relevant to the following emission sources (where simple quantification methodologies have been developed for Hong Kong) and to quantify and report a Scope 3 emissions:

- Methane gas generation at landfill in Hong Kong due to disposal of paper waste.
- Mobile sources controlled by users of the concerned building dedicated for particular employees/groups of employees working in the buildings are not included under Scope 1. However, the reporting entity may choose to report these under Scope 3 as transport for employees.
- GHG emissions due to electricity used for fresh water processing by Water Supplies Department.
- GHG emissions due to electricity used for sewage processing by Drainage Services Department (if the sewage collected within physical boundary is treated by the Drainage Services Department).

Scope 3 – Other direct emissions

Scope 3 – Other direct emissions Methane from Landfill – Disposal of Waste paper

- Emission due to methane gas generation at landfill in Hong Kong caused by the disposal of paper waste.
- GHG emissions due to electricity used for fresh water processing by Water Supplies Department.
- GHG emissions due to electricity used for sewage processing by Drainage Services Department (if the sewage collected within physical boundary is treated by Government department).

Table 7: Methane Generation at Landfill in Hong Kong due to Disposal of Paper Waste

Step 1 A	Step 2 B	Step 3 C	Step 4 D	Step 5 E	Step 6 F	Step 7 G
Source description (i.e. Area / Dept)	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 of waste) ¹⁰⁰	Indirect emissions in tonnes of CO ₂ equivalent ((B - C + D - E) x F / 1000)
					4.8	
Total						

Scope 3 – Other direct emissions Due to electricity for Fresh Water Processing by WSD

Scope 3 – Other direct emissions Due to electricity for Sewage Processing by DSD

Table 8: GHG Emissions due to Electricity Used for Fresh Water Processing by Water Supplies Department

Step 1 A	Step 2 B	Step 3 C	Step 4 D
Source description (i.e. Area / facilitates the water service bill in reporting)	Amount of water consumed as listed on the water service bill (m ³)	Emission factor (kg / m ³) ¹⁰⁰	Emissions in tonnes of CO ₂ equivalent (B x C / 1000)
Total			

Table 9: GHG Emissions due to Electricity Used for Sewage Processing by Drainage Services Department

Step 1 A	Step 2 B	Step 3 C	Step 4 D
Source description (i.e. Area / facilitates the water service bill in reporting)	Fresh water consumption (m ³)	Default Emission Factor (kg / m ³) ¹⁰⁰	Emissions in tonnes of CO ₂ equivalent (B x C / 1000)
Total			

Source description: Fresh water consumption (m³)
 Default Emission Factor (kg / m³)
 (0.7 x Emission Factor) assuming 5% of the fresh water consumed will enter the sewage system.

Source description: Other residential, industrial and commercial purposes (i.e. x Emission Factor) assuming 10% of the fresh water consumed will enter the sewage system.

GHG Emission Factor (in kg CO₂e / m³)

Year	2021	2020	2018	2017
Emission Factor	0.732	0.687	0.596	0.578

Other Scope 3 Sources

- Extraction and production of purchased materials and fuels for sources covered in Scope 1 or for generation of electricity / Towngas gas covered in Scope 2.
- Transportation of purchased materials or goods, fuels, products, waste, employees, occupants and guests, to and from the concerned buildings (other than those covered under Scope 1).
- Business travel by employees.
- Emissions from outsourced activities or other contractual arrangements.
- Use of sold products and services.
- Waste disposal other than those covered in the above list.

International Standardization

Links with International Emissions Reporting Framework

- Scopes of emissions (direct and indirect) and removals mentioned in the Guidelines are defined in accordance with the international reporting framework published by the World Resources Institute (WRI) / World Business Council for Sustainable Development (WBCSD), as reported in *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard and International Organization for Standardization (ISO), as reported in ISO14064-1.*

Reporting methodology

- 1. Determine the Organisational Boundary – the physical boundary for accounting & reporting**
 - Usually matches the boundary of the building concerned
 - But can choose to account for emissions for adjoining buildings or those sharing centrally provided services
- 2. Determine the Operation Boundary**
 - emissions for which the organisation is responsible
 - emissions removals from site
- 3. Determine the reporting period**
 - Usually 12 months to match other accounting cycle
- 4. Collect necessary data and quantify the GHG performance**
- 5. Prepare the report**

Initially for Scopes 1 and 2 and then optional Scope 3 sources

Content of report

- Approaches to data collection and quantification
- Conversion factors
- Emissions factors
- Working procedures
- Worksheets

- Total emissions for Scope 1 and Scope 2 activities (in tonnes of CO₂ equivalent);
- Emissions data for each separate scope and for each type of GHGs (in tonnes of CO₂ equivalent);
- Total GHG removals from Scope 1 operations, in tonnes of CO₂ equivalent;
- Methodologies used to quantify emissions and removals of GHG, including any methodologies changes since the last report of emissions and removals;
- Changes in GHG emissions and removals since the last report over time, including any recalculations to previously reported emissions and removals

Check and Balance

- Collect consistent volumetric or mass data on fuels
 - Fuel receipts
 - Invoices
 - Metering
 - Tank dips
- Consistent time periods for all data
- All sources included or exclusions justified
- Correct emission factors
- Calculations

Reporting Format (1)

1. Name of the reporting entity;
2. Description of the reporting entity
 - Some possible descriptions are:
 - (a) Building management with a single responsible occupier;
 - (b) Building management with all end-users;
 - (c) Building management with some of the end-users (with details of the end-users participated);
 - (d) Building management only of a building of multiple responsible occupiers; and
 - (e) Others (with full details).
3. Reporting period (with start and end dates)
4. Scope of physical boundary chosen
 - (a) Location of the building(s)
 - (b) Description of the purpose of the building(s) or physical boundary chosen
Some possible descriptions are: (i) Dwelling; (ii) Retail; (iii) Restaurants; (iv) Hotel / hostel; (v) Residential; (vi) School; (vii) University; (viii) Sports complex; and (ix) Community centre
 - (c) Description of physical boundary with detailed information (including the respective construction floor areas) on the areas covered in the exercise by (i) Common areas (including common facilities); and (ii) Terrace areas.
 - (d) Description of areas excluded in the exercise.

Reporting Format (2)

5. Scope of operational boundary chosen
 - (a) Description of Scope 1 activities included and excluded
 - (b) Description of Scope 2 activities included and excluded
 - (c) Description of Scope 3 activities included
6. Methodologies for quantifying emissions and removals
 - (a) List of activities for which simplified methodologies and conversion factors in the guidelines are used for quantification
 - (b) Details (including necessary references) of other methodologies and conversion factors used for quantification
 - (c) Details of any changes in methodologies and conversion factors since the last report
 - (d) Details on any re-calculation of previously reported emissions and removals because of changes in methodologies and conversion factors
7. Information on GHG emissions and removals
8. Information on GHG emissions and removals over time
 - (a) Summary of the quantities and changes of GHG emissions and removals since the first report
 - (b) Details of any changes to previously-reported emissions and removals
9. Information on GHG offsets and programmes
 - (a) Description of GHG performance against internal and / or external benchmarks (if any) including any ratio indicators used
 - (b) Sectors and areas identified to improve GHG performance
 - (c) Description of activities / programmes to improve GHG performance including provision of in-site renewable energy sources and on-site offsetting activities. For example, if the reporting entity can only quantify the amount of paper waste recycled, the amount of GHG avoided due to recycling of paper waste can be reported here.
10. Other optional information
11. Contact person of the reporting entity
12. List of data sources, references, etc.

Final Reporting Table



Reporting Period	Scope 1 & 2 (Total)					Scope 3	Total
	2018	2019	2020	2021	2022		
GHG Emissions (tCO ₂ e)							
GHG Removals (tCO ₂ e)							
Net GHG Emissions (tCO ₂ e)							
GHG Intensity (tCO ₂ e/Revenue)							
GHG Intensity (tCO ₂ e/Operational Expenditure)							

Summary of Results

Summary of Results

Total Scope 1 Emissions: _____ Tonnes of CO₂ Equivalent

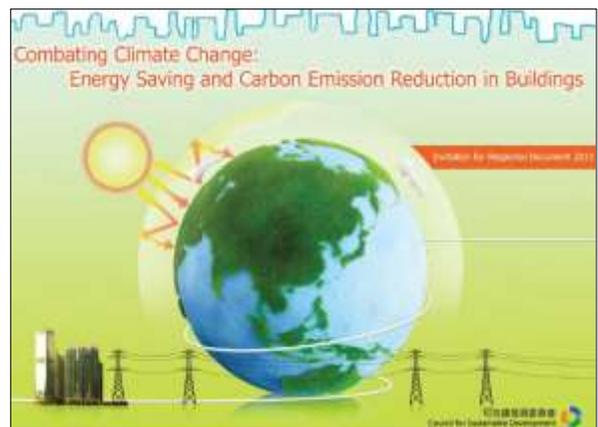
Total Scope 1 Removals: _____ Tonnes of CO₂ Equivalent

Total Scope 2 Emissions: _____ Tonnes of CO₂ Equivalent

Total Scope 3 Emissions: _____ Tonnes of CO₂ Equivalent

Total other GHG Offsets / Removals: _____ Tonnes of CO₂ Equivalent

GHG Performance in Ratio Indicator:



The End



Thank You