



# GUIDE TO LOW CARBON FIRE STATIONS

**Practical Guide** on  
Carbon Audit and Management



Consultant :  
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# About this Guide

» Climate change posed an unprecedented global challenge for everyone. Hong Kong is committed to contributing to the solution by taking community-wide actions to reduce greenhouse gases (GHG) emissions.

Carbon audit is an effective process to understand and measure our carbon footprint and a first step to identify appropriate carbon reduction measures.

This guide introduces the know-how of carbon audit and sets out the major steps of conducting a basic carbon audit for fire stations/ambulance depots.

A wide range of measures are also illustrated to facilitate fire stations/ambulance depots management to reduce carbon emissions and to save operation cost.



Read on if you want to:

- cut your energy bills;
- improve the condition of your equipment and facility at fire station;
- engage your staff on low carbon actions;
- enhance the efficiency of resource management; and
- contribute to the environment.

# Background

The Paris Agreement adopted in the 21st session of the Conference of Parties to the United Nations Framework Convention on Climate Change is a crucial step in forging global efforts in combating climate change. 195 countries have agreed to strive for the common goal of holding the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels. Countries should also strive to achieve carbon neutrality (i.e. no net carbon emissions to the atmosphere) by the second half of this century. With the positive outcome of the Paris Agreement, Hong Kong must ready itself for making greater efforts to combat climate change and reduce our carbon emissions.

Conducting carbon audit is a common first step of action. It helps assess the carbon performance and identify room for emission reduction in an organization. It is a cornerstone for saving energy as well as taking forward other low carbon and green measures.



This series of Practical Guides on Carbon Audit and Management outlines how an organisation can measure and manage its carbon footprint, and provide practical guides and examples for reference by the carbon audit practitioners and also the users of buildings and facilities. With content tailor-made for nine different types of premises and facilities, including offices, schools, swimming pools, community halls, etc, these Guidebooks would stimulate the collaboration across different sectors to drive Hong Kong's low carbon transformation.

The more that we are aware of our impact, the more prepared we can contribute to combating climate change. The Environment Bureau will continue to facilitate the public and private sectors to work together and to close the gap between awareness and action to build a low-carbon economy and a greener future for Hong Kong.



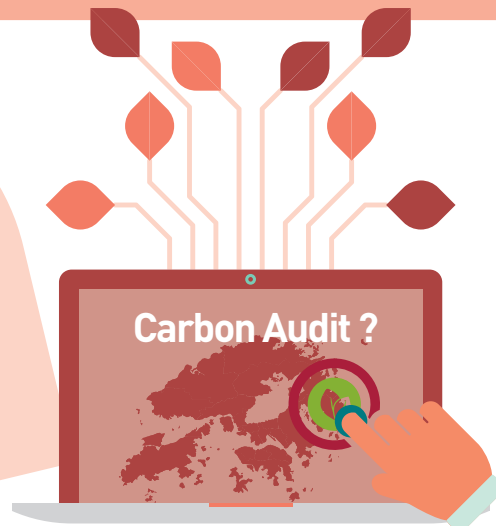
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# Introduction

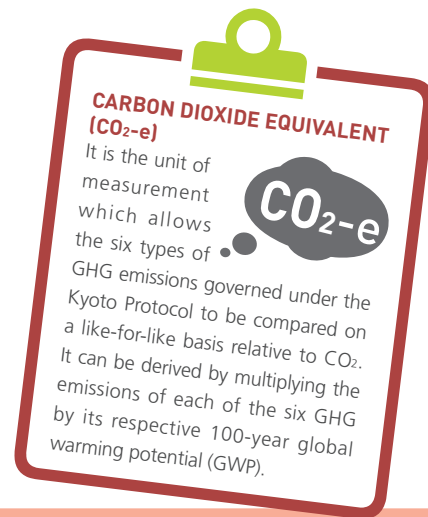
In this chapter we explain what **carbon audit** is and the benefits of doing so for fire stations/ ambulance depots



## What is Carbon Audit?

Excessive greenhouse gas (GHG) emissions cause climate change. This poses the largest threat ever to humankind worldwide. Governments and businesses around the world carry out a wide array of initiatives to reduce GHG emissions to combat climate change. These include advancing the use of renewable and cleaner energy sources, improving energy efficiency and encouraging better energy and carbon management

Carbon footprint refers to the total GHG emissions caused directly and indirectly by an organisation's activities. Carbon audit is a scientific means of quantifying an organisation's GHG emissions and a useful starting point for carbon management and reduction.

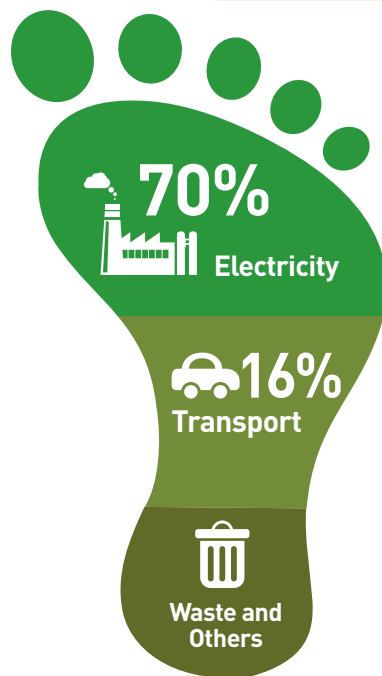


## Carbon Audit in Hong Kong

Hong Kong is a service economy with limited energy-intensive manufacturing. Nearly 70% of Hong Kong's GHG emissions are attributed to electricity generation. Transport sector comes next (~16%) and waste constitute ~5% of total emissions.

Buildings, including fire stations/ambulance depots, account for nearly 90% of electricity consumption. According to the Hong Kong Fire Services Department (HKFSD) Environmental Report 2013, the total consumption of electricity was 34,517,271 kWh, in which the Fire Services Headquarters (FSHQ) Building accounted for 6,343,785 kWh. The FSHQ is one of the major Government buildings with annual electricity consumption exceeding 500,000 kWh. If fire stations pursue better electricity consumption management and improve energy efficiency, this will not only cut their energy costs, but also effectively reduce Hong Kong's overall carbon emissions.

### HK's GHG Emissions by Sector in 2014\*



- HK's Total GHG Emissions in 2014:

**44,900** kilotonnes CO<sub>2</sub>-e

- HK's Emission per Capita in 2014:

**6.2** tonnes CO<sub>2</sub>-e

\* Provisional figures subject to revision



The Environmental Protection Department (EPD) and the Electrical and Mechanical Services Department (EMSD) have devised a set of Carbon Audit Guidelines to facilitate fire stations to calculate the GHG emissions from the operation and to identify areas of improvement.

**Read the Guidelines at :**

<https://www.climate-ready.gov.hk/page.php?id=56&lang=1>

To lead by example, the Government has:

- Rolled out energy-cum-carbon audits for more than 120 Government buildings and public facilities, including 22 fire stations and ambulance depots;
- Encouraged major Government buildings to carry out regular carbon audit to track the effectiveness of carbon reduction efforts;
- Conducted a “paper approach” carbon audit exercise for more than 40 major Government buildings in 2016/17; and
- Launched the Carbon Footprint Repository (CFR) ([www.carbon-footprint.hk/](http://www.carbon-footprint.hk/)) on 15 December 2014 for listed companies to disclose their carbon footprint.





Reduce Operational Cost



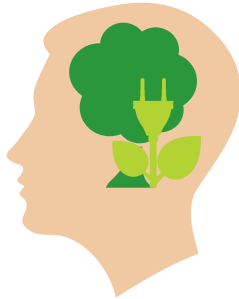
Improve Building's Image



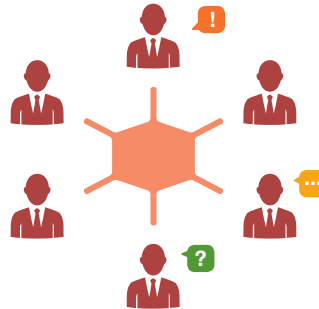
Demonstrate Environmental Responsibilities



## Managing And Reducing Your Carbon Footprint Can Bring About Many Advantages



Raise Staff Members'  
Environmental Awareness

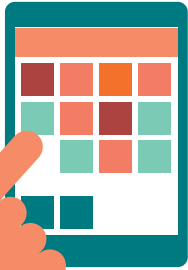


Meet Stakeholders' Expectation



Support Government's Reduction Target





# What is Carbon Audit

In this chapter we explain the major steps of conducting a carbon audit and the data needs to be collected by fire stations/ambulance depots for calculation

The major steps in conducting a carbon audit:



## STEP I. Define Physical and Operational Boundaries

An important first step is to set clear and explicit physical and operational boundaries of your fire station/ambulance depot that is included in the carbon audit.

### PHYSICAL BOUNDARY

Physical boundary refers to the physical area occupied by the organisation which usually matches the site boundaries of the fire station/ambulance depot concerned.

### OPERATIONAL BOUNDARY

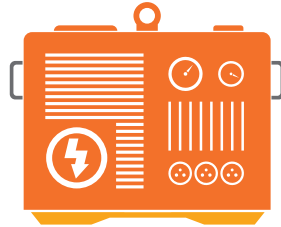
Operational boundary refers to the scope of emissions from activities under the fire station/ambulance depot's operational control. There are 3 scopes (Scope 1, 2 and 3) in accordance with the Guidelines.

## STEP II. Identify Emission Sources

### SCOPE 1: DIRECT EMISSIONS AND REMOVALS



Stationary source combustion:  
e.g. Towngas heaters and boilers/Gas heaters



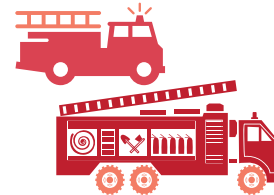
Stationary source combustion:  
e.g. Emergency electricity generators



Fugitive emissions from air  
conditioning/refrigeration  
systems/fire extinguishers



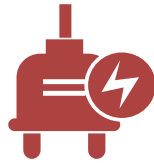
Newly planted trees that are able  
to reach at least 5 metres in  
height (\*Removal Source)



Mobile source combustion:  
e.g. Vehicles for operations

\* Based on the emission factor set out in the Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings (Commercial, Residential or Institutional Purposes) in Hong Kong published by the Environmental Protection Department in February 2010 (the Carbon Audit Guidelines), 23kg carbon dioxide will be removed by a newly planted tree that can reach at least 5m in height per year. Newly planted trees referred to those trees planted within the physical boundary of the audited buildings/premises after the beginning stage of construction of the concerned buildings/premises. Please refer to page 20 of the Carbon Audit Guidelines for details.

## SCOPE 2: ENERGY INDIRECT EMISSIONS



Electricity purchased



Towngas purchased

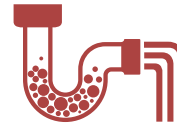
## SCOPE 3: OTHER INDIRECT EMISSIONS (Optional To Include)



Paper waste disposal



Fresh water consumption



Sewage discharge



Clinical/Chemical waste disposal



Emissions from hired transportation

## FIRE STATION ENERGY CONSUMPTION

The fire station/ambulance depot is a building that is in use 24 hours which naturally consumes a significant amount of energy. The carbon footprint is the calculation of carbon emissions produced from the consumption of energy at fire stations/ambulance depots. The following sources are the major contributors to carbon emissions in fire stations

- Electricity and Towngas;
- Mobile fuels delivered to the fire station's fuel tanks;
- Fuel supplied to fire appliances/ambulances, supporting vehicles and vessels (diesel, LPG, gasoline and petrol);
- Water consumption.



### STEP III. Data Collection

Once the emission sources are identified, the fire stations/ambulance depots should coordinate to collect and collate the following activity data associated with these sources. Where any data is not available, estimations and assumptions would have to be made.

#### ACTIVITY DATA TO BE COLLECTED

##### SCOPE 1: DIRECT EMISSIONS AND REMOVALS



Fuel consumption receipts/records/meter readings (e.g. Towngas, diesel oil, LPG gasoline or petrol for fire station/ambulance depot's vehicles and vessels)



Refrigerant and fire extinguisher purchase, storage and disposal records



Records of number of trees planted that are able to reach at least 5 metres in height within the physical boundary of the fire stations/ambulance depots

##### SCOPE 2: ENERGY INDIRECT EMISSIONS



Electricity bills/meter readings



Towngas bills/meter readings

##### SCOPE 3: OTHER INDIRECT EMISSIONS



Water bills



Paper purchase and recycling records



Hired transportation for passengers or for delivery of goods or services procured by the fire stations/ ambulance depots

## STEP IV. Apply Emission Factors for Calculation

The carbon footprint (measured in tonnes of CO<sub>2</sub>-e) is calculated by multiplying the activity data by the respective emission factor and the global warming potential (GWP) of the respective GHG emitted:

$$\text{CO}_2\text{-e} = \text{Activity Data} \times \text{Emission Factor} \times \text{Global Warming Potential}$$


For step-by-step guidance on calculation, please refer to Appendix A: Reporting Table Templates for Carbon Emission.

### EMISSION FACTOR

A factor which identifies the per kilogram carbon dioxide equivalent (CO<sub>2</sub>-e) arising from a particular activity.

Most of the emission factors are provided in the Carbon Audit Guidelines, or available in the latest Annual Reports/Sustainability Reports of the respective organisations.

The emission factor of electricity consumed is available from the Sustainability Reports of CLP Group<sup>1</sup> or The Hongkong Electric Co. Ltd<sup>2</sup>, depending on where your fire station/ambulance depot is located.

For example, if the electricity consumption of a fire station/ambulance depot located in New Territories is 10,000kWh in 2014, the emission factor of CLP in 2014 (i.e. 0.64 kgCO<sub>2</sub>-e/kWh) should be used. [2014 GHG emission (tonnes CO<sub>2</sub>-e): =10,000 kWh (activity data) x 0.64kgCO<sub>2</sub>-e/kWh (emission factor) x 1 (global warming potential of CO<sub>2</sub>) = 6.4 tonnes CO<sub>2</sub>-e]

### GLOBAL WARMING POTENTIAL

Global warming potential (GWP) is a quantified measure of the globally averaged relative radioactive forcing impacts of a particular GHG. Carbon dioxide was chosen as the reference gas and its GWP is set to 1.

The GWP of the major GHG covered in the Carbon Audit Guidelines are:

- carbon dioxide (CO<sub>2</sub>): 1
- methane (CH<sub>4</sub>): 21
- nitrous oxide (N<sub>2</sub>O): 310

1. Sustainability reports of CLP Group  
<https://www.clpgroup.com/en/sustainability/sustainability-reports>

2. Sustainability reports of The Hongkong Electric Co. Ltd.  
<https://www.hkelectric.com/en/corporate-social-responsibility/sustainability-reports>

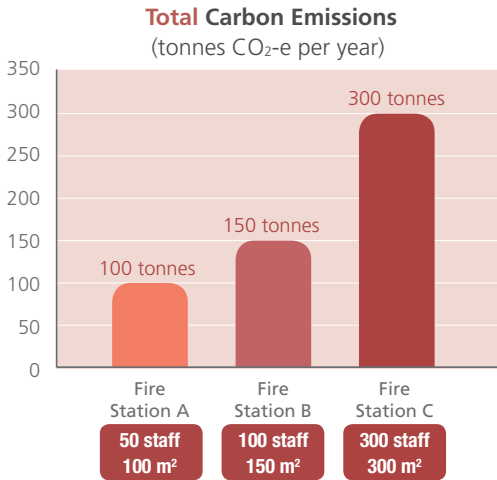
## STEP V. Report and Disclose

Communicating your carbon footprint helps engage your internal stakeholders (staff members, appointed officials and other fire and emergency services agencies) and external stakeholders (suppliers and communities) about the fire station/ambulance depot's impact to climate change and motivate them to take carbon reduction measures.

You can use an appropriate ratio indicator to represent the fire station/ambulance depot's carbon footprint in proportion to a

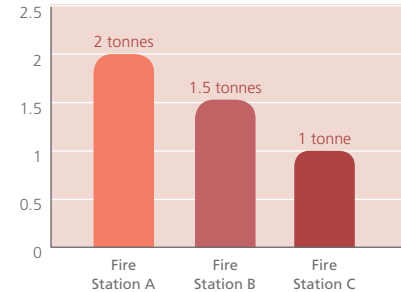
defined operational measuring unit, for example, GHG emissions per fire station floor area, GHG emissions per staff or scope 1 emissions per distance travelled are some ratio indicators applicable for fire stations.

For more benchmarking references, please refer to Appendix B: Performance Indicator References for Energy Consumption.



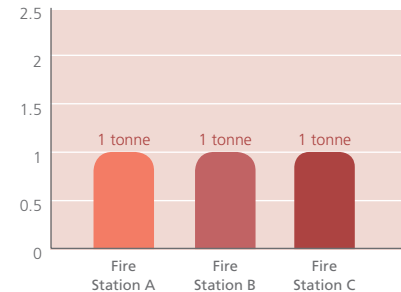
### Normalised Total Carbon Emissions

(tonnes CO<sub>2</sub>-e per year per staff)

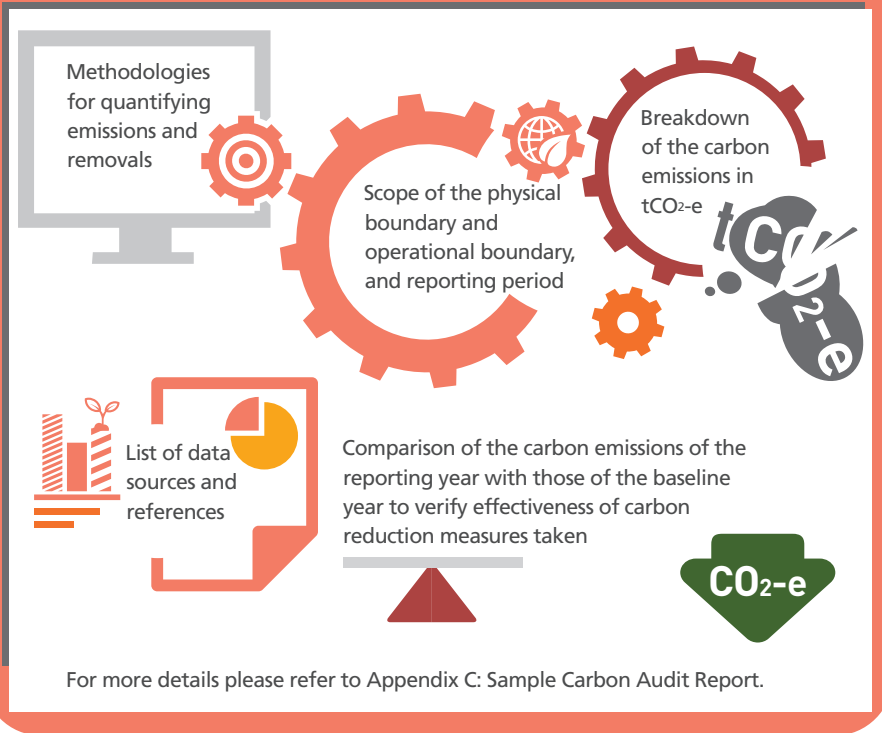


### Normalised Total Carbon Emissions

(tonnes CO<sub>2</sub>-e per year per m<sup>2</sup>)



An audit report may include the following information:



## SEEK INDEPENDENT VERIFICATION

You can add credibility to your audit report findings through employing a qualified 3rd party to verify whether the carbon audit process adheres to the principles of relevance, completeness, consistency, transparency and accuracy.

## WAYS OF CARBON DISCLOSURE

- Communicate with staff through trainings and internal newsletter
- Communicate with suppliers and communities through posters, promotion or exhibitions
- For government fire stations/ambulance depots, disclose the carbon audit results and findings in the Department's annual Environmental Report

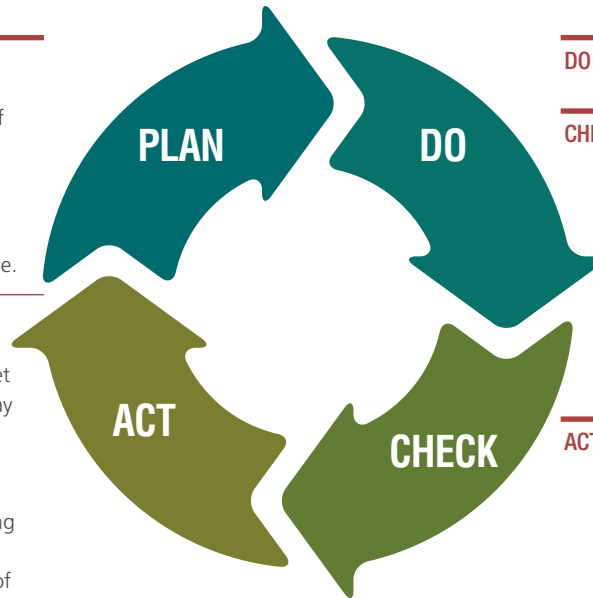


## WHAT'S NEXT AFTER CARBON AUDIT? CARBON MANAGEMENT

Fire stations/ambulance depots need good carbon management for continual improvement in carbon reduction. The ISO (the International Organisation for Standardisation) specifies a Plan-Do-Check-Act (PDCA) management framework to incorporate carbon and energy management into daily organisation practices.

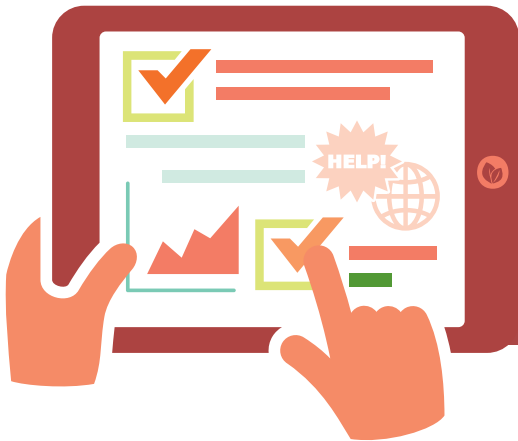
### Carbon Management Framework

- PLAN** **STEP 1 Establishing a Carbon Management Policy**
- Demonstrate the commitment of management of fire station/ ambulance depot to carbon management
  - Set objectives and targets for improvement against the baseline.
- STEP 2 Establishing a Carbon Reduction Plan**
- Establish a plan to achieve the set objectives and targets, which may include better management practices, minor hardware retrofitting, and engineering improvement works or retrofitting with more energy efficient installations upon “end of life” of existing installations.



- DO** **STEP 3 Implementing the Carbon Reduction Plan**
- CHECK** **STEP 4 Conducting Regular Carbon Audit**
- Set up systematic procedures for monitoring of carbon emissions and the effectiveness of the reduction measures
  - Make adjustments when the fire station/ambulance depot is not progressing well towards the reduction objectives
- ACT** **STEP 5 Maintaining the Carbon Reduction Plan**
- Review audit findings by the management of fire station/ambulance depot to ensure its continuing suitability, adequacy and effectiveness for continual improvement
  - Communicate reduction success with internal and external stakeholders





# Checklist for Conducting Carbon Audit



To gauge the readiness of a fire station/ambulance depot for conducting carbon audit, the management and/or administrator can complete the below checklist for quick assessment and start gathering the information as listed to facilitate an effective carbon audit process.



Yes / No / Not Applicable

FACILITIES INFORMATION (ESSENTIAL INFORMATION)		
1	Is the following information/data available?	
a)	Gross Floor Area, m <sup>2</sup>	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
b)	No. of staff	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
c)	No. of vehicles and vessels	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
d)	Fire station/ambulance depot layout plan or floor plan to show owned/controllable indoor, outdoor and communal area	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
e)	No. of calls records (fire calls, special service call or ambulance call)	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
SCOPE 1: DIRECT EMISSIONS AND REMOVALS		
2	If there is any machine or equipment in the fire station/ambulance depot operated by fuel, is there any record of the type and amount of fuel consumed by these machines or equipment for the last 12 months?	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3	If there is any fire station/ambulance depot-owned vehicle associated with the operation of the fire station/ambulance depot, is there any record of the type and amount of fuel consumed by these vehicles for the last 12 months?	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
4	Any record of type (i.e. HFC/PFC) and amount of refrigerants consumed by the air-conditioning/refrigeration equipment in the fire station/ambulance depot for the last 12 months?	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
5	Any record of new trees planted/removed from the fire station/ambulance depot? (Only apply to trees that can grow taller than 5m in height)	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>



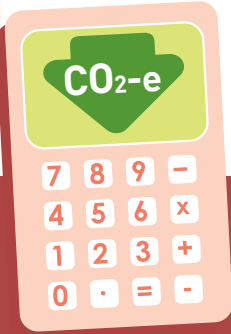
Yes / No / Not Applicable

## SCOPE 2: ENERGY INDIRECT EMISSIONS

6	Any electricity bill of the fire station/ambulance depot for the last 12 months?	
7	Any Towngas bill of the fire station/ambulance depot for the last 12 months?	
8	<b>Optional Information:</b> Any meter installed to measure electricity consumption at different floors/zones	
9	Any individual electricity consumption record for below electrical appliances?	
	<input type="checkbox"/> Air-conditioning <input type="checkbox"/> Lighting <input type="checkbox"/> Equipment (e.g Water Heating, Sterilisation, etc.)	
	<input type="checkbox"/> Boiler <input type="checkbox"/> Elevator <input type="checkbox"/> Chiller	
10	Any inventory of below equipment?	
	<input type="checkbox"/> Lighting <input type="checkbox"/> Equipment <input type="checkbox"/> Servers	

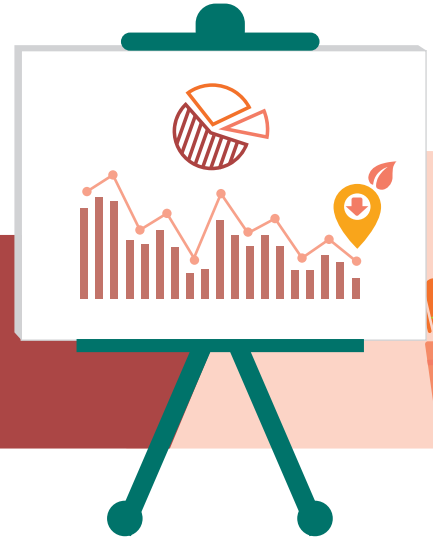
## SCOPE 3: OTHER INDIRECT EMISSIONS (OPTIONAL)

11	Any receipt/record of amount of paper stored, used and recycled in the fire station/ambulance depot for the last 12 months?	
12	Any water bill of the fire station/ambulance depot for the last 12 months?	
13	Any purchase record showing quantity and size of carboys for drinkable water consumption?	
14	Any record of overseas business travel of staff for the last 12 months showing means of transportation, number of trips, origin and destination?	
15	Any record of flight carbon offsetting?	
16	If there is any hired vehicle associated with the operation of the fire station/ambulance depot, is there any record of the type and amount of fuel consumed by these vehicles for the last 12 months?	
17	Any record of clinical/chemical waste trip ticket?	



# How to Reduce Carbon Emissions

In this chapter we introduce feasible measures and information that would make carbon reduction and savings possible for fire stations/ambulance depots. Many of them are simple, straightforward actions that won't cost you anything.






Reduction Potential		Capital Investment		Ease of Implementation	
	Significant		Significant or long term		Relatively complex transformation or hardware installation/Involve many stakeholders/Implement upon "end of life" of existing installations
	Moderate		Moderate		Need careful planning before implement due to potential impact to operation
	Minor		Minor		Ready-to-implement housekeeping measures which cause no disruption to operation
		Nil	No Cost		

































# Sector-specific Carbon Reduction Initiatives for Fire Stations



Sector-specific Carbon Reduction Initiatives	Reduction Potential	Capital Investment	Ease of Implementation
<b>Lighting System</b>	to	Nil to \$ \$ \$	to
<ul style="list-style-type: none"> <li>Consider a lower and appropriate lighting level for lobby, corridors, storerooms, common rooms, kitchens, bathrooms/ changing rooms and apparatus bays</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Install occupancy/motion sensors in areas not frequently used (e.g. backstairs, storage rooms)</li> </ul>		\$ \$	
<ul style="list-style-type: none"> <li>Install light sensors to optimise the use of artificial lighting when there is sufficient natural daylight (e.g. day rooms, living areas, gyms, canteens, leisure areas)</li> </ul>		\$ \$	



	Reduction Potential	Capital Investment	Ease of Implementation
<b>Sector-specific Carbon Reduction Initiatives</b>	to 	Nil to   	 to   
<b>Fire Service Equipment</b>			
<ul style="list-style-type: none"> <li>Enable the standby or low power modes for equipment where feasible</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Maintain regularly the equipment to keep their moving parts clean and free of dusts to maintain optimal efficiency</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Switch off equipment and sterilisers when not in-use</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Set timers to operate the equipment at programmed times through a week only</li> </ul>			 
<b>Catering Facilities</b>			
<ul style="list-style-type: none"> <li>Reduce use of disposable and non-recyclable eating utensils</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Educate staff and visitors not to waste food</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Offer "low carbon menu" or locally grown/produced ingredients</li> </ul>			
<ul style="list-style-type: none"> <li>Keep fridge and freezer doors shut and defrost regularly</li> </ul>			
<ul style="list-style-type: none"> <li>Install food waste composters for converting food waste into fertilisers</li> </ul>		  	  
<ul style="list-style-type: none"> <li>Use energy-efficient liquid chilling systems for food preservation</li> </ul>		  	 

Sector-specific Carbon Reduction Initiatives	Reduction Potential	Capital Investment	Ease of Implementation
	 to 	Nil to   	 to   
<b>Vehicle Management</b>			
<ul style="list-style-type: none"> <li>Instruct contractors to optimise the route planning/scheduling for the delivery service</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Instruct contractors to keep their fleet properly tuned: inefficient car will use more fuel and emit more pollutants</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Instruct contractors to maintain correct tyre pressure by regular inspection and inflation</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Ensure no idling vehicles with running engines</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Install fuel monitoring equipment on vehicles</li> </ul>			
<ul style="list-style-type: none"> <li>Adopt electric or hybrid vehicles</li> </ul>		  	  
<ul style="list-style-type: none"> <li>Use biodiesel for vehicles</li> </ul>		  	

Keep your vehicles' tires properly inflated can save up to 180-320 kg of CO<sub>2</sub> per year.

According to a research result from University of Idaho, use of bio-diesel B20 reduces carbon dioxide emissions by 15% compared with petroleum diesel.




































## General Carbon Reduction Initiatives

	Reduction Potential	Capital Investment	Ease of Implementation
	 to 	Nil to   	 to   
Lighting System			
• Switch off lighting when sections are not in use		Nil	
• Maximise use of natural light as far as practicable		Nil	
• Keep light fixtures and lamps clean and well-maintained to maximise their efficiency		Nil	
• Use LED emergency exit signs			
• Use mirror reflectors to redirect most of the light emitted towards the area to be illuminated		 	 
• Adopt photocells and/or timer control for external lighting		 	 
• Separate light switches for different light zones			 
• Use electronic ballasts to replace electromagnetic ballasts			 
• De-lamp for areas with higher-than-required lighting level		Nil	
• Adopt energy efficient lighting (e.g. T5 fluorescent lamps and LED)		 	  

A T5 with electronic ballast saves 30% of CO<sub>2</sub> compared with a T8 fitted with electromagnetic ballast.

75% of the electricity used to power electronics and appliances is consumed while the products are turned off.



























General Carbon Reduction Initiatives	Reduction Potential	Capital Investment	Ease of Implementation
	 to 	Nil to   	 to   
<b>Heating, Ventilation and Air Conditioning (HVAC) System</b>			
<ul style="list-style-type: none"> <li>Avoid installing air-conditioners with direct sunlight exposure</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Clean filters/fan coil units regularly</li> </ul>			 
<ul style="list-style-type: none"> <li>Place weather strips on doors and windows to prevent leakage of conditioned air</li> </ul>			 
<ul style="list-style-type: none"> <li>Carry out regular leakage checks and replacement of pressure gauges, pressure hose and connectors of air compressors to reduce possible leakage of refrigerants</li> </ul>			 
<ul style="list-style-type: none"> <li>Ensure system operating mode match the actual requirements, as they vary throughout the day</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Set timers at different sections to operate the HVAC system only when it is occupied</li> </ul>			
<ul style="list-style-type: none"> <li>Apply anti-ultraviolet films on windows to reduce heat gain</li> </ul>		 	 

Implement roof top greening can help to minimise the heat absorption on concrete surfaces and cool down the environment.




























It is estimated that solar heat gain through glazing can account for 15%-20% of the air conditioning cooling load.

By reducing the shading coefficient (SC) to half of its original value, can save 4%-5% of annual air-conditioning electricity consumption.



General Carbon Reduction Initiatives	Reduction Potential	Capital Investment	Ease of Implementation
	to 	Nil to 	 to 
<b>Heating, Ventilation and Air Conditioning (HVAC) System</b>			
• Use low-e glass to block heat-generating ultraviolet light			
• Use Variable Refrigerant Volume (VRV) to optimise refrigerant flow			
• Adopt Central Control and Monitoring System (CCMS) or Building Management System (BMS)			
• Use split-type air conditioners with Grade 1 Energy Efficiency Label			
• Adopt water-cooled air conditioning systems			
• Install unclosed door alert/hydraulic door closer to avoid escape of cooled air			
• Use thermal wheels or heat pipes to facilitate heat recovery between the air intake and exhaust air			
• Use automatic tube cleaning systems in condenser			
• Install high efficiency Electronically-Commutated Permanent Magnet Motor (ECPM) for chillers to save energy			





















General Carbon Reduction Initiatives	Reduction Potential  to 	Capital Investment Nil to    	Ease of Implementation  to   
<b>Paper Consumption</b>			
• Reuse paper or use paper on both sides, wherever possible		Nil	
• Set computers and printers to default duplex and economical modes		Nil	
• Disseminate information by electronic means wherever possible to reduce paper use		Nil	
• Use smaller fonts and line spacing for documents that must be printed		Nil	
• Use e-fax to screen junk fax		Nil	
• Cease internal circulation of hardcopies of shift table, telephone directory, memo, meeting minutes, etc. to reduce paper consumption		Nil	
• Purchase printing paper, toilet paper and paper towels with recycled content or sustainable sources (e.g. FSC™, PEFC, SFI)		 	 
• Use electronic system to substitute paper-based office administration systems or filing system		 	 

General Carbon Reduction Initiatives	Reduction Potential	Capital Investment	Ease of Implementation
	 to 	Nil to    	 to   
<b>Water Consumption</b>			
• Fix dripping taps immediately		Nil	
• Recycle and reuse grey water for cleaning and irrigation		Nil	 
• Carry out regular leakage tests on concealed piping and check for overflowing tank			
• Install water saving devices for water taps			
• Use dual-flush toilets		 	 
• Use faucets and urinals with infrared sensors		 	 
• Install automatic sensor water taps		 	 
• Use products with Grade 1 Water Efficiency Labels, such as water taps, washing machines, urinal equipment and flow controllers		 	 

Turn off the shower after soaping up, then turn it back on to rinse. A four-minute shower uses approximately 75 to 150 litre of water.

Compared to virgin paper, each tonne (1000kg) of recycled paper can save 17 trees, 380 gallons of oil, three cubic yards of landfill space, 4000 kilowatts of energy, and 7000 gallons of water.





























Automatic sensor water taps not only more hygienic, it also able to save up to 70% on water conservation when compared with manual activated taps.

General Carbon Reduction Initiatives	Reduction Potential	Capital Investment	Ease of Implementation
		Nil to 	
<b>Boilers and Pipework</b>			
<ul style="list-style-type: none"> <li>Optimise pressure level and operation of gas boilers during non-peak hours</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Maintain boilers regularly</li> </ul>			
<ul style="list-style-type: none"> <li>Insulate boilers, hot water tanks, pipes and valves properly to prevent heat escaping</li> </ul>			
<ul style="list-style-type: none"> <li>Install energy efficient boilers for heating water</li> </ul>			
<ul style="list-style-type: none"> <li>Install electronic de-scaling devices for gas boilers</li> </ul>			
<ul style="list-style-type: none"> <li>Replace relatively lower efficiency pump motors to high efficiency motors (e.g. Class EFF1)</li> </ul>			

Lighting accounts for about 40% of the electric energy use of a typical commercial facility. Daylighting can have a significant impact on the energy use of a building. With new technologies lighting such as high efficiency T5; LED and Daylight control systems, building can reach up to a 60% reduction in lighting power use during daylight hours.

Compared with old furnace and boiler system, a high-energy efficiency boiler can reduce towngas consumption up to 20% and maintain a 90% - 98.5% annual fuel utilisation efficiency.

A Grade 1 air conditioner saves up to 29% of energy and CO<sub>2</sub> comparing to a Grade 5 model. Up to \$480 in electricity cost can be saved per year.

General Carbon Reduction Initiatives	Reduction Potential	Capital Investment	Ease of Implementation
	 to 	Nil to   	 to   
<b>Lifts</b>			
<ul style="list-style-type: none"> <li>Shut down idled lifts during off peak hours</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Shut off ventilation fans for idled lift cars</li> </ul>			
<ul style="list-style-type: none"> <li>Use Variable Voltage Variable Frequency (VVVF) controllers or energy optimisers to optimise energy consumption and reduce wear and tear of lift system</li> </ul>		  	  
<ul style="list-style-type: none"> <li>Install energy re-generation systems in elevators to convert potential energy generated from the movement of the elevators to electrical energy</li> </ul>		  	  

A 15-second lift journey consumes as much energy as a 60W light bulb does in an hour.

Compared to conventional lifts, regenerative lifts are 20% to 30% more energy efficient

Leaving a computer on overnight for a year creates enough CO<sub>2</sub> to fill a double decker bus.

Only 5% of the power drawn by a phone charger is used to charge the phone. The other 95% is wasted when it is left plugged in.

General Carbon Reduction Initiatives	Reduction Potential 	Capital Investment Nil to 	Ease of Implementation 
<b>Staff and Community Engagement</b>			
<ul style="list-style-type: none"> <li>Affix energy saving, water saving and paper saving labels to raise staff's awareness</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Encourage staff to join environmental activities organised by green groups</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Encourage the use of staircase instead of taking the lift for inter-floor traffic</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Integrate environmental policy and action into staff's daily training</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Reduce use of disposable and non-recyclable product</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Educate staff and facility users not to waste food</li> </ul>		Nil	
<ul style="list-style-type: none"> <li>Train staff with basic carbon audit techniques to facilitate the continual monitoring of carbon emission of premises</li> </ul>			
<ul style="list-style-type: none"> <li>Promote carbon reduction to staff through organising energy saving/carbon reduction campaigns</li> </ul>			
<ul style="list-style-type: none"> <li>Provide more recycling bins for waste separation and recycling</li> </ul>			
<ul style="list-style-type: none"> <li>Encourage staff to purchase locally grown/produced ingredients instead of imported food</li> </ul>			
<ul style="list-style-type: none"> <li>Encourage staff to re-use equipment, uniform and material that retired/left the service in training</li> </ul>			
<ul style="list-style-type: none"> <li>Use energy-efficient liquid chilling systems for food preservation</li> </ul>			

	Reduction Potential	Capital Investment	Ease of Implementation
<b>General Carbon Reduction Initiatives</b>	leaves to	Nil to	to
<b>Fire Station/Ambulance Depot Greening</b>			
<ul style="list-style-type: none"> <li>Plant trees</li> </ul>			
<ul style="list-style-type: none"> <li>Appoint certified arborists for proper tree management</li> </ul>			
<ul style="list-style-type: none"> <li>Set up a green roof and/or green walls</li> </ul>			
<b>Renewable Energy Demonstration</b>			
<ul style="list-style-type: none"> <li>Install sunlight tracking bulbs to transmit solar energy to support the lighting of space</li> </ul>			
<ul style="list-style-type: none"> <li>Install solar panels on roof top or thin film transparent type solar cells on windows</li> </ul>			
<ul style="list-style-type: none"> <li>Install vertical or horizontal wind turbines for generating electrical energy</li> </ul>			

Leaving your fan running overnight over the summer wastes enough energy to:

- run an LCD TV over the same period.
- power your smartphone for 25 years.
- power your laptop for a year.

Bigger does not mean better. An oversized air conditioner is less energy efficient, more expensive and have a shorter lifespan due to constant starting and stopping.

It is a misunderstanding that turning lights off and then back on uses more energy than leaving them on all the time.



# Case Studies of Carbon Reduction Initiatives adopted in Government Buildings and Public Facilities



## Case Study 1: Service-on-demand escalator

Installation of service-on-demand escalators in the building, including both automatic start/stop and two-speed controls

### Energy Saving:

Up to 52% and 14% energy saving for the automatic start/stop and two-speed controls escalators respectively.\*



Service-on-demand escalators with passenger sensing post

## Case Study 2: Variable speed drive

Adoption of variable speed drive (VSD) in Heating, Ventilation and Air Conditioning (HVAC) system

### Energy Saving:

Around 5% of total energy saving of the premises depends on the operational characteristics.\*



VSD installed in HVAC system

## Case Study 3: High efficiency type air-cooled chillers

Replacement of existing air-cooled chillers by high efficiency type air-cooled chillers

### Energy Saving:

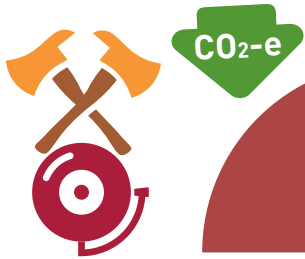
Around 20% of total energy saving of the premises depends on the operational characteristics.\*



High efficiency air-cooled chiller

\* Variation of energy saving level depends on the size and operational characteristics of the premises.





# Case Study

In this chapter we highlight exemplary practices of carbon and environmental management of selected fire stations/ambulance depots



## 1. Kai Tak Fire Station

### Profile

- Kai Tak Fire Station provides fire and emergency ambulance services for the Kai Tak Cruise Terminal and Kai Tak Development area
- The fire station has an area of 2,250 square metres and is of six-storey. It comprises a four-bay appliance room with ancillary and supporting facilities
- The fire station has obtained provisional Platinum rating in “Building Environmental Assessment Method (BEAM) Plus New Buildings” of the Hong Kong Green Building Council

### Key Initiatives

- Installation of around 43% of green coverage through multiple planters, vertical greening and green roofs, which is double the minimum requirement (20%) for government buildings
- Introducing natural daylight into the interior space as far as possible through large windows and skylights composed of heat insulating glass, solar tubes and provision of balconies
- Installation of sun-shading fins on the west-facing external wall to minimise energy consumption of the air-conditioning system
- Use of water permeable paving blocks made of recycled materials on the external ground
- Adoption of motion sensors to optimise lighting use



Being resource efficient, energy-saving and reducing waste are our priorities in protecting the environment. Climate change is affecting everyone, we can take steps to make a difference.

**Mr. Ng Ka Lok,**

Senior Station Office, Fire Services Department — Kai Tak Fire Station



# Useful Resources



## A. General References (in alphabetical order)

- Carbon Reduction Certificates Scheme of Hong Kong Awards for Environmental Excellence (HKAEE)  
    ↳ [http://www.hkaee.gov.hk/english/category/carbonless\\_cert/28.html](http://www.hkaee.gov.hk/english/category/carbonless_cert/28.html)
- ISO 14064-1:2006 Greenhouse gases — Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals  
    ↳ [http://www.iso.org/iso/catalogue\\_detail?csnumber=38381](http://www.iso.org/iso/catalogue_detail?csnumber=38381)
- Greenhouse gas emissions and carbon intensity  
    ↳ [https://www.climateready.gov.hk/files/pdf/HKGHG\\_CarbonIntensity\\_201612.pdf](https://www.climateready.gov.hk/files/pdf/HKGHG_CarbonIntensity_201612.pdf)
- Greenhouse gas emissions by sector  
    ↳ [https://www.climateready.gov.hk/files/pdf/HKGHG\\_Sectors\\_201612.pdf](https://www.climateready.gov.hk/files/pdf/HKGHG_Sectors_201612.pdf)
- Greenhouse gas emission trend  
    ↳ [https://www.climateready.gov.hk/files/pdf/HKGHG\\_Trend\\_201612.pdf](https://www.climateready.gov.hk/files/pdf/HKGHG_Trend_201612.pdf)
- Guidelines to Account for And Report on Greenhouse Gas Emissions and Removals for Buildings in Hong Kong  
    ↳ <https://www.climateready.gov.hk/page.php?id=56&lang=1>

- HK EE Net  
 ↘ <http://ee.emsd.gov.hk/eindex.html>
- The GHG Protocol — Corporate Accounting and Reporting Standard  
 ↘ <http://www.ghgprotocol.org>



## » B. Fire Station/Ambulance Depot Specific References (in alphabetical order)

- Alaska, Saint Paul Fire Station — Energy Audit (Final Report)  
 ↘ <http://www.akenergyefficiency.org/wp-content/uploads/2013/05/ALEUT-Nortech-SNP-Fire-Station.pdf>
- Assessment of the Carbon Footprint of the Bomberos of Costa Rica  
 ↘ [http://web.cs.wpi.edu/~rek/Projects/Bomberos\\_B12.pdf](http://web.cs.wpi.edu/~rek/Projects/Bomberos_B12.pdf)
- Carbon Trust — Greater Manchester Fire & Rescue Service — Carbon Management  
 ↘ <http://www.carbontrust.com/our-clients/g/greater-manchester-fire-and-rescue-service/>
- Energy Saver — Furnaces and Boilers  
 ↘ <http://energy.gov/energysaver/furnaces-and-boilers>
- Essex County Fire & Rescue Service — Environmental Performance Report (April 2011 to Mar 2012)  
 ↘ [http://www.essex-fire.gov.uk/images/efa/Agenda\\_Item\\_7\\_APPX\\_Environmental\\_Performance\\_report\\_april\\_2011-\\_march\\_2012.pdf](http://www.essex-fire.gov.uk/images/efa/Agenda_Item_7_APPX_Environmental_Performance_report_april_2011-_march_2012.pdf)
- Global Warming and the Fire Service — The Local View in Asia (02 April, 2008)  
 ↘ [http://www.hemmingfire.com/news/archivestory.php/aid/62/Global\\_warming\\_and\\_the\\_fire\\_service\\_\\_96\\_the\\_local\\_view\\_in\\_Asia.html](http://www.hemmingfire.com/news/archivestory.php/aid/62/Global_warming_and_the_fire_service__96_the_local_view_in_Asia.html)

- Hong Kong Fire Service Department — Environmental Report  
 ↘ <http://www.hkfsd.gov.hk/eng/publications.html>
- Scottish Fire and Rescue Services — Environmental Performance Review 2009/10  
 ↘ <http://www.gov.scot/resource/doc/921/0108216.pdf>
- San Francisco Fire Department — Departmental Climate Action Plan (2011-2012)  
 ↘ [http://sfenvironment.org/sites/default/files/fliers/files/sfe\\_cc\\_2013\\_fd\\_cap\\_fy1112.pdf](http://sfenvironment.org/sites/default/files/fliers/files/sfe_cc_2013_fd_cap_fy1112.pdf)
- Seattle Government — Integrated Lighting for Fire Stations: Daylighting and Electric Lighting Strategies  
 ↘ [http://www.seattle.gov/Documents/Departments/FireLevy/Consultants/Sustainability\\_TBDaylight.pdf](http://www.seattle.gov/Documents/Departments/FireLevy/Consultants/Sustainability_TBDaylight.pdf)
- Town of Windham North Fire Station Energy Assessment Report  
 ↘ <http://www.windhammaine.us/DocumentCenter/View/420>



## C. Carbon Calculators

There is a wide range of calculators available which help individuals and organisations to measure their carbon footprints. These calculators also provide useful information about carbon reduction. Some examples (in alphabetical order) are provided below:



#### For general use internationally

- Calculation Tools — The Greenhouse Gas Protocol Initiative  
    ↘ <http://www.ghgprotocol.org/calculation-tools>

#### For local household and personal use

- Carbon Calculator — Hong Kong And China Gas Company Limited  
    ↘ <http://www.lowcarbonaction.com/en/footprint.aspx>

#### For local household

- Carbon Calculator — The Hongkong Electric Co. Ltd  
    ↘ <https://www.hkelectric.com/en/customer-services/carbon-calculator>

#### For local household, retail, catering, school and office

- Carbon Manager — The Council for Sustainable Development  
    ↘ <http://carbon-manager.hkpc.org/website/eng/index.asp>

#### For local enterprises, especially SMEs

- CGCC-Carbon Management Tool — The Chinese General Chamber of Commerce  
    ↘ <http://cmt.cgcc.org.hk/eng/home.html>

#### For local household and personal use

- One Tonne Challenge Calculator — Kadoorie Farm and Botanic Garden (KFBG) Corporation  
    ↘ <http://www.climatechange.hk/eng/join-now.aspx>

#### For buildings of commercial, residential or institutional purposes

- Electronic version (Excel) of template for conducting carbon audit and for reporting the findings  
    ↘ <https://www.carbon-footprint.hk/node/52>



An electronic version of this reporting template is available from EPD's Carbon Footprint Repository (CFR) Website: <https://www.carbon-footprint.hk/node/52>

The electronic version has built in all the emission factors and formulas for calculating GHG emissions arising from different sources, and that EPD will review and update the relevant emission factors used in this electronic version on a regular basis.

**Table 1: GHG Emissions from Stationary Sources**

Step 1	Step 2			Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
A	B	C	D	E	F	G	H	I	J
Source description with location (e.g. boilers, furnaces, ovens and emergency electricity generator etc.)	Fuel Information			CO <sub>2</sub> emission factor <i>Note 2</i>	CO <sub>2</sub> emissions in tonnes of CO <sub>2</sub> equivalent $((B \times E) / 1000)$	CH <sub>4</sub> emission factor <i>Note 3</i>	CH <sub>4</sub> emissions in tonnes of CO <sub>2</sub> equivalent $((B \times G) / (1000 \times 1000) \times GWP \text{ Note 4})$	N <sub>2</sub> O emission factor <i>Note 3</i>	N <sub>2</sub> O emissions in tonnes of CO <sub>2</sub> equivalent $((B \times I) / (1000 \times 1000) \times GWP \text{ Note 4})$
	Fuel used		Fuel type <i>Note 2</i>						
	Amount	Unit <i>Note 1</i>							
<b>Total</b>									

Please insert more rows as necessary

**IMPORTANT: Combustion of Towngas from stationary sources should also be reported in Table 1 (refer to Tables 1-1 to 1-3 for the emission factors) as it falls into the category of direct emissions. Indirect emission of purchased Towngas should be calculated in Table 5.**

Note 1: Select the appropriate fuel unit

Note 2: Select the appropriate fuel type and the corresponding emission factor (from Table 1-1) for calculation

Note 3: Refer to Table 1-2 for calculating CH<sub>4</sub> emissions and Table 1-3 for N<sub>2</sub>O emissions

Note 4: Global Warming Potential (GWP) of CH<sub>4</sub> is 21 while it is 310 for N<sub>2</sub>O

## Emission Factors for Stationary Combustion Sources

**Table 1-1 CO<sub>2</sub> Emission Factor by fuel type**

Fuel Type	Emission Factor	Unit
Diesel Oil	2.614	kg/litre
LPG	3.017	kg/kg
Kerosene	2.429	kg/litre
Charcoal	2.970	kg/kg
Towngas	2.549	kg/Unit

**Table 1-2 CH<sub>4</sub> Emission Factor by fuel type**

Fuel Type	Emission Factor	Unit
Diesel Oil	0.0239	g/litre
LPG	0.0020	g/kg
Kerosene	0.0241	g/litre
Charcoal	5.5290	g/kg
Towngas	0.0446	g/Unit

**Table 1-3 N<sub>2</sub>O Emission Factor by fuel type**

Fuel Type	Emission Factor	Unit
Diesel Oil	0.0074	g/litre
LPG	0.0000	g/kg
Kerosene	0.0076	g/litre
Charcoal	0.0276	g/kg
Towngas	0.0099	g/Unit

\* For the most updated figures, please refer to <https://www.climateready.gov.hk/page.php?id=56&lang=1>

**Table 2: GHG Emissions from the Mobile Sources**

Step 1	Step 2		Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
A	B	C	D	E	F	G	H	I
Source description (by different vehicle and fuel types)	Fuel Information		CO <sub>2</sub> emission factor <small>Note 1</small>	CO <sub>2</sub> emissions in tonnes of CO <sub>2</sub> equivalent ((BxD)/1000)	CH <sub>4</sub> emission factor <small>Note 2</small>	CH <sub>4</sub> emissions in tonnes of CO <sub>2</sub> equivalent ((BxF)/(1000x1000) x GWP <small>Note 4</small> )	N <sub>2</sub> O emission factor <small>Note 3</small>	N <sub>2</sub> O emissions in tonnes of CO <sub>2</sub> equivalent ((BxH)/(1000x1000) x GWP <small>Note 4</small> )
	Amount of fuel used (in litres)	Fuel type						
<b>Road Transport</b>								
<b>Navigation</b>								
<b>Aviation</b>								
<b>Total</b>								

Please insert more rows as necessary

**Notes for GHG Emissions from Mobile Source**

Note 1: Refer to Table 2-1 for CO<sub>2</sub> emission factors for different vehicle and fuel type.

Note 2: Refer to Table 2-2 for CH<sub>4</sub> emission factors for different vehicle and fuel type.

Note 3: Refer to Table 2-3 for N<sub>2</sub>O emission factors for different vehicle and fuel type.

Note 4: Global Warming Potential (GWP) of CH<sub>4</sub> is 21 while it is 310 for N<sub>2</sub>O.



## Emission Factors for Mobile Combustion Sources

**Table 2-1 CO<sub>2</sub> Emission Factor**

Fuel Type	Emission Factor	Unit
Diesel Oil (DO)	2.614	kg/litre
Unleaded Petrol (ULP)	2.360	kg/litre
Liquefied Petroleum Gas (LPG)	1.679	kg/litre
	3.017	kg/kg
Gas Oil (For Ships only)	2.645	kg/litre
Kerosene (Including Jet Kerosene)	2.429	kg/litre

**Table 2-2 CH<sub>4</sub> Emission factor**

Vehicle Type	Fuel Type	Emission Factor	Unit
Motorcycle	ULP	1.422	g/litre
Passenger Car	ULP	0.253	g/litre
	DO	0.072	g/litre
	LPG	0.248	g/litre
Private Van	ULP	0.203	g/litre
	DO	0.072	g/litre
	LPG	0.248	g/litre
Public Light Bus	DO	0.072	g/litre
	LPG	0.248	g/litre
Light Goods Vehicle	ULP	0.203	g/litre
	DO	0.072	g/litre
Heavy Goods Vehicle	DO	0.145	g/litre
Medium Goods Vehicle	DO	0.145	g/litre
Ships	Gas Oil	0.146	g/litre
Aviation	Jet Kerosene	0.069	g/litre
Other Mobile Machinery	DO	0.0239	g/litre
	LPG	0.0036	g/litre
		0.006	g/kg
	Kerosene	0.0241	g/litre

\* For the most updated figures, please refer to <https://www.climateready.gov.hk/page.php?id=56&lang=1>

**Table 2-3 N<sub>2</sub>O Emission Factor**

Vehicle Type	Fuel Type	Emission Factor	Unit
Motorcycle	ULP	0.046	g/litre
Passenger Car	ULP	1.105	g/litre
	DO	0.110	g/litre
Private Van	ULP	1.140	g/litre
	DO	0.506	g/litre
	LPG	0.000	g/litre
Public Light Bus	DO	0.506	g/litre
	LPG	0.000	g/litre
Light Goods Vehicle	ULP	1.105	g/litre
	DO	0.506	g/litre
Heavy Goods Vehicle	DO	0.072	g/litre
Medium Goods Vehicle	DO	0.072	g/litre
Ships	Gas Oil	1.095	g/litre
Aviation	Jet Kerosene	0.000	g/litre
Other Mobile Machinery	DO	0.007	g/litre
	LPG	0.0000	g/litre or g/kg
		Kerosene	0.0076

**Table 3: GHG Emissions (HFC and PFC) arising from Refrigeration/Air-conditioning Equipment (Operating Process)**

Step 1 A	Step 2 B	Step 3 C	Step 4 D	Step 5 E	Step 6 F	Step 7 G
Type of refrigerant <sup>Note 1</sup>	Amount of refrigerant at the beginning of the reporting period (kg)	Amount of refrigerant purchased during the reporting period (kg)	Amount of refrigerant disposed (through environmentally responsible means) during the reporting period (kg)	Amount of refrigerant at the end of the reporting period (kg)	GWP of refrigerant <sup>Note 2</sup>	GHG emissions (HFC and PFC) in tonnes of CO <sub>2</sub> equivalent $((B + C - D - E) \times F/1000)$
<b>Total</b>						

Please insert more rows as necessary.

Note 1: Enter the type of refrigerant of the equipment

Note 2: Refer to Table 3-1 for the Global Warming Potential (GWP) of the corresponding refrigerant

**Table 3-1 Global Warming Potentials (GWP) of Common Refrigeration/Air-Conditioning Refrigerants** <sup>Note 1</sup>

Gas or Blend	GWP	Information Source <sup>Note 2</sup>
HFC-23	11,700	A
HFC-32	650	A
HFC-125	2,800	A
HFC-134a	1,300	A
HFC-143a	3,800	A
HFC-152a	140	A
HFC-236fa	6,300	A
R-401A	18	B
R-401B	15	B
R-401C	21	B
R-402A	1,680	B
R-402B	1,064	B
R-403A	1,400	B
R-403B	2,730	B
R-404A	3,260	B
R-406A	0	B
R-407A	1,770	B
R-407B	2,285	B

Gas or Blend	GWP	Information Source <sup>Note 2</sup>
R-407C	1,526	B
R-407D	1,428	B
R-407E	1,363	B
R-408A	1,944	B
R-409A	0	B
R-409B	0	B
R-410A	1,725	B
R-410B	1,833	B
R-411A	15	B
R-411B	4	B
R-412A	350	B
R-413A	1,774	B
R-414A	0	B
R-414B	0	B
R-415A	25	B
R-415B	105	B
R-416A	767	B
R-417A	1,955	B

Gas or Blend	GWP	Information Source <sup>Note 2</sup>
R-418A	4	B
R-419A	2,403	B
R-420A	1,144	B
R-500	37	B
R-501	0	B
R-502	0	B
R-503	4,692	B
R-504	313	B
R-505	0	B
R-506	0	B
R-507 or R-507A	3,300	B
R-508A	10,175	B
R-508B	10,350	B
R-509 or R-509A	3,920	B
PFC-116(C <sub>2</sub> F <sub>6</sub> )	9,200	A
PFC-14(CF <sub>4</sub> )	6,500	A

Note 1: Refrigerants, with components other than HFCs and PFCs, have been well-recognised to have effects on our climate systems. Nevertheless, the Guidelines only cover those which are in the group of Kyoto protocol recognised gases (CO<sub>2</sub>, CH<sub>4</sub>, HFC, PFC, SF<sub>6</sub> and N<sub>2</sub>O). Hence, in the Guidelines, GWPs of all refrigerants other than HFCs and PFCs are considered to be zero.

Note 2: Information sources:

A: IPCC Second Assessment Report (1995)

B: "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.

\* For the most updated figures, please refer to <https://www.climate.gov.hk/page.php?id=56&lang=1>

**Table 4: Direct GHG Removals from Newly Planted Trees**

Step 1	Step 2	Step 3	Step 4	Step 5
A	B	C	D	E
Source description (Location of the trees planted)	No. of trees planted <sup>Note 1</sup> (unit)	No. of trees removed <sup>Note 1</sup> (unit)	CO <sub>2</sub> removal factor <sup>Note 2</sup> (kg/unit/year)	CO <sub>2</sub> removals in tonnes of CO <sub>2</sub> equivalent ((B-C) x D/1000)
			23	
<b>Total</b>				

*Please insert more rows as necessary*

Note 1: Please input the no. of trees planted, and no. of trees removed which are able to reach at least 5m after the beginning stage of construction.

Note 2: The default figure for the removal potential of each unit of tree is suggested based on Hong Kong's location, woodland types, and estimated density of trees. The figure is applicable to all trees commonly found in Hong Kong which are able to reach at least **5 metres in height** after the beginning stage of construction.

**Table 5: GHG Emissions from Electricity Purchased from Power Companies**

Step 1	Step 2	Step 3		Step 4	
A	B	C <sup>Note</sup>		D	
Facility/source description (i.e. Area/facilities the electricity bill is reporting)	Amount of electricity as shown in electricity bill (in kWh)	Emission factor* (kg/kWh)		Indirect GHG emissions in tonnes of CO <sub>2</sub> equivalent (B x C/1000)	
		Power company – specific	Territory-wide default value	Power company – specific	Territory-wide default value
<b>Total</b>					

Please insert more rows as necessary

Note: The reporting entity is required to account for GHG emissions associated with the electricity purchased in Hong Kong based on two emission factors. First, the reporting entity will quantify the emissions based on a territory-wide default value of **0.7kg/kWh**. Second, the reporting entity will quantify the emissions based on specific emission factors provided by its respective provider of electricity. In case that the specific emission factor for the reporting period is not available at the time of accounting, the latest specific emission factor from the power company may be used as an approximation. These specific emission factors are available from the power companies' websites. For reference, the table below indicates the emission factors of the two power companies in Hong Kong for the past 7 years.

GHG Emission Factor for Different Power Companies in Hong Kong (in kg CO <sub>2</sub> -e/kWh)							
Power Company	2009	2010	2011	2012	2013	2014	2015
CLP <sup>#</sup>	0.56	0.54	0.59	0.58	0.63	0.64	0.54
HEC <sup>*</sup>	0.84	0.79	0.79	0.79	0.78	0.79	0.78

<sup>#</sup> Emission factors for CLP were derived from information in CLP Group's Sustainability Report.

<sup>\*</sup> Emission factors for HEC were derived from information in HEC's Sustainability Report.

\* For the most updated figures, please refer to <https://www.climateready.gov.hk/page.php?id=56&lang=1>

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

Step 1	Step 2	Step 3	Step 4
A	B	C	D
Facility/source description (i.e. Area/facilities the Towngas bill is reporting)	Amount of Towngas purchased (Unit <sup>Note</sup> )	Emission factor (kg/Unit)	Indirect GHG emissions in tonnes of CO <sub>2</sub> equivalent (B x C/1000)
<b>Total</b>			

Please insert more rows as necessary

Note: Each unit registered by gas meter represents that the town gas with a heat value of 48 MJ. Based on the information from the Hong Kong and China Gas Company, the emission factors for the past three years were derived as below. This factor only accounts for the emissions during the production of Towngas within the company. Reporting entity should report in Table 1 as well the GHG emissions associated with combustion of Towngas within the physical boundary under Scope 1.

In case that the emission factor for the reporting period is not available at the time of accounting, the latest emission factor from the Towngas company may be used as an approximation.

GHG Emission Factor (in kg CO <sub>2</sub> -e/Unit of Towngas purchased)							
Year	2009	2010	2011	2012	2013	2014	2015
<b>Emission Factor</b>	0.628	0.620	0.618	0.610	0.620	0.600	0.605

\* For the most updated figures, please refer to <https://www.climateready.gov.hk/page.php?id=56&lang=1>

**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/floor)	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 <sub>2</sub> -e/ kg of waste) <sup>Note</sup>	Indirect emissions in tonnes of CO <sub>2</sub> equivalent ((B + C - D - E) x F/1000)
<b>Total</b>					4.8	

Please insert more rows as necessary.

Note: For simplifying the accounting process, the default emission factor assumes that the **total raw amount** of CH<sub>4</sub> emitted throughout the whole decomposition process of the paper waste disposed at landfills will be emitted into the atmosphere within the same reporting period as paper waste collected. In addition, the default value does not take into account the reduction in emission due to collection, recovery and utilisation of landfill gas due to the management practices at landfill

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

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

Please insert more rows as necessary

Note: Emission factor of GHG emissions due to electricity used for processing fresh water = Unit electricity consumption of fresh water (from WSD) x Territory-wide default value (i.e. 0.7kg/kWh) of purchased electricity provided in Table 5.

In case that the unit electricity consumption for processing fresh water for the reporting period is not available at the time of accounting, the latest emission factor from table below may be used as an approximation.

GHG Emission Factor (in kg CO <sub>2</sub> -e/m <sup>3</sup> )						
Year	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
<b>Emission Factor</b>	0.410	0.415	0.440	0.414	0.402	0.407

\* For the most updated figures, please refer to <https://www.climateready.gov.hk/page.php?id=56&lang=1>



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

Step 1	Step 2	Step 3	Step 4
A	B	C	D
Source description (i.e. Area/facilities the water service bill is reporting)	Fresh water consumption (m <sup>3</sup> )	Default Emission Factor (kg/m <sup>3</sup> ) Note	Emissions in tonnes CO <sub>2</sub> equivalent (B x C/1000)
<b>Total</b>			

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

Source description	Default Emission Factor (kg/m <sup>3</sup> )
Restaurants and catering services	(0.7 x Emission Factor) assuming 70% of the fresh water consumed will enter the sewage system.
Other commercial, residential and institutional purposes	(1.0 x Emission Factor) assuming 100% of the fresh water consumed will enter the sewage system.

In which emission factor is the emission factor of GHG emissions due to electricity used for processing fresh water derived from the following equation  
 Emission Factor = Unit electricity consumption of processing sewage (from DSD) x Territory-wide default value (i.e. 0.7kg/kWh) of purchased electricity provided in Table 5

In case that the unit electricity consumption for processing sewage for the reporting period is not available at the time of accounting, the latest emission factor from table below may be used as an approximation.

GHG Emission Factor (in kg CO <sub>2</sub> -e/m <sup>3</sup> )						
Year	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
<b>Emission Factor</b>	0.172	0.170	0.170	0.167	0.169	0.181

\* For the most updated figures, please refer to <https://www.climateready.gov.hk/page.php?id=56&lang=1>

Reference Benchmark for Energy Utilisation Index of Commercial Sector

Principal Group 1 – Restaurant and Retail

SUBGROUP <sup>(1)</sup>	ANNUAL ENERGY CONSUMPTION PER AREA <sup>(2)</sup> (MJ/M <sup>2</sup> /ANNUM)
B1: Chinese Restaurant	4636
B2: Non-Chinese Restaurant	4060
B3: Fast Food Shop	6622
B4: Bar	1536
B5: Other Eating and Drinking Place	5729
B6: Arcade/Basement/Upper Floor Shop	1479
B7: Street Front/Ground Floor Shop	1778

Principal Group 2 – Accommodation

SUBGROUP <sup>(1)</sup>	ANNUAL ENERGY CONSUMPTION PER AREA <sup>(2)</sup> (MJ/M <sup>2</sup> /ANNUM)
B8: Hotel	898
B9: Guest House	1326
B10: Home for the Aged	1872
B11: Service Apartment	702

Principal Group 3 – Hospital and Clinic

<b>SUBGROUP<sup>(1)</sup></b>	<b>ANNUAL ENERGY CONSUMPTION PER AREA<sup>(2)</sup> (MJ/M<sup>2</sup>/ANNUM)</b>
B12: Hospital	1131
B13: Clinic	1709
B14: Private Dental Clinic	379
B15: Medical Laboratory	639

Principal Group 4 – Educational Services

<b>SUBGROUP<sup>(1)</sup></b>	<b>ANNUAL ENERGY CONSUMPTION PER AREA<sup>(2)</sup> (MJ/M<sup>2</sup>/ANNUM)</b>
B16: University	752
B17: Post-secondary College	185
B18: Adult Education/Tutorial/Vocational Course	630
B19: Secondary School	214
B20: Primary School	186
B21: Kindergarten	427
B22: Special Education School	120

Principal Group 5 – Warehouse

<b>SUBGROUP<sup>(1)</sup></b>	<b>ANNUAL ENERGY CONSUMPTION PER AREA<sup>(2)</sup> (MJ/M<sup>2</sup>/ANNUM)</b>
B23: Refrigerated Warehouse	1282
B24: Non-refrigerated Warehouse	85

Principal Group 6 – Office Flatted Factor

<b>SUBGROUP<sup>(1)</sup></b>	<b>ANNUAL ENERGY CONSUMPTION PER AREA<sup>(2)</sup> (MJ/M<sup>2</sup>/ANNUM)</b>
B25: Office Flatted Factor	518

Principal Group 7 – Central Services for Shopping Arcade

<b>SUBGROUP<sup>(1)</sup></b>	<b>ANNUAL ENERGY CONSUMPTION PER AREA<sup>(2)</sup> (MJ/M<sup>2</sup>/ANNUM)</b>
B26: Central Services for Shopping Arcade	2302

Principal Group 8 – Private Office

<b>SUBGROUP<sup>(1)</sup></b>	<b>ANNUAL ENERGY CONSUMPTION PER AREA<sup>(2)</sup> (MJ/M<sup>2</sup>/ANNUM)</b>
B27: Central services for building (multiple tenants) with central air-conditioning supply for tenants	476
B28: Central services for building (multiple tenants) without central air-conditioning supply for tenants	155

Principal Group 9 – Government Office

<b>SUBGROUP<sup>(1)</sup></b>	<b>ANNUAL ENERGY CONSUMPTION PER AREA<sup>(2)</sup> (MJ/M<sup>2</sup>/ANNUM)</b>
B32: Whole building (multiple users)	985

Note:

- (1) Definition of each subgroup can be refer to [http://ecib.emsd.gov.hk/en/glossary\\_cmc.htm](http://ecib.emsd.gov.hk/en/glossary_cmc.htm)
- (2) Stakeholders are encouraged to consider these energy utilisation indexes as one way, but not the only way, of improving their energy performance with respect to the past. Comparisons of indicators between business operations within the same sector should be made with caution. Businesses in the same subgroup may be operating under different economic, environmental and operational constraints, causing different energy performance. The business processes in different business subgroups are inherently varied resulting in different achievable energy performance levels. The energy utilisation indexes are derived from studies on a limited size of samples within the population of respective energy-consuming groups. These indicators should not be construed as representative energy consumption levels of the population, nor as territory-wide standards which businesses in the respective energy-consuming groups should comply with.

Source: EMSD's Energy Utilisation Indexes and Benchmarks for Residential, Commercial and Transport Sectors  
<http://ecib.emsd.gov.hk/en/index.htm>

1. Name of the reporting entity: *e.g. XYZ Office Building*
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).

*e.g. XYZ Office Building is the headquarters of XYZ Co. Ltd. The daily building management duty is borne by Administration Division.*
3. The reporting period (with start and end dates): *e.g. 1st Jan 2014 to 31st Dec 2014*
4. Scope of physical boundary chosen
  - (a) Location of the building(s): *e.g. XYZ Street, Hong Kong*
  - (b) Description of the purpose of the building(s) or physical boundary chosen:  
*e.g. Area to be reported is the total indoor and outdoor areas from the ground floor to the roof of XYZ Office Buildings*

(c) Building Information:

<b>Building Name</b>	<i>e.g. XYZ Office Building</i>
<b>Address</b>	<i>e.g. XYZ Street, Hong Kong</i>
<b>Gross Floor Area</b>	<i>e.g. 10,000 m<sup>2</sup></i>
<b>Number of Floor</b>	<i>e.g. 6 (G/F, 1-5/F)</i>
<b>Year Build</b>	<i>e.g. 1984</i>
<b>Number of staff</b>	<i>e.g. 300 full time employee</i>
<b>Floor Usage</b>	<i>e.g. All area, excluding plant room, carparks and server rooms, operate from Monday to Friday except Public Holidays</i>

(d) Description of areas excluded in the audit: *e.g. Commercial tenants in G/F are excluded from this carbon audit.*

5. Scope of operational boundary chosen

(a) Description of Scope 1 activities included and excluded:

*e.g. Testing of emergency generator, mobile sources, GHG removal by tree planting, fugitive emission;*

(b) Description of Scope 2 activities included and excluded:

*e.g. Consumption by purchased electricity;*

(c) Description of Scope 3 activities included:

*e.g. Paper waste disposed at landfills, consumption of fresh water, treatment of wastewater*

6. Methodologies

- (a) List of activities for which simplified methodologies and conversion factors in the Guidelines are used for quantification
- (b) Details (including necessary reference) 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

*e.g. The reporting and working procedures for calculating GHG emissions and removals as detailed in the “Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Building(Commercial, Residential or Institutional Purposes) in Hong Kong – 2010 Edition” compiled by EPD and EMSD were adopted.*

7. Conclusion

Information on GHG emissions and removals for *e.g. XYZ Office Building*

Reporting Period: *e.g. 01/01/2014 – 31/12/2014*

Scope of Emissions	Emissions by Gas Type (in tonnes of CO <sub>2</sub> -equivalent)					
	Carbon dioxide (CO <sub>2</sub> )	Methane (CH <sub>4</sub> )	Nitrous oxide (N <sub>2</sub> O)	Hydrofluoro- Carbons (HFCs)	Perfluoro- Carbons (PFCs)	Total
<b>Scope 1 Direct Emissions</b>						
<b>Stationary Combustion Sources</b>						
Internal Combustion Engines	1.438	0.00028	0.00126	N/A	N/A	1.440
<b>Mobile Combustion Sources</b>						
Road Transport	32.914	0.066	4.860	N/A	N/A	37.840
<b>Fugitive Emissions</b>						
Refrigeration	N/A	N/A	N/A	0	0	0
<b>Scope 1 Emissions Total</b>	<b>34.352</b>	<b>0.06628</b>	<b>4.86126</b>	<b>0</b>	<b>0</b>	<b>39.280</b>
<b>Scope 1 Direct Removal</b>						
Planting of Additional Trees	0.759	N/A	N/A	N/A	N/A	0.759
<b>Scope 1 Removals Total</b>	<b>0.759</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.759</b>



Scope of Emissions	Emissions by Gas Type (in tonnes of CO <sub>2</sub> -equivalent)					
	Carbon dioxide (CO <sub>2</sub> )	Methane (CH <sub>4</sub> )	Nitrous oxide (N <sub>2</sub> O)	Hydrofluoro-Carbons (HFCs)	Perfluoro-Carbons (PFCs)	Total
<b>Scope 2 Energy Indirect Emissions</b>						
Electricity Purchased						2,235.634 Note A
Towngas Purchased						0
<b>Scope 2 Emissions Total</b>						<b>2,235.634</b>
<b>Scope 3 Other Indirect Emissions</b>						
Methane Generation at Landfill due to Disposal of Paper Waste	N/A	26.803	N/A	N/A	N/A	26.803
Electricity for Processing Fresh Water						1.965
Electricity for Processing Sewage						0.883
<b>Scope 3 Emissions Total</b>	<b>N/A</b>	<b>26.803</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>29.651</b>
Other GHG Offsets/Removals	0	0	0	0	0	0
<b>Net Emissions Total (Scope 1 Emissions Total + Scope 2 Emissions Total + Scope 3 Emissions Total – Scope 1 Removals Total – Other GHG Offsets/Removals)</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2,303.806</b>

(Note A: The emissions based on territory-wide default value is e.g. 2,235.634, while the emissions based on CLP emission factor is e.g. 2,044.008.)

### **Summary of Results**

Total Scope 1 Emissions : e.g. 39.280 Tonnes of CO<sub>2</sub> Equivalent

Total Scope 1 Removals : e.g. 0.759 Tonnes of CO<sub>2</sub> Equivalent

Total Scope 2 Emissions : e.g. 2,235.634 Tonnes of CO<sub>2</sub> Equivalent

Total Scope 3 Emissions : e.g. 29.651 Tonnes of CO<sub>2</sub> Equivalent

Total other GHG Offsets/Removals: e.g. 0 Tonnes of CO<sub>2</sub> Equivalent

### **GHG Performance in Ratio Indicator(s):**

*e.g. Emission per Total Gross Floor Area: 0.2303 tonnes CO<sub>2</sub>-e/m<sup>2</sup>/annum*

8. Information on GHG offsets and programmes
  - (a) Description of GHG performance against internal and/or external benchmark (if any) including any ratio indicators used
  - (b) Scopes and areas identified to improve GHG performance
  - (c) Description of activities/programmes to improve GHG performance including provision of on-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.

*e.g. We have completed the chiller replacement in Dec 2013. The carbon emission was reduced from 2,609.156 tonnes CO<sub>2</sub>-e in 2013 to 2,303.806 tonnes CO<sub>2</sub>-e in 2014. We will complete the replacement works of all T8 fluorescent tubes to T5 fluorescent tubes in the XYZ Office Building by March 2016. These newly replaced fluorescent tubes are more energy saving than the existing tubes. As a result, the electricity consumption on the lighting facilities will be decreased and the GHG emission from the building will hence be reduced.*
9. Contact person of the reporting entity  
*e.g. Mr. XYZ (XYZ@XYZ.com)*
10. Reference  
*e.g. "Guidelines to account and report Greenhouse Gas Emissions and Removals for Building of Commercial, Residential or Institutional Purposes in Hong Kong" 2010 revision*



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