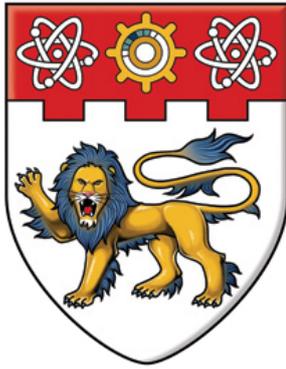


This document is downloaded from DR-NTU, Nanyang Technological University Library, Singapore.

Title	The green house effect
Author(s)	Lim, Marie Shimin.; Xue, Jianyue.
Citation	Lim, M. S., & Xue, J. (2012). The green house effect. Final year project report, Nanyang Technological University.
Date	2012
URL	http://hdl.handle.net/10220/9413
Rights	Nanyang Technological University



NANYANG
TECHNOLOGICAL
UNIVERSITY

The Green House Effect

A Feature Writing Final Year Project

A Final Year Project Report
submitted in partial fulfilment of the requirements for the
Bachelor in Communication Studies with Honours
Wee Kim Wee School of Communication and Information
Nanyang Technological University
Academic Year 2011/2012

Project ID: 44139

Prepared by
Marie Lim Shimin (088513K10)
Xue Jianyue (088480K10)

FYP Supervisor:
Debbie Goh Pei Chin

CONTENTS

1. INTRODUCTION	4
1.1 Description of our project	4
1.2 Why we chose the green building issue	5
1.2.1 Impact	5
1.2.2 Timeliness	6
1.2.3 Public duty to inform and educate	6
2. BACKGROUND INFORMATION	8
3. PROPOSED AUDIENCE	11
4. ANALYSIS OF STYLE USED	13
5. METHODS	16
5.1 Research.....	16
5.2 Contacting Sources	16
5.2.1 Government agencies and corporations	16
5.2.2 Academics	18
5.2.3 Public	19
5.2.4 Photos	19
6. REFLECTIONS	20
6.1 Difficulties encountered and problems solved.....	20
6.2 Insights learnt.....	22
6.2.1 It pays to be professional	22
6.2.2 It pays to dig deep into the history early on.....	22
6.2.3 It is emotionally fulfilling to attempt a topic we are unfamiliar with	23
7. ACKNOWLEDGEMENTS	24
8. ABOUT US	25
9. SOURCE LIST	26
9.1 The Big Players.....	26
9.2 The Community	26
9.3 The Science.....	27
10. BIBLIOGRAPHY	29
11. FEATURE SERIES “THE GREEN HOUSE EFFECT”	30

11.1 The Big Players.....	30
<i>11.1.1 Green buildings join the fight against climate change</i>	30
<i>11.1.2 Timeline</i>	38
<i>11.1.3 What is Green Mark all about?</i>	38
11.2 The Community	39
<i>11.2.1 My house is greener than me</i>	39
<i>11.2.2 What's new?</i>	43
<i>11.2.3 What are the green features at Treelodge?</i>	43
<i>11.2.4 Keeping sane while going green</i>	44
<i>11.2.5 What we can do to save the earth</i>	47
11.3 The Science	48
<i>11.3.1 Self-powering buildings break free from fossil fuel</i>	48
<i>11.3.2 Air-conditioned nation no more</i>	53
<i>11.3.3 Human waste to power Singapore's new flats</i>	56
11.4 Editorial.....	60

1. INTRODUCTION

1.1 Description of our project

The Green House Effect is a feature writing project about green buildings in Singapore. It explores the rising popularity of environmentally friendly buildings and the impact it would have on Singaporeans in terms of energy savings and protection from the effects of global warming.

Green buildings are defined as environmentally-friendly buildings which are constructed and maintained in a way that minimises damage to the Earth's ecosystem and the natural environment. Such buildings are equipped with energy-producing abilities (such as solar power panels), energy-saving abilities (such as energy-efficient lighting and air-conditioning), rooftop gardens and an intelligent architectural design that maximises ventilation, natural lighting while minimising heat entry into the building interior. Green is a vague word and many businesses, commercial products and celebrities have labelled themselves 'green'. However, in the *The Green House Effect*, we have adopted Singapore's Building and Construction Authority's definition of green building as a starting point. Green buildings in Singapore are recognised as so after receiving the Green Mark Award, a scheme launched by the BCA in 2005 to certify buildings that are environmentally friendly.

The Green House Effect is a 16-page news publication divided into three sections: The Big Players, The Community and The Science. They centralise around the overall theme of green buildings. The first section is an opening wrap-up of the green building movement and discusses some of the existing problems of transforming buildings into green ones. The second section contains an anchor story which explores the mindsets of ordinary people living in Treelodge@ Punggol, Singapore's greenest public housing estate. This is accompanied by a profile of a green activist who took a green lifestyle to the extreme but eventually came back to moderation. The last section deals with the technology behind the making of zero-energy buildings. It contains an anchor story based on a zero-energy temple and two stories on reducing air-conditioning use and powering a flat with waste collected from toilets. The project ends with an editorial about how nature is our first home and why it is so important to protect it.

Buildings and the environment are potentially dry and technical topics. Although *The Green House Effect* is a feature-writing project, we spent a considerable amount of effort on photography and graphics to make our stories more reader-friendly. A total of 31 photographs were used for the project, of which 30 of them were taken by us and one photograph for the profile story which is obtained from a source (credit is given). We also added in some graphics such as a timeline to illustrate how the green building movement has evolved over the years. In addition, we have written nuggets of information inside coloured boxes scattered across the publication. The bulk of the story, however, is told through our feature stories. The graphics and pictures are designed to complement, not replace, the written stories which is ultimately the focus of our project.

We started work on this project in the August last year. Over the next seven months, we interviewed architects, engineers, landscape artists, policymakers and top officials from government statutory boards such as the National Research Foundation and the Building and Construction Authority. We also managed to meet up with Mr Mah Bow Tan, the former Minister of National Development who oversaw the green building movement during his 12 years as Minister. We approached him because he had played a pivotal role in the birth of Singapore's green building movement. In addition, we traced the beginnings of the green building, also known as sustainable urban infrastructure, back to the 1990s when Singapore started exploring ways to reduce energy use. National plans were drawn up to ensure sustainable growth for Singapore, and buildings are increasingly recognised as a major source of carbon emissions in these plans.

1.2 Why we chose the green building issue

1.2.1 Impact

We chose to do a news project on green buildings because this issue has a nationwide impact. When we started our project, there are already several hundred green buildings in Singapore. By the time we completed our project, Singapore had just announced its thousandth green building: The Pasir Ris Sports and Recreation Centre. The rapid increase in green buildings is part of an ambitious blueprint called Sustainable Singapore. The blueprint, co-written by an Inter-Ministerial Committee in 2009, aimed to transform Singapore into an eco-city by 2030.

One of the goals of the blueprint is to certify 80 percent of Singapore's buildings as Green Mark buildings by 2030. Green Mark is a scheme launched in 2005 by the Building and Construction Authority to recognise environmentally-friendly buildings. Besides cutting down on the country's dependence on fossil fuel imports, the blueprint will expand a budding green economy in Singapore because buildings will require green air-conditioners, green concrete and green architecture. With only 13 percent of buildings green today, the Singapore has another 67 percent to work on before the 2030 deadline. This represents a \$300 billion business opportunity for building companies and other related firms, according to Mr Tai Lee Siang, President of the Singapore Green Building Council. The expansion of the green economy, spurred on by the rise of green buildings, will also generate thousands of jobs for Singaporeans.

1.2.2 Timeliness

New green buildings are being announced every now and then in the mainstream media. Singapore has recently reached a milestone in its green building movement with the announcement of the thousandth green building in March. There are reports released by non-governmental organisations such as World Wildlife Fund (WWF) listing Singapore as the highest carbon emitter per capita and pointing an accusing finger at the building sector for contributing 15 percent of Singapore's carbon footprint. Green building business conferences are also becoming common in Singapore, the last one being the 3rd Green Building Asia conference in early March. Singapore's newest industrial park, CleanTech Park, is about to open soon. The business park has many green buildings too. Thus, we feel it is an appropriate time to release an in-depth news package about the green building movement, its coming of age and the problems it faces.

1.2.3 Public duty to inform and educate

'Green buildings' is a technical and potentially dry topic. It is also a challenging one because it involves five to six fields of knowledge converging on a building project. Reading about buildings can be tiring for the ordinary man on the street. However, we realised its immense importance and relevance to Singapore as an island state surrounded by rising seas,

completely dependent on energy imports for our electricity generation. Therefore, we took upon the challenge to create an interesting news package that will attract more Singaporeans to find out more about what is happening to the places we live, work and play.

2. BACKGROUND INFORMATION

Singapore's green building movement can be traced back to the Singapore Green Plan 1992, a national plan which outlined steps to transform Singapore into a model green city by 2000. Early efforts to promote green buildings can be traced to the first eco-architecture seminar held by the Singapore Institute of Architects in 1994. This led to the first Eco-Building Architectural Design Competition in 1995. The winner of this first competition is Mr Tang Guan Bee. His building design, however, was not translated into reality because green buildings not profitable back in the 1990s. No developer or construction firm was willing to take up his design.

At the turn of the century, however, there was an explosion of news coverage on the topic of environmentalism. At the same time, conflicts in the Middle East drove up oil prices and caused ripples throughout the global economy. It caused inflation and economic hardship in many parts of the world. During those years, books written by famous authors such as former United States Vice-President Al Gore, *The Inconvenient Truth*, also raised awareness of climate change.

Starting from a decade ago, officials at the Building and Construction Authority (BCA) started to consider creating an award scheme for green buildings in Singapore. They wanted to find a way to slow down the dramatic rise of electricity use in the country and do their part to save the Earth from global warming. Unfortunately, the scheme did not receive much support from the Ministry of National Development (MND) and the building industry back then. This was due to the slower economic growth in Singapore between 2001 and 2004. Many construction firms are suffering from reduced growth in the construction industry. Plans to create an award for environmentally-friendly buildings were shelved for two to three years.

This changed in late 2004 when Dr Yacoob Ibrahim was transferred to the MND for a year. He came from the Ministry of Environment and Water Resources. Given his background in environmentalism, one of the first things he asked at the MND was whether the Ministry were doing anything about environmentalism. As a result, the plans for a green building award scheme were revived and within three months, it was launched in 2005. This scheme

was named the Green Mark award and it offered monetary incentives for developers who invest in environmentally-friendly buildings. In addition, the government invested more than \$50 million in research and development in the field of green building technology.

The green building movement got off to a slow start. Only 17 buildings took up the Green Mark award in 2005, a tiny fraction in a country with more than 10,000 buildings. Many developers were reluctant to take up green building projects because they are more expensive than normal ones. Many are also not aware of the business case for environmentally friendly buildings. For example, the high upfront costs can be offset by bigger energy savings in the long run. There are, however, early supporters of the movement such as City Developments Limited, Lend Lease and the Housing Development Board. These organisations are big players in the building community and they started investing heavily into environmentally friendly apartments, shopping malls and public housing estates.

A few years into the Green Mark scheme, the government announced changes in legislation. In September 2007, the Building Control (Amendment Bill) was passed, and all buildings will have to go green from 2008. In the same year, the BCA also revealed a \$10 million plan to create Singapore's first zero-energy building. In 2008, Singapore set up a research and development centre for solar energy called Solar Energy Research Institute of Singapore (SERIS). The centre conducts research to improve the energy-making abilities of solar power cells and to establish them as the leading source of alternative energy on the island. Singapore also started investing in a green technology workforce. In 2008, the government announced plans to open a fourth public university, the Singapore University of Technology and Design, by 2015. Among the degrees offered include a bachelor of science with a major in architecture and sustainable design.

The green building movement accelerated in 2009 with the launch of Sustainable Singapore, an ambitious blueprint to transform the country into an eco-friendly city by 2030. The Singapore Green Building Council was also set up. The Council is an industry body made up with members from the public sector and the private sector, and it aims to improve collaboration between the private and public sector in the quest to speed up the growth of green buildings. In addition, there was considerable buzz in the industry with the opening of Singapore's first "zero-energy building". This building is the retrofitted BCA Academy in

Braddell and it can generate electricity beyond its own needs. It became a special building to showcase the latest green building technologies, and demonstrate the effectiveness of intelligent architectural design which allows good ventilation, thus reducing the need for air-conditioning.

Today, there are more than one thousand green buildings in Singapore. The thousandth green building is the Pasir Ris Sports and Recreation Centre. The centre's solar panels provide up to 12 percent of the building's annual energy needs, helping its owners save about \$57,000 each year. Going forward, major players in the building industry told us that the biggest challenge lies in retrofitting the existing buildings. Many of these buildings were constructed before the national push towards sustainable urban infrastructure. Some of these buildings require extensive analysis and renovation before they can transform into green ones. Some building owners prefer to wait for the building life-cycle to end, demolish them and rebuild a new and greener building in its place.

3. PROPOSED AUDIENCE

The target audience we have in mind is The Straits Times reader who is interested in understanding how a highly-urbanised country like Singapore is attempting to marry global warming concerns with its economic goal of national prosperity.

This segment of the population can relate to our project because it concentrates on two elements that are highly visible in their daily lives.

Firstly, buildings, a dominant feature in our urban landscape which is often overlooked. Its presence is accepted but its impact and repercussions on Mother Earth are seldom acknowledged or understood.

Secondly, climate change which is responsible for the scorching temperatures and most visible through flash floods. Its damage is often measured in its impact on business operations.

These two elements are common features in our everyday lives and thus, highly relevant to the readers.

Our stories are also written for the general reader, who may not have much knowledge on the green building movement which is gaining momentum in Singapore, but would still be drawn to broad national development issues such as Singapore's building blueprint and research priorities.

The green building movement and climate change, however, involve a lot of jargon. In addition, national development issues are complex and government-level planning and directives are difficult to digest.

Thus such concepts were simplified and clearly explained for the average reader. We also specially divided the news package into three sections – with names that are self explanatory – so that readers can easily navigate and explore the issues involved in the green building movement.

By providing a balance of stories covering the business concerns, the views of the man on street as well as the scientific progress in this area, we provided very readable stories to tackle the issue.

We propose to publish the package in May to coincide with the annual Green Mark awards, which is given out in the same month. This would make the package timely as we believe other green-themed news reports would surface during that period. In addition, the article “human waste to power Singapore’s new flats” is time sensitive as the scientists we interviewed are seeking a patent. That article, in particular, is embargoed until May.

4. ANALYSIS OF STYLE USED

Our style is written in accordance with The Straits Times house style. This freed us from the need to spend time deciding how to phrase certain terms and numbers. Since we were familiar with the style, it was easier to maintain consistency when writing especially as there was more than one author. Thus, numbers one to nine were spelt and numbers larger than that were numerical. Units of measurement were truncated, such as sq m instead of square metre. In addition, scientific terms were standardised. For example, bio-gas is spelt with a hyphen.

The Straits Times is the most-read newspaper in Singapore with an average daily circulation of 367,000. Thus, many news readers are familiar with the style of writing. Writing in accordance with their house style would thus allow us to convey the story through terms the reader understands and avoid lengthy and excessive explanations of terms which are considered common knowledge. For example, we could write “Treelodge@Punggol is the Housing Development Board’s first green housing project” instead of having to launch into an explanation about it being the statutory board of the Ministry of National Development responsible for public housing and its position as the largest developer in Singapore.

This allowed us to focus on issues that were important: how the government, developers, architects, members of the public and scientific community as well as the private sector interact to find a way to harmonise profitable construction with climate change concerns.

In addition, should we seek publication in the local papers, it will be easier for us to adapt the package for The Straits Times Saturday Special Report without extreme editing on our part.

We rigorously adhered to British English spelling. In addition, we used active sentences, interesting and detailed profiles of our interviewees, strong titles and sub headlines, attention-grabbing leads and likened difficult concepts to real-life experiences so that readers would be able to digest the complicated concepts and at the same time be enthralled by the story being told.

This was especially important as the building industry, scientific community and environmental community often used jargon which the man of the street would not

comprehend. In addition, buildings can be seen as a very dry topic and the science behind the green technology is often complex. It was often necessary to use terms such as “green” and “building” and so we had to make a concerted effort to enliven the article and use alternative terms where possible. Thus, the articles are peppered with metaphors and analogies to entice the reader. We also attempted to humanise buildings and drew parallels to everyday objects such as a sponge, to make the science understandable and relatable for the reader.

Despite not being an illustrated feature, our articles were interspersed with bright and colourful photos in order to keep the reader engaged and help the reader visualise the story. Small boxes and graphics also helped to break up the monotony of pure text and allowed us to present important information in a simplified manner.

The term “green” is used to cover many eco-friendly movements and ideas. Thus, we tried to cover a variety of green. In terms of buildings, this was largely limited to carbon emissions and energy efficiency. But we briefly brought up organic food during the profile story of a green activist to show that the idea of “green” is not limited to these areas.

Our first package ‘the big players’ was as much about the industry’s struggle to find balance between building green buildings and maintaining profitability as about the history of the green movement. To tackle the former, we spoke to the big players on the market – this provided the macro perspective about the trends and what it means for Singapore. For the latter, we relied heavily on historical archives and old news clippings. This helped us weave a narrative that took into account both past and present forces shaping the green building movement and well as take stock of its success and failures thus far.

The second package ‘the community’ reported more on the public’s opinion and concerns regarding the greening of buildings. It showed the progress of the movement on the ground level.

The final package ‘the science’ used many scientists and academic expert voices to showcase limits of current technology and the possibilities for the future.

These packages give readers a good sense of the green building movement in Singapore from the perspectives of various key players, thus, catering to the interest of different readers. The

readers can be enriched by the stories and gain a deeper understanding of the direction that Singapore is heading towards.

5. METHODS

5.1 Research

We started our project with intensive research on the green building movement from online news databases and libraries at Nanyang Technological University and National University of Singapore. The research helped us to understand who the big players in the industry were as well as the relevant agencies and organisations involved in the push towards greener buildings. It also helped to highlight the important buildings, history, milestones and recent developments, which were crucial to the construction of a timeline consisting of 28 entries detailing 20 years of greening.

Green buildings news is frequently featured in the local newspapers. Thus, we made a concerted effort to track the news and cut out the relevant articles. This allowed us to be aware of important developments in the topic and aided us in narrowing down our topic to an area not usually covered so as to ensure that the package would still be newsworthy at the point of submission.

Over the months, our story ideas evolved and firmed up. Whilst some ideas were eventually discarded or spiked after a single draft, these ideas were always backed by solid research and interviews.

5.2 Contacting Sources

5.2.1 Government agencies and corporations

Government ministries, statutory boards and agencies such as the Ministry of National Development, National Research Foundation, the Housing Development Board and the Building and Construction Authority were integral to our project as they are in charge of setting the national directive for research, urban development and the construction and building industry.

Having interned in local media outlets, we understood the difficulties in getting government sources. Thus, we hoped to bypass the corporate communications and establish relationships directly with the top people in these government agencies. To do so, we attended to major

functions – the international green building conference in 2011 and the third green building Asia conference in 2012. In order to enter the first conference, we paid \$100 each and mingled with speakers across the globe. The entry fee of the second conference, however, was beyond our means – a few thousand dollars. Thus, one writer liaised with the online media publication ‘Eco-Business’. He entered the conference as a reporter, wrote an article for the outlet and in doing so, attendance was free-of-charge.

This allowed us to meet our potential interviewees face-to-face and introduce our project. We later emailed them requesting for an interview, and many top figures such as Mr Tsoi Mun Heng, director of the energy innovation challenge directorate, under the prime minister’s office, National Research Foundation, agreed to the interview. The conferences also allowed us to mingle with people in the industry and helped us gain valuable “friends” through whom we managed to contact our targeted interviewees.

Major developers such as City Development Ltd and Lend Lease were also important sources for our stories as they provided a private sector perspective. We emailed City Development Ltd and name-dropped government figures that we had interviewed. After much persuading, they eventually agreed to an email interview – the only non-face-to-face interview we conducted.

We took a special effort to ensure that most interviews were face-to-face. We felt that this would allow for more spontaneous responses and give us the chance to mould our interview depending on what the interviewee shared. We were also able to push the interviewee for responses and get more depth.

During the six-month internship in 2011, one of the writers had worked with someone who knew local green activist Olivia Choong. Thus, we were able to liaise with her directly and we interviewed her in the comforts of her own home. Ms Choong is in charge of Green Drinks Singapore, the local chapter of an internationally recognised non-profit movement, which brings together individuals and business to share on sustainability issues. Through her, we managed to directly contact the head of sustainability in Asia, Lend Lease, Mr Mann Young for an interview.

We took time to develop our contacts and did not rush into interviewing and reporting. Speaking to these industry players helped us further our understanding of the topic. Often they would highlight a concept or idea that we had not heard of, thus filling up the gaps in our knowledge. This was invaluable in helping us establish a firm foundation in the area.

Despite the above efforts, we had to email some important sources, such as Mr Mah Bow Tan, without the benefit of a stringer. Fortunately, he responded to the email and when we met him prior to one of his meet-the-people sessions for an interview.

5.2.2 Academics

We visited the experts in the field for insights, analysis and information about their research. We put together a list of relevant professors of various departments such as the department of building at NUS and reached out to them through email. While not all of them replied, we managed to get a good number of interviews.

It was especially important in science stories to gain face-to-face interviews as when, left to their own devices, scientists tended to ramble on in scientific jargon. With our prodding, the scientists were more likely to explain the terms again in terms that the man on the street could understand. Interviewees who were apprehensive on the phone also opened up when they met us in person. In fact, most of them were willing to speak beyond the initially agreed timing and we were able to get the information we needed.

Some scientists were concerned about maintaining secrecy due to patent issues and we managed to assure them that the information would be embargoed until they were ready to release it.

Many scientists whom we interviewed were eventually not quoted in the article. But, the time spent with them was not a waste. They helped us to understand what was new in the field and gave us the chance to practice and refine our list of questions to ensure that later interviews covered a wider breadth and depth.

5.2.3 Public

The public's opinion was a crucial part of 'the community' package and made it necessary for us to walk the ground. It was important to see the residents in their homes to gain a fuller picture of their lifestyles. Thus, we decided to go door-to-door to conduct these interviews.

One of the writers had experience doing such legwork for a local media outlet during the six-month internship. Thus, she was not discouraged when initially, residents and members of the public declined to be interviewed. Through sheer perseverance, she eventually managed to get a solid number of interviews for the article.

5.2.4 Photos

We decided that although our news package was not that of an illustrated feature, photographs would help to break up the monotony of pure text and make the articles a more interesting read. But, this decision was made after many interviews had been conducted. Thus, the photo of Olivia Choong was provided by Ms Choong herself – the only photo used that had to be credited. In the interviews that followed, we ensured that we had a camera on hand to capture pictures of the interviewees and their workplace.

We devoted a day to photo taking – we drove around the island taking pictures of relevant buildings and people. We spent the morning touring the green facilities in Punggol. In the afternoon, we drove to the BCA Academy, the National Library Building, Nanyang Polytechnic, Tan Tock Seng Hospital and ended our journey at the marina barrage where we took pictures of the skyline.

6. REFLECTIONS

6.1 Difficulties encountered and problems solved

To get vital information about the green building movement, we had to talk to architects, engineers, developers, government officials and policymakers. 'Green buildings' is a technical topic and there is a limit to how much information and insight we can obtain from talking to ordinary people on the street. Our list of sources is dominated by experts and it was extremely difficult to reach out to them. They are very busy individuals and many of our emails went unanswered. Our calls rarely went through and they spent a great deal of time overseas. They are also not very willing to talk to students, and would often refer us to lower-ranking officials who are not able to answer all our questions. The best way to find them would be at green building conferences. Unfortunately, these green building conferences can cost up to \$1,000 per person and therefore, very unaffordable for student reporters with a limited budget.

We took many tips employed by rookie reporters entering a new beat, or even by foreign correspondents who are 'parachuted' into countries to cover breaking news events of global significance. We did not rush into reporting. Instead, we analysed the green building community in depth by conducting a background assignment. Time was dedicated to understanding the power relations between the various government ministries, statutory boards, academic institutions, commercial players and ordinary people living in buildings. We focused on building a professional network with existing players in the industry. We even took the effort to act like them, dress like them at conferences, understand the technical terms they used in discussions, and being physically at places where they hang out in large numbers. We created our own name cards and exchanged them at green building conferences.

To gain entry into these expensive fairs, one writer linked up with Eco-Business, an online-based green business news portal. He volunteered as free writer and published three stories on the website. In return, he obtained much needed exposure to the world of green journalism and established some 70 contacts from various industries linked to the green building movement. After each conference, we contacted many of these sources for our FYP and many of them agreed to face-to-face interviews because they recall meeting with one of our

group members at the fair. We relied on the power of facial recognition and first impressions to gain access to top players in the industry.

Our second difficulty relates to the extensive coverage of green buildings in the mainstream media, especially the Business Times. These reports are pretty comprehensive and timely. We found it difficult to find fresh angles and add value to the existing literature of news reports. To make matters worse, developers and government bodies take special effort to publicise every new green building to the mainstream media, and professional reporters often respond positively to them. Although it was still quite possible for us to write small stories of about 500 to 700 words each, writing a compelling news package of 10,000 words was daunting.

We were determined to find a fresh approach to the issue, but doing so is not easy. To understand everything about the green building scene that has been covered by the media, we spent seven weeks searching and compiling all green building coverage on Channel News Asia online, the Straits Times and the Business Times. We used the Lexis Nexis database extensively and searched for green buildings across a 20-year time span. We downloaded these stories onto Microsoft Word documents and they ran into a couple of hundred pages. After that, we spent a few hours each day loading story by story into Google Documents, categorising them according to their year of publication and linking them together using URLs.

In effect, we have created a customised, personal news archive dedicated to green buildings in the news. By relying on Google cloud computing, this archive can be accessed through any computer with an internet connection, and it is relatively ‘crash-proof’ compared to memory spaces in our four-year-old laptops. Through this customised archive, we identified national trends, unfulfilled promises and unresolved issues and established a ‘helicopter view’ of the green building movement over the years. We were able to identify columns written by architects and government officials and understand some of the causes that they had fought so hard for. By understanding the historical context of green buildings, we were able to go straight to the point during our hard-won interviews with building experts. We did not waste precious time learning about the basic facts.

Our third difficulty relates to the technical nature of the green building topic, worsened by an information explosion within the field of environmentalism. There was too much data and news coverage available on the internet, libraries and newspapers, making it difficult for us to determine the gist of the topic.

To solve this problem, we had to spend a really long time understanding the various technologies behind green buildings. Before conducting an interview, or even sending out an email request for it, we read intensively these topics with every resource we can find, including a whole list of offline sources too. We visited information centres such as the National University of Singapore School of Design information centre. We spent some effort understanding the nature of information and chose our documents selectively. For example, we took special notice of 'helicopter view' documents such as PowerPoint PDFs uploaded by experts for the purpose of conferences. These PowerPoint presentations helped us to organise our view of the green building movement. In addition, we also looked out for national reports done by statutory boards, yearly reports done by developers, and collected green magazines from green building conferences. Some of the best documents we received from green building conferences are the annual energy consumption reports done by the Energy Market Authority. We relied on these hard copy booklets for some of the statistics written inside our stories.

6.2 Insights learnt

6.2.1 It pays to be professional

We took special effort to observe how the building professionals dress, greet each other, and entertain their guests. In doing so, we make them feel like we are part of them, understanding them and not judging them with our limited knowledge of the industry. They were pleasantly surprised after learning that we had name cards too, and they returned our gesture by offering us their name cards too.

6.2.2 It pays to dig deep into the history early on

We were given seven months to complete our final-year project. Therefore, we are fully aware that this news package will be judged as work worthy of a seven-month effort. We

made full use of the time, digging on the history of the green building movement and talking to as many people as we can. The process was extremely tedious but it paid off. Whenever we conducted long and detailed discussions with our interviewees, we were able to understand the historical context of their valuable input.

6.2.3 It is emotionally fulfilling to attempt a topic we are unfamiliar with

Many of our peers in the Wee Kim Wee School of Communication are generally afraid of attempting any topic related to 'engineering'. We were initially afraid too, but we decided to take up the challenge and leave behind something different for our prospective readers and also for the many people who supported our education over the past four years. It had been a challenging final-year project, but we gave all we had. In the process, we learnt many interesting facts and developments about the world of construction, architecture, real estate and clean energy. We delved into fields that are alien to us, but found great encouragement and support from a number of building professionals.

7. ACKNOWLEDGEMENTS

It would like to thank everyone who helped us with our final year project.

We are truly indebted and thankful to our project supervisor, assistant professor Debbie Goh Pei Chin, who provided invaluable guidance and fantastic suggestions for us to improve the product. She was a stalwart supporter, a pillar of strength and a source of encouragement during our moments of doubt and confusion.

The project would not have been possible without the support of our interviewees, who were extremely patient and willing to slowly explain complicated concepts numerous times. We are grateful for their kindness and indulgence.

We are also obliged to many peers and seniors who encouraged us and helped us improve on our project.

Lastly, we would like to thank our parents who have been there for us throughout these long months. We are beholden to them for their love and support.

8. ABOUT US

Marie Lim | W080063@e.ntu.edu.sg

I have always enjoyed writing, and so, majoring in journalism seemed to me like a natural step of progression. Even then, I was unprepared for the experience of news-writing – that of pleasure alloyed with excruciating pain. Each article is a painstaking work of art. And behind the texts is a story of long-hours, late nights, great difficulties and frustration in obtaining relevant interviews, information and statistics. I learnt valuable reporting tips and information gathering skills during my six-month internship at The New Paper. But this made the FYP a bigger challenge as, by then, I was used to writing spot-news and arts/entertainment features that had a short turnover time. Working with another reporter, who has a different approach, thinking, and writing style has taught me how to play to each person's strength, especially when producing a large news package.

Xue Jianyue | jianyue09@gmail.com

I am a simple guy who is immensely curious about the world we live in. How does the world work? How will it evolve? What is the essence of human nature? My favourite reading topics are about science and history. In addition, I am also addicted to current affairs. That addiction started during the September 11 terrorist attacks in 2001. I was glued to the newspaper for several months and it affected my secondary school examinations. It is, however, something I am proud of. Luckily, I did not do too badly for examinations because seven years later, I still made it to Nanyang Technological University to pursue journalism at the Wee Kim Wee School of Communication and Information. While studying in this school, I was lucky to be given opportunities to write stories and shoot photographs in the United States, Myanmar and Thailand. I was also privileged to spend 26 weeks as an intern correspondent at Thomson Reuters, writing stories about the international business community. During my final year as an undergraduate, I am thankful to have a hardworking and reliable team mate for this final-year project. It had been a great experience and I hope that readers will enjoy the stories in *The Green House Effect*.

This page is intentionally left blank

This page is intentionally left blank

This page is intentionally left blank

10. BIBLIOGRAPHY

Research and Statistics Unit, Energy Market Authority, Republic of Singapore. (2011) *Energising Our Nation*. Singapore. Energy Market Authority

Energy Market Authority. (2011) *Statement of Opportunities for the Singapore Energy Industry 2011*. Singapore. Energy Market Authority.

Fogarty, D. (2011) Singapore raises sea defences against tide of climate change. *Thomson Reuters*. Retrieved from <http://www.reuters.com/article/2012/01/27/uk-climate-singapore-idUSLNE80Q00J20120127>

Kai, F. (2012). Flash floods hit several parts of Singapore. *Yahoo Singapore*. Retrieved from <http://sg.news.yahoo.com/flash-floods-hit-raffles-city.html>

Agence France-Presse. (2012) Singapore top carbon emitter in Asia-Pacific. *Agence France-Presse*. Retrieved from <http://newsinfo.inquirer.net/156727/singapore-top-carbon-emitter-in-asia-pacific%E2%80%94wwf>

Building and Construction Authority. (2012). *Singapore celebrates 1,000th BCA Green Mark Building Project*. Retrieved from http://www.bca.gov.sg/Newsroom/pr26022012_GM.html

Housing Development Board. (2010). *HDB to Develop Punggol as the Singapore's First Eco-Town for the Tropics*. Retrieved from <http://www.hdb.gov.sg/fi10/fi10296p.nsf/PressReleases/38ED16EFE18DDA8C482576B800265A27?OpenDocument>

11. FEATURE SERIES “THE GREEN HOUSE EFFECT”

11.1 The Big Players

11.1.1 Green buildings join the fight against climate change

The city-state has awakened to the dangers of global warming and are looking to green buildings for help

Along a sun-splashed beach at East Coast Park, workers in yellow helmets are enlarging stone breakwaters to hold out rising sea levels caused by melting polar ice caps linked to global warming.

In January, flash floods caused by prolonged downpours hit several parts of Singapore, the latest in a series of floods affecting the island since 2010. At Raffles City shopping mall in the heart of the business district, the floods forced some shopkeepers to stop operating for a few hours.

Deeper into the Singapore heartland at the Building and Construction Authority (BCA) Academy along Braddell Road, it is back to school for architects, engineers and construction managers, studiously taking notes on how to make air-conditioning more efficient.

Stung by freak weathers and rising seas, Singapore is waking up to the realities of a global warming. The heavily-urbanised island is coming down hard on a big culprit, buildings, identified as a reason behind the country's high carbon emissions, a driving force behind the warmer climate.

Buildings here consume about 31 percent of electricity, and the figure jumps to 49 percent when households are included, according to the BCA.

Although buildings do not release large volumes of carbon dioxide, their heavy use of electricity pushes power plants to burn more fossil fuel, releasing more greenhouse gases into the air.

To deal with this problem, the country has mobilised an army of architects, engineers, developers and scientists to turn buildings 'green'. This means slashing electricity use in buildings and getting them to generate their own electricity.

Supporters argue that green buildings can reduce utility bills, improve people's health and bring jobs to Singapore. Critics, however, warn of higher costs.

Last February, Pasir Ris Sports and Recreation Centre was crowned the country's thousandth green building. The centre's solar panels provide up to 12 percent of the building's annual energy needs, helping its owners save about \$57,000 every year.

"This will help to mitigate climate change as the building sector contributes 16 percent of Singapore's total carbon emissions," said Deputy Prime Minister Teo Chee Hean at the opening of the centre.

The centre's green efforts are part of an ambitious national blueprint called Sustainable Singapore, launched in 2009 with the goal to transform Singapore into an environmentally friendly city.

Pushed and co-written by Mr Mah Bow Tan, the Minister for National Development for 12 years until leaving the Cabinet last year, it planned to transform 80 percent of the urban landscape into green buildings by 2030.

Only 13 percent have made the mark so far. These buildings are given Green Mark awards, launched in 2005 by the BCA to recognise sustainable urban design.

The BCA acts like a stern teacher, grading the buildings by ticking off a long checklist. About half the points are based on how efficiently the building uses energy, while the remainder of points are given based on the building's ability to save water, materials and to generate clean power.

BCA is in for the long haul. To meet the 80 percent target, they have to transform around 8,000 more buildings within the next 18 years.

"It's a huge challenge," said Mr Mah. "We will require a lot of incentives, mandatory requirements and a lot of strict targets."

Money Matters

In a country made prosperous by trade, proponents of green buildings have to play by the rules of capitalism.

Even City Developments Ltd (CDL), the leading developer in green buildings, cannot escape the realities of the market. Back in 2008, CDL managing director Kwek Leng Joo told the media that "businesses are for profit".

"Companies are out there not primarily to do charity work, think about how they should protect the environment or how they should repay kindness to society," said Mr Kwek. "The primary obligations are to the shareholders and investors."

But CDL believes that they have a duty to protect the environment and ensure the future of business and society.

“In the mid-1990s, as our business continued to expand internationally, we reflected on our corporate vision and direction,” Mr Kwek said.

“Looking ahead with reference to the global trend, we believed that it’s timely to change the perception of our building industry which was deemed having a negative impact to the environment,” he added.

But switching over to green buildings can be financially challenging for some building owners.

According to BCA, green buildings are 0.3 to eight percent more expensive than normal buildings. The extra costs, called the green cost premium, are due to features such as better air-conditioning, solar panels and even rooftop gardens.

The crux of the issue is the payback period, the time it takes for developers to recover the cash spent on green features.

Today, this period ranges from two to eight years, but not all companies are willing to wait that long.

And Mr Mah is aware of these commercial pressures. The key to success, he believes, is to encourage market demand for eco-friendly buildings.

“If the general public doesn’t buy in, they are not going to force the developers to build better buildings,” he said.

That was one reason behind the creation of the Green Mark awards. The BCA wants it to function like a badge of honour, increasing the attractiveness of green buildings to developers, tenants and the public.

To differentiate building performances, the Green Mark has four levels. The lowest grade is Green Mark Certified, followed by Green Mark Gold, Gold Plus and Platinum.

The man behind the scheme, Mr Tan Tian Chong from the BCA, deliberately cancelled the bronze and silver stages.

“Nobody will want a silver Green Mark. It has no snob appeal,” he said, laughing.

Carrots And Sticks

If such an appeal existed, it was not obvious in the first few years. Mr Tan recalled that only 17 buildings took up the Green Mark when it was launched in 2005.

Among the first green buildings is the National Library Building in Bugis.

“We had a hard time trying to explain what the Green Mark is and its importance,” said the Director of the BCA’s technology development division.

After a slow start, the government stepped in. Incentives and legal measures, called the “carrots and sticks” by Mr Mah, were used to push the slow-moving building industry.

The first ‘carrot’, a \$20 million incentive dangled in front of developers in 2006, offered a grant of up to \$6 per square metre of built area to deal with extra costs of making buildings environmentally-friendly.

The scheme worked and was exhausted within three years. A total of 102 building projects achieved Green Mark status with its help, according to Mr Tan.

The BCA introduced a new incentive in 2009, which allows more floor area to building owners who take the green route. Several hundred more buildings responded positively to the scheme.

“In the last three years, it accelerated a lot because of these schemes,” said Mr Tan. “At the same time, the industry is becoming more familiar with the benefits of going green.”

The government also waved the ‘stick’. Policymakers changed legislation in 2007, making it compulsory for all new buildings to be green from 2008 onwards.

Not In A Hurry

Despite such incentives and legislation, going green still takes a backseat to other concerns.

In March, the Khoo Teck Puat Hospital (KTPH) decided to convert a rooftop garden into another general ward to relieve the shortage of hospital beds.

The hospital’s move reflects the space crunch in many public buildings which is set to worsen as the island gets more crowded.

From 2000 to 2010, the number of people per sq km jumped from 5,900 to 7,126.

This high population density makes it hard for buildings to turn green whilst staying comfortable, said Mr Mah.

Buildings are packed tightly to meet the high population density. To make matters worse, many of these buildings were constructed before the push for eco-friendly buildings began in the early 2000s.

These older buildings account for 80 percent of the urban landscape, according to an estimate by building expert Dr Lee Siew Eang from the National University of Singapore.

Given their massive scale, Mr Mah believes that greening these existing older buildings will be the biggest challenge faced by Singapore’s planners.

Some building owners do not invest in green technologies for older buildings because it is not profitable.

As a result, the industry has to wait for these buildings to be demolished and rebuilt, but this will take time as buildings are made to last several decades, explained Mr Mah.

Some buildings from the colonial-era will not be demolished too. These are protected by law because of their historical value.

“Heritage buildings will always be kept,” said Mr Mah. “Some of them might not be very energy-efficient, but we just have to live with it.”

In the meantime, Singapore will have to bear with their poor performance.

Mr Mah warned that such buildings “consume very large amounts of energy.” Buildings last up to 40 to 50 years, and if energy is not used efficiently, it will translate to huge costs, he added.

Already, some international observers are unhappy with amount of carbon emissions released by Singapore’s building sector.

The World Wildlife Fund (WWF) published a grim report this month listing Singapore has the largest carbon emitter per head in the Asia-Pacific.

It accused the building and corporate sector of helping Singapore win this dirty honour.

“Singapore... is a society that maybe is one of the best examples of what we should not do,” said WWF president Yolanda Kakabadse.

In response, the National Climate Change Secretariat argued that WWF’s per capita method of measuring carbon emissions is unfair to small countries such as Singapore.

This is due to the island’s small land area, coupled with high population density and lack of readily available alternative energy sources.

Green Pioneers Push Ahead

As BCA tries to encourage more developers to turn their properties green, a few green building pioneers are showing the way forward.

CDL, the leading developer in green buildings, invests about two to five percent of construction costs on a building’s eco-friendly features.

“Society benefits from the reduced environmental impact,” said CDL managing director Kwek Leng Joo. In addition, he said that customers can enjoy savings and even see a rise in their property’s value.

Some of CDL’s award-winning, Green Mark certified projects include City Square Mall and Republic Plaza, an iconic skyscraper in the heart of the central business district.

But CDL has had its fair share of difficulties. When it first started greening buildings a decade or more ago, the local industry did not know much about environmental sustainability.

“It was an uphill task to find experts and support in this area,” recalled Mr Kwek, who was director and managing director of CDL since 1980 and 1995 respectively.

“The majority of customers were also indifferent to the importance of the issue.”

CDL also faced resistance from the builders and consultants, whom they collaborate with to construct a building.

To counter this, CDL established a grading system, called the 5-Star EHS Assessment System, to measure the level of environmental and safety performance of the contractors.

This has helped it win over many stakeholders and partners – consultants, architects, customers and investors. Today, they are the most decorated Green Mark private developer in Singapore.

Some \$12 million in electricity was saved annually from its 27 Green Mark buildings between 2008 and 2010, according to CDL.

Investing For The Long-Term

The prospect of such savings has attracted another major player in the green building industry: Lend Lease.

The Australian developer is behind the retrofitted Parkway Parade shopping mall and the biomedical research hub Biopolis, both Green Mark certified buildings.

Mr Mann Young, head of sustainability for Asia at Lend Lease, feels that there is “still a lot of skepticism out there” on what a green building really is.

“There is a lot of talking and not much action for some parties and companies,” he said.

He urged developers to consider long-term benefits, especially in the climate of rising energy costs and falling prices of green products due to improvements in technology and manufacturing processes.

Thus, green products are not an additional cost, but as an upfront investment to protect buildings against rising energy costs, he said.

“Don’t build it cheap, build it sustainably,” he said. “Think about the value of the building five to 10 years from now.”

To further its green efforts, Lend Lease targets partnerships with developers who focus on mid- to long-term ownership of properties. Such companies value green properties more, according to Mr Young.

This is because the green investments make sense 10 years down the road. If a developer wants to own the property for just three years, it will not make commercial sense, he explained.

Even in a financial crisis, Mr Young said that companies should not give up on greening efforts.

While he acknowledged that building firms will be more cautious in spending, opportunities for growth will exist for the green economy.

“The green industry is creating jobs, creating new skills and enhancing the individual’s opportunity to grow and learn,” he said.

Let The Market Fight For You

Higher cost of green buildings is not a worry for Mr Subbaih Ramar, project manager at the Ministry of Manpower Service Centre, a new building which is scheduled to open this June.

In fact, the Ministry has achieved a feat rarely seen in the industry, spending below the given budget to complete this green centre.

He said that estimates by architects and consultants put the cost at \$68 million but the price tag so far is around \$60 million.

The trick, according to Mr Ramar, is to call for separate tenders for different parts of the building instead of one tender for the whole building.

This will allow the developer to get market prices for items such as the furniture, electrical appliances, fire equipment and air-conditioning, he said.

“They came out cheaper than expected,” Mr Ramar said happily.

In contrast, if a developer outsources these green items to the main contractor in charge of the building construction, it will cost more, he said.

“Just let the entire industry compete. The whole of Singapore can decide the market price,” he said.

But developers are reluctant to do so because more tenders mean more paperwork, he explained.

Mr Ramar also believes that it is not hard to transform older buildings.

He points to the 25-year-old MOM complex, which received the Green Mark Platinum award last year for its energy efficient air-conditioning, light sensors and energy efficient lift mechanisms.

“When you do retrofitting, you are like a doctor. You must study the building first, which one is good for retrofitting, which one is not good for it.”

But he cautions against renovating for the sake of going green. Understanding the building’s purpose and its inhabitants’ needs is a better way to go about it.

A building undergoes renovation every 10 years to keep up with population growth, he said, and that is the best opportunity to install green features.

“Imagine if you have a car, you don’t buy a new one just because you want to go green,” he said. “When your family becomes bigger, you can take the opportunity to buy a bigger green car.”

Greening Buildings For Life

The Singapore family of green buildings is set to get bigger. The BCA is now also targeting restaurants, retail outlets and even shopping markets as part of its plan to engage people living inside buildings.

Mr Tan from BCA said that tenants can account for 40 to 60 percent of the building’s energy consumption.

“If we can get this group to contribute, they will make the building green for life.”

Besides the tenants, Mr Ramar hopes that the BCA will focus on another group of professionals – facility managers.

These managers keep the buildings operational throughout its life-cycle, which can last several decades.

He feels that facility managers are not concerned about greening the building because cost savings go into the developers’ pockets.

“A lot of facility managers will ask: ‘Why must I do this? I’m not getting any extra money,’” he said.

Such mentalities are an obstacle towards greening.

“Until the age of socially responsible consumerism dawns in Singapore, the key challenge that developers will continue to face is to drive demand for green buildings through education,” said Mr Kwek from CDL.

The green economy is still in its “infancy” and demand for green buildings is just beginning to grow in Singapore, he said.

However, Mr Kwek is heartened to see that consumer mindsets have started to change with increased awareness of climate change and its environmental impact.

“We are optimistic that this growing consciousness may eventually extend to retailers and individuals,” he said.

11.1.2 Timeline

Singapore’s journey towards sustainable urban infrastructure 1992 – 2012

A timeline with 28 entries culminating in a graphic with statistics and quotes.

11.1.3 What is Green Mark all about?

5 information boxes explaining:

- What is Green Mark
- Green Mark Award rating system
- Business case for green buildings
- Incentives for existing buildings
- Incentives for new buildings

11.2 The Community

11.2.1 *My house is greener than me*

Treelodge@Punggol boasts of many green features and is the model town for Singapore's future. But, its residents tell a different tale

Mr Andrew Lee shrugged his shoulders and appeared nonchalant when asked about the eco-friendly features in his four-room flat.

“Don't know about them,” said the 40-year-old sales manager, who has been a resident for a year.

When pressed about the special wash basin-toilet pedestal system in the toilet and the recycle chutes in the corridors, the father of three replied: “I don't use them, nothing special”.

He asserted that living in Treelodge@Punggol was “just like in any other neighbourhood” and admitted to not knowing that the flat was eco-friendly when he bought it.

In the same block, a few storeys below, the scene replayed itself.

Mr Darren Quek, 26, a civil servant, readily conceded that he is not concerned about climate change and the environment.

“The eco-friendly features were not a consideration when I bought this flat,” said Mr Quek, who lives with his wife and two children.

He has heard of the water efficiency features but knows little beyond that.

Treelodge is the Housing Development Board's (HDB) first green housing project and home to HDB's one millionth flat. Nestled in Singapore's first eco-friendly town, Punggol, it boasts of 712 units of premium flats housed in seven 16-storey residential blocks surrounded by lush greenery and wide open fields.

Located along Punggol Road, it is within walking distance of Punggol MRT Station and Damai LRT Station.

It was built at a cost of \$120 million and serves as a testbed for innovative green technologies with features such as solar panels and rainwater recycling.

It opened in 2010 and received the Building and Construction Authority's (BCA) Green Mark Platinum – an award recognising sustainable building design.

Treelodge sits close to a host of green facilities that promote sustainable urban living, such as My Waterway@Punggol – Singapore's longest man-made waterway which connects Punggol Reservoir to Serangoon Reservoir.

With the opening of the first eco-blocks and other green amenities in Punggol, HDB hoped that the new town's green features would raise environmental awareness among its people.

The responses of the residents, however, illustrate that buildings are evolving at a faster pace than people's mindsets and that creating green awareness remains an uphill challenge in Singapore.

Punggol was first unveiled as a vision of the model town for the next century in 1998 by then Prime Minister Goh Chok Tong.

This was reaffirmed in the sustainable development blueprint in 2009 and later in 2010, when HDB revealed its plans to develop Punggol as Singapore's first eco-town.

This means that Punggol is home to more eco-friendly buildings and developments in the northern coastal town are likely to achieve Green Mark awards.

"As the largest developer in Singapore, we have the responsibility to promote environmental sustainability," said then HDB chief executive officer Tay Kim Poh during a conference hosted by HDB in 2010.

Punggol also has designated cycling paths and spaces for car pool services to encourage residents to adopt more environmentally-friendly ways of travelling.

Mixed Success

Occupants of this green haven, however, are seemingly not more environmentally conscious than the rest of the island's inhabitants.

Mr Ng Chun Tat, 38, a senior engineer and head of the Sustainability and Building Research at HDB's Building Research Institute said that it all "boils down to the people element, something that no one can control".

Even if the infrastructure is there, people can choose to ignore the green message, he said.

"Are we expecting people to be more eco-friendly just by living in Treelodge? No," said Mr Ng. "If people opt not to do anything, then nothing will change."

But Treelodge's existence creates an opportunity to bring up and discuss sustainable urban living, said Dr Janil Puthuchery, a Member of Parliament of Pasir Ris-Punggol Group Representation Constituency which covers Treelodge.

He said that Treelodge is a "focal point" in many discussions because it is specially designed to be environmentally friendly.

“That’s good but I don’t expect that just because you are a resident at Treelodge, you will automatically buy into it,” he said.

“But, it becomes an excuse, a reason or a platform for us to have that conversation,” said the advisor to Punggol West Grassroots Organisation.

Mr Ng said that HDB conducts activities, send brochures, sets up exhibitions and puts up educational panels at Treelodge to constantly drive home the message that residents have a crucial role to play.

“Through all these communication channels, we hope to spark off a fire, which will ignite and blossom into fireworks,” he added with a laugh.

And it seems that some efforts have paid off.

According to Ms Polly Yeung, an architect at HDB’s Building Research Institute, a survey conducted by an external assessor showed that residents in Treelodge and Punggol were “more receptive towards green features” than residents of other estates.

While HDB declined to release the report, it shared that for a typical 12-floor HDB block, Treelodge used less water and energy than a block that did not have such eco-features.

But most of these green features are pre-installed, raising the question of whether residents would be as receptive if they had to fork out extra cash.

Treelodge houses 2,000 sq m of solar panels on its roof, which generate energy to meet the demand of common area services such as lifts and corridor lighting.

The lifts use 10 percent less energy than conventional lifts. Motion sensors at the staircases means that lighting is provided on-demand.

The roof also boasts of 400 sq m of space to collect rainwater. This water is drained into a storage tank, which can store up to 7,000 litres of water.

Residents such as Mr Andrew Lee, however, paint a grim picture of the realities of the perception of such impressive green features.

“The solar panels do not concern us. I can’t see them. I haven’t seen a difference in my power bills and water bills,” said Mr Lee, who used to live in Ang Mo Kio.

Mr Ng from HDB is aware of this problem, which he describes as “unique” to Singapore.

He said: “If you ask people whether they practice green habits, they will ask ‘what benefits do I get’. You have to give them gift vouchers.”

He explains that people might not see the value in going green as the results are not immediately apparent.

The solar panels and other green features have slashed the cost of operating common facilities by reducing electricity use.

“This is so that residents don’t have to pay more S&C (service and conservancy) charges even though electricity tariffs are rising,” he said.

He explained that an estate with more greening will need more maintenance. The upside, however, is that residents will enjoy the greenery, shade and cooling surroundings.

“So, they are benefiting. But are they willing to pay extra S&C? At this moment, I don’t think so,” said Mr Ng.

Already, the cost of the eco-friendly features such as solar panels, which powers the communal facilities, do not contribute to the price of the flat, explains Mr Ng, but residents want everything free-of-charge.

A Recycling Haven

Mr Haja Nizamudeen, Chairman of Punggol Coral Tree Residents’ Committee, which oversees Treelodge, paints a different picture.

He believes that residents of the block are “proud” to be living in the first green HDB building.

“People now understand the benefits of being eco-friendly. When they live in the building, it is in their subconscious. It changes their lifestyle,” he said.

This is most apparent in the residents’ recycling habits.

According to Ms Yeung at HDB, the amount of recyclables collected in Treelodge was three times more than that of other estates.

The reasons may lie with the accessibility of the recycling chutes – There is a centralised refuse chute dedicated to recyclables in the corridors on every floor.

Mdm Chai Soo Choo, 55, a resident of Treelodge, is not aware of the eco-friendly design of the flat. But, she often recycles.

“I have to wait till my grandchildren fall asleep,” she said. “Then I run out and use the recycling chute.”

Another resident Mrs Lian, 30, a purchaser, does not consider herself an eco-friendly person. However, she does make it a point to use the recycling chute.

From her observations, other residents are also doing their part for the environment. They keep the place clean and recycle, she said.

Already, this is a step in the right direction and hints at the potential for the future.

In 2006, Singapore posted lacklustre recycling figures, lagging behind developed countries such as Norway. That year, in a bid to promote recycling, the National Environmental Agency (NEA) introduced recycling bins at void decks of HDB blocks.

Today, recycling chutes are seen on every floor of Treelodge and the amount of recyclables collected show that change is slowly in the making.

Taking It To The Schools

The problem now is getting people to take action and go beyond what is given. Unlike people in other countries, who are willing to pay more to lead a sustainable lifestyle, Singaporeans need incentives to make change, said HDB's Mr Ng.

Dr Puthuchery believes that for deep-seated behavioural change to take place, a top-down approach would not be effective.

A more successful approach, he said, is to "persuade people to make the change for themselves, to take ownership".

HDB recognises that education plays an important role in changing habits. It has an array of programmes targeted at schoolchildren such as the eco-learning journey and the heartland ambassador programme.

The heartland ambassador programme involves primary and secondary school students, who go door-to-door in Punggol to speak about the importance of water conservation.

Through these programmes, HDB hopes to "instil a green lifestyle message".

Besides the HDB, related government agencies such as NEA, the national water agency PUB and the National Parks Board organise both nationwide campaigns and campaigns specific to Punggol.

"It boils down to exposure," said Mr Ng. "It has to start from young as a habit. It's not just putting the infrastructure but also encouraging the right mindset from young."

11.2.2 What's new?

A box explaining three new facilities in Punggol, Singapore

11.2.3 What are the green features at Treelodge?

8 short entries about various green features at Treelodge@Punggol

11.2.4 Keeping sane while going green

A local green activist shows that even going green has its limits

In her first month of turning vegetarian in 2008, Ms Olivia Choong began to lose her mind.

She became emotional over every little thing and her health started on a downward spiral. She rapidly lost 3kg from her already slim frame.

In her fervour to become environmentally friendly, she flipped her life inside out and upside down.

Meat and seafood were struck off her diet after she realised that farming animals creates high carbon footprints.

She also stopped using the air-conditioner, avoided disposable items, reduced electricity and water consumption, shopped for eco-friendly shoes, bought vintage dresses and searched for organic cosmetics and underwear.

“I think it was guilt that drove me to do a lot of these things and it came to a point when I realised that the guilt was just silly. We just do the best we can but not be frivolous,” said Ms Choong, 33.

These days, Ms Choong takes green in moderation.

While living a sustainable lifestyle is still a large part of her mantra, she has come to terms with how far one can go to be green. She now accepts that she must pick and choose her battles wisely and that change is a long-drawn process.

Her affinity with green began when she was 18, as a punishment.

Caught eating late at night in her boarding school dormitory in Australia, she was made to empty milk cartons into the recycling bins.

This kick-started her recycling habit and helped her establish a firm green foundation.

“At that age, I was trying to fit in. I didn’t want to be an outcast. My peers were recycling so I did it too,” she said. “Eventually it was ingrained in me, and I began to do it every day even after I returned to Singapore.”

The catalyst that set her on the tracks towards eco-friendly living, however, was Live Earth – concerts held in 12 cities across the globe to combat climate change – in 2007.

“In between the concerts, there were the public service announcements and I said to myself ‘oh my god, this is serious, we got to do something’,” she said.

Thus, she co-founded Green Drinks Singapore, the local chapter of an internationally recognised non-profit movement, which brings together individuals and businesses to share on sustainability issues.

Not satisfied with what she had achieved, she set out to make changes to her lifestyle.

Turning vegetarian in a bid to combat climate change, however, soon evolved into a detrimental diet for her body.

“I kept on losing weight. And I didn’t feel healthy even though I was eating vitamins. I was wasting away,” she said. “It was especially difficult because, for me, putting on weight is very difficult.”

Alas, it was not meant to be – her parting with meat was permanent, but her break from fish would only be temporary.

Nutritionists advised her against a total rejection of fish as her body was lacking in vitamin B. And so, in 2011, she started to eat fish again.

She sheepishly confessed that she had not read up prior to embarking on the extreme diet change.

Her weight has since stabilised. And she no longer sees the need to purchase expensive organic underwear that she feels is “not even comfortable”.

In addition, her long-drawn battle with her family has helped her realise that she should let nature take its course.

When she first started to drive the green message home, Ms Choong, who lives with her parents, harangued them on their environmentally unfriendly habits until “they were all annoyed”.

She eventually stopped harassing them and soon began to see changes take place – this, however, took four long years. Today, her father drives a hybrid car.

Her mother, Mrs Michelle Choong, who is a retired accountant in her mid-60s, believes that Ms Choong has created greater environmental awareness in the family.

While it requires more work on Mrs Choong’s part to reuse the water from the washing machine, wash containers for recycling and bring her own bags to supermarkets, she has started to make these activities a habit.

“We didn’t start off as a green family. She started, and later, we followed. And now she keeps an eye on us,” said Mrs Choong.

When Ms Choong first started to zealously advocate green habits, she would switch off all the lights in the house.

This, however, was a concern for Mrs Choong, as the family stays in a bungalow and total darkness is a “security issue”.

They have since come to a compromise to turn off the garden lights after a certain hour and the living room and staircase lighting when not in use.

But, she is still not totally convinced about the case for going green. While it is a “nice idea”, she believes that there is a limit to being eco-friendly.

“In truth, you can only do so much. Do you expect people to cook with coal? Chop their own firewood? It’s all about small steps,” she said. “We try to accommodate where possible as long as it is not that much of an inconvenience.”

She has considered installing solar panels but that was due to the potential cost-savings rather than the eco-benefits.

Unfortunately, the roof of the house cannot withstand the weight without major renovations.

Today, the family has learned to live with differing opinions over what to eat and how to do things.

When Mrs Choong shops for apples, she buys apples for her husband, and organic apples for her daughter.

“But, whatever you do or choose, she’ll be there staring at you,” said Mrs Choong with a laugh.

Ms Choong’s passion for green has spilled over into her career.

In 2010, the mass communications graduate, who has a post-graduate diploma in public relations, founded Sustainable PR, a public relations firm that helps raise awareness of green businesses and promotes sustainable products and practices.

The one-woman company was not an expensive investment – she works from home and does freelance writing to supplement her income.

Her projects usually span three months or less. Her longest assignment, which lasted eight months, was for Terra Plana, a company which sells shoes made from natural and recycled material.

Being in-charge means that she has the prerogative to choose her clients.

“I have to really believe in the product. If I cannot justify to myself how it is a good green product, then I won’t take on the client,” she said.

She is working towards reducing her commitments in Green Drinks and freeing up time to focus on growing her company.

Ms Choong strongly believes that the answers to eco-friendly living “need not be high-tech and expensive”.

“You don’t need to buy new technology to help you save energy. Sometimes it’s about teaching yourself to do things differently,” she said.

11.2.5 What we can do to save the earth

5 information boxes explaining:

- Household energy use
- What you can do on the road
- What you can do at home
- Public housing and utilities usage
- Possible effects of climate change on Singapore

11.3 The Science

11.3.1 Self-powering buildings break free from fossil fuel

A memorial dedicated to dead soldiers of World War II has found a new purpose. It houses an array of solar panels, wind turbines and energy-saving features, making it a model for green buildings in Singapore

If the world cuts off fuel supplies to Singapore today, a six-storey Buddhist temple will be a beacon of light in the darkness.

Nestled at the foothills of Bukit Chandu off West Coast Highway, the Poh Ern Shih temple forges ahead in freeing Singapore from her reliance on imported energy.

Built with a red pagoda of solar panels and wind turbines, the memorial to fallen soldiers of World War II has started generating electricity beyond its own needs.

Its success raises the possibility of turning more buildings into batteries. This means getting power from wind and sunlight, ending Singapore's near-complete reliance on foreign fuel imports to meet its energy needs.

Such buildings would also be immune to fuel supply disruptions across the globe.

Mr Lee Boon Siong, 72, a devout Buddhist, manages this self-sustaining temple with his wife and ten regular volunteers, providing religious services to an estimated hundred devotees.

Inspired by self-powering houses in Canada, where he resided for 16 years, Mr Lee spent the last four years installing solar panels, energy-efficient lighting and water collection tanks onto the temple.

The solar panels cost about \$200,000, but he said it will only take five years to recover the cost as he will reap energy savings in the long-run.

"When the building produces excess electricity, my bill is negative," said the retired lawyer. "It makes a lot of sense for Singaporeans to go down this route."

Poh Ern Shih is one the few zero-energy buildings in Singapore, the other being the Building and Construction Authority (BCA) Academy along Braddell Road.

A zero-energy building generates more power than consumed. Similar buildings are already found in the United States, Europe and Malaysia.

"It's technically possible to turn every building into a green building," said Mr Lee. "The whole country can generate power."

Tapping The Sun

Such possibilities were distant dreams in the 1860s, when French mathematician August Mouchet first proposed an idea for solar-powered steam. Together with his assistant Abel Pifre, they constructed the world's first solar-powered engines.

But solar power was not widely used in buildings today. High cost of solar panels and slow returns of investment have deterred many from taking it up.

Fossil fuels such as petroleum, coal and natural gas turned out to be much cheaper and easier to use. Today, they account for nearly 100 percent of Singapore's energy sources.

But this is slowly changing. Mr Christophe Inglin, managing director of solar equipment maker Phoenix Solar, argued that grid parity, a point where solar power will cost as much as fossil fuel, is "nearly there" for Singapore.

This grid parity will allow solar power to compete with fossil fuels in the market, leading to its mainstream acceptance.

Presenting data at the Clean Energy Expo Asia conference last November, Mr Inglin said that Singapore will be first Southeast Asian country to reach that point.

This is partly helped by rising oil prices over the past decade, advancements in solar technology and the entry of China into the solar market.

In the search for cleaner energy, Mr Tsoi Mun Heng, director of the energy innovation challenge directorate at the National Research Foundation, believes that solar power is the way to go.

Even though its potential is constrained by Singapore's land shortage, Mr Tsoi said that solar power is still best option compared to wind, tidal and nuclear power.

"Ideally, we want an energy source with no radioactive fallout and carbon dioxide emissions. It also has to be free, abundant and will never run out. That's a tall order."

Unlocking Bigger Wallets

Few buildings, however, are able to replicate Poh Ern Shih's success without support from larger, cash-rich organisations.

For the BCA Academy, its 1,540 sq m of solar panels was funded by the Economic Development Board. Similarly, Poh Ern Shih receives tax-free donations from the devotees which helped to cover the cost of solar panels.

Such funds are not available for individual home owners, according to Mr Tsoi Mun Heng.

He points to the high upfront cost for solar panels as a barrier to turning buildings to power plants.

“You need to pay 20 years of electricity upfront, and then the sun slowly pays you back. That kind of financing model is very difficult for many people.”

But he believes this can be solved through initiatives such as solar leasing – an initiative in 2011 by Housing Development Board (HDB) to allow private companies to pay for solar cells on rooftops.

“The company takes the risk and pay for everything upfront. They sell electricity generated from the sun to the residents and that’s how they get their money back,” he explained.

Mr Tsoi believes that higher demand in bigger markets will also help to make the investment affordable.

Mr Ng Chun Tat, head of the sustainability and building research at HDB, believes that it is commercially possible to install solar panels on a larger scale.

Investing in solar power already makes commercial sense, said the senior engineer, adding that on paper, every dollar invested on solar power will generate more than a dollar in returns.

“But for a small company, they only have one or two blocks. Of course, the price of solar panels will be more expensive,” he said.

“For us, it’s different. We have economies of scale, we have 9,000 buildings. If one day, HDB decides to implement this, the whole price will just drop.”

And the idea is not that far-fetched. HDB could open the floodgates to wide-scale implementation of solar panels on many buildings in Singapore.

“It will not be immediate but I think it is possible,” Mr Ng said. “One day, you will see all our buildings with solar panels.”

Hydro-Power

Even when solar power is insufficient, buildings in the future can turn to another new source – hydrogen power harnessed from water.

While lacking in drinkable water, Singapore has abundant rainfall throughout the year and is surrounded by seas.

About 2342.22mm of rain falls in Singapore each year, with the longest recorded dry spell lasting only 40 days, according to National Environmental Agency.

Recognising the potential of rainwater in powering buildings, Dr Ernest Chua Kian Jon at the National University of Singapore (NUS) is leading a four-man team in developing a cost-effective way to extract power by using rain collected on rooftops and solar power from photovoltaic (PV) panels.

A popular type of solar panel, the PV panel converts sunlight directly into electricity.

“Rooftops can be equipped with PV panels which make use of sunlight to produce enough electricity for electrolyzing water, separating the hydrogen and oxygen,” said Dr Chua.

“The hydrogen is then stored into fuel cells which in turn generate power for communal equipments of the block.”

But Dr Chua estimates that, within five to 10 years, the hydrogen system will be ready for the local market.

“This system can be implemented easily in HDB apartments, converting them into energy-generating buildings,” he said.

“It will also provide extra shielding from sunlight on rooftops, resulting in reducing the cost of air-conditioning for the buildings.”

The hydrogen system can also split seawater, an abundant resource for an island state, making the power generation possibilities endless.

“If you can build power plants along the coastal areas, you have the potential to power a city just using seawater and solar energy,” he said.

Expansion Plans

And powering up the entire city is the dream of Mr Lee, the owner of Poh Ern Shih temple.

When he moved to Canada in 1969, he observed how the locals maximise every resource around their houses.

“Living in cabins in the forest, we have no government electricity,” he recalls. “But we have generators, solar, wind, and also turbines on the flowing river.”

In the Canadian cities, Mr Lee also observed solar cells in the rooftops and windows. He believes Singapore can adopt similar practices.

He is not satisfied with what he has achieved in his temple. He is dreaming of plans to produce even more electricity. Next month, a third batch of solar panels will adorn the temple roofs.

There are even plans to tap energy from rainwater running down from the temple rooftop. When the temple was renovated in 2008, Mr Lee had specially arranged some temple pillars to have a hollow core.

Like a mini-dam, he plans to channel rainwater through turbines placed within these cores to generate hydroelectric power.

Through these measures, he wants to ensure that the monastery will always generate extra electricity like a resilient battery.

Thinking Of The Future

Mr Lee's investment into green technology is costly, but temple devotee Lee Ah Choon, 48, believes they are a long-term investment.

"It's (the temple) not something you build for a short while," said the devotee who donates about \$300 to \$400 a month to the temple.

"When we donate, we don't have to see returns," the chemical engineer added. "The temple is doing a lot of charitable work. They allow old folks to come, eat meals and learn about the religion."

Temple volunteer Angie Ng is also fully supportive of the greening efforts.

"If you look at the oil prices today, it is always increasing," said the 49-year-old who had spent three years helping out at Poh Ern Shih.

"For such a big temple, electricity bills are rather big figures."

Ms Ng said that devotees and volunteers are generally supportive of Mr Lee's efforts. Although some had reservations over the extra costs, she recalled that Mr Lee had already "tried his best" to explain why green technologies are important.

"He probably did his calculations," said Ms Ng. "If we can generate electricity ourselves, the bill won't be such a heavy burden on us."

Mr Lee is proud of his temple. When visitors arrive, the 72-year-old man eagerly ushers them around like a child showing off his new toy.

From the underground water storage tanks, to the rooftop solar pagodas, to the stains on the newly whitewashed wall caused by offshore refineries nearby, Mr Lee misses nothing and enthuses about the possibilities of the future.

But deep in his heart, he laments that Singapore has not invested in green technologies earlier.

"We are so dependent on our neighbours for oil and electricity, for everything we need," he said.

He believes that the country must step up efforts to produce alternative energy, and it has to come from Singaporeans, especially the younger generation.

“They have to believe in it. It has fallen onto the shoulders of their generation now.”

11.3.2 Air-conditioned nation no more

The country wakes up to the realities that the chiller plant is not so cool after all

Singaporeans are so accustomed to air-conditioning, even the dead will not do without it.

From the moment they are born to when they are put to rest, Singaporeans are in air-conditioned environments.

But this invention is bad for Mother Earth; Air-conditioners turn buildings into power-hungry monsters that gobble up nearly twice as much power from the electricity grid.

This is putting the country’s geography at risk, pushing scientists and government officials to seek solutions in the source of the problem – the air-conditioning unit.

Introduced by the West in the 1950s, the cooling system is praised as the “most important invention of the 20th century” by former Prime Minister Lee Kuan Yew for its role in creating a conducive work environment in the tropical city-state.

In 2001, Mr Lim Swee Say, Singapore’s then-environment minister, told air-conditioning executives that “air-conditioning plays a crucial role in our economy”.

“Without it, many of our rank-and-file workers would probably be sitting under coconut trees to escape from the heat and humidity, instead of working in high-tech factories,” he said.

But inefficient air-conditioning is a worry for Mr Tan Tian Chong, the director of the Building and Construction Authority (BCA) technology division.

He said that many existing buildings are guilty of it.

“There is a joke, Singapore is two weathers: It’s winter in the building, and summer outside,” he recalled, laughing out loud. “We are ridiculed for wearing winter clothing in the building.”

He believes that this is caused by zealous builders in the past who over-designed the system.

“In the old days, people play safe,” said Mr Tan.

“You never get fired for oversizing air-conditioning. You get fired if there is insufficient capacity, because the whole place gets warm,” he added.

The ill-effects of air-conditioners also go beyond electricity consumption.

Associate professor Wong Nyuk Hien, an expert on temperatures in urbanised areas, is concerned about air-conditioners heating up the air around buildings.

“Air-conditioning is not a magical thing. It makes us feel very cool, but it extracts the heat and throws it outside the building,” said the researcher at the National University of Singapore.

The heat returns into the building easily through glass facades, a common feature of commercial buildings. This leads to a “vicious cycle”, said Dr Wong, as heat re-entering the building forces the air-conditioner to dump more heat into the environment, using up more power in the process.

A warmer environment will result in higher sea levels as the heat is transferred into the oceans causing sea water to expand. This is cause for worry for the island city.

Last year, the government mandated that the height of all new reclamations be raised by a metre to 2.25 m above the highest recorded tide level, underscoring concerns about a warmer climate.

As rising sea levels eat into the low-lying island’s hard-won territory, scientists are expressing concerns over its sustainability.

Reducing Energy Use

Some scientists are busy reinventing technologies to curb Singaporeans’ habit of turning on the air-conditioner. These inventions may not stop the use of air-conditioners but they aid in Singapore’s quest to turn green by reducing their energy consumption.

To address this ‘vicious cycle’ of heat re-entering buildings, Dr Yang En Hua from Nanyang Technological University is developing a phase-changing material to improve building insulation.

Like a sponge, the material absorbs excess heat during the day and releases it at night, keeping temperatures stable within its walls.

Such a material is inspired by the fascinating physics of melting ice, said the assistant professor from the School of Civil and Environmental Engineering. As water changes from ice to liquid, its temperature remains at zero degree Celsius despite absorbing heat energy.

“When you try to cool down your beverage, you surround it with ice,” he said, referring to ice boxes containing can drinks and bottles. “Compared to zero-degree water, The ice has a longer life because it takes a longer time to increase temperature.”

The phase-changing material works in the same way. Embedded in the walls of buildings, the material melts when temperatures rise above a certain point, and solidifies when the surroundings cool.

In the process, it absorbs excess heat and maintains the temperature within the building.

However, the phase-changing material requires a certain temperature difference between day and night to activate. Making this work in Singapore is challenging because local temperature ranges seldom go beyond 10 degrees.

Dr Yang is still hunting for a suitable material to make this technology work, and he estimates that it would take five to 10 years for such a product to be accepted by the industry.

In the meantime, Dr Khin Zaw, a researcher at the Solar Energy Research Institute is fine-tuning an air-conditioner that was invented years ago in Germany at the Fraunhofer Institute for Solar Energy Systems.

The energy saving air-conditioner, called Evaporatively COoled Sorptive (ECOS) heat exchanger, operates with the help of sunlight, an abundant source of energy here, thus making it a greener alternative to conventional air-conditioners.

Many air-conditioners used here are also inefficient in the tropics and the ECOS system is designed to tackle this problem.

Air-conditioners use chilled water to cool and dry the air. As water vapour condenses into droplets, heat is released. In Singapore’s humid air, more heat is produced upon condensation, sabotaging the cooling process and adding to the machine’s workload, he explained.

“Our formula separates the dehumidification and cooling. The beauty is that when we supply the air into the system, the air becomes both dry and cool,” he said.

The BCA also introduced a scheme targeted at improving air-conditioning efficiency.

A \$100 million green mark incentive encourages owners of existing buildings to upgrade the energy performance of their chiller plants.

The scheme will fund half the cost of an energy audit to determine the efficiency of air-conditioning and co-fund up to 35 percent (capped at \$1.5 million) of the costs needed for energy efficiency improvements.

Despite these incentives, Mr Tan said that some building owners have other priorities.

“Sometimes instead of spending the money on the air-conditioning, the building owner wants to redo the place to attract more tenants with better aesthetics,” he said. “Some of them don’t look forward to all these disruptions to do retrofitting.”

Lessons From The Past

Besides technological innovations and upgrades, architectural designs of the past can also help alleviate Singapore’s dependence on air-conditioning.

Dr Nirmal Kishnani, a sustainability expert and green building advocate, said that the greening role of architecture is neglected as builders focus on pushing the limits of engineering.

He believes that passive design – constructing buildings in a way that maximises natural sunlight and airflow without relying only on air-conditioning and lighting – has been sidelined in our rush to urbanise.

These days, such designs are only found in older buildings with colonial architecture.

“A colonial bungalow will have these verandas, big windows and high ceilings. It’s very breezy,” he said.

“There are many pathways for wind to travel in these houses. You probably don’t need to rely as much on air conditioning and electrical lighting.”

But such architecture is not practical today, according to Dr Kishnani, as people’s preferences have changed over the years.

“People don’t want to be forced to live like their grandparents. We want to have the choice to switch on the air-conditioning when we feel like it,” he said.

11.3.3 Human waste to power Singapore’s new flats

NTU scientists are trying to generate bio-gas from faeces flushed down toilets

The foul odour of urine, faeces and other week-old excrement hangs in the air.

Seemingly oblivious to the stench, a group of scientists at Nanyang Technological University are tinkering at glass pipes in a labyrinth of tubes and machines filled with human waste, determined to find a way to harness energy from what is flushed down and forgotten.

At the heart of the project is a special toilet that separates human waste to produce fertiliser and energy. Invented in the 1990s in Sweden, it is gaining popularity in Europe.

More than 10,000 km across the globe in Singapore, little is known about the toilet.

But that is about to change – NTU's Residues and Resource Reclamation Centre (R3C) has acquired the toilet so that it can refine the system for better waste collection and water usage in the city-state.

If implemented in buildings island-wide, the toilet will not only save water, but generate as much as three percent of Singapore's growing energy needs through renewable resources.

"In the long-term the toilet is really helpful for water and electricity saving," said Dr Rajinikanth Rajagopal, 35, a research fellow at the R3C. "By separating the waste, you can also recover nutrients and produce bio-gas for power."

An average person generates around 200 grams of solid waste daily, according to Dr Rajagopal. This means Singapore can produce a whopping one million kg of faeces each day from a population of over five million.

When flushed together with water, each litre of this waste water will produce 0.5 litres of bio-gas. And a single cubic metre of bio-gas can produce 6 MW of electricity.

Called the No-Mix Toilet, it contains two holes in the toilet bowl which splits the urine and faeces. The waste is channelled into reactors, housed within various neighbourhoods, for processing.

"The waste treatment process will be decentralised," Dr Rajagopal said. "Instead of one main treatment plant for all of Singapore, there will be smaller plants across the island. This will reduce the cost of transporting the waste."

Inside these reactors, solid waste is broken down in an oxygen-free environment, releasing methane which can be used to power the corridor lights and lifts in buildings.

Thus, the reactor doubles up as an environmentally-friendly neighbourhood power source as methane gas is a cleaner alternative to crude oil.

Such technologies are increasingly vital as Singapore, a resource-hungry state, has seen its annual electricity consumption nearly triple from 1990 to 2010.

Business Monitor International, a London research firm, projects that Singapore's electricity consumption will grow at a rate of 3.7 percent per year over the next decade.

The other product collected from the toilet, urine, is rich in nitrogen and phosphorus. Once separated from the solid waste, it can be made into fertilisers.

While it is too early for him to estimate the potential yield in fertiliser, Dr Rajagopal suggests that urbanised Singapore can export any excess fertilisers to neighbouring countries.

Scientists started work on this new toilet in June 2010. After looking at similar toilets in Sweden and Germany, they found room for improvement to better suit Singapore's use.

R3C's version relies on vacuum technology to suck in the waste, a method used in airplane toilets, and will conserve water by using half the amount of water per flush compared to the European version.

This is also 80 percent less water per flush compared to existing toilets.

This is useful for Singapore, where water is an important resource. Severely constrained by its small size, the island lacks natural freshwater lakes, making it difficult to obtain enough portable water for its people.

Recycling waste water is not new to water-scarce Singapore. The country began exploring water reclamation as early as 1972.

In 2000, it built its first water reclamation plant to produce NE Water, treated waste water that is purified and safe to drink.

Today, there are four water recycling plants across the island producing 30 percent of Singapore's water needs.

But the government is not satisfied. Singapore's latest sustainable development blueprint, launched in 2009, called for greater water self-sufficiency by reducing total domestic water consumption from 156 litres per person per day in 2008 to 140 litres per person per day by 2030.

As part of the blueprint, the government has invested heavily in clean technology research to assist the island's transformation into an eco-city.

And reclaiming waste is not cheap. The National Research Foundation (NRF), a statutory board tasked with spearheading research in Singapore, has provided R3C with S\$10 million to design this new toilet and waste management system.

"NRF saw potential in our project because it is helpful for water conservation and waste management," said Dr Rajagopal. "It will do good for the people of Singapore."

Much of the grant is spent not on the toilet, but improving the waste treatment process – an extensive system of pipes, tanks and chemistry.

For now, R3C is working with the Housing Development Board (HDB) and Public Utilities Board towards wide-scale implementation of this sanitation technology.

After June 2014, if all goes well, residents living in new HDB estates such as Punggol and Woodlands will get to use the new toilet.

Scientists are currently discussing with Lyda Building Products, a local contractor, to develop a prototype.

While the exact cost of the toilet is not confirmed, Dr Apostolos Giannis, 35, another R3C research fellow, believes that the price of both the new and existing toilets will be about the same.

“The main cost of the system is the development of the treatment plants,” he said, adding that the costs will be borne by government agencies.

Even if the toilet ends up more costly than conventional ones, Dr Rajagopal said the long-term benefits should be considered.

“In the beginning, the initial capital investment might be higher if you have to invest in the treatment and the piping,” he said. “But in the long run, it’s really helpful for water and electricity saving and extra costs will be nullified.”

11.4 Editorial

Flip open any property magazine today and the home seeker will be greeted with a visual feast on glossy paper.

Futuristic glass condominium towers, rooftop gardens filled with gorgeous flowers, ornamental ponds and fountains housing healthy and vibrant koi fish and, to top it all off, adorable, smiling children frolicking at the edges of the page.

The developer is selling the concept of a dream home – a charming safe haven for raising a family and spending the golden years.

What is often missing from the picture are the electricity bills.

But, the smitten home-seeker succumbs and buys the unit anyway.

A month later, the first electricity bills arrive. Will it be a lavish \$500, a thrifty \$70 bill or something even more bizarre: A negative \$20 bill?

The answer will depend on whether the apartment is environmentally-friendly or not.

Eco-friendly homes are gaining popularity in Singapore for a good reason.

Mother Earth is sick. To feed the burgeoning economic growth worldwide, humans are burning more fossil fuels, releasing more carbon dioxide and inflating world temperatures.

To supply sand, wood and metal to construct our growing cities, we have destroyed forests, marine ecosystems and left ugly scars on the Earth's surface after abandoning our iron and platinum mines.

As we build bigger and more fanciful buildings to feed our desires for better homes, bigger factories and taller skyscrapers, we have forgotten an important fact: Nature was our first home.

Before we learned to farm, cook and build cities, humans lived as hunters and gatherers for two million years. We lived alongside nature, hiding under trees or inside caves for shelter and protection.

Returning to the forest to roost, however, is not a practical option. Instead, we should learn to construct a sustainable urban landscape.

Just like how clothes reflect the wearer's personality and lifestyle, buildings reflect the priorities and philosophy of the society.

And that reflection is an ugly one: Cold, hard and calculative souls, who place monetary concerns over the welfare of the environment.

But, we share a symbiotic relationship with buildings. We make the buildings, and buildings make us. Green buildings with better ventilation and environmental awareness will result in healthier and more productive people.

Awareness of this relationship, coupled with dire predictions and doomsday scenarios, have shifted our priorities and accelerated the ‘rescue efforts’ of governments and scientists.

Singapore’s strategy to tackle carbon emissions is to push for energy efficiency in all sectors.

Skeptics, however, would point out that the island-state contributes less than 0.2 percent of all carbon emissions worldwide – so what we do in this tiny coastal city is not going to change the world.

But Mother Theresa once said: “I alone cannot change the world, but I can cast a stone across the waters to create many ripples.”

Similarly, Singapore’s efforts to go green can have a global impact.

Green technological advances from a tropical country is useful to neighbours in the region. Successful green schemes and legislation help build a scaffold for other countries’ green climb.

We will never be the change that saved the Earth, but we can be the change that led the way.

And this is vital to building a future for the next generation.