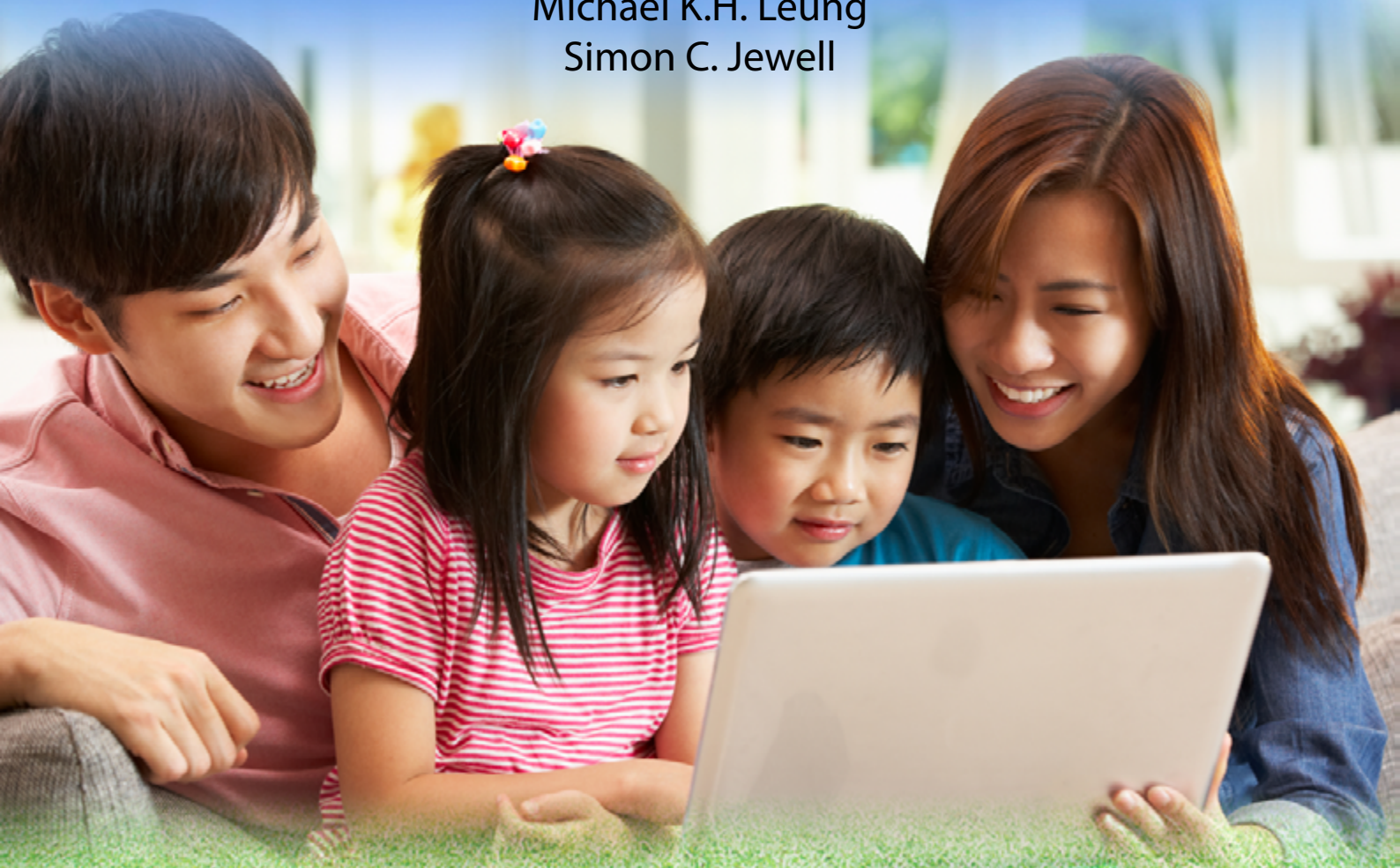


# Carbon Footprint Management Toolkit for Sustainable Low-Carbon Living

## *Carbon Audit Guidelines*

Michael K.H. Leung  
Simon C. Jewell



香港城市大學  
City University  
of Hong Kong



可持續發展委員會  
Council for  
Sustainable Development

# Carbon Footprint Management Toolkit for Sustainable Low-Carbon Living

Principal Investigator: **Michael K.H. Leung**  
Associate Professor and Associate Dean  
Director, Ability R&D Energy Research Centre

Team Members: **Simon C. Jewell**  
**Sam W.K. Cheng**  
**Karthikeyan Rengasamy**  
**Li Li**

School of Energy and Environment  
City University of Hong Kong



可持續發展委員會  
Council for  
Sustainable Development

This project is funded by the Sustainable Development Fund

The Sustainable Development Fund was established by the Hong Kong Council for Sustainable Development for developing public awareness of the principals of sustainable development and encouraging sustainable practices in Hong Kong.

Published in June 2013

© Text, photos and graphics: City University of Hong Kong. All rights reserved.

ISBN: 978-962-442-358-7



# Preface

Low-carbon lifestyle plays an important role in achieving the balance among economy, society and environment for a sustainable future. “*Carbon Footprint Management Toolkit for Sustainable Low-Carbon Living*” is custom-made for the domestic sector to raise awareness of greenhouse gas emissions and to facilitate carbon emission reductions at home for low-carbon lifestyle. The *Toolkit* is also designed for teaching and learning to support general education in Hong Kong. There are two main components in the *Toolkit*: (1) *Carbon Audit Guidelines* and (2) *Carbon Calculator*. In addition to the conventional sources of carbon emissions (i.e. electricity, town gas, fuels, wastes, water etc.), the *Toolkit* covers the emissions produced throughout the lifecycle of products we consume and use in our daily lives, such as food, electrical appliances, electronic products, clothing etc.



# Contents

**1** 1. Greenhouse Gas Emissions & Climate Change

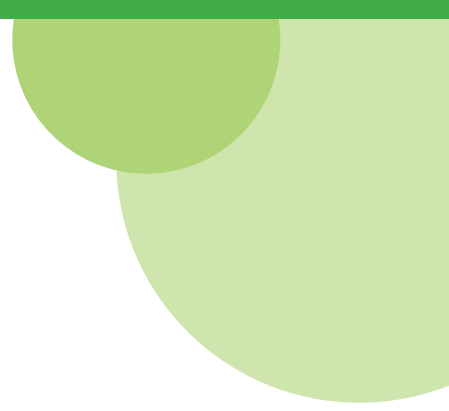
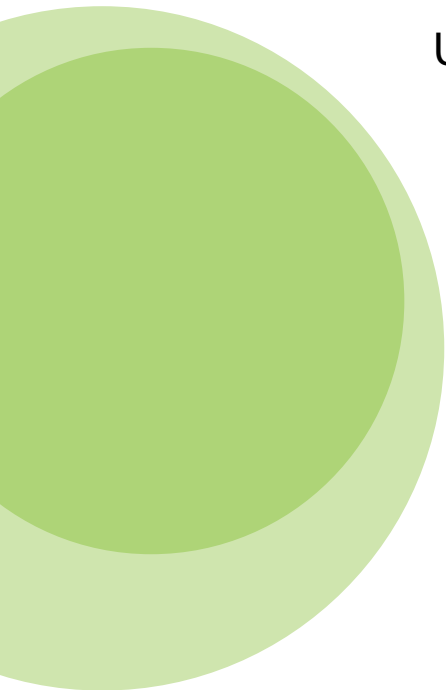
2. The Environment & Our Homes **5**

**8** 3. Calculating Your Carbon Footprint

4. Environmentally Friendly Tips **16**

**18** 5. Clean Energy & The Future

Useful Links **20**



# 1. Greenhouse Gas Emissions & Climate Change

## Why should I manage my Carbon Footprint?

Greenhouse gas emissions from human activities and the consequent climate change pose serious threats to the world's ecology. The arising problems directly cause harms to our environment, health, society and economy. Being a leading world city, Hong Kong should devote more resources to minimise our greenhouse gas emissions and play a leading role in environmental protection. For the commercial sector, the Hong Kong Government should establish effective energy and environmental policies to guide companies to achieve low-carbon performance.

Equally importantly, we should be aware of greenhouse gas emissions we produce in the domestic sector and carbon reduction is everybody's responsibility. Have you ever considered the environmental impacts of our busy metropolitan lifestyles and high consumptions of fuel, electricity, food and water? Have you ever considered the impacts of all the wastes resulting from the way we live for convenience and luxury? These are just a few things which could determine the sustainability of future generations.

“Carbon footprint” is a measure of the environmental impact we have in terms of the greenhouse gases we produce. By making behavioural changes in our daily lives, we can effectively reduce our carbon footprint and achieve low-carbon living.

### Quick Green Evaluation

Test whether you are environmentally friendly or not!

#### 1. Do you switch off the standby power of electronics when not in use?

- A. Always 2 marks
- B. Sometimes 1 mark
- C. Never 0 mark

#### 2. Do you prefer public transport over private car?

- A. Always 2 marks
- B. Sometimes 1 mark
- C. Never 0 mark

#### 3. Do you separate and recycle your waste?

- A. Always 2 marks
- B. Sometimes 1 mark
- C. Never 0 mark

#### 4. Are you vegetarian?

- A. Yes 2 marks
- B. No 0 mark

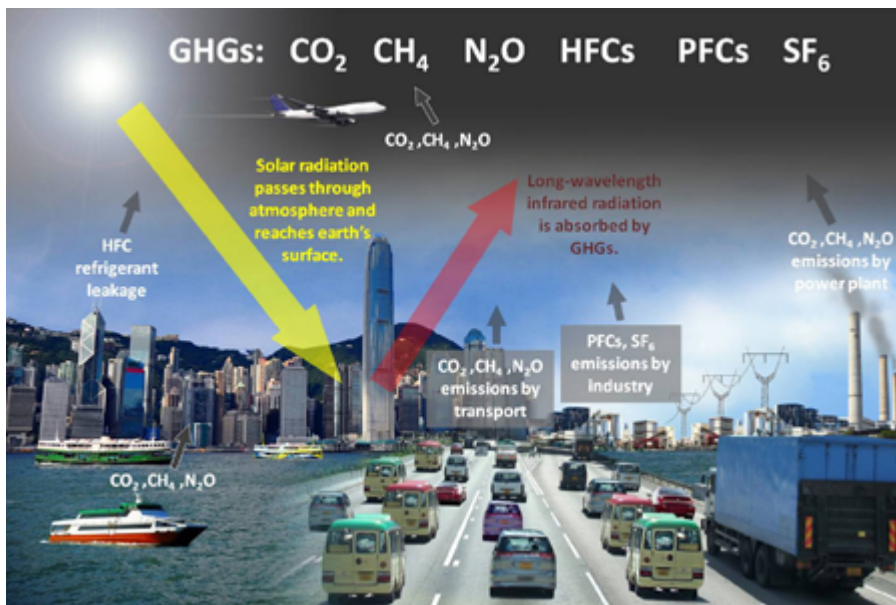
What is your score?

- 7-8 marks Excellent! You should have a small carbon footprint. Keep it up and promote low-carbon practices to others.
- 4-6 marks Good! Still, there is room for improvement. Use the *Toolkit* to calculate your carbon footprint and find out what you can do to manage your carbon footprint.
- <4 marks Your carbon footprint is probably large! The *Toolkit* should provide you with many useful tips for reducing your carbon footprint.



## What is greenhouse effect and how are we influencing it?

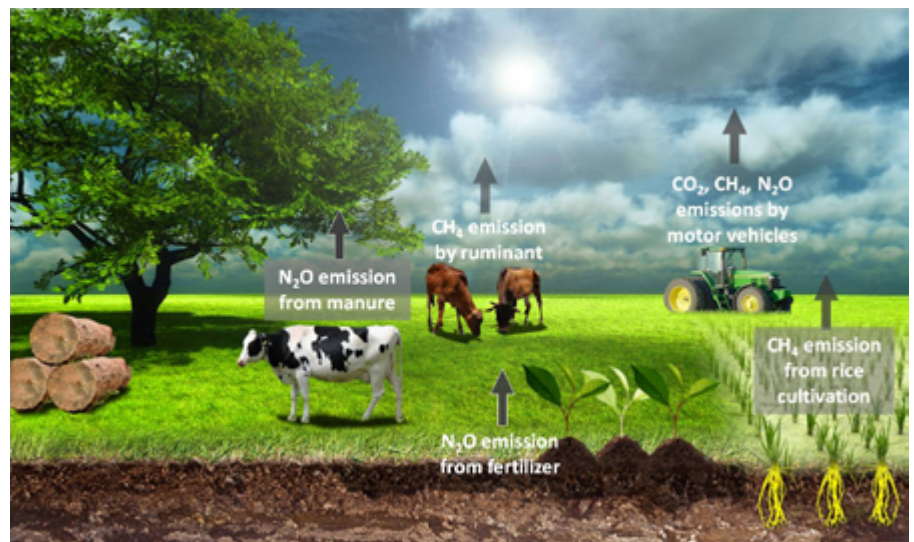
The greenhouse effect is a natural phenomenon which has historically provided the living conditions for organisms to grow and survive. Solar radiation from the Sun reaches the Earth and whilst some is reflected back to space, a large percentage is kept within the atmosphere due to the presence of greenhouse gases (GHGs), such as carbon dioxide ( $\text{CO}_2$ ) and methane ( $\text{CH}_4$ ). They absorb reflected infrared radiation from the Earth's surface and thus trap the heat. The higher the GHG concentration in the atmosphere, the more intensive the greenhouse effect.



Major greenhouse gases (GHGs) include carbon dioxide ( $\text{CO}_2$ ), methane ( $\text{CH}_4$ ), nitrous oxide ( $\text{N}_2\text{O}$ ), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride ( $\text{SF}_6$ ). Individual GHG has different degree of global warming effect per unit mass of its emission. Carbon dioxide equivalent ( $\text{CO}_2\text{-e}$ ) is defined as a measure of GHG emission using  $\text{CO}_2$  as the reference global warming potential.

“Global warming, along with the cutting and burning of forests and other critical habitats, is causing the loss of living species at a level comparable to the extinction event that wiped out the dinosaurs 65 million years ago. That event was believed to have been caused by a giant asteroid. This time it is not an asteroid colliding with the Earth and wreaking havoc: it is us.”

*Al Gore*



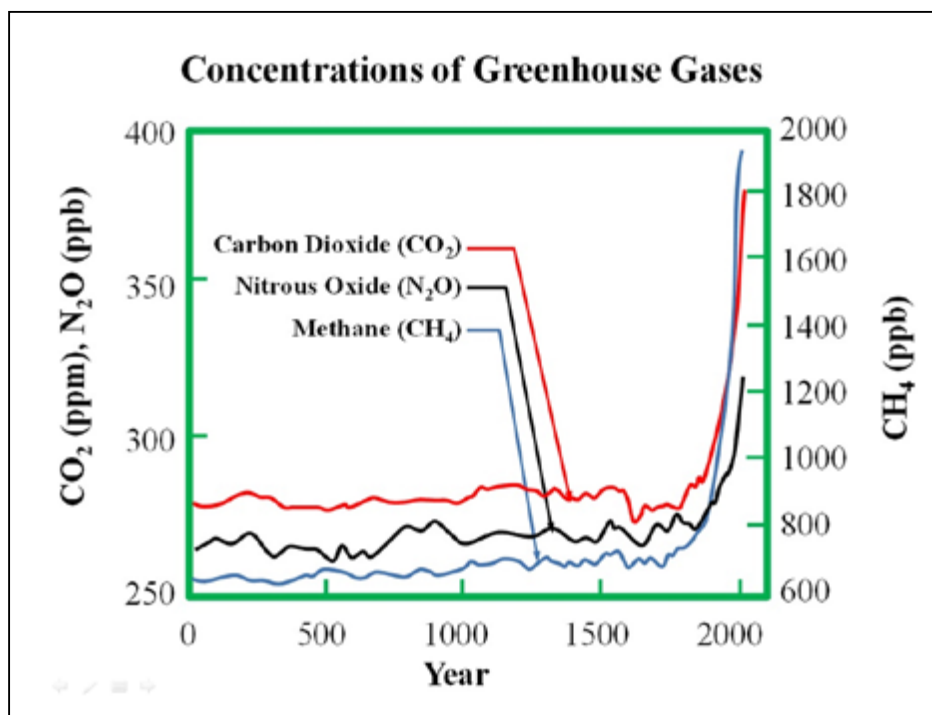
“The saddest fact of climate change... is that the countries it will hit hardest are already among the poorest and most long-suffering.”

*Bjorn Lomborg*



Since the Industrial Revolution in late 18<sup>th</sup> century, our intensive anthropogenic activities have been increasingly emitting GHGs, resulting in rapid increases in the GHG concentration in the atmosphere. The consequence we are now realising is that the Earth is warming too much!

Between 1906 and 2005, the global mean temperature has increased by 0.6-0.9°C and is certain to continue increasing. Estimate for the 21<sup>st</sup> century temperature increases range between 1.1 and 6.4°C depending on what actions we take to reduce the greenhouse gas emissions.



**FACT**  
Mining and burning of coal, natural gas and petroleum are the largest sources of anthropogenic greenhouse gas emissions.

“450 scenario presented in the World Energy Outlook, which sets out an energy pathway consistent with the goal of limiting the global increase in temperature to 2°C by limiting concentration of greenhouse gases in the atmosphere to around 450 parts per million of CO<sub>2</sub>.”

*International Energy Agency*

“Climate change is occurring, is caused largely by human activities, and poses significant risks for - and in many cases is already affecting - a broad range of human and natural systems.”

*U.S. National Research Centre*



# What are the consequences of excessive global warming?

Global warming and climate change have numerous impacts on humans and wildlife.

## Sea-level Rise

Rising ocean temperatures result in the melting of glaciers and ice sheets. Melting ice sheets in Greenland and the Antarctic will lead to a rise in sea-levels worldwide. At the same time oceans expand at higher temperatures, increasing the problem dramatically. Low-lying coastal regions, home to 70% of the World's population, are at very high risk.

## Damages to Eco-systems and Biodiversity

Climate change is a global problem and affects every single organism on the planet. As the temperature of the oceans and atmosphere rises, many plants and animals that were once well adapted will face destruction of their habitats or even extinction. Temperatures could also lead to increased prevalence and spread of diseases.

## Extreme weather events

There is a strong link between global warming and weather. With higher land and ocean temperatures, the hydrologic cycle will be intensified, resulting in greater frequency of extreme weather, such as storms, typhoons, droughts and floods.

## Positive Feedback Mechanisms

An increase in global temperature can lead to further increase in temperature which will worsen the problems we face. Melting of ice makes the Earth's surface less reflective, which will increase surface temperatures. Melting of permafrost could lead to the release of pockets of greenhouse gases. Examples such as these could cause a "tipping point" whereby temperature rises beyond reversible levels.

It's not too late! If we make smart choices as a community, we can help reduce these impacts.

NASA satellites indicate that the Arctic ice cap is melting at a rate of 9% every decade, adversely affecting native people and the habitats of species such as polar bears.

Scientists estimate global warming of just 1°C above the 1990 levels would result in all coral reefs being bleached and 10% of global ecosystems being transformed.

Temperature rises exceeding 1-3°C could lead to reduced agricultural productivity in major food producing regions due to water shortage, heat stress, pests and disease.

Equatorial regions are expected to experience wetter weather due to climate change.  
Subtropical regions are expected to experience drier weather and more droughts.

Tropical rainforests are currently disappearing at a rate of 214,000 acres per day, equivalent to the entire space occupied by New York.





## 2. The Environment & Our Homes



As a coastal city, Hong Kong could be hit hard by climate change. It is estimated that the global average sea level will rise by 18-59 cm by 2100 compared with 1980-1999. This could threaten many coastal regions, including Hong Kong.

“2.2 Earths are needed if everyone in the World lived a similar lifestyle to that of Hong Kong people.”

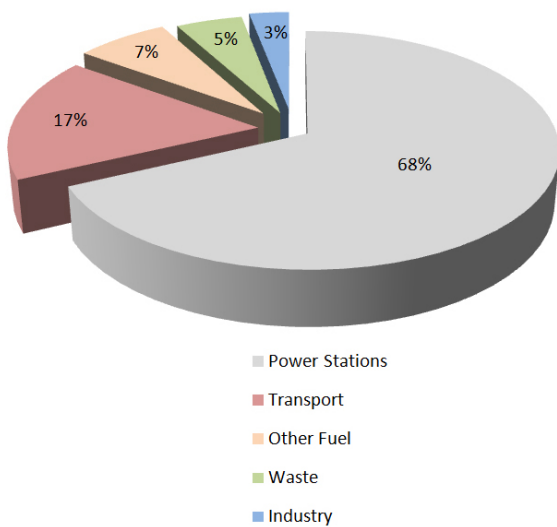
*WWF Hong Kong*

### What are the major sources of GHG emissions in Hong Kong?

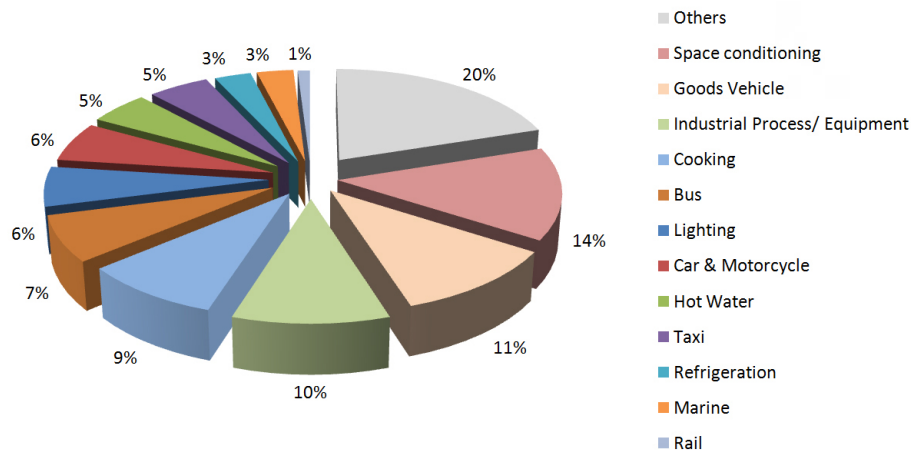
### What can we do to manage our carbon footprint?

There are more than 7.1 million residents in Hong Kong, residing in 2.4 million domestic households. Our total GHG emissions amount to 42 million tonnes of CO<sub>2</sub>-e per year and the per capita emission is 6 tonnes of CO<sub>2</sub>-e per year. The main sources of GHG emissions in Hong Kong are presented in the pie chart below. The energy related sources dominate GHG emissions. The majority of energy we consume is for our air-conditioning, hot water supply, cooking and transport.

**Hong Kong GHG Emissions**



**Hong Kong Energy Enduse**





## Electricity

In Hong Kong, there are two electricity utilities, namely CLP Power Hong Kong Limited (CLP) and Hong Kong Electric Company Limited (HEC). They separately supply electricity to different regions of Hong Kong. The current overall fuel mix for electricity supply by CLP and HEC consists of 54% coal, 23% natural gas and 23% nuclear energy. As the fossil-fuel based generators burn coal and natural gas, GHGs ( $\text{CO}_2$ ,  $\text{CH}_4$  and  $\text{N}_2\text{O}$ ) and other airborne pollutants (sulphur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds and particulate matters) will be emitted to the atmosphere. Clearly, the first thing we can do to reduce our GHG emissions is to consume less electricity in our homes and workplace.



## Transport

Public transport is much more environmentally friendly than private cars in terms of kilograms of  $\text{CO}_2$ -e emission per passenger per kilometre travelled. Among all the public transport means in Hong Kong, MTR has the smallest  $\text{CO}_2$ -e emission factor primarily due to the concept of economy-of-scale effect with a large number of passengers. The values of different emission factors of the transport sector are summarized in Chapter 3.



## Food

Food production is a major contributor to our carbon footprint. So how does it relate to the emission of greenhouse gases?

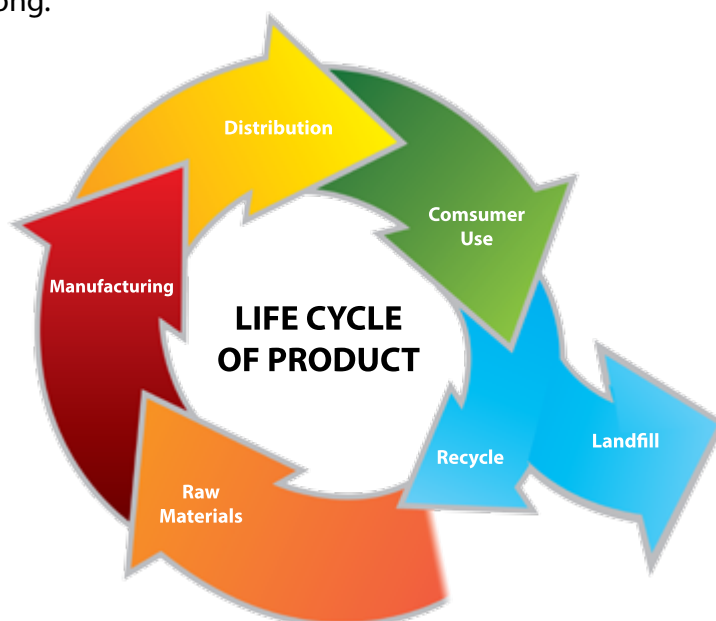
Vegetables and fruits are found at the bottom of our food chain. They grow quickly, require little space and require the least energy in production. The cultivation of rice has higher GHG emission because considerable amount of methane is emitted in rice field. Livestock are higher in the food chain and require more food and energy inputs as well as more space. Cows and sheep have longer lifetimes and, as ruminant animals, they also release methane during digestion. It is also noted that Hong Kong imports over 95% of its food and most food products travel thousands of kilometres to Hong Kong. For instance, the steak we consume in average travels over 12,000 km. This part of the GHG emission is significant.

We can greatly reduce our carbon footprint by eating less meat and eating more vegetables! We can also eat more local produce to reduce the emissions from transporting imported food.



## Consumer Products

Lifecycle assessment (LCA) is an approach to calculating a product's carbon footprint. The GHG emissions occur during: extraction of raw materials, manufacturing of parts and final products, overseas and domestic transportation, retail distribution, consumer use and finally disposal of the product. It is important to recognise that when you purchase a consumer product, you are responsible for its lifecycle GHG emissions; even though most of the indirect emissions are produced abroad in the production of goods imported to Hong Kong.



## Waste

In Hong Kong, the per capita municipal solid waste (MSW) disposal rate in 2011 is 1.27 kg per day. The waste disposed by landfill will be decomposed and the process will emit methane. Reducing, reusing and recycling (3Rs) are the best ways to lower our carbon footprint from waste.



## 3. Calculating Your Carbon Footprint

Up to this point, we have looked at how our daily activities release GHGs that accumulate to global impacts on climate. Most probably the best solution is to make behavioural changes to promote low-carbon lifestyle in a way that is more environmentally conscious and can practically achieve carbon reduction.

The *Carbon Calculator* of this *Toolkit* allows you to quantify your household carbon footprint based on your GHG-emitting activities. The best way to analyse your footprint is over a 12-month period because most of the important GHG emission sources, such as consumptions of electricity, town gas, water etc., have seasonal variations. Thus, data collected for 12 consecutive months give a more accurate analysis of your carbon footprint.


### Five Easy Steps for Managing Your Carbon Footprint at Home

1. Collect data about various aspects of your daily household activities, including electricity, town gas, water, transportation, food, consumer products, waste, etc.
2. Input the data in the *Carbon Calculator* online and obtain the carbon footprint analysis of your family.
3. Identify the particular aspects or habits where you incur the greatest carbon footprint.
4. Read the tips section of the *Toolkit* so you know how you can make improvement.
5. Make behavioral changes so you can lower your carbon footprint!




Below are samples of the utility bills we receive regularly. They provide useful information for carbon footprint calculation, such as actual consumptions of electricity, town gas and water.


# ELECTRICITY



全面關懷大獎



10th Anniversary




中環電力有限公司 香港九龍紅磡海傍道19號 CLP Power Hong Kong Limited 8 Laguna Verde Avenue, Hung Hom, Kowloon, HK

MR EARTH  
FLAT A  
FRIENDLY EARTH VILLAGE  
KOWLOON  
HONG KONG

註冊客戶及供電地址  
Registered Customer & Supply Address

MR EARTH  
FLAT A  
FRIENDLY EARTH VILLAGE  
KOWLOON  
HONG KONG



住宅用電

發單日期(日-月-年)	由	至	按金	
04-05-13	06-03-13	04-05-13	\$300.00	
	共 61	日用电量		
電力費用 (每兩個月)	每度	77.8 ¢	400 度	\$311.20
	每度	89.3 ¢	369 度	329.52
燃料調整費	每度	17.8 ¢		136.88
地租及差餉特別回扣	每度	-3.3 ¢		-25.38
政府電費補貼				-300.00
上月零數撥來				0.89
零數撥入下次				-0.11
總數				\$453.00
政府電費補貼摘要 (由2011年起計, 貴戶已獲電費補貼總額: \$2,250.00)				
上次電費補貼餘額				\$0.00
今次電費補貼				300.00
扣減今次電費				-300.00
電費補貼餘額撥入下次				0.00

帳類及商戶編號 : 02

繳款限期


26-05-13

應繳總數

\$453.00

電錶號碼	今次讀數	前次讀數	讀差位數	用電度數
1234567	36435	35666	1	769
			總數	769

香港電燈有限公司  
The Hongkong Electric Co., Ltd.



MR EARTH  
FLAT A  
FRIENDLY EARTH VILLAGE  
CENTRAL  
HONG KONG ISLAND

聯戶號碼  
1234567891

賬單日期  
10/06/13

家庭供電

電表號碼	電表讀數		用電度數	10/05/13 - 10/06/13 (31 天)	金額 (元)
	今次	上次			
1234567	35259	34424	835		
				基本電費	714.71
				政府電費補貼	-150.00
				燃料價條款調整 每度 37.000 分	308.95
				上次賬單結轉	0.14
				撥入下月賬款	-0.80

835 Units





**煤氣**  
**Towngas**

MR EARTH  
FLAT A  
FRIENDLY EARTH VILLAGE  
KOWLOON  
HONG KONG

客戶號碼: 0123-4567-89

請於 2013年3月26日前  
繳付此賬 \$182.00

賬單資料 發單日期: 2013年 3月14日

上期限單總數  
繳費: 2013年 1月23日  
上期限單餘數

7 Units

100.15 \$  
-100.00  
0.15

24小時報錶  
☎ 2880 5522  
網址: www.towngas.com

歡迎每月報錶

由	至	1度 = 兆焦耳	煤氣用量 (兆焦耳)
2013年 1月13日	2013年 2月13日	7度 x 48	336
1219 抄錶讀數	1226 估計讀數		

本月煤氣用量是根據過往紀錄估算, 請致電 2890 5522 報錶。  
煤氣標準收費 73.58  
燃料調整費 (每兆焦耳 6.110 仙) 20.53  
保養月費 9.50

5 Units

103.61  
首月費用 103.61

下次發單日期: 2013年 5月14日, 如在此日期前報錶, 所報讀數將會作為計算煤氣用量的參考

由	至	1度 = 兆焦耳	煤氣用量 (兆焦耳)
2013年 2月13日	2013年 3月13日	5度 x 48	240
1226 估計讀數	1231 估計讀數		

3月13日的估計讀數 1231 是根據2月15日的抄錶讀數 1226 而估算。



付款通知書

MR EARTH  
FLAT A  
FRIENDLY EARTH VILLAGE  
KOWLOON  
HONG KONG

繳款單編號 123-456-789-10  
應繳總額 \$317.60  
在此日期或之前繳付 26/05/2013

WATER

上次繳款日期	上次繳款金額	現存按金款額	爭議金額	分期付款金額
01/03/2012	\$389.70	\$250.00	\$0.00	\$0.00

收費說明:

現有水錶編號: MSL07405489

供水性質: 住宅供水 (010010)

排污費收費率: \$1.71/立方米

水錶編號	日期	度數	日期	度數
1234567	10/02/2012	817	07/06/2012	876



59 Cubic meter

計度數	客戶報讀度數
耗水量 118日	每日平均耗水量
59 立方米	0.500 立方米



## CO<sub>2</sub>-equivalent

When using the emission factors provided and calculating your carbon footprint you might notice use of the units "CO<sub>2</sub>-e", which represents equivalent carbon dioxide emissions. This quantity is the concentration of carbon dioxide that would cause the same amount of global warming as another greenhouse gas which is emitted.

For example, ruminant animals such as cows release methane (CH<sub>4</sub>) as part of digestion. Using the CO<sub>2</sub>-e concept, the CH<sub>4</sub> emission can be converted into equivalent CO<sub>2</sub> by using the global warming potential as a multiplying factor.

e.g. 1 tonne of CH<sub>4</sub> x 21 = 21 tonnes of CO<sub>2</sub>-e

↙ GWP of CH<sub>4</sub>

Greenhouse Gas	Global Warming Potential, GWP
Carbon dioxide, CO <sub>2</sub>	1
Methane, CH <sub>4</sub>	21
Nitrous oxide, N <sub>2</sub> O	310
Hydrofluorocarbon HFC-23, CHF <sub>3</sub>	11700
Hydrofluorocarbon HFC-134a, CH <sub>2</sub> FCF <sub>3</sub>	1300
Sulphur hexafluoride, SF <sub>6</sub>	23900

Source: IPCC 2007

### FACT

Although CO<sub>2</sub> has the lowest global warming potential among the major GHGs, CO<sub>2</sub> is the most serious GHG because it is present in the atmosphere in much higher quantities than other GHGs



## Greenhouse Gas Emissions Factors

The following GHG emissions factors (*EFs*) quantify the CO<sub>2</sub>-e emissions of GHG-emitting activities. For consumer products, food and beverages, the emission factors represent the lifecycle CO<sub>2</sub>-e emissions accounting for the production, transport and waste disposal per unit item. The lifecycle CO<sub>2</sub>-e emission excludes any emission during the stage of usage because the corresponding emission sources, mostly energy and water consumptions, are taken into account in separate categories. Commonly used emission factors are listed below for easy reference. More emission factors applicable to households are already programmed in the online *Carbon Calculator* of this *Toolkit*.

### Utilities

#### Electricity

Utility	<i>EF</i>	Remark
CLP	0.540 kg CO <sub>2</sub> -e per unit	1 unit = 1 kilowatt-hour (kWh)
HEC	0.790 kg CO <sub>2</sub> -e per unit	1 unit = 1 kilowatt-hour (kWh)

Note:

- CLP supplies electricity in Kowloon, New Territories and Lantau Island.
- HEC supplies electricity in Hong Kong Island and Lamma Island.

#### Town gas

Utility	<i>EF</i>	Remark
Towngas	3.173 kg CO <sub>2</sub> -e per unit	1 unit = 48 Mega Joules (MJ)

#### Water

Department	<i>EF</i>	Remark
Water Supplies Department	0.410 kg CO <sub>2</sub> -e per unit	1 unit = 1 cubic metre (m <sup>3</sup> )

### Public Transport

Type	<i>EF</i> <sub>distance</sub> (kg CO <sub>2</sub> -e per passenger per km)	<i>EF</i> <sub>fare</sub> (kg CO <sub>2</sub> -e per HKD)
MTR	0.0072	0.0102
Bus	0.0295	0.0515
Minibus	0.0642	0.0883
Tram	0.0274	0.0685
Taxi	0.1162	0.0197
Ferry	2.0082	1.3688

Note:

There are two different types of emission factors for public transport:

1. *EF*<sub>distance</sub> is applicable if you know the distance you travel. However, we normally do not know exactly how many km we travel.
2. *EF*<sub>fare</sub> is more convenient to use. It gives the CO<sub>2</sub>-e emission per Hong Kong dollar spent on the fare.





## Food

Type	EF (kg CO <sub>2</sub> -e per kg)
Beef	16.433
Pork	3.169
Chicken	4.723
Fish	6.050
Eggs (per egg)	0.281
Rice	3.194
Fruit/Vegetables	0.072

## Beverages

Type	EF (kg CO <sub>2</sub> per unit)
Distilled water	0.767 kg CO <sub>2</sub> per Litre
Juice	0.258 kg CO <sub>2</sub> per glass
Coffee	0.015 kg CO <sub>2</sub> per cup
Tea	0.005 kg CO <sub>2</sub> per cup
Soft drink	0.159 kg CO <sub>2</sub> per can

## Electrical Appliances

Type	EF (kg CO <sub>2</sub> -e per unit)
Air-conditioner	140.07
Dehumidifier	79.05
Refrigerator	156.96
Washing machine	245.04
TV set	86.31

## Electronic Products

Type	EF (kg CO <sub>2</sub> -e per unit)
Mobile phone	21.414
Desktop computer	318.467
Notebook computer	248.000
Tablet computer	135.000

## Clothing

Type	EF (kg CO <sub>2</sub> -e per unit)
Adults' general clothing item	7.923
Adults' coat/jacket	14.971
Children's general clothing item	5.374
Children's coat/jacket	10.478

### Note:

The emission factor of CLP is lower than that of HEC mainly because a considerable part of the CLP electricity is generated by nuclear power and imported from Guangdong Daya Bay Nuclear Power Station to Hong Kong. There is no GHG emission during the operation of a nuclear power plant.



## Carbon Footprint Calculation

The general formula applied for calculating the CO<sub>2</sub>-e emission of each GHG-emitting event is

$$\text{CO}_2\text{-e Emission} = \text{Quantity of GHG-emitting event} \times \text{Emission Factor}$$

Sample calculations of the online *Carbon Calculator* are presented in the following tables.

### Electric Utility

Electricity consumption (unit)	EF (kg CO <sub>2</sub> -e per unit)	CO <sub>2</sub> -e Emissions (kg CO <sub>2</sub> -e)
7,920	0.54	4,277

### Town Gas Utility

Town gas consumption (unit)	EF (kg CO <sub>2</sub> -e per unit)	CO <sub>2</sub> -e Emissions (kg CO <sub>2</sub> -e)
360	2.533 (Direct) 0.620 (Energy Indirect)	1,142

### Water Supply

Town gas consumption (unit)	EF (kg CO <sub>2</sub> -e per unit)	CO <sub>2</sub> -e Emissions (kg CO <sub>2</sub> -e)
420	0.410	172

### Public Transport

Type	Charges paid (HKD)	EF (kg CO <sub>2</sub> -e per HKD)	CO <sub>2</sub> -e Emissions (kg CO <sub>2</sub> -e)
MTR	6,000	0.010	60
Bus	2,400	0.052	125
Minibus	600	0.088	53
Tram			
Taxi			
Ferry			
Airplane			



## Total Carbon Footprint

Category	GHG Emission
Utilities	5,663 kg CO <sub>2</sub> -e
Transport	238 kg CO <sub>2</sub> -e
Food	160 kg CO <sub>2</sub> -e
Beverages	486 kg CO <sub>2</sub> -e
Clothing	172 kg CO <sub>2</sub> -e
Electrical Appliances	744 kg CO <sub>2</sub> -e
Electronic Products	471 kg CO <sub>2</sub> -e

## Carbon Footprint Report

The *Carbon Calculator* will generate a carbon footprint report that summarizes the quantitative details. From the report, you can clearly identify which ones of your household activities are most GHG-emission-intensive. Accordingly, you can make proper behavioural changes and take actions to reduce your carbon footprint.

### Three Scopes of GHG Emissions

With reference to the GHG Protocol by World Resources Institute, the GHG emissions reported are classified into three scopes. For the domestic sector, the three scopes cover the following typical emission sources.

Scope 1 Direct Emissions	<ul style="list-style-type: none"> <li>Burning of town gas or liquefied petroleum gas (LPG) for water heating and cooking</li> <li>Burning petrol or diesel oil for private car</li> <li>Tree planting activities (negative emission)</li> </ul>
Scope 2 Energy Indirect Emissions	<ul style="list-style-type: none"> <li>Electricity purchased</li> <li>Town gas purchased</li> </ul>
Scope 3 Other Indirect Emissions	<ul style="list-style-type: none"> <li>Waste disposal</li> <li>Water consumption</li> <li>Public transport</li> <li>Food, beverages and consumer products (lifecycle approach)</li> </ul>



## 4. Environmentally Friendly Tips

We now come to, perhaps, the most important stage of carbon footprint management, which is carbon footprint reduction. We have discussed 3Rs for waste management in the previous section. For the overall carbon footprint management, we add one more "R" to become 4Rs representing Reduce, Reuse, Recycle and Replace. By practising the following environmental-friendly tips, you can effectively reduce your carbon footprint, protect the environment as well as save money.



- Try to reduce your use of air-conditioners or heaters. Air-conditioners consume an extra 6% of electricity for every degree lower in temperature, Using a fan instead for 4 hours every day, you would reduce 1 tonne of carbon dioxide emission per year and save electricity.
- Remember to switch off and unplug lights and other electrical appliances when not in use. Up to 10% of electricity used in homes is consumed by appliances left on standby, approximately equivalent to 100 kg of CO<sub>2</sub>-e emission per year.
- If you drive, try to lower your speed and avoid excessive acceleration and deceleration. The more aggressively you drive, the more fuel is consumed. Petrol vehicles emit 3 kg CO<sub>2</sub>-e per litre consumed.
- Turn off the tap when brushing your teeth. If you brush for 2 minutes and leave the tap on, you could use up to 10 litres of water each time, plus the electricity used in processing and pumping.
- Avoid travelling abroad by aeroplane as aeroplanes are the most polluting form of transport. A round-trip flight between Hong Kong and London produces 2 tonnes of CO<sub>2</sub>-e per passenger.



- Bring your own containers when purchasing takeaway food. Using your own spoons and chopsticks every day could avoid up to 3.5 kg of CO<sub>2</sub>-e emissions per year.
- Reuse cardboard boxes and containers for storage. You can save almost 4 tonnes of CO<sub>2</sub> for every tonne of cardboard boxes disposed by landfill.
- Reuse plastic bottles by filling them with water and placing them in the freezer. Once the water freezes the bottle can be reused as an ice pack. Plastic bottles can also be used for planting seedlings for your garden. Each tonne of reused bottles can reduce up to 1.5 tonnes of CO<sub>2</sub>-e emissions.



## RECYCLE

- Recycle paper after using both sides. For every ton of paper produced 24 trees are cut down.
- Recycle spent batteries at your local MTR station. Discarded batteries at landfills leak pollutants into the soil and underground water tables, making up to 600 tonnes of water undrinkable.
- Recycle unwanted household items by donating and trading them with your friends, relatives and local charities. Recycling a single T-shirt can save more than 6 kg of carbon dioxide emissions, a mobile phone up to 50 kg.
- Recycle newspaper or read the news online. For every 1 tonne of newspaper recycled, 2.5 tonnes of carbon dioxide are avoided.

## REPLACE

- Replace private transport with public transport, such as MTR, buses, minibuses, and trams. You can reduce over 5 kg of CO<sub>2</sub>-e emissions by taking public transport per ride.
- Replace your incandescent light bulbs with long-life compact fluorescent (CFL) or LED bulbs. LEDs and CFLs last up to 15 times longer and use up to 80% less electricity. If you turn on 6 light bulbs for 6 hours every day, upgrading would avoid 600 kg of your CO<sub>2</sub>-e emissions every year.
- Replace drinks held in disposable containers with drinks held in reusable bottles. Tetra-pak boxes can't be recycled and their production emits large amount of carbon dioxide. If you avoid a pack of drink every day, you would reduce nearly 7 kg of carbon dioxide emissions per year.
- Replace bath with shower; and take shorter showers to save water and energy. If you reduce your shower time by 5 minutes every day you can reduce 8 kg of carbon dioxide emissions per year.
- Dry your clothes outside rather than using a clothes dryer. Even energy efficient dryers can use up to 1.8 kWh of electricity in a 1 hour cycle, equivalent to switching on 45 light bulbs for 1 hour.



Are you already practising some of the above tips? Raise your awareness on your household carbon-emitting sources. You should be able identify more carbon-emission-reduction measures.

Please do not just stop here. Spread the message to your friends and relatives. Let them know about the problems our World is facing. With the dedication of all human beings, the World will be a better place to live for generations to come!

If you do not know any recycling station or recycling bin nearby, you may visit the EPD website for more info and make a request.

One person's garbage is another person's gold. If you have items that you don't want, try giving them to friends, family or charities.

## 5. Clean Energy & The Future

Electricity and town gas consumptions are the two main sources of our GHG emissions. Related fossil-fuel combustion causes massive emissions of carbon dioxide. Using renewable energy to replace fossil fuels is definitely a clean, sustainable alternative.

### Wind Energy

Among various sources of renewable energy, wind energy is probably the most promising source for large-scale electricity generation in Hong Kong. Presently, there is one large wind turbine in Hong Kong, located on Lamma Island and operated by Hong Kong Electric Company Limited (HEC). Both power utilities (CLP and HEC) have plans to build off-shore wind farms in Hong Kong for increasing renewable energy in our fuel mix.



### Solar Energy

Solar water heaters can effectively reduce our town gas or electricity consumption for water heating. They are also highly cost effective and help us save money. However, the applications of solar water heaters in Hong Kong are limited mainly because of space constraint.

An alternative use of solar energy is by solar photovoltaics (PV) to convert sunlight into electricity. The largest PV systems in Hong Kong is also located on Lamma Island and operated by HEC. Presently, the cost of PV is still high and the payback period is commonly too long. Building integrated photovoltaics (BIPV) becomes more attractive in Hong Kong as the BIPV panels can also be used as building exterior walls and roofs for lower the overall installation cost.

### Biofuel

In Hong Kong, biodiesel supply is commercially available. The biodiesel suppliers collect waste cooking oil from local restaurants and convert it by chemical reaction into biodiesel. The biodiesel can be used in diesel engines of motor vehicles and generators. The cycle of production and burning of the biodiesel is carbon neutral.





## Hybrid and Plug-in Electric Vehicles

If you have to drive, choose an environmental-friendly car. Hybrid vehicles are equipped with regenerative braking systems. While you step on the brake, the mechanical energy will be converted into electricity stored in battery. The electricity will be used to run the electric motor when you step on the accelerator.

Plug-in electric vehicles (EVs) running on electricity are becoming increasingly popular. Depending on the fuel mix of the electric power grid, the cleaner the energy sources, the lower the GHG emissions of EVs. Besides low GHG emissions, plug-in EVs can reduce roadside airborne pollutant emissions. There are 1,000+ electric charging points in Hong Kong.

## Moving Towards a Clean Energy Future

Renewable energy is not widely used because presently it is still relatively expensive compared with conventional fossil-fuels based energy supply. However, if we take into account the estimated monetary loss of the environmental impacts and health risks caused by fossil fuels, renewable energy is the only option. We should raise awareness of such environmental issues and express our views to the government. Therefore, proper energy and environmental policies can be set to guide Hong Kong towards the economic-environmental balance for achieving a sustainable future.

# Useful Links

## **2006 IPCC Guidelines for National Greenhouse Gas Inventories**

<http://www.ipcc-nggip.iges.or.jp/public/2006gl>

## **Carbon Trust UK**

<http://www.carbontrust.com>

## **DEFRA**

<http://www.defra.gov.uk>

## **Food and Agriculture Organization of the United Nations**

<http://www.fao.org/home/en/>

## **Greenhouse Gas Protocol**

<http://www.ghgprotocol.org>

## **Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings In Hong Kong, HKSAR/EMSD & EPD**

[http://www.epd.gov.hk/epd/english/climate\\_change/ca\\_guidelines.html](http://www.epd.gov.hk/epd/english/climate_change/ca_guidelines.html)

## **Hong Kong Council for Sustainable Development**

<http://www.susdev.gov.hk>

## **Hong Kong Environmental Protection Department (EPD)**

<http://www.epd.gov.hk>

## **International Energy Agency**

<http://www.iea.org/>

## **iSustainable.org**

<http://www.iSustainable.org>

## **SME Carbon Audit Toolkit**

<http://www6.cityu.edu.hk/aerc/sme/guideline.asp>

## **United Nations Framework Convention on Climate Change (UNFCCC)**

<http://unfccc.int>

## **US National Oceanic and Atmospheric Administration**

<http://www.noaa.gov>

## **US National Research Centre**

<http://www.n-r-c.com>





ISBN: 978 962-442-358-7  
2013 City University of Hong Kong.  
All Rights Reserved