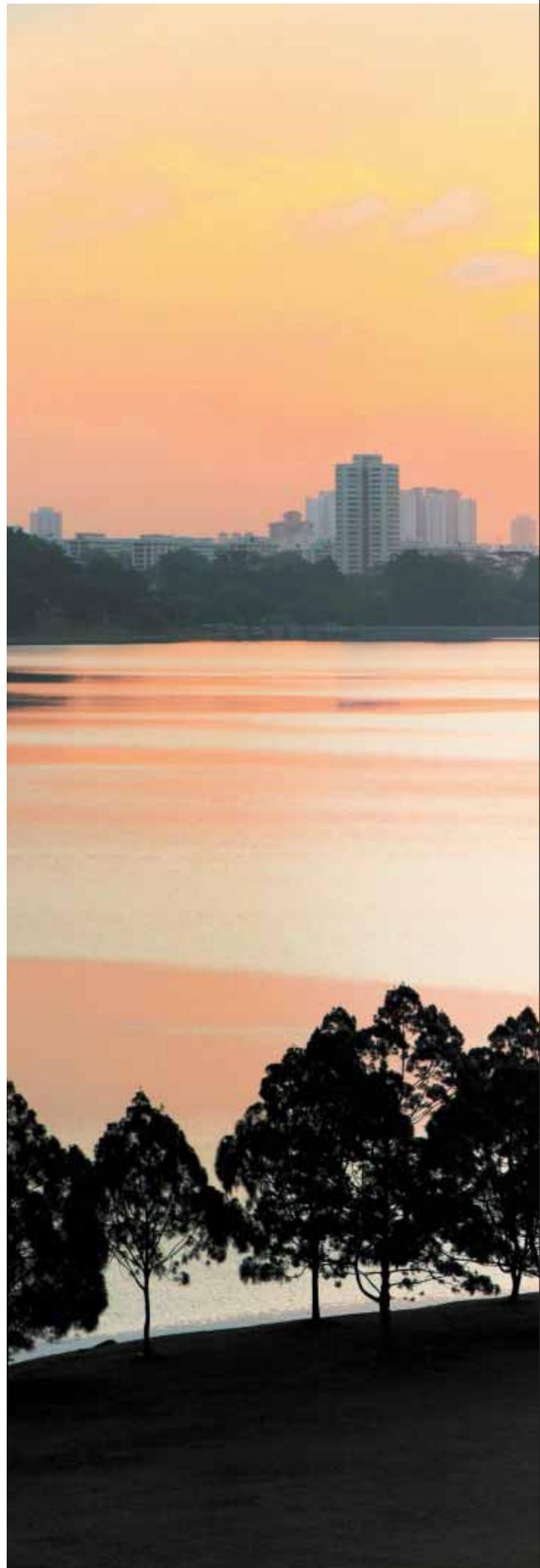


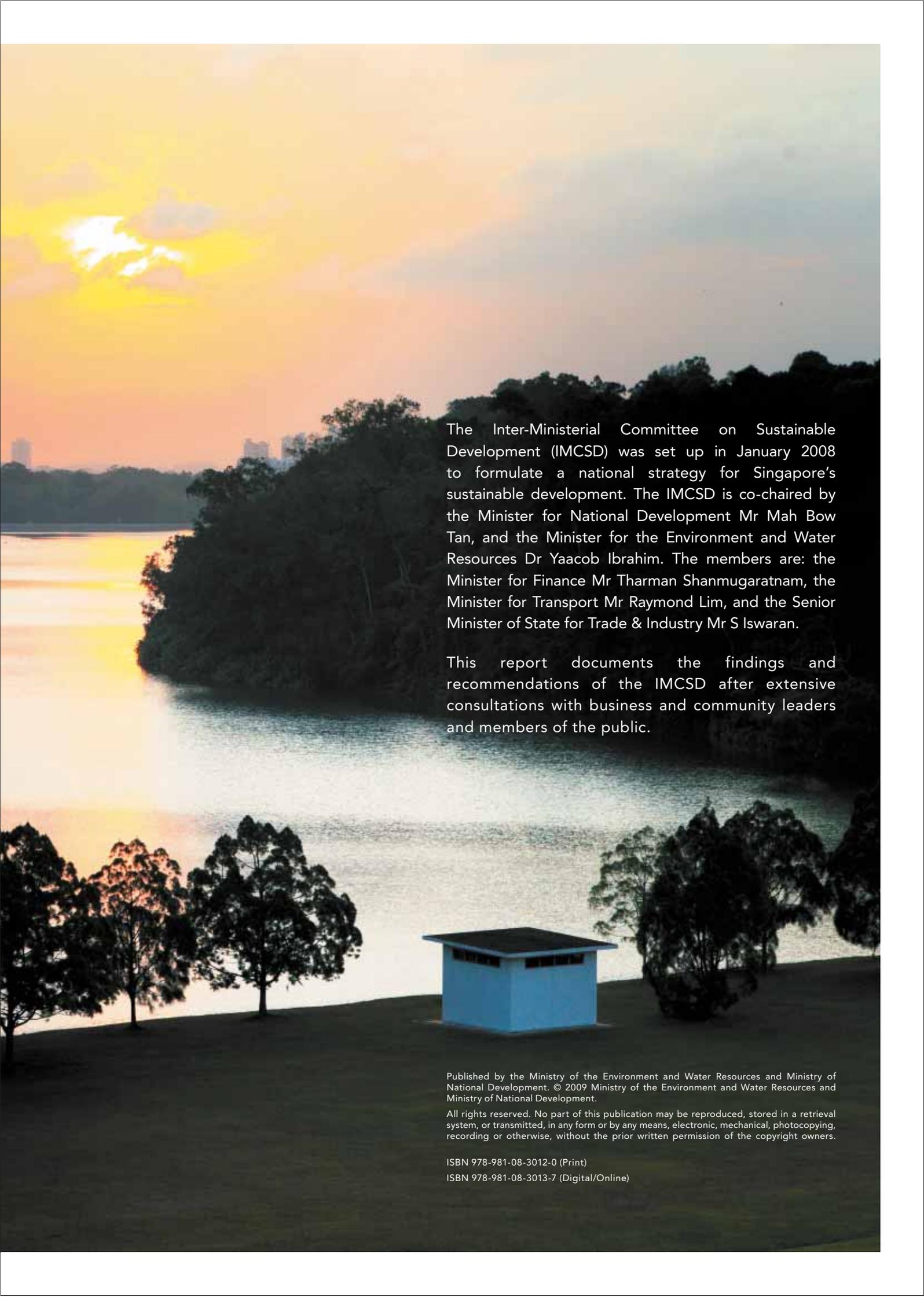
**A LIVELY AND LIVEABLE SINGAPORE:**  
STRATEGIES FOR SUSTAINABLE GROWTH



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The Inter-Ministerial Committee on Sustainable Development (IMCSD) was set up in January 2008 to formulate a national strategy for Singapore's sustainable development. The IMCSD is co-chaired by the Minister for National Development Mr Mah Bow Tan, and the Minister for the Environment and Water Resources Dr Yaacob Ibrahim. The members are: the Minister for Finance Mr Tharman Shanmugaratnam, the Minister for Transport Mr Raymond Lim, and the Senior Minister of State for Trade & Industry Mr S Iswaran.

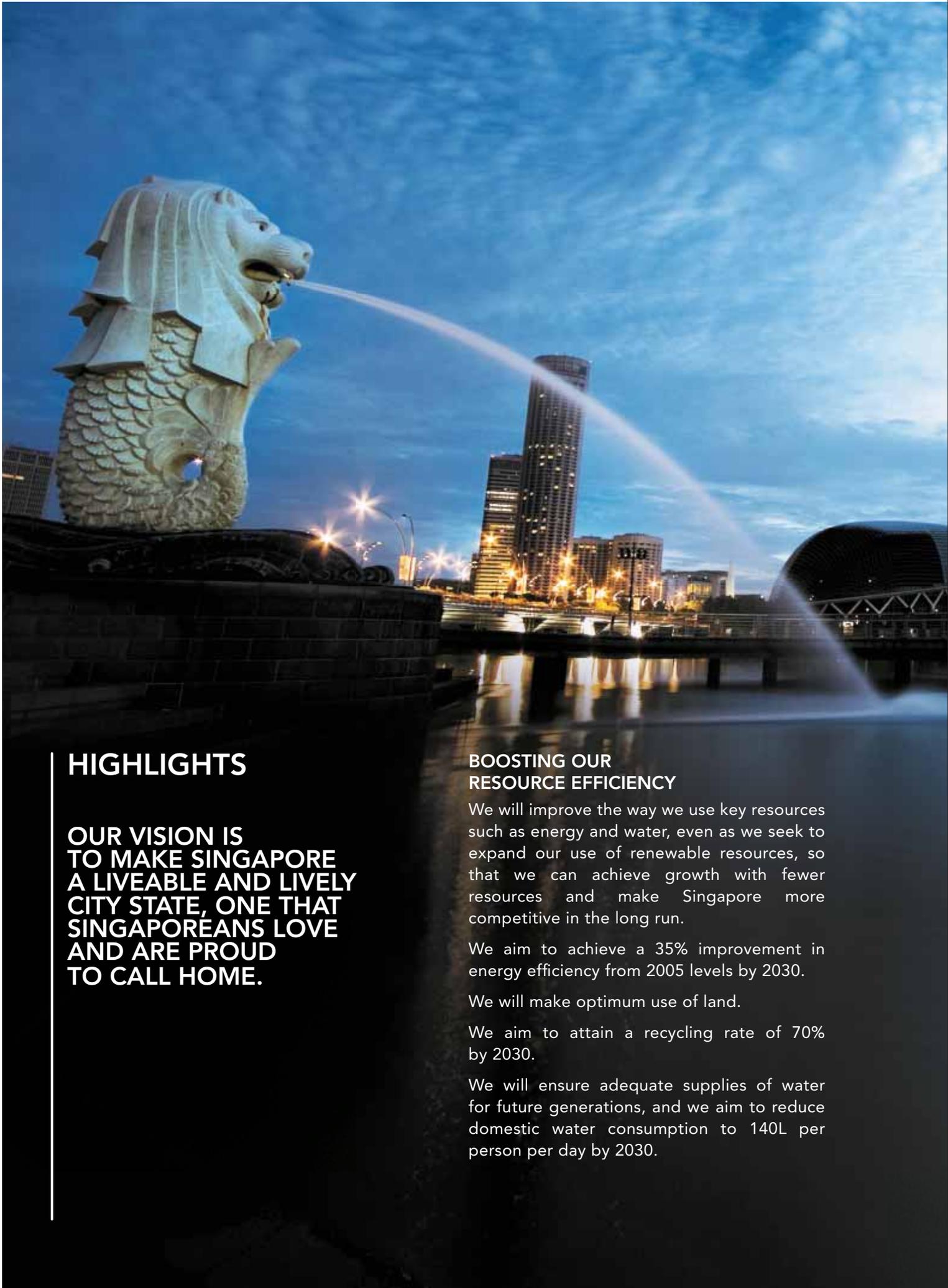
This report documents the findings and recommendations of the IMCSD after extensive consultations with business and community leaders and members of the public.

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## HIGHLIGHTS

**OUR VISION IS TO MAKE SINGAPORE A LIVEABLE AND LIVELY CITY STATE, ONE THAT SINGAPOREANS LOVE AND ARE PROUD TO CALL HOME.**

### **BOOSTING OUR RESOURCE EFFICIENCY**

We will improve the way we use key resources such as energy and water, even as we seek to expand our use of renewable resources, so that we can achieve growth with fewer resources and make Singapore more competitive in the long run.

We aim to achieve a 35% improvement in energy efficiency from 2005 levels by 2030.

We will make optimum use of land.

We aim to attain a recycling rate of 70% by 2030.

We will ensure adequate supplies of water for future generations, and we aim to reduce domestic water consumption to 140L per person per day by 2030.



## **ENHANCING OUR URBAN ENVIRONMENT**

Our aim is to become a top city in Asia in terms of quality of life. Singapore will develop as a sustainable, high-density city that is clean and green, with excellent connectivity and a sense of space.

We aim to reduce the level of fine particles in the air (PM<sub>2.5</sub>) to 12µg/m<sup>3</sup> and cap Sulphur Dioxide (SO<sub>2</sub>) levels at 15µg/m<sup>3</sup> by 2020, and maintain the same levels up to 2030.

We aim to have 0.8ha of green space for every 1,000 persons and increase greenery in high-rise buildings to 50ha by 2030.

We aim to open up 900ha of reservoirs and 100km of waterways for recreational activities by 2030.

We aim to improve accessibility for pedestrians and cyclists and have 70% of all journeys made via public transport.

## **BUILDING CAPABILITIES**

We will invest in building new capabilities and testing new technologies to help us overcome our resource limitations, improve environmental performance and spur economic growth. As we build up our knowledge in how to grow in a more environmentally-friendly way, Singapore can work with others to promote and build sustainable cities around the world.

## **FOSTERING COMMUNITY ACTION**

We will encourage community ownership and participation in building a clean, green and resource-efficient Singapore. Our goal is to make environmental responsibility part of our people and business culture, in the way we live, work, play and commute.



8 April 2009

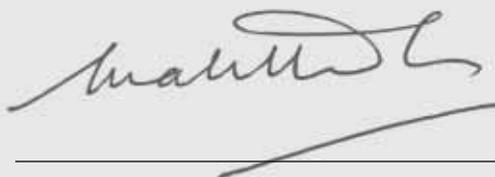
Prime Minister

## **REPORT OF THE INTER-MINISTERIAL COMMITTEE ON SUSTAINABLE DEVELOPMENT**

1. In January 2008, you set up the Inter-Ministerial Committee on Sustainable Development (IMCSD) to develop a national framework and key strategies for Singapore's sustainable development.
2. Sustainable development for Singapore is about achieving development while minimising its impact on resources and our environmental quality, such that development today does not come at the expense of the quality of the living environment for current and future generations. Looking ahead, we are aware that population and economic growth could strain our domestic resources and impact our environmental quality if we are not vigilant. We also need to be able to respond to growing global resource scarcity and do more as a responsible global citizen to combat the challenges posed by climate change.
3. The IMCSD therefore identifies the following four strategies to ensure Singapore's continued sustainable development. First, to improve resource efficiency in energy, water and waste management so that we will be more cost competitive and efficient in the long run. Second, to enhance our physical environment through controlling pollution, increasing our greenery as well as cleaning and beautifying our water bodies. Third, to engage the community and encourage them to play their part by adopting more responsible practices, habits and lifestyles. Fourth, to build up our technologies and capabilities in order to realise our sustainable development targets, spur economic growth and export our expertise.
4. The IMCSD has now completed its work and submits its findings and recommendations in this Blueprint. We are confident that the recommendations will help Singapore achieve a higher level of environmental sustainability over time. This will provide our current and future generations with a cleaner and greener environment to live in, and yield concrete benefits to businesses and households in terms of cost savings from resource efficiency.
5. This Blueprint reflects our common aspiration for an economically vibrant yet liveable Singapore. It sets clear goals to measure our performance in sustainable development, and outlines a set of actionable strategies and plans to make our development more environmentally sustainable in the next decade. The collective and sustained efforts of the people, public and private sectors to

change the way we live, work, play and commute will be key to achieving the goals. Hence this Blueprint marks the beginning of a closer 3P (People sector, Private sector and Public sector) partnership for sustainable development.

6. We wish to record our gratitude to all those who have contributed time and effort to make this Blueprint possible. This includes the many members of the public and leaders from non-governmental organisations, businesses, grassroots organisations, academia, media as well as CDC Mayors whom we have met. In total, we met more than 700 people in various focus group discussions and received over 1,300 suggestions from the public. We have also been ably supported by officials in various Ministries and Statutory Boards.
7. We also thank you for entrusting us with this task of ensuring that we and future generations have a lively and liveable Singapore to live, work and play in.



Mr Mah Bow Tan (Co-Chairman)



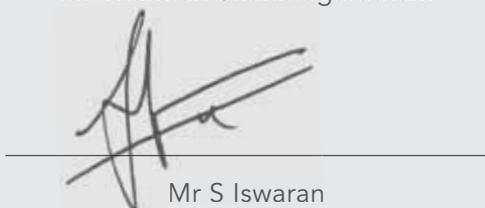
Dr Yaacob Ibrahim (Co-Chairman)



Mr Tharman Shanmugaratnam



Mr Raymond Lim



Mr S Iswaran

*Prime Minister  
Singapore*

9 April 2009

**Mr Mah Bow Tan**

Minister for National Development

Co-Chairman, Inter-Ministerial Committee on Sustainable Development

**Dr Yaacob Ibrahim**

Minister for the Environment and Water Resources

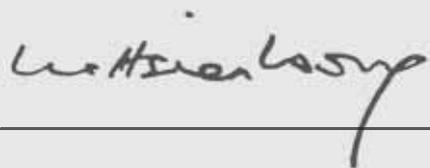
Co-Chairman, Inter-Ministerial Committee on Sustainable Development

## **REPORT OF THE INTER-MINISTERIAL COMMITTEE ON SUSTAINABLE DEVELOPMENT**

1. Thank you for your letter of 8 April 2009, submitting the report of the Inter-Ministerial Committee on sustainable development.
2. Sustainable development means achieving the twin goals of growing the economy and protecting the environment, in a balanced way. Singapore has practised sustainable development even before the term was coined. We pursue growth in order to have the means to improve our lives. We also safeguard our living and natural environment, because we do not want our material well-being to come at the expense of our public health or overall quality of life.
3. Singapore is a small island with finite space, limited water supplies and no natural resources. Yet, we have overcome our constraints, grown and developed into a modern city. Through imaginative city design, careful planning and judicious land use, we have housed close to five million people in a clean and green city, with one of the best urban environments in the world.
4. We must build on this to do even better, and preserve our high quality of life for our children.
5. This is a challenging goal. As our economy and population continue growing, our city will become denser. As Asian economies take off, they will consume and demand more energy and raw materials, and push up their prices worldwide. From a global perspective, Singapore's needs are very small. But we still need to secure our access to resources and do our best to conserve energy and water. This is especially so as Singapore has few alternatives to fossil fuels. Climate change is a serious long-term problem for mankind. As a responsible member

of the international community, we must do our part in global efforts to address climate change and reduce greenhouse emissions.

6. Sustainable development demands long term attention and effort. Some measures will incur disproportionate costs and impair our competitiveness. We have to adopt a pragmatic approach, find the most cost-effective solutions and pace the implementation appropriately so that we do not hurt our economy. We should also invest in capability building and R&D, to take advantage of new technologies that facilitate sustainable development. Your Committee has developed a blueprint to guide our efforts. It will not be the last word on these issues, but it will take us a significant step forward.
7. This issue concerns not just one or two ministries, but the whole country. Hence we will tackle it using a whole-of-government approach. The people and private sectors also have to work with the public service on this important venture.
8. I thank all your Committee members, as well as the many organisations and individuals who contributed to the report. I am encouraged that so many came forward with their ideas and suggestions. It shows that Singaporeans take an active interest in making Singapore a better place to live in. As we continue to remake our nation to become more vibrant and liveable, what matters is not just new hardware and infrastructure of our city, but also the character and spirit of our people. All Singaporeans should play a part in this transformation, and build a Singapore that we can proudly call our home.



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01

EXECUTIVE SUMMARY –  
SINGAPORE: A LIVELY,  
LIVEABLE, AND  
WELL-LOVED HOME



# 01

## EXECUTIVE SUMMARY – SINGAPORE: A LIVELY, LIVEABLE, AND WELL-LOVED HOME



From the start, Singapore saw itself as a Garden City. Having independence thrust upon us unexpectedly, we had first to develop our economy and provide jobs for the people. Yet, we also knew that we could not focus only on economic growth. Even though the term “sustainable development” was not widely used then, we knew that we had to make the most of our scarce resources and attain a good quality living environment in this compact city state.

Therefore, we planned our land use wisely. We set up strict pollution controls to keep the air and waters clean, even as we urgently wooed new industries. We carried out a massive exercise to green our city and clean up our rivers. The result is today’s Singapore: business-focused and investor-friendly, yet clean and green.

But Singapore cannot stand still. We are in a continual race to attract investments and talents against stiff global competition. A thriving economy, able to provide ample good jobs for its people, is our starting point. But we have to continue to minimise the impact of growth on the environment and to use resources efficiently. We want to build Singapore into one of the most liveable cities in Asia – clean, green, safe and efficient, for Singaporeans now and in the future.

Our vision is to make Singapore a liveable and lively city state, one that Singaporeans love and are proud to call home.

This is our blueprint to realise this vision. It contains the strategies and initiatives we believe are needed for Singapore to achieve both economic growth and a good living environment over the next two decades. The government will, actively and imaginatively, draw up policies, regulations and incentives to promote this. However, for us to succeed, our business leaders, our community leaders and our people, have to share a common vision, and work together to bring about changes needed in our households, our communities, our businesses and our country. Ultimately, Singapore will be our best home if each one of us has contributed to its development, and together shaped a sustainable city that reflects our shared aspirations and our values as a society.

## THE CHALLENGES AHEAD

Singapore imports most of the food and water we consume, as well as the resources and materials needed for our industries. We

have to be plugged into the global system of trade and communications. Challenges facing the world, from the present financial crisis to the looming threat of climate change, have a greater impact on a small island such as ours. Singapore will have to join hands with others – countries, cities, communities – to address these global challenges.

We will face even bigger challenges in the future. These are:

### Managing the Demands of a Growing City

The growth of our city will put more pressure on our limited land, water and energy resources. Our city will also have to be more densely built as our economy grows and our population expands. It will be more and more challenging to ensure that economic growth does not come at a high environmental price: depriving us of the clean air, water and land we have worked for over the years.

### Adapting to Growing Resource Constraints

As cities across the world grow, the global demand for and cost of energy, food, and construction materials will also rise. As a resource scarce country, Singapore needs to use non-renewable resources like oil and gas more efficiently if we want to remain competitive and keep up economic growth. Even with renewable resources, such as water, we need to use them wisely and ensure that there will be sufficient supply for future generations. For Singapore, sustainable development means learning to achieve more with less.

## Mitigating Climate Change

Today, few doubt that global warming is a reality and human actions are contributing to it. It is clear that the way the world produces and uses resources is straining the planet's environment, leading to rising temperatures and sea levels, and falling ice and snow cover. To secure our collective long-term future, we need decisive action from all countries, including Singapore.

## THE SINGAPORE WAY

For Singapore, sustainable development means achieving both a more dynamic economy and a better quality living environment, for Singaporeans now and in the future.

We need the economy to grow. This creates jobs, raises our standard of living, and yields the resources that we need to safeguard our environment. But we must grow in a sustainable way, or else a high GDP per capita will be achieved at the expense of our overall quality of life, and cannot be maintained over the longer term. Protecting our environment safeguards a high standard of public health for our people, and makes our city attractive to Singaporeans and foreigners alike.

We have to achieve these twin economic and environmental objectives in a balanced way.

The world now faces a major economic crisis. But this should not cause us to lose sight of the long-term need to pursue these twin objectives. Indeed, the crisis presents us with both the challenge and the opportunity to boost our resource efficiency. If we succeed, we would

have helped to secure our future, by making our economy leaner and more competitive when the global economy recovers.

We will keep to our "Singapore Way" of pursuing long-term economic growth and environmental sustainability, by upholding the following principles:

- **Long-Term, Integrated Planning:** We will align our policies – from energy to transport to industry and urban planning – and take a long-term and complete view of our needs and circumstances. Indeed, this ability to plan and act in unison towards the overall goal of sustainable growth is one of our key strengths.
- **Pragmatic and Cost-Effective Manner:** We have to secure our twin goals of promoting economic growth and a good environment in the most cost-effective way. We must constantly ask ourselves "what works", and we will not shy away from long-term measures that are necessary, even if they entail short-term costs. But we will pace the implementation of these measures and provide help to temper and soften the short-term costs to businesses and individuals.
- **Flexibility:** The challenges to maintain economic growth and a good environment will span many decades. We therefore have to remain nimble, and adjust flexibly to changes in technology and in the global environment. We will invest in building our capabilities today to give us more options to better respond to the challenges of tomorrow.



Energy efficiency is a key priority

## DELIVERING: OUR STRATEGIES AND INITIATIVES

Implementing these principles and delivering on our vision for Singapore as a city which is liveable, lively and well-loved by its citizens and visitors alike, calls for much effort, imagination, and commitment.

We have a four-pronged strategy: boosting our resource efficiency, enhancing our urban environment, building our capabilities, and fostering community action.

### 1. Boosting Our Resource Efficiency

As Singapore has to import most of its resource needs, we have to ensure that we are making the most of what we use, always aiming to do more with less. Over the next two decades, we

will substantially improve our efficiency in using energy, water, and land.

Singapore does not have viable sources of renewable energy (such as wind, geothermal or hydropower). We will therefore have to focus on raising efficiency, aiming for a 35% improvement in energy efficiency from 2005 levels by 2030.

We will make optimum use of land, and seek to reach a recycling rate of 70 per cent by 2030.

We will also ensure adequate supplies of water for future generations, and we aim to reduce domestic water consumption to 140L per person per day by 2030.

Specific measures to deliver on these goals include:

- **Pricing energy appropriately:** We will continue to price energy according to sound

market principles, to make sure there is no waste and over-use. In addition, we will look at setting energy prices to reflect the environmental impact of energy-production and to further encourage conservation.

- **Providing information for better decisions:**

We will make more information on energy use, costs and benchmarks available to firms and consumers so that they can manage their usage and reduce waste. This can include mandating energy labelling and minimum performance standards for key electrical appliances, and setting energy performance benchmarks for industrial processes.

- **Boosting energy-efficient industry designs, processes and technologies:**

We will provide financial incentives and set new standards to promote more investment in energy-efficient technologies, designs and industrial processes. We will encourage industries to adopt good energy management systems to enhance their efficiency. In the longer term, we will study whether to set minimum energy performance standards for various types of industrial equipment and processes.

- **Building capabilities in renewable energy:**

In tropical Singapore, solar energy is now the most promising renewable energy source. We will invest early in solar technology test-bedding projects to prepare to use solar technology on a larger scale when the cost of solar energy falls closer to that of conventional energy.

- **Promoting resource-efficient buildings:**

We aim to have 80% of our existing buildings achieve at least a Green Mark Certification rating by 2030. For new buildings within

strategic districts, a higher rating of Green Mark Gold<sup>Plus</sup>/Platinum will be a condition for the land sales. We will also seek to improve the energy efficiency of public housing estates by 30% for mature HDB estates and 20% for new estates by introducing energy-saving devices.

- **Promoting public transport:**

We aim to have a 70:30 ratio between public and private transport journeys made during morning peak hours by 2020. The Land Transport Authority (LTA)'s Masterplan spells out the ways to do this. We will also refine private vehicle ownership and usage policies, and introduce new technologies for public transport.

- **Expanding our water supply:**

We will expand our water catchment areas from half to two-thirds of Singapore's land area, develop new fringe catchments, tap on more used water, and strive to raise recycling yields. We will build a trans-island pipeline network to link up our NEWater plants with demand areas.

- **Improving our water efficiency:**

We aim to reduce domestic water consumption to 140L per person per day by 2030, down from 156L in 2008, through promoting water-saving habits and appliances. We will promote water-efficient buildings and the use of water-efficient devices and process designs within industries. This includes promoting water monitoring and management systems in commercial and industrial premises. We will also mandate water-efficiency labelling for water fittings. Where feasible, industries will be encouraged to implement water recycling and replace potable water with NEWater or seawater.



Integrating greenery and waterways into the new Jurong Lake District



The Henderson Wave bridge is part of the Southern Ridges treetop walk

- **Minimising waste upstream:** We will engage industry to find ways to reduce packaging materials through the voluntary Singapore Packaging Agreement. We will provide co-funding to help companies redesign processes to reduce waste in their production.
- **Facilitating household recycling:** We will increase recycling facilities in housing areas. We will pilot the use of separate chutes for recyclables in more housing estates.
- **Targeting major sources of waste:** We will promote the recycling of large sources of waste that now have low recycling rates, such as plastic and food waste. In the longer term, we will study the feasibility of mandating the recycling of such waste.
- **Expanding our land resource:** Apart from reclaiming more land and building more intensively, Singapore will also develop an underground land use master plan that identifies potential uses for this space.

- **Enhancing land use planning:** The Urban Redevelopment Authority (URA) will further refine its urban land use planning framework and develop Marina Bay and Jurong Lake District into a new generation of sustainable high-density districts.

## 2. Enhancing Our Urban Environment

Our hard-earned clean and green environment has improved the quality of life for our people, and has made Singapore more attractive to investors and visitors. We will make further efforts to enhance public cleanliness, improve air quality, integrate greenery and waterways into the cityscape, conserve our natural biodiversity, and preserve a sense of space and comfort in a high-density city.

We aim to reduce Particulate Matter (PM) 2.5 levels to  $12\mu\text{g}/\text{m}^3$  and cap Sulphur Dioxide ( $\text{SO}_2$ ) levels at  $15\mu\text{g}/\text{m}^3$  by 2020, and maintain the same levels up to 2030.

We aim to have 0.8ha of green space for every 1,000 persons and increase greenery in high-rise buildings to 50ha by 2030.

We aim to open up 900ha of reservoirs and 100km of waterways for recreational activities by 2030.

We aim to improve walkways and cycling infrastructure for pedestrians and cyclists and have 70% of morning peak hour journeys made via public transport.

We will do this by:

- **Reviewing air emission standards.** We will regularly review emission standards for industry and transport to keep our air quality good. We will benchmark ourselves against top cities in Asia, but also ensure our standards do not impose prohibitive costs on industry.
- **Adopting new technologies:** As industry and transport are major sources of air pollutants, LTA will test if new technologies such as diesel hybrid vehicles, electric vehicles and diesel particle filters are feasible and cost-effective. The government will promote the use of more efficient pollution control equipment for industries, and the use of more efficient sulphur recovery systems for refineries.



Seamless connectivity between bus and rail

- **Pricing pollution:** In the longer term, the government will consider using financial measures to better reflect the social cost of pollution from vehicles in order to discourage excessive use of vehicles and encourage more people to use cleaner vehicles.
- **Improving water quality in our waterways and reservoirs:** PUB, the national water agency, will take steps to ensure that our streams, canals and reservoirs remain clean. We will protect our water sources from pollution caused by leaking sewers, soil and silt erosion, as well as the discharge of used water into drains. We will do this by repairing and upgrading old sewers, and working with construction contractors to promote better site management and housekeeping.
- **Making our city cleaner:** We will enhance public education and step up enforcement against littering. We will also clean public areas more often and better. Efforts to curb littering will also keep our waterways clean.
- **Improving transport links:** We will continue to improve our public transport system to make it a viable alternative to the car. LTA will make it easier for people to walk or cycle to key transport hubs, such as MRT stations and bus interchanges, or to get around towns.
- **Enhancing our greenery:** As Singapore becomes more built up, we will do more to enhance the sense of space, greenery and comfort for our people. We will have new parks, park connectors and new leisure options. The government will work with various agencies to research cost-effective ways of introducing more greenery in high-rise areas, and give incentives to the private sector to do so.



Solar pilot project in our public housing estates

- **Opening up our blue spaces:** The PUB will expand its Active, Beautiful and Clean Waters programme, to transform Singapore’s reservoirs, canals and drains into beautiful lakes, rivers and streams that can support more water-based activities.
- **Conserving urban biodiversity:** Singapore has already managed to keep a rich biodiversity alongside a vibrant economy in a compact and densely populated city. The National Parks Board will implement a new National Biodiversity Strategy and Action Plan to document and conserve this biodiversity in Singapore.

### 3. Building Our Capabilities

We have successfully achieved both economic growth and environmental sustainability over the years. Singapore is now well placed to

serve as a living laboratory for companies and research organisations to research, develop and test their ideas on environmental sustainability in a high-density urban setting. Singapore will build new environmental and technological capabilities so that we can be a global centre for knowledge and ideas on sustainable development in a high-density urban setting. This will lead to new businesses, products and services which the world needs to adopt a more sustainable lifestyle.

In line with this, we will:

- **Invest in R&D:** The government will test-bed new technologies in many areas (land use planning, water technologies, vertical greenery, solar adoption and green building) together with the private sector and academia – and adapt them to our local needs. We will also encourage more research in our local universities and test-bed new technologies



Community recycling drive organised by the South West Community Development Council

within key public projects, such as at Marina Bay, Punggol new town and Jalan Bahar CleanTech Park.

- **Facilitate international sharing of knowledge:** We have established the Centre for Liveable Cities to promote the sharing of best practices between Singapore and other cities. Singapore will host events such as the World Cities Summit and the Singapore International Water Week to promote sustainable development among cities.

#### 4. Fostering Community Action

However, to build a sustainable economy and environment, we need the support of the community itself. Community, business leaders, and non-government organisations, should

promote an environmentally responsible lifestyle through their everyday decisions and actions. Schools will also have to inculcate this consciousness in our young, and communities will have to care for our environment on an ongoing basis. We will facilitate this by:

- **Promoting community efforts:** Community groups and non-government organisations are critical in engaging and educating the public on how to adopt a more eco-friendly lifestyle. The Community Development Councils have pledged to reach out to their residents through their programmes. Organisations within the people sector can also form partnerships (such as between environmental groups and grassroots organisations or educational institutions) to promote environmental awareness and action.

- **Promoting industrial efficiency:** Businesses can promote resource efficiency as part of their productivity movements, and adopt new processes and systems to reduce the environmental impact of their operations.
- **Setting the pace:** The public sector will act as an enabler and pace-setter. It will take the lead to make government agencies and public buildings more resource efficient.

## A SUSTAINABLE SINGAPORE

This report is the result of extensive consultations with business and community leaders and members of the public, to develop a common vision for a sustainable Singapore. Realising this vision will call for all Singaporeans to each play his or her part.

The government will lead by example through its policies and actions. It will provide more information for consumers to make more well-informed decisions, address market failures through financial incentives and disincentives,

set minimum standards and put in place laws to promote sustainable development. It has committed \$1 billion to be spent over the next five years to achieve the goals outlined in this blueprint.

Companies will need to develop and deploy cleaner technologies. Businesses should incorporate environmental considerations into their operations, from production to consumption and disposal. Families have to embrace a responsible, environmentally friendly lifestyle.

Working together, we can keep Singapore economically and environmentally sustainable well into the future. We will overcome our natural constraints and geographical confines, and cooperate with other countries on global environmental problems, particularly the growing pressures that development is putting on our planet. By doing so, we can build a Singapore that we, and future generations, will cherish and be justifiably proud to call home.





**02**

**SUSTAINABLE  
DEVELOPMENT –  
“THE SINGAPORE WAY”**

# 02

## SUSTAINABLE DEVELOPMENT – “THE SINGAPORE WAY”



Singapore is a city but also a state. We have to locate our homes, offices, industries, public infrastructure and parks all within only 700 square kilometres of land. With one of the highest population densities in the world, we have to plan the growth of our city carefully to ensure that we can continue to grow the economy and provide a good environment for Singaporeans now and for the future.

## THE SINGAPORE WAY

Singapore will continue to follow three key principles in our development.

### Long-Term, Integrated Planning

We will continue to plan our land use and infrastructure needs over the horizon of a few decades. We will also continue to consider environmental, economic and social objectives holistically when we plan.

### Pragmatic, Cost-effective Approach

We pursue growth and a good environment together, not one at the expense of the other. We need economic growth to provide good jobs for our people and to give us the means to build a liveable city. Yet we do not pursue this growth at all costs. We also put in place stringent environmental regulations and a process to plan and manage land use to guide our development. In addition, we invest in environmental infrastructure and consistently clean our waterways and green our city.

We try to select the most cost-effective method to achieve these sustainable development goals. But we will adopt measures that may incur costs in the short-term, if these measures help us achieve our goals in the long-term.

### Flexibility

We are not rigid in our approach, and will adapt our policies and measures over time as our circumstances change.

Some technologies may be very costly today so we will not implement them in a big way now.

However, technology will improve over time, and one day, these technologies could help us achieve more and at a lower cost. Therefore, we will continue to selectively test leading edge technologies now so that we have the expertise to implement them on a larger scale in the future when they become cost effective.

## WHAT WE HAVE DONE SO FAR

Forty years ago, Singapore faced overcrowding in the city, poor living conditions and a severe lack of infrastructure. Today, Singapore is home to close to 5 million people. We have enough water and energy to meet our industrial, commercial and residential needs. There is an integrated public transport system with smooth-flowing roads. Our residents live in a vibrant city with clean air, lush greenery and flowing waterways for all to enjoy.

This transformation did not come about by chance. It was achieved through a multi-pronged effort to guide development, and with the broad support of people and businesses.

### Land Use Planning

Our holistic approach to development starts with land use planning.

The Concept Plan is Singapore's long-term strategic land use and transportation plan. It guides Singapore's development over a timeframe of a few decades. Agencies involved in economic, social, environmental and infrastructural development jointly drew up this Plan and review it every ten years. This approach allows us to weigh different

development objectives and ensure that we have enough land to support future economic and population growth, as well as to retain a high quality living environment. The first Concept Plan was developed in 1971 and guided the development of key infrastructure projects such as the Singapore Changi International Airport as well as the Mass Rapid Transit System (MRT).

The Master Plan translates the broad, long-term strategies of the Concept Plan into detailed plans. It guides Singapore's development in the medium-term, over a period of 10 to 15 years. The Urban Redevelopment Authority (URA) reviews the Master Plan once every 5 years in consultation with the stakeholders in the people, public and private sectors.

The URA follows a few principles in land use planning to ensure that Singapore can continue to grow despite its small size:

- Develop a compact city to conserve land and optimise the provision of infrastructure.
- Promote the use of public transport by providing an extensive rail network and intensifying land use around rail stations.
- Decentralise commercial centres to reduce the need to travel and reduce peak hour traffic congestion caused by traffic flowing in and out of the city centre.
- Provide a quality living environment by offering a wide variety of housing choices and comprehensive amenities within each new town to serve residents' needs.
- Retain Singapore's natural and built heritage by safeguarding Nature Reserves and Nature Areas and selectively conserving buildings with outstanding architecture and historical significance.

## Pollution Control

Singapore has clear and rigorous environmental regulations and city planning guidelines to manage pollution from industries and minimise the negative impact on the quality of life in Singapore. For instance, we locate heavy industries mainly in Jurong Island and Tuas, as far away from residential areas as possible. We also allow a proposed industrial development only if it can comply with pollution control standards and if it can safely dispose of the waste it generates. We complement these standards with strict monitoring and enforcement.

Singapore also has a comprehensive approach to controlling water pollution. First, we control pollution at source. PUB, Singapore's national water agency, repairs and upgrades old sewers to prevent them from leaking and contaminating our waters. PUB also works with contractors to make sure their construction sites do not discharge silt into drains, and educates industrial and commercial operators on proper housekeeping so that their factories and shops do not pollute our waters. In addition, it installs float-booms and gratings to prevent litter from entering the main waterways.

Second, PUB improves the flow of water in our reservoirs and waterways to improve water quality and promote aquatic life. It has a system to circulate the waters in the main tributaries within the Marina Catchment to reduce algae and odours caused by stagnant water. PUB will also implement systems to keep the water in reservoirs well mixed and aerated.

Third, through public education programmes, PUB encourages the public to play an active role in caring for our waterways and reservoirs and keeping them clean.



Singapore taps on high quality recycled water called "NEWater" to expand its water supply

## Water Management

By 2011, about two-thirds of Singapore's land area will be used as water catchment, to collect and store rain water. However, Singapore's small land area means that our catchment size is ultimately limited. Hence, we "recycle" water to meet our needs.

We produce NEWater by purifying treated used water using cutting-edge membrane filtration technologies, to make water that is exceptionally clean and safe to drink. In fact, NEWater is greatly demanded by non-domestic customers, such as wafer fabrication plants, that require highly purified water. By 2011, with the completion of our fifth plant at

Changi, NEWater will be able to meet up to 30% of Singapore's total water needs, up from the current 15%.

In addition to water from local catchments, imported water and NEWater, Singapore has introduced desalination to turn seawater into fresh, drinking water.

Singapore also has high standards of sanitation and used water management. Singapore is 100% seweraged and we have invested in a Deep Tunnel Sewerage System (DTSS) to meet our long-term needs. The DTSS also helps in the large-scale collection of used water for recycling into high grade NEWater.



Non-incinerable waste and ash from waste incineration are disposed offshore at the Semakau landfill

## Waste Management

Singapore has developed an integrated waste management system that collects and disposes of waste effectively.

We collect refuse daily from homes to ensure a high standard of public cleanliness and hygiene. We incinerate all waste that can be burnt, in efficient waste-to-energy plants which meet stringent emission standards. This allows us to save on land needed for landfill, and also meet 2% to 3% of Singapore's electricity needs.

We use our only landfill, the Semakau landfill, to dispose of the ash from waste incineration as well as non-incinerable waste like construction debris. Semakau landfill is located at sea, about 8km from mainland Singapore. The landfill is expected to last 40 years at the current rate of usage,

and will become part of our future land-stock when completely filled. During its construction, we made efforts to conserve biodiversity. As a result, there is a rich variety of flora and fauna on the island. Semakau Landfill was even lauded in *New Scientist* in April 2007 as the "Garbage of Eden" – a showcase of an environmentally friendly system of waste management.

To reduce the need for incineration and landfill, we have promoted recycling and the reduction of waste. Under the National Recycling Programme (NRP), we provide centralised recycling bins and the door-to-door collection of recyclables every fortnight in public housing and private landed housing estates. The National Environment Agency (NEA) has also launched a voluntary Singapore Packaging Agreement to reduce packaging waste, starting with the food and beverage industry. This will be gradually extended to other industries.

## Energy Policy

Singapore does not subsidise energy so as not to encourage over-consumption. Instead, we restructured the electricity industry to introduce greater market competition. This has encouraged the industry to look for innovative solutions and use new technologies to generate power more efficiently. As a result of competition, electricity is increasingly produced from natural gas-fired combined cycle power plants, as these are more efficient and cost-effective than oil-fired steam plants.

The government has also launched the national energy efficiency plan, E<sup>2</sup> Singapore, to encourage industry, buildings, transport and households to use energy more efficiently. The plan includes initiatives to raise public awareness of energy efficiency, to promote energy saving technologies and systems, and to set standards for household appliances which use a lot of energy.

## Transport Management

Singapore plans for sufficient transport capacity as it develops. As we have limited land for roads, we locate commercial activities closer to homes, and build self-contained residential communities to reduce the need to travel. We have also invested in a comprehensive and robust public transport system.

Singapore was the first in the world to charge cars for driving into the city when we introduced the Area Licensing Scheme (ALS) in 1975 to reduce traffic congestion in the city. The scheme was then extended to major expressways with the Road Pricing Scheme (RPS). In 1998, the Electronic Road Pricing (ERP) system replaced the manual ALS and RPS. Under the ERP system,



Singapore was the first in the world to introduce congestion charging in the city in 1975, which evolved into the current Electronic Road Pricing system

motorists pay each time they drive into a congestion prone area. The ERP also allows us to vary charges according to traffic conditions. In this way, we can reduce traffic congestion and optimise the use of our roads by spreading traffic across the network. The Vehicle Quota System (VQS), introduced in 1990, also helps to regulate the increase in the number of vehicles.

## City Greening

From our early days of nation building, we set out to build Singapore into a Garden City.

We set aside land for parks and built park connectors to link our parks and nature areas. We have also conserved unique areas of biodiversity and selected nature areas.

## Noise Management

In such a densely built-up city like Singapore, some noise is inevitable since construction work and traffic flow take place close to homes. However, we have measures to ensure that noise levels remain acceptable to safeguard our quality of life.

For instance, NEA enforces noise limits to control how much noise construction sites can make. To reduce the impact of traffic noise, we ensure a minimum distance from buildings to major roads and MRT tracks. We also set limits on noise from the exhaust of individual vehicles. Our noise limits are reviewed regularly, taking into account feedback from the public and industry, as well as international best practice.

## WHERE WE ARE TODAY

### High Quality Living Environment

Singapore has a vibrant, attractive, safe and liveable environment for our people, and we are gaining international recognition for this. Mercer Human Resource Consulting ranked Singapore 1<sup>st</sup> in Asia and 8<sup>th</sup> in the Asia Pacific region in terms of quality of life, in their 2007/2008 Quality of Living Survey. Singapore also gained positive exposure in international magazine rankings of liveable cities, like Monocle Magazine's yearly ranking of liveable cities, and Ethisphere's 2020 Global Sustainability Centres.

### Clean Air

Singapore's air quality compares well with major cities, with our PSI<sup>1</sup> being in the "good" range for 96% of the days in 2008. We achieved this

despite being a small and densely-populated city-state with clusters of heavy industry.

### Sustainable Water Resources

In four decades, Singapore overcame water shortages despite the lack of natural water resources. We now have four different sources, our "Four National Taps", to provide us with a stable and sustainable water supply. These are water from local catchment areas, imported water, NEWater and desalinated water.

Singapore's achievements in integrated water management and NEWater have won us numerous international accolades, including the renowned Stockholm Industry Water Awards in 2007.

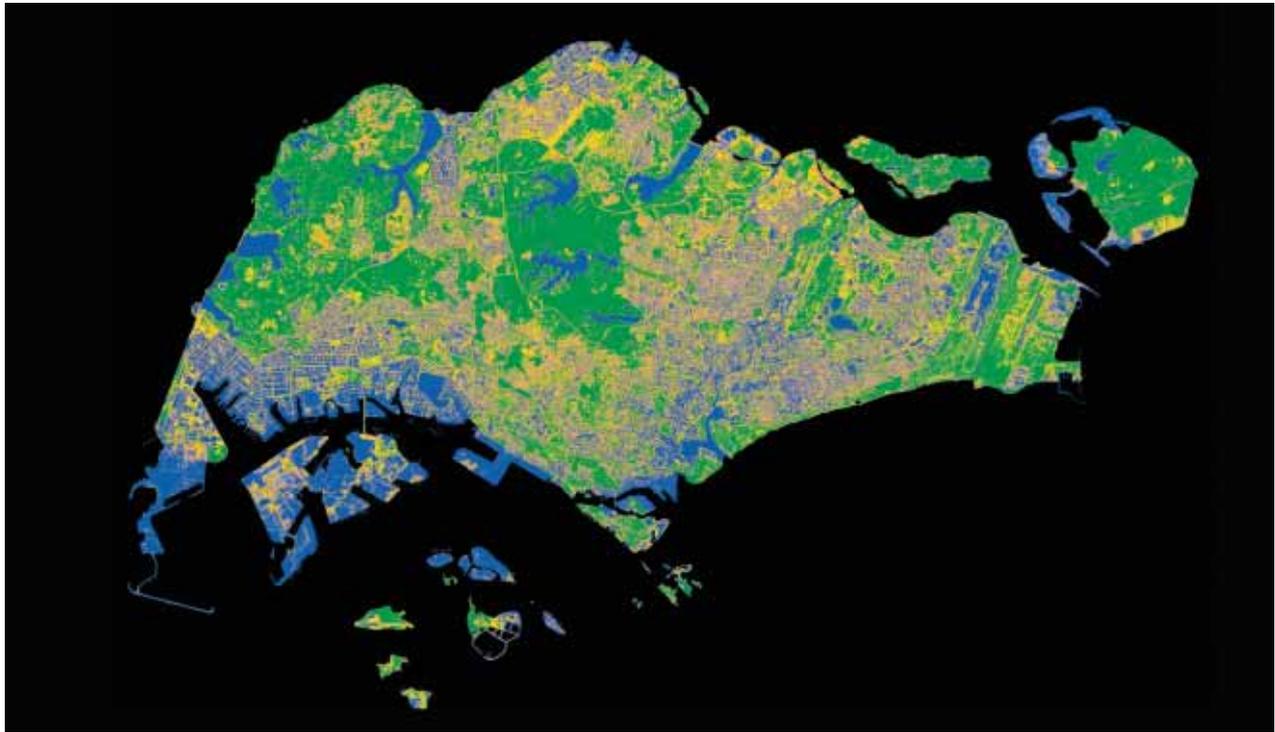
### Waste

Over the last decade, Singapore's domestic waste disposed per capita has been falling despite continued growth. We reached a recycling rate of 56% in 2008. However, we can further increase recycling, especially for waste streams with low recycling rates such as food and plastic wastes.

### Energy

Singapore's energy intensity, or energy consumption per dollar GDP, improved by 15% between 1990 and 2005. Between 2000 and 2007, electricity produced by natural gas increased from 19% to 79% of the total

<sup>1</sup> The Pollutant Standards Index (PSI) was developed by the United States Environmental Protection Agency (USEPA). It takes into account the ambient concentrations of key air pollutants and translates them into an overall index ranging from 0 to 500. PSI levels of 0 to 50 are considered good, and levels from 51 to 100 are moderate. Index levels above 100 are considered unhealthy.



Between 1986 and 2007, the green cover in Singapore grew from 36% to 47% despite a 68% growth in population

electricity produced, and overall generation efficiency rose from 37% to 44%.

## Transport

Despite being the world's second most densely-populated country, our city's transport system is consistently ranked among one of the top three in the world<sup>2</sup>, with 71% of journeys being completed under an hour.

## Greenery / Urban Biodiversity

10% of Singapore's land is committed as green space, of which about half are gazetted nature reserves. If we add to this our extensive roadside greenery and island-wide Park Connector network, close to half of Singapore is covered by greenery. Our city is

home to 2,900 species of plants, 360 species of birds and 250 species of hard corals. The Sungei Buloh Wetland Reserve is an accredited member of the East Asian-Australasian Flyway in recognition of its role as an internationally significant stop-over point for migratory shorebirds.

## NEXT STEPS

Singaporeans can be proud of the progress we have made on sustainable development. We must now consider what our strategies and policy responses should be for the next lap of Singapore's development. The next chapter identifies the challenges to sustainable development that will shape our response.

<sup>2</sup> International Association of Public Transport (UITP) 2006 "Mobility in cities" report.



# 03 | OUR VISION AND GOALS FOR THE FUTURE



# 03

## OUR VISION AND GOALS FOR THE FUTURE



Cities will be the main centres of population growth over the next 40 years. The United Nations projects that almost 70% of the world's population will live in cities by year 2050<sup>1</sup>. Therefore, to provide for future generations, cities around the world have to develop in a clean and environmentally responsible way.

<sup>1</sup> United Nations Population Division/DESA, World Urbanization Prospects: The 2007 Revision.

Singapore can lead by example and show how a small, economically vibrant, densely populated city in the tropics can grow in an environmentally friendly manner. By doing so, we also make it more likely that our children can live in a good environment and have good jobs. Sustainable development protects our children's future.

Sustainable development can only be achieved through long-term attention and effort. This chapter explains why it has become more important for us to grow in an environmentally friendly way and sets out our goals for 2030.

## OUR FUTURE CHALLENGES

### 1. Our City will Continue to Grow, but Our Resources are Limited

Singapore's population grew from 4 to 4.84 million in less than a decade, and will grow further in the future. A larger population will support our economic growth and make our city more vibrant.

However, our water and energy resources will not grow proportionately with population and economic growth. And as our land is limited, our city will have to be more densely built if we want to fit in more economic activities and more people. When we locate residential, leisure and industrial land uses closer together, it will be even more difficult to maintain a high quality clean and green environment.

### 2. We will have to Compete for Scarcer Resources Worldwide

Our city will continue to grow, but so will other cities. Over time, there will be greater demand

for energy and other natural resources globally, and the prices of these resources will go up. Singapore's resource needs are very small in the global context. But we will be affected when these resources become scarcer and more expensive because we import almost all our resource needs, including basic items such as energy, food and water.

Singapore has to be able to do more with less if we want to continue to grow in the future.

### 3. Our Environment is at Risk

Development around the world has strained our common environment. Climate change is happening as a result of human activities such as the burning of fossil fuels in power stations, and deforestation. In the future, we can expect to see global temperatures and mean sea levels rise significantly. All cities, including Singapore, may experience more extreme temperatures, heat waves and heavy rainfall more frequently. Therefore, every country, including Singapore, must act to reduce the emission of greenhouse gases and fight climate change.

## OUR VISION

Sustainable development for Singapore means developing in a way that allows us to give our current and future generations both good jobs and a good living environment.

Our vision for Singapore in 2030 is for it to be a lively and liveable global city that is loved by its residents. In 2030, our city will offer a unique combination of economic opportunity, vibrancy and a quality environment.

- **A More Competitive Economy:** Singapore will be more resource efficient, and hence



Singapore's biomedical hub, Biopolis, incorporates environmentally sustainable features like district cooling and building-integrated photovoltaics

more competitive and resilient, in a future world where resources will become scarcer. By then, Singapore will also be a global city well known for its knowledge, expertise and services in helping cities achieve both economic growth and a high quality environment.

- **The Best Home for Singaporeans:** Singapore will be one of the top cities in Asia in terms of the quality of its living environment. Our people can enjoy clean air, clean water

and a lush green environment, and be able to travel around the city easily. We will have an environmentally responsible community living in Singapore that actively keeps Singapore clean and green.

- **A Global Magnet for Talent:** Singapore will be one of the best places to work in because it offers many economic opportunities as well as a first class living environment. Singapore will become a vibrant and cosmopolitan global city.

## GOALS BY 2030

Sustainable development is a long term process. Therefore, the blueprint has a 20-year timeframe, and we have identified key goals for 2030 to guide us towards a more lively and liveable city. To ensure that we remain on track, we have also set intermediate goals for 2020.

### Energy – Greater efficiency and diversification

Goal: Reduce our energy intensity (per dollar GDP) by **20%** from 2005 levels by 2020, and by **35%** from 2005 levels by 2030.

### Waste – Towards zero landfill

Goal: Improve our recycling rate from 56% in 2008 to **65%** in 2020 and **70%** in 2030

### Water – Towards self-sufficiency and greater efficiency

Goal: Reduce total domestic water consumption from 156 litres per capita per day in 2008 to **147 litres** per capita per day by 2020, and **140 litres** per capita per day by 2030.

### Air Quality – Cleaner air

Goals:

- Reduce the annual mean for ambient fine Particulate Matter (PM<sub>2.5</sub>) from  $16\mu\text{g}/\text{m}^3$  in 2008 to  **$12\mu\text{g}/\text{m}^3$**  by 2020 and maintain it at this level till 2030.
- Cap ambient Sulphur Dioxide (SO<sub>2</sub>) levels at  **$15\mu\text{g}/\text{m}^3$**  by 2020 and maintain it at this level till 2030.

### Clean, Blue and Green Physical Environment

- Increase the green park space by 900ha to **4,200ha** by 2020, and reach a park provision of **0.8ha per 1,000 population** by 2030.
- Increase the length of our park connectors (linear parks) from 100km in 2007 to **360km** by 2020.
- Introduce **30ha** of skyrise greenery by 2020 and **50ha** of skyrise greenery by 2030.
- Open **820ha** of reservoirs and **90km** of waterways for recreational activities by 2020 and have **900ha** of reservoirs and **100km** of waterways open for recreational activities by 2030.

### Capability and Expertise

Build Singapore into an outstanding knowledge hub in the latest technology and services that will help cities grow in a more environmentally friendly way.

### Environmentally Responsible Community

Build a community in Singapore where everyone adopts a more environmentally responsible lifestyle. Environmental responsibility will be part of our people and business culture.



Each of us can help to build Singapore into a lively yet livable city, an ideal home for us

## KEY PRIORITIES

We will focus on four key priorities to achieve our vision:

- **Improve Resource Efficiency** so that we can grow with fewer resources. If we can achieve more with less, we can reduce costs and free up precious resources to continue to grow our economy. We will emerge more competitive in the long run.
- **Improve the Quality of Our Environment** by controlling pollution and improving our physical landscape, so that we can continue to enjoy clean air and water, and live in a well-connected city with high public health standards.
- **Build Up Our Knowledge** in how to grow in a more environmentally friendly way, using technology to overcome our resource constraints, now and in the future. As we experiment and build up our knowledge, Singapore can also work with others to promote and build sustainable cities around the world.
- **Encourage Community Ownership and Participation** in building a clean, green and resource-efficient Singapore. Business leaders, non-government organisations and community leaders can work together to encourage people to make more environmentally responsible choices in the way they live, work, play and commute.

## CONCLUSION

The Government will monitor and inform the public of the progress we have made as a nation in achieving these goals. These goals will also be reviewed within five years and adjusted if necessary to take into account improvements in technology, cost-effectiveness of measures, public response and international developments.

The following chapters will outline the initiatives that will change the way we live (built environment and households), commute (transport), play (natural environment) and work (industries), to achieve these goals.





**04**

**LIVE – A SUSTAINABLE  
WAY OF LIFE**

# 04

## LIVE – A SUSTAINABLE WAY OF LIFE



Today, Singaporeans enjoy a high standard of living. We live in good quality housing and have access to modern amenities. As our population grows and our material wellbeing improves, we also consume more and generate more waste. In the past 10 years, households in Singapore consumed 64% more electricity<sup>1</sup>, 21% more water<sup>2</sup>, and generated 21% more solid waste.<sup>3</sup>

In the next 10 years, we can work together to make the way we live less wasteful – by choosing more resource-efficient lifestyle options and making our built environment more resource efficient. We can make new efforts in four key areas:

- Promoting a more environmentally responsible lifestyle
- Promoting resource-efficient buildings
- Making public housing more resource-efficient through innovative design and new technologies
- Stepping up public cleanliness efforts to make our city cleaner

<sup>1</sup> Total household consumption of electricity increased from 3,794GWh in 1995 to 6,226GWh in 2007.

<sup>2</sup> Total water consumption increased from 596,957m<sup>3</sup>/day in 1995 to 723,957m<sup>3</sup>/day in 2007.

<sup>3</sup> Total solid waste generated increased from 4.6 million tons in 1997 to 5.6 million tons in 2007.

## Key Recommendations

### Promoting a More Sustainable Lifestyle

- 1 Reduce the daily per capita water consumption to 147L by 2020 and 140L by 2030, through the promotion of water-efficient devices and water conservation.
- 2 Introduce minimum energy performance standards for household air-conditioners and refrigerators by 2011 and set minimum water efficiency standards for water appliances in new developments and existing premises undergoing renovation from July 2009.
- 3 Achieve an overall recycling rate of 65% by 2020 and 70% by 2030 through providing more recycling facilities and introducing new measures, such as incentives, to increase recycling.

### Promoting Resource-Efficient Buildings

- 4 Establish a Green Mark GFA Incentive Scheme to encourage new buildings to attain Green Mark Gold<sup>Plus</sup> and Platinum ratings. Require new developments in key areas to achieve Green Mark Gold<sup>Plus</sup> and Platinum ratings through land sales conditions.
- 5 Target 80% of our existing building stock (by GFA) to achieve at least Green Mark Certified rating (minimum level of energy efficiency) by 2030. Establish a \$100mil Green Mark Incentive Scheme for existing buildings to undergo energy efficiency retrofitting.
- 6 New public sector buildings with 5,000sqm of air-conditioned floor area to achieve Green Mark Platinum rating. Require existing government buildings with more than 10,000sqm air-conditioned floor area to attain Green Mark Gold<sup>Plus</sup> rating by 2020.

### Making Public Housing More Resource Efficient

- 7 Reduce energy consumption in the common areas of new estates and mature estates by 20% and 30% respectively.
- 8 Implement a large-scale solar test-bed for public housing spanning 30 precincts islandwide.
- 9 Develop a new generation of environmentally friendly housing districts along the Punggol Waterway.

### Enhancing Public Cleanliness

- 10 Step up public education, cleaning and enforcement.

## PROMOTING A MORE SUSTAINABLE LIFESTYLE

### Public Education

We have to do more to educate people on how their lifestyle will impact the environment and their costs of living, and how to lead more resource-efficient lives. The National Environment Agency (NEA) and the PUB, Singapore's national water agency, have launched major national initiatives to encourage people to reduce their energy and water consumption at home.

- The 10% Energy Challenge provides households with practical energy saving tips to encourage them to reduce their energy consumption by 10%. NEA also promotes home energy audits and educates the public about energy-efficient appliances through its website and events. NEA will also collaborate closely with retailers and suppliers to improve the availability and affordability of energy-efficient household appliances.
- The Housing and Development Board (HDB) works with NEA and the Energy Market Authority (EMA) through the Energy SAVE programme to encourage residents in public housing estates to adopt simple energy saving habits and replace home appliances with more energy-efficient models.
- We want to reduce the daily per capita domestic water consumption from 156 litres in 2008 to 147 litres by 2020 and 140 litres by 2030. PUB works with organisations, including resident committees, and the community to form Water Volunteer Groups



The 10% Energy Challenge provides practical energy saving tips to households

(WVGs) under the 10-Litre Challenge. WVGs conduct house visits to educate home-owners on water conservation practices and assist in the installation of water-saving devices. The PUB has also set up an interactive website to help the public assess their individual water usage and learn how to achieve savings of 10 litres per person per day.

### Empower Consumers to Make Resource-Smart Choices

Consumers need information to make resource-smart purchasing decisions. The government will therefore mandate the labelling of consumer products to provide consumers with more information on the performance of such products.

- The government mandated energy efficiency labelling for household air-conditioners and refrigerators from January 2008. It has extended mandatory energy labelling to clothes dryers in April 2009.
- The government will also mandate water efficiency labelling of appliances, starting with taps, dual-flush low capacity flushing

cisterns and urinals in 2009. It will consider mandatory labelling for showerheads and washing machines in the future.

## Set Minimum Performance Standards

The government will set minimum performance standards to remove inefficient models from the market.

- The government will introduce minimum energy performance standards for household air-conditioners and refrigerators by 2011 and extend minimum energy performance standards to other household appliances in future.
- From July 2009, new developments and existing premises undergoing renovation will have to install water appliances that have at least a “one-tick” water efficiency rating. The government will consider further tightening of standards in tandem with

technology advances and the availability of more efficient models in the market. For instance, we have required all low-capacity flushing cisterns in new domestic premises and those undergoing renovation to be dual-flush from July 2009.

## Recycling

The National Recycling Programme (NRP) was launched in April 2001. Under the programme, the Public Waste Collectors (PWCs) distribute recycling bags or bins to households in HDB and landed estates and collect recyclables door-to-door every fortnight. Since 2001, the household participation rate in recycling increased from 15% in 2001 to 63% in 2008.

The PWCs have further installed 1,600 centralised recycling bins in HDB estates. Residents can deposit their recyclables at any time of the day and need not walk more than

## SAVING MORE BY USING LESS

Ms Alexandra Nicole Manalo, is a real life example of how much it pays to save the environment, literally. She proactively reminded her younger siblings to switch off the computer and television after use. Her family also set the timer for two of their three air-conditioners to operate for only four hours a day. Just by applying these simple energy saving tips under NEA’s 10% Energy Challenge, Ms Manalo’s family reduced their energy consumption by about 30% from May to August 2008, saving about \$235 during this period<sup>4</sup>. This is equivalent to more than \$700 in annual savings.

Mdm Ong, a resident in Jalan Kukoh, installed water-saving devices such as a water-efficient showerhead, constant flow regulators and thimbles, and practices water saving tips such as re-using the rinse water from the washing machine and using water from the washing of vegetables and rice to water her plants. Through these simple measures, Mdm Ong reduced her monthly water consumption by 8%. Other measures that can help to save water include taking shorter showers, washing in a filled sink and not under a running tap, running the washing machine on a full load, and using a half flush for liquid waste.

<sup>4</sup> From May to August 2008, average electricity tariff was 23.88 cents per kWh.

150m to do so. In addition, there is a network of 2,200 recycling bins located in public areas, such as malls, markets, MRT stations and bus interchanges.

In November 2008, the government mandated the provision of recycling bins in condominiums and private apartments. When this is fully implemented by 2009, all households in Singapore will have convenient access to recycling facilities. In the future,

- NEA will further promote recycling by increasing the number of recycling bins and the collection frequency.
- NEA will study the feasibility of installing new infrastructure, such as combined public litter and recycling bins, and a separate chute for recyclables, taking into consideration their operational effectiveness and cost impact.
- NEA will set up a new 3R (Reduce, Reuse and Recycle) fund of \$8 million over two years to co-fund projects that promote the reduction, reuse and recycling of waste.
- NEA will study the long term feasibility of mandating the recycling of certain large waste streams with low recycling rates, such as food waste.

## PROMOTING RESOURCE-EFFICIENT BUILDINGS

Buildings contribute 16%<sup>5</sup> of our nation's total energy consumption. Energy cost can constitute about 20% to 40% of the total operating cost for a typical building. If we make our buildings more resource efficient, we can save energy and save on electricity bills too.

The Building and Construction Authority (BCA) has launched the Green Mark Scheme<sup>6</sup> to promote resource-efficient buildings in Singapore. This scheme covers both new and existing buildings, and has a strong focus on energy efficiency. Studies show that buildings can achieve between 10% to 30% reduction in energy consumption through energy-efficient building design and the use of energy-efficient equipment.

### New Buildings

BCA established a \$20 million Green Mark Incentive Scheme (New Buildings)<sup>7</sup> in 2006 to incentivise new buildings to go green. Singapore is also one of the few countries in the world to mandate green building standards. From April 2008, all new buildings have to meet the Green Mark Certified rating.

The government will introduce the following new initiatives to encourage more resource-efficient new buildings.

- The government will establish a Green Mark GFA Incentive Scheme (New Buildings) to incentivise developers to attain Green Mark Gold<sup>Plus</sup> and Platinum ratings.

<sup>5</sup> Buildings contributed to about 16% of total energy use in 2007. This excludes households and consumers' consumption that amounts to about 9%.

<sup>6</sup> The Green Mark Scheme is a rating system to evaluate the environmental impact and performance of buildings. Buildings can be awarded Certified, Gold, GoldPlus or Platinum ratings, corresponding to an energy efficiency improvement of about 10-15%, 15-25%, 25-30% or more than 30% respectively. Other criteria include water efficiency, site/project development and management, indoor environmental quality and environmental protection, as well as innovation.

<sup>7</sup> Additional Gross Floor Area (GFA) could reach up to 1% of total GFA or 2,500sqm (whichever is lower) for Green Mark Gold<sup>Plus</sup> buildings, and up to 2% of total GFA or 5,000sqm (whichever is lower) for Green Mark Platinum buildings.



## OCEAN FINANCIAL CENTRE

### Cost-Effective and Tenant-Oriented Sustainable Design

In March 2008, the Ocean Financial Centre (OFC) received the highest accolade of Green Mark Platinum Award from the Building and Construction Authority. With the help of their architects Pelli Clarke and Architects 61, Keppel Land developed the OFC as a sustainable office development with tenants in mind. The OFC has eco-features that can reduce energy consumption by 35% (9GWh per year), and water consumption by 37% (42,000 m<sup>3</sup> per year). The energy and water savings enable Keppel Land to pay back a 3% to 5% increase in construction cost within seven to nine years. Other intangible

benefits include better indoor air quality and environment, which contribute to improved employee productivity and wellness.

### Energy Efficiency Features

The OFC achieves energy savings by using an energy-efficient air-conditioning and mechanical ventilation system (including a hybrid chilled water system), an energy-efficient lighting system, an “ECO Switch” control programme and a regenerative drive system for the fastest elevators in Singapore. The iconic glass tower also uses triple-glazed façade glass with state-of-the-art low emissive coating to maximise light transmittance and transparency while minimising heat gain. As a result, the OFC is able to achieve an Energy Efficiency Index<sup>8</sup> of 174kWh /m<sup>2</sup> / year.

### Other Green Features & Use of Sustainable Technologies

Water is saved through the collection of condensate from the air handling units (AHU), rainwater harvesting, and the extensive use of efficient water fittings. This building also has extensive vertical green walls to provide a cooler and greener environment and lush sky gardens that allow occupants to enjoy nature even at their workplace. The roof crown of the OFC will be topped off with a glass-canopied roof with multi-terraced sky gardens. This building has the largest photovoltaic (PV) system assembly for a commercial building in the Central Business District that will harness 75kWp of solar energy.

<sup>8</sup> The Energy Efficiency Index (EEI) is a measure of the energy efficiency or intensity of a building, calculated by dividing the building's annual electricity consumption by the building's total floor area. Data centres and carparks are excluded from the electricity and floor area calculations due to their specialised functions and energy consumption profiles.



Features of a Green Mark building



## XILINX ASIA PACIFIC HEADQUARTERS

Located at Changi Business Park, Xilinx's Asia Pacific Headquarters is the first privately developed industrial facility to be awarded the Green Mark Platinum Award. A Fortune 100 "Best Companies to Work For" since 2001, Xilinx wanted to create a sustainable and conducive working environment for its employees. The building incorporates both passive design features such as internal green courtyards to allow natural daylighting, as well

as active features such as a double-skinned façade to reduce thermal transfer, energy-saving lighting with a computerised brightness control system and the recycling of condensate water for landscape irrigation. The green features result in an increase of 1.1% in construction cost, but allow Xilinx to reap an estimated savings of \$500,000 each year. Therefore, Xilinx can pay back the higher construction cost within 1.25 years.

- The government will require new buildings in key development areas<sup>9</sup> to achieve higher Green Mark ratings (Platinum and Gold<sup>Plus</sup> ratings) as part of its land sale requirements.
- The public sector will take the lead by requiring new public sector buildings with more than 5,000sqm air-conditioned floor area to achieve Green Mark Platinum rating.
- In the longer term, BCA will consider the need to further tighten the mandatory Green Mark rating for new buildings.

### Existing Buildings

Our existing buildings form the bulk of our building stock. We can potentially achieve an overall 5% to 10% improvement in energy efficiency for our existing building stock if we can encourage 400 to 600 existing large buildings to adopt green building features. This alone means a potential annual cost savings of some \$100 million<sup>10</sup>.

<sup>9</sup> Areas include Marina Bay and the Central Business District, Jurong Gateway, Kallang Riverside and Paya Lebar Central which are key new growth areas.

<sup>10</sup> Based on the electricity tariff rate for Jan – Mar 2009.



## DESIGNING FOR GREEN

Punggol will herald a new generation of eco-living that Singaporeans can look forward to in the next decade and beyond. The development of Punggol Town along a 4.2km Punggol Waterway will incorporate a number of new features.

- Greenery along the promenade will mitigate an increase in ambient temperature and provide a cooler environment along the waterway.
- Water management strategies such as rainwater harvesting and aeration ponds, at strategic areas along the promenade, will improve the quality of the water and provide a friendly environment for active water sports.
- A cycling network throughout the waterway promenade will encourage a vehicle-free environment and healthy lifestyle. It will be linked to adjacent residential precincts, the Town Centre and the coastal promenade leading to Coney Island and Punggol North.
- Residential developments along the waterway will be minimally Green Mark Certified. In fact, the HDB embarked on their first "Eco-precinct" project Treelodge@ Punggol in 2007, which comprises seven 16-storey residential blocks with a total of 712 flats. It is Singapore's first Green Mark Platinum Award public housing project. The development incorporates environmentally friendly features that aim to enhance the ecology of the site, minimise energy consumption and utilise effective water and waste management processes. These features include solar panels to power common area lighting, rooftop greening to cool down the living environment, and collection of rainwater to wash common areas.

More environmentally friendly features will be incorporated as the area develops, in order to realise the vision of environmentally friendly living by the water.



Facade greening is encouraged via the provision of planters and green balconies. The window facades are oriented in a north-south direction and in the direction of prevailing winds to minimise heat build up from the western sun and facilitate ventilation. The gable-end walls are insulated to prevent heat transmission into the units, especially from the afternoon sun.



The dwelling units are designed to capitalise on natural daylight and effective cross-ventilation to lower energy usage from lighting and mechanised cooling.



The residential buildings sit on a landscaped deck above the naturally ventilated carpark and driveways to keep the podium level vehicle-free and green.



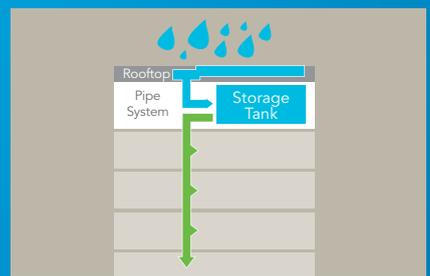
Extensive greenery has also been provided to some areas of the rooftop to reduce heat gain in the estate.



Treelodge@Punggol



Solar panels are provided at the rooftop to harness solar energy to power common area lightings. Motion sensors placed at staircases and the carpark also help to reduce energy consumption.



Rainwater is harvested at the rooftop of each residential block to help lower the usage of potable water at the common areas.

A **centralised refuse chute for recyclable waste** is provided at every residential block. Recycling is also encouraged through the provision of recycling bins along common areas such as the landscape deck.

**Water-efficient fittings**, such as the dual flushing cum integrated basin-toilet pedestal system, are installed for each unit.

The government will introduce the following new initiatives to encourage 80% of the existing building stock to achieve the minimum Green Mark Certified rating.

- The government will establish a \$100 million Green Mark Incentive Scheme (Existing Buildings) to encourage the retrofitting of large existing buildings to include more green building features.
- Existing government buildings with more than 10,000sqm air-conditioned floor area will have to attain the Green Mark Gold<sup>Plus</sup> rating to achieve greater energy efficiency. They will do so progressively by 2020, as part of their upgrading and replacement cycle.
- In the longer term, the BCA will consider mandating the declaration of Green Mark or energy labelling for existing buildings. This will empower tenants and home buyers with more information to make energy-efficient rental and property purchasing choices. BCA will also study the need to mandate minimum Green Mark ratings or energy performance standards for existing buildings.

### **New Enhancements to the Green Mark Scheme**

Over the next few years, BCA will work with other agencies to develop new Green Mark schemes to benchmark a variety of other specific development types, such as infrastructure works (e.g. MRT stations), office interiors, parks, food and beverage outlets as well as landed homes.

## **MAKING PUBLIC HOUSING MORE RESOURCE EFFICIENT**

Our public housing estates are planned, built and maintained with resource considerations in mind. Our self-contained townships minimise the need to travel and optimise the use of land. Existing design features facilitate cross-ventilation and natural lighting to reduce energy consumption.

The HDB will seek to make public housing, including both existing and new estates, even more resource-efficient in three ways.

### **Build More Eco-Friendly Public Housing**

- HDB will develop a new generation of environmentally friendly public housing, such as in Punggol New Town and Dawson Estate. For instance, HDB has planned for a waterfront residential area along the new east-west corridor in Punggol with the theme of "Green Living by the Waters". There will be a new 4.2km long waterway lined with some 21,000 public and private housing dwelling units. These residential developments will incorporate environmentally friendly features and green technology.

### **Test-Bed New Technologies in Public Housing**

Singapore enjoys lots of sun year round, and our urban environment offers unutilised roof space for the deployment of solar panels. Many Singaporeans have suggested the installation of solar photovoltaic (PV) panels within public

housing estates. However, the cost of solar-generated electricity at the moment is still about twice that of grid electricity generated from fossil fuels. Nevertheless, the technology is still evolving and the price gap may narrow over time.

- HDB will embark on an islandwide test-bed of solar technology within 30 public housing precincts nationwide. Costing \$31 million, this project will help HDB to implement solar technology on a wider scale when it becomes cost effective to do so in the future. The results of this test-bed project will help HDB to better incorporate solar technology requirements into the design of new flats and familiarise Town Councils with the technical and maintenance issues for solar installations. These large-scale solar test-beds will also provide an opportunity to train skilled personnel within Singapore in the installation and maintenance of solar systems.

### Improve Resource Efficiency in Public Housing Maintenance

PUB conducts regular briefings for Town Councils on water efficiency measures. These measures include the use of proper cleaning equipment with water-saving features, strict control on common area taps, and strict supervision of contractors' workers to ensure prudent use of water. Going forward,

- HDB is working with the Town Councils to reduce energy use of the common areas of existing public housing estates by some 30%. For instance, they will make mature housing estates more energy-efficient by replacing outdoor and corridor high-



New generation of environmentally friendly public housing in Dawson Estate

energy lamps with more energy-efficient lighting solutions.

- HDB will also try to reduce energy consumption of the common areas in new HDB estates by 20% by introducing energy-efficient light fittings and lift systems.

## ENHANCING PUBLIC CLEANLINESS

Since the launch of the Keep Singapore Clean campaign in 1968, the government has adopted a multi-pronged approach to maintain public cleanliness in Singapore. This approach comprises of an effective cleaning regime, public education, and enforcement to deter littering. These measures have contributed to our clean living environment.



## PUTTING SUN POWER TO WORK

HDB test-bedded solar photovoltaic (PV) systems at two existing public housing precincts at Serangoon and Wellington, as part of the Energy SAVE Programme. The PV panels, which were installed on the roof of the residential blocks and multi-storey carparks, can generate electricity of 220kWh per day for each precinct – enough to meet the electricity requirements for the common services (inclusive of lifts, water pump etc.) for one residential

block for one day. Excluding the upfront costs of the solar panels, the solar panels in each precinct can generate approximately \$1,600 worth of energy per month.

The total electricity generated by the PV system and the reduction in carbon dioxide emissions is displayed at the ground floor lift lobby of each block, so as to promote residents' awareness of the renewable energy initiatives implemented at the precincts.

The government will continue to adopt these approaches to sustain high standards of public cleanliness in Singapore.

- We will maintain an efficient and effective cleaning regime and regularly review the cleaning frequency and intensity to ensure that our public places remain clean.
- We will partner various community groups to extend the outreach of the anti-littering message. We will revive the national

campaign on public cleanliness to remind the public of the importance of public cleanliness. We will also make an effort to educate our youths not to litter.

- We will conduct studies to better understand littering behaviour, so that our policies and programmes can be refined.
- We will review penalties for littering regularly and carry out more intensive enforcement to deter the minority of recalcitrant offenders.

## CONCLUSION

In the next 10 years, we will progressively make our buildings more resource efficient and build more eco-friendly homes for Singaporeans. Each and every one of us can also do our part by making more environmentally friendly choices in our everyday lives. By doing so, we can start to save money today and more importantly, help to build a better Singapore for tomorrow.



**05**

**COMMUTE – CLEANER,  
GREENER AND MORE  
CONVENIENT TRAVEL**



# 05

## COMMUTE – CLEANER, GREENER AND MORE CONVENIENT TRAVEL



Over the years, Singapore has built an extensive public transport system and put in place policies to discourage car ownership and usage because we have limited land to build roads. We were one of the first cities in the world to implement vehicle ownership control and congestion pricing.

Today, travelling from place to place is relatively easy in Singapore and our city remains congestion free. But our roads already take up some 12% of our total land area. Our transport sector also accounts for about 13% of our overall energy consumption and 50% of the fine particles (specifically PM2.5<sup>1</sup>) in the air. Therefore, we have to plan ahead to ensure that our transport system is able to meet two important objectives in the future: lower environmental footprint and more convenient travel. We have to achieve these goals without incurring disproportionately high costs for our people.

We will achieve a cleaner, greener and more convenient transport system by 2030 in three ways.

- Enhancing public transport to meet the commuting needs of a growing population
- Improving resource efficiency by reducing fuel consumption and adopting fuel efficient technologies
- Achieving cleaner transport through cleaner diesel vehicles and cleaner forms of commuting

<sup>1</sup> Fine Particulate Matter (PM2.5) refers to particulate matter that is 2.5 micrometers in diameter or smaller - 1/30th the diameter of a human hair. These fine particles can aggravate heart and lung diseases.

## Key Recommendations

### Enhancing Public Transport

- 1 Achieve a modal share of 70% of journeys made during morning peak hours via public transport by 2020, through doubling our rail network and developing a more integrated and seamless connection between our bus and rail services.

### Improving Resource Efficiency

- 2 Manage the growth of private transport, by halving the annual vehicle population growth rate to 1.5%, refining our Electronic Road Pricing system, and improving schemes (e.g. Off-Peak Car scheme and Park and Ride scheme) to reduce car usage.
- 3 Improve the energy and fuel efficiency of both private and public transport, by implementing a mandatory Fuel Economy Labelling Scheme for passenger cars and light goods vehicles from April 2009, test-bedding new technologies such as diesel-hybrid buses, and developing a Green Framework for rail systems.

### Achieving Cleaner Transport

- 4 Reduce PM2.5 level from  $16\mu\text{g}/\text{m}^3$  in 2008 to  $12\mu\text{g}/\text{m}^3$  by 2020 and maintain this level until 2030 with cleaner diesel vehicles.
- 5 Establish a vehicle emission test laboratory.
- 6 Encourage cycling and walking with investments in infrastructure such as covered linkways, cycling paths and parking facilities for cyclists at MRT stations.



MRT is the backbone of our public transport system



Real-time bus arrival information helps commuters plan their journeys

## ENHANCING PUBLIC TRANSPORT

We can achieve a more sustainable transport system if more Singaporeans travel by public transport. Public transport is, by far, the more efficient mode of transport, both in terms of land and energy use. A single-deck bus transports up to 80 passengers while an average passenger car only carries up to 5 persons. A car carrying only the driver uses 9 times the energy used by a bus and 12 times that used by a train, on a per passenger-kilometre travelled basis.

To encourage more people to travel by public transport, we must make public transport more accessible and more convenient to commuters. The government has set aside more than \$40 billion to improve the public transport system to achieve the target of having 70% of journeys made by public transport during morning peak hours by 2020.

## Doubling Our Rail Network

- The Land Transport Authority (LTA) will continue to upgrade our rail infrastructure to bring direct rail access to new areas. It will double the current rail network from the current 142km to 278km by 2020. This will be achieved with the completion of the Circle Line and Downtown Line and the addition of new lines and extensions, such as the North-South Line Extension, the Tuas Extension, the Thomson Line and the Eastern Region Line. Where demand justifies, more trains will also be added to improve the capacity of existing rail lines.

## Ensuring a More Integrated and Seamless Hub-and-Spoke System

- LTA will take over the role of central bus planning to enhance the inter-connectivity between our bus and rail services to achieve

an integrated public transport system. There will be more frequent and direct feeder bus services so that commuters can reach the transfer hubs quickly, and enjoy seamless and efficient transfers to the Mass Rapid Transit (MRT) or trunk buses.

- LTA will also introduce more measures to give buses priority over other traffic (e.g. through more bus lanes, right of way at bus bays, signal priority at junctions) so that bus travel is faster and more reliable.
- LTA will also provide real-time and multi-modal public transport travel information through online and mobile platforms, to help commuters plan their journey more conveniently.

Together, these measures will reduce overall journey times for commuters using public transport.

## IMPROVING RESOURCE EFFICIENCY

We can improve the resource efficiency of the transport system by managing the growth of private transport, improving fuel efficiency of both private and public modes of transport, and pricing fuels correctly.

### Managing the Growth of Private Transport

Singapore is one of the few cities in the world to successfully implement a vehicle quota system, which has helped us maintain the annual vehicle population growth rate at 3%. At this growth rate, however, the current vehicle population will still increase by 40%

to about 1.2 million vehicles by 2020. This cannot continue because our road space grew by 1% per year over the last 15 years and is expected to increase by only 0.5% per year over the next 15 years.

- Therefore, we have lowered our vehicle population growth rate to 1.5% per year from 2009 and will further review this after three years.
- We will also have to continue to manage road usage. Congestion pricing, which Singapore pioneered, has now been adopted by other cities. We will refine our Electronic Road Pricing (ERP) system, and take advantage of technological developments to develop our next generation ERP system to ensure our roads remain congestion free.
- In addition, we will also review schemes such as the Off-Peak Car scheme and the Park and Ride scheme to reduce overall car usage.

### Encouraging Fuel-Efficient Vehicles

Within the private transport sector, we will continue to encourage vehicle owners to switch to more fuel-efficient vehicles.

- From April 2009, NEA has introduced the Fuel Economy Labelling Scheme (FELS), which provides buyers of passenger cars and light goods vehicles with fuel economy information at the point of sale. This will empower consumers with information to make more fuel-efficient vehicle purchases.
- The government will also regularly review the Green Vehicle Rebate (GVR) scheme to encourage consumers to purchase green and fuel-efficient cars.



Drivers who opt for environmentally-friendly cars enjoy the Green Vehicle Rebate

- Global trends indicate that electric vehicles will eventually be introduced into the mainstream automobile market. Therefore, we will test-bed these vehicles in Singapore to enable us to facilitate their future adoption.

### **Making Buses and Trains More Energy Efficient**

Within the public transport sector, we can similarly use new technologies to make buses and trains more energy efficient.

- LTA will carry out a trial of diesel hybrid buses with private and public bus operators to study the feasibility of applying this technology to our bus fleets. A diesel hybrid bus uses an electric motor to complement the diesel engine for propulsion. These

buses have been introduced in the UK, the US, Hong Kong, Tokyo and New Zealand. Based on trials conducted overseas, diesel hybrid technology for buses can improve fuel economy by 15-30%, as well as reduce PM2.5 emissions by up to 85%.

- In addition, LTA is working to develop a Green Framework for the Rapid Transit System (RTS) to improve the design and engineering of the RTS network to achieve greater energy efficiency.

### **Pricing Fuel Correctly**

- The government will price fuel correctly and maintain our policy of not subsidising fuel usage. We will regularly review the rate of fuel duty as a form of general vehicular usage charge, to encourage commuters and

## MAKING CYCLING A WAY OF LIFE: THE TAMPINES EXAMPLE

In Tampines Town, cycling has become a convenient mode of transport for intra-town travel and short trips to key transport nodes. A Committee comprising the Singapore Police Force, LTA and the Tampines Grassroots was formed to oversee a pilot trial and study if cycling on footways would be feasible. The trial has enabled the Committee to identify measures needed to improve the acceptance of cycling on footways, including stepping up public education and enforcement. The trial has also yielded useful information on infrastructural improvements that can better ensure pedestrian and cyclist safety.

LTA has been working with the relevant government agencies to firm up a comprehensive cycling path in Tampines Town, and will be adding an estimated 7km of cycling path by 2010. The cycling path will link cyclists to major transport nodes such as the bus interchange and the MRT station, making it easier for people to take public transport. LTA will also be building more and better bicycle parking facilities near the Tampines MRT station.

transport companies to save fuel, to encourage commuters to switch to public transport, and to take into account the environmental impact of fuel usage. However, the government is mindful of rising living and business costs associated with any increase in fuel duty and will consider the cost implications carefully in reviewing fuel taxes.

## ACHIEVING CLEANER TRANSPORT

The diesel vehicles on our roads emit fine particles into the air (PM2.5), which can penetrate deep into the lungs and has been linked to respiratory and cardiovascular illnesses. To protect public health, we target to lower our ambient PM2.5 level from  $16\mu\text{g}/\text{m}^3$  in 2008 to  $12\mu\text{g}/\text{m}^3$  by 2020. We aim to maintain the PM2.5 level at  $12\mu\text{g}/\text{m}^3$  up to 2030, even if our economy and vehicle population continue to grow.

### Reviewing Emissions Regulations

We can reduce PM2.5 emissions by tightening emission regulations over time. Singapore has adopted the Euro IV emission standards for diesel vehicles. Euro IV diesel vehicles emit about 70% less PM2.5 compared to their Euro II counterparts. With effect from 1 October 2006, all new diesel vehicles are required to comply with the Euro IV emission standards. We expect all taxis to achieve Euro IV emission standards by 2014, and LTA will work with public bus operators to attain this standard for all their buses by 2020. The government will also consider tighter emission standards, such as the Euro V emission standard, for new diesel vehicles when it is cost effective to do so.

### Using Cleaner Transport Technology

We will also use new technology to improve the environmental performance of vehicles.



Bicycle parking facilities help cyclists transfer to the public transport system

For instance, Diesel Particulate Filters (DPFs) that are fitted to diesel vehicles can potentially reduce up to 85% of the vehicles' PM emissions. However, they cost two to three times more than traditional diesel oxidation catalytic technology<sup>2</sup>. LTA will conduct trials on the use of the DPF on a range of diesel-driven vehicles and assess its feasibility and cost-effectiveness in reducing PM<sub>2.5</sub> emissions. LTA will also study alternative fuel technologies that can make commuting cleaner.

### Establishing Local Emission Testing Capability

LTA, in partnership with the private sector, will establish a vehicle emission test laboratory in Singapore to measure vehicle emissions. This



Covered linkways to MRT stations make public transport more accessible and convenient

testing facility will be the first of its kind in Singapore and will support the trials on DPF installation and diesel hybrid buses.

### Encouraging Cleaner Forms of Commuting

We will also promote cleaner forms of commuting, such as cycling. Bicycles do not pollute the air and require no fuel. Cycling is also good for the health. We have put in place infrastructure, such

<sup>2</sup> Diesel Oxidation Catalysts (DOCs) are one of the most common diesel emissions control technology used for retrofitting today. DOCs help control PM emissions by oxidising (i.e. burning) the soluble organic fraction of particulate matter, but are less efficient in doing so compared to DPFs.

as park connectors, to promote cycling as a recreational activity. More will be done to promote cycling as an alternative mode of transport, especially for travelling within towns and short distance commuting to key public transport facilities (such as MRT stations and bus interchanges).

- Over the next five years, LTA will, in partnership with community stakeholders, invest more than \$43 million to implement cycling networks in selected HDB towns including Tampines, Yishun, Sembawang, Pasir Ris and Taman Jurong. These will improve access for cyclists and enhance pedestrian and cyclist safety. Besides HDB towns, LTA will also examine the feasibility of implementing cycling paths in new districts such as Marina Bay.
- In addition, LTA will provide more and better-designed bicycle parking facilities near MRT stations to help cyclists transfer to the public transport system for longer distance travel.

As a start, LTA will build over 1,200 additional cycle parking lots in Tampines, Pasir Ris and Yishun towns by 2010.

- Beyond this, LTA has also worked with public transport operators to allow foldable bicycles on buses and trains during off-peak hours.

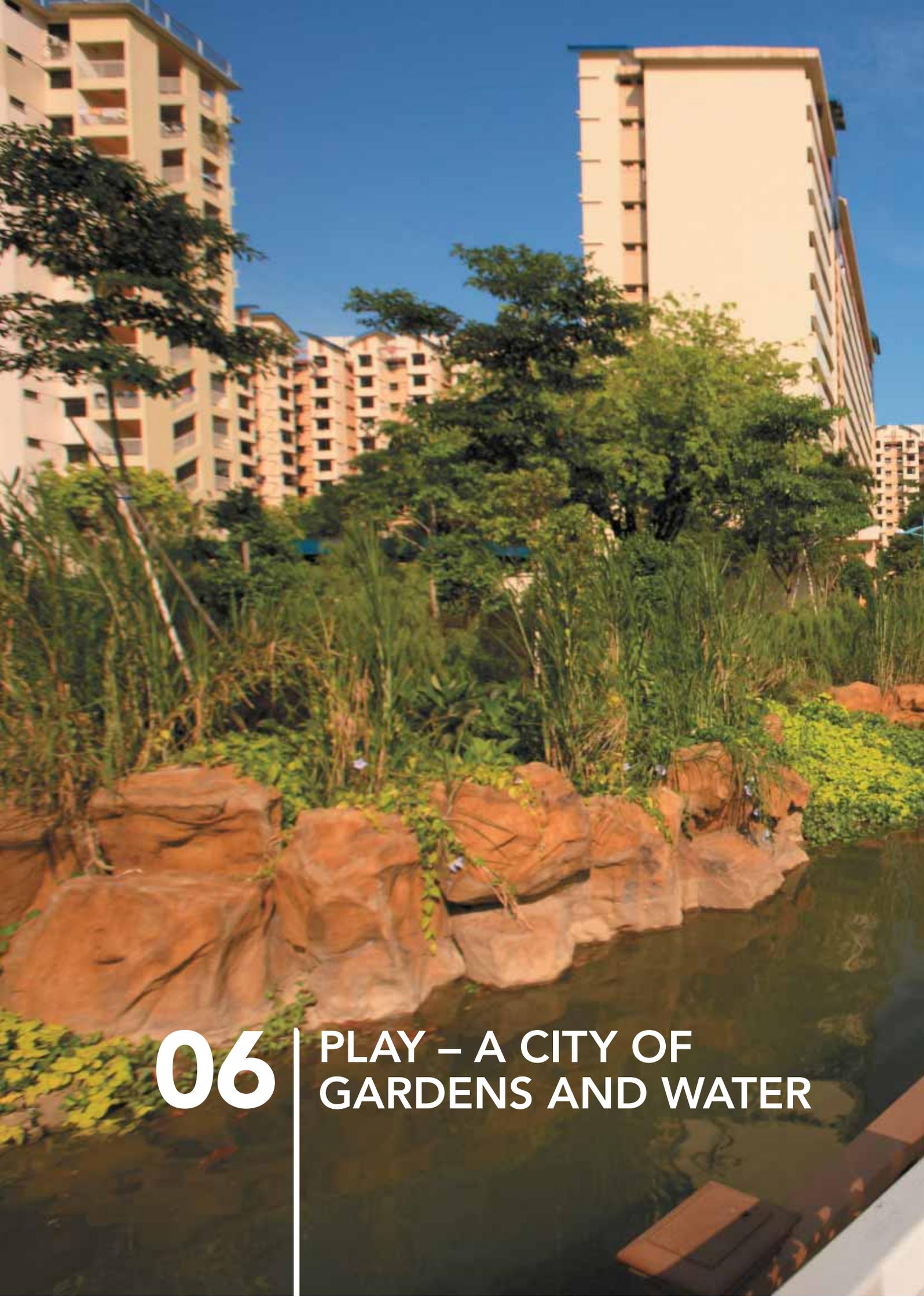
### Promoting Pedestrian-Friendly Environment and Enhancing Connectivity

LTA will also make our public transport system more accessible and convenient for pedestrians.

- It will introduce more covered linkways and pedestrian overhead bridges around MRT stations and bus interchanges.
- Pedestrians can also enjoy more seamless transfers as LTA develops more integrated transport hubs and co-locates them with commercial developments.

## CONCLUSION

A Singapore city with a first class living environment must have a cleaner, greener and more convenient transport system. We have made comprehensive plans to upgrade the transport infrastructure and enhance its environmental performance. We will have a cleaner and more fuel-efficient vehicle fleet by 2030. However, our city in 2030 will be shaped just as much by the individual commuting choices of our people as they are by these plans. If all of us choose to use public transport more, drive less and adopt cleaner and more fuel-efficient options, we can look forward to a better living environment for all in the future.



**06**

**PLAY – A CITY OF  
GARDENS AND WATER**



# 06

## PLAY – A CITY OF GARDENS AND WATER



Singapore is well known for being a garden city. Today, close to half of Singapore is covered by greenery, and there are thousands of species of flora and fauna living together with us in our city. Our extensive roadside greenery, parks and nature areas make Singapore a great home to live in.

As our population grows, we will have to make a greater effort to ensure that we continue to make space for greenery and our natural heritage. For the future, we hope to transform our city into a City of Gardens and Water. We want to see our city nestled in greenery, our waterways come alive and our residents enjoy better access to nature and our rich biodiversity. We seek to achieve this in a few ways:

- Creating more parks and nature-based leisure options in Singapore
- Promoting skyrise greenery to soften our densely built urban landscape
- Transforming drains, canals and reservoirs to support recreational use
- Protecting and enhancing our biodiversity to conserve our natural heritage for all to enjoy

## Key Recommendations

### Creating More Parks and Nature-Based Leisure Options

- 1 Provide 0.8ha of park land per 1,000 persons by 2030. In the shorter term, increase the amount of green park space by 900ha by 2020.
- 2 Make parks more accessible, by tripling the length of park connectors from 100 to 360km by 2020 and developing new leisure options around green spaces.

### Promoting Skyrise Greenery

- 3 Add some 30ha and 50ha of skyrise greenery by 2020 and 2030 respectively, including 9ha of green roofs on multi-storey carparks in public housing estates.
- 4 Introduce various initiatives to promote skyrise greenery. This includes co-funding for green roofs in the Central Business District and Orchard Road areas, a landscape replacement policy for new developments in the Downtown Core (including Marina Bay), Jurong Gateway and Kallang Riverside; and bonus GFA for rooftop outdoor refreshment areas to incentivise provision of rooftop landscaping in the Central Area.

### Transforming our Waterbodies

- 5 Open up 820ha of reservoirs and 90km of waterways for recreational activities by 2020 and 900ha of reservoirs and 100km of waterways by 2030.

### Protecting and Enhancing Biodiversity

- 6 Implement a National Biodiversity Strategy and Action Plan to research, document and conserve biodiversity in Singapore.
- 7 Develop a City Biodiversity Index with international partners to promote biodiversity conservation efforts among cities globally.

## CREATING MORE PARKS AND NATURE-BASED LEISURE OPTIONS

### Creating New Parks

We will set aside more land for parks.

- The National Parks Board (NParks) has already planned for an additional 900ha of parkland for the next 10 years. This will bring our total parkland to 4,200ha by 2020. By 2030, we aim to have 0.8ha of parkland per 1,000 population.
- The new parks to be created include Gardens by the Bay in the heart of the new downtown, Coney Island Park and the expansion of Sungei Buloh Wetlands. These parks will host various community activities along themes like health and wellness and arts and culture, for park users to enjoy.

### Environmentally-Friendly Features in Parks

Our parks will also be greener, in more ways than one.

- NParks will implement new environmentally-friendly measures within all our regional parks. These measures include the recycling of horticultural waste as well as the reduced use of energy, water and chemical products. In addition, NParks will design some of the new parks to enhance biodiversity.

### Making Parks More Accessible

- Our network of park connectors will be extended from 100km to 360km by 2020.

These recreational corridors will connect clusters of major parks in the various regions of the island. This network will be complemented by seven loops and a 150km round-island route that allows our people to walk, jog and cycle closer to the coastline and greenery.

### Creating New Nature Based Leisure Options

The Urban Redevelopment Authority (URA) has planned for new recreational areas for city dwellers to take a respite from the intense city life in Singapore. Among these are unique leisure venues at Changi Point, Punggol Coast and Lim Chu Kang.

- Changi Point today already offers an array of recreational amenities from chalets and resorts to the popular Changi Village food centre. The URA will build upon the existing infrastructure and lush greenery, to introduce new uses and activities that will enhance Changi as a coastal recreational destination. The Punggol coastline is a popular fishing



Future coastal promenade at Punggol will provide more leisure options for residents



## GARDENS BY THE BAY

The Gardens by the Bay comprises three distinctive waterfront gardens – Gardens at Marina South, Gardens at Marina East and Gardens at Marina Centre. The Gardens will be Singapore’s premier urban outdoor recreation space at Marina Bay.

The 54ha Gardens at Marina South will be the largest and the first of the three Gardens to open in 2011. It will showcase the best of tropical horticulture and garden artistry, with displays of tropical flowers and coloured foliage. It will also demonstrate energy and water conservation designs and measures.

At the heart of the Gardens are two key features:

- A Cooled Conservatory Complex. The Conservatories will be an architectural icon,

a horticultural attraction and a showcase of energy-efficient technology. It will provide an all-weather “edutainment” space within the Garden. Comprising a “Cool Moist” biome (0.9ha) and a “Cool Dry” biome (1.2ha), it will display plants and flowers from the Tropical Montane and Mediterranean environments.

- Supertrees. Designed as tree-like structures over 30m in height, the Supertrees are uniquely designed vertical gardens, with emphasis placed on creating a “wow” factor through the vertical display of tropical flowering climbers, epiphytes and ferns. The Supertrees will also be integrated with solar energy and water technologies to help cool the Conservatories.

and leisure destination for families. URA and NParks will be constructing a 11km coastal promenade connecting Sengkang Riverside Park, Punggol Point and Punggol Park. URA has also planned for two recreational clusters along the promenade at Punggol Point and Punggol East where people can enjoy horseback riding and camping.

- URA will develop the Lim Chu Kang area into a weekend countryside getaway by introducing agri-tainment options (such as spas, rustic chalets) amidst existing farms, nature areas and the reservoir. At the Kranji Reservoir, a new nature trail in the Kranji Marshes will offer trekking enthusiasts a view of the freshwater wetland and its resident birdlife and butterflies. Beyond the marshes, there will be new waterfront trails with lookout points and pavilions to offer people

a panoramic view of the reservoir. New park connectors and nature trails will be created to connect parks and farms in the area to make them more accessible to the public.

## PROMOTING SKYRISE GREENERY

In addition to expanding park space, we can further expand greenery by going upwards. Skyrise gardens have sprung up on various buildings in Singapore, including the roofs and top decks of Housing and Development Board (HDB) multi-storey carparks and some new HDB flats. Such skyrise greenery reduces heat transmitted through the roof, reduces ambient temperature and glare, improves sound insulation for buildings, and with the right use of plants, can increase our biodiversity.



Rooftop gardens in public housing at Punggol provide more green spaces while optimising land use



## MARINA BARRAGE

The Marina Barrage is a prime example of Singapore's holistic approach to water management and is the flagship of PUB's ABC Waters Programme. A 3-in-1 project, it creates an additional source of water supply, acts as a tidal barrier to alleviate flooding in the low-lying city areas and also serves as a lifestyle attraction right in the heart of the city.

The Marina catchment is the island's largest and most urbanised catchment, spanning 10,000 hectares. The Barrage is essentially a dam across the Marina Channel, creating the Marina Reservoir. Together with the new Serangoon and Punggol reservoirs, the Marina Reservoir will increase Singapore's water catchment from half to two-thirds of our land area.

In addition, the Marina Barrage is designed and built on environmentally-friendly principles. Its iconic green roof serves as an insulation layer to lower indoor temperature, thereby reducing the building's air-conditioning requirements. It also has the largest collection of solar panels for a single installation – 405 in all – which convert solar energy into utility grade electricity to supplement the daytime power requirements of the Marina Barrage.

Visitors to the Marina Barrage can enjoy waterfront alfresco dining or picnics on the Green Roof while taking in picturesque views of the city skyline and Marina Reservoir. In addition, they can visit the Sustainable Singapore Gallery to find out more about Singapore's sustainable development efforts.

Our aim is to add 30ha of skyrise greenery by 2020 and 50ha by 2030 through the following new initiatives.

- HDB will target to develop 9ha of green roofs on the top deck of existing multi-storey carparks in the residential heartlands over the next three years.
- The government will incentivise the development of skyrise greenery in strategic locations in the city. NParks will pilot a grant scheme to co-fund up to half the installation cost for green roofs, focusing on the Central Business District and Orchard Road areas for a start. URA will also grant existing buildings within the key activity corridors in the Central Area (such as Orchard and in the existing Downtown) bonus gross floor area (GFA) to be used for rooftop outdoor refreshment areas if developers provide rooftop landscaping for their developments.
- URA will adopt a landscape replacement policy to introduce greenery into new developments, as we develop and intensify the use of our land in the city and new growth areas. All new developments in the Downtown Core (including Marina Bay), Jurong Gateway and Kallang Riverside will have to provide landscape areas equivalent to the overall development site area in the form of skyrise greenery and ground level communal landscape areas.

## TRANSFORMING OUR WATERBODIES

We have developed a dense network of canals and waterways to manage storm water and to meet Singapore's water needs. They can also



Our waterways are open for recreational activities such as kayaking

be better used for recreation and to soften our cityscape.

Under the Active, Beautiful, Clean (ABC) Waters programme, PUB, Singapore's national water agency, will transform our drains, canals and reservoirs into beautiful and clean streams, rivers and lakes that are integrated with the surrounding parks and green spaces. These reservoirs and waterways can support water-based recreational activities, such as kayaking, canoeing and sailing and serve as community focal points for events and recreation. This programme brings people closer to our waterways and inspires Singaporeans to keep our waterways clean and to conserve water.

- For a start, 27 projects will be implemented over the next few years. By 2020, 820ha of reservoirs and 90km of waterways will be opened for recreational activities. By 2030, PUB will implement more than 130 projects in business and heartland areas, opening up 900ha of reservoirs<sup>1</sup> and 100km of waterways for recreational use.

<sup>1</sup> The 11 reservoirs which would be opened for recreational activities are: Bedok, MacRitchie, Lower Seletar, Upper Seletar, Lower Pierce, Marina, Pandan, Kranji, Jurong Lake, Punggol and Serangoon.

## PROMOTING SPECIES CONSERVATION

Hornbills are large birds and there are only 54 species of them worldwide. There has been no record of the breeding of this hornbill species in Singapore since at least 1855, although birds have occasionally been spotted in Singapore up until the 1920s. Therefore, it was indeed surprising to find the Oriental Pied Hornbill breeding in Pulau Ubin in 1997, as they require large trees for their nest holes. The hornbill population has grown since they started breeding naturally in Pulau Ubin and NParks currently monitors around 45 to 50 hornbills around Pulau Ubin and the Changi area.

To help our local hornbills survive and flourish, NParks coordinated a joint project with Nanyang Technological University, Jurong Bird Park and CVM Private Limited. This project



involves setting up nest boxes in our parks and gardens to entice the Oriental Pied Hornbill to move from Pulau Ubin to the main island. Some of these nest boxes are equipped with video cameras to allow researchers to study their behaviour inside the nests, making it a world-first attempt at studying hornbill nesting behaviour in the wild, in a city setting!

## PROTECTING AND ENHANCING BIODIVERSITY

Singapore has rich biodiversity for an island of its size. As a comparison, Singapore, which is 0.2% the size of UK, has some 360 species of birds or 60% of the number of species found in the UK. This is despite us having a vibrant economy, one of the highest population densities in the world, and no countryside or hinterland.

Today, key indigenous ecosystems – namely the Bukit Timah Nature Reserve (lowland dipterocarp forest), Central Catchment Nature Reserve (freshwater swamp forest), Sungei Buloh Wetland Reserve (mangroves) and Labrador Nature Reserve (coastal hill forest) – are legally

protected. These four nature reserves cover more than 3,000ha or 4.5% of Singapore's land area.

In land scarce Singapore, we will always have to make tough trade-offs between different land uses. Nevertheless, we will keep the Nature Areas<sup>2</sup> for as long as possible. Some of these areas are integrated with parks to allow our people to get closer to and enjoy nature. The URA will also seek to focus development in urbanised areas before undeveloped areas are opened up. Where development must take

<sup>2</sup> As reflected in the Special & Detailed Controls Plan of URA's Master Plan 2008

place, we can seek to adopt innovative measures to reduce the impact on greenery and biodiversity. For instance, by linking parks and nature reserves with park connectors and planting suitable trees and shrubs, we can help butterflies and birds to fly from park to park. This is beneficial for species survival as populations of these creatures can be too vulnerable if confined to a single park.

As a step forward, NParks is developing an action plan – the Singapore National Biodiversity Strategy and Action Plan – to conserve our natural heritage for the next 10-15 years. The Plan comprises initiatives in a few key areas.

- **Conservation and rehabilitation programmes:** Under the Plan, NParks will make new efforts to conserve and rehabilitate species, including putting in place monitoring programmes, species surveys, improvements of habitats in Nature Reserves, Nature Areas and parkland and reintroduction of rare species. For instance, NParks will utilise our parks for ex-situ conservation and to house or re-create ecosystems that have been lost. NParks is also studying the development of Eco-links<sup>3</sup> between nature reserves. This will help to ensure the survival of species of plants and animals by preventing inbreeding and loss of genetic diversity.
- **Biodiversity considerations in policy and decision-making:** The government will take into account biodiversity issues when making decisions, and adopt holistic approaches towards the conservation of our natural environment. Findings from various research efforts can also enrich our policy making process and help facilitate balanced decision making.



The Chek Jawa Wetlands is home to a rich variety of biodiversity

- **Research and documentation of Singapore's biodiversity and natural environment:** This includes biodiversity valuation studies, research on how to enhance biodiversity in urban settings outside nature areas, a central information portal on biodiversity and a red data list that targets species for conservation.
- **Public education:** NParks will work with non-governmental organisations to promote public awareness and appreciation of Singapore's biodiversity.

<sup>3</sup> This eco-link is a wildlife or landscape linkage with the primary function of connecting at least two significant habitat areas to help plants and animals previously isolated in small pockets to spread and interact with other populations.

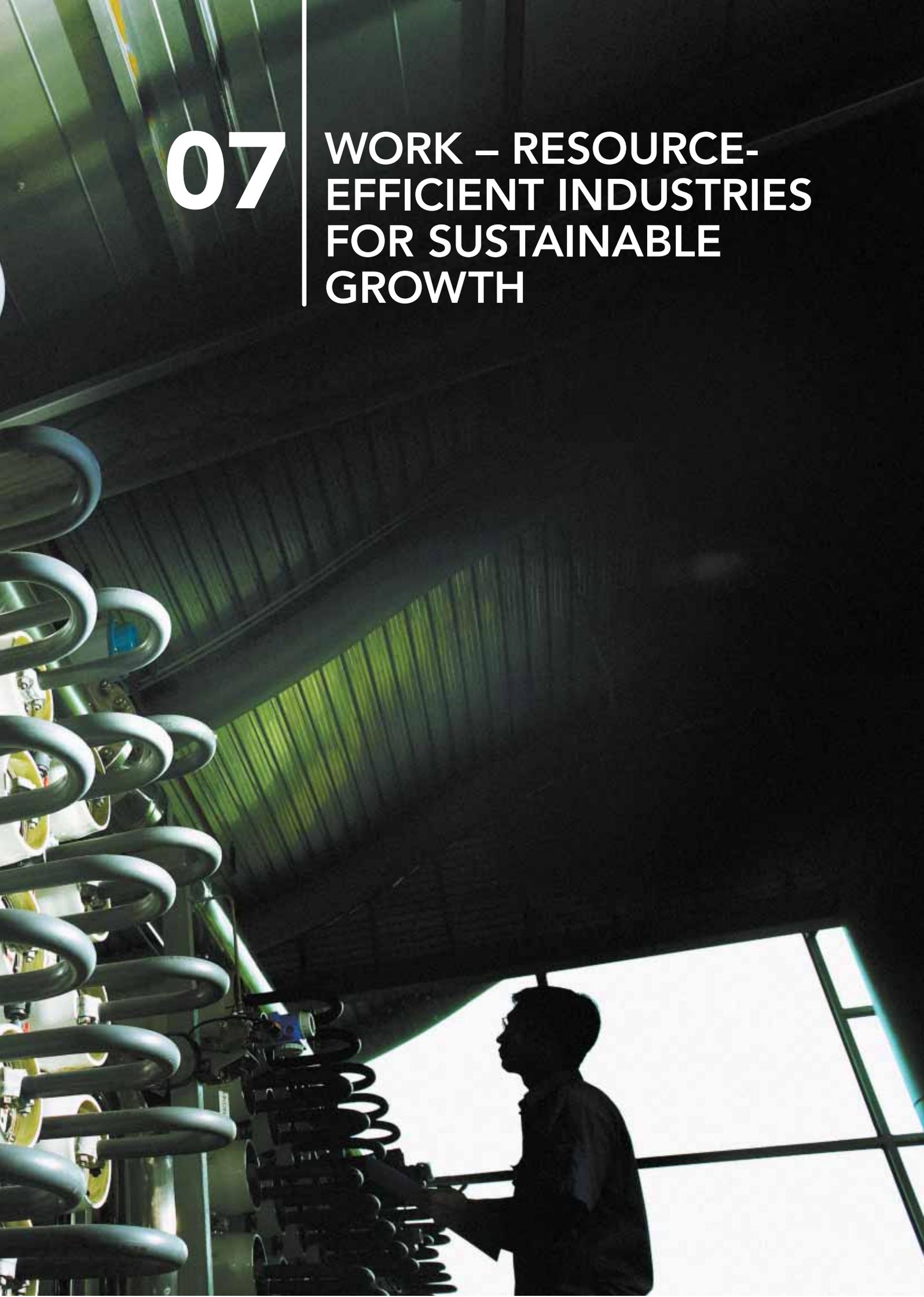
- **Domestic and international collaboration:** NParks will partner international organisations, public interest groups and private companies to jointly develop the knowledge base and capability to expand conservation efforts. Singapore will also do its part to promote conservation efforts in the region and beyond through various bilateral and multilateral initiatives. For instance, at the 2008 Meeting of the Conference of the Parties to the

Convention on Biological Diversity (CBD), Singapore proposed the development of a self-assessment tool for cities to evaluate the efforts of biodiversity conservation at the city level. In February 2009, Singapore and the CBD Secretariat co-hosted successfully the first expert workshop on the development of the Singapore Index on Cities' Biodiversity.

## CONCLUSION

The growth of our city does not have to come at the expense of our quality of life. With careful planning and innovative solutions, our small city state can continue to prosper as a global city and economic hub, yet remain a green and blue playground for all its residents.





**07**

**WORK – RESOURCE-  
EFFICIENT INDUSTRIES  
FOR SUSTAINABLE  
GROWTH**

# 07

## WORK – RESOURCE-EFFICIENT INDUSTRIES FOR SUSTAINABLE GROWTH



Singapore believes that growth and environmental sustainability are compatible and mutually reinforcing. Over the years, we managed to achieve economic growth together with a good quality environment. We did this by introducing policies early in the course of industrial development to safeguard environmental quality. Economic growth in turn gives us the means to further improve our living environment.

Going forward, we want to build even cleaner and more resource-efficient industries, which will help industries improve cost competitiveness, and open new economic opportunities for Singapore. We will achieve these goals in a few ways:

- Promoting energy efficiency among industries and businesses
- Enhancing water security and efficiency to support growing industrial needs
- Promoting waste minimisation and recycling in industry to conserve resources
- Controlling pollution from industries to ensure that industrial growth does not come at the expense of public health and the environment
- Promoting Clean Technology and Sustainable Urban Solutions as new growth sectors

## Key Recommendations

### Promoting Energy Efficiency

- 1 Facilitate energy-related benchmarking for key industrial sectors.
- 2 Establish a national Energy Efficiency Circle Programme to promote a culture of sustained energy efficiency improvement in companies.
- 3 Promote more energy-efficient technologies and systems, such as co-generation and tri-generation within power generation plants and industrial facilities, and green data centres.

### Enhancing Water Security and Efficiency

- 4 Expand NEWater infrastructure and promote water efficiency to support future industry needs.

### Promoting Waste Minimisation and Recycling

- 5 Set standards for recycled products to increase their uptake.
- 6 Introduce an accreditation system for companies that recycle construction and demolition waste.
- 7 Extend the Singapore Packaging Agreement beyond the food and beverage industry.

### Controlling Pollution

- 8 Cap ambient SO<sub>2</sub> levels at an annual mean of 15µg/m<sup>3</sup> by 2020 and maintain the same ambient SO<sub>2</sub> levels in 2030.

### Promoting Clean Technology and Sustainable Urban Solutions

- 9 Promote Clean Technology and Sustainable Urban Solutions as new economic growth sectors, in tandem with our sustainable development efforts.
- 10 Develop a 55ha CleanTech Park at Jalan Bahar as a platform for test-bedding clean technologies.



## KEPPEL MERLIMAU COGEN

Keppel Merlimau Cogen is a 500MW natural gas-fired combined cycle co-generation plant located on Jurong Island. The project provides utilities like steam, de-mineralised water, firefighting water, cooling water and pipe service corridor to industrial and utility consumers on Jurong Island. Co-generation is typically 30-40% more competitive in the production of

steam vis-à-vis conventional boilers due to its higher efficiency. By consolidating demand for utilities, third party utilities providers like Keppel Merlimau can produce utilities at lower prices through greater economies of scale. Chemical companies benefit both from lower price of utilities as well as the ability to outsource non-core functions to the Multi-Utilities Service Providers.

## PROMOTING ENERGY EFFICIENCY

Today, the industry sector accounts for more than half of total national energy consumption. If we make our industries more energy efficient, we can greatly enhance Singapore's energy security and make our economy more resilient to fluctuations in energy supply. Energy efficiency will also improve the cost competitiveness of our industries, especially that of energy-intensive industries such as our refinery, petrochemical, electronics and pharmaceutical industries.

To encourage businesses to invest greater management attention and resources in energy efficiency, we have to provide companies with more information on energy efficiency,

help them build energy management expertise and support them with financing through co-funding schemes. We have already embarked on several initiatives in these areas.

### Raise Awareness

The National Environment Agency (NEA) and its partners periodically organise seminars, conferences and workshops to bring together local and overseas experts and various stakeholders to share knowledge, expertise and best practices in energy efficiency. NEA has also developed a website, [www.e2singapore.gov.sg](http://www.e2singapore.gov.sg), that provides information on available energy efficiency schemes and energy efficiency case studies.

## Build Capability

The Energy Sustainability Unit (ESU) of the National University of Singapore (NUS) has developed a Singapore Certified Energy Manager (SCEM) programme that offers a formal training and certification system in the area of energy management. NEA provides an SCEM training grant that offsets a portion of the training fees for the curriculum. The ESU of NUS also operates an accreditation scheme for Energy Services Companies (ESCOs) to enhance the professionalism and quality of energy services offered.

## Facilitate Adoption

NEA's Design for Efficiency Scheme (DfE) provides funding assistance to investors in new facilities in Singapore to integrate energy and resource efficiency improvements at the design stage. Designing an industrial facility in an energy efficient manner ex-ante is more cost-effective and can achieve greater energy savings as compared to implementing retrofitted upgrades after a facility has been built.

NEA has established an Energy Efficiency Improvement Assistance Scheme (EASe) to co-fund the cost of energy audits by up to 50%, to encourage companies to study their energy consumption and identify potential areas for improvement. NEA's Grant for Energy Efficient Technologies (GREET) scheme helps companies to offset part of the cost of implementing energy efficiency measures. Companies can also tap on the Investment Allowance (IA) Scheme if the capital expenditure results in greater energy efficiency.

In the future, we hope to further improve energy efficiency in our industries with the following new initiatives:

- **Facilitate Energy-Related Benchmarking:** In our industry consultations, many companies indicated that energy benchmarks are useful in helping them improve their energy efficiency. The government will work with leaders in various industries to conduct studies to establish appropriate energy-related benchmarks for key industrial sectors. With these benchmarks, companies will be better able to assess their relative energy performance and their energy efficiency potential.
- **Establish a National Energy Efficiency Circle Programme:** NEA will introduce an Energy Efficiency Circle Programme to promote a culture of sustained energy efficiency improvement in our companies, similar to what had been done for productivity with Quality Circles. An Energy Efficiency Circle programme is built around small groups of employees that regularly identify potential energy efficiency opportunities in their area of work and discuss what can be done to realise this potential. This programme will provide tools for companies to involve employees in energy efficiency improvements, as well as recognition for companies that have done so.
- **Promote Energy Management Practices:** The government will study the feasibility of mandating certain energy management practices for large energy users, such as the appointment of trained energy managers and the implementation of an energy management system (EMS) within companies.  
  
EMS helps companies integrate energy efficiency into their management practices. Implementing an EMS involves a company identifying key energy performance

indicators, setting baseline standards and energy efficiency goals, setting up a cross-divisional team to develop and implement an action plan to achieve the goals and setting up systems to monitor the company's energy performance. It also involves informing workers of the company's energy efficiency goals, training workers to implement energy efficiency systems and rewarding staff for achieving energy savings. Global companies that have an EMS have demonstrated that it can bring about significant benefits. For example, 3M achieved a 35% improvement in energy productivity between 2000 and 2005, and this translated to cost savings of US\$190 million. Toyota improved energy intensity by 26% in eight years, while Dow Chemical improved energy intensity by 22% between 1994 and 2005, and is targeting another 25% cut from 2005 to 2015.

- **Promote Co-generation and Tri-generation Technology:** We will achieve energy efficiency if more industries use co-generation and tri-generation technology. Co-generation is the simultaneous production of both electricity and useful heat (steam) from a fuel source. It can reduce the amount of fuel needed to generate both electricity and steam by 15-20%, as compared to generating them separately. Tri-generation plants are even more efficient as the same fuel source is also used to produce chilled water. For companies with combined demand for electricity and steam, or electricity, steam and chilled water, co-generation and tri-generation can result in significant energy savings. Currently, such technology is utilised by multi-utilities service providers (MUSP) on

Jurong Island and by companies in Tuas. The government will continue to work with the private sector to extend the MUSP models to other industrial sectors and geographical areas within Singapore.

- **Promote Energy Efficiency in Data Centres:** Data centres, server rooms and IT equipment account for a significant amount of energy use in buildings. The government will work with the Information and Communications Technology (ICT) industry to develop and promote the adoption of green data centre standards that will reduce the power consumption of IT systems. These standards will take into account the ongoing international efforts in this area as well as guidelines and best practices for data centre design, setup and operations. The public sector will also adopt green data centre practices and promote awareness of green data centre benefits among data centre operators in the public sector, develop training and certification programmes for the public and private sector data centre operators, and promote R&D in energy efficient data centres.
- **Establish Energy Efficiency Standards:** The government will continue to study global best practices in promoting energy efficiency and where appropriate, refine our local legislative and regulatory framework. For instance, we will study the experiences of countries that have legislated minimum energy efficiency standards for major energy-consuming equipment and systems, and examine if it is feasible to use legislation to further promote energy efficiency.



Localised water supply could be developed to meet non-domestic water demand in industrial clusters

## ENHANCING WATER SECURITY AND EFFICIENCY

Water is a key resource that supports the growth of our industries. Today, the non-domestic sector accounts for half of Singapore's water demand. The demand for water will increase as water intensive industries such as petrochemical and wafer fabrication continue to grow. Hence, we have to continually develop alternative sources of water supply and promote water efficiency.

In the future, we will make the following additional efforts to expand water supply:

- **Expand NEWater Capacity:** PUB will steadily expand Singapore's NEWater production capacity and the distribution network. We

will complete the construction of the fifth and largest NEWater plant to date (50mgd) at Changi by 2010, and link the NEWater clusters with pipes to form an island-wide network. Industries in wafer fabrication and petrochemical require highly purified water. By supplying them with NEWater, we can better meet their needs and reduce the demand for potable water.

- **Develop Localised Water Supply:** A large portion of non-domestic demand is concentrated in industrial clusters such as Jurong Island. There is potential to develop localised sources to meet these needs, through measures such as process water recycling and desalination. In these clusters, there are also opportunities to recover heat for water production. A promising example

is membrane distillation, which taps low-grade steam or waste heat from power stations, incineration plants or industrial processes to supplement the energy requirements for desalination. PUB is now planning for a demonstration plant to validate the technical and economic feasibility of this system. Once the results are proven, PUB will work closely with the private sector to commercialise it.

NEWater and desalinated water are more resilient to changes in weather. The expansion of these unconventional sources of water will increase our water supply and help us meet any future challenges to our water supply posed by weather changes.

We will also step up our efforts to promote water efficiency:

- **Promote Awareness:** PUB will facilitate sharing of best practices and expertise in water-efficient design and management through outreach and education programmes. It will develop self-diagnostic tools to allow industry users to assess their performance relative to similar organisations and industry benchmarks, and identify opportunities for improvement.
- **Build Capabilities:** PUB will equip facility and operation managers with water audit skills through the Water Efficiency Manager Course, so that they can identify gaps and develop their own water conservation strategies.
- **Promote Industry-led Initiatives:** PUB will seek to help industries manage their water demand through financial incentives as well as recognition and awards under the 10% Challenge programme. For example, the Water Efficiency Fund will help industries

to defray part of the capital costs of water recycling systems. The Water Efficient Buildings programme encourages the use of water-efficient fittings and assists building owners in monitoring their water consumption. PUB will adopt a sector-specific approach to identify areas for improvement in water conservation, starting with hotels, schools and commercial buildings.

## PROMOTING WASTE MINIMISATION AND RECYCLING

Singapore needs to reduce the amount of waste it generates as it has limited land for landfill and incineration plants. NEA will seek to promote waste minimisation and recycling through a few ways.

- **Promote Less Packaging:** An effective way of reducing waste is to reduce the amount generated during production. In June 2007, NEA signed a voluntary Singapore Packaging Agreement with NGOs, industry associations and businesses in the food and beverage sector. Signatories undertake to re-design their product packaging to reduce waste, such as by using less material, and using more recycled or recyclable materials. The agreement will be expanded in future to cover other product lines.
- **Provide Financial Support for Recycling:** NEA will launch a 3R (Reduce, Reuse, Recycle) Fund in 2009 to co-fund projects that minimise waste and promote recycling. These projects include provision of waste recycling infrastructure, re-design of processes to reduce waste, and the provision of innovative sorting or recycling equipment or systems.



Pollution control requirements are imposed on industries to manage their impact on the environment

- **Promote Use of Recycled Products:** NEA is working with industry associations such as the Waste Management and Recycling Association of Singapore (WMRAS) to set standards for recycled products to promote their use among industries. For example, NEA worked with the National Parks Board (NParks), a major generator of horticultural waste and a major consumer of compost, to set recycled content requirements for compost. WMRAS also worked with the Building and Construction Authority (BCA) and NEA to set up a new industry-led accreditation system for construction and demolition waste recycling facilities, to raise the quality and standards of recycled construction material.

## CONTROLLING POLLUTION

NEA imposes pollution control requirements on all industrial developments to prevent, reduce and control pollution. Major industrial developments are required to carry out pollution control studies to assess all sources of pollution and to recommend mitigating measures that can be incorporated into the design and operation of the developments. For instance, industries have to observe emission concentration standards for air pollutants and controls on fuel quality. After industrial developments are set up, NEA requires them to carry out self-monitoring to ensure that these standards are adhered to. NEA also carries out regular checks, such as

source emission testing and fuel analyses, and takes enforcement action against violators.

Singapore will have to be more vigilant towards pollution control as our city becomes more densely built. Therefore, we will continue to review and enhance our pollution control regulations in the future.

- **Capping Sulphur Dioxide Emission:** NEA will continue to review pollution standards and requirements regularly to ensure that they are in line with international best practices while not imposing prohibitive costs on the industry. In particular, a key air pollutant of concern from industry is sulphur dioxide (SO<sub>2</sub>) which can impair respiratory functions and aggravate existing respiratory and cardiovascular diseases. NEA will seek to achieve the goal of capping ambient SO<sub>2</sub> levels at an annual mean of 15µg/m<sup>3</sup> in 2020, and maintaining it at this level in 2030. It will therefore work with major emitters, such as oil refineries, petrochemical plants and power generation companies, to use cleaner fuels and put in place more pollution control measures.
- **Managing Noise Pollution:** Singapore's dense urban landscape means that noisy activities (such as construction works) are sometimes located close to residences. The government takes a balanced approach towards controlling environmental noise – it recognises that a certain amount of noise is inevitable, but requires industry to take measures to ensure that noise levels remain acceptable. NEA develops noise pollution standards and guidelines that are benchmarked to international standards, in consultation with the industry. However, as we strive for a higher quality of life in Singapore over time, NEA may need to both review

these measures as well as consider new ones, such as tightening construction noise limits.

## PROMOTING CLEAN TECHNOLOGY AND SUSTAINABLE URBAN SOLUTIONS

In the next decade, the government will invest more in developing clean technology<sup>1</sup> and sustainable urban solutions<sup>2</sup> as new growth areas. Apart from overcoming our own constraints, this will also allow us to contribute to sustainable development in the region and beyond.

The Economic Development Board (EDB) will nurture new economic opportunities in clean technologies and urban solutions in three ways:

- **Create a Vibrant Research Ecosystem:** EDB will create a vibrant research ecosystem in clean technology and urban solutions, comprising world-class R&D centres, equipment companies, supplier base, testing and certification services, funds and incubator projects. EDB will establish high-quality environment research centres of excellence that can train specialised manpower as well as provide technical expertise to the local industry. In addition, it will put in place new programmes to groom talent and specialist manpower. These include funding research centres of excellence to train manpower,

<sup>1</sup> Although there is no standard definition, clean technology is often referred to as products, services, and processes that harness renewable materials and energy sources, dramatically reduce the use of natural resources, and cut or eliminate emissions and wastes.

<sup>2</sup> Sustainable urban solutions refer to products and services that meet the needs of those living in cities, which include traffic management, waste collection, recycling, pollution control and water supply.



## JALAN BAHAR CLEANTECH PARK

The Jurong Town Corporation (JTC) and Economic Development Board (EDB) are developing the Jalan Bahar CleanTech Park for companies undertaking clean technology activities such as R&D, test-bedding, prototyping and light manufacturing. The Park will showcase sustainable building and infrastructure features and provide a plug-and-play environment to facilitate test-

bedding of Urban Solutions that are practical and scalable. This CleanTech Park will focus on achieving low carbon emissions, and integrate existing surrounding ecological features with the built-up area. Located next to Nanyang Technological University (NTU), the 55ha CleanTech Park will be developed over 20 years with the first development ready in 2011.



## SOLAR ENERGY RESEARCH INSTITUTE OF SINGAPORE (SERIS)

In the last few years, Singapore has already attracted an array of private Cleantech R&D centres such as GE Water, Siemens Water, Bosch (solar) and Vestas (wind). Cleantech R&D centres were also launched in our institutes of higher learning. These include the Solar Energy Research Institute of Singapore (SERIS) in the National University of Singapore (NUS), NUS Environmental Research Institute (NERI) and Nanyang Environment and Water Research Institute (NEWRI).

SERIS is Singapore's national laboratory for innovative solar energy research and was set up in April 2007 as part of the National University of Singapore (NUS). It has a budget

of \$130 million over five years and is led by CEO Professor Joachim Luther, formerly the Director of the Fraunhofer Institute for Solar Energy Systems (ISE). The institute seeks to collaborate with industry on solutions-focused R&D in the areas of crystalline and thin-film silicon solar technology, novel photovoltaic devices as well as solar and energy-efficient buildings. SERIS also provides testing and certification services for solar photovoltaic modules under New Energy Technology Pte Ltd, a tripartite partnership between SERIS, VDE Institute and Fraunhofer ISE. Currently staffed by a team of 30 personnel, the institute is expected to grow to 100 researchers by 2011.

more scholarship programmes and a visiting professor programme. It will also provide funds on a competitive basis to encourage local research institutes to undertake breakthrough R&D activities in clean technology and other urban solutions.

- **Facilitate Test-Bedding:** As a small, compact and densely populated urban centre with a strong regulatory framework, Singapore is an ideal living laboratory for companies to test-bed and adapt solutions for use worldwide. Siemens is already setting up its Global Centre of Competence for City Management here. This centre will be a test-bed and launch pad for innovative IT solutions in city management. Many other local and foreign companies have also used Singapore as a launch pad to initiate R&D projects and test out their new ideas and solutions before exporting them to emerging cities in China, India, Southeast-Asia and the Middle East.

To further consolidate Singapore as a living laboratory for companies, the government will make available public facilities such as water treatment plants, incineration plants

and public transportation systems as development platforms for the private sector to test-bed technologies. This will catalyse public-private sector collaborations to develop new solutions for Singapore as well as allow private sector companies, both local and overseas, to test-bed new technologies that can be subsequently exported worldwide.

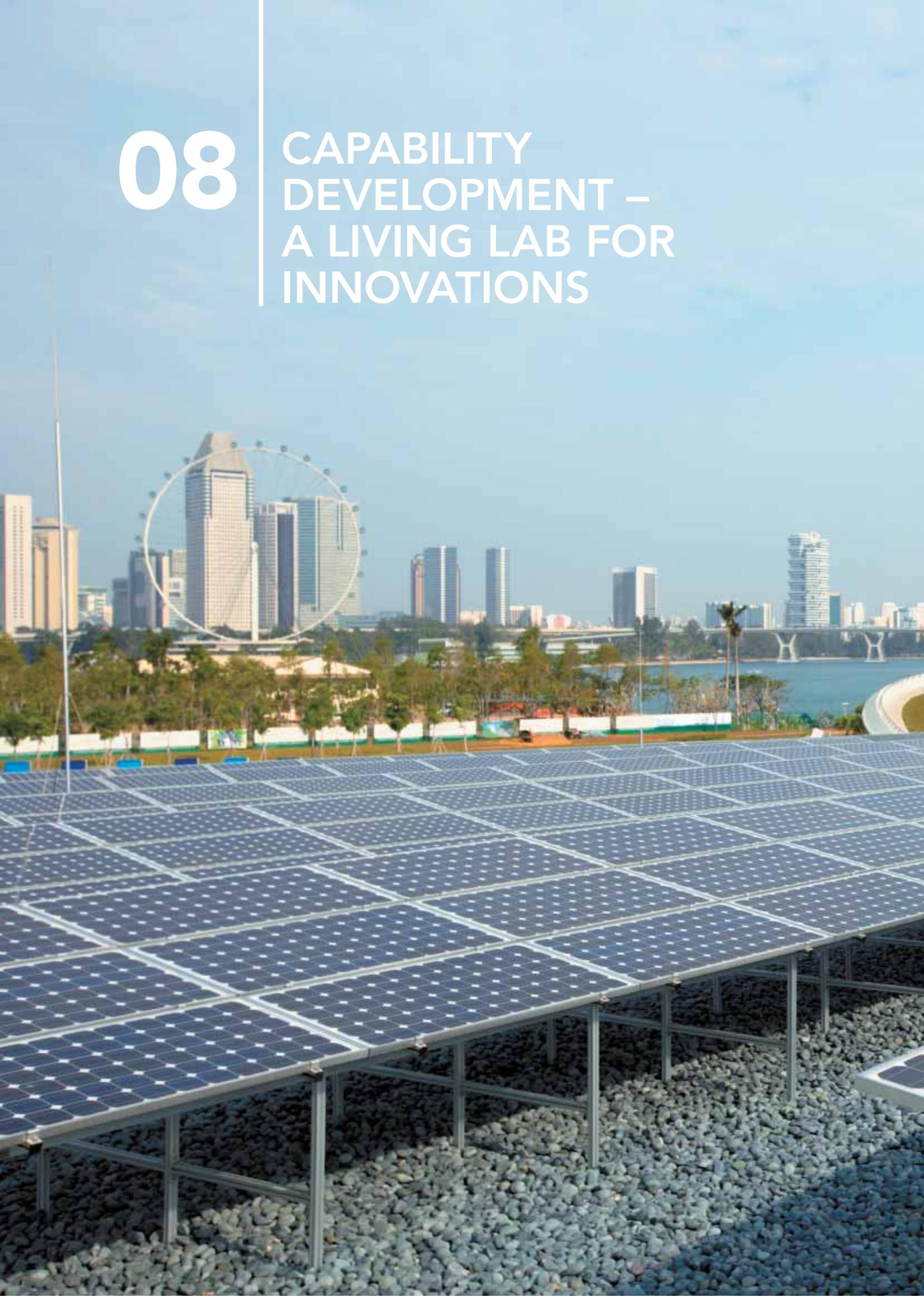
- **Expand and Deepen the Industry Cluster in Clean Technologies:** EDB will actively seek to attract leading global companies in clean technologies to base their headquarters, manufacturing and business development operations, as well as R&D facilities in Singapore. These investments will further facilitate the transfer of know-how and promote collaboration between global companies and our local research institutes and companies. At the same time, the government will step up efforts to help our local companies better internationalise their business and operations, such as organising related industry conferences and trade exhibitions to profile the companies' products.

## CONCLUSION

Economic growth and environmental sustainability go hand-in-hand. By making concerted efforts to boost the resource efficiency of our industries and develop clean technology as a new economic growth area, we can achieve environmental sustainability while supporting future economic growth.

08

CAPABILITY  
DEVELOPMENT –  
A LIVING LAB FOR  
INNOVATIONS





# 08

## CAPABILITY DEVELOPMENT – A LIVING LAB FOR INNOVATIONS



Since independence, Singapore has made a virtue of its constraints, and its limitations, a source of competitive advantage. Singapore's resource and size constraints are not a handicap. Instead they serve as the impetus for us to innovate and become a leader in resource-efficient technologies.

Our goal is to establish Singapore as a Hub for sustainable development solutions in the next decade and beyond.

We seek to achieve this goal in two ways:

- Develop key capabilities and technologies, especially in resource efficiency and urban planning and design
- Develop Singapore as a knowledge hub and provider of services relating to environmentally sustainable urban development

## Key Recommendations

- 1 Conduct research to improve Singapore's effectiveness in maximising our sources of water, as well as increase the energy efficiency of water treatment.
- 2 Establish a new \$5 million incentive scheme to develop prototype building designs that achieve at least 50% improvement in energy efficiency.
- 3 Develop Marina Bay and Jurong Lake District as our new generation of sustainable high-density districts.
- 4 Establish a five-year research program to adapt water sensitive urban design concepts and technologies to local use.
- 5 Invest in R&D and manpower in clean energy and water technologies.
- 6 Expand R&D in other clean environment technology areas such as waste management.
- 7 Promote international exchange of ideas in sustainable development.
- 8 Contribute Singapore's expertise to help build environmentally sustainable cities across the world.

## DEVELOPING CAPABILITIES AND TECHNOLOGIES

Technology and innovation can help us achieve both economic growth and a good living environment. Singapore will continue to invest heavily in research and development (R&D). We will learn and adapt the latest technology to our local needs, while developing new knowledge in areas such as resource efficiency, clean energy and urban planning, which we can share with other cities that face similar challenges as us in managing future growth.

### Water Technologies

Singapore has limited land to store water. PUB, Singapore's national water agency, will conduct further R&D to improve Singapore's effectiveness in water treatment as well as to maximise our sources of water.

A key research priority of the PUB is to find ways to increase the energy efficiency of water production processes, which currently use up a significant amount of energy. PUB will promote research to improve the energy efficiency of seawater desalination processes in order to make desalination a more viable source of water. It will also study low-chemical or zero-chemical water treatment processes, such as ultraviolet disinfection, to improve safety, water quality and resource utilisation in water treatment. In addition, sludge produced by used water treatment processes can be a useful source of energy or materials. PUB will study an integrated anaerobic-aerobic treatment process to reduce sludge production and increase biogas that can in turn be used to power the water treatment plant.

## MAKING EACH DROP COST LESS

Under a Challenge Request-for-Proposal for energy-efficient seawater desalination technologies, the Environment and Water Industry Development Council (EWI) awarded \$4 million in June 2008 to Siemens Water Technologies to develop an innovative electro-chemical process that uses only 1.5kWh of energy per m<sup>3</sup> of seawater – much lower than current standards – to purify seawater to meet drinking standards. Unlike conventional reverse osmosis processes which extract the water, this technology removes the salt from seawater, which consists of 97% water and only 3% salt.

Another emerging water technology is membrane distillation, which utilises low-grade steam or waste heat from power stations or incineration plants to supplement the energy requirements for producing drinking water from seawater. This enables the membrane distillation process to utilise a net energy input of less than 1kWh/m<sup>3</sup> of freshwater produced. PUB is working closely with the private sector to test-bed and commercialise these technologies.

### Energy-Efficient Building Technologies

The Building and Construction Agency (BCA) will continue to promote R&D and test-bedding of green building technology.

The Ministry of National Development (MND) has established a \$50 million Research Fund for the Built Environment to support such research.

An international panel of experts comprising green building experts from around the world was also formed in October 2008 to advise BCA on promoting and implementing green buildings in Singapore.

Going forward, BCA will establish a new \$5 million incentive scheme to encourage developers to collaborate with experts worldwide to develop prototype building designs that can achieve at least 50% improvement in energy efficiency.

### Urban Planning and Design

Singapore is able to achieve sustainable growth within our limited land area because we have a long-term land use planning framework that integrates infrastructure, policies and technology to meet the development needs of the country.

Going forward, the Urban Redevelopment Authority (URA) will seek to develop Marina Bay and the Jurong Lake District as our new generation of sustainable high-density districts. It will conduct further research and studies of new technologies and our physical landscape and use the results to refine its land use planning framework. It will apply the enhanced planning framework to the overall planning of these new districts to make them even more sustainable.

The URA, the National Parks Board (NParks), the Land Transport Authority (LTA), the Housing and Development Board (HDB) and the National University of Singapore (NUS) will also conduct further research on high-density living to develop new urban planning and design guidelines that can help us achieve economic, social and environmental development in a more balanced way.



Planning for a sustainable high-density mixed-use district at Jurong Lake

### Water Sensitive Technologies and Urban Design

NParks and PUB will embark on a research programme to adapt water sensitive urban design concepts and technologies to local use. The project will evaluate the performance and local application of “Active, Beautiful, Clean (ABC) Water” design features<sup>1</sup> like bio-retention swales, rain gardens and constructed wetlands. These could act as natural purification systems to improve water quality in our reservoirs and waterways. NParks and PUB will launch pilot projects to evaluate the use of these sustainable water features.

<sup>1</sup> ABC Waters design features are engineering features that mimic natural systems to mitigate the impact of urban stormwater run-off on the environment. ABC Waters Design Guidelines will integrate planning and design of such features with the urban environment.



Artist impression of Marina Bay

## MARINA BAY – A SUSTAINABLE DISTRICT

Marina Bay will be a vibrant and sustainable high-density district with a mixed-use live, work, play environment. The district hosts the Marina Bay Financial Centre, Marina Bay Sands Integrated Resort, the Gardens by the Bay and the Marina Barrage. The Urban Redevelopment Authority (URA) is working closely with various government agencies such as the Building and Construction Authority (BCA), National Parks Board (NParks), Land Transport Authority (LTA), the national water agency PUB and the National University of Singapore (NUS) to further enhance the sustainability of Marina Bay.

### Sustainable Planning

- The District is planned following sustainable development principles. For example, the area is being developed as a seamless extension of the existing Central Business District, allowing the new developments to tap into the existing infrastructure and integrate with existing developments.
- URA intends to develop an urban bio-climatic map for the area to allow its planners to take advantage of prevailing wind flows to

improve pedestrian comfort, increase the use of external spaces and manage the effects of heat gain through appropriate urban design and landscape planting.

### Better Energy Efficiency

- The government will require all new developments at Marina Bay to achieve a minimum Green Mark Platinum or Gold<sup>plus</sup> standard.
- A District Cooling System (DCS) is also in place within the Common Services Tunnel network. The DCS achieves savings through economies of scale and reduces the amount of space needed for a mechanical plant within individual developments.
- The new Waterfront Promenade around Marina Bay will include design features to cool the ambient air temperature and improve pedestrian comfort. The LED lighting, outdoor fans and the Visitor Centre will be powered by solar energy. The Visitor Centre will include sustainable design features such as natural daylighting and natural ventilation.

## Greenery and Water Management

- The Marina Barrage and the Marina Reservoir will collect all rainwater within the urban catchment area to increase our water resources and to control flooding. The barrage includes resource-efficient design and features.
- URA will require all new developments within Marina Bay to provide skyrise greenery and ground level communal landscaped areas which are equivalent to the site area of the development. NParks will operate a new Skyrise Greenery Incentive Scheme to incentivise existing developments in the City Centre to green up their roofs.
- The 101ha world-class Gardens by the Bay and extensive landscape planting within the district will provide the public with green spaces for recreation and allow for biodiversity. URA will work with NParks and PUB to incorporate more biodiversity, water recycling and water sensitive design features in Marina Bay.

## Sustainable Transport

- A comprehensive public transport network, planned to be in place by 2020, will allow commuters to be within an average of 5 minutes walk from their destinations. The Rapid Transit System (RTS) Stations will be seamlessly integrated with a comprehensive pedestrian network at the Bay that is part of the larger planned pedestrian network within key districts in the city centre. The comprehensive pedestrian network, including underground, street-level and upper level walkways, will facilitate inter-building connectivity and encourage the use of public transport.
- An intra-district network of cycling paths, which can link with the larger island-wide Park Connector Network, is also being studied.

## A Place for All to Enjoy

- There will be an extensive waterfront promenade and a network of covered and open spaces for people to gather in and enjoy.
- The Marina Bay Development Agency will manage the public areas and continue to work with stakeholders to coordinate a year-round calendar of events with the aim of enhancing the sense of identity and vibrancy of Marina Bay.
- Singapore's first Art Park will foster a greater sense of community ownership and will feature a number of art works by students.

## Heritage Conservation

- The conservation and adaptive re-use of key heritage buildings around Marina Bay, including the former Clifford Pier and Customs Harbour Branch Buildings, Change Alley Aerial Plaza, Fullerton Hotel and the Asia Insurance Building, will provide a historical reference to the past.



Conservatories, Gardens at Marina South

## CLEANING WATER THE NATURAL WAY

The PUB and the Housing and Development Board (HDB) have set up an experimental rain garden at Balam Estate. The rain garden creates a garden habitat, promotes biodiversity and provides an aesthetically pleasing landscape. Stormwater interacts with the soil and plants in the rain garden and is cleansed of litter and pollutants.

The Sengkang Riverside Park Constructed Wetland System consists of two sedimentation basins and a macrophyte zone designed for a catchment area of 9.35ha. A macrophyte zone is an area where water is naturally cleansed of nutrients that are absorbed by aquatic plants. It uses wetland plants to cleanse stormwater runoff. The sedimentation ponds collect fine particles and sediments from the stormwater runoff before discharging it into the macrophyte zone where wetland plants



The rain garden in Balam Estate filters stormwater naturally, creates a natural habitat for biodiversity, and adds to the landscape

such as Typha and Cyprus treat the water to improve its quality. The treated water can then be reused for irrigation in the park.

## THE VARIABLE SALINITY PLANT: MAXIMISING EVERY SINGLE DROP

Conventional water treatment processes are able to treat freshwater or seawater but not both. PUB developed a patented Variable Salinity Plant (VSP) that is able to treat feed water of varying salinity to potable water. The VSP can potentially enable Singapore to tap on marginal sources of water from our fringe catchments to further increase the water catchment area in Singapore. PUB successfully proved the technical feasibility of the VSP through a 240m<sup>3</sup> per day pilot plant at Bedok



Water Reclamation Plant in 2004. Following this, a medium-scale demonstration plant of 4560m<sup>3</sup> per day was built and has been operating since July 2007.

## POSITIONING SINGAPORE AS A SUSTAINABLE DEVELOPMENT HUB

Singapore is a good place for companies and research organisations to develop and test their ideas in an urban setting because it has skilled people with environmental management and system integration expertise. Going forward, we will continue to invest in R&D and manpower development programmes to further enhance Singapore's attractiveness as a base for research and export of new technologies, as well as an innovative thought-centre on high-density urban living and sustainable development.

### Research and Test-Bedding Programmes

The government has set aside \$680 million to build new capabilities in Clean Energy and Water Technologies. The funding supports both research and test bedding programmes as well as manpower development programmes. The Clean Energy and Water Technology sectors can potentially create an economic value-add of \$3.4 billion and generate employment of 18,000 by 2015.

The government provides funding incentives and infrastructure for Institutes of Higher Learning, Research Institutes and companies to conduct basic and applied research and to demonstrate innovative solutions in Singapore. It has launched several schemes to facilitate the entire technology development lifecycle, from basic and applied research, pilot and demonstration trials to commercialisation. This includes an incubator programme that helps to nurture clean energy and water technology start ups through business mentoring and financial support. The \$20 million

Solar Capability Scheme (SCS) encourages innovative design and integration of solar panels into buildings. This scheme helps to build up the capabilities of designers, architects and system integrators in solar energy companies.

### Manpower Development Programmes

Singapore has launched a number of initiatives to train specialist manpower and research talent for the clean energy and water technology sectors. NUS and the Nanyang Technological University (NTU) have set up several R&D centres of excellence such as the DHI-NTU Water and Environment Hub, Singapore Membrane Technology Centre (SMTTC), Singapore Delft Water Alliance (SDWA) and the Solar Energy Research Institute of Singapore (SERIS). Scholarships are also awarded to promising individuals to train the next generation of researchers to support the growth of the industry.

### Clean Environment Technology

Singapore will also build up capabilities in other areas of clean environment technology, such as urban waste management technologies. This will augment our existing initiatives and strengthen our positioning as a provider of sustainable urban solutions.

### Facilitate Global Knowledge Exchange

Although Singapore is a small country, we can help to promote and build environmentally sustainable cities beyond our shores.

We will continue to organise international conferences to facilitate open dialogue and



The Singapore International Water Week provides a global platform for water solutions

sharing with the global community on technologies and policies related to sustainable development. The biennial World Cities Summit brings together leaders, city mayors, policy-makers, urban planners, experts, industry and international organisations to discuss challenges facing cities and share best practices to promote vibrant and liveable cities. The Singapore International Water Week provides a global platform for water solutions. It brings together policy makers, industry leaders and experts to discuss water solutions, showcase technologies and celebrate technological achievements in water management.

The Ministry of National Development and the Ministry of the Environment and Water Resources have also set up the Centre for Liveable Cities (CLC), a policy-oriented think tank. CLC brings together Singapore's expertise on sustainable urban development in the areas of good governance, urban planning, effective resource management,

quality living environment, affordable housing and sustainable transport solutions. CLC will distil and deepen Singapore's urban development expertise through developing case studies and undertaking projects and research of an interdisciplinary nature. It will facilitate the sharing of knowledge and best practices among cities in the region through workshops, seminars and training programmes. CLC will also develop links and strategic partnerships with key regional and international organisations, cities and other centres of excellence.

Singapore is also happy to partner other nations and cities to design and build environmentally sustainable townships in other parts of the world. In doing so, we hope to encourage more cities to grow in a clean and resource efficient way. The URA has set up the URA Consulting Group and the PUB has set up WaterHub to provide training and consultancy in urban planning and water management respectively to cities that require such services.



## MOVING TOWARDS ZERO ENERGY BUILDINGS

Singapore has embarked on a Zero Energy Building (ZEB) project to showcase and test-bed green building technologies. The project involves retrofitting an existing building to serve as BCA's academy, which will house offices, classrooms, a library resource centre as well as a visitor centre. This ZEB@BCA Academy is designed to be 100% powered by solar energy and will be about 60% more energy-efficient than the norm. It will also incorporate advanced green building

technologies. These include personalised cooling for occupants, integrated facade devices to shade the building and bring daylight to the interior, and vertical greenery to reduce solar gains and glare. The ZEB@BCA Academy is scheduled for completion in the second half of 2009. It is a joint project between BCA, the National University of Singapore (NUS) and key industry players DP Architects, Beca Carter and Davis, Langdon & Seah.

## CONCLUSION

The environmental challenges ahead open up opportunities for Singapore to innovate and create sustainable development solutions with partners across the globe. Together, we can use technology to improve lives and protect the environment, not only in Singapore, but across the world.

**09**

**COMMUNITY –  
ACTING TOGETHER  
FOR A SUSTAINABLE  
SINGAPORE**



# 09

## COMMUNITY – ACTING TOGETHER FOR A SUSTAINABLE SINGAPORE



Sustainable development is a long-term, ongoing effort. We can continue to achieve growth and a good environment if everyone believes that sustainable development is important and makes an effort to adopt a more environmentally responsible lifestyle. The leaders and activists in the people, private and public sectors can work together to make environmental sustainability part of the Singapore culture.

## Key Recommendations

- 1 The government will make available funding to support the work of NGOs and facilitate more networking among NGOs.
- 2 The Community Development Councils will promote environmental awareness and action to more than 2 million people through programmes under their local district plans.
- 3 The government will use a \$1.5 million 3P Partnership Fund to assist organisations from across the people, public and private sectors to realise worthy ideas on environmental sustainability.
- 4 Schools will step up their efforts in promoting environmental education.
- 5 Public sector will adopt more environmental sustainability practices both as a consumer of goods and services and as a responsible employer.

## PEOPLE SECTOR LEADERSHIP

### Advocacy and Action by Non-Governmental Organisations

The Non-Governmental Organisations (NGOs) in Singapore have been actively engaging the community in resource conservation, public cleanliness and nature conservation. These NGOs include the Singapore Environment Council (SEC), a pioneer environmental NGO in Singapore, the Waterways Watch Society (WWS) and Nature Society Singapore (NSS) as well as other youth-centric NGOs such as the Environmental Challenge Organisation (ECO), Singapore Halogen Foundation and SYiNC (a network of youth volunteers who organise events to instil civic consciousness).

For instance, SEC has organised the annual Schools Green Audit Awards since 2000 to encourage students to cut down on energy and water wastage and find ways to reduce and recycle. They have also promoted the use of greener modes of transportation through their Green Transport Week and promoted green consumerism through their Green Labelling Scheme. WWS has organised many programmes to encourage Singaporeans to take care of our water resources. NSS organises free nature walks for the public and 'show-and-tell' sessions for younger children to promote nature education and ecological care of the water body at Kranji wetland. The Restroom Association of Singapore (RAS) developed the Happy Toilet programme to recognise the efforts put in by owners of public toilets to improve their cleanliness standards and launched a national LOO (Let's

Observe Ourselves) campaign to encourage better user behaviour.

- The government will make available funding to help NGOs spearhead new initiatives. The government will also facilitate more networking platforms, both locally and overseas, to promote cooperation among the NGOs and encourage the exchange of ideas on sustainable development. Some examples are the annual National Youth Environment Conference jointly organised by the National Youth Achievement Award Council and the Ministry of the Environment and Water Resources (MEWR), and the Youth Habitat portal helmed by the SEC, to engage youths on environment issues through various platforms.



The Plant-A-Tree programme, a collaboration between the Garden City Fund and the Singapore Environment Council, lets the public play a part in greening Singapore



## WATCHING OUT FOR OUR WATERWAYS

The Waterways Watch Society (WWS) has been an active partner in helping to keep the Singapore's waterways clean. Its members patrol the waters in the Kallang Basin or the Singapore River area with an eye on litter almost every weekend. Formed in 1998, the mission of WWS is to gather like-minded volunteers to protect the aesthetics of our waterways and to raise awareness of the

importance of caring for and protecting our environment. As one of the "adopters" under the PUB's "Our Waters" programme, the Society has been providing regular feedback to the government agencies during their river patrols, to help curb pollution at its source. WWS also initiated a learning camp for students, public education roadshows as well as beach/river clean-up sessions.

### Ground Up Initiatives at the Grassroots

At the community level, the Community Development Councils (CDCs) actively encourage residents to get involved in their community and to care for the environment. The CDCs take turns to co-organise the annual launch of the Clean and Green Singapore<sup>1</sup> programme with the National Environment Agency (NEA) to inspire all Singaporeans to care for and protect the environment. The CDCs and grassroots organisations also work with NEA, PUB, Singapore's national water agency, and the National Parks Board (NParks)

to promote energy and water conservation as well as nature appreciation.

In support of this blueprint, the five CDCs have each developed plans, in partnership with their local grassroots organisations, to promote environmental awareness and a more environmentally responsible way of life.

<sup>1</sup> Known as Clean and Green Week before 2007. The Clean and Green Singapore (CGS) Programme consists of educational activities to promote an environmentally friendly lifestyle. CGS begins with a carnival in either October or November each year, and this is followed by a series of environmental events and initiatives held through the next year.

- South West CDC (SWCDC) engaged grassroots organisations within its districts to develop ECo (Environment & Community) Plan South West – themed “Tomorrow Starts Today”. The Plan envisions a high quality living environment and a community that is engaged and responsible. Together with corporate and community partners, SWCDC is seeking to reach out to 220,000 households to achieve five ECo Goals. These are (i) reduce energy consumption for 80,000 households by changing to energy efficient light bulbs; (ii) appreciate nature by planting 1 million native plants (iii) maintain public health and a clean environment by engaging and training volunteers from 20 schools to assess the cleanliness of public toilets (iv) recognise individuals who display social graciousness and kindness in the community through awards; and (v) facilitate active citizenry by recruiting an annual target of 1,600 Junior Environment Ambassadors to champion environmental and public health issues in the community.
- North West CDC (NWCDC) has embarked on a 3-tier Green Plan involving programmes at the School, Community and National levels to reach out to 124,000 residents a year. The NWCDC Green Plan aims to strengthen people-private-public sector partnership, provide opportunities for students and the community to organise innovative environmental protection projects and to increase awareness of students and the residents on sustainable development. NWCDC also aims to help 4,500 households reduce energy and water consumption through the Energy Audit and 10 Litre Challenge programmes.
- Central CDC targets to reach out to 800,000 residents to raise their awareness of environmental and public health issues. It will provide opportunities for the community to come forward and champion public health initiatives and live out environmental friendly lifestyles. One example is SWITCH (Simple Ways I Take to Change My Habits) which aims to educate and enable residents to reduce their energy consumption.
- North East CDC (NECDC), through its Public Health & Environmental Watch Group’s 2008 / 2009 Environment Work Plan, seeks to promote greater awareness and community action to care for the environment. The Environment Work Plan has an intended outreach of about 700,000 residents. To facilitate their outreach, NECDC will be working with NEA to design and build a mobile exhibition bus that will reach out to 78 schools and also Grassroots Organisations (GROs) in the district.
- South East CDC plans to reach out to 150,000 residents and engage schools, grassroots organisations and Voluntary Welfare Organisation (VWO)s’ to care for the environment. Caring for the environment can also serve a dual purpose and help those in need. An example is the ‘Recycling actions by Caring Hearts@South East’ programme where participating schools will target to collect 50,000 pieces of clothing and used books for recycling and reuse by families in need.



## BUILDING RESPONSIBLE PRACTICES: CDL

City Developments Limited (CDL), a pioneering property developer in Singapore, has been incorporating sustainable business practices and promoting green outreach programmes as an integral part of its corporate social responsibility policy since the late 1990s. Today, eco-friendly features such as energy saving lights, pneumatic waste disposal system and multiple recycling corners have become the cornerstone of all CDL residential developments.

Beyond building and managing properties with environmental sustainability in mind,

CDL has gone the extra mile to influence its consultants and contractors to do their part for the environment. CDL's Environment, Health & Safety Policy was established in 2003 to help promote a "safe and green" corporate culture. CDL monitors the environmental impact at the worksite, as well as influences its employees, consultants and contractors to adopt eco-friendly practices. CDL has also actively supported efforts by governmental agencies, Non-governmental Organisations, the youth, and the community at large to promote environmental awareness.

## PRIVATE SECTOR LEADERSHIP

Over the years, many companies have adopted business practices which reduce the environmental impact and improve the resource efficiency of their operations. For example, United Microelectronics Corporation optimised their chiller system and improved its efficiency by 12%, achieving estimated cost savings of over \$200,000 per month. The Regent Singapore, a certified Water-Efficient

Building, adopted the Reduce, Replace and Reuse approach to water management, and reduced its water consumption by some 16%.

Some companies have also actively encouraged environmental participation within the company and partnered NGOs and schools to promote environmental awareness. For instance, more than 170 companies have participated in NEA's Corporate and School Partnership Programme (CASP) which is a platform for companies to work with schools on environmental education.

Through the programme, students are encouraged to find solutions to environmental issues and in the process, they develop a sense of ownership towards the environment. Since its inception in 2004, the number of such partnerships has grown from 4 to over 100. More and more companies are also participating in PUB's programmes such as the Friends of Water and Our Waters programmes.

Some companies have also co-organised or sponsored environment-related awards and events. Some of these include the Sembawang Shipyard's Green Wave Competition, Senoko Power's National Weather Study Project, Bayer South East Asia's Bayer Young Environmental Envoy Programme, and HSBC's Seashore Life Programme.

At the industry level, industry organisations such as the Singapore Manufacturers Federation (SMA) have sought to promote resource efficiency. For instance, SMA is working with the SEC to promote resource conservation and Eco-Office among SMA members.

The government will continue to facilitate business participation in environmental sustainability. For example, NEA provides a seminar-style platform for companies to network and share their best practices in environmental sustainability through its Corporate Environment Champions Programme.

## PUBLIC SECTOR LEADERSHIP

### Environmental Education in Schools

We have to educate people from young on the importance of sustainable development and the environmental impact of the choices they make. Schools play a vital role in this effort. Hence, the Ministry of Education (MOE) has made environmental education part of the school curriculum. Environmental education is also one of the criteria in the School Excellence Model, which is used to appraise the overall performance of schools.



Everyone can play a part to keep our environment clean

## POWERING THE GREEN DRIVE: SENOKO

Senoko Power Limited, Singapore's largest electricity producer and retailer, has made caring for the environment its business. The company pioneered the use of natural gas for electricity generation purposes in 1992, and replaced its less efficient oil-fired plant with high-efficiency, gas-fired Combined Cycle Plant. This resulted in a reduction of approximately 2.5 million tonnes of carbon dioxide (CO<sub>2</sub>) per year. In addition, recognising the growing concern of climate change, Senoko launched a National Weather Study Project (NWSP) in 2005 to promote awareness of weather patterns, climate change and global warming among the youth in Singapore. By the second year of NWSP in 2007, two-thirds of all Singapore schools contributed a total of 372 projects.

Within the company, Senoko engages all employees and business partners in waste reduction and recycling programmes. It invested in a desalination plant at Senoko Power Station



to achieve self sufficiency in its water needs. Senoko has also adopted Sungei Sembawang and brought 10 schools on board to join in the regular clean-up of the river.

MOE has incorporated environmental topics such as recycling, energy and water conservation into the formal curriculum of subjects like geography, social studies and science. Several schools have also gone one step further by developing additional dedicated environmental education modules. Marsiling Secondary School, for example, introduced a 30-hour module that integrates topics on the environment while Nanyang Girls' High students are required to take a compulsory 25-hour programme on environmental science. NEA assists teachers

and students to develop and implement these additional environmental education initiatives.

NEA and PUB also encourage and train teachers and students to develop and implement their own environmental initiatives. A network of Environmental Education Advisors has been established within schools to act as a key point of contact and to promote better communication between teachers and NEA. More than 2,000 student "Environment Champions (EC)" are appointed to act as role models or "advocates"



## COMMONWEALTH SECONDARY SCHOOL

Commonwealth Secondary School converted the school pond into a Constructed Treatment Wetland to recycle used water for watering the plants in the school compound. The school introduced an Environmental Education Curriculum to help secondary one students understand the importance of water as a strategic resource and why it is crucial for Singapore to be self-sufficient in water. The school also adopted Sungei Pandan and Pandan Reservoir.

to assist their teachers in implementing school-wide and community initiatives. NEA trains youths to conceptualise and implement projects through the Youth Environment Envoy (YEE) programme. To date, more than 200 youths have been trained as YEEs. Similarly, PUB has initiated the "Water Ambassadors" programme that has already trained and equipped more than 2,000 students from uniform groups like the National Cadet Corps and Scouts Association with the knowledge and skills to spread the message of conserving, valuing and enjoying our waters to their schoolmates, families and friends.

PUB and NEA have also developed programmes to help students learn about environmental sustainability outside of classrooms. For example, they conduct "Learning Journeys" for students to the NEWater visitor centre, Marina Barrage, incineration plants, Semakau landfill and meteorological stations. Under PUB's "Our Waters" programme, students learn to take care of our waterways by conducting

activities such as patrols and clean-ups to ensure the cleanliness of their "adopted" waterways.

Going forward, schools will play an even bigger role in promoting environmental education.

- MOE will review and update the curriculum of environment-related subjects to generate more academic interest in and shape future careers relating to sustainable development, e.g. in clean energy and water technology.
- NEA and PUB will actively engage the school leadership to develop more environmental education programmes and disseminate best practices on environmental education among the local network of schools.
- BCA will work with MOE to study the development of a prototype "sustainable school" that will yield resource savings and provide a conducive and healthy learning environment. The campus itself will also serve as an educational platform

for students to learn about and even experiment with green building technology.

### 3P Partnership Fund

The public sector facilitates and participates in people-private-public sector partnerships on sustainable development.

- NEA will leverage on a \$1.5 million 3P Partnership Fund to assist organisations from across the people, public and private sectors that may lack the financial resources to realise worthy ideas on environmental sustainability. Through this fund, NEA hopes to forge even more intra- and inter-sector partnerships amongst individuals,

organisations, and companies to promote sustainable development.

### Public Sector Walks The Talk

Finally, the public sector will show leadership in environmental sustainability both as a consumer of goods and services and as a responsible employer. Public servants will be agents of change by using energy and resources more judiciously, and playing their part to improve the public sector's performance in resource efficiency. The government will also lead by example by using its substantial procurement spending to effect change and demonstrate the benefits of environmental sustainability. Please see Appendix 1 for details.

## CONCLUSION

Since early 2008, thousands of individuals and representatives of organisations have contributed their ideas and support to develop this blueprint. Now is the time for us to act together to turn our ideas into reality and achieve our aspirations for Singapore. With a strong common vision and joint action by the people, public and private sectors, we can together make Singapore a vibrant and liveable city we are all proud to call home.

**CONCLUSION –  
BUILDING OUR  
FUTURE TOGETHER**



Five million people now call Singapore home, nearly three times the number in 1960. Since then, we have cleared squatter colonies and slums in our city. In their place, we built a modern city, wired and connected to the world. We established new industries, created good jobs, greened our city, cleaned up our rivers, improved public health and built a world-class public transport system. We enjoy a high standard of living today because the earlier generation of Singaporeans consciously sought to safeguard our clean and green city while developing our economy.

Singapore today, with its gleaming skyscrapers and cosmopolitan people, may seem a world apart from its humble origins. But our resource constraints remain. Our land supply is limited. We have to import energy, water and food. With a small domestic market, we have to

continually make ourselves relevant to the global economy if we want to grow and create good jobs.

The current generation of Singaporeans will have to find creative ways to keep our economy growing and thriving, while acting as stewards of the environment, both for today, and for future generations to come.

We will have to do this in the face of new and increasingly difficult challenges. Singapore is now in the midst of a global economic crisis. The crisis is a timely reminder that we cannot take economic growth for granted. Faced with the pressures to cut costs, save jobs and jump start the economy, we may be tempted to set aside our environmental sustainability goals as luxuries that we cannot afford at this time. But doing so will be too short sighted.

Just as we did 40 years ago, we must give equal priority to maintaining a good living environment even as we seek to boost our economy and combat unemployment. There is now greater urgency to do so. There will be greater competition for land, energy and water, as our economy and population grow further. It will also be more difficult to maintain our air quality, public cleanliness and a sense of space and comfort as our city becomes more densely built in the future. The challenges of climate change require all nations, including Singapore, to make an effort to reduce the emission of greenhouse gases.

This Blueprint contains ideas from stakeholders in the public, private and people sectors on how to develop Singapore in a more environmentally sustainable way. Going forward, we have to do more in a few areas.

First, we have to enhance our resource efficiency because rising demand for resources is likely to outpace supply growth in the long run. It is also the most practical and effective way for Singapore to help address global climate change. Business and community leaders we consulted said that we should pursue energy efficiency as aggressively as we did in finding solutions to overcome our water dependency.

Second, we will need to keep pollution under control and make Singapore an even cleaner and greener city to live in, as our city becomes more densely populated. A high quality living environment will also give Singapore an edge in the global competition for local and foreign capital and talent in the years to come.

Third, we have to invest more in technology to find new solutions to overcome our resource constraints. Cities around the world face the same challenges of achieving growth while reducing the negative impact of growth on the environment. As we innovate to overcome our challenges, we can in turn contribute to solving the world's most pressing problems and create new job opportunities for our residents.

Implementing these plans will require us to take a long term view to our development, and commit to invest in environmental sustainability in both good times and bad. Some measures in this blueprint, such as helping households to reduce electricity and water consumption, will yield immediate savings. Yet, others may require us to incur upfront costs to put in place new systems and processes or to invest in testing new technologies to enhance resource efficiency.

We will take a pragmatic approach. We will not put aside our plans just because we incur some costs in the short term to implement these plans. On the contrary, we will set clear goals and track our progress. However, we will implement the plans in a way that avoids sharp cost increases for businesses, households and commuters in a time of economic hardship. As a start, the government will invest \$1 billion over five years to support the implementation of the plans in this Blueprint. Part of this sum will go towards helping businesses reduce the upfront costs of investing in resource efficient buildings, systems and processes. By doing so, we are also helping them improve their cost competitiveness over the medium term.

The government's efforts alone are inadequate. We need a "whole of nation" effort to make Singapore a more sustainable city. The private sector will have to act in environmentally responsible ways, even as they seek to exploit business opportunities and create much-needed jobs. Citizens and individuals will have to be prepared to make personal adjustments to their lifestyles.

The time to act is now. By working hand in hand today, we can bring about a second transformation of Singapore – into a high value, innovation powered economy within a city of gardens and water. Above all, we can build a future Singapore that we all aspire to – a liveable, lively, and well-loved home – as our gift to our children and future generations of Singaporeans.

**APPENDIX 1  
PUBLIC SECTOR PUTS  
ENVIRONMENTAL SUSTAINABILITY  
INTO PRACTICE**

The public sector will walk the talk. It will adopt measures to better economise on the use of resources such as energy and water. By demonstrating the economic and environmental benefits of such measures, we hope to encourage individuals and companies to take action to become more efficient and sustainable as well.

## EXISTING EFFORTS

Over the last two years, the government embarked on the following efforts:

- All large<sup>1</sup> government office buildings, as well as polytechnics and ITEs, will conduct energy audits to improve their energy efficiency by March 2010. As at January 2009, 12 of 48 buildings have completed energy audits, adopted energy saving measures and reaped \$3 million in total annual savings. Another 10 buildings have completed energy audits and are in the process of implementing energy efficiency measures that can achieve a potential annual saving of \$2.5 million. The remaining 26 buildings will complete their audits within the next year.
- All large government buildings have to ensure that the ambient indoor air temperature is maintained within the range of 22.5°C to 25.5°C.
- Large government buildings have to progressively meet a minimum standard of 4.7 in terms of the Coefficient of Performance (COP)<sup>2</sup> of their air conditioning plants, either after their energy audits or at the next chiller plant replacement. A few of our buildings are already able to meet this standard. Currently, CPF Building, Environment Building and MOM building have each achieved a COP

of at least 4.7. The Treasury is expected to improve its COP to 5.4 by August 2009.

- From April 2007, all new government building developments with more than 5,000m<sup>2</sup> Gross Floor Area (GFA) have to attain BCA's Green Mark (GM) Scheme Certified Level or higher. This was subsequently made mandatory for all new buildings in Singapore with GFA of 2,000m<sup>2</sup> or more in April 2008.

## FUTURE MEASURES

The public sector will implement the following new measures:

### Energy Efficiency

- **Energy Audits:** We will require buildings with central air-conditioning systems and air-conditioned floor area of more than 10,000m<sup>2</sup> to also conduct energy audits by FY2011<sup>3</sup>. Mandatory audits will also be extended to infrastructure facilities, which account for almost 15% of total public sector electricity consumption.
- **Energy Smart Office label:** The Energy Smart Office label provides recognition for best practices in energy efficiency for buildings in Singapore. Office buildings with energy

<sup>1</sup> With more than 15,000m<sup>2</sup> of air-conditioned floor area.

<sup>2</sup> The COP is an indicator used for measuring the efficiency of chiller plants. According to ASHRAE (American Society of Heating Refrigeration and Air-Conditioning Engineers) standards, a COP of 4.7 would fall under the 'Good' category, achievable by 'high-efficiency optimised chiller plants'.

<sup>3</sup> Financial Year (FY) 2011 starts from April 2011 and ends at March 2012.

performance amongst the nation's top 25%, and which maintain a healthy and productive indoor environment, can qualify for the Energy Smart label<sup>4</sup>.

We will require all existing government office buildings with central air-conditioning systems and more than 10,000m<sup>2</sup> air-conditioned floor area to achieve the Energy Smart Office label, within two years of their energy audits<sup>5</sup>. New government office buildings with central air-conditioning systems also have to attain the label within 2 years of operations.

- **Coefficient Of Performance (COP) of air-conditioning plants:** A major potential source of energy savings for buildings is improving the system efficiency of their central air-conditioning plants, as measured by their COP. The upfront cost required to optimise these plants to achieve a COP of 4.7 is expected to be less than \$1 million, with a payback period of about 4.5 years.

We will extend the requirement to install instrumentation to monitor the COP of central air-conditioning plants and to achieve a COP of at least 4.7 at the next available opportunity, to buildings with more than 10,000m<sup>2</sup> air-conditioned floor area.

- **Maintaining appropriate ambient indoor temperature:** We will encourage all government agencies to work with energy service companies (ESCO) to determine how best to monitor indoor temperatures and ensure that the indoor air temperature of all government premises remain within the range of 22.5°C to 25.5°C. An increase of 1°C in the air-conditioned indoor room

temperature could reduce air-conditioning electricity consumption by about 3%.

- **Office Information and Communication Technology (ICT) equipment:** We will require all new office ICT equipment to meet the latest ENERGY STAR standards, where available, from FY2009 onwards. We estimate that adopting the latest ENERGY STAR 4.0 standards for desktops, monitors and laptops alone can save the government about \$12.8 million annually, or net lifecycle savings of \$30.7 million.

## Water Efficiency

The Water Efficient Buildings (WEB) initiative under the PUB's 10% Challenge Programme seeks to reduce water consumption in the non-domestic sector. To date, 444 government buildings including schools are already certified as Water Efficient Buildings.

PUB will work with all government agencies and schools to achieve the WEB label for buildings they own by FY2010.

## Recycling

Currently, approximately 73% of government agencies already implement recycling programmes, which include initiatives to recycle paper products, plastics, metals (e.g. aluminium

<sup>4</sup> Qualifying buildings are also required to achieve a COP of at least 4.7 for their central air-conditioning plants.

<sup>5</sup> Buildings which have already completed their energy audits should attain the Energy Smart Office label by end FY10.

cans) and print cartridges. Proceeds from the sales of these recyclables for each agency can amount to a few thousand dollars annually.

Going forward, all government agencies will implement recycling programmes by FY2009.

## General Environmental Sustainability

- **Eco-Office Label:** The Eco-Office Green Office label rates offices on a range of practices – energy efficiency, recycling, water conservation, reducing paper use, purchase of environmentally friendly office equipment, use and reuse of reusable resources, and monitoring of resource consumption.

Government offices have to achieve the Eco-Office Green Office label by FY2011.

- **Green Mark (GM):** Buildings with higher GM levels use less energy than typical buildings,

and energy savings over the buildings' lifetime exceed any higher upfront cost involved. For instance, new buildings which achieve the GM Platinum standard are expected to reduce energy consumption by 30-35% and the cost savings achieved can pay back the additional upfront capital cost within 6 years. Existing buildings which achieve the GM Gold<sup>PLUS</sup> standard can reduce energy consumption by about 25-30%, with a payback period of 6 to 10 years.

Going forward, all new government buildings with more than 5,000m<sup>2</sup> air-conditioned floor area, including buildings with development cost fully or partly funded by the government (e.g. new universities and hospitals), will have to attain the GM Platinum level. Existing government buildings with more than 10,000m<sup>2</sup> air-conditioned floor area also have to attain the GM Gold<sup>PLUS</sup> standard by 2020.

**APPENDIX 2**  
**IMCSD PUBLIC CONSULTATION**

This report is jointly created by the people, private and public sectors in Singapore. Over the span of one year, the Inter-Ministerial Committee on Sustainable Development (IMCSD) and government officials met with members of the public, leaders of non-governmental organisations and businesses, members from academia, media editors, and Mayors.

Thousands of people responded enthusiastically to the consultations and contributed their ideas and aspirations for a Sustainable Singapore through various channels. The IMCSD received over 1,300 suggestions via the Sustainable Singapore website and more than 700 people participated in the focus group discussions, public forums and dialogue sessions. Grassroots leaders also contributed their ideas to the feedback agency, REACH (Reaching Everyone for Active Citizenry @ Home).

The public's views helped to shape the Committee's recommendations in the blueprint. The following are some examples of the key recommendations the IMCSD has adopted in direct response to the public feedback.

## Recycling

**What Some Suggested** There were many ideas on how to further promote recycling, including stepping up public education and providing more extensive recycling facilities.

**Our Response** NEA will study the feasibility of installing new infrastructure that can make recycling even more convenient. These include combined public litter and recycling bins, separate chutes for recyclables, and pneumatic

refuse conveyance system (PRCS) with a recycling function. A new 3R Fund will also be established to provide some financial assistance to companies to offset the cost of putting in place new recycling programmes.

## Green Buildings

**What Some Suggested** There were many suggestions on what government, businesses and individuals can do to reduce energy consumption, particularly in promoting green buildings (e.g. double glazing, tropical architecture), making public lighting more energy-efficient (e.g. phasing out incandescent light bulbs, having motion sensors for lighting in public places), and tackling "over-cooling" in buildings.

**Our Response** The government will establish a \$100 million Green Mark Incentive Scheme (Existing Buildings) to encourage the retrofitting of large existing buildings to include more green building features. The public sector mandates all large public buildings to undergo energy audits and adopt energy-saving measures. Some of these include upgrading existing chiller plants and maintaining ambient indoor air temperature at between 22.5°C to 25.5°C.

## Solar Energy

**What Some Suggested** Many Singaporeans have suggested the installation of solar panels within our public housing estates.

**Our Response** HDB will embark on an islandwide test-bed of solar technology within 30 public housing precincts. This will help HDB prepare for implementing solar technology on a wider scale when it becomes cost-effective to do so.

## PUBLIC FORUMS

Two public forums on 'Building a Sustainable Community' and 'Enhancing the Built Environment' were held in October and November 2008 respectively to discuss preliminary ideas for the blueprint. The forums were attended by more than 400 members of the public.

The forum on 'Building a Sustainable Community' was chaired by Minister for the Environment and Water Resources, Dr Yaacob Ibrahim, together with panellists Mr Howard Shaw (Executive Director of the Singapore Environment Council), Dr Josephine Kwa (Chief Operating Officer of NSL Ltd), and Mrs Teo Khin Hiang (then Principal of Commonwealth Secondary School). The panellists shared their views on how the people and private sectors could work with the public sector to build a community

with environmentally-friendly practices and behaviour that would contribute to sustainable development in Singapore.

The forum on 'Enhancing the Built Environment' was chaired by Minister for National Development, Mr Mah Bow Tan, together with panellists Associate Professor Lee Siew Eang (Director of the Centre for Total Building Performance and head of the Energy Sustainability Unit at the School of Design and Environment of NUS), Mr Tai Lee Siang (then President of the Singapore Institute of Architects), and Dr Shawn Lum (President of Nature Society). The panellists shared on the significant potential for energy savings in our built environment, how the architecture industry could promote green design, and the challenges of nature conservation in Singapore's urban context.

## Vehicular Emissions

**What Some Suggested** There were many calls for taxis and buses to emit fewer pollutants or switch to cleaner fuels such as CNG.

**Our Response** All new diesel vehicles are required to meet the Euro IV standard, which results in less harmful emissions. The LTA expects all taxis and buses to attain this standard by 2014 and 2020 respectively. The LTA will also trial the use of Diesel Particulate Filters (DPFs), a technology that can further reduce the emission of harmful substances, on a range of diesel-driven vehicles for possible widespread application. It will also study alternate fuel technologies such as hybrids.

## Cycling

**What Some Suggested** There were many calls to promote cycling, for instance, by establishing separate lanes and clear rules for cyclists, and installing better facilities (e.g. bicycle stands, shower/locker facilities) for cyclists.

**Our Response** LTA will be implementing cycling networks within HDB towns and providing parking facilities near MRT stations to promote cycling as an alternative mode of transport, especially for intra-town and short distance commuting to key public transport nodes.

## Greenery

**What Some Suggested** There were many suggestions on increasing the amount of greenery in Singapore, such as creating more park spaces in HDB estates, and utilising the rooftop spaces to plant more greenery.

**Our Response** NParks will be expanding our parkland by 900ha over the next 10 years, to bring our total parkland to 4,200ha by 2020. The length of park connectors will also be increased to 360km to make these parks more accessible. HDB will be developing green roofs on the top deck of multi-storey car parks. The government will incentivise existing building owners within strategic zones to implement green roofs and vertical greenery. URA will also be requiring new developments within strategic zones to provide landscape areas within the developments.

## Biodiversity

**What Some Suggested** There were many calls to conserve our natural biodiversity.

**Our Response** NParks will be developing the Singapore National Biodiversity Strategy and Action Plan to guide our efforts at conserving our natural heritage over the next 10 to 15 years. The Action Plan includes conducting new research and documentation as well as promoting public awareness and appreciation of Singapore's biodiversity.

## MAJOR CONSULTATION ACTIVITIES

### TIME PERIOD

January 2008

April 2008

June to July 2008

July 2008

July 2008

July 2008

July 2008

July to August 2008

August to September 2008

September 2008

### MILESTONES

The Inter-Ministerial Committee on Sustainable Development (IMCSD) was set up to formulate a national framework and strategy for Singapore's sustainable development in the context of the emerging domestic and global challenges.

NUS and NParks surveyed the general public and professionals including architects, landscape architects, developers and policy makers for their views on vertical greenery. The large majority indicated that they would like to see the implementation of vertical greenery in buildings in which they work or live, and felt that vertical greenery would help to enhance Singapore's image as a Garden City.

LTA held meetings with industry partners to discuss proposals to improve fuel efficiency and promote cleaner forms of transport. Possible trials to test the viability of diesel hybrid buses with private and public bus operators, diesel particulate filters on diesel vehicles, electric vehicles, and setting up a vehicle emissions test laboratory, were suggested.

A website, [www.sustainablesingapore.gov.sg](http://www.sustainablesingapore.gov.sg), was launched to solicit public feedback and suggestions on how we could make the way we live and play, commute and work more sustainable.

40 companies were surveyed on Energy Management System (EMS) and energy efficiency measures. The companies highlighted several barriers to adopting energy efficiency measures and gave suggestions on how these could be better implemented.

Singapore Packaging Agreement (SPA) Governing Board met the 34 signatories of the SPA to gather feedback. The signatories highlighted the need for more public education on the importance of reducing packaging waste.

HDB showcased the Yishun cycling track project at the "Enriching My Yishun" exhibition. 95% of the residents polled were supportive of having a more extensive network of cycling tracks in Yishun.

Site visits were conducted on premises with ongoing food waste recycling programmes. Companies gave feedback about the challenges in implementing food waste recycling.

HDB conducted a survey in Sembawang, Jurong, Aljunied, Ang Mo Kio and West Coast on the implementation of skyrise greenery in estates. A great majority of the residents supported the initiative to introduce more green roofs to existing multi-storey carparks (MSCPs).

LTA had discussions with advisors and grassroots leaders on the proposed cycling routes and measures to ensure riders' conduct.

## MAJOR CONSULTATION ACTIVITIES

### TIME PERIOD

September to December 2008

October 2008

October 2008

November 2008

November 2008

December 2008

December 2008

January 2009

January 2009

February 2009

March 2009

April 2009

### MILESTONES

BCA and relevant agencies met with an international panel of experts to discuss proposed initiatives in the Second Green Building Master Plan. Views of industry stakeholders were also taken in through three focus group discussions with developers, architects, construction companies, facilities managers, etc.

BCA met with more than 40 representatives from SIA, REDAS, ACE, IES, banks and building owners, construction material suppliers, facility managers and stakeholders from the Construction Industry on initiatives for the Second Green Building Masterplan.

First Public Forum – ‘Building a Sustainable Community’.

Public exhibition on Sustainable Development was held at the Marina Barrage in conjunction with the launch of Clean and Green Singapore. The exhibition was repeated at the National Library for 1 week in December 2008.

Second Public Forum – ‘Enhancing the Built Environment’.

HDB met with residents of Serangoon North to seek feedback on water-efficient appliances in households during the Save Energy, Save Money, Save the Environment exhibition at Serangoon North Ave 3.

IMCSD co-Chairmen had a dialogue with REACH’s Policy Workgroup on Physical and Environmental Sustainability. They discussed, among others, the possibilities of integrating urban developments with nature, and promoting greater public awareness through schools and grassroots organisations.

HDB met up with town councils to discuss plans to promote energy efficiency in common areas under the Energy SAVE Programme.

URA and NParks held focus-group consultations with representatives from developers (REDAS, etc) and building professionals (SIA, SILA, SIP, etc) to seek feedback for two proposed skyrise greenery related schemes.

HDB held focus group discussions with town councils to explore the use of solar panels in public housing.

Relevant Non-Governmental Organisations (NGOs) such as Nature Society were consulted on the draft National Biodiversity Strategy and Action Plans.

Launch of this report.

## ACKNOWLEDGEMENTS

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### IMCSD Executive Committee

#### Co-Chairmen

- Mr Tan Yong Soon, Permanent Secretary, Ministry of the Environment and Water Resources
- Mr Tan Tee How, Permanent Secretary, Ministry of National Development

#### Sub-Committee Chairmen

- Mr Loh Khum Yean, Deputy Secretary (Industry), Ministry of Trade and Industry (Co-Chairman, Work Sub-Committee) [from June 2008]
- Mr Goh Chye Boon, then Deputy Secretary (Industry), Ministry of Trade and Industry (Co-Chairman, Work Sub-Committee) [to May 2008]
- Mr Andrew Tan, Chief Executive Officer, National Environment Agency (Co-Chairman, Work Sub-Committee) [from January 2009]
- Mr Lee Yuen Hee, then Chief Executive Officer, National Environment Agency (Co-Chairman, Work Sub-Committee) [to December 2008]
- Mr Lim Boon Wee, Deputy Secretary (Land and Corporate), Ministry of Transport (Chairman, Commute Sub-Committee)

#### Members

- Ms Chang Hwee Nee, 2 Deputy Secretary, Ministry of National Development
- Mrs Rosa Daniel, Deputy Secretary, Ministry of the Environment and Water Resources
- Mr Ng Wai Choong, Deputy Secretary (Policy), Ministry of Finance

- Mr Chew Tai Soo, Ambassador-at-Large, Ministry of Foreign Affairs

#### IMCSD Secretariat

- Mr Chua Soon Guan, Director (Strategic Policy), Ministry of the Environment and Water Resources (Co-Lead)
- Ms Teoh Zsin Woon, Director (Strategic Planning), Ministry of National Development (Co-Lead)
- Officials from the respective Ministries and their Statutory Boards

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