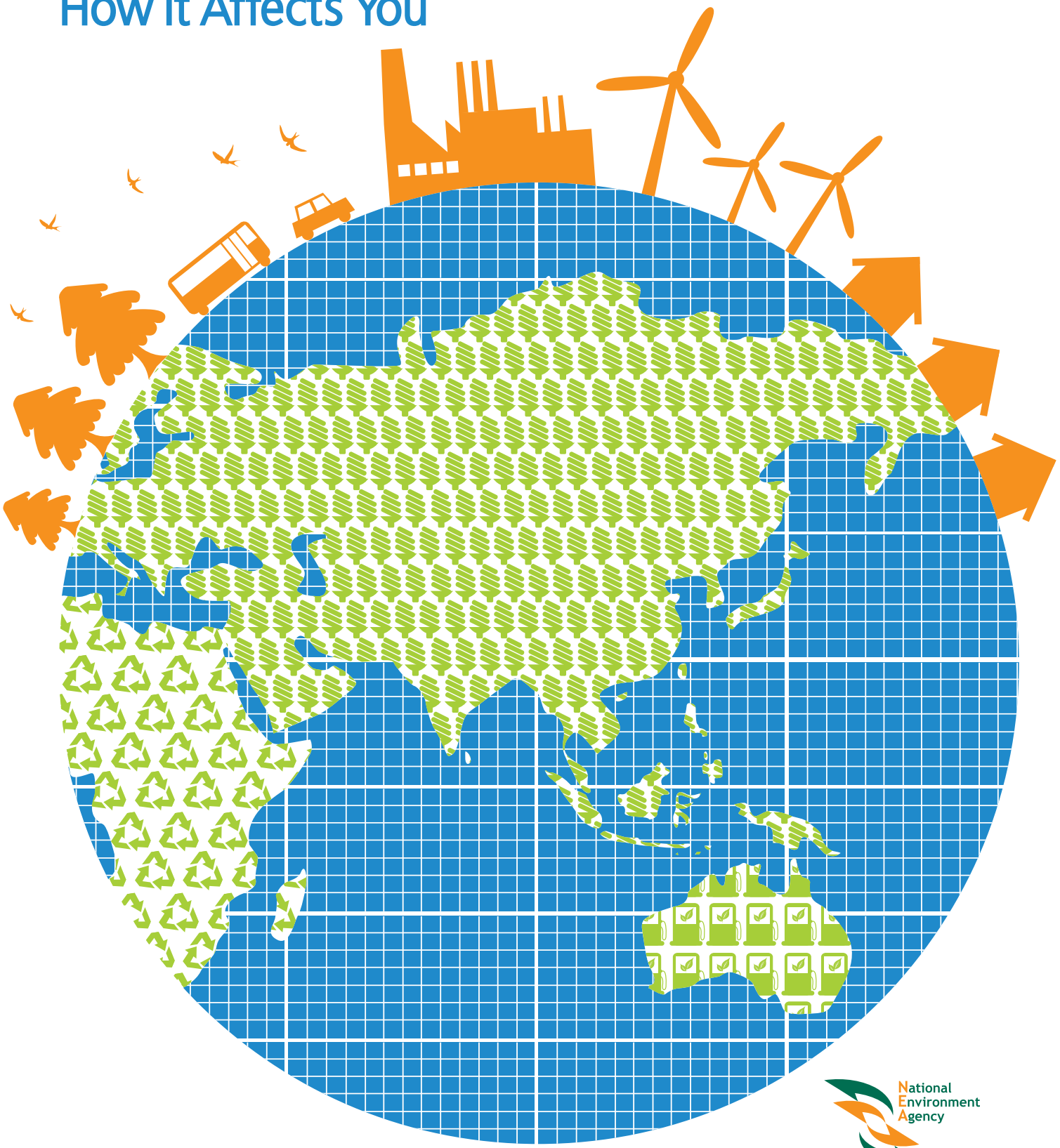
Climate Change

How It Affects You



National Environment Agency

Our Environment - Sustain and Enjoy

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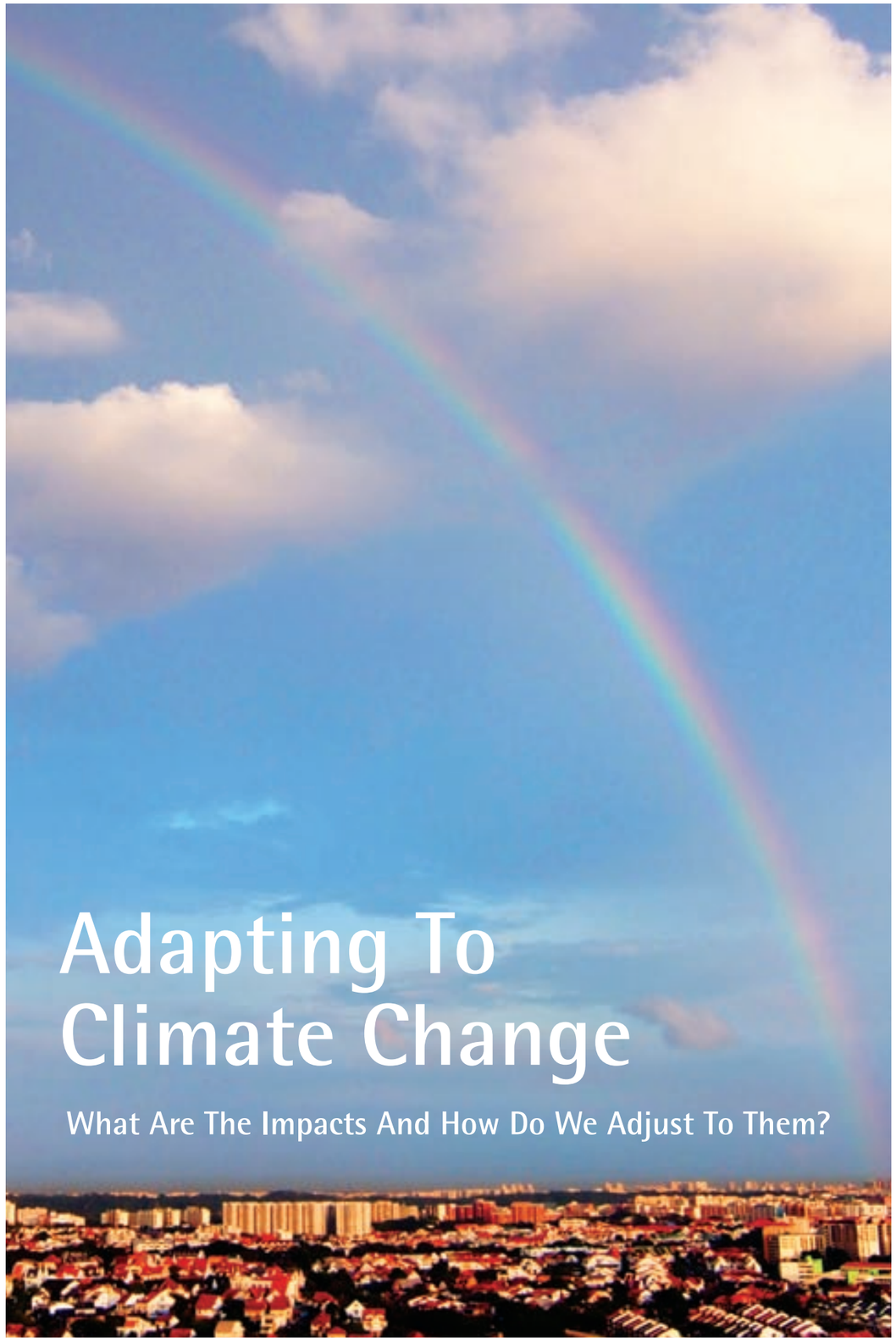


What Is Climate Change?

When someone comments on how hot or wet a day is, they are talking about weather events. The weather at any particular location can change significantly from day to day.

The climate of a location is the long-term average of the weather for that location. When the climate pattern for a location starts to change or becomes more variable, climate change has occurred.

Scientists and policy makers are concerned about such changes in climate patterns, as these could have serious implications on the well-being of both the natural environment as well as human life.

Is The Earth Really Getting Warmer?

From the observations of increases in global average surface temperatures kept since 1850, it is now evident that the Earth is getting warmer. In fact, eleven of the twelve years from 1995 to 2006 are ranked among the warmest years. The linear warming trend over the 50 years from 1956 to 2005 (of about 0.13°C per decade) is nearly twice that for the 100 years from 1906 to 2005[1].

Based on the 4th IPCC Assessment Report, global average surface temperatures could rise by between 1.1°C and 6.4°C by the end of the 21st century.

What Are The Possible Impacts?

A much warmer climate will create a very different world and one possibly less hospitable to human life. Higher temperatures will result in the thermal expansion of the sea and the melting of glaciers and ice caps, which are expected to lead to rising sea levels. Based on the 4th IPCC Assessment Report, the global mean sea level is projected to rise by 18 to 59 cm by the end of the 21st century.

Sungei Buloh Wetland Reserve

There will also be other possible effects of climate change, which can vary in severity from region to region. These include:

- Impact on water resources due to changes in rainfall and snowfall patterns
- More frequent and severe extreme weather events like heavy rainfall and dry spells
- Loss of biodiversity and natural ecosystems
- Increased risk of seawater inundation and erosion in coastal areas
- Greater pressure on infrastructure such as water supply and drainage systems and coastal protection
- Impact on public health, such as increased heat stress and the spread of some infectious diseases

[1] Source: IPCC 4th Assessment Report, 2007. The Intergovernmental Panel on Climate Change, or IPCC, is an international scientific body and is considered the world's leading authority for the assessment of climate change. The IPCC was set up by the World Meteorological Organisation and the United Nations Environment Programme.

What About Singapore? Have We Been Getting Warmer Too?

Trends in our local weather records are consistent with global observations of climate change. Since the 1970s, Singapore has experienced an average warming rate of 0.25°C per decade. In the Singapore Straits, tide gauge data show that the mean sea level has increased by about 3 mm per year over the last 15 to 17 years. However, long-term analysis of historical rainfall patterns does not indicate any significant trend as there has been a large natural variability in our annual rainfall from year to year.

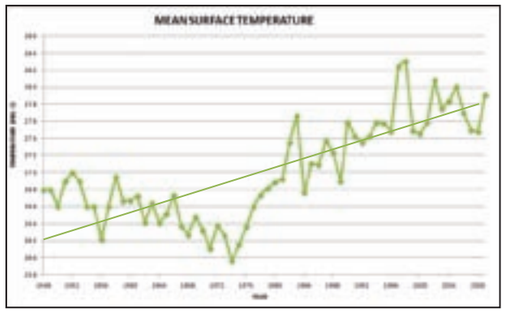


Fig 1: Mean surface temperature data collected from 1948 to 2009 at the Changi Meteorological Station

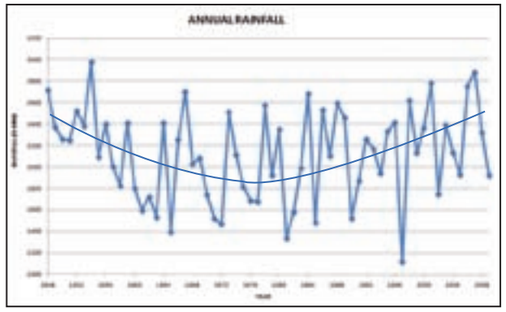


Fig 2: Total annual rainfall data collected from 1948 to 2009 at the Changi Meteorological Station

One of the meteorological stations used to track mean surface temperatures in Singapore

How Will Climate Change Affect Us In The Future?

An understanding of how Singapore might be affected by climate change in the future is important to determining what we need to do to adjust to these changes. With this in mind, an inter-agency technical group, led by the National Environment Agency (NEA), has commissioned the first nationwide Climate Change Study to look into the long-term effects of climate change on Singapore (see Box Story on page 6 for details of the study and challenges faced).

The findings, which are summarised in the table below, are consistent with the projections in the 4th IPCC Assessment Report (AR4).

Climate Change Projections (in 2100 relative to present)	IPCC AR4 Projections	Phase 1 Study Local Findings
Change in Average Temperature (°C)	+ 1.7 to + 4.4 (A1B Scenario, SE Asia)	+ 2.7 to + 4.2 (A1B Scenario)
Change in Rainfall (%)	- 2 to +15 (A1B Scenario, SE Asia)	No discernible trend. Further studies needed.
Change in Mean Sea Level (m)	+ 0.18 to + 0.59 (All IPCC Scenarios, Global)	+ 0.24 to + 0.65 (3 IPCC Scenarios)

The findings reflect the current understanding of climate change and state of climate science and modelling. The study did not find a discernible trend for rainfall projections. More studies will be needed to update the findings as climate science and models improve over time, and more information becomes available.

How was the Climate Change Study conducted?

The Climate Change Study builds on the work and findings of the IPCC's 4th Assessment Report and follows the IPCC's methodologies. The methodologies and computer models adopted for the Study were peer reviewed by a panel of international experts familiar with IPCC methodologies. This ensures that the methodologies used are in line with international best practices.

The Study consists of two phases:

Phase 1 of the Study was conducted by the Tropical Marine Science Institute of the National University of Singapore (NUS) in collaboration with international experts. This phase seeks to assess how climate change may affect Singapore up to the year 2100 and build up our local capabilities in climate change science. The effects investigated are primarily sea-level rise and changes in meteorological patterns such as temperature and rainfall.

Commissioned in October 2009, **Phase 2** is conducted by the A*STAR Institute of High Performance Computing in collaboration with researchers from NUS and other research institutes. It involves studies on the impacts of climate change on public health, biodiversity and energy demand.

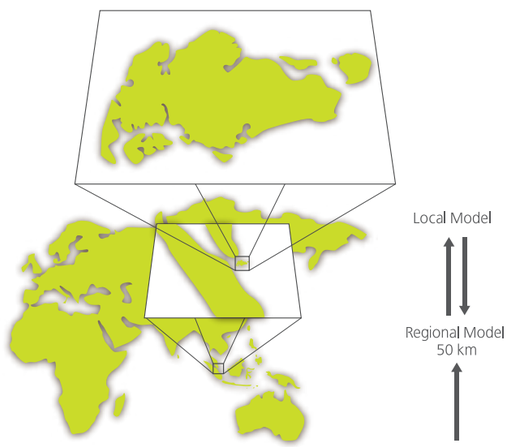
In the Study, projections for the years up to 2100 were computed based on three different IPCC emissions scenarios developed by the IPCC Special Report on Emissions Scenarios (SRES). The emissions scenarios are labelled based on their relative greenhouse gas emissions levels – High (SRES A2), Medium (SRES A1B) and Low (SRES B1). These three emissions scenarios were selected as sufficient data was available to enable meaningful computer model simulations. We will update these findings in tandem with future improvements of global climatic models and better understanding of climate science.

What are the Challenges in Projecting Climate Change for Singapore?

There is inevitably some scientific uncertainty associated with projecting the future climate. This uncertainty arises for a number of reasons. For example, there is natural inter-annual variability in global mean temperature and climate models can never be complete representations of our hugely complex climate system. As scientists increase our knowledge of the climate system, the degree of uncertainty will be reduced.

Global Climate Models (GCMs) make projections of the future global climate based on prescribed scenarios developed by the IPCC. The scenarios represent possible trends of greenhouse gas emissions in the future. The resolution of the GCMs is too coarse for the development of local adaptation measures for a country like Singapore. Hence, downscaling techniques are employed to project the future local climate based on the outputs of the GCMs. Such techniques may be either statistical-based (using statistical methods) or dynamical-based (using high-resolution regional climate models).

Modelling the climate system of Southeast Asia is a challenging task. For example, the journal *Scienc*e has reported that "none of the climate models assessed by the IPCC can simulate the observed monsoon rainfall and its inter-annual and decadal variability. It is not possible to simulate the mean monsoon rainfall and its variability or to make skilful seasonal predictions with existing climate models. One cannot expect the projections of regional climate changes to be reliable"[2] .



Downscaling method

[2] "Monsoon Mysteries", J Shukla, Science, 318, Oct 12, 2007

Is Singapore Ready To Adapt To The Potential Impacts Of Climate Change?

Singapore has taken a long-term approach to infrastructure planning and protection in order to support urban and economic growth. As a result, some measures are already in place that would address the potential impacts of climate change. Various agencies are also looking into additional measures that may be necessary as climatic models improve and global understanding of climate science evolves.

Keeping the City-State Cool

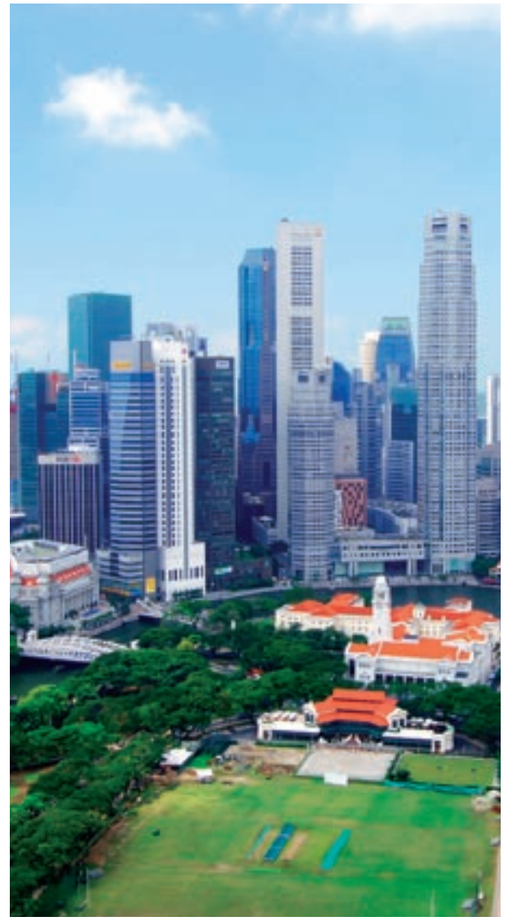
A warmer climate could lead to the greater use of air-conditioners and increase demand for energy. To help reduce the impact on energy demand, various agencies are implementing steps to make our buildings and urban development cooler and more energy efficient. These steps include encouraging environmentally friendly building designs and increasing green cover in urban areas to help cool the surroundings.

In January 2005, the Building and Construction Authority (BCA) introduced the Green Mark to recognise new buildings with environmentally friendly features. Under the Green Mark scheme, buildings are awarded Certified, Gold, GoldPlus or Platinum ratings based on a set of criteria including energy and water efficiency. Since April 2008, all new buildings and existing buildings undergoing major retrofitting with a gross floor area above 2000 m^2 must meet the Green Mark Certified standard. The BCA has also provided incentives to encourage building owners to aim for higher Green Mark standards for both new and existing buildings. The BCA has set a target for 80% of our existing buildings to achieve at least a Green Mark Certified Rating by 2030.

To encourage environmentally friendly designs at the planning stages of precinct/district developments, the BCA has launched the Green Mark District. This scheme is an extension of the BCA Green Mark for Buildings and aims to encourage holistic and integrated environmental friendly planning and design at the district level.

The Urban Redevelopment Authority (URA) and the National Parks Board (NParks) are working closely to extend our green cover island-wide, by opening new parks and green spaces and planting more vegetation along roads and around buildings.

Through its Community-in-Bloom programme, NParks has successfully nurtured the creation of more than 300 community gardens island-wide in residential estates, schools and workplaces. The URA and NParks have also been promoting rooftop and vertical greenery on residential and commercial buildings through planning guidelines and incentives. The Housing Development Board (HDB) is in the process of introducing rooftop greenery to multi-storey car parks and residential buildings.


Green spaces along roads and around buildings

Protecting Singapore's Coastline

Currently, about 70% to 80% of Singapore's coastline is protected from erosion by waves and storms by hard wall or stone embankments. The rest of the coast consists of natural areas such as beaches or mangroves.

Since 1991, all new reclamation projects have to be built to a level of 125 cm above the highest recorded tide level. This provides an adequate buffer against the projected sea level rise in the short and medium term. Moving forward, the Government is looking at adaptation measures to protect our foreshore and coastal areas against potential sea level rises. Existing revetments, which protect the coast against erosion, may have to be strengthened and reinforced, while natural areas may have to be protected using different coastal defence systems. As mangroves protect coasts against erosion, NParks is also studying methods to prevent the decline of these habitats in coastal areas.

In addition, active monitoring of sea levels around Singapore will provide data to guide adaptation planning. This will be done through the Singapore Satellite Positioning Reference Network (SiReNT), operated by the Singapore Land Authority (SLA). A system to monitor receding coastlines and provide an indication of the rate of rising sea levels through SiReNT is being tested.

SiReNT

Preserving Singapore's Biodiversity

NParks launched the National Biodiversity Strategy and Action Plan (NBSAP) in September 2009 to guide its nature conservation efforts in the long term. A key strategy under the NBSAP is to safeguard Singapore's biodiversity and to conserve Singapore's habitats and ecosystems for long-term sustainability. Healthy habitats and ecosystems, such as forests and coral reefs, can also help absorb and store carbon dioxide (CO_2).

NParks is also working with international experts to develop the Singapore Index on Cities' Biodiversity to evaluate and benchmark our biodiversity conservation efforts with those of other cities.

Mangrove forest

Coral reef at Semakau Landfill

Managing Our Water Resources

PUB, the national water agency, will continue to develop Singapore's water resources to ensure a sustainable water supply for the population and industry.

Apart from expanding local water catchments through the Marina, Punggol and Serangoon reservoirs, Singapore has developed alternative sources, namely seawater desalination and NEWater, which are not subject to changing weather conditions. PUB is researching further alternatives such as Variable Salinity Plant technology, which converts water of varying salinities into drinking water. This will potentially allow Singapore to collect water from smaller rivers that have not been tapped.

The Marina Barrage: A reservoir in the city

Built across the mouth of the Marina Channel, the Marina Barrage creates Singapore's 15th reservoir. Marina Reservoir has the largest and most urbanised water catchment area of 10,000 hectares, or about one-sixth the size of Singapore. Together with Punggol and Serangoon reservoirs, it will increase the water catchment areas from half to two-thirds of Singapore by 2011. Besides being a source of water, the Marina Barrage also serves as a flood management facility and a hotspot for recreational activities. As the water in the Marina Basin is unaffected by the tides, its water level will be kept constant all year round. This is ideal for all kinds of recreational activities such as boating, windsurfing, kayaking and dragon boating.

Marina Barrage

Managing Floods

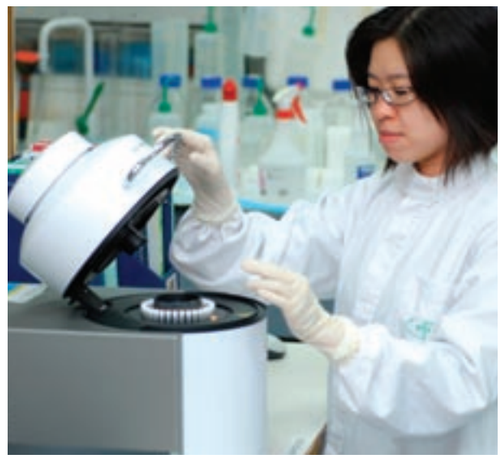
Singapore receives an average of 2400 mm rainfall annually, despite occasional dry spells. PUB has developed an extensive drainage infrastructure across the country that has reduced flood-prone areas by 97% over the last 30 years. PUB will continue to implement drainage improvement programmes to alleviate and prevent flooding in Singapore, and further reduce the flood-prone areas. Through its Active, Beautiful, Clean Waters (ABC Waters) programme, rain gardens are implemented where possible to help slow down the peak flow from rainfall and retain rainwater for a longer period in the catchment area.

High sea levels can aggravate inland flooding particularly during sudden storm surges. Since 1991, the PUB has required new reclamation projects to be built at least 125 cm above the highest recorded tide level. This provides an adequate buffer against the projected sea level rise in the short and medium term.

PUB, together with other agencies, will continue to monitor sea level and rainfall trends to develop appropriate responses to deal with future flooding risks.

Controlling Vector-Borne Diseases

Singapore is situated in the tropical region where vector-borne diseases such as dengue are endemic. During the warmer periods of the year, more dengue cases are observed. The NEA has implemented an integrated, evidence-based dengue control programme consisting of mosquito surveillance and control, enforcement, research, community outreach and public education to reduce dengue transmission in Singapore.



Tapping on research to better fight dengue

Mitigating Climate Change

How Can We Limit The Extent Of Climate Change?

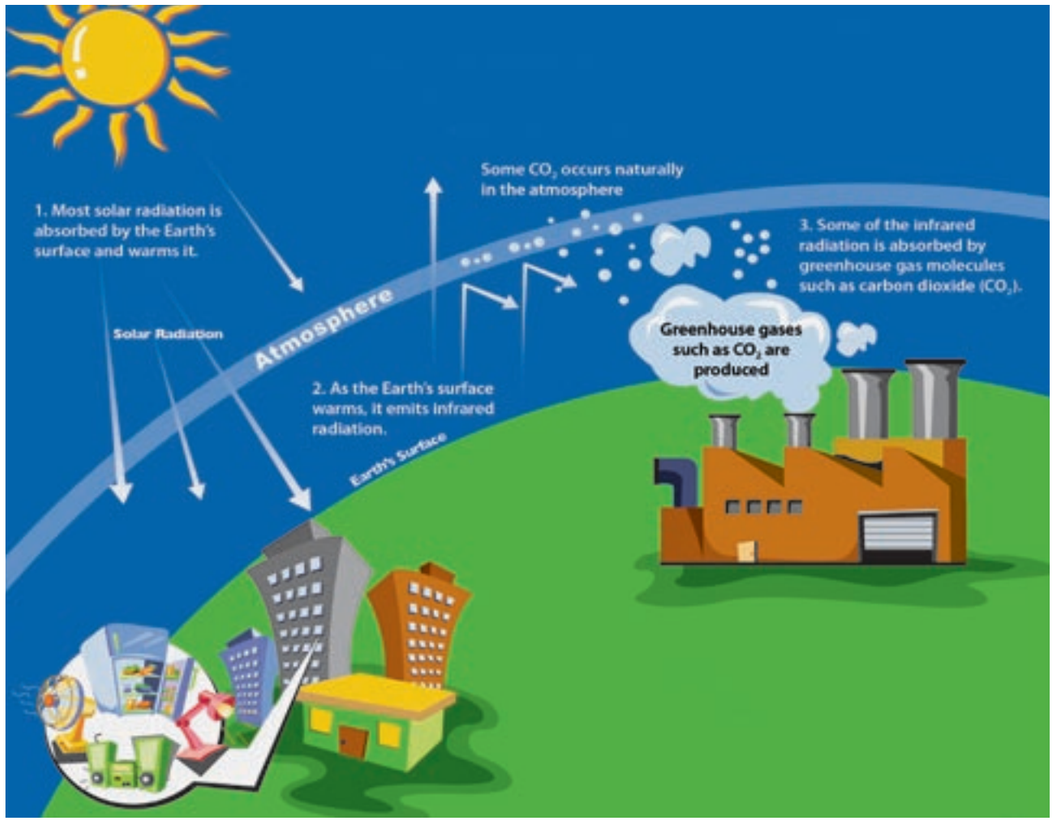
What Is Causing The Climate To Change?

> "Human activity -- particularly the burning of fossil fuels -- has made the blanket of greenhouse gases around the earth "thicker." The resulting increase in global temperatures is alterating the complex web of systems that allow life to thrive on earth, such as cloud cover, rainfall, wind patterns, ocean currents, and the distribution of plant and animal species."
>
> UNFCCC[3]

To Understand Why Our Planet is Heating Up, We Need to First Understand the Greenhouse Effect.

The Earth is warmed by energy from the Sun. Most of this energy is returned back into space. Greenhouse gases in the atmosphere help to absorb part of this returned energy, keeping the Earth warm enough for life to exist. Without this natural Greenhouse Effect, the global average temperature would be 33°C lower than what it is today[4].

What has happened over the last 100 years is that there has been a build up of greenhouse gases, especially carbon dioxide (CO_2), in the atmosphere. This increase in CO_2 levels has enhanced the Greenhouse Effect by trapping more heat within the atmosphere, contributing to a warmer planet.



[3] UNFCCC refers to United Nations Framework Convention on Climate Change
[4] Source: WMO Global Atmosphere Watch

What Is Causing This Build Up In Greenhouse Gases?

Scientists have identified human activities as the likely cause for this build up of greenhouse gases in the atmosphere, resulting in climate change. Activities of mankind such as the burning of fossil fuels in power stations to generate electricity, the use of petrol and diesel in vehicles etc, have released large amounts of CO_2 and other greenhouse gases into the air. Since the Industrial Revolution, widespread burning of fossil fuels has led to a rapid rise in CO_2 emissions, from 280 parts per million (ppm) in the late 18th century to 387 ppm in the first decade of the 21st century.

The largest growth in greenhouse gas emissions comes from the energy, industrial and transportation sectors. Energy generation accounts for more than a quarter of global greenhouse gas emissions from human activities, while industry accounts for about 19%. Forestry (including deforestation) and agriculture contribute 17% and 14% respectively. Transportation accounts for 13%, while emissions from residential and commercial buildings make up 8%. The remaining 3% comes from the waste and wastewater sectors (refer to Fig 3).

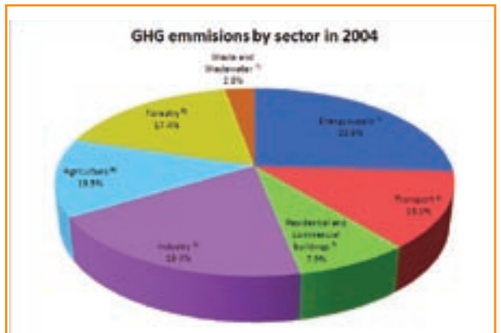


Fig 3: GHG emissions by sector in 2004 (source: AR4, IPCC)

Notes to Figure:

1) Excludes refineries, coke ovens etc., which are included in industry.
2) Includes international transport (bunkers), excludes fisheries. Excludes off-road agricultural and forestry vehicles and machinery.
3) Includes traditional biomass use.
4) Includes refineries, coke ovens etc.
5) Includes agricultural waste burning and savannah burning (non-CO_2). CO_2 emissions and/or removals from agricultural soils are not estimated in this database.
6) Data include CO_2 emissions from deforestation, CO_2 emissions from decay (decomposition) of above-ground biomass that remains after logging and deforestation, and CO_2 from peat fires and decay of drained peat soils.
7) Includes landfill CH_4, wastewater CH_4 and N_2O, and CO_2 from waste incineration (fossil carbon only).

At the same time, intense urban development and population growth have led to the widespread loss of natural habitats that trap and store CO_2. This has reduced the Earth's ability to remove CO_2 from the atmosphere, resulting in these greenhouse gases accumulating in the atmosphere over time.

If the world fails to take action to cut greenhouse gas emissions, atmospheric greenhouse gas concentrations are expected to increase to between 600 ppm and 1550 ppm[5] by 2100. To keep the increase in global temperature to less than 2°C above pre-industrial levels, a target recognised by global leaders under the Copenhagen Accord, atmospheric greenhouse gas concentration has to be kept below 450 ppm.

We need to take steps to reduce greenhouse gas emissions if we are to succeed in limiting the effects of climate change in the coming decades.

Are there any greenhouse gases, besides CO_2?

There are five other gases besides CO_2 identified as potent greenhouse gases. Two of these, methane (CH_4) and nitrous oxide (N_2O), are emitted mainly through agricultural activities and account for about 14% and 8% of global greenhouse gas emissions respectively. The other greenhouse gases are fluorinated gases, mainly emitted by industries and accounting for about 1% of greenhouse gas emissions. However, CO_2 is regarded as the key contributor to the Greenhouse Effect as it accounts for about 77% of global greenhouse gas emissions from human activities.

[5] A range of possible CO_2 concentrations is provided as changes in socio-economic conditions, demographics and technological improvements from the present to 2100 will affect the actual emissions of greenhouse gases.

How Is Singapore Contributing Towards International Action On Climate Change?

Singapore's greenhouse gas emissions account for less than 0.2% of the world's total. Combustion of fossil fuels for energy accounts for the bulk of emissions in Singapore.

As an alternative-energy disadvantaged country, Singapore lacks the natural endowments to make significant use of non-fossil alternatives such as hydropower, wind and geothermal energy. With only 700 km² of land area, Singapore also lacks the land for widespread deployment of renewable energy sources.

In addition, as an export-oriented economy, a large proportion of the energy consumed in Singapore is used for the manufacture of goods for the global market.

Furthermore, Singapore has expressed its intent to adopt a greenhouse gas emission reduction target of 16% below the 2020 business-as-usual scenario, as part of a global agreement on climate change in which all countries implement their targets in good faith. Our actions under the Sustainable Singapore Blueprint will contribute to this effort.

Energy Efficiency: Our Core Strategy

The Government has set out plans to transform Singapore into an energy smart nation and enhance our urban environment in the long term.

The Sustainable Singapore Blueprint identifies the challenges to Singapore's continued development in a sustainable manner and the policies and measures needed to address these challenges. A key challenge is the increasing need for scarce resources like energy and water. This has to be addressed by getting consumers and businesses to use resources such as energy, water and land in a more efficient manner. The Blueprint has set a goal of improving Singapore's energy intensity (energy consumed per dollar GDP) by 35% from 2005 levels by 2030.

To achieve this, the Government will implement measures such as:

- Pricing energy appropriately, based on sound market principles;
- Providing information on energy use and costs to consumers through schemes such as mandatory energy labelling for appliances and removing the most energy inefficient air-conditioners and refrigerators from the market through minimum energy performance standard;
- Encouraging greater adoption of energy efficient practices, processes and technologies in companies through incentives and standards;
- Promoting energy efficient building designs; and
- Encouraging increased use of public transport instead of private transport.

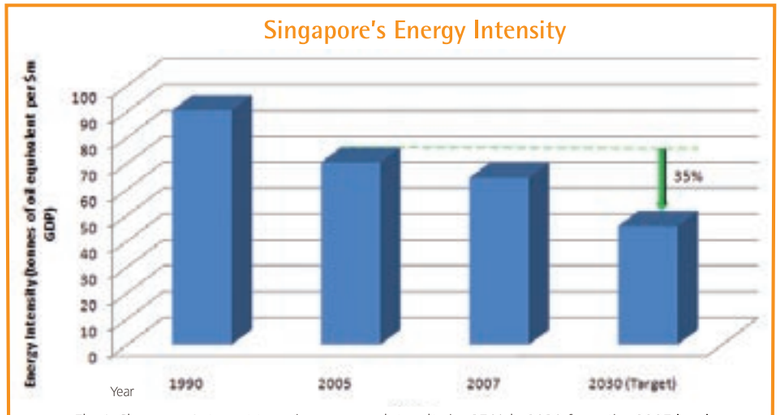
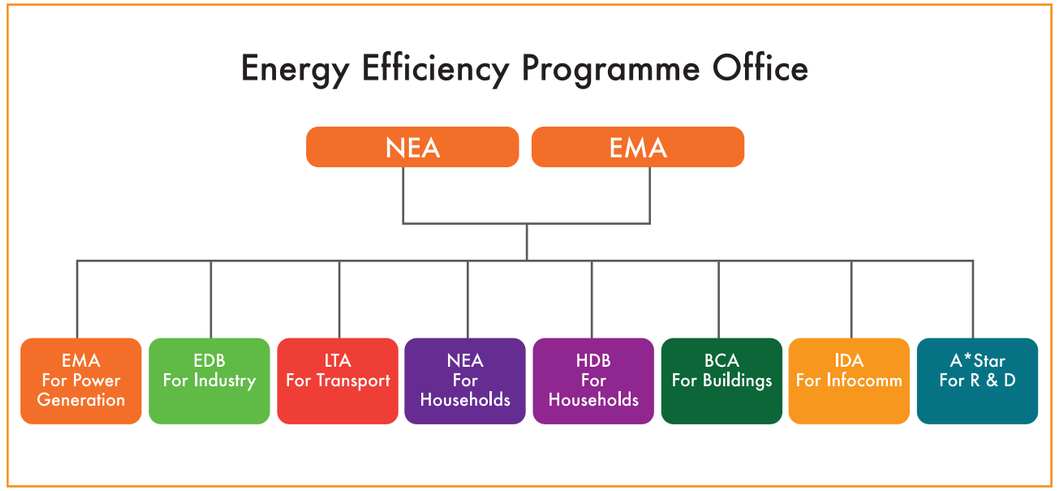


Fig 4: Singapore's target to reduce energy intensity by 35% in 2030 from the 2005 level.

Energy Label

In May 2007, the Energy Efficiency Programme Office (E²PO) was established to coordinate the Government's efforts to promote energy efficiency in all sectors of the economy: power generation, industry, transport, buildings, and households. The E²PO is a multi-agency committee led by the National Environment Agency and the Energy Market Authority, with representation from the relevant agencies responsible for driving energy efficiency in the various sectors of the economy.



PowerSeraya repowers to natural gas

Energy Supply in Singapore

In Singapore, the buying and selling of energy takes place in an open market. In a competitive market, power generation companies have the incentives to choose the most efficient technologies available to keep their operating costs low. This has led to a switch from fuel oil to natural gas, which now accounts for 79% of the electricity generated, from just 19% in 2000. Besides being more economical, natural gas helps to lower CO_2 emissions as natural gas-fired power stations emit 40% less CO_2 than fuel oil per unit of electricity generated.

The switch from fuel oil to natural gas, together with other energy efficiency measures, has helped to improve Singapore's energy intensity by 22% between 1990 and 2007. There is less potential for fuel switches to natural gas going forward and all sectors will have to look at other measures such as energy efficiency and adopting energy-saving habits.

What Can I Do To Help?

Every one of us has a part to play to address the challenges of climate change. We can do so by using energy, water and other resources wisely, and minimising wastage. Such actions also benefit us by reducing our utility bills.

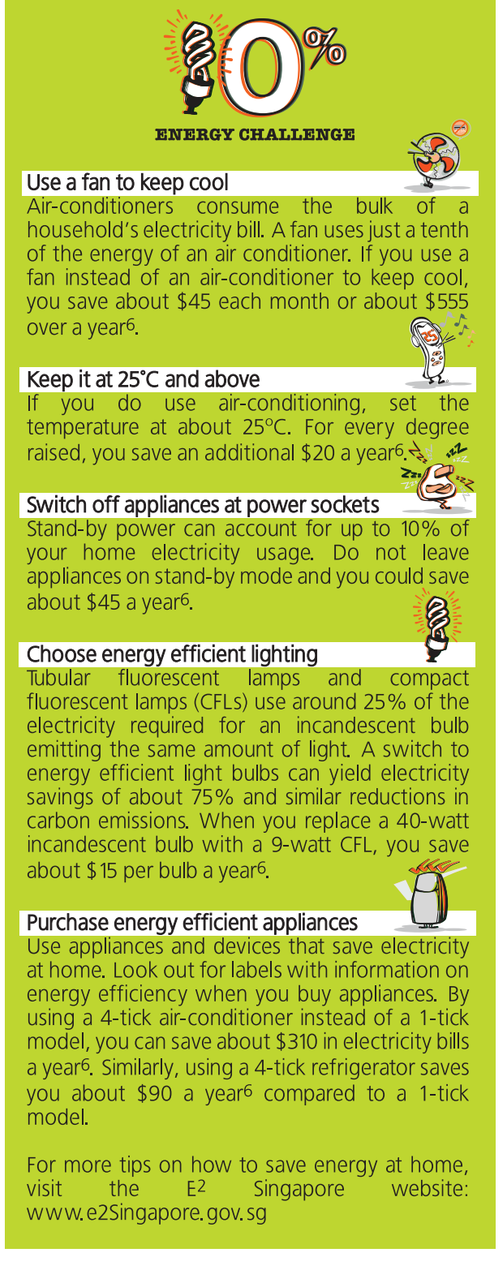
Switch off appliances at power sockets

Conserve Energy

Conserving energy does not mean changing your lifestyle drastically. You do not need to read under moonlight or take cold showers just to save electricity at home.

Energy conservation is about using energy in a smart way – using less energy to achieve the same results. Not only does it help to reduce carbon emissions, using less energy will also lower your energy bills.

To learn how you can reduce your home electricity consumption by 10% or even more, take up the 10% Energy Challenge.



Use a fan to keep cool

Air-conditioners consume the bulk of a household's electricity bill. A fan uses just a tenth of the energy of an air conditioner. If you use a fan instead of an air-conditioner to keep cool, you save about $45 each month or about $555 over a year[6].

Keep it at 25°C and above

If you do use air-conditioning, set the temperature at about 25°C. For every degree raised, you save an additional $20 a year[6].

Switch off appliances at power sockets

Stand-by power can account for up to 10% of your home electricity usage. Do not leave appliances on stand-by mode and you could save about $45 a year[6].

Choose energy efficient lighting

Tubular fluorescent lamps and compact fluorescent lamps (CFLs) use around 25% of the electricity required for an incandescent bulb emitting the same amount of light. A switch to energy efficient light bulbs can yield electricity savings of about 75% and similar reductions in carbon emissions. When you replace a 40-watt incandescent bulb with a 9-watt CFL, you save about $15 per bulb a year[6].

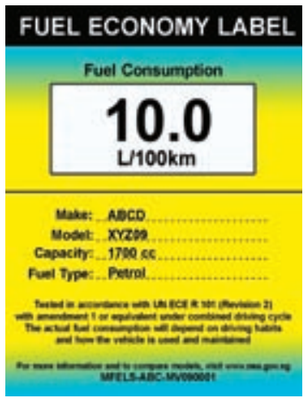
Purchase energy efficient appliances

Use appliances and devices that save electricity at home. Look out for labels with information on energy efficiency when you buy appliances. By using a 4-tick air-conditioner instead of a 1-tick model, you can save about $310 in electricity bills a year[6]. Similarly, using a 4-tick refrigerator saves you about $90 a year[6] compared to a 1-tick model.

For more tips on how to save energy at home, visit the E² Singapore website: www.e2Singapore.gov.sg

[6] Based on average 2009 electricity tariff of $0.2048 per kWh, assuming a single-split, 1000W air-conditioner, a 75W electric fan and 400-litre refrigerator used 365 days a year, and assuming 35W of stand-by power in a home.

Rebate is given to owners of green vehicles



Fuel Economy Label

Getting Around the Fuel Efficient Way

Take the MRT train or bus instead of driving if you can. You will help to reduce the amount of fossil fuels consumed and reduce not only CO_2 emissions, but also air pollutants. A car carrying just the driver uses about nine times the energy used by a bus, and 12 times that used by a train.

Buy a fuel-efficient car if you do have to own a car. Better still, buy a green car such as a hybrid model. You can enjoy a green vehicle rebate when you buy green vehicles. A car that can travel 14 km with 1 litre of petrol saves you about $1,200 a year compared to a car that runs at 10 km per litre.

Conserve Water

All of us have a part to play in ensuring that in Singapore there is enough water for our future. Look out for the Water Efficiency Label when you choose water devices. The more ticks, the more water-efficient the device. Energy is required to produce and treat water. When we choose a water-efficient product, you not only conserve water but also reduce energy use indirectly and save money in the long run.

By making simple changes in your daily routine, such as taking shorter showers, running your washing machine on full load, repairing leaks promptly and monitoring your family's water consumption closely, you can save 10 litres of water a day. To find out more about water conservation tips (the 10-Litre Challenge), visit www.tenlitres.sec.org.sg. You can also call PUB's 24-hour call centre at 1800 284 6600 for a free water saving kit.

Minimise Waste Generation

Reuse items wherever you can and recycle waste such as paper, plastic bottles, glass bottles and packaging. The 3R habit of Reduce, Reuse and Recycle helps not only to conserve resources but also saves energy, hence reducing CO_2 emissions.

Spread the Word

Encourage your friends and neighbours to do the right thing, that is, be environmentally friendly in their day-to-day habits. Consider joining environmental programmes organised by your local Community Development Council, the National Environment Agency and various non-government organisations.

You can be eco-friendly in the office too. Find out how you can create an eco office at Project Eco-Office (www.ecooffice.com.sg), a joint initiative between the Singapore Environment Council (SEC) and City Developments Limited (CDL).

Water Efficiency Label

Going Forward

The science of climate change is an evolving and complex subject. The science has improved considerably over the last few decades, but there are still some natural processes that are not well understood, such as the melting of the ice sheets and effects of clouds on climate. Coupled with the natural variability of weather patterns, this has resulted in significant uncertainty about the magnitude of the projected climatic changes.

There is also difficulty in projecting climate change in the long term. Policies and measures adopted over decades may have a large impact on the long-term stabilisation levels of atmospheric greenhouse gases. Technological advances and the rate and method of socioeconomic development of various countries will also influence the amount of greenhouse gases emitted. All these factors will affect the actual magnitude of future climate change.

The IPCC has started work on the preparation of its 5th Assessment Report (AR5). In the meantime, the Singapore Government will continue to build up its capabilities in climate science and keep up with developments in climate science and modelling to improve our understanding and knowledge of this important field. Singapore also collaborates with renowned international institutions to increase our knowledge base and technical expertise in climate change.

Government agencies will work closely together to monitor the likely effects of climate change on life in Singapore. There will be regular reviews of the sufficiency of Singapore's existing adaptation measures. And should they be required, the Government will identify new measures to address the consequences of climate change and manage their impact to ensure that Singapore enjoys a sustainable future in and beyond the 21st century.

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