


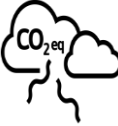







Weekend Buzz
MacRitchie Reservoir Park, 2018
Photo by Michael Yamashita





YOUTH DIALOGUE: CHALLENGES & OPPORTUNITIES OF SINGAPORE'S SUSTAINABLE DEVELOPMENT

October 2018




SINGAPORE FACES A RANGE OF SUSTAINABILITY CHALLENGES

<p>Potential water constraints as demand set to 2X by 2060 (from current level)</p> 	<p>Pledge to reduce emissions intensity by 36% from 2005 levels by 2030</p> 	<p>Ageing population:</p> <p>By 2030, 1 in 4 Singaporeans will be aged 65 and above, up from 1 in 8 today</p> 
<p>Semakau Landfill is projected to run out of space by 2035</p> 	<p>Singapore imports over 90% of its food supply, and is vulnerable to global food supply shocks</p> 	
<p>Land shortage may lead to difficult trade-offs between redevelopment and heritage preservation</p> 	<p>Risk of compromising biodiversity protection due to continued development</p> 	

EXAMPLES OF INNOVATIVE RESPONSES TO CHALLENGES

Water constraints	PUB and the private sector are continuing to develop and refine waterless industrial processes, and find ways to increase the efficiency of water recycling techniques such as desalination	
Land shortage	Jurong Rock Caverns tunnels over 100 metres below Jurong Island's Banyan Basin, creating ~1.5 million cubic metres of underground oil storage space - equivalent to 580 Olympic-sized pools	
Ageing population	Robots programmed to teach exercise routines at senior activity centres, where each robot is able to monitor up to six seniors at a time and provide feedback on whether they are performing the exercises correctly	
Biodiversity protection	Biodiversity at Punggol Waterway boosted by ~20% due to installation of floating wetlands and use of freshwater-tolerant mangroves	

3 CORE PRINCIPLES OF SUSTAINABLE DEVELOPMENT

<p>Be cognisant of trade-offs</p>  <p>Involves balancing competing demands given specific constraints</p>	<p>Holistic, long-term planning</p>  <p>Involves avoiding quick fixes & laying the groundwork for sustainable change</p>	<p>Caring at the core</p>  <p>Involves considering the interests of others when making decisions</p>
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INTRODUCTION

Temasek organised a youth dialogue on sustainable development, the first youth-targeted session in the Ecosperity Conversations series, on 30 August 2018. The session included a presentation by Speaker of the Parliament of Singapore, Mr. Tan Chuan-Jin, on what sustainability means for Singapore in the context of its economic, demographic and social trajectories. Speaker Tan touched on a wide-ranging set of issues, including Singapore's natural resource constraints, food security challenge, ageing population implications, and the need to pursue not just economic growth, but a higher quality of economic growth that enhances the well-being of residents. He explored the many trade-offs that policymakers face when tackling these sustainability challenges, and emphasised the role of compassion and caring at the core of many of these issues. This summary report covers the key sustainability topics covered during the session, and includes some additional insights to complement the discussion.

SINGAPORE FACES A RANGE OF SUSTAINABILITY CHALLENGES

The United Nations defines sustainable development as *development that meets the needs of the present without compromising the ability of future generations to meet their own needs*.¹ As many cities grapple with sustainability issues linked to rapid urbanisation, including but not limited to increased congestion and the lack of affordable public housing, Singapore faces its own unique set of challenges.

Some of these challenges are not new, particularly those associated with Singapore's natural resource constraints; and while the country has tackled them admirably since independence, these challenges remain pertinent. In addition, economic prosperity and demographic changes have created a fresh set of sustainability challenges for Singapore. As population ageing continues and the pursuit of non-economic needs (i.e. social and culture) intensifies, these new challenges will become increasingly evident.

This section summarises the range of sustainability issues discussed during the session.

- **Water constraints.** In Mr. Lee Kuan Yew's words, "every policy has to bend at the knees for our water survival".² Through efficient long-term planning and a relentless commitment towards R&D, Singapore has overcome many of its well-documented water challenges. In the process, Singapore has come to be internationally recognised as a model city for integrated water management.³

¹ UN Documents. "Our Common Future, Chapter 2: Towards Sustainable Development." Available at: <http://www.un-documents.net/ocf-02.htm>

² Ministry of Communications and Information. *Three famous LKY quotes on NOT going with the flow*. Available at: <https://www.gov.sg/microsites/everdropcounts/three-famous-lky-quotes>

³ Public Utilities Board. *Singapore Water Story*. Available at: <https://www.pub.gov.sg/watersupply/singaporewaterstory>

Despite the progress, Singapore can ill-afford to be complacent as water demand is forecasted to double by 2060 to over 850 million gallons a day, driven by continued population and economic growth. On the supply side, Singapore's bilateral agreement with Malaysia to purchase 250 million gallons of water daily (more than half of current daily demand) from its neighbour will expire in 2061.

Singapore's **water demand is set to double by 2060** – a year before water deal with Malaysia expires

- **Land shortage.** With only around 720 square kilometres of land area to provide for housing, infrastructure, industry, commercial and leisure use, land availability remains one of Singapore's key concerns. This is despite having expanded in physical size by 24 percent since 1960, largely through land reclamation programmes.

To support economic and population growth, the government has signalled its intention to expand its land area to 770 square kilometres by 2030.⁴ However, Singapore may be experiencing limits to land reclamation using sand due to the rising cost of imported sand, increased public awareness and scrutiny of the harmful impact on the ecosystem and the encroachment of shipping lanes and territorial limits.

- **Emissions reduction commitments (including energy efficiency).** Environmental and climate change concerns have increased the pressure on industry to switch to clean and renewable energy in Singapore. As part of its commitment to the Paris Agreement on climate change, Singapore has pledged to reduce its emission intensity by 36 percent from 2005 levels by 2030.⁵

The government has also announced a tax of S\$5 per tonne of greenhouse gas (GHG) emissions from 2019 onwards. The tax will be levied on companies that emit 25,000 tonnes or more of GHG annually, putting financial pressure on firms to be more energy efficient. This carbon tax rate will be reviewed and could increase to between S\$10 and S\$15 by 2030.⁶ Energy Market Authority (EMA) data shows that the chemicals and petroleum refining sectors were responsible for more than 60 percent of the country's CO₂ emissions in 2010,⁷ suggesting that a key pillar of Singapore's economy is likely to come under economic competitive pressures.

Singapore has pledged to **reduce its emission intensity by 36 percent** from 2005 levels by 2030

⁴ Bloomberg (2017). "Singapore Is Finding It Harder to Grow, Literally". Available at: <https://www.bloomberg.com/news/articles/2017-10-30/singapore-is-finding-it-harder-to-grow-literally>

⁵ Channel NewsAsia (2017). "Singapore reaffirms commitment to Paris climate agreement after US pullout." Available at: <https://www.channelnewsasia.com/news/singapore/singapore-reaffirms-commitment-to-paris-climate-agreement-after-8905862>:

⁶ The Straits Times (2018). "Singapore Budget 2018: Carbon tax of SG\$5 per tonne of greenhouse gas emissions to be levied". Available at: <https://www.straitstimes.com/singapore/singapore-budget-2018-carbon-tax-of-5-per-tonne-of-greenhouse-gas-emissions-to-be-levied>

⁷ Energy Market Authority (2012). *Energising our Nation – Singapore Energy Statistics 2012*. Available at: www.ema.gov.sg/media/files/publications/EMA_SES_2012_Final.pdf and National Climate Change Secretariat (2013). *Industry Energy Efficiency. Technology Roadmap*. Available at: <https://www.nccs.gov.sg/docs/default-source/default-document-library/industry-energy-efficiency-technology-roadmap.pdf>

- **Food security.** As Singapore imports more than 90 percent of its food supply, it is vulnerable to unexpected supply-demand imbalances.⁸ However, the external environment is increasingly uncertain and volatile due to factors such as reduced harvest caused by climate change, the spike in food consumption from the growth of the middle class in food-exporting countries, and volatile geopolitics.⁹

Singapore imports over 90 percent of its food supply

Acutely aware of the issue, the Singapore government has set aside more land for agricultural production and introduced mechanisms to encourage methods that are more productive. For example, the evaluation criteria for the tender of 60 hectares of land in Lim Chu Kang and Sungei Tengah have a strong focus on productivity gains rather than on price alone.¹⁰ This complements the Food Security Roadmap which outlines strategies to boost the country's overall resilience to unexpected supply shocks.¹¹

- **Ageing population.** By 2030, 1 out of 4 Singaporeans will be aged 65 and above, up from 1 in 8 today.¹² This is largely a function of the low replacement rate and increasing life expectancy in Singapore. The national fertility rate fell to a seven-year low of 1.16 in 2017¹³, while advancements in healthcare and medical technologies have contributed to a high average life expectancy of around 83 years.¹⁴

By 2030, 1 out of 4 Singaporeans will be aged 65 and above, up from 1 in 8 today

Singapore's ageing demographics has both economic and social implications. On the economic front, a key question is around how economic growth can be sustained through higher labour productivity and keeping people economically active for a longer period. The state's budget will come under strain as a larger proportion of spending may need to be allocated towards medical and social services, even as the proportion of tax paying residents to total residents decline.

On the social front, some countries have experienced tensions linked to ageing communities. For example, in Japan, the number of seniors abused by their family members surged 21 percent between 2006 and 2016.¹⁵ As the share of the elderly rises rapidly, Singapore must continually tweak the design of its physical realm (e.g. amenities for elderly) and social

⁸ Agri-Food & Veterinary Authority of Singapore. *Singapore's Food Security*. Available at: <https://agrifood.net/images/cfs43/CFS43%20Side-event%20background%20document%20-%20%20Lessons%20from%20Singapore.pdf>

⁹ Today (2017). "The Big Read: Far from people's minds, but food security a looming issue." Available at: <https://www.todayonline.com/singapore/big-read-far-peoples-minds-food-security-looming-issue>

¹⁰ Channel NewsAsia (2017). "36 new plots of farm land with 20-year leases to be open for tender." Available at:

<https://www.channelnewsasia.com/news/singapore/36-new-plots-of-farm-land-with-20-year-leases-to-be-open-for-8837994>

¹¹ Agri-Food & Veterinary Authority of Singapore. *Singapore's Food Security*. Available at: <https://agrifood.net/images/cfs43/CFS43%20Side-event%20background%20document%20-%20%20Lessons%20from%20Singapore.pdf>

¹² National Population and Talent Division (2018). "Older Singaporeans to double by 2030". Available at: <https://www.population.sg/articles/older-singaporeans-to-double-by-2030>

¹³ Channel NewsAsia (2018). "Singapore's fertility rate at new 7-year low of 1.16: Josephine Teo". Available at:

<https://www.channelnewsasia.com/news/singapore/singapore-total-fertility-rate-new-low-1-16-10002558>

¹⁴ Data retrieved from: <https://www.singstat.gov.sg/find-data/search-by-theme/population/death-and-life-expectancy/visualising-data>

¹⁵ National Population and Talent Division (2018). *Singapore's Silver Age*. Available at: <https://www.population.sg/articles/singapores-silver-age>

policies (e.g. encouraging more engagement between younger and older generations of Singaporeans) to create socially sustainable societies for current and future generations.¹⁶

- **Preserving cultural heritage.** Increasing attention is being placed on the need to strengthen aspects of social sustainability, including preserving culture, tradition and heritage. In particular, participants debated the trade-offs regarding plans to redevelop Bukit Brown Cemetery, and emphasised the importance of documenting sites affected by other needs. Heritage is important as it brings together people of diverse backgrounds through shared experiences which could ultimately lead to a more empathetic and cohesive society.¹⁷

A 2014 Heritage Awareness Survey showed that 80 percent of Singapore residents agree that it is vital to preserve all aspects of Singapore's heritage for current and future generations.¹⁸ The government's response has been the development of the SG Heritage Plan – the first master plan for Singapore's heritage and museum sector – which outlines the broad strategies and initiatives for the sector from 2018 to 2022 and beyond.¹⁹

- **Protecting biodiversity.** Participants were also vocal about biodiversity conservation in Singapore and its role in providing an overall better quality of life for current and future generations. Singapore has always placed strong emphasis in this area, as evidenced by the over 300 parks and four nature reserves on the island despite space constraints.²⁰ Building on the National Biodiversity Strategy and Action Plan (NBSAP) for Singapore which provides a national framework to promote conservation, Singapore's National Parks Board works in partnership with other relevant government agencies and stakeholders to maintain and enhance urban greenery and biodiversity.²¹

TURNING CONSTRAINTS INTO OPPORTUNITIES

While some may perceive Singapore's natural resource constraints as a development handicap, Speaker Tan was keen to stress that many of Singapore's achievements are a result of effective responses towards these constraints by turning them into opportunities. This section highlights some examples of how scarcity has bred innovative action in Singapore.

- **Energy-efficient water reclamation techniques and water conservation.** Singapore has established itself as a global hydrohub and is home to 180 water companies and 20 water research centres. The Public Utilities Board (PUB), Singapore's national water agency, collaborates closely with local and international partners to conduct applied R&D along

¹⁶ Social sustainability is often overlooked and must be addressed alongside environmental and economic aspects of sustainability to attain the most sustainable outcome possible. Socially sustainable communities have been described as those that are equitable, diverse, connected and democratic and provide a good quality of life. See: <https://esg.adec-innovations.com/about-us/fags/what-is-social-sustainability/>

¹⁷ <https://www.oursgheritage.sg/what-is-the-heritage-plan-for-singapore/what-is-heritage/>

¹⁸ Heritage Awareness Survey 2014. See: <https://www.oursgheritage.sg/why-now/>

¹⁹ National Heritage Board (2018). *What is our heritage plan?* Available at: <https://www.oursgheritage.sg/what-is-the-heritage-plan-for-singapore/>

²⁰ Information retrieved from: <https://www.nparks.gov.sg/gardens-parks-and-nature/parks-and-nature-reserves>

²¹ National Parks (2015). *Urban Biodiversity*. Available at: <https://www.nparks.gov.sg/biodiversity/urban-biodiversity>

different parts of the water value chain. Reclaimed water (called NEWater in Singapore) and desalinated water are two of PUB's biggest achievements. However, the current desalination methods are energy-intensive, while NEWater recovery is not at optimal levels yet. As such, PUB is constantly investing in research to significantly reduce energy consumption and chemical use in the treatment process.²²

To mitigate the projected increase in non-domestic water demand, PUB and the private sector are also continuing to develop and refine waterless processes, as well as increase the recycling of treated effluent and the use of seawater for cooling. Many of these innovative water conservation methods are already common in industrial hubs such as Jurong Island.

- **Solar energy generation.** According to the Energy Market Authority, solar energy is the renewable energy source with the greatest potential for wider deployment in Singapore, and the government has set a target to raise solar generation to 1 gigawatt-peak (GWp) beyond 2020.²³

Singapore is utilising rooftops and floating platforms to increase its solar penetration

In order to navigate land constraints, different systems of floating solar panels are being tested at Tengeh Reservoir. Other solar-related innovations that are gaining traction include microgrid storage systems and Building Integrated Photovoltaics (BIPV) – the incorporation of solar generation capabilities into building design.

- **Underground space utilisation.** The Singapore government is looking to launch an Underground Master Plan in 2019, which will map out Singapore's underground spaces and their potential uses.²⁴ Government agencies are already pursuing some innovative ideas, including underground water storage, and locating utilities such as refuse systems and electrical substations underground. An outstanding example of innovation in underground space use is the Jurong Rock Caverns – an underground rock cavern for storing oil-related products. It tunnels over 100 metres below Jurong Island's Banyan Basin, freeing up about 60 hectares of usable land above ground and creating 1.47 million cubic metres of underground storage space – equivalent to 580 Olympic-sized pools.²⁵

²² Public Utilities Board (2017). *R&D at a glance*. Available at: https://www.pub.gov.sg/Documents/RD_in_Numbers.pdf

²³ Energy Market Authority. Available at: https://www.ema.gov.sg/solar_photovoltaic_systems.aspx

²⁴ The Straits Times (2018). "Masterplan of Singapore's underground spaces ready by 2019". Available at: <https://www.straitstimes.com/politics/masterplan-of-singapore-s-underground-spaces-ready-by-2019>

²⁵ Surbana Jurong Project List. Available at: <https://surbanajurong.com/sector/jurong-rock-caverns/>

- **Urban agriculture to increase local production.** Singapore's land and food challenges make vertical farming, a form of urban agriculture, an appealing option. The number of licensed vertical farms grew from just one in 2012 to seven in 2016, producing a range of produce from vegetables to aquaculture.²⁶ The benefits of vertical farming include both environmental sustainability and economics, thanks to rising demand for fresh, organic, and sustainably produced foods in high-income countries.

The number of vertical farms grew from just one in 2012 to seven in 2016

- **Robotics and advanced analytics to support elderly care.** Singapore's ageing profile will add to its healthcare constraints. To pre-empt an expected increase in hospitalisation rates, Changi General Hospital, through its Centre for Healthcare Assistive and Robotics Technology, is exploring various robotics applications to raise productivity in areas such as transportation (of drugs, documents, linens, beds etc.) and precision surgery.²⁷ The Infocomm Development Authority and Ministry of Social and Family Development also commissioned robots to teach exercise routines at senior activity centres, where each robot is able to monitor up to six seniors at a time and provide feedback on whether they are performing the exercises correctly.²⁸

Innovations in elderly care range from robotics technology to remote monitoring

Another innovative development is healthcare gamifying through mobile apps to elicit lifestyle changes that complement treatments and enhance prevention. For example, insurance firms are incentivising policyholders to meet health targets on mobile apps with rewards such as cashback from premiums and discounts at retailers.

Other relatively nascent areas include remote monitoring and personalised medicine using advanced data analytics. The Woodlands Health Campus – which will be opened in stages from 2022 – will use artificial intelligence and predictive algorithms to analyse large amounts of data to make diagnosis more accurate. Patients will wear electronic wristbands that allow caregivers to track their vitals remotely even after they have been discharged.²⁹

- **Augmented reality to promote heritage.** The emergence of new technology can help enhance the sustainability of Singapore's heritage. For example, the National Museum of Singapore is using Google's Tango technology and elements of virtual reality to enrich visitors' experience of Singapore's stories and their connection to the past.³⁰ Another

²⁶ The Strait Times (2016). "Vertical farms on the rise in land scarce Singapore". Available at: <http://www.straittimes.com/lifestyle/vertical-farms-on-the-rise-in-land-scarce-singapore>

²⁷ GovInsider (2016). "How will robots help run Singapore's hospitals?" Available at: <https://govinsider.asia/digital-gov/how-will-robots-help-run-singapores-hospitals/>

²⁸ The Straits Times (2016). "Robocoaches to get seniors in shape". Available at: <https://www.straittimes.com/singapore/robocoaches-aim-to-get-seniors-in-shape>

²⁹ GovInsider (2017). "Woodlands Health Campus to use AI and robotics for patient care". Available at: <https://govinsider.asia/innovation/woodlands-health-campus-to-use-ai-and-robotics-for-patient-care/>

³⁰ The Straits Times (2017). "National Museum of Singapore uses augmented reality to tell building's history". Available at: <https://www.straittimes.com/lifestyle/arts/national-museum-of-singapore-uses-augmented-reality-to-tell-buildings-history>

example is the use of virtual and mixed reality technologies in heritage education. For instance, local independent production house Beach House Studios and the Ministry of Education collaborated over four months to develop a series of mixed reality lessons for primary school students that covered topics such as farming and historical buildings in Singapore.³¹

- ***Innovative biodiversity and ecological engineering.***

The Punggol Waterway is a 4.2 kilometres man-made waterway by HDB that meanders through Punggol New Town, designed to capture the area's rich coastal heritage and provide water-based recreational activities for residents.³² As a result of two green engineering innovations – the Floating Wetland System and freshwater-tolerant mangroves – biodiversity in the area was boosted by around 20 percent, with new species of birds, butterflies and dragonflies observed along the waterway.³³

At the man-made Punggol Waterway, innovations have boosted biodiversity by 20%

THREE CORE PRINCIPLES OF SUSTAINABLE DEVELOPMENT IN SINGAPORE

The conversations at the dialogue were encouraging as they demonstrated the passion that young Singaporeans have for sustainability issues. While Singapore has responded well to its sustainable challenges, many of these challenges are likely to intensify with continued economic development. There were three key takeaways principles that all stakeholders in the country should have in mind in the face of these continued challenges.

- **Be cognisant of the trade-offs.** Overcoming the various sustainability challenges requires making difficult trade-offs. One way to examine these trade-offs is through the lens of the government budget. There is a finite amount of financial resources available to the state each year, which is responsible for allocating these resources across priority areas as efficiently as possible. Increasing spending on public healthcare to account for ageing trends will mean less resources are available for maintaining and upgrading roads, schools and public housing, amongst others.

Underlying the annual budget lies a number of other policy trade-offs that need to be constantly assessed. For instance, how does Singapore choose between higher taxes and the need to reinforce the concept of personal and family responsibility? What is the impact

³¹ Techgoondu (2017). "Experiencing Singapore-made virtual reality school lessons and medical training". Available at:

<https://www.techgoondu.com/2017/05/24/experiencing-singapore-made-virtual-reality-school-lessons-medical-training/>

³² Housing and Development Board. Available at: <https://www.hdb.gov.sg/cs/infoweb/about-us/our-role/smart-and-sustainable-living/punggol-waterway>

³³ Today (2016). "Biodiversity thriving on artificial Punggol waterway". Available at:

<https://www.todayonline.com/singapore/biodiversity-punggol-boosted-through-enhanced-greenery-area>

of higher taxes on foreign capital and labour, and is Singapore's current economy resilient enough to withstand potentially negative shocks that come with it? Increasing current expenditure may lead to immediate higher well-being or even sustainable long-term growth if invested productively, but may also jeopardise Singapore's strong reputation of fiscal discipline in the capital markets. How and when should Singapore utilise its reserves while factoring in issues of equitable intergenerational transfers?

The trade-off between biodiversity and land use was another key dialogue theme. Singapore's land requirements will continue to come into direct conflict with the need to conserve biodiversity. In most cases, the clearing of land for new infrastructure will unavoidably lead to some destruction of flora and fauna, but the key is to be as "light-footed" as possible, and to take necessary remedial actions.

Another trade-off stemming from Singapore's land constraints is the need to strike a balance between the desire to preserve historical sites with the need for development. This tension has previously led to public dissent, particularly over the demolition of the Old National Library building, and more recently, Bukit Brown Cemetery.

There are no easy solutions to these trade-offs and, ultimately, Singaporeans have to make these decisions in a collaborative manner. The key, however, is to engage in constructive and inclusive discussions based on balanced and well-supported arguments.

- **Holistic and long-term planning.** Singapore should guard against quick-fix solutions to deal with complex and long-term sustainability challenges. For example, given the shrinking labour force, sustainable economic growth can only be achieved through higher labour productivity. A truly sustainable approach to higher labour productivity includes retraining workers to adapt to dynamic labour market conditions (e.g. robotics and digitisation), changing the curriculum and mindsets of parents to prepare the younger population for emerging industries, ensuring that Singapore has the enabling conditions for new, fast-growing industries to flourish, among others. Effective communication is required to create the policy space needed for holistic, long-term planning.
- **Caring at the core.** Finally, Singapore must double-down on its efforts to create a compassionate society. As actors in society have diametrically different needs and interests, policy trade-offs will invariably create relative winners and losers. Inspiring people to consider the needs and interests of others, to care more for one another, and encouraging businesses to be responsible for their operating environments, would go a long way in helping tackle some of Singapore's many sustainability challenges.