

**New Senior Secondary Liberal Studies
Teaching Package on
‘Energy Technology and the Environment’**

**Green Roofs and The Alleviation Of Global
Warming**

Hong Kong Liberal Studies Teachers’ Association

June, 2010

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Foreword

Climate change has become an issue of global concern in recent years. There are a lot of reports saying that many parts of the world are experiencing abnormal weather conditions and polar ice is melting. Some scholars are worried that abnormal weather patterns will not only upset the Earth's ecology, but also affect the daily activities of humans and even shorten the Earth's life expectancy. The continuous exploitation and consumption of non-renewable energy resources such as oil by humans not only has given rise to a large amount of exhaust gases but is also the major cause of global warming.

In fact, many countries, scientists and commercial organisations have been making an ardent effort to develop measures to alleviate global warming. 'Green roof' is one of those measures. The focus of this teaching package lies not in encouraging students to familiarise themselves with the procedures for constructing a 'green roof' or memorise the facts and figures about the benefits of 'green roofs', including reducing energy consumption and pollution. Rather, it aims to provide them with a chance to identify the challenges and opportunities faced by the government and different sectors in deciding whether to implement green-roof projects and how to carry out those projects, plus an opportunity to think of ways to achieve sustainable development.

This teaching package makes use of several learning tools to help students organise and analyse the results of class discussions in an orderly manner, and review their own opinions on the adoption of green roofs. Teachers may make reference to the teaching strategies and design of this teaching package and guide their students to study other global warming alleviation measures or projects.

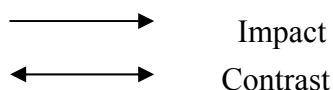
1. A Diagrammatic Sketch of the Preliminary Teaching Plan

Form 1: A diagrammatic sketch of the preliminary teaching plan

Theme: Green Roofs and the Alleviation of Global Warming

Case Study: The Implementation of Green Roof Projects in Hong Kong

Relevant concepts involved in the case and their interconnectedness	Initial questions for enquiry
<pre> graph TD energy((energy)) -- leads to --> greenhouse((Greenhouse effect)) greenhouse -- leads to --> global((Global warming)) energy -- pollutes --> environment((Environment)) energy -- pollutes --> quality((Quality of life)) greenhouse -- diminishes --> quality global -- alleviates --> quality greenroofs((Green roofs)) -- improves --> environment greenroofs -- improves --> quality greenroofs -- enhances --> greenhouse greenroofs -- consider --> cost((Cost)) greenroofs -- consider --> sanitation((Sanitation)) greenroofs -- reduce --> energy </pre>	<ul style="list-style-type: none"> ■ How is global warming related to human activities and energy consumption? ■ How do science and technology affect the environment? How can they help achieve sustainable development and improve the quality of life? ■ What are the limitations of the global warming alleviation measures? How can a balance be struck in order to achieve sustainable development?



2. Key Questions for Enquiry

Form 2: Related ‘modules’, ‘themes’, and ‘questions for enquiry’

Modules and themes	‘Questions for enquiry’ proposed in the <i>Guide</i>	Page numbers in the <i>Guide</i>
Module 6 Theme 1	■ To what extent does the development of energy technology create or solve environmental problems?	Page 53
Module 6 Theme 2	■ How do science and technology match with sustainable development? What are the constraints? ■ What responses could be made by the public, different sectors, and governments regarding the future of sustainable development?	Page 55 Page 55
Module 2 Theme 1	■ How can individuals or organisations contribute to the maintenance and improvement of the quality of life? What are the obstacles to their efforts? Which groups of people are most affected if these obstacles are not removed?	Page 27

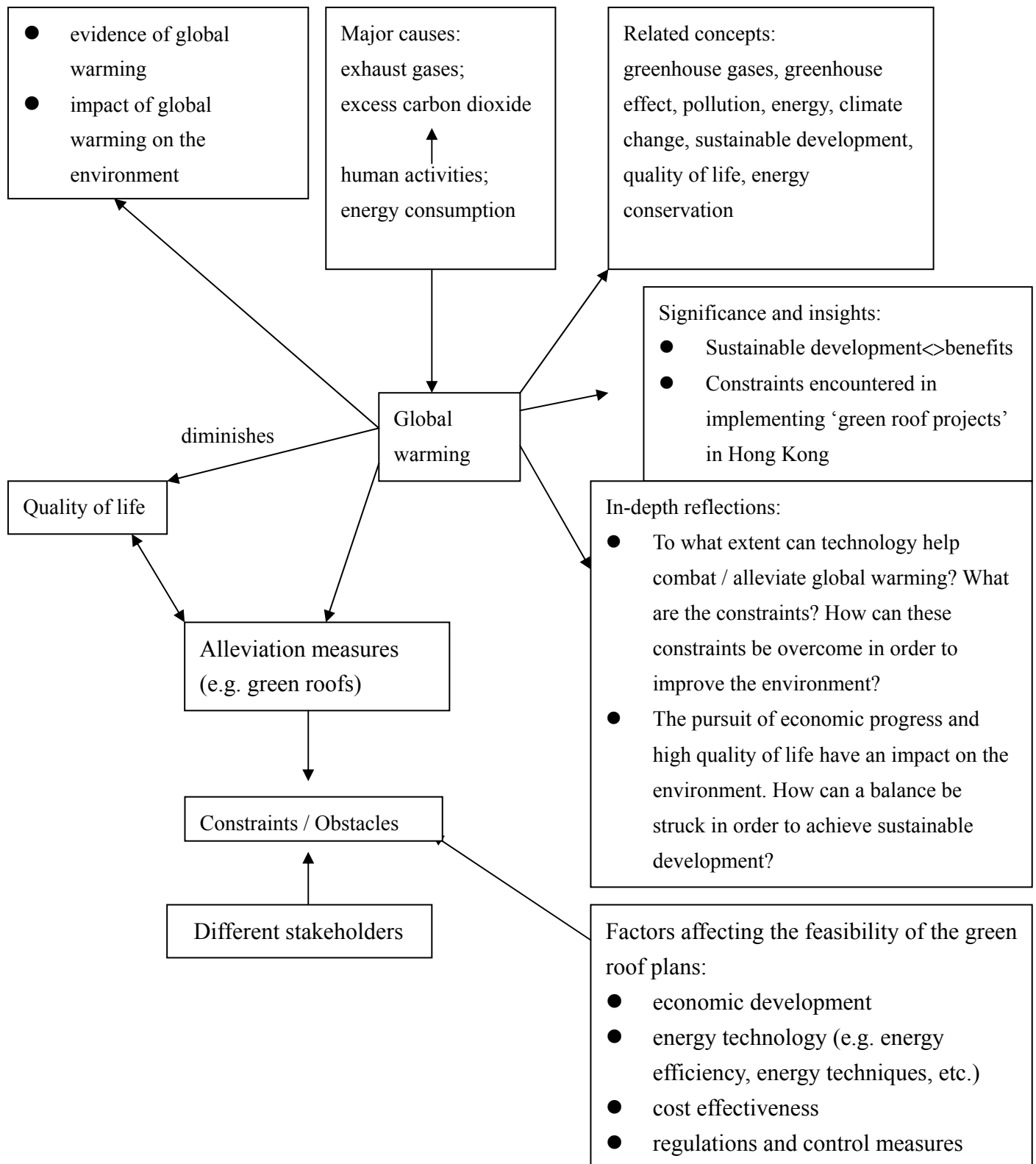
3. Detailed Planning for the Teaching Focuses

Form 3: Contents of learning

Related concepts	Related knowledge	Related values (page numbers in the <i>Guide</i>)	Related ‘generic study skills’
<ul style="list-style-type: none"> ● Global warming, energy consumption, emissions reducing, climate change, greenhouse gases, pollution, energy efficiency, sustainable development, cost effectiveness, quality of life 	<ul style="list-style-type: none"> ● Greenhouse gases ● Greenhouse effect ● Pollution problems and climate changes caused by energy consumption ● Green zones ● Green ratio ● Renewable energy resources 	<p>Betterment of humankind; respect for evidence; interdependence; responsibility; sustainability; respect for quality and excellence (Pages 49, 53, 55, 27)</p>	<ul style="list-style-type: none"> A. Information collection and processing skills B. Thinking from multiple perspectives C. Skills in identifying key concepts D. Skills in discerning key ideas, attitudes and values implied in the information E. Skills in evaluating the views of both sides F. Skills in providing evidence and explanations G. Verbal expression H. Listening skills I. Writing skills J. Skills in identifying real-life examples and opinions that are related to the issue K. Skills in proposing constructive solutions

4. A Diagrammatic Sketch of the ‘Teaching Plan’

Diagram 1: A diagrammatic sketch of the ‘teaching plan’



Significance and insights: only those related to the issue are included

In-depth reflections: reflections on broader questions derived from the issue in question

5.1 The Arrangement of Lessons

Form 4: The arrangement of lessons

Number of periods	Key contents and objectives of the lessons	Questions for enquiry	Relevant modules and themes specified in the <i>Guide</i>	The flow of the specific teaching plan: Instructional methods / activities	Teaching materials	Values, attitudes and skills
2	<ul style="list-style-type: none"> ■ To learn about the facts and evidence of global warming ■ To learn about the magnitude of global warming and its impact on the quality of life ■ To understand that social and technological developments are to blame for 	<ul style="list-style-type: none"> ■ How is global warming related to human activities and energy consumption? ■ How do science and technology affect the environment? 	<p>Module 6: Theme 1: To what extent does the development of energy technology create or solve environmental problems?</p> <p>Theme 2: How do the living styles of people and social development</p>	<ul style="list-style-type: none"> ■ The teacher asks the students to collect information on the contributing factors to global warming before the lessons begin. ■ The teacher shows the students ‘Source 1’ or plays the online video (the opening part of ‘Urban Greening’, a television documentary produced by the Hong Kong Connection) introduced in ‘Source 2’ to familiarise them with the evidence and magnitude of global warming. ■ The teacher asks the students to discuss in groups the contributing factors to global warming and the human activities involved, as well as the environmental problems brought about by these human activities with reference to the information they have collected before lessons, and complete ‘Worksheet 1’. (The teacher may hand out ‘Source 3’ to the students if necessary.) ■ The teacher invites each group to report their findings 	<p>Source 1 Source 2</p> <p>Source 3 Worksheet 1</p>	<ul style="list-style-type: none"> ■ Respect for evidence ■ Information collection skills ■ Verbal expression and effective communication with group members ■ Skills in expressing opinions and stance ■ Sense of responsibility ■ Betterment of

Number of periods	Key contents and objectives of the lessons	Questions for enquiry	Relevant modules and themes specified in the <i>Guide</i>	The flow of the specific teaching plan: Instructional methods / activities	Teaching materials	Values, attitudes and skills
	<p>global warming</p> <ul style="list-style-type: none"> ■ To know the different types of greenhouse gases ■ To understand that there is a pressing need to take immediate remedial actions to alleviate the current situation 		<p>affect the environment and the use of energy?</p>	<p>and adds a few comments when necessary.</p> <ul style="list-style-type: none"> ■ The teacher summarises what students have learnt in the lessons by asking them the following questions: <ol style="list-style-type: none"> 1. What are the possible causes of greenhouse effect, greenhouse gases and global warming? 2. What is the possible relationship between global warming and the exploitation and consumption of energy resources? 3. Which aspects of the quality of life are affected by global warming (students should not confine their answers to the environmental aspect)? <p>(The teacher may also make use of ‘Source 4’ or the motion picture on greenhouse effect available at http://www.energyland.emsd.gov.hk/eng/energy/envir_global.htm to summarise what students have learnt in the lessons)</p> ■ The teacher asks the students to gather information on ‘green roofs’ after lessons and complete ‘Worksheet 2’. (The teacher may drop a hint to the students by 	<p>Source 4</p> <p>Worksheet 2</p>	<p>humankind</p> <ul style="list-style-type: none"> ■ Interdependence

Number of periods	Key contents and objectives of the lessons	Questions for enquiry	Relevant modules and themes specified in the <i>Guide</i>	The flow of the specific teaching plan: Instructional methods / activities	Teaching materials	Values, attitudes and skills
				referring them to the website of the HK Green Building Technology Net at http://gbtech.emsd.gov.hk/english/minimize/tech.html)		

Number of Periods	Key contents and objectives of the lessons	Questions for enquiry	Relevant modules and themes specified in the <i>Guide</i>	The flow of the specific teaching plan: Instructional methods / activities	Teaching materials	Values, attitudes and skills
2	<ul style="list-style-type: none"> ■ To know the environmental conservation measures adopted in other metropolises such as Tokyo, Beijing, New York and London, which include green 	<ul style="list-style-type: none"> ■ How can science and technology help achieve sustainable development and improve the quality of life? ■ What are the limitations of the global warming alleviation 	<p>Module 6: Theme 2</p> <p>What responses could be made by the public, different sectors, and governments regarding the future of sustainable</p>	<ul style="list-style-type: none"> ■ The teacher invites the students to give a brief presentation on the information they have collected by asking them the following questions, through which students can gain a preliminary idea about certain environmental concepts such as ‘green roofs’ and green zones, green walls, green ratio, and energy efficiency regulations for buildings: <ol style="list-style-type: none"> 1. What are ‘green roofs’? 2. What are the different types and designs of ‘green roofs’? 3. What are the advantages of ‘green roofs’? 	<p>Source 5</p> <p>Source 6</p>	<ul style="list-style-type: none"> ■ Thinking from multiple perspectives ■ Skills in discerning views, attitudes and values in the information ■ Rational analysis

Number of Periods	Key contents and objectives of the lessons	Questions for enquiry	Relevant modules and themes specified in the <i>Guide</i>	The flow of the specific teaching plan: Instructional methods / activities	Teaching materials	Values, attitudes and skills
	<p>zones, sky gardens / green roofs, green walls, green ratio, energy efficiency regulations for buildings, etc.</p> <p>■ To learn about how energy conservation technology is applied in buildings</p> <p>■ To examine the constraints faced in implementing green roof</p>	<p>measures? How can a balance be struck in order to achieve sustainable development?</p>	<p>development?</p> <p>Module 2: Theme 1</p> <p>How can individuals or organisations contribute to the maintenance and improvement of the quality of life? What are the obstacles to their efforts? Which groups of people are most affected if these obstacles are not removed?</p>	<p>The teacher may give the students feedback with reference to ‘Source 5’ or by showing them a television documentary introducing ‘green roofs’, namely ‘Recapturing Nature’s Green’, produced by the Hong Kong Connection (Source 6).</p> <p>■ The teacher organises a ‘Jigsaw Puzzle Activity’ for the students to start discussion.</p> <p>■ Scenario: Students are asked to imagine themselves as Environmental Protection Department officials who are responsible for the implementation of ‘green roof projects’ in Hong Kong. They are required to study the feasibility of the green roof projects as well as the difficulties and obstacles that they may encounter (e.g. why green roofs are successfully adopted in other metropolises, but not in Hong Kong?). They also have to decide on a road map for implementing the ‘green roof projects’ as well as draft policies to promote / enforce the mandatory installation of ‘green roofs’ on new buildings.</p>		<p>■ Skills in comparing different viewpoints</p> <p>■ Skills in providing evidence and explanations</p> <p>■ Verbal expression</p> <p>■ Ability to give immediate response</p> <p>■ Skills in tackling problems</p> <p>■ Skills in organising information</p>

Number of Periods	Key contents and objectives of the lessons	Questions for enquiry	Relevant modules and themes specified in the <i>Guide</i>	The flow of the specific teaching plan: Instructional methods / activities	Teaching materials	Values, attitudes and skills
	projects in Hong Kong as well as its feasibility from different perspectives			<ul style="list-style-type: none"> ■ The teacher divides the students into five expert groups, namely Group A, B, C, D and E, and hands out ‘Source 7: Resource A’ to Group A, and ‘Resource B’ to Group B, and so on. ■ Each expert group is asked to study and analyse the ‘Resource’ they have received. Based on the perspective(s) implied in the information, they are asked to respond to the questions: ‘Should “green roofs” be adopted in Hong Kong?’ and ‘How should the constraints and obstacles be overcome?’ ■ The teacher re-divides the students into four to five big groups (depending on the size of the class). Each big group should consist of one to two members from each expert group. The group members are asked to select one member as the secretary and one to two members as the presenter(s). ■ Each member of the group takes turn to report the analysis, arguments, concerns and decision of his / her expert group to the other group members before the whole group kicks off a further discussion on the 	<p>Source 7 (Resources A to E)</p> <p>Worksheet 3</p>	and expressing opinions in written form

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				<p>question: ‘Should “green roofs” be adopted in Hong Kong?’. Each group then summarises the opinions of all the group members. The secretary jots down the key points and results of the discussion on ‘Worksheet 3’. (The teacher may remind the students to carry out the discussion taking into account the three aspects of sustainable development: economic, social and environmental.)</p> <ul style="list-style-type: none"> ■ The teacher invites each group to report their decision and the reasons behind the decision. The other groups jot down the key points of the presentation on ‘Worksheet 4’. ■ With reference to their notes on ‘Worksheet 4’, each group decides on a group whose presentation is the most all-rounded one (i.e. one that can cover and strike a balance between the three aspects of sustainable development). ■ The teacher gives each group feedback based on the adequacy and appropriateness of the supporting evidences, as well as whether the tension between 	Worksheet 4	

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				<p>economic development and environmental conservation has been effectively responded to in the presentation.</p> <ul style="list-style-type: none"> ■ The teacher summarises the students' work by asking them the following questions: <ol style="list-style-type: none"> 1. In what ways can 'green roofs' alleviate global warming? 2. What stakeholders are involved in the implementation of 'green roof projects' in Hong Kong? 3. What major factors should be considered when deciding whether to implement 'green roof projects' in Hong Kong or not? 4. What will be the difficulties in striking a balance among the three aspects of sustainable development when implementing green roof projects in Hong Kong? 5. What roles do science and technology play in sustainable development as reflected in the discussions on 'green roofs'? How can the 		

Number of Periods	Key contents and objectives of the lessons	Questions for enquiry	Relevant modules and themes specified in the <i>Guide</i>	The flow of the specific teaching plan: Instructional methods / activities	Teaching materials	Values, attitudes and skills
				<p>relevant scientific knowledge perform its functions during the decision-making process?</p> <ul style="list-style-type: none"> ■ Follow-up assignment: the teacher chooses a sample assignment for the students to complete after class according to their learning progress and abilities. In addition, the teacher asks each group of students to choose a measure that has already been launched by the government to alleviate global warming or one that is about to be implemented, and complete ‘Worksheet 5’ based on what they have learnt in class (students may have to find additional information if necessary). 	Sample Assignments 1 - 3 Worksheet 5	

5.2 Assessment Form / Criteria for the Study Progress

Integrated Skills Table

Teachers can use the table below to assess students' performance.

	Supplementary Skills	Excellent	Acceptable	Need improvement
1	Identify the core of the problem or the main controversy			
2	Identify relevant facts, opinions and values			
3	Identify arguments and evidence in favour of a proposition			
4	Categorise information			
5	Compare and contrast opinions and viewpoints			
6	Evaluate the reliability of information			
7	Demonstrate causal relationships			
8	Conceptualisation (able to identify concepts from examples and conduct discussions based on the concepts)			
9	Critical thinking			
10	Reflective thinking (closely re-examine known facts or beliefs)			
11	Think from multiple perspectives			
12	Provide explanations or arguments			
13	Propose solutions			
14	Show stance / rationale / value orientation			
15	Substantiate arguments with appropriate examples			
16	Provide criteria for evaluation			

(The above table can be used to assess the performance of an individual student, a group of students, or the whole class in different activities. However, not every activity involves all 16 supplementary skills.)

6. 'Sample Assignments'

6.1 Sample Assignment 1

A. Summary of Expert Groups' Presentation

Complete the following table based on the presentation of each expert group regarding the question: 'Should green roofs be adopted in Hong Kong?'

Expert group	Major concern(s)	Summary of speech and Stance
A		
B		
C		
D		
E		

B. Personal views

With reference to class discussions, state whether you will support the government's proposal to legislate for the mandatory implementation of 'green roof projects' in Hong Kong or not? Make your stance clear and provide supporting arguments.

6.2 Sample Assignment 2

Read the following passages carefully:

Source 1:

The Hong Kong Government is about to roll out the last environmental initiative for this year as a response to global warming. Consultation paper will be launched the day after tomorrow (28th December 2007) at the earliest to seek public opinion on the proposed legislation, which mandates that key service installations of new buildings, like lighting, air-conditioning, electrics, lifts and escalators, should comply with the specified energy efficiency requirements. An additional capital outlay in the region of 3% to 5% of the building construction cost may have to be incurred as a result of the new legislation. Nevertheless, according to government statistics, the payback period for the additional capital investment is about six years. The saved cost for the energy is enough to cover the increased building cost, so it will be cost effective in the long run. If the communal areas of new commercial buildings and residential buildings are enrolled into the scheme, it is estimated that the proposal will finally result in savings of 0.28 billion kilowatt-hours (kWh) each year, which contributes to a reduction in carbon dioxide emissions of 200,000 tonnes.

Secretary for the Environment Edward Yau once anticipated that the proposed implementation of 'Building Energy Codes' (BECs) would not be likely to spark off much debate in society. He hoped the bill can be passed by the Legislative Council (LegCo) within this legislative year. Like many other new environmental initiatives put forward by the Environmental Bureau recently, such as the idling engine ban as well as the environmental levy on plastic shopping bags, public consultation always goes before legislation. However, given the contentious nature of those issues, most of them are unlikely to be passed in this legislative year. In other words, it is possible that legislation for the mandatory implementation of BECs – an anti-global warming measure launched by the government – may 'surpass' all its counterparts and be completed as scheduled.

Source: Translated from 〈新廈強制節能最快週五諮詢〉 (2007) 《明報》，12月26日。

Source 2:

In fact, the Building Energy Codes (BECs) has been operating since 1998. However, enrolment into the scheme is voluntary. By October this year (i.e. 2007), only 1944 certificates of compliance have been issued to 774 buildings complying with the codes. Among them, the majority are government buildings while private properties only constitute an insignificant number. This indicates that voluntary compliance with the BECs is not satisfactory.

According to the BECs issued by the Electrical and Mechanical Services Department (EMSD), compliance with the energy efficiency standards of installations including lighting, air-conditioning, electrics, lifts and escalators may bring about 10% to 15% annual savings in energy bills.

Source: Translated from 〈新廈強制節能最快週五諮詢〉 (2007) 《明報》，12月26日。

Answer **ONE** of the questions below:

1. If you were a Hong Kong developer, what would be your opinion on the government's proposal to legislate for the mandatory installation of green roofs on new buildings? What would be your opinion on its plan to require the key service installations of new buildings to comply with the specified energy efficiency standards by means of legislation?
2. Suppose you were a Hong Kong developer. Write a letter to the government in response to its plan to legislate for the mandatory compliance with the specified energy efficiency standards by new buildings. State your opinions and suggestions.

6.3 Sample Assignment 3 (Advanced Level)

Suppose you were the Secretary for the Environment, who is going to legislate for the mandatory compliance of energy efficiency standards by new buildings. With reference to class discussions, decide how you would implement green roof projects in Hong Kong (the projects will cover both new and old buildings).

7. Thinking Tools That Support ‘Learning Activities’

Worksheet 1

What are the human activities that cause global warming? What environmental problems do these activities bring about?

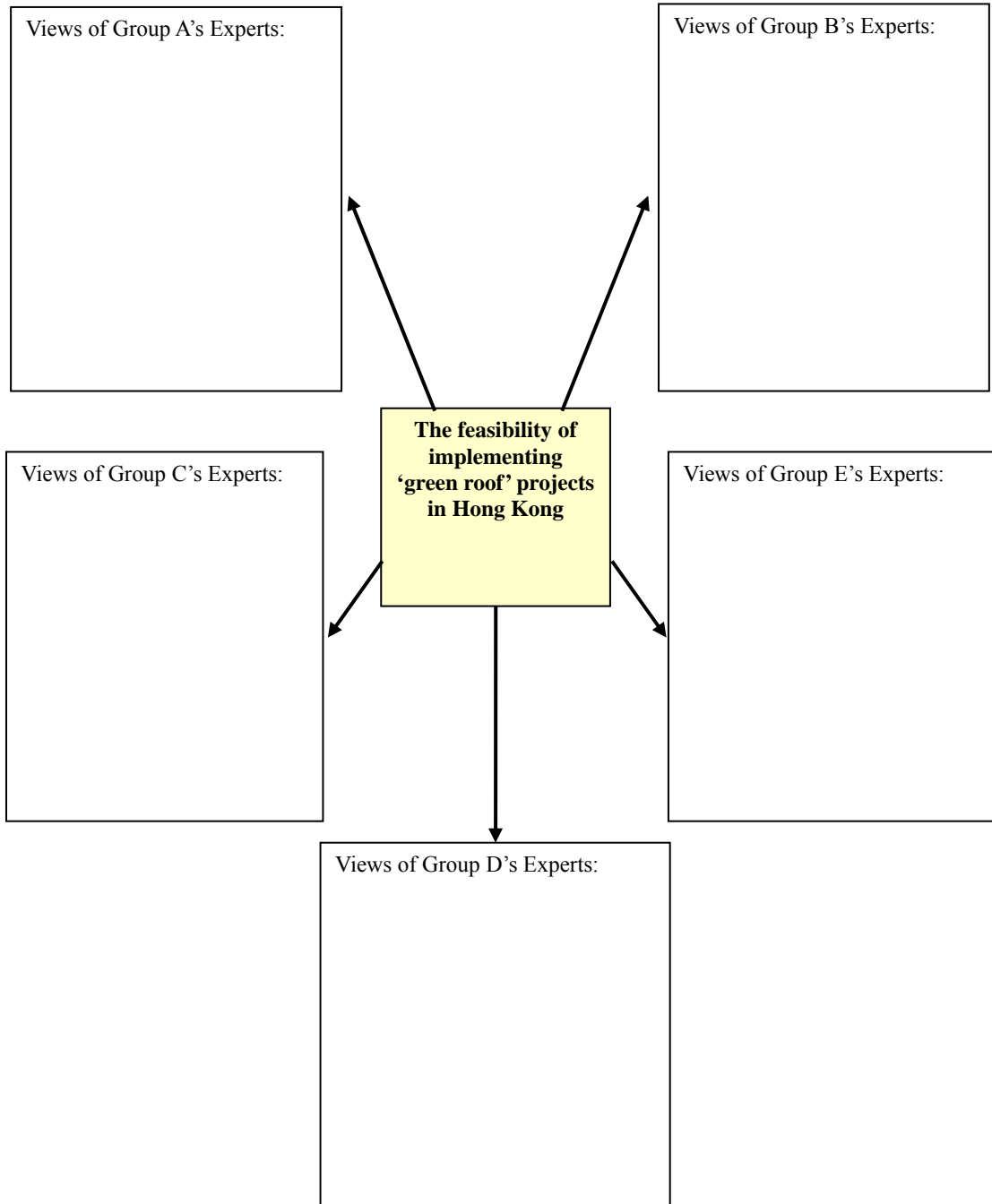
Human activities that cause global warming	Environmental problem(s) that the activity may bring about

Worksheet 2

Collect information on green roofs and then complete the following table:

What are green roofs?
What are the different types of green roofs?
What are the advantages of green roofs?
If green roofs are to be included in the building or housing estate that you live in, would you support the proposal? Why or why not?

Worksheet 3: Record of Group Discussions



Worksheet 4: Record of Group Presentation

Group	Decision	Reasons / Evidences
	<input type="checkbox"/> Comprehensive implementation of the 'green roof projects' <input type="checkbox"/> Adopting 'green roofs' on certain buildings / housing estates* first, and then extending the measure to the other buildings / housing estates at a later time <input type="checkbox"/> Only installing 'green roofs' on certain buildings / housing estates* <input type="checkbox"/> Oppose the implementation of the 'green roof projects' *Please specify:	
	<input type="checkbox"/> Comprehensive implementation of the 'green roof projects' <input type="checkbox"/> Adopting 'green roofs' on certain buildings / housing estates* first, and then extending the measure to the other buildings / housing estates at a later time <input type="checkbox"/> Only installing 'green roofs' on certain buildings / housing estates* <input type="checkbox"/> Oppose the implementation of the 'green roof projects' *Please specify:	
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	<input type="checkbox"/> Comprehensive implementation of the 'green roof projects' <input type="checkbox"/> Adopting 'green roofs' on certain buildings / housing estates* first, and then extending the measure to the other buildings / housing estates at a later time <input type="checkbox"/> Only installing 'green roofs' on certain buildings / housing estates* <input type="checkbox"/> Oppose the implementation of the 'green roof projects' *Please specify:	

Worksheet 5 (After-class Group Exercise)

Choose one measure that has already been launched by the government to alleviate global warming or one that is about to be implemented. Write a report of about 500 to 1,000 words on the measure based on what you have learnt in class and / or any additional information you have come across. Your report should include the following:

1. Title of the measure
2. Date / proposed date of implementation
3. Government department(s) / Organisation(s) concerned
4. Brief introduction of the measure
5. The function of the measure in alleviating global warming
6. Responses of different stakeholders to the measure
7. Difficulties and constraints in implementing / promoting the measure
8. Should the government implement or continue to implement it? (Please provide evidence and / or suggestions for further improvement)

8. Relevant Resources for Classroom Teaching

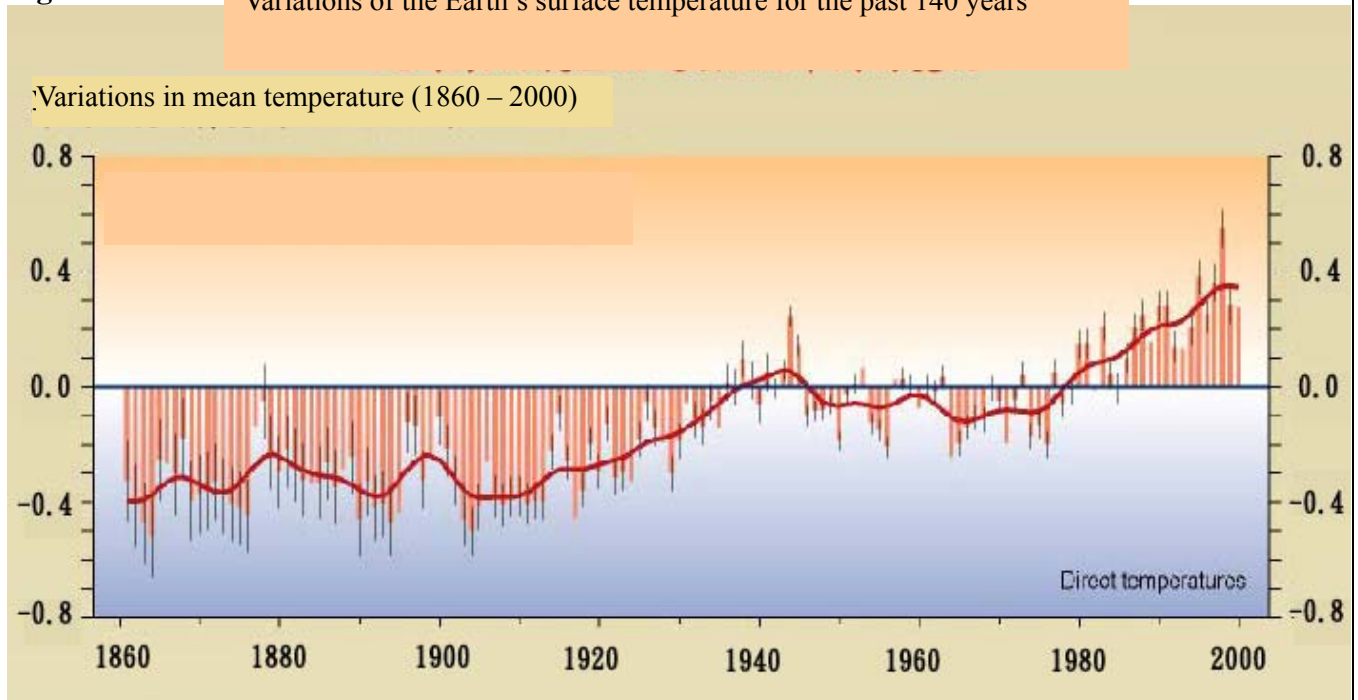
Source 1: What is the evidence that global warming is under way?

A report by the Intergovernmental Panel on Climate Change (IPCC) points out that the global average temperature has increased by approximately 0.8°C during the past 140 years, from 13.5°C in 1860 to 14.4°C in 2000. However, the trend is not linear. The Earth's surface temperature started to rise rapidly a century ago. It experienced the first warming period between 1910 and 1945, followed by a cold period of 30 years. Temperature rose again in 1976 and continued to rise afterwards. We are now experiencing a warming period where temperature keeps on rising (Figure 1). At the same time, the sea level recorded has been fluctuating. Both the Amsterdam and Brest Sea Level Stations found an increase of 130mm of the global average sea level, which has been rising over the last century.

To measure the extent and thickness of the sea ice in the Arctic and Antarctic, not only satellite remote sensing techniques are relied upon, but also on-site measurement is employed. In the 1950s and 1990s, the United States Navy sent out submarines to take measurement of the draft of sea ice. Data collected shows a decline in sea-ice thickness from about 3.1m in the 1950s to an average of 1.8m in the 1990s, which is a significant reduction of 42%. This indicates that sea ice is thinning.

Figure 1

Variations of the Earth's surface temperature for the past 140 years



Source: Intergovernmental Panel on Climate Change. (2006). *Variations of the Earth's surface temperature for....* Retrieved 31 December, 2009, from Tropical Rainforest Conservation webpage:

<http://www.mongabay.com/images/2006/graphs/ipcc-temp.jpg>

Source 2: ‘Hong Kong Connection: Recapturing Nature’s Green’

Description: People in Japan are taking advantage of urban redevelopment projects to re-green the highly urbanised metropolis, thereby mitigating the urban heat island effect. One of the biggest property developers in Japan has kicked off a green urban redevelopment project. It hopes to bring back green scenery to the country for the sake of the environment as well as the well-being of the people.

In the Mainland, the government has also established standards for public building designs. Buildings in the country are required to comply with the energy efficiency standards. When planning for the development of the Futian District in Shenzhen, the local government decides to reserve plenty of land in the district for building green zones. Local developers may answer the government’s call to make the greening effort more complete.

The Hong Kong government has not yet launched any initiatives to cut greenhouse gas emissions and reduce the urban heat island effect. A local university is conducting a pilot scheme to experiment on sky gardens on buildings. Researchers responsible for the study hope the government will formulate corresponding guidelines to promote sky gardens across the territory, which they believe will add vibrancy to the city. On the other hand, government departments are also making an ardent effort to carry out green works. However, do we really have green policies that pinpoint on the deteriorating environment?

How to borrow: The video tape can be borrowed from Radio Television Hong Kong. For further details, please visit the following website: <http://www.rthk.org.hk/channel/tv/tvarchivecatalog/>

Source: 鄭翠娟（編導），（2007年4月23日）回歸自然[鏗鏘集]。香港：香港電台。

Source 3: What are the major causes of global warming?

There are many causes of global warming, some natural and others human. For natural causes, many people suspect that global warming is a direct consequence of the increased amount of energy radiating from the sun. However, this perception has been proven wrong by scientists, who measured the amount of incoming solar radiation in outer space as well as on Earth's surface, and found that there were no significant changes in the amount of solar radiation. Today, scientists generally believe that global warming is triggered by the following natural factors:

1. Changes in the distance between the Sun and the Earth, resulting in a change in the amount of incoming solar radiation;
2. Some scientists believe that when the number of sunspots increases, the amount of solar radiation increases accordingly (however, the validity of this claim has yet to be verified through satellite surveillance);
3. Continental drift and morphological fluctuation;
4. Head-on collision between comets and the Earth;
5. Short-term cooling of the atmosphere as a result of a volcanic eruption.

Man-made factors also have a role to play. Among them, the most obvious ones are the dramatic increase in global population and the rapid development of technologies. Nearly a millennium ago, the world only had a population of approximately 0.6 billion. The figure rose to one billion in 1900 and reaches six billion at the present time, which is a shocking rise. A further increase of five billion is projected for the next 200 years. Growth in population entails a rising demand for resources as well as increasing consumption of fossil fuels by vehicles and factories. All these are causes for the increase in greenhouse gases. In addition, the over-exploitation and cultivation of land as well as the deforestation of virgin forest are upsetting the balance of both the ecosystem and the natural climatic cycle.

What is greenhouse effect?

Under normal conditions, after absorbing solar radiation, the earth surface and the atmosphere emit infrared radiation to space to maintain a balance. However, affected by greenhouse gases, the atmosphere absorbs more infrared radiation than it re-radiates to space. This results in an increase in the Earth's surface temperature. This phenomenon is known as the 'greenhouse effect'. Since human activities keep on producing plenty of greenhouse gases, more and more infrared radiation is trapped in the atmosphere, which aggravates the greenhouse effect.

Types of greenhouse gases:

Greenhouse gases make up less than one per cent of the atmosphere. The major greenhouse gases include carbon dioxide (CO₂), methane (CH₄), chlorofluorocarbons (CFCs), and ozone (O₃).

Source: Extracted and Translated from

1. 綠力生活網 (2009 年 12 月 1 日)〈何謂「溫室效應」〉,《綠力生活網》。取自：
<http://www.gple.com.tw/modules/news/article.php?storyid=4> (瀏覽日期：2009 年 12 月 31 日)
2. 柳中明 (2003 年 11 月 8 日)《講座：北極冰融・全球暖化》。講座地點—文化大學推廣教育部大夏館，台北。

Table 1: The major greenhouse gases and their sources

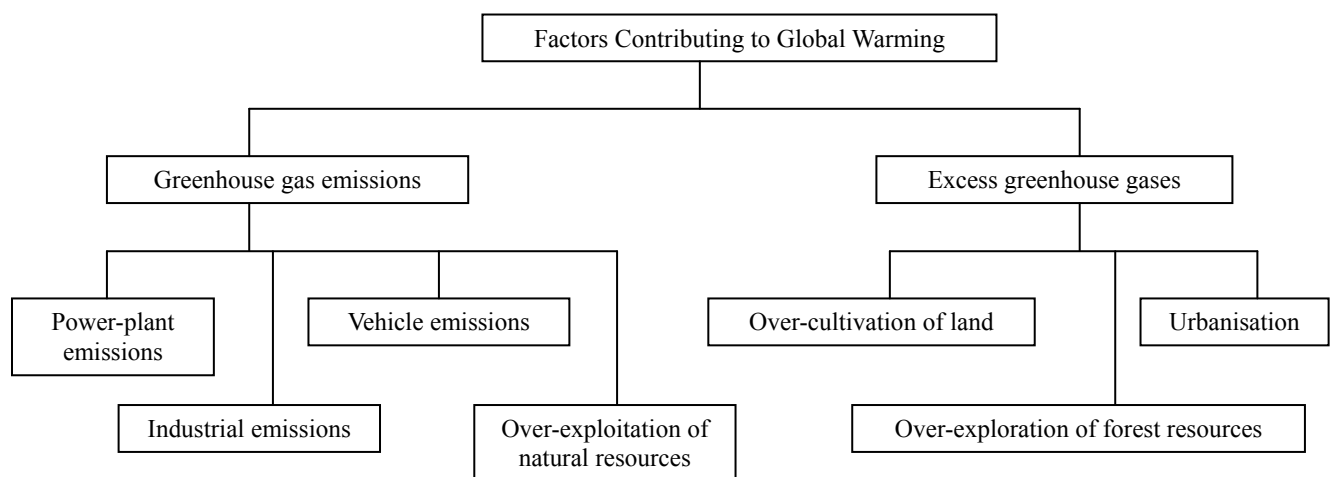
Greenhouse gas	Sources
Carbon Dioxide (CO ₂)	1) Fossil fuel combustion 2) Land-use change (deforestation)
Methane (CH ₄)	1) Biomass burning 2) Enteric fermentation 3) Rice paddies
Nitrous Oxide (N ₂ O)	1) Biomass burning 2) Fuel 3) Chemical fertilisers
Chlorofluorocarbons (CFCs)	Industrial production
Sulphur Dioxide (SO ₂)	1) Volcanic activities 2) Coal and biomass combustion
Ozone (O ₃)	Photochemical reactions involving O ₂
Carbon Monoxide (CO)	1) Plants 2) Human activities (vehicle and industrial emissions)

Source: 地球保護（無日期）〈對人類生活的潛在影響〉，《地球保護》。取自：
<http://s96.tku.edu.tw/~296650178/index5.htm>（瀏覽日期：2009 年 12 月 29 日）

Source 4: (For Teachers' Reference):

Examples of human activities that cause global warming:

- Burning of fossil fuels
- Over-exploitation of natural resources
- Greenhouse gas emissions
- Deforestation
- Power-plant emissions
- Industrial emissions
- Vehicle emissions
- Urbanisation
- Over-cultivation of land
- Exploration of forest resources



Source 5: Green Roofs

Introduction

A 'green roof' is a roofing assembly consisting of a waterproof membrane and additional component layers – including growing media for plants, drainage, and root protection systems – allowing for the propagation of vegetation across all or part of a roof surface. Green roofs can be used in industrial facilities, residences, offices and other commercial buildings.

Benefits of green roofs

'Green roofs' can bring substantial benefits to the environment and the ecology. These benefits include:

(a) Mitigating the 'urban heat island effect'

The urban heat island effect is mainly caused by the many hard and reflective surfaces (e.g. rooftops), which absorb solar radiation and re-radiate it as heat, resulting in a rise in the temperature, making cities hotter than the countryside around. Reduction of the urban heat island effect can bring about lots of benefits such as reducing the floating of dust, particulate matter and smog throughout the city. Replacing conventional roofs with green roofs can significantly reduce the temperature above the roof through transpiration and photosynthesis of the vegetation.

(b) Reducing heat gain from roof

Green roofs insulate buildings by preventing heat from transmitting through the building roof. The reduction of heat gain from the roof can reduce the cooling energy consumption of air-conditioning system. The insulation properties can be maximised by using a growing medium with a low soil density and high moisture content. However, this benefit will be less significant in multi-storey buildings because of the low ratio of roof area to the total exposed building facade. Since green roofs are more complex than simple insulators, project-specific building envelope analysis is required to predict energy effectiveness under specific project conditions.

(c) Prolonging the life of roofing materials

Green roofs can provide protection to waterproofing materials of the roof structure. Their value in roof protection has been demonstrated by more than thirty years of experience in overseas countries. The multiple layers of the green roof protect the underlying roof materials from the elements in three ways:

- i) protecting from mechanical damage from humans, animals and debris, etc.;
- ii) shielding from ultraviolet radiation;
- iii) buffering temperature changes, minimising damage due to the daily expansion and contraction of the roof materials.

(d) Reducing sound transmission

The multiple layers of 'green roofs' can be used for sound insulation. They can absorb, reflect or deflect sound waves produced by machines, cars or airplanes. The substrate of green roofs can block low frequency sound waves and the plants on the top can block the high ones.

(e) Controlling storm water runoff

During rainstorms, green roofs act as a sponge absorbing much of the water that would otherwise run off.

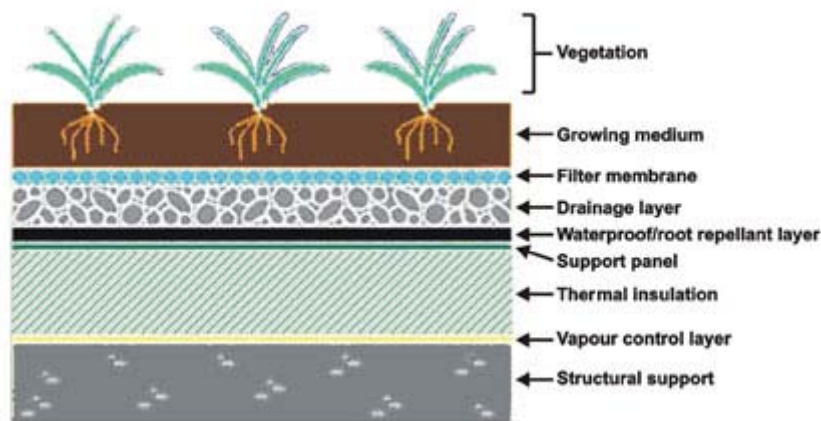
(f) Others

In addition to the above benefits, adopting 'green roofs' can create wildlife habitats and beautify the environment.

Structure of green roofs

There are two main types of 'green roofs', namely 'extensive green roofs' and 'intensive green roofs'. Extensive 'green roofs' usually require a thin soil depth of 150mm (approximately five feet) or less. They are more suitable for lightweight buildings. This type of 'green roofs' is capable of accommodating a wide variety of low-maintenance terrestrial plants and grasses, which grow spontaneously. Intensive 'green roofs', on the other hand, often require a deeper soil depth of not less than 300mm (approximately ten feet). They are usually sky gardens, where big trees or shrubs grow.

As extensive 'green roofs' have less constraints on the structural loading capacity of buildings and lower maintenance requirements than intensive 'green roofs', they are widely adopted in many countries. A typical 'green roof' is composed of various layers performing different functions. Some layers provide nutrients and support for plants, while others protect the waterproofing systems from damage and allow drainage. The picture below illustrates the typical structure of a 'green roof':



Roof type scenarios in Hong Kong

In Hong Kong, there are three main green roof types – Sky Gardens, Podium Gardens (New Buildings) and Existing / Low-maintenance Buildings.



(Left) Sky Gardens (Source and copyright © Greenlink Küsters Ltd., 2006), (Centre) Podium Gardens, (Source and copyright © ArchSD, 2005), (Right) Existing Buildings (Source and copyright © Urbis Ltd., 2006)

- ◆ Sky Gardens are built on high-rise buildings, usually 20 storeys and above. Sky Gardens are usually designed as part of the building and may be intensive or extensive green roofs depending on their usage.
- ◆ Podium Gardens are usually 2 to 5 storeys high forming the base of a residential or office tower. These gardens are usually intended for full access by the building occupants or the public and are therefore always intensive green roofs.
- ◆ Existing and Low-maintenance Buildings include existing office and residential towers and other buildings such as public infrastructure buildings. Due to weight constraints and the low need for maintenance, extensive green roofs would generally be adopted.

Design considerations

The application potential of green roofs is large because of their versatile functions. Green roofs can be installed on new buildings and incorporated into the existing buildings and structures. When designing green roofs, a number of factors have to be taken into account. Here are some examples:

- Climate (especially temperature and rainfall patterns)
- Strength of the supporting structure of the buildings
- Size, height and orientation of the roof
- Type of waterproofing of the building
- Visibility, compatibility with architecture

Example Projects

1. Electrical and Mechanical Services Department's new headquarters at Kai Tak

Part of the roof of the EMSD's new headquarters is a garden. This design helps provide heat insulation and cuts down the load of cooling of the air-conditioning system.

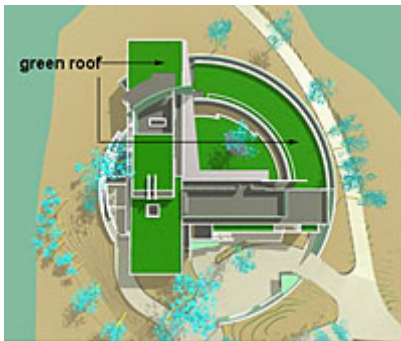


Source: EMSD (2007 年 2 月) 〈Study on Green Roof Application in Hong Kong, 〉, 《建築署》。取自：
http://www.archsd.gov.hk/english/knowledge_sharing/1354-Green-Roofs-ES-Chinese-2007-02-16.pdf (瀏覽日期：2009 年 12 月 29 日)

部分圖片來源：Architectual Services Department.(2007).Image.Retrieved January 4, 2010, from
http://www.archsd.gov.hk/ExhGallery_ViewPage.asp?viewPhoto=True&viewProject=EMSD&PhotoName=Project_Exhibition/emsd_hq_photo12.jpg

2. Veterinary Laboratory at Tai Lung, Sheung Shui, Hong Kong

The green part in the graph is of green roof design with green plants. This design helps heat insulation of the building.



(Source: http://www.hku.hk/mech/sbe/case_study/case/hk/vet/fea_gn_roof.htm)

Reference

1. Hui, S. C. M., Benefits and potential applications of green roof systems in Hong Kong, In Proceedings of the 2nd Megacities International Conference 2006, 1-2 December 2006, Guangzhou, China, pp. 351-360.

(Source: HK Green Building Technology Net)

Source 6: 'Hong Kong Connection: Urban Greening'

Description: The United Nations' latest report on global warming, which was released in early April, warns that approximately one-third of Earth's animals and plants will become extinct in 50 years if global temperature continues to increase.

Apart from global warming, Japan is also under threat from the heat island effect, which has led to the continuing increase in the country's temperature. Japanese experts have anticipated forty years ago that the temperature in Tokyo would rise. Now, the prophecy has come true. The Japanese government has been establishing corresponding policies to increase the amount of green works and require new buildings to maintain a satisfactory green ratio. Green roofs have become one of the prime directions for development in Japan. What is the current situation of green roof technology in Japan? How did the Japanese make use of green works to create commercial opportunities?

Hong Kong is also a densely populated and highly urbanised city. The average temperature in urban areas in Hong Kong is higher than the increased global temperature. Despite its geographical advantages, Hong Kong has made slow progress in going green. Some local scholars have started to study the feasibility as well as benefits of implementing green roof projects in Hong Kong. However, what exactly should be done if urban greening is to be achieved? Hong Kong Connection will explore this issue by reviewing the experiences of Japan as well as those of the other countries in these two episodes.

How to borrow: The video type can be borrowed from Radio Television Hong Kong. For further details, please visit the following website: <http://www.rthk.org.hk/channel/tv/tvarchivecatalog/>

Source: 鄭翠娟（編導），（2007年4月16日）把綠色還給大地 [鏗鏘集]。香港：香港電台。

Source 7 (A 1)

Green roofs can reduce room temperature (Summary)

Jim Chi-yung, chair Professor of the Department of Geography, the University of Hong Kong, has been studying green roofs in Hong Kong over the past year. He planted three kinds of plant species on the roof of the Runme Shaw Building in the university, taking up about 2,000 square feet of space. Preliminary findings show that the day time roof temperature of a conventional building can reach up to 54°C in the summer while that of a green-roofed building can be kept at 32°C or below.

Professor Jim explained the transpiration of plants has a cooling effect on the Earth. ‘The extensive installation of green roofs in regions with high building density can significantly bring down the temperature of the whole region. Overseas experiences show that the difference can be several degrees Celsius. In other words, green roofs are effective in mitigating the urban heat island effect.’

He added green roofs can also help improve air quality because plants can filter out air particulates. If the protection layer is kept in good repair, the lifespan of the waterproofing systems can be extended by two to three times, thus reducing the maintenance costs.

When asked about whether planted roofs will increase the risk of pest or bird-related diseases, Jim responded with a sense of humour, ‘There is no insect-free garden in the world!’ He said it is normal to find caterpillars and ants in gardens. If their number grows too large, a few drops of pesticides can fix the problem. Although plants will attract certain local bird species, it is not likely that the risk of bird-related diseases such as avian flu will be increased because such diseases are usually spread by migratory birds.

Source: Translated from 〈過濾空氣微粒降溫高達 22°C〉(2007)《星島日報》，9 月 27 日

Source 7 (A 2)

Jim Chi-yung, chair Professor of the Department of Geography, the University of Hong Kong, says it is not difficult to create a 'green roof'. The key is to ensure the drainage layer and water retention layer are well-constructed and drought-resistant plant species are used, so that irrigation and maintenance can be kept to a minimum.

Professor Jim is in favour of the Housing Department's initiative to cover the rooftops of public housing estates with plants for a greener environment and reduced room temperatures. He stresses that, above all, it is important to raise the residents' awareness of the benefits and effects of green roofs. He suggests that the Housing Department opens the roofs to the residents, and even allows them to farm on the roofs. 'The government has allocated some land for citizens to experience farming and planting with their family members. It'll be more convenient if they can do so on the roofs of their buildings. This is also very educational,' said Professor Jim.

Source: Translated from the Sun Online (31-10-2006) (or 〈助散熱省電○九年落成 油塘新公屋首設綠化天臺〉(2006)《太陽報》，10月31日。)

According to the articles above, what are the expert's views on the implementation of 'green roof projects' in Hong Kong? What are his reasons and evidence? What are the implications of his views on the implementation of 'green roof projects' in Hong Kong?

Source 7 (B)

Green roofs may become a breeding ground for germs and pests Scholars: there are bound to be a lot of maintenance problems (Extract)

The Department of Biology of the Chinese University of Hong Kong has conducted a study (from July 2005 to August 2006) on the roof of an office building in a Gammon construction site, which is also the first green-roofed building in Hong Kong. The study looks into several aspects of green roofs, including plant coverage, changes in grass species, as well as the multiple ecological environment created by the roof lawn. In the study, half of the roof lawn (*Lot A*) was mowed regularly or weeded occasionally, while the other half (*Lot B*) was left to grow on its own without any intervention.

Lai Ka-ho, a biology research student at the university as well as the person-in-charge of the study, examined the ecology of the roof lawn on a regular basis for the whole year. Findings show that the lawn was ‘invaded’ by local grass species just a month after it was created. By the time spring arrived, there were nearly 20 such grass species taking root in the lawn, which outnumbered the original foreign species. *Lot B*, where natural growth of grasses took place, has become a breeding ground for insects such as butterflies, moths, ants, crickets, millipedes, spiders, and so on. There were more than three ant’s nests and millipede nests in *Lot B*. The same kinds of insects were also found in *Lot A*, but in smaller numbers.

The principal investigator, Chiu Siu-wai, pointed out that the amount of fungi, fermentation bacteria and other bacteria found in the roof lawn were 450, 390, and 180 times of that found in an indoor environment respectively. Among them, toxic and disease-causing microorganisms were also found, such as sickle fungi, which have been found recently in contact lenses solution and believed to be the cause of keratitis. Serious infection may occur if wounds on skin come into contact with those fungi and (fermentation) bacteria.

Chiu agrees that green roofs have a cooling effect, and they can act as a natural drainage for rain water. Moreover, they also serve the purpose of conservation by providing local plant species a suitable habitat. Nevertheless, citizens should be aware that green lawns on the roofs will inevitably attract insects. If due care is not given, such natural ecological environments may finally bring inconvenience to the daily activities of urban residents.

‘We’ve interviewed certain office staff of the construction site. They’ve also noticed that the plants on the office roof are attracting birds, and they are concerned about the increased risk of avian flu. Since plants also invite mosquitoes, the staff are also worried that there is a rising risk of diseases spread by mosquitoes and an increased risk of Japanese encephalitis,’ said Chiu. She stressed the importance of respecting plants as a form of life. ‘Better think carefully about issues such as maintenance and sustainability before jumping into ‘green roofs’ just because others are doing so,’ Chiu cautioned. She also pointed out that the impact of residual pesticides on health should also be

taken into consideration if insecticides are to be used extensively.

Source: Extracted and Translated from 〈綠化屋頂或惹病菌蟲患 學者：須承擔連串管理問題〉
(2006)《明報》，10月13日。

According to the articles above, what are the experts' views on the implementation of 'green roof projects' in Hong Kong? What are their reasons and evidences? What are the implications of their views on the implementation of 'green roof projects' in Hong Kong?

Source 7 (C1)

Green roof cost estimates for Hong Kong (Summary)

2.4.1 In Hong Kong, the capital costs associated with Green Roofs are not high relative to total building costs.

- ♦ Intensive Green Roofs usually range from **\$1,000/m²** to **\$5,000/m²** (market average: \$2,000/m²)⁷
- ♦ Extensive Green Roofs usually range from **\$400/m²** to **\$1,000/m²** (market average: \$500/m²)⁸

2.4.2 Recurrent costs are also not high. The maintenance labour requirements associated with intensive green roofs are directly comparable with those associated with at-grade park operations, which vary widely between easily accessed sites to very inaccessible or remote sites. The maintenance requirements for extensive green roofs are untested in Hong Kong. Beijing and Shanghai experience shows that as little as 1 to 3 minutes per m² per year is needed for extensive green roofs (if designed correctly and with low-maintenance plants). These facts translate into the following recurrent costs:

- ♦ Intensive Green Roofs usually range from **\$6.5/m²/year** to **\$44/m²/year** (average: \$20/m²/year)⁹
- ♦ Extensive Green Roofs are estimated to range from **\$0.8 /m²/year** to **\$2.25 /m²/year**.

⁷ Capital costs for intensive green roofs include all components above the roof slab. Having been derived from a small sample size, the range of figures provided (\$1000/m² to \$5000/m²) should be used as a rough guide only.

⁸ Capital costs for extensive green roofs are usually built as retro-fit projects and are therefore easily isolated into discrete green roof costs.

⁹ The horticultural costs are estimated to cost between \$6.5/m²/year to \$20/m²/year. Additional costs may push this value up to \$44/m²/year if: 1) the site is difficult to access, 2) there are dangerous working conditions, 3) small areas are covered, 4) refuse collection is expected in high traffic areas, 5) problematic pests are encountered, 6) if high maintenance plants are used and 7) if electricity and lighting costs are included.

Extracted from: Architectural Services Department (2007), *Study on Green Roof Application in Hong Kong: Final Executive Summary, Chapter 2.4*

(Retrieved from

http://www.archsd.gov.hk/english/knowledge_sharing/1354-Green-Roofs-ES-Chinese-2007-02-16.pdf)

Source 7 (C2)

Maintenance requirements of green roofs (Summary)

Maintenance requirements of green roofs are determined by many factors – height, micro-climate, soil types, soil depth, irrigation, species used and access (access is most often the most crucial factor influencing maintenance costs).

Hong Kong's sub-tropical climate (high rainfall and humidity) necessitates higher maintenance requirements than in temperate climates. Maintenance operations for green roofs include waterproof inspections, drainage inspections, removal of litter, electricity and lighting, plant health inspections, replacement planting, irrigation, pruning, mowing and grass cutting, fertilising, disease & pest control, as well as weeding.

Extracted from: Architectural Services Department, *Study on Green Roof Application in Hong Kong: Final Executive Summary* Chapter 3

Source 7 (C3)

Green roofs are 'practical but unappealing'?! (Extract)

'For newly-built properties, further observations will be required to evaluate whether the installation of green roofs can help push the prices up and enhance the quality of the buildings; while for existing buildings, the prime concern will be who should pay the costs,' said Lin Wu-sheng, chairman of the Green Real Estate Research Centre of the China Merchants Property Development Co., Ltd. Lin also expressed that roofs have very limited usable area, only a little of which is reserved for greening projects while the majority is designated for accommodating lifts and generator rooms, as well as for emergency evacuation.

Source: Translated from 〈屋頂綠化“叫好不叫座”?!〉(2009)《中國房地產報》，11月24日。

What stance do the articles above take regarding the implementation of 'green roof projects' in Hong Kong? What are the reasons and evidences? What implications do the opinions expressed in the articles have on the implementation of 'green roof projects' in Hong Kong?

Source 7 (D1)

Problems of different types of green roofs (Summary)

- Unique and critical green roof issues often relating to sky gardens include: extreme growing conditions, safety, rooftop utilities, water pressure, waterproofing, hauling of materials, and narrow plant selection for extreme conditions.
- Unique and critical green roof issues often relating to podium gardens include: safe public access (including barrier-free access), safety, refuge floor space, waterproofing, planting design, and critical plant selection criteria (often for very shady conditions in places).
- Unique and critical green roof issues often relating to existing and low-maintenance buildings include: state of the existing roof, structural loading capacity and waterproofing, safety (for maintenance primarily), critical growing media (lightweight, inert, well-drained, well-aerated, fire-resistant and nutrient retentive) and critical plant selection criteria (which grows in lightweight shallow soils, is wind and drought tolerant, and has non-invasive roots).

Source: Architectural Services Department, *Study on Green Roof Application in Hong Kong: Final Executive Summary* Chapter 2.1

Source 7 (D2)

Green roofs are ‘practical but unappealing’?! (Extract)

In terms of technological features, a roof generally consisting of a roof deck, a thermal insulation layer, a waterproof layer as well as a protection layer is good enough. However, if green roof facilities are to be incorporated, the compatibility between the roof and the other systems of the building concerned should be achieved. Nicely-built green roofs help in effective waterproofing of the building while badly-built ones may lead to phenomena such as water leaks and damaged waterproofing systems.

Source: Translated from 〈屋頂綠化“叫好不叫座”?!〉(2009)《中國房地產報》，11月24日。

Source 7 (D3)

The experience of Lianhe Gongfang

More than 10,000 square meters of Lianhe Gongfang (聯合工房) were designated for building green roofs. However, the investors changed their minds when the construction phase began. The original plan of covering the entire rooftop of the office building with plants was reduced to half of the rooftop, with the other half reserved for decoration purposes. The reasons for this change are as follows: 1) entire greening entails higher maintenance costs while half greening can also achieve the same results of offsetting the heat island effect and beautifying the environment; 2) special attention is needed to ensure waterproofing safety if green roofs are to be installed because there could be serious consequences if the waterproof layer of the roof is pierced through by plants, and 3) more importantly, half greening ensures better cost controls.

Source: Translated from 〈屋頂綠化“叫好不叫座”?!〉(2009)《中國房地產報》，11月24日。

What stance do the articles above take regarding the implementation of 'green roof projects' in Hong Kong? What are the reasons and evidences? What implications do the opinions expressed in the articles have on the implementation of 'green roof projects' in Hong Kong?

Source 7 (E1)

Consultant proposes subsidising green roofs

The Architectural Services Department (ArchSD) has recently commissioned a consultant company to conduct a study on the adoption of green roofs in Hong Kong. The completed study, namely *Study on Green Roof Application in Hong Kong*, is the first green-roof project initiated by the government. It affirms the benefits of green roofs through reviewing local and overseas experiences and proposes a wide range of benefits of green roofs such as economic benefits, which include reduced maintenance and cooling costs due to increased building insulation and energy efficiency.

Source: Translated from 〈顧問倡資助綠化屋頂〉(2007)《星島日報》，4月27日。

Source 7 (E2)

Green roof benefits (Summary)

The benefits of Green Roofs are well-researched overseas. These benefits can be grouped as 1) Amenity and Aesthetic, 2) Environmental, and 3) Economic benefits. The amenity and aesthetic as well as the economic benefits of green roofs are shown as follows:

Amenity and Aesthetic Benefits

- ◆ Leisure and Functional Open Space - Flat roofs provide urban dwellers with the amenity and recreational space essential for healthy living.
- ◆ Visual Amenity Value – Green roofs offer an attractive view to high-rise buildings.
- ◆ Health and Therapeutic Value - Psychological studies have demonstrated that the restorative effect of natural scenery holds the viewer's attention, diverts their awareness away from themselves and worrisome thoughts and elicits a meditation-like state. However, this benefit largely depends on the location and use of any particular green roof.

Economic Benefits

- ◆ Building Insulation and Energy Efficiency - Green roofs reduce maintenance and cooling costs due to increased building insulation and energy efficiency. It is estimated that there could be a net annual energy savings of around **15%** for a five-storey commercial building. Nonetheless, this benefit is likely to be appreciated by upper floors only.
- ◆ Increased Roof Life - Green roofs insulate roofing materials from ultraviolet light and reduce the expansion and contraction of roofs caused by daily extremes of temperature, thus prolonging roof life.
- ◆ Green Building Assessment and Public Relations - Green building assessment schemes exist in several countries. Their purpose is to encourage environmentally sound building practice. There is also considerable public relations value in projecting an environmentally conscious image for a building development or organisation. Green roofs can contribute to the credit rating of developments assessed under such schemes and can be a highly visible way in which a development can draw attention to its environmental 'credentials', which may contribute to increased property value.

Source: Architectural Services Department, *Study on Green Roof Application in Hong Kong: Final Executive Summary (Chapter 1.2)*

What stance do the articles above take regarding the implementation of 'green roof projects' in Hong Kong? What are the reasons and evidences? What implications do the opinions expressed in the articles have on the implementation of 'green roof projects' in Hong Kong?

9. 'Learning and Teaching' Reference Materials Relevant to the Teaching Plan

1. Mingpao News Special Category – Environment (明報新聞網環保篇)
<http://specials.mingpao.com/cfm/Category.cfm?CategoryID=1381&SpecialsID=138>
2. Legislative Council Panel on Environmental Affairs, *2007 – 08 Policy Agenda: Policy Initiatives of the Environment Bureau* (2007-2008 年施政報告及施政綱領中有關環境局的政策措施文件)
<http://legco.gov.hk/yr07-08/chinese/panels/ea/papers/ea1022cb1-34-1-c.pdf>
3. Architectural Services Department, *Study on Green Roof Application in Hong Kong: Final Executive Summary* (建築署「香港綠化屋頂應用研究.」行政摘要
http://www.archsd.gov.hk/english/knowledge_sharing/1354-Green-Roofs-ES-Chinese-2007-02-16.pdf
4. Hong Kong Connection: Urban Greening (episode 1226) (鏗鏘集 - 「回歸自然」)
<http://www.rthk.org.hk/rthk/tv/hkce/20080221.html>
5. Hong Kong Connection: Recapturing Nature's Green (episode 1227) (鏗鏘集 - 「把綠色還給大地」)
<http://www.rthk.org.hk/rthk/tv/hkce/20080214.html>
6. HK Green Building Technology Net (香港綠色建築科技網)
http://gbtech.emsd.gov.hk/tc_chi/minimize/tech.html
7. Greenpeace (綠色和平網站)
<http://www.greenpeace.org/china/ch/>
8. Wikipedia: Green Roof (維基百科：綠化屋頂)
<http://zh.wikipedia.org/zh-tw/%E7%B6%A0%E5%8C%96%E5%B1%8B%E9%A0%82>