

Sustainable Singapore Blueprint



Message from the Prime Minister

Sustainability has always been integral to the Singapore story.

Our founding Prime Minister, Mr Lee Kuan Yew, said, “I have always believed that a blighted urban jungle of concrete destroys the human spirit. We need the greenery of nature to lift up our spirits.” In our early years, even as we provided basic necessities for our people, such as affordable housing; public infrastructure such as clean water, sewers and roads, education and jobs, we did so with “sustainable development” in mind, long before the expression became popular.

Just two years after independence in 1967, we launched the Garden City programme, with a vision to make Singapore a highly liveable city filled with greenery. We planted trees around public housing estates, cleaned up streets, cleaned up the heavily polluted Singapore River in the heart of the city, regulated and shifted pollutive industries, and enacted new laws against pollution. We conserved our Nature Reserves and built community parks that are spread throughout the country.



We expanded local catchments to capture as much rainwater as we could, and developed new technologies like water reclamation and desalination. Year by year, we overcame the challenges of urban development and became a clean and green city, thanks to the foresight and the hard work of our pioneers.

However, every generation has challenges of its own. All of us now face new risks, such as climate change and rising sea levels, or the threat of dangerous new pathogens like bird flu or the Zika virus. A growing global population and increasing urbanisation will also place greater pressures on resources such as water and energy.

The Sustainable Singapore Blueprint is our response to these challenges and a framework to guide our sustainability efforts until 2030. This latest 2015 edition outlines our national vision, and plans for our home, environment and future — an even more liveable and sustainable Singapore. It is our contribution to sustainable development at the global level.

To actively reduce our carbon footprint, and make better use of limited water, land, and energy resources, we will build “eco-smart” towns and public transit infrastructure, so that people can travel seamlessly around a “car-lite” urban environment. We will strive to become a zero waste nation, consuming less materials and giving them a second lease of life. We will build a green economy, nudging our businesses into doing good while also doing well.

We also encourage civic participation for an active and gracious community. The Blueprint takes in the views of more than 130,000 people via consultations on land transport and urban development master plans, public dialogues and surveys. In turn, it seeks to inspire Singaporeans to play a part in building a liveable and sustainable Singapore.



The Marina Barrage
Photo credit: PUB, Singapore's National Water Agency

However, no country can tackle these complex challenges on its own. We all have to work together, each country making its contribution. Singapore supports global efforts towards sustainable development. In April 2016, Singapore joined 170 other countries in signing the Paris Agreement. We host platforms like the World Cities Summit, Singapore International Water Week and CleanEnviro Summit Singapore so that all of us can learn from one another and inspire one another to do better. We also offer ourselves as a Living Lab where companies can work closely with government agencies to innovate and use new technology for sustainable urban solutions.

Our pioneers built a clean and green Singapore. It is our duty and responsibility to build on their legacy, to make Singapore even greener and more liveable, and to work with others to build better cities and a healthier planet, for ourselves and future generations.

Lee Hsien Loong
Prime Minister, Singapore

The Singapore Story on Sustainability and Liveability

Singapore was green long before it was fashionable to do so.

Our journey towards sustainability started in the 1960s before environmental issues became a global concern. We were a fledgling nation facing high unemployment with an unskilled labour force, predominantly living in urban slums that lacked sanitation and the support of adequate public infrastructure.

Our leaders then asked bold questions to ensure the long-term sustainability of Singapore and made a conscious decision to “green” our country. Then-Prime Minister Mr Lee Kuan Yew believed that “a blighted urban jungle of concrete destroys the human spirit” and that “we need the greenery of nature to lift our spirits”. In 1963, he planted the first tree that allowed the Garden City to take root.

Thereafter, Singapore launched its Keep Singapore Clean Campaign in 1968, clamped down on air pollution through the 1971 Clean Air Act and moved pollutive industries away from residential areas in the 1970s. These were bold steps for a newly industrialising country. By the 1980s, we had transformed the heavily polluted Singapore River into a beautiful vibrant destination.

Today, Singapore is regarded as a liveable and sustainable city. It houses five and a half million people in 719 square kilometres of land, but residents enjoy a high quality of life despite the high population density. We host international urban solutions meetings such as the biennial World Cities Summit, Singapore International Water Week and CleanEnviro Summit Singapore, which have attracted international interest.

Looking back, Singapore’s sustainability efforts can be distilled into a systematic framework that leaders can apply to their own cities. In its pursuit of sustainable development, Singapore has held three outcomes constant. A competitive economy attracts investments and provides jobs, a sustainable environment helps the city thrive despite limited natural resources, especially land and fresh water, and a high quality of life benefits people. These outcomes are not always at odds; solutions to achieve one outcome can create opportunities for another. For instance, our quest for water sustainability and the expanding water sector now provides about 14,000 jobs with a value-add of close to S\$2 billion per year.

Singapore’s three key outcomes are built on the twin foundations of integrated master planning and development,

and dynamic urban governance. Integrated master planning means planning for the long term, sometimes as far as a century ahead, yet retaining the flexibility to review plans as our needs change. Since the early decades of Singapore’s growth, the Urban Redevelopment Authority (URA) has regularly reviewed Singapore’s land-use plans to meet land demands while balancing economic and social development.

Integrated planning entails planners making use of digital planning tools to model future land use scenarios using data from the whole-of-government. Singapore also embraces new and innovative technologies to explore new frontiers where no other city has gone before. We embarked on ambitious projects such as the underground Deep Tunnel Sewerage System that criss-crosses the country to channel used water to centralised water reclamation plants. We will be one of the first countries in the world to implement satellite-based electronic road pricing to manage traffic congestion. Dynamic urban governance, meanwhile, means leading with vision and pragmatism, underpinned by a culture of integrity in the public service, and strong institutions with well-thought-out systems and processes. Government agencies engage the public and community groups, giving people a stake in their city’s long-term good. The agencies also work with the private sector to address certain gaps efficiently.

The Singapore we have today did not come about by chance. It is the result of visionary leadership, careful, long-term planning and the hard work of our forefathers who created this place we call home.

Photo credit: Ministry of the Environment and Water Resources



"Eco-Smart" Endearing Towns

We begin our sustainability journey where it matters most: *at home*. Through thoughtful planning and design of residential areas, Singapore makes it easy for people to live comfortably and in harmony with the environment.

Lush greenery, recreational spaces, and liveable districts that feature innovative design and technology are key to helping residents maintain a green lifestyle and enjoy a high quality of life.

CASE STUDY

Punggol Northshore

In residential homes, innovative design and technology such as the smart features at the Punggol Northshore district provide ways for people to save energy and water, and keep the environment clean.

The coastal town of Punggol in Singapore's north-east is a test-bed for smart urban planning and green technologies. Punggol Northshore, its latest district, is Singapore's first batch of "smart" public housing, kitted out with new technologies that enable residents to live with a lighter environmental footprint. Its development was guided by the Housing and Development Board's Sustainable Development Framework that sets out key desired sustainability outcomes.

In the planning of Punggol Northshore district, Singapore's Housing and Development Board (HDB) analysed wind flow, solar irradiance and shading to identify the best locations for solar panels and outdoor community amenities. It also modelled how water, waste, transport, energy and other systems interact to help planners and designers understand the trade-offs involved when integrating green features into the estate. In common areas, public lights and fans will be controlled by sensors, which will automatically adjust to optimise energy use while meeting residents' needs. In their homes, residents will be able to monitor and manage their home energy consumption in real time. They will have a pneumatic waste disposal system that will be cleaner, and will also track waste and recycling volumes and patterns, so that waste is collected only when needed.

However, the Punggol Northshore district, to be completed in 2020, is just the start. HDB, which houses more than 80% of the resident population, has test-bedded various sustainable urban solutions for existing estates. For instance, its Greenprint test-bed looks at how existing estates like Yuhua and Teck Ghee can be retrofitted with green features such as solar panels to harness renewable energy, bicycle parking to encourage green mobility, pneumatic waste systems to manage household waste more efficiently and hygienically, and rooftop and vertical greenery for a more pleasant living environment.



Artist's impression
of Punggol
Northshore
Image credit: HDB

CASE STUDY

Jurong Lake District – Jurong Lake Gardens

The Jurong Lake District in the west of Singapore, once a sleepy residential and industrial suburb, is currently being revitalised as a sustainable, mixed-use urban district that includes office, retail, and hotel spaces. At its heart is the 90-hectare Jurong Lake Gardens, which will be Singapore's third national garden. Located in the heartlands, it will be a people's garden that offers all segments of the community access to quality spaces for leisure and recreation. When completed, it will complement two existing world-class national gardens — the Singapore Botanic Gardens and Gardens by the Bay.

Jurong Lake Gardens mirrors Singapore's journey as a nation that balances development and conservation. The Gardens' habitats will be enhanced to demonstrate that urban landscapes can also support rich biodiversity, with a focus to create a high-quality, sustainable environment for Singaporeans from all walks of life to enjoy. Its development will be done sensitively with the intention to create spaces for families and the community to come together. At the same time, the development of Jurong Lake Gardens will also include the provision of infrastructure to create a seamless integration with the new Science Centre grounds and the lake. There will also be exciting horticultural concepts that feature the latest advances in science and technology, as well as science-based play equipment and amenities to facilitate discovery and learning.



Artist's impression of Jurong Lake Gardens
Image credit: National Parks Board

Singapore is known for its strong water management, which fulfills several aims at once: ensuring a reliable water supply, providing resilience against floods, and offering people community and lifestyle space.

RETROSPECTIVE

Singapore River and ABC Waters

In the early days of Singapore's independence, water supply and sanitation were pressing concerns. We suffered water shortages and were heavily reliant on water imported from Malaysia. At the same time, our rivers were polluted, and Singapore was prone to floods.

Singapore's leaders envisioned water sustainability, and a clean and flood-free environment. One key strategy to enhance water supply was to capture as much as possible of the 2,400 millimetres of annual rainfall. Stormwater also needed to be tamed to address the problem of flooding. To keep up with rapid development in the 1970s and 1980s, concrete, utilitarian drains and canals were constructed in the fastest ways possible to alleviate and preempt flooding.

In 1977, Singapore began cleaning up the highly polluted Singapore River and Kallang Basin as a first step towards tapping their catchment areas, which made up 30% of Singapore's land area then. The project to resettle squatters, relocate street hawkers, pig farms, and boatyards, dredge the river of sludge and rubbish, and tile the riverside and carry out landscaping, was completed in 1987.

By 2011, as Singapore progressively increased

its water catchment to two-thirds of the country's land area, we began to recognise water bodies and catchment areas as places for lifestyle and recreation. Through trails, boardwalks and water sports, we made reservoirs more accessible to the public and started transforming utilitarian drains into attractive waterways.

In 2006, Singapore's national water agency, PUB, launched the Active, Beautiful, Clean Waters (ABC Waters) Programme which builds community spaces around water bodies, integrates canals with the urban landscape, and improves water quality by using natural cleansing features. Water bodies and waterways have become a part of "home" that people enjoy and cherish. They enable people to learn about sustainable water supply and how everyone can play a part to achieve it.

ABC Waters projects often require close collaboration across agencies. For instance, Kallang River @ Bishan-Ang Mo Kio Park, a flagship ABC Waters project, was a joint effort between the National Parks Board and PUB. A large concrete drain was transformed into a meandering river and integrated with the adjacent park. The two agencies share maintenance responsibilities and work together to educate the public on the responsible and safe use of parks and waterways.



Kallang River @ Bishan-Ang Mo Kio Park, a flagship ABC Waters project. Photo credit: PUB

A "Car-Lite" Singapore

Going "car-lite" reduces traffic congestion and air pollution, as well as the city's carbon footprint. Besides environmental considerations, it is also about making cities serve pedestrians instead of vehicles. A "car-lite" city is one with

efficient and accessible rail and bus networks, streets and paths that are conducive for walking and cycling, and smart, on-demand point-to-point transport options.

CASE STUDY

A Civic District for the People

The Civic District, on the banks of the Singapore River, is the historic birthplace of modern Singapore. It is home to some of the most significant historic buildings, landmarks, monuments, and spaces in the city — for example, the former Supreme Court and City Hall buildings, Old Parliament House and the Padang, a public open space. The Urban Redevelopment Authority (URA) has undertaken extensive improvement works in and around the district to enhance the experience of this integrated arts, cultural and lifestyle precinct.

A spacious new lawn in front of Victoria Theatre and Concert Hall and the Asian Civilisations Museum, framed by mature rain trees, not only helps to create open vistas and majestic views of the historic Victoria Theatre and Concert Hall, but also adds greenery to soften the landscape and provide shade from the sun. The open space is also now equipped with power, water and lighting so that event organisers can "plug and play", and visitors walking along the Singapore River can take a break at stepped plazas or on benches equipped with mobile-phone charging points. Several new amenities will be installed, such as a new children's playground and better way-finding mechanisms at key entrance points.

A number of roads, such as the former Old Parliament Lane, have been converted into pedestrian areas/walkways. Connaught Drive has been repaved with enhanced landscaping, to create a more walkable space, seamlessly connecting the Padang and Esplanade Park. With these works, the Asian Civilisations Museum, the Victoria Theatre and Concert Hall, and the Arts House, a popular arts venue, are connected to each other within a unified precinct and park setting.

In February 2016, URA piloted the first edition of Car-Free Sunday SG — a six-month pilot — in the area around the Civic District and the Central Business District. For the pilot, these city streets were closed to vehicular traffic on the last Sunday morning of every month. With the roads free of cars, walkers, joggers and cyclists were able to take to the streets, while adjacent open spaces hosted sports and fitness sessions, family-friendly activities and a breakfast picnic area. A myriad of activities transformed the area into a walkable, cyclist-friendly and activity-filled precinct. Through the pilot programme, Singaporeans are able to enjoy the city in a new way, and to experience the benefits of a city with fewer cars.



Artist's impressions of a car-free Civic District
Image credit: URA



Schemes for sharing electric and autonomous vehicles could be a way to take more vehicles off the road while still offering residents convenient means of getting around.

CASE STUDY
Electric Vehicle (EV) Car-sharing

Car-sharing allows Singaporeans to access cars without needing to own one, and enables our car population to be used more efficiently. It helps encourage car-owners to switch to public transport and rely on car-sharing for occasional trips, thus reducing the number of cars on the roads. Today, the Housing and Development Board supports car-sharing by providing convenient car-sharing parking lots in 110 public housing car parks.

Following a 2011 test-bed to assess the technical feasibility and establish the presence of EVs in Singapore, an EV car-sharing programme will soon be implemented. This will make car-sharing in Singapore even more environmentally-friendly.

The EV car-sharing programme will involve 1,000 passenger cars, making EVs more available to the public, and catalysing investments in EV charging infrastructure nationwide. It will also provide industry players with the opportunity to develop and test innovative and potentially disruptive e-mobility solutions, with the aim of eventually exporting them to other cities in the region.



Bolloré Bluecars will be used for Singapore's electric vehicle (EV) car-sharing programme.
Photo credit: Economic Development Board

Singapore's original "car-lite" innovation was a bold policy step: introducing road pricing to manage traffic congestion. It has since evolved into what is known as the Electronic Road Pricing or ERP system, and is considered a policy success internationally.

RETROSPECTIVE
Regulating Car Usage with Electronic Road Pricing

As Singapore's population and economy grew and developed in the early years after independence, our vehicle population also began to grow rapidly. From 1962 to 1973, the motor vehicle population grew at an average of 9% each year. Congestion around the Central Business District worsened, causing traffic delays and air pollution.

As little could be done to expand the road network due to the old city layout, Singapore introduced the Area Licensing Scheme (ALS) in 1975, becoming the first country in the world to use congestion pricing to discourage car usage. Drivers had to buy and display a licence on their dashboards to enter a restricted zone. The scheme redistributed traffic to other routes, cutting more than 40% of traffic entering the Central Business District during restricted hours, and reduced congestion.

But as a manual system, it had limited flexibility in adjusting the congestion charges in response to changes in traffic conditions. In 1998, Electronic

Road Pricing (ERP) replaced the ALS. The fully automated ERP scheme uses in-vehicle units to deduct a fee from a prepaid card each time a car travels past an ERP gantry. Such gantries are installed along roads that are prone to congestion. Most importantly, it allows the congestion charge for different roads and areas to be adjusted easily as traffic conditions change. It took months of public outreach to implement the ERP system smoothly.

A year after implementation, traffic volumes on the roads with ERP gantries had dropped by 15% on average. Today, the ERP scheme continues to evolve to keep pace with new technology. Singapore is developing an ERP system based on Global Navigation Satellite System (GNSS) technology. This will allow the possibility of managing traffic congestion through distance-based pricing which is more equitable as motorists will be charged proportionately according to the distance travelled on these congested roads.



Singapore's Electronic Pricing System (ERP) helps to keep traffic congestion in check. Photo credit: Land Transport Authority

Towards a Zero-Waste Nation

Singapore aims to move towards becoming a zero waste nation by reducing its consumption of materials, and reusing and recycling them to give them a second

lease of life. It keeps Singapore clean and healthy, conserves precious resources, and frees up land that would have otherwise been used for landfills.

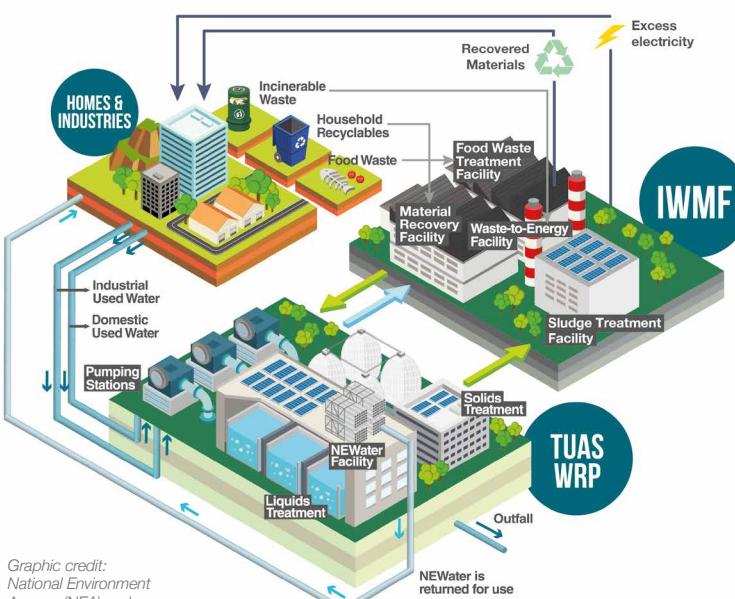
CASE STUDY

Co-location of Tuas Water Reclamation Plant and Integrated Waste Management Facility

The treatment of used water and the treatment of waste have traditionally been independent processes. Used water is channelled by sewers to water reclamation plants, recyclables to recycling plants, and incinerable waste to waste-to-energy plants.

Now, as part of Phase 2 of the Deep Tunnel Sewerage System (DTSS), Singapore intends to co-locate its upcoming Tuas Water Reclamation Plant (TWRP) with an Integrated Waste Management Facility (IWMF) to optimise land use and more efficiently reclaim water, generate energy, and process waste. The compact TWRP in the western region will have even more advanced features to improve energy efficiency and reduce waste, and be highly automated to minimize manpower needs. In addition, PUB, Singapore's national water agency, is currently test-bedding various technologies that have the potential to harness more energy from used water for use in the new TWRP.

Meanwhile, National Environment Agency (NEA) is developing the IWMF which will be equipped with state-of-the-art technologies for handling multiple waste streams and optimising resource and energy recovery. The waste streams include incinerable waste, household recyclables from Singapore's National Recycling Programme, source-segregated food waste, and dewatered sludge from the TWRP.



Graphic credit:
National Environment Agency (NEA) and PUB.

The co-location of the IWMF and TWRP will provide both NEA and PUB with many opportunities to reap the benefits of a water-energy-waste nexus. These include:

- Co-digestion of IWMF's food waste with TWRP's sludge to increase the production of biogas
- Use of TWRP's biogas at IWMF to increase IWMF's overall plant thermal efficiency and power production
- Supply of electricity from IWMF to TWRP to lower TWRP's energy cost
- Supply of treated effluent water from TWRP to IWMF for its processes

The TWRP and IWMF will help to meet Singapore's used water and waste management needs far into the future.

CASE STUDY

Singapore Packaging Agreement

Packaging waste such as bottles and cans makes up a third of Singapore's domestic waste by weight. In 2007, NEA signed a voluntary agreement, the Singapore Packaging Agreement, with industry and non-government organisations to reduce packaging waste.

Companies that sign the Agreement pledge to cut their packaging waste, by making improvements to their packaging design, usage practices or manufacturing processes. They can also share their experiences, exchange practical ideas, and collaborate with others to develop waste reduction solutions. More than 170 organisations, including industry associations, companies, and non-governmental organisations, have signed this Agreement. Since 2007, the signatories have cumulatively reduced about 26,000 tonnes of packaging waste, saving more than S\$58 million in material costs for locally-consumed products. Each year, the 3R Packaging Awards recognise signatories who have made notable efforts and achievements in reducing packaging waste such as reducing the thickness of packaging. For example, by redesigning a drink bottle to use less plastic, F&N Foods cuts its annual plastic usage by 34.3 tonnes. It won a Distinction Award in 2015 for this and other efforts.

In 2015, a packaging benchmarking database was launched to urge businesses to improve their packaging design and use of materials, and encourage them to reduce the amount of packaging in their products. There are packaging weight benchmarks for product categories such as cooking oil, chilled juice and powder detergent. This will ultimately help conserve resources and reduce waste generation.



3R Packaging Awards 2015 Winners. Photo credit: NEA

RETROSPECTIVE

Singapore Waste Management Story Incineration and Semakau Landfill

Singapore's original motivation to manage waste stemmed from a public-health perspective and a desire to attract investors. It found it also had to balance waste management with land-use demands, so it turned to incineration to minimise the space needed for landfills.

Land-scarce Singapore incinerates its waste to conserve landfill space and harvest energy from burning. The first waste-to-energy plant in Singapore opened for business in 1979. Today, all incinerable waste is disposed of at four waste-to-energy plants that supply up to 3% of Singapore's energy needs, with another plant to be built by 2019. The new, highly efficient plant will generate 800 kWh of electricity per tonne of waste — a great leap from Singapore's first incineration plant, which produced 180 kWh per tonne.

However, even incineration ash has to be disposed of somewhere. By the 1990s, Singapore had run out of suitable landfill sites on the mainland and an offshore landfill had to be considered. Singapore already had decades of expertise in land reclamation, and the engineering expertise to ensure that pollutants would not leach into the surrounding seawater. In 1994, it was decided that Pulau Semakau, an island south of mainland Singapore, would be developed for a landfill.

The 350-hectare landfill, bounded by Semakau and neighbouring Pulau Sakeng, was designed with a membrane-lined bund to prevent leaching, while corals and mangroves from the site were relocated or replanted. Semakau Landfill began receiving incineration ash and non-incinerable waste in 1999. In 2005, it was opened to the public for sport fishing, birdwatching and other recreational activities. The landfill receives the ash from incineration, as well as non-incinerable waste like treated industrial sludge that is safe for landfilling. After being expanded in 2015, it will provide for Singapore's waste disposal needs till 2035.

Even as Singapore continues to develop the nation's solid waste infrastructure, the nation's waste output is projected to increase. The sustainable solution is to minimise waste and maximise recycling through the practice of the 3Rs (reduce, reuse and recycle). This will bring us closer to the targeted 70% recycling rate by 2030 and help make the vision of working towards a "Zero Waste Nation" a reality.



Singapore's first offshore and only existing landfill. Photo credit: NEA

A Leading Green Economy

Our businesses will adopt greener practices, our city will be a hub for the cutting-edge business of sustainable development, and jobs will be created in this exciting and meaningful sector.

CASE STUDY

SolarNova Programme

With the falling cost of solar energy systems and new business models such as power purchase agreements, solar energy is the most promising renewable energy source for Singapore. In 2014, Singapore announced its plans to raise the adoption of solar power to 350 MWp by 2020. Then, solar installation nationwide stood at a mere 19 MWp. To support this push, the Singapore Economic Development Board launched the landmark SolarNova programme. The programme aims to accelerate solar deployment in Singapore by promoting and aggregating solar demand across government agencies.

Over time, systems will be installed on the rooftops of about 6,000 public buildings such as public housing, schools, police stations and utility plants. The programme is the first of its kind in the world on such a scale. The Housing and Development Board (HDB), Singapore's public housing agency, which manages housing for more than 80% of the city's population, serves as the government's central procurement agency for solar energy systems. By aggregating the public sector's demand for solar energy, smaller agencies with less rooftop space or lower energy demand can benefit from economies of scale and lower costs from bulk tenders.

The first SolarNova tender for 76 megawatt peak of energy was awarded in December 2015. It will cover 831 HDB blocks, and eight Ministry of Home Affairs and PUB sites, with installations expected to be completed in end-2017. Apart from raising domestic solar adoption and combating climate change, SolarNova will strengthen Singapore-based solar enterprises and in turn, spur the private sector to adopt more solar energy.

The escalating adoption of cost-competitive solar energy in Singapore has opened up new innovation opportunities around smart grid and energy management. It has also strengthened Singapore's position as the leading clean energy hub in the region. From a handful of companies in 2007, Singapore is now host to about 50 solar companies serving the region.



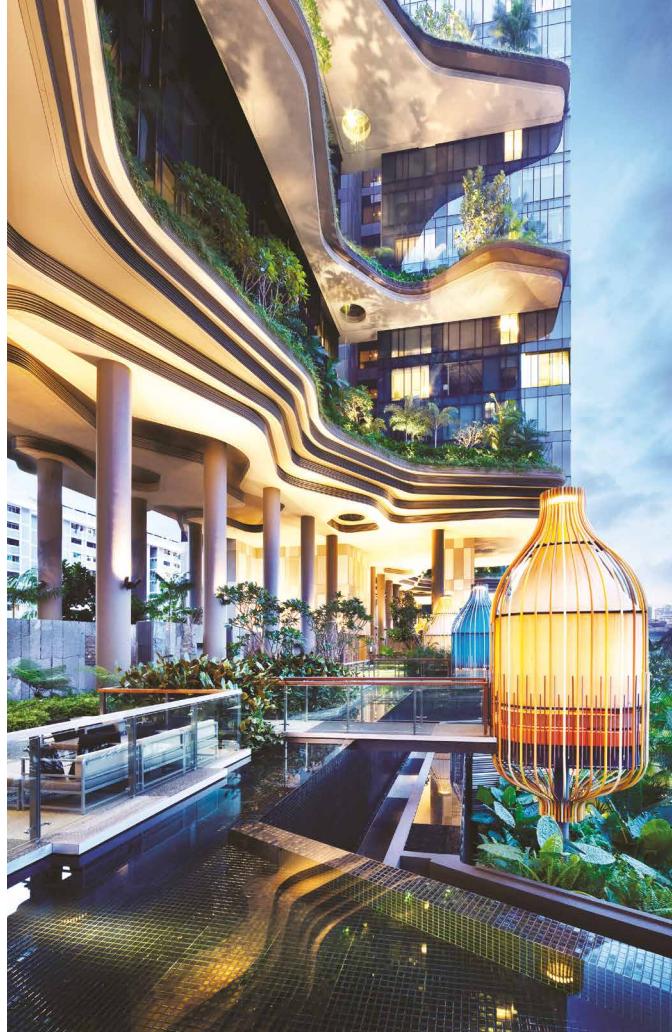
Solar system installation at Jurong Town Council. Photo credit: Sunseap

Singapore's building sector, too, is driven to become more sustainable through a combination of incentives, research investments, and gradually raising the bar on minimum green-building standards, under the national Green Building Masterplan.

CASE STUDY
Green Building Masterplan

Greening buildings is one of the most effective ways for a city to reduce its overall carbon footprint. In 2005, the Building and Construction Authority (BCA) launched a Green Mark rating scheme to assess tropical buildings' environmental performance. BCA have set a target for 80% of Singapore buildings to achieve these standards by 2030. The Green Building Masterplan, updated every few years, sets out a multi-pronged approach to accelerate sustainability in the built environment sector. The third Green Building Masterplan, published in 2014, encourages building owners and tenants to become more energy-efficient. Incentives such as gross-floor-area bonuses and financing are used to encourage the adoption of more energy-efficient equipment.

In the public sector, the government leads by example. All new and existing public sector buildings must achieve environmental sustainability standards. Strategic sites in key growth areas are also required to achieve high Green Mark standards as part of the Government Land Sales conditions. To further research and development efforts in Singapore, BCA has launched the S\$52 million Green Buildings Innovation Cluster. This will boost the development and testing of promising and innovative technologies and green building solutions among research institutions, property developers, and other building professionals. In 2016, the BCA's SkyLab, the world's first high-rise, rotating rooftop laboratory in the tropics, will begin testing new green building technologies.



PARKROYAL on Pickering, a BCA Green Mark Platinum Non-Residential Building.
Photo credit: PARKROYAL on Pickering

Internationally, Singapore shares its expertise with cities around the world through its involvement in international projects, such as the BCA Centre for Sustainable Buildings, a collaboration with the United Nations Environmental Programme to promote best practices and build capacity. The BCA Green Mark scheme has also attracted interest from the region, with more than 280 overseas applications from 14 countries to date.

As of 2015, there are more than 2,600 green building projects in Singapore. This amounts to more than 76 million square metres, or more than 30% of buildings' total gross floor areas.

RETROSPECTIVE
Birth of a Water Industry

Singapore is internationally renowned for its expertise in water treatment and management. Today, its water industry is known for doing well while conserving scarce resources. It was born out of the city's urgent need for a stable, clean water supply, but has become a national asset.

From its earliest years, Singapore knew domestic water sources and imported water alone would not meet the future needs of a rapidly growing population and economy. It had already considered using recycled water and desalinated water to meet demand. In the 1990s, national water agency PUB sent engineers and officials on study trips to the US and the Middle East to observe water recycling and desalination methods. It carried out trials and built pilot plants when costs became competitive.

In 2003, Singapore became one of the first countries in the world to make widespread use of reclaimed water, which it calls NEWater. Singapore's first desalination plant was completed in 2005 by Hyflux under a Design, Build, Own and Operate (DBOO) approach. This procurement model has since been used for a number of NEWater and desalination plants, and has encouraged the development of new technologies and systems.

In recent years, Singapore has gone from managing water as a resource to viewing it as an economic asset. In 2006, a multi-agency programme office was set-up to promote research and development in the field and grow

the water industry. With S\$470 million from the National Research Foundation over 10 years, PUB aims to position Singapore as a global hub for leading-edge technologies and further Singapore's vibrant research community. It offers funding and commercialisation help for basic and applied research and development, graduate scholarships for water technology research, financial incentives, and mentoring for startups. Beyond funding, PUB provides space in its facilities for promising new water technologies to be test-bedded under actual site conditions.

Today, thanks to Singapore's substantial investments in water technology, a thriving cluster of about 180 water companies and more than 20 research centres has emerged, providing services along the entire water value chain. Local companies such as Hyflux have been able to expand internationally on expertise gained here.

Over the next five years, PUB will continue to work with all relevant agencies to build on this foundation, with closer integration for sustainable urban solutions. We will explore innovative ways to tap on shared synergies and reduce our land and resource footprint.



PUB invests in R&D, such as membrane technologies, to ensure a sustainable water supply. Photo credit: PUB

An Active and Gracious Community

The ingenuity and can-do spirit of Singaporeans is instrumental in our journey towards a clean and green Singapore. It is the collective effort,

commitment, and shared values of ordinary citizens which will create a better home, environment, and future for all.

CASE STUDY **Rail Corridor**

Community input is essential to the Rail Corridor project, for instance: turning a disused railway track into a continuous green trail for recreation.

The Rail Corridor is a disused railway line where Keretapi Tanah Melayu (KTM) trains used to run between Malaysia and Singapore. By the standards of any city, the Rail Corridor is a rare gem. It runs uninterrupted for 24 kilometres from north to south of Singapore, and threads through diverse landscapes and communities where close to one million residents live. A grassroots movement blossomed when conservation-minded citizens campaigned for it to be kept green and for historic landmarks to be preserved.

Since the railway land became disused when the Singapore train terminus was relocated from the city to the northern border of Singapore four years ago, the Urban Redevelopment Authority (URA) has engaged with different segments of the community extensively to gather feedback on their aspirations for how the Rail Corridor space should be used. Exhibitions and workshops were also held. Many were excited over what the Rail Corridor could become, and asked for the distinctive character of the Rail Corridor to be kept.

In March 2015, URA invited professional design teams to develop concept proposals for the Rail Corridor based on the community's aspirations. The winning proposals, announced in November 2015, were awarded for their ability to strengthen the Rail Corridor's identity, connectivity, landscape and heritage while providing an inclusive, vibrant public space.

For instance, the trail will be made more accessible for people of all ages and abilities. It will get new access points and basic amenities like rest areas and toilets. It will be a continuous trail that links nature and heritage, and support a range of activities along its route. These proposals are being refined further following the latest rounds of feedback received from stakeholders and the general public.



Treks along the Rail Corridor.
Photo credit: URA

While the community plays an active role in shaping the future of the Rail Corridor, a diverse group of community leaders and residents focuses their attention on preserving the rustic character of the island of Pulau Ubin.

CASE STUDY **The Ubin Project**

Pulau Ubin, an island off mainland Singapore's north-east coast, was home to villages and granite quarries dating back to the 1800s. Today, it provides day-trippers from the mainland with a respite from the city's hustle and bustle.

In 2014, the Ministry of National Development started the Ubin Project to seek ideas from the public on how the island's rustic charm, natural environment, biodiversity and cultural heritage can continue to be enjoyed by Singaporeans for generations to come. A Friends of Ubin Network (FUN) was set up to guide the project. The group includes biodiversity experts, educators, history lovers, socio-anthropologists, students, volunteers and Ubin's community leaders and residents, banded together by their love for the island and the shared vision of preserving the unique character of Ubin.

Their recent activities include mapping the island's biodiversity, documenting its historical sites such as shrines and temples, and interviewing residents to capture a slice of life on the island. Pulau Ubin is also the site of a clean energy micro-grid test-bed and reforestation efforts to enhance habitats for biodiversity.



Ubin Quarry. Photo credit: URA



Ubin Day 2015 — an annual community event involving ministers, agencies and community groups.
Photo credit: URA

CASE STUDY **Keep Singapore Clean Movement**

Singapore has a reputation for being a clean city — but only because of its small army of cleaners. The Keep Singapore Clean Movement aims to get every resident to take responsibility for the city's cleanliness.

A national call for Singapore to be a "truly clean city" spawned the Keep Singapore Clean Movement in 2012. The ground-up campaign aims to foster a stronger sense of social responsibility about keeping public spaces clean, and make zero tolerance for littering a social norm. The movement is led by the Public Hygiene Council, which advocates for public cleanliness, with members from non-government, private and public sectors. Some of its activities to foster greater community ownership of our environment include school and community litter-picking sessions, student and community advocacy, and greater deterrence through engagements by specially-trained volunteers to educate littering offenders to be more socially gracious.

An inaugural island-wide "Operation WE Clean Up!" event was held in May 2015, inspiring activities in schools, communities and companies across the island to keep our shared spaces clean. We also aim to turn littering hotspots into "bright spots" where stakeholders take ownership of cleanliness and lead by example. Today, the movement has more than 15,000 volunteers, including students, interest groups, business and community leaders, and ordinary residents.

LEFT PHOTO
Grassroots leaders, community partners and residents joining hands to keep the shared and public spaces clean within their neighbourhood.
Photo credit: NEA

RIGHT PHOTO
Students learning to put their values into action through the clean-up exercise.
Photo credit: NEA



RETROSPECTIVE

Community In Bloom

Some initial green efforts, such as Singapore's national tree-planting drive, were mainly led by the government. Over time, they evolved to include more community involvement.



Community in Bloom Garden on multi-storey car park. Photo credit: URA

In 2005, the National Parks Board (NParks) launched the Community in Bloom programme, after residents of Mayfair Park Estate, a private residential estate, came together to plant their own community gardens. The programme encourages a gardening culture in Singapore and promotes a sense of identity and ownership among the community.

From a single experimental garden, the programme has since grown into a movement with close to 1,000 community gardens spread across the island. People from all walks of life from public and private estates, schools and organisations have come together to form gardening interest groups, plant flowers, fruits and vegetables, and work together to beautify their living environments.

Today, these thriving self-help networks share knowledge of horticulture and collaborate in the maintenance of their gardens. Where needed, NParks offers technical guidance and advice. The Community in Bloom programme provides residents with a sense of ownership over the landscape, keeping them rooted in their local community.



Community in Bloom Garden at Khoo Teck Puat Hospital. Photo credit: NParks

Beyond Singapore

In an interdependent world, environmental problems respect no boundaries and are too large to be solved by a single country alone.

CASE STUDY

World Cities Summit, Singapore International Water Week and CleanEnviro Summit Singapore

A trio of flagship events — the World Cities Summit, Singapore International Water Week, and CleanEnviro Summit Singapore — provides the platform for government leaders and industry experts to learn and share their rich experiences with regards to sustainable urban solutions. The events present opportunities for governments to engage with industry players who can provide these solutions.

These events focus on the role of cities, as urbanisation proceeds at an unprecedented rate and cities grow in importance around the world. Cities drive economic growth, create hubs for talent and innovation, and can help pioneer solutions to problems like climate change and public health.

The three events attract as many as 20,000 participants from around the world, comprising city mayors, government ministers, industry experts, academia and non-governmental organisations. Through such events, Singapore shares its sustainable development journey. We also learn from other cities' solutions such as London's transport system, Copenhagen's pocket parks, or Bilbao's arts and cultural development.

As a small island-state, Singapore collaborates with other countries to respond to the multifaceted environmental challenges that we face.

Through exchanging knowledge and sharing our experiences with others, we deepen our understanding of the environmental challenges, develop capabilities, and find innovative solutions.



www.worldcitiessummit.com.sg



www.siww.com.sg



www.cleanenvirosummit.sg

CASE STUDY

Singapore Cooperation Programme

Globally and bilaterally, Singapore cooperates with countries and international organisations to address environmental issues including air pollution, water quality and waste management.

In the immediate years after Singapore's independence in 1965, we benefitted from technical assistance by developed countries and international organisations, which helped lift Singapore from a Third World country to a modern city-state.

Today, we in turn share our development experience and knowledge with friends around the world via the Singapore Cooperation Programme. Since its inception in 1992, more than 107,000 foreign officials have taken part in courses ranging from trade and economy and port management, to governance, urbanisation and climate change.

Singapore will implement a new Sustainable Development Programme to help other developing countries progress towards the 2030 Agenda for Sustainable Development. We will offer leadership programmes on good governance and public sector leadership in partnership with the United Nations Development Programme (UNDP) Global Centre for Public Service Excellence. Singapore will also partner UN agencies and others to provide technical assistance programmes in a wide range of fields pertaining to sustainable cities as well as water and sanitation solutions.



Permanent Representatives to the UN in New York visiting the Singapore City Gallery. Photo credit: Ministry of Foreign Affairs

CASE STUDY

Temasek Foundation Leaders in Urban Governance Programme

Singapore also conducts targeted, high-level executive training schemes such as the Temasek Foundation Leaders in Urban Governance Programme, aimed towards international city leaders.

The Temasek Foundation Leaders in Urban Governance Programme (TFLUGP) is a 5-day executive workshop targeted at city leaders and senior officials, run by Singapore's Centre for Liveable Cities (CLC), a knowledge centre for liveable and sustainable cities.

The programme shares Singapore's high-density and high-liveability guiding principles in urban development and management, and helps participants apply these principles to their respective cities. Participants identify urban solutions and develop an action plan for their cities.

Supported by the Temasek Foundation, there have been four runs since 2012. The latest run in 2015 saw government leaders and urban practitioners share Singapore's expertise in areas ranging from urban planning to solid waste management. Urban and economic specialists from the World Bank were also present to share best practice examples in areas such as urban regeneration and municipal financing.

Programme participants interact with senior practitioners from Singapore to glean deep and practical insights. They also visit field sites such as the Singapore River and Gardens by the Bay to experience urban solutions firsthand.



Participants at TFLUGP 2015. Photo credit: CLC

CASE STUDY

Sino-Singapore Tianjin Eco-city

One of Singapore's most notable international projects on promoting sustainable development is the Sino-Singapore Tianjin Eco-city.

The Sino-Singapore Tianjin Eco-city was jointly launched in November 2007 as the second flagship government-to-government project between Singapore and China. In this project, both countries work together to jointly develop a model eco-city in China which emphasises sustainable development, environmental protection and social harmony.

A 30 square kilometres site of a barren wasteland filled with saltponds and polluted water bodies was chosen for the Eco-city. Today, the site has been transformed into a liveable and vibrant city. As at April 2016, there are more than 50,000 people living and working in the Eco-city. There are residential developments, industry parks and social amenities such as a neighbourhood centre modelled after Singapore's community centres, schools and parks. The Eco-city has been actively pursuing eco-development. This includes rehabilitating its 2.6 square kilometres wastewater pond, conducting research in green development, developing green building standards, tapping renewable sources like wind, solar, and geothermal energy, encouraging residents to lead environmentally-conscious lifestyles, and promoting green transport.

In 2013, both governments endorsed a refreshed vision for the Eco-city to be a leader in eco-development, a vibrant model satellite city, and a harmonious city with an innovative social governance framework. The Eco-city serves as a reference for other Chinese cities in sustainable development and urbanisation, and has been designated as China's first National Green Development Demonstration Zone.



Before (2008). Photo credit: Ministry of National Development



After (2015). Photo credit: Ministry of National Development

CASE STUDY

Andhra Pradesh – Building a New Capital City

Today, Singapore is working closely with the South Indian state of Andhra Pradesh to build a new capital city.

In November 2014, the South Indian state of Andhra Pradesh asked Singapore to partner the state in the master planning and development of Amaravati, its new capital. The two governments signed a Memorandum of Understanding to collaborate on its development.

An inter-agency team from Singapore, including CLC, is working with and advising Andhra Pradesh officials on Amaravati's master planning. The master planning team drew from Singapore's experience to ensure that key principles such as strategic long-range planning, the provision of jobs and homes, environmental management, the enhancement of green and blue spaces, and others, were captured in Amaravati's

master plans. It also made sure that the plans considered ground realities and local land-planning issues.

But integrated master planning is only one part of the formula for a successful city; dynamic urban governance is key to realising these plans. Andhra Pradesh's new Capital Region Development Authority is in charge of the future planning and administration of the capital region and city. CLC is working closely with the new authority to refine its institutional set-up and manpower recruitment policies and processes, so that it can implement master plans quickly and effectively.

The transit-oriented Amaravati, with parks, a central business district, and a waterfront promenade, will be built within the next ten years.



Chief Minister Naidu and the AP delegation learning from Executive Director, CLC Mr Khoo Teng Chye and URA Senior Architect Linda Lui about the planning and development of the Marina Bay downtown area in November 2014. Photo credit: CLC



2030 Targets

Today, we stand on the efforts of Singapore's pioneers and those who came before us in our quest to create a sustainable and liveable Singapore. We hope to build upon this foundation, set stringent targets to serve our people and environment, overcome constraints through innovative solutions, and turn obstacles into opportunities for growth. Each person plays a role in creating a liveable and endearing home, a vibrant and sustainable city, and an active and gracious community.

KEY

2015	Current level
2030	Increase will meet target Decrease will meet target

INDICATOR

Green and Blue Spaces

	2015 LEVELS	TARGETS FOR 2030	PERCENTAGE CHANGE TO ACHIEVE 2030 TARGET
▶ Amount of skyscraper greenery	72 ha	200 ha	+178%
▶ Green spaces: Parks and park connectors open to recreational activities	4,172 ha		Park Provision Ratio of 0.8 ha / 1,000 population
a) Amount of park space	302 km	400 km	+32%
b) Length of park connector ¹	974 ha	1,039 ha	+7%
▶ Blue spaces: Waterbodies and waterways open to recreational activities	98 km	100 km	+2%
a) Amount of waterbodies	68 km	180 km	+165%
b) Length of waterways	83%	90%	+7%-pts
▶ Length of Nature Ways	355 km	700 km	+97%
▶ Proportion of households within 10-min walk of a park	66%	75%	+9%-pts

Mobility

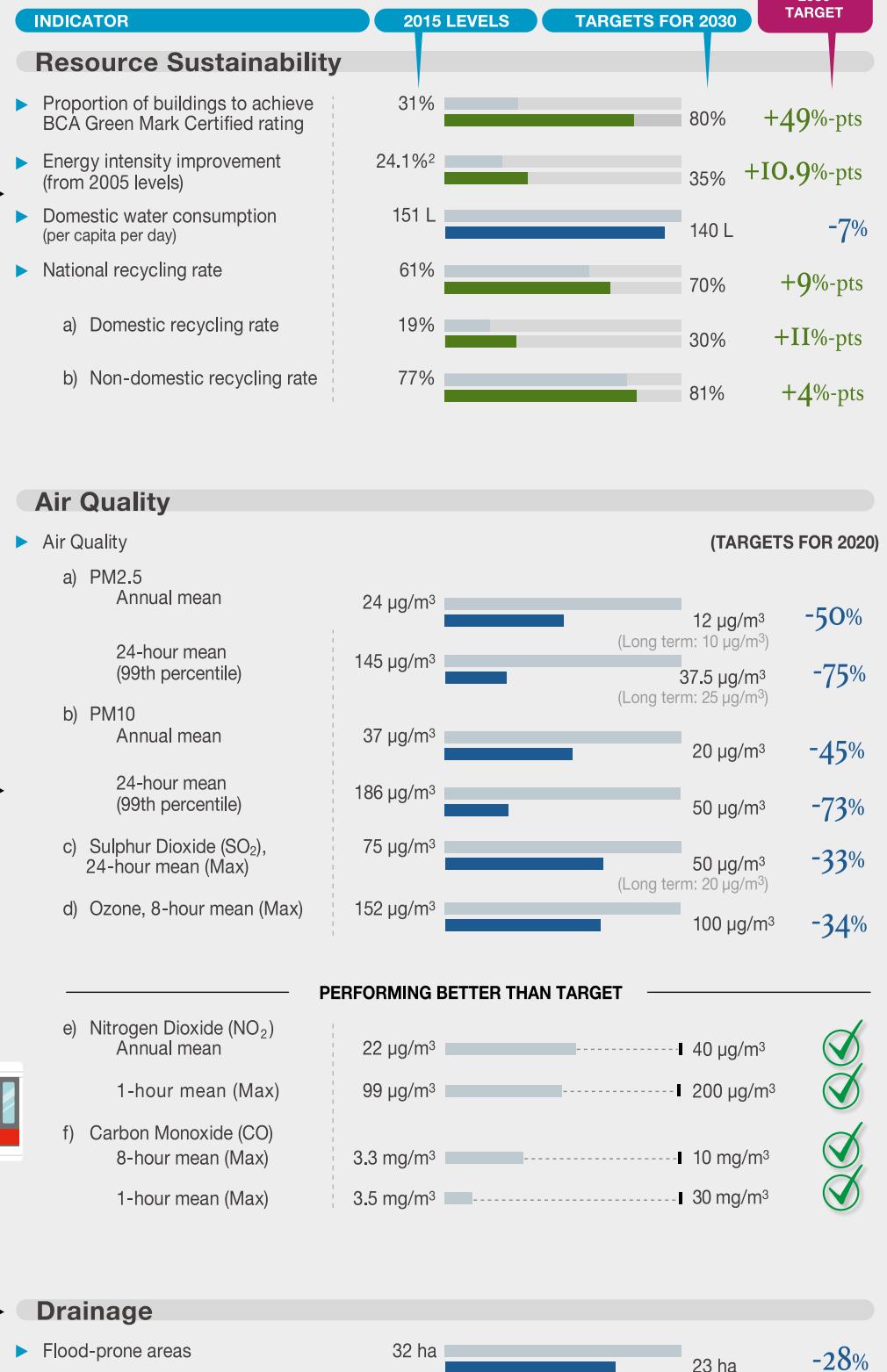
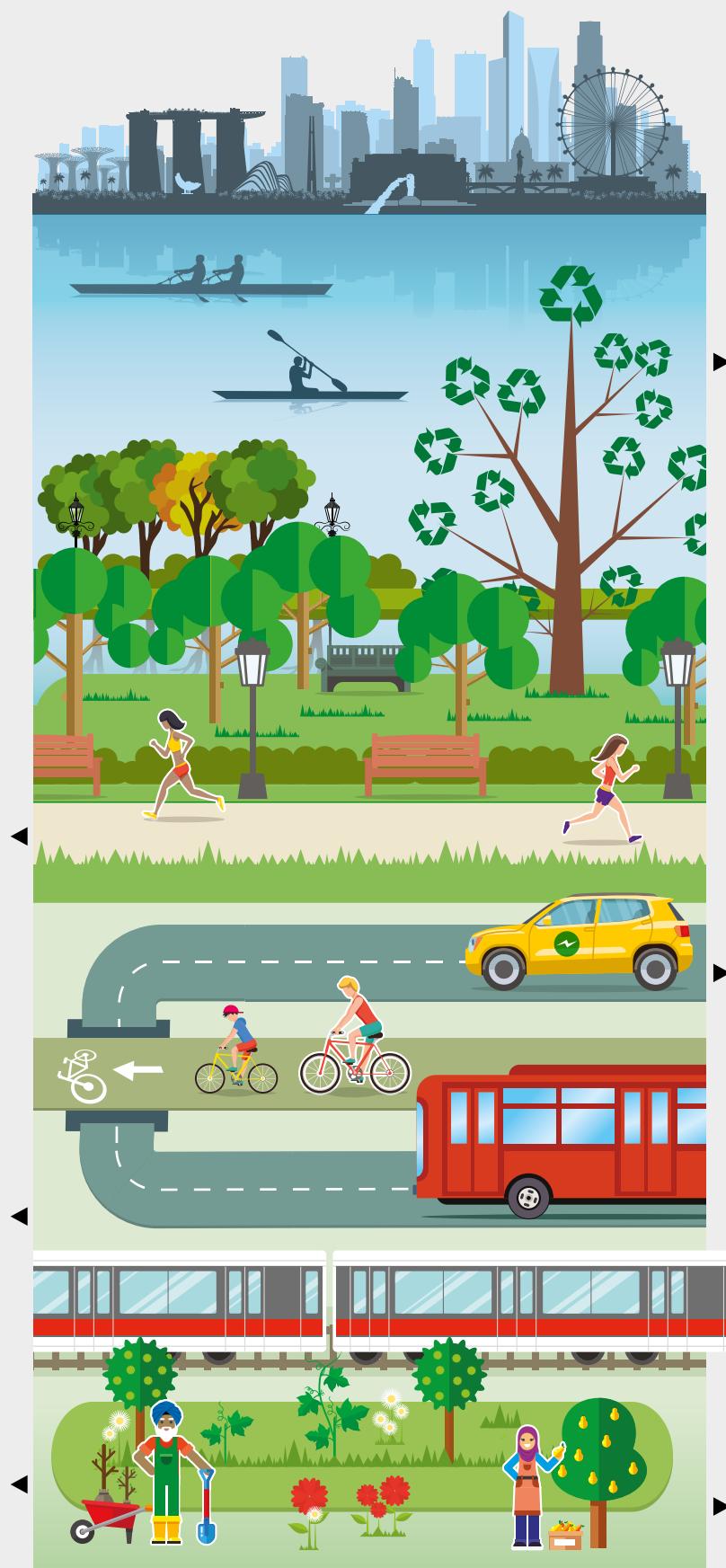
	2015 LEVELS	TARGETS FOR 2030	PERCENTAGE CHANGE TO ACHIEVE 2030 TARGET
▶ Length of cycling paths	200 km	360 km	+80%
▶ Modal share of journeys during peak hours made via public transport	60%	80%	+20%-pts
▶ Length of rail network	1,500	5,000	+233%
▶ Proportion of households within 10-min walk of a train station	995	2,000	+101%

Community Stewardship

	2015 LEVELS	TARGETS FOR 2030	PERCENTAGE CHANGE TO ACHIEVE 2030 TARGET
▶ Number of active green volunteers	1,500	5,000	+233%
▶ Number of Community in Bloom Gardens	995	2,000	+101%

¹Includes Round Island Route

²In 2013





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