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**The Future of Urban Sustainability:
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ETHOS

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ISSUE 24, AUGUST 2022

Preface

by **Hugh Lim**
Executive Director
Centre for Liveable Cities, Ministry of National Development Singapore

Climate change poses major risks and potential disruptions, but it also offers opportunities to coalesce efforts towards a more sustainable future. The New Climate Economy estimated in 2018 that bold action against climate change could yield a direct economic gain of US$26 trillion through to 2030, as compared with business-as-usual—and these were just conservative numbers.[1] Other opportunities include the creation of green jobs, leveraging technology for smart solutions and spurring green growth through green finance. Actions against climate change could also bring health and environmental benefits—for example, shifting towards renewable energy and electric vehicles in cities would enhance air quality and reduce cases of respiratory-related illnesses.

While the benefits of working towards a sustainable future are clear, there are concerns that current global actions may be falling short of climate targets—an Intergovernmental Panel on Climate Change (IPCC) report in 2022 indicated that harmful carbon emissions from 2010 to 2019 have never been higher in human history. This puts us on a pathway to global warming of more than double the 1.5°C aspiration that was agreed in Paris in 2015. On a more positive note, it is still possible to halve emissions by 2030, if governments ramp up action now. To limit global warming to around 1.5°C, global emissions would have to peak before 2025 at the latest and be reduced by 43% by 2030.

Governments around the world remain key players to steward and support this transition, as well as capture opportunities for its people. This issue of ETHOS seeks to feature the different aspects of this transition to limit global warming.

In understanding climate change and devising policy solutions, using a futures lens can help us better anticipate issues, prepare for alternative pathways in advance, and instil agility in responding to trends and crises.

Additionally, the interdependencies between various industries, activities, and players require systems thinking to unlock synergies while balancing trade-offs. At the Centre for Liveable Cities (CLC), we aim to promote and share knowledge on such approaches as a Futures Centre on Urban Liveability. In the past year, we have convened the perspectives of relevant stakeholders to draw plausible future scenarios for Singapore as a city. Through this process, we hope to support more informed policy thinking and planning for the Infrastructure and Environment (I&E) sector.

In assessing sustainability, city indices act as a mirror to our policy and planning efforts, and such data can help monitor our progress towards targets—especially among cities with similar environmental and development challenges—and share frameworks and strategies for sustainability. CLC's indices research has revealed that although Singapore's performance may be limited by natural resources and land scarcity, our challenges also serve to spur us towards realising opportunities for innovation in terms of energy, waste and environmental strategies, as well as in research and development.

In realising ambitions towards sustainable development, other cities like Los Angeles and Espoo have found creative ways to bring their citizenry on the journey, capturing rich data through crowdsourcing. These are some good examples of how cities tap a multi-layered collaboration between public agencies, businesses and the community to make a difference in sustainability performance.

In Singapore, various pilots have led to transformation at different scales—helping developers, regulators and solution providers ramp up innovations for sustainability against real world constraints. In so doing, we can pioneer business and developmental models that work to tackle climate change. The pathway to net-zero carbon for every city would most likely be different, depending on inherent constraints and governance models, and being able to learn and adapt would help cities achieve more ambitious climate targets.

A huge thank you to all contributors for sharing their ideas and knowledge in this issue of ETHOS. On the launch of the issue at the 8th edition of the World Cities Summit (WCS) that brings global leaders, businesses and experts to Singapore, I hope we can inspire each other in the journey towards preparing our cities for critical uncertainties in our climate future. ◼

Note

1. New Climate Economy, *Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times* (Washington DC: New Climate Economy, 2018). See https://newclimateeconomy.report/2018/.

Editorial

by **Dr Alvin Pang**

Editor-in-Chief, ETHOS

This special issue of ETHOS, brought to you in partnership with the Ministry of National Development's Centre for Liveable Cities, explores the theme of urban sustainability. The global pandemic, followed closely by unsettling geopolitical conflict, has led to a cascade of disruptions to the supply chains that for decades have helped lift the wellbeing of billions around the world. Beyond these urgent, immediate concerns, the dire prospect of climate change and its impacts looms large, particularly in an era of deepening energy and resource constraints, food insecurity, and societal unrest. In the 21st century, governments around the world are being challenged like never before to pursue economic development and societal progress in ways that are resilient and sustainable in the long term (*p. 6*). In this light, greening a society is about having a strategy that offers it the best chance to foster and preserve—to *sustain*—its survival and success in increasingly uncertain circumstances.

The solutions societies will need to address these issues will involve thoughtful regulation, significant investment and technical knowhow. But for sustainability to stick, there must be concerted action from across every sector: public, private, and the people. This can be a source of new opportunities for all. Sustainability will not only be the purview of a niche of green specialists; existing jobs will need to be redesigned to be aligned with sustainability goals, even as new ones

are created when technologies, markets and needs evolve (*p. 18*). We may also have to reframe the way we evaluate policies and projects, to better factor in environmental and social costs and benefits that are not well accounted for by conventional measures (*p. 26*). There are also encouraging signs that the public, particularly a younger generation, is taking the issue of sustainability to heart, and is prepared to make choices towards the greater good (*p. 36*), although they may still need support to translate their aspirations into consistent action (*p. 58*).

While the challenges we face are daunting, we are not alone in confronting them. Humanity has become an urban species. Around the world, cities—as confluences of populations, markets, resources and ideas—are leading the way in developing and deploying practical new approaches to nurturing more sustainable, liveable and healthy societies (*p. 72; p. 78*). City and government leaders are part of a growing community of practitioners who can learn from one another; even as they are spurred by global competition to become ever more attractive places to live, work and play (*p. 88*). The thriving city of tomorrow will be one with a culture of self-reflection about its strengths and shortcomings, a mindset of continual improvement (*p. 96*), clarity about the deep needs of its denizens (*p. 104*), and a commitment to serve them all well, with the full range of tools and measures at hand (*p. 112*). In drawing inspiration from wherever we can to make our cities more sustainable and liveable places to be, we are offering ourselves and our children the prospect of a future that is not only viable but dynamic, enticing and deserving of our best collective efforts.

I wish you a stimulating read. ∎

The Future of Urban Sustainability: Implications for Governance

by **Elly Chiu and Yuichi Kikuzawa**

How might we continue to build sustainability and liveability for our people, in the face of local and global shifts, resource pressures, changing societal values and other discontinuities?

Elly Chiu leads the Centre for Liveable Cities' Foresight team, which identifies drivers of change and develops city scenarios to inspire thinking on how policy and strategy can respond or prepare. She is also part of a research team at the Centre which conducts forward-looking studies on planning for a Healthy City.

Yuichi Kikuzawa works at the research team at the Centre for Liveable Cities, where he focuses on policies, strategies, and international collaborations for the future of city planning. His research is premised on deep understanding of urban systems and how to derive integrated solutions for cities.

Threats to Urban Sustainability: Adopting a Futures Lens

Cities everywhere are grappling with an array of global, regional and local shifts, and risks that threaten the future of urban sustainability. The outcomes of these complex, accelerating changes are difficult to foresee. What shocks and discontinuities may impact resource flows in and out of our cities, for instance? What are the deep transitions that may change the way we live, work, play and move about the city? How might new technologies impinge on resources or the environment, or perhaps unlock new opportunities for better resource and environmental stewardship? How these issues play out will have an impact on our cities' ability to improve their sustainability. Furthermore, many sustainability-related issues are 'wicked problems' which are highly complex, difficult to define, with multiple stakeholders and no immediate or obvious solutions.

While we cannot fully predict the future, cities can better anticipate and prepare for alternative scenarios in advance, and therefore afford themselves more flexibility to respond and adapt to change in good time. The Centre for Liveable Cities (CLC)'s Foresight team has identified and developed a set of discontinuities and trends as a starting point for developing plausible scenarios for Singapore as a city in 2040. Below, we discuss several key discontinuities we believe will have a more direct impact on our ability to improve urban sustainability.

What is Sustainability?

Sustainability is broadly defined as "meeting the needs of the present without compromising the ability of the future generations to meet their needs".[1]

For this discussion, we consider sustainability at the city level, i.e., urban sustainability: the idea that a city is developed in a way that harmonises economic growth, social inclusion, and environmental protection.

Note

1.   UN Brundtland Commission, 1987.

Global Resource Shifts and Cliffs

Globally, climate change is one of the biggest threats to urban sustainability. It is predicted to profoundly impact cities directly through extreme weather patterns (e.g., more frequent and intense droughts and storms; heatwaves; blizzards), sea-level rise, ocean acidification, habitat and biodiversity loss.

Climate change also makes the world's already fragile food system even more vulnerable. Our food habits and systems have resulted in 75% of the world's food coming from just 12 plant and five animal species, despite the more than 300,000 known edible plants.[1] This reduction in genetic variety leaves food supply more prone to disease, pests, unrest, and a changing climate. For example, the cost of pasta has recently been pushed to

a 13-year high after extreme heat and drought hit Canada (where two-thirds of the world's traded durum wheat comes from), even as other countries produced lower harvests than expected in 2021.[2]

While food species have become less genetically diverse, invasive species pose a growing threat to cities. Invasive species do particularly well in urban areas as they are more adaptable to high levels of disturbance than native counterparts. Since 1980, records of invasive species have increased by 40%.[3] Newcomers can push endemic species into extinction, upsetting the equilibrium of ecosystems.[4]

Geopolitical and civil unrest add further to food supply chain risks. The Russian invasion of Ukraine has caused wheat and corn prices to rise by 12% and 14.5% within the first two months of 2022, given that Russia is the world's top wheat exporter and Ukraine is "the breadbasket of Europe" due to its production of wheat, barley, and rye.[5] Between January 2022 to March 2022, a World Bank study estimated 53 new policy interventions affecting food trade had been imposed—of which 31 restricted exports, and nine involved curbs on wheat exports.[6]

Winners and Losers in the Shift to Decarbonisation

As the global urgency around climate action increases, industries in many cities have announced decarbonisation goals and roadmaps. The acceleration of decarbonisation efforts however, may themselves alter resource flows between countries. Certain countries dominate clean energy value chains or access to critical minerals such as rare earths, lithium, and cobalt. Within an overall environment of great power competition, smaller countries face geopolitical or supply hurdles in getting access to needed technologies and materials, hampering their speed of decarbonisation.

As the world pivots away from fossil fuels, cleaner energy supplies may become a 'new oil' upon which geopolitics will be premised, with attendant political and business risks. Cities around the world have begun regional sourcing for clean energy. For example, Amsterdam, Copenhagen, and Tokyo are engaging neighbouring regions and partners for renewable power generation. Singapore plans to adopt similar regional sourcing of renewable energy, but this brings its own challenges, since every other country is also pushing for clean energy. Malaysia, for instance, banned renewable electricity sales in late 2021. Extreme weather events may also render

The acceleration of decarbonisation efforts may alter resource flows between countries.

renewable energy sources unreliable. For example, droughts in Taiwan in 2021 disrupted the generation of hydropower and led to a steep rise in energy costs.

One way to mitigate supply-side risk and manage demand could be the development of wider regional energy infrastructure. For instance, cross-boundary energy grids such as the Greater Mekong Sub-region grid or the Laos-Thailand-Malaysia-Singapore Power Integration Project are currently being pursued. For a city-state such as Singapore, however, uncertainties remain. How will we manage increased price and supply volatility amid rising local and regional demand for renewable energy? What are the land and infrastructure implications of continuing to source energy from multiple renewable and low-carbon sources (e.g., hydrogen facilities, carbon sequestration, PV panels)?

Innovations to Accelerate Carbon Abatement

At the city-level, Singapore continues to ramp up domestic renewable energy production to reduce carbon emissions. In addition, to achieve net-zero carbon targets, industries will need to adopt a host of abatement technologies and approaches, including scrubbers, carbon capture, blue or green hydrogen technologies, some of which will necessitate additional land-take. Creative use of rooftops, reservoirs, vacant land, and sea space can help, though there are competing needs and technical limitations.

The price and accessibility of renewable energy generation and storage has

the potential to turn today's model of energy supply and demand on its head. 'Buildings as a grid' and other decentralised energy initiatives are already taking off in other cities. For example, UPS has developed its own smart grid and made its entire fleet of London-based delivery vehicles electric; and Marks & Spencer is the owner of one of the largest solar rooftop plants in the UK.[7] Battery improvements will also make it easier for building owners, residents, and even EV motorists to store and resell unused energy back to the grid. While this increases the costs and complexity of balancing supply and demand in the main grid, the adoption of smart grids and artificial intelligence (AI) may aid in local optimisation.[8]

> **We need to consider the impact of data-rich activities on our material world.**

New Ways of Living and Consuming— Boon or Bane?

Singapore's information and communications technology (ICT) spending has already seen annual

increases of 30% and 10% in 2020 and 2021 respectively. We need to consider the impact of data-rich activities on our material world.[9]

Data-heavy activities such as blockchain, cloud computing, and AI are transforming our economy and our way of life. However, the physical infrastructure for data storage and processing consumes enormous amounts of energy, which imposes costs on the planet. Even autonomous cars, for instance, require up to 20% more energy than regular EVs. Globally, energy use by ICT is projected to increase and exceed 20% of the global total by 2030.

In Singapore, e-commerce sales was estimated to have hit S$8 billion in 2021 and has been projected to grow to S$13.4 billion by 2026.[10] E-commerce deliveries could result in 36% more delivery vehicles in cities based on current models.[11] Big-box retailers' and food delivery service providers' promises of extreme ease, speed and savings have conditioned consumers to expect everything we buy online to show up on their doorsteps in a matter of days or even hours. Optimising for speed, however, means fewer opportunities for logistics companies to consolidate orders, and leads to even more delivery vehicles on the road.[12] In 2020, goods vehicles numbered 140,000, far exceeding the 15,700 taxis and 71,000 private vehicles.[13]

E-commerce will also continue to generate more waste and could breed a throwaway culture. While Singapore's overall waste generated has been on a downward trend since 2017, the changes have been gradual.[14] Packaging accounts for about a third of the domestic waste in

Singapore, and more than half is typically made of plastic. Yet domestic waste recycling and plastic waste recycling rates continue to remain dismal, at 17% and 4% respectively.[15]

As a live-work-play-shop lifestyle in the metaverse becomes prevalent, city dwellers may spend even more of their time in the digital realm—leaving brick-and-mortar facilities, from retail outlets to community amenities and public spaces—sitting idle. On the bright side, land freed up from the transition to digital modes can become available to other social, economic and environmental needs.

The Regenerative Paradigm—A New Panacea?

Urban sustainability efforts today are premised on 'minimising impact' or 'doing less bad'. Regenerative approaches

> **Green technologies may also place unintended burdens on the environment if their end-of-life phase is not managed well.**

Singapore is no stranger to the potential of 'urban mining' as a regenerative city approach.

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move beyond these ideas, and focus on achieving net-positive impacts by working in alignment with living systems. For instance, nature-based solutions to infrastructure development consider ecosystem-scale approaches that protect, manage or restore ecosystems to simultaneously benefit human wellbeing and enhance biodiversity.

While regenerative approaches are not new, and Singapore itself has adopted nature-based solutions (one type of regenerative design), there is a newfound urgency in adopting more of such methods, in light of climate and resource pressures.

Green technologies show promise for the decarbonisation effort, but they may also place unintended burdens on the environment if their end-of-life phase is not managed well. For instance, solar panels have a lifespan of about 30 years, and the problem of their proper disposal looms large. There is currently little incentive to recycle them, given the cost of recovering the materials and toxic chemicals inside the panels,[16] but improper disposal of these solar panels

becomes an environmental concern and a waste of increasingly in-demand resources. Disposing of spent lithium-ion batteries that power most electric vehicles (lifespan of 10 to 20 years) will pose similar challenges.

Another way to meet resource requirements while supporting decarbonisation is to scale up 'urban mining': the recovery and reuse of a city's materials from buildings, infrastructure, or products. With 99% of its construction waste recycled, and more recent efforts to push for the recycling of electronic waste, Singapore is no stranger to the potential of 'urban mining' as a regenerative city approach.[17]

Supporting regenerative approaches for urban sustainability, frameworks such as the Living Building Challenge recognise that buildings and infrastructure can be made 'regenerative' and 'net positive' in terms of water, energy, and materials through its lifecycle. Developers can choose to build with rapidly renewable materials, like fast-growing wood, hemp, bark, cork, straw, bamboo, materials from biochar;[18] as well as new bio-materials such as self-repairing concrete, windows that 'breathe' without the need to open them, or the use of microalgae.[19] For example, Hamburg's BIQ Building is the first to supply part of its energy consumption through panels containing microalgae.[20] Infrastructure could also be designed for 'multiple generations' with standardised, modularised designs that can be easily reused and adapted during retrofitting or rebuilding.

Other regenerative approaches that cities are currently exploring include shifting from the conventional model

> **Amsterdam has become the world's first city to adopt the 'doughnut' economics model—where policies must meet essential social goals, while operating within environmental thresholds.** 〝

of constant growth, as measured by GDP, to one that is regenerative and distributive by design. Some thinkers even advocate for 'de-growth', with "societies that prioritise social and ecological wellbeing instead of corporate profits, over-production and excess consumption"[21]; or 'a-growth', which "effectively ignores GDP as an overall measure of progress".[22]

As an example of such thinking in practice, Amsterdam has become the world's first city to adopt the 'doughnut' economics model—where policies must meet essential social goals, while operating within environmental thresholds. The city needed to increase its housing stock (as 20% of tenants cannot even cover their basic needs after paying rentals). However, Amsterdam's CO_2 emissions were 31% higher than in

1990, with imports of building materials contributing to this. To resolve these two problems, policymakers mandated the use of recycled and natural materials in the construction sector.[23] Under the 'doughnut' economics model, Amsterdam also factors in impacts beyond its borders, e.g., air pollution created in other countries where factories make goods imported by the Netherlands, or the social impact of cocoa grown elsewhere but imported via Amsterdam.

In considering regenerative design approaches, Singapore may need to address several factors. How might 'regenerative design' ideas inform our natural and built ecosystems, and urban governance? How might we build domestic capabilities in regenerative design? To what extent can Singapore become a regenerative city that considers environmental thresholds and social goals?

> **As environmental pressures grow and the urgency of sustainable development increases, we may see the rise of 'hardline' sustainability culture.** 〝

Managing the Carbon Footprint of Building Construction and Operation

Specific to Singapore's built environment, regulations may need to take into account embodied carbon (i.e., CO_2 emitted when construction materials are produced) and resource considerations. Embodied carbon typically constitutes 30% of the overall built sector's emissions (the other 70% comes from building operations). In Singapore, where the lifespan of buildings is shorter due to urban renewal, embodied carbon emissions could go up to 40%.[1] Managing the carbon emissions of buildings, both while they are being constructed and while they are in use, will be key.

As greener and less carbon-intensive innovations replace extractive technologies, city leaders should consider the opportunities offered by new technologies (e.g., living buildings; regenerative materials and infrastructure). New business models could further improve urban sustainability. For instance, building owners could adopt 'infrastructure-as-a-service' models, where a service provider takes on the costs for certain assets and fittings in the building (e.g., solar generation, energy storage, charging infrastructure), leases these out to the building owner, and undertakes to replace/recycle the assets at the end of their useful life.

Note

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Implications for Urban Governance

As environmental pressures grow and the urgency of sustainable development increases, urban governance will need to consider how it responds to society's expectations, particularly if we see the rise of a more 'hardline' sustainability culture. Singaporeans have become increasingly aware of sustainability issues, scoring 83% in the OCBC Climate Index.[24] Citizens are starting to speak up—for example, about 2,000 people attended Singapore's first ever climate rally in 2019, to push for bolder climate actions.[25] However, these demands tend to skew towards preserving the status quo; whereas urban governance will need to balance these demands for preservation, with the need for development and rejuvenation.

> **Cities should consider how to develop relevant and sufficient green skills to support progressively challenging decarbonisation and sustainability efforts.**

Urban governance should also consider the importance of human capital to support sustainability, especially as green skills become increasingly complex. In the years to come, the low-hanging fruit of 'easy', low-cost solutions will have been adopted, leaving increasingly difficult, expensive, and time-consuming issues to resolve.[26] This means that more experienced green skillsets and expertise will be needed to design and implement ever more sophisticated solutions. Cities should consider how to develop relevant and sufficient green skills to support progressively challenging decarbonisation and sustainability efforts.

Communities and self-organising groups also play a role. Citizens everywhere have been proactively responding to climate change and resource insecurity by increasing self-sufficiency, community resilience and action. An example of this is the Transition Network, a growing movement of community-led projects that emerged in the UK.

Another initiative, the Local Futures movement, encourages local place-based networks of production and consumption of energy and food by scaling action steps for various stakeholders, from institutions to individuals.[27] Other contextualised models include Seoul's community planning groups and Pittsburgh's public-private-civic coalition building.

Urban sustainability cannot be achieved through the separate pursuit of economic development, social inclusion or environmental preservation. With sustainability culture on the rise as a popular movement, we may start to see more conflict between environmental protection, carbon abatement, and economic development priorities. True progress towards urban sustainability is only feasible when the government, industries and communities work in tandem to strike the right balance between economic, social and environmental needs. ■

A Network for Change

Each transition initiative in the Transition Network rallies local communities to work towards a low carbon, socially just future, through more active participation from the community. In the 15 years since its founding, it has spread to over 48 countries.[1]

By selling €100 shares to its locals, Transition Minett (south of Luxembourg) raised €50,000 to install a solar farm capable of producing 26,000 kWh/year.[2]

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SKILLING UP FOR A
GREEN FUTURE

In conversation with ETHOS, the Chief Skills Officer of SkillsFuture Singapore (SSG) outlines bold plans to green Singapore's economy and workforce.

by **Gog Soon Joo**

Dr Gog Soon Joo is Chief Skills Officer at SkillsFuture Singapore, a statutory board under the Ministry of Education. She oversees the skills development system in Singapore, through working with tripartite partners in the identification, dissemination and measurement of the skills needs of Singapore's economy. She works with global researchers, EdTech, HRTech and CareerTech partners in shaping the skills ecosystem.

Dr Gog serves as council member at the WEF Global Future Council for Education and Skills. She is also a member of the Advisory Board at the Nanyang Technological University Centre for Research and Development in Learning, and a member of the International Committee of Experts for UNESCO Global Network of Learning Cities.

THERE IS A NEED TO ACT QUICKLY AND EARLY TO CAPTURE OPPORTUNITIES, ESPECIALLY IN NEW GROWTH AREAS.

The world is gearing up to take action to address climate change as well as environmental and resource sustainability. What economic opportunities does this represent for Singapore?

The Singapore Green Plan details the nation's ambition to leverage the global green agenda to achieve growth, transformation and sustainability objectives.[1] This is a purposeful transformation to be sustainable and competitive. We expect to see the green wave touch every job (a.k.a., greening of current jobs). Different work functions from branding and marketing, to communications, finance, engineering, and operations will need to embrace new knowledge, understand market demand and design processes, and products to support green demand.

Given that a skilled workforce is a key enabler for Singapore's Green Economy Strategy, there is a need to act quickly and early to capture opportunities, especially in new growth areas such as agritech, carbon services and trading, electric vehicles, green finance, clean energy, circular economy and resource optimisation, and sustainable tourism.

Other initiatives, while nascent, such as Climate Impact X (CIX)—a global carbon exchange and marketplace, and APAC's first sustainable aviation fuel (SAF) plant being built in Tuas, will give Singapore a competitive advantage to maintain its hub and R&D position.

What is the state of Singapore's green sector today? Where do you see the greatest potential for development?

Progressive sectors in Singapore's green agenda include Built Environment, Clean Energy, Hospitality, Manufacturing, and Water. The Building Construction Authority's Green Mark has spurred the Built Environment sector to promote and facilitate green buildings and design sustainability since 2005. Some of Singapore's prominent land developments, like the Gardens by the Bay and Marina Bay Sands, are examples of biophilic design, focusing on integrating nature with the built environment.

The Singapore Tourism Board, together with the Singapore Hotel Association and its member hotels, have also been innovatively managing their energy costs, food waste and chemical usage. Manufacturing companies are also leading in sustainable manufacturing technologies and practices, from sustainable product design to ethical sourcing, sustainable packaging, and energy transition. Singapore's water treatment is ranked among the world's best in the innovative method of desalinating sea water, including NEWater. These are clear examples of how Singapore has been active in embracing Environmental-Social-Governance (ESG) goals.

While Net Zero steals the headlines, we should not neglect newer green efforts. For example, Agri-Tech, Aqua-Tech, and Alternative Protein Production developments are exciting areas to follow. We recently witnessed Eat Just opening their lab-grown meat facility that will produce lab-grown chicken, and Shiok Meats winning awards for its lab-grown seafood like shrimp and crab. Next Gen Foods, a plant-based food company, recently raised USD$100 million in series-A funding. We have even set up SGProtein and FoodPlant, sharing R&D, manufacturing and distribution ecosystems for companies to trial new products and scale production.

These efforts also support our food security 30 by 30 agenda to build up Singapore's agri-food industry's capability and capacity to produce 30% of our nutritional needs locally and sustainably by 2030.[2]

The greatest potential for us is using Singapore as a R&D lab and launch-pad to export the innovative capability, know-how and skills developed in Singapore to the world. This has always been our modus operandi: seeing the world market as the hinterland.

THE GREATEST POTENTIAL FOR US IS TO EXPORT THE INNOVATIVE CAPABILITY, KNOW-HOW AND SKILLS DEVELOPED IN SINGAPORE TO THE WORLD.

EXISTING JOB CONTENT AND TASKS PERFORMED WILL CHANGE AS BUSINESSES INCORPORATE GREEN TECHNOLOGIES AND MAKE THEIR BUSINESS PRACTICES MORE SUSTAINABLE.

What skillsets, capacities and mindsets will Singapore need to grow our green sector and attain our own sustainability goals?

In past decades, Singapore has gone through two rounds of mass-skilling: in the 1990s, we pushed out a national computer programme to acquaint our citizens with the use of computers. Again, in the mid-2000s, we pushed out national programmes on digital literacy (e.g., use of e-payment, apps) to support mass-skilling of foundational skills. For green skills, SSG will continue the effort in broad-skilling citizens and the workforce in foundational knowledge and awareness of the green economy, while ensuring an adequate supply of upskilling opportunities in vertical sectors and business functional areas.

From our data analysis, the impact on jobs and skills will primarily be through the 'greening' of current jobs—existing job content and tasks performed will change as businesses incorporate green technologies and make their business practices more sustainable. New knowledge in different aspects of the green economy will become part of work requirements in time to come, including in horizontal functions such as Branding & Marketing, Finance, Procurement, and Human Resource. New job roles such as Digital Sustainability Lead, Sustainability Engineer and Sustainability Manager will see increasing hiring demand.

Singapore has the right skills ecosystem—from R&D at corporate laboratories in our universities to Centres of Innovation in the polytechnics—to support frontier R&D innovation and translation of science and technology applications in the economy. Hence, our polytechnics and universities are major players in supporting R&D and its translation to the workplace and marketplace: a critical part of the value chain. The R&D and Proof-of-Concept projects happening across various industries are essential to inform us of potential job content changes and emerging skills demand.

On top of R&D, the Continuing Education & Training (CET) ecosystem under the charge of SSG will facilitate the acquisition of targeted skills for enterprises to adopt new business models and processes, to capitalise on the green agenda.

SSG, as the national skills authority, supports the Singapore Green Plan through:

1 Anticipating green skills needs for our economy and updating our national Green Skills Taxonomy.

2 Disseminating Jobs-Skills Insights (JSI) for the Green Economy in a timely manner to targeted stakeholders (citizens, enterprises, IHLs & Training Partners), such as through our annual Skills Demand for the Future Economy report.[3]

3 Ensuring adequate supply of CET courses in green skills to support re-skilling and up-skilling across sectors and job functions.

4 Monitoring the closing of skills gaps at the national level.

WE ARE BEGINNING TO SEE MORE BUSINESSES JUMPING IN TO SHIFT CONSUMPTION BEHAVIOUR AND PROVIDE MORE SUSTAINABLE OPTIONS.

How will shifting public attitudes, consumer behaviours and changing lifestyles impact support for and adoption of green tech and measures?

Greater public awareness of the carbon footprint and environmental impact of our lifestyles and consumption behaviour will shape the overall adoption of the green agenda. We are beginning to see more businesses jumping in to shift consumption behaviour and provide more sustainable options, e.g., SPECO (environmental friendly cleaning), BarePack (sustainable food delivery), Decathlon (bring your own bag), FairPrice (support local produce), etc. Over time, we believe these will become habits of choice.

At the same time, awareness programmes mounted by the Ministry of Sustainability and Environment concerning rising sea levels, and the other public communications efforts (e.g., the CNA Green Plan) will help shape the public's attitude towards responsible consumption.

Paint us a picture of Singapore's prospects as we pursue urban sustainability in the years ahead.

I envisage a video showing a group of visitors entering a gallery (such as the URA City Gallery), standing in front of the big Singapore model. The gallery will showcase where the green innovations are being lived out by the citizens, participated in by the industries, and the exciting R&D taking place. The counters of our Net Zero achievements and other indicators (e.g., carbon footprint per capita) are featured in the exhibition, alongside another part showcasing Singapore-based solutions supporting other economies across the globe.

At an individual level, I hope to one day use apps developed by a local enterprise to help me keep track of my carbon footprint, from the mode of transportation used to the consumption of energy, the sources of my food and the restaurants/hawkers preparing the food. If we can gamify the experience and make it intuitive, coupled with the right incentives, it will help us accelerate a nation-wide change.

What should policymakers and the public sector bear in mind as we work towards our Green Plan goals?

Heeding insights from historians of technology,[4] we have to pay attention to cultural acceptance of a new way of life. How do we co-create a society that takes joint responsibility for sustainable developmental growth? How do we manage trade-offs and inconvenience as part of our green transformation? How do we involve citizens in the transformation at home, at work, and within their community? ∎

Notes

1. SG Green Plan, "Let's Build A City of Green Possibilities Together", accessed June 27, 2022, https://www.greenplan.gov.sg/.

2. Singapore Food Agency, "30 by 30", accessed June 27, 2022, https://www.ourfoodfuture.gov.sg/30by30.

3. SkillsFuture, "Skills Demand for the Future Economy", accessed June 27, 2022, https://www.skillsfuture.gov.sg/skillsreport.

4. Society of The History of Technology, "SHOT Publications", accessed July 5, 2022, https://www.historyoftechnology.org/publications/.

VALUING SUSTAINABILITY
AND THE ENVIRONMENT

by **Leong Chi Hoong and Angelyn Teo**

Non-market methods of valuing the costs and benefits of environment protection can better inform policymaking for sustainable development.

Dr Leong Chi Hoong currently leads the Environmental Behavioural Sciences and Economics Research Unit (EBERU) at the Ministry of Sustainability and the Environment (MSE).

Angelyn Teo is an economist in EBERU, a multi-disciplinary research team that leverages economics, behavioural insights and data analytics to support the development, implementation and evaluation of environmental policies.

INTRODUCTION

Cost-benefit analysis (CBA) is a standard tool that policymakers use to evaluate policies. In a typical CBA, the monetary value of a policy's costs and benefits are computed and compared. If the benefits of the policy outweigh its costs, it means that implementing it would increase society's welfare, on balance. For instance, when evaluating whether to build a park, policymakers would weigh the fiscal costs of financing its construction vis-à-vis the monetary and non-monetary benefits for park users and residents in the vicinity.

However, applying CBA to sustainability and environmental policymaking is challenging. Unlike other economic goods and services, property rights for environmental goods are typically poorly defined as no stakeholder owns the environment and there are no markets to trade environmental goods. Consequently, the corresponding monetary value of the benefits of environmental protection generally cannot be inferred from market valuation. Undervaluing these externalities can therefore lead to the under-provision of environmental public goods.

Given the above limitations of market valuation of environmental goods, a range of non-market valuation techniques have been developed to estimate the benefits of protecting the environment, which in turn may better inform policymaking in the environmental domain. These techniques can be broadly categorised as *revealed preference* and *stated preference* methods.

Unlike other economic goods and services, property rights for environmental goods are typically poorly defined as no stakeholder owns the environment and there are no markets to trade environmental goods.

REVEALED PREFERENCE APPROACH

In a revealed preference approach, non-marketed values are estimated by observing data on behaviours in a proxy market (such as a non-marketed attribute that has an impact on property prices). A common strategy in revealed preference studies is *hedonic pricing*, which estimates the value of a good and breaks its value down into constituent characteristics. For instance, this method hypothesises that potential home buyers would be willing to pay more for houses with better environmental quality, and that home sellers value better environmental quality, so sellers would only agree to sell a house which is located in an area with a better environment if it commands a higher price. As such, when applied to home prices and with appropriate data on environmental characteristics, hedonic pricing on property transactions can provide insight into the value of protecting the environment.

Another approach in revealed preference studies is the travel cost method, which estimates the value of the environment by observing whether an individual is willing to invest time and effort to travel to a place with a good natural environment. This method hypothesises that if an individual decides to visit such a location, his valuation of the visit would be equivalent to or higher than the costs of travelling to it. Such costs could include both direct costs of travelling and indirect or implicit costs of time foregone due to the visit. However, in small, highly urbanised cities like Singapore, the travel cost method may undervalue the non-market value of Singapore's environmentally attractive sites, due to the ease of mobility within a small geographical region.

REVEALED PREFERENCE IN PRACTICE

A range of environmental goods have been valued in revealed preference studies, such as:

Improved air quality[1, 2, 3, 4, 5]

The impact of water quality on house prices[6, 7, 8]

The impact of hazard waste clean-up on the housing market[9, 10]

Notes

1. D. Jr. Harrison and D. L. Rubinfeld, "Hedonic Housing Prices and the Demand for Clean Air", *Journal of Environmental Economics and Management* 5, no. 1 (1978): 81–102.

2. V. Kerry Smith and Ju-Chin Huang, "Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models", *Journal of Political Economy* 103, no. 1 (1995): 209–227.

3. K. Y. Chay and M. Greenstone, "Does Air Quality Matter? Evidence from the Housing Market", *Journal of Political Economy* 113, no. 2 (2005): 376–424.

4. C. W. Kim, T. T. Phipps, and L. Anselin, "Measuring the Benefits of Air Quality Improvement: A Spatial Hedonic Approach", *Journal of Environmental Economics and Management* 45, no. 1 (2003): 24–39.

5. P. Bayer, N. Keohane, and C. Timmins, "Migration and Hedonic Valuation: The Case of Air Quality", *Journal of Environmental Economics and Management*, 58, no. 1 (2009): 1–14.

6. C. G. Leggett, and N. E. Bockstael, "Evidence of the Effects of Water Quality on Residential Land Prices", *Journal of Environmental Economics and Management* 39, no. 2 (2000): 121–144.

7. P. J. Poor, K. L. Pessagno, and R. W. Paul, "Exploring the Hedonic Value of Ambient Water Quality: A Local Watershed-Based Study", *Ecological Economics* 60, no. 4 (2007): 797–806.

8. P. J. Walsh, J. W. Milon, and D. O. Scrogin, "The Spatial Extent of Water Quality Benefits in Urban Housing Markets", *Land Economics* 87, no. 4 (2011): 628–644.

9. M. Greenstone and J. Gallagher, "Does Hazardous Waste Matter? Evidence from the Housing Market and the Superfund Program", *The Quarterly Journal of Economics* 123, no. 3 (2008): 951–1003.

10. S. Gamper-Rabindran and C. Timmins, "Does Cleanup of Hazardous Waste Sites Raise Housing Values? Evidence of Spatially Localized Benefits", *Journal of Environmental Economics and Management* 65, no. 3 (2013): 345–360.
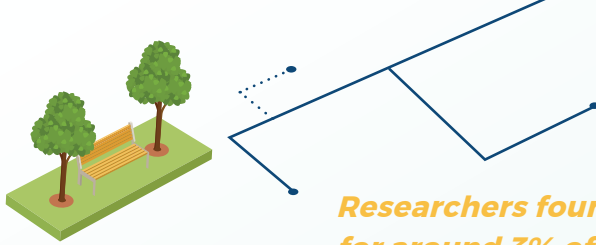
Researchers found that vegetation accounted for around 3% of the average property value, for all public housing apartments sold between April 2013 and April 2014.

In Singapore's context, academics have used the hedonic pricing approach to estimate the value of vegetation and greenery. In one study, Belcher and Chisholm examined the impact of different types of green spaces on the resale prices of public housing apartments built by the Housing and Development Board (HDB).[1]

The study found that managed vegetation (e.g., parks, park connector network and roadside greenery) was associated with higher property values. These results were in line with the intuition that residents were willing to pay more for the ecosystem services and recreational activities provided by this greenery. The researchers also found that this vegetation accounted for around 3% of the average property value, amounting to a total monetary value of S$179 million for all public housing apartments sold between April 2013 and April 2014.

These results corroborated the findings of a 2016 MSE study which estimated the non-market value of the Active, Beautiful and Clean Waters (ABC Waters) project at the Bishan-Ang Mo Kio (AMK) Park.[2] The study employed a difference-in-differences methodology to estimate the causal impact of the ABC Waters project on the prices of nearby properties.[3] After taking into account macroeconomic trends and factors that could affect property prices, differences in house values between houses nearer to and further away from the Bishan-AMK Park could be attributed to the Bishan-AMK Park. Results from the analysis suggest that residents were willing to pay for the improvement in park amenities associated with the ABC Waters project.

While revealed preference studies have been applied to a wide range of environmental goods, there can be limitations to this non-market valuation approach. First, a suitable proxy market needs to be identified and such a market might not exist in some cases. For example, hedonic pricing can only be used to estimate the value of green spaces to residents staying near parks. Individuals staying far away from these parks might place value on green spaces, but do not reveal their preferences through housing prices. Second, revealed preferences might not be able to account for all the factors that affect house prices, especially when aspects of individual preferences are unobserved.

To overcome these limitations, researchers use the stated preference approach to non-market valuation.
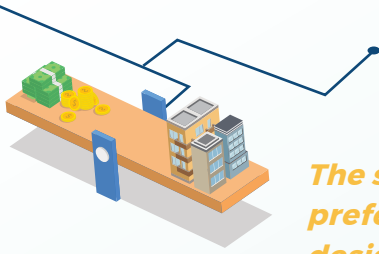
The survey questionnaires used in stated preferences studies need to be carefully designed to ensure that accurate estimates of willingness-to-pay are obtained.

STATED PREFERENCE APPROACH

Unlike the revealed preference approach, stated preference studies elicit individuals' valuation of an environmental good through surveys. These studies can estimate the willingness-to-pay for environmental goods even in the absence of a proxy market, since they ask respondents for their valuations directly.

Stated preference approaches can be broadly categorised into *contingent valuation* and *choice modelling* studies. In a contingent valuation study, respondents to the survey are presented with a hypothetical change in the environment (e.g., building a new park in the neighbourhood) and asked if they would be willing to pay for that change. A choice modelling study extends the contingent valuation methodology by presenting respondents with a series of choice situations. These choice situations are designed with a fixed set of attributes, but each alternative in the choice situation will contain combinations of different levels of the attributes. For example, attributes could include the number of trees, park size, park amenities, and costs to the respondent. Respondents are then asked to choose their preferred alternative in each choice situation. Analysis of respondent choices provides

an estimate of the willingness-to-pay for the attributes used to describe the policy options.

The survey questionnaires used in stated preferences studies need to be carefully designed to ensure that accurate estimates of willingness-to-pay are obtained. To guide the development of such questionnaires in stated preferences studies, the US National Oceanic and Atmospheric Administration (NOAA) convened a panel of economists led by two Nobel laureates to evaluate the stated preference approach.[4] The NOAA panel concluded that stated preference surveys should follow a set of best practices to obtain reliable willingness-to-pay estimates. These include: (i) defining the status quo and the changes to this status quo; (ii) choosing the elicitation method (how the respondents' willingness-to-pay are obtained, e.g., open-ended or dichotomous choice question) and the payment vehicle (the modes of payment for the good or policy e.g., fees or increased taxes); (iii) implementing the survey on the target sample population; and (iv) estimating the willingness-to-pay based on responses to the survey. These best practices have been updated over the years through research and experience.[5]

STATED PREFERENCE IN PRACTICE

Stated preference studies have been used in a wide range of contexts to estimate the value of environmental goods, including:

Damage assessments from pollution events, such as the Exxon-Valdez oil spill in the US[1]

The value of the natural environment [2, 3, 4]

The willingness-to-pay for climate change and adverse weather events [5, 6]

Notes

1. R. T. Carson, R. C. Mitchell, M. Hanemann, R. J. Kopp, S. Presser, and P. A. Ruud, "Contingent Valuation and Lost Passive Use: Damages from the Exxon Valdez Oil Spill", *Environmental and Resource Economics* 25, no. 3 (2003): 257–286.

2. J. Bennett, "The Contingent Valuation Method: A Post-Kakadu Assessment", *Agenda: A Journal of Policy Analysis and Reform* (1996): 185–194.

3. J. N. Sanchirico, D. K. Lew, A. C. Haynie, D. M. Kling, and D. F. Layton, "Conservation Values in Marine Ecosystem-Based Management", *Marine Policy* 38 (2013): 523–530.

4. R. Scarpa, T. J. Gilbride, D. Campbell, and D. A. Hensher, "Modelling Attribute Non-Attendance in Choice Experiments for Rural Landscape Valuation", *European Review of Agricultural Economics* 36, no. 2 (2009): 151–174.

5. S. Akter, J. Bennett, and M. B. Ward, "Climate Change Scepticism and Public Support for Mitigation: Evidence from an Australian Choice Experiment", *Global Environmental Change* 22, no. 3 (2012): 736–745.

6. W. D. Shaw and J. Baker, "Models of Location Choice and Willingness to Pay to Avoid Hurricane Risks for Hurricane Katrina Evacuees, *International Journal of Mass Emergencies and Disasters* 28, no. 1 (2010): 87–114.

Technology has enabled researchers to better describe proposed changes to the status quo.

Technology has enabled researchers to better describe proposed changes to the status quo, enabling respondents to visualise the impact of different proposed options. Iftekhar et al. designed a novel choice modelling survey that used virtual reality to describe proposed ABC Waters projects to respondents.[6] This enabled respondents to immerse themselves in the envisioned ABC Waters environment when making their choice.

Leong also used a novel survey questionnaire design to estimate the willingness-to-pay for construction noise abatement by using audio clips to enable respondents to perceive different noise levels.[7] This approach circumvented the limitations of previous studies that used textual descriptions of noise levels, which may be difficult for respondents to appreciate.

Ng, Foo, and Leong also used a choice modelling survey to estimate the willingness-to-pay for various typologies of active mobility (AM) infrastructure.[8] A key variable in the choice modelling survey was the maximum permissible speed of active mobility devices. The researchers provided respondents with relevant images and videos corresponding to the attribute levels in each choice set to clarify understanding of the choice task. ∎

CONCLUSION

Market failures associated with environmental protection and sustainability presents a unique set of challenges for policymakers. Unlike most other economic goods, markets for environmental goods are typically non-existent and it is not possible to infer the value of the environment from market values. Hence, we look at the use of non-market valuation techniques to estimate the monetary benefits of environmental goods.

The techniques described above can be applied to a wide range of environmental policies, including promoting resource conservation, encouraging circular economy, mitigating climate change, and maintaining public cleanliness and hygiene. Estimates from these studies provide a more accurate assessment of benefits associated with policies, thus enabling policymakers to more fully weigh the costs and benefits of environmental protection policies.

However, there are some limitations to non-market valuation techniques. For instance, the revealed preference approach can only be used when there is a suitable proxy market to reference and data is available for collection and analysis. In the case of stated preference surveys, there is a long process of first crafting the right survey questionnaire, then conducting the survey and eventually collecting respondents' data for analysis. There is also a need to balance the trade-off between the sample size of survey respondents for more robust analysis and the overall costs to conduct the study. Hence, for stated preference studies, sufficient time must be set aside for the study, and they should only be undertaken if the fiscal outlay and/or environmental impact of the policy being considered is significant.

Notes

1. R. N. Belcher and R. A. Chisholm, "Tropical Vegetation and Residential Property Value: A Hedonic Pricing Analysis in Singapore", *Ecological Economics* 149 (2018): 149–159. The researchers used ordinary least squares regression in the baseline model and controlled for location characteristics (e.g., distance to nearby schools, food centres and transportation nodes) and apartment attributes (e.g., floor area, apartment type, and storey). A key assumption of the ordinary least squares regression is that the residuals of the regression are independently and identically distributed. As property prices of nearby apartments may be more highly correlated than properties that are located further away, the researchers controlled for this spatial autocorrelation by estimating a hierarchical mixed-effect model.

2. Leong Chi Hoong, "Cost Benefit Analysis of the Active, Beautiful and Clean Waters Programme", quoted in *Evidence-based Policymaking in Singapore: A Policymaker's Toolkit* (Singapore: Civil Service College, 2016), 52–53.

3. The study categorised properties into treatment and control groups based on their distance from the park. The treatment group was defined to be properties within 400 m of the park, while properties located 400 m to 600 m away from the park were placed in the control group. Both groups were exposed to similar macroeconomic trends, but the treatment group enjoyed better amenities from the ABC Waters project. As such, comparison of the price trends of the control and treatment groups allowed the impact of the Bishan-AMK Park's ABC Waters project on house value to be isolated.

4. K. Arrow, R. Solow, P. R. Portney, E. E. Leamer, R. Radner and H. Schuman, "Report of the NOAA Panel on Contingent Valuation", *Federal Register* 58, no. 10 (1993): 4601–4614.

5. For a review of these practices, see: R. J. Johnston, K. J. Boyle, W. Adamowicz, J. Bennett, R. Brouwer, T. A. Cameron et al., "Contemporary Guidance for Stated Preference Studies", *Journal of the Association of Environmental and Resource Economists* 4, no. 2 (2017): 319–405.

6. M. S. Iftekhar, J. Buurman, T. K. Lee, Q. He, and E. Chen, "Non-Market Value of Singapore's ABC Waters Program", *Water Research* 157 (2019): 310–320.

7. C. H. Leong, *Willingness to Pay for Noise Abatement in Singapore* (Canberra: Australian National University, 2019).

8. W. Ng and T. Foo, "Estimating Singaporeans' Willingness-to-Pay for Active Mode Infrastructure" (internal study, Land Transport Authority, 2020).

GREEN TRANSPORT IN SINGAPORE:

PUBLIC ATTITUDES, INTENTIONS AND ACTIONS

by **Chong Wen Wei, Leong Wai Yan, Karenza Mosquera, Ng Kai Xuan and Ng Sheng Yang**

With recent studies indicating strong support for green transport among Singaporeans, especially among youth, a greener, people-centric land transport system for Singapore is well within our reach.

Chong Wen Wei is Behavioural Scientist in the Economics Unit, Policy & Planning Group of the Land Transport Authority. He focuses on applying behavioural/psychological tactics and empirical methods to promote people-centric design and strategy.

Leong Wai Yan is Chief Transport Economist in the Economics Unit, Policy & Planning Group of the Land Transport Authority. He oversees the Economics Unit.

Karenza Mosquera is Economist in the Economics Unit, Policy & Planning Group of the Land Transport Authority. Her current work areas include conducting research to understand public acceptance and attitudes towards transport policies and initiatives.

Ng Kai Xuan is Economist in the Economics Unit, Policy & Planning Group of the Land Transport Authority. Her current work entails experimental design and empirical analysis in the behavioural research domain to facilitate policymaking.

Ng Sheng Yang is Economist in the Economics Unit, Policy & Planning Group of the Land Transport Authority. His current work areas include conducting research on travel behaviours and vehicle markets to support policy development.

INTRODUCTION

The scientific consensus is that global climate change resulting from the emission of greenhouse gases in the modern industrial era has had far-ranging environmental and health consequences worldwide.[1] Although Singapore is not a major greenhouse gas producer, contributing only 0.1% of global carbon emissions, we nevertheless are making significant domestic efforts towards net zero emissions by or around the middle of the century, which align with our international obligations, such as the Paris Agreement, to help limit global warming to 1.5°C above pre-industrial levels.

With transport being Singapore's third largest CO_2-equivalent emitter, at about 16% of total emissions,[2] aggressive efforts are being made under the SG Green Plan 2030[3] to (a) 'green' public transport fleets, (b) increase public transport peak-period modal share, (c) encourage active mobility modes, and (d) promote cleaner vehicles, culminating in a recently announced pledge to cut 80% of peak land transport emissions by or around middle of the century.[4]

REDUCING SINGAPORE'S LAND TRANSPORT CARBON FOOTPRINT

Travelling by an electric car (EV), electric bus or train cuts carbon emissions by 50%, 70%, and 90% respectively, compared to driving an internal combustion engine (ICE) car.[1] Additionally, the carbon footprint for active modes (e.g., walking or cycling) is practically zero. To make significant cuts in the land transport carbon footprint, Singapore needs to strongly promote the use of active mobility (AM) and public transport (PT) even as we continue to green our land transport fleets and infrastructure.

To encourage active commutes, the Government is investing heavily in the nation's AM infrastructure. For example, the Islandwide Cycling Network programme plans to increase our cycling network to more than 1300 km by 2030. Efforts are also well underway to repurpose existing road space that enhance safety and connectivity for walking and cycling.

"Before" and "After" artist impressions of the road repurposing of Woodlands Ring Road conducted in August 2021
Source: Land Transport Authority Singapore

To complement existing AM infrastructure, the Government is also ensuring that PT remains a green and attractive choice. The Land Transport Authority (LTA) has committed to having all public bus fleets run on cleaner energy by 2040, with half of these buses to be electric by 2030. Energy saving features are also being progressively introduced into PT infrastructure. LTA intends to expand the country's rail network from 230 km to 360 km over the next 15 years to increase its accessibility, reducing the need for private transport.[2] The ambition is that by 2040, 9 in 10 peak period trips will be made on 'Walk, Cycle, Ride' modes, with most of these trips made via active modes or PT.

While private vehicles are generally not as green as PT, their carbon footprint can still be reduced if ICEs are replaced with EVs that have zero tailpipe emissions. Hence, encouraging EV adoption is another important strategy, underlined by recently announced initiatives such as (a) upgrading existing electrical infrastructure to support wider usage of residential charging networks, (b) installing EV chargers in public housing carparks over the next few years, and (c) continuously reviewing new policies and regulations to ensure the safety and reliability of EV charging. These initiatives complement existing policies that regulate vehicle ownership and usage by further lowering the baseline rate of road vehicle emissions.

Notes

1. Ministry of Transport, "Speech by Minister for Transport, Mr S Iswaran at the Committee of Supply Joint Segment on Singapore Green Plan 2030", accessed May 3, 2022, https://www.mot.gov.sg/news/in-parliament/Details/ speech-by-minister-for-transport-mr-s-iswaranat- the-committee-of-supply-joint-segment-onsingapore-green-plan-2030.

2. Land Transport Authority, "Growing Singapore's Land Transport Network", accessed accessed May 3, 2022, https://www.lta.gov.sg/content/ltagov/en/upcoming_projects.html.

We need Singaporeans on Board

Even as LTA introduces bold initiatives to reduce the carbon footprint of our land transport system, we cannot achieve our vision without public support and buy-in. Hence, as we push on with this sustainable journey, we need to know what Singaporeans think about these efforts and whether they are supportive of the Government's new policies.

Crucially, we also need to understand the different profiles of aspirations and needs in our population and how we might cater to them.

Three recent studies we have worked on offer glimpses into how our citizens think and feel about greener transport, highlighting the opportunities and pitfalls that policymakers should keep in mind when planning for effective change.

PUBLIC WILLINGNESS TO EMBRACE GREENER TRANSPORT OPTIONS

The first study, the Sustainable Behaviours and Perceptions Survey (SBPS), was carried out with some 600 car owners and non-owners, in collaboration with the National University of Singapore (NUS) in December 2021.[5] SBPS aimed to compare car owners against non-car owners along several self-reported dimensions pertaining to the adoption and prioritisation of carbon-saving activities across various domains such as transport, food and energy.

Our second study, titled Green Commuting among Youths (GCY), was a nationally representative survey conducted by LTA in March 2022 using OPPi, an online AI-powered opinion crowdsourcing and engagement tool. Respondents were shown various opinion statements about environmental views and car ownership aspirations where they could respond with either "Yes", "No", or "Undecided". We sampled around 600 youths between the ages of 18 and 31.

Finally, the EV Adoption Study (EVAS) was a survey conducted in collaboration with the Ministry of Communications and Information in January 2022 to understand receptivity towards EVs, including EV purchase intentions. The survey received around 1,000 responses from vehicle owners and prospective vehicle buyers in Singapore.

Both car and non-car owners equally acknowledge that reducing car use should be a key priority.
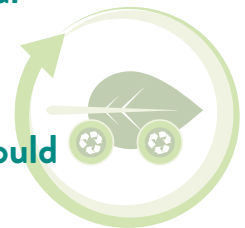
SBPS: CAR OWNERS VERSUS NON-CAR OWNERS

Environmental Priority

As we push towards a greener future for Singapore, the SBPS suggests that both car and non-car owners equally acknowledge that reducing car use should be a key priority.

In the survey, both car and non-car owners are asked to rank nine different environmental behaviours (see Figure 1)—with varying levels of carbon-saving impact, to be promoted in Singapore to mitigate climate change—from 1 (*lowest priority*) to 10 (*highest priority*). They also report their level of adoption for each of these behaviours in their day-to-day life on a scale of 1 (*not at the moment*) to 7 (*always*).

Dotted lines indicate grand means

B1: Xdrive (H)	B2: XBuyClothes (H)	B3: LessMeat (H)	B4: FanNotAirCon (H)	B5: Xwastefood (L)	B6: AirCon25deg (L)	B7: OffHeater (L)	B8: OffWallSwitch (L)	B9: BYOB (L)
Take public transport, walk or cycle, rather than drive.	Only buy clothes when necessary.	Eat less meat.	Use the fan instead of air-conditioning at home.	Ensure no food is being thrown away after meals.	Set the air-conditioning temperature at 25 degrees or above.	Switch off the water heater immediately after showers.	Switch off electrical appliances at the wall socket when not in use.	Bring your own bag or container when you have to shop or buy food.
Average Priority Level								
7.26	5.00	4.16	7.10	6.85	6.75	6.92	7.06	6.51

The average adoption level (vertical axis) and average priority level (horizontal axis) for each of the nine behaviours across car and non-car owners is shown, with each behaviour being classified as having high (H) or low (L) carbon savings.

Figure 1. Adoption Levels against Perceived Priority of Environmental Actions

Among these surveyed behaviours, "Take PT, walk or cycle, rather than drive" (*Xdrive*) rank the highest overall in terms of perceived priority level for both groups. The carbon savings from not driving the car add up very quickly compared to the other eight behaviours, and thus we may also infer that Singaporeans have correctly identified the top environmental behaviour to prioritise.

This heartening result suggests that both car and non-car owners recognise the vital importance of LTA's car-lite vision in realising a more sustainable future for Singapore, and we can leverage this unifying theme of mitigating climate change to rally more people to adopt car-lite lifestyles.

Loyalty to Cars

Unsurprisingly, car owners have a fairly low adoption level of *Xdrive* as shown in Figure 1, but even so, there is significant heterogeneity in the *intention* of car owners to switch to non-car alternatives. Not every car owner is captive to their car.

We reach this conclusion by analysing how car owners classify themselves into five different stages of reducing car use (see Figure 2).[6] The stages range from having no reason or intention to reduce car use (*stage 1*) to having taken some action towards reducing car use (*stage 5*).

Encouragingly, 59% of car owners report being in *stages 3 to 5*: meaning that minimally, they had some intention to reduce car use and did not write it off as impossible. However, we find a sizeable proportion (40%) of car owners classifying themselves into *stages 3* and *4*. These car owners are experiencing an intention-action gap whereby they want to reduce car use but have not yet acted on their intentions.

Self-reported Stages of Adoption (Towards Non-car Modes)

Car Owners, n=294

Label	Stage Description	Option Text
STAGE 1 **Contented Car Users**	Drivers that see no reason or intention to reduce car use.	At the moment, I use the car for most of my trips. I am happy with my current level of car use and see no reason why I should reduce it.
STAGE 2 **Grudging Car Users**	Drivers that believe reducing car use is currently impossible.	At the moment, I still use the car for most of my trips. I would like to reduce my current level of car use, but, at the moment, I feel it would be impossible for me to do so.
STAGE 3 **Potential Car → PT Switchers**	Drivers that want to reduce car use but are unsure of how to start.	At the moment, I do use the car for most of my trips. I am currently thinking about changing some or all of these trips to non-car modes (i.e., public transport, walking, cycling, personal mobility devices), but at the moment I am unsure how I can replace these car trips, or when I should do so.
STAGE 4 **Potential Car → PT Switchers**	Drivers that have reduction plans which have not been implemented.	At the moment, I use the car for most of my trips, but it is my aim to reduce my current level of car use. I already know which trips I will replace and which alternative transport mode I will use, but, as yet, I have not actually put this into practice.
STAGE 5 **Car → PT Switchers**	Drivers that have taken some steps towards reducing car use.	Because I am aware of the many problems associated with car use, I already try to use non-car modes as much as possible. I will maintain or even reduce my already low level of car use in the next few months.

Figure 2. Stages of Adoption of Non-Car Modes among Car Owners

Loyalty to Public Transport

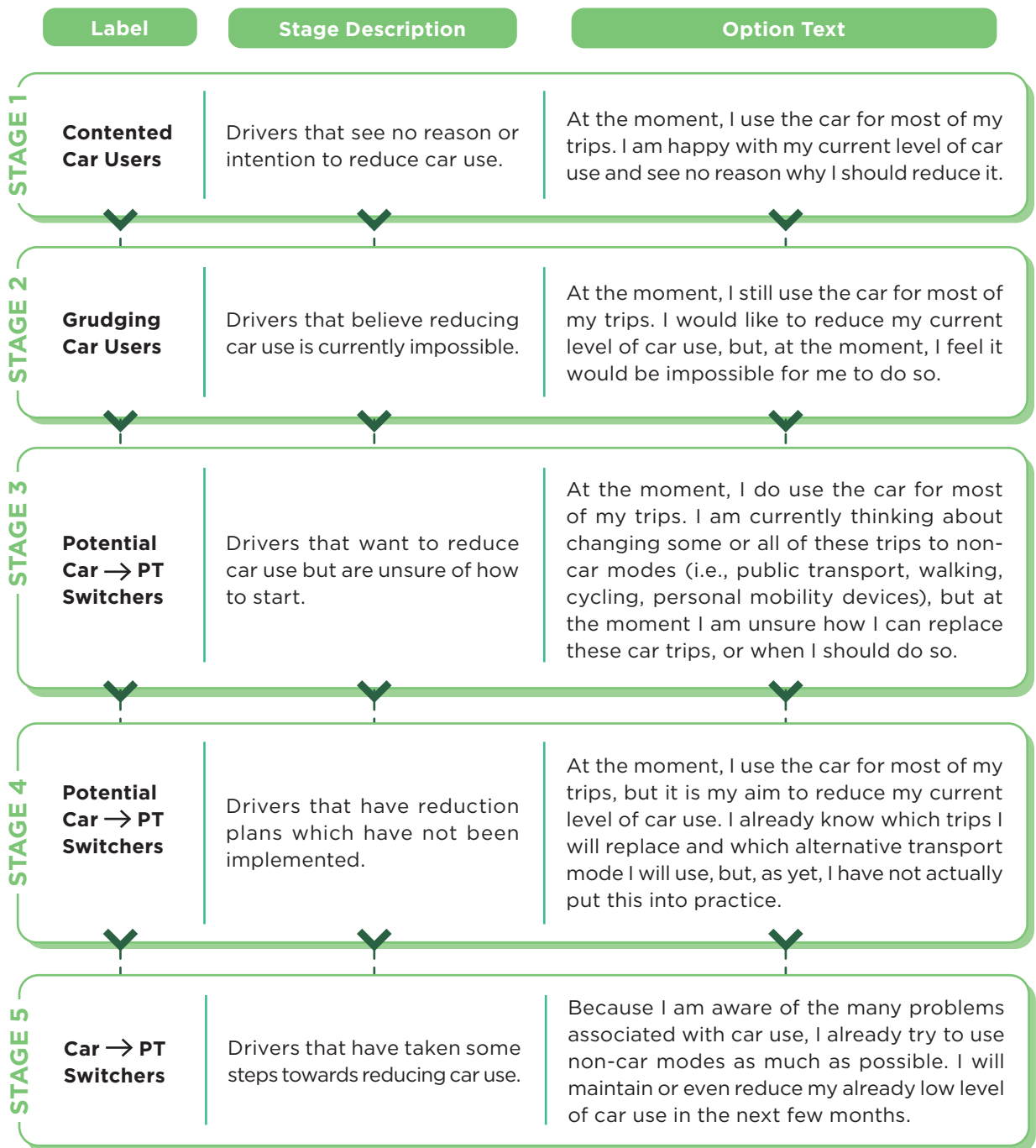On the other hand, how worried should we be about non-car owners switching towards car dependency? We extend the five-stage model originally designed for car owners to assess how non-car owners classify themselves into different stages of private transport adoption (see Figure 3).

The encouraging news is that in contrast to car owners, non-car owners are more homogeneous in their intentions to stick with their current mode, with a majority (66%) who report being "contented PT users" (*stage 1*), in contrast to just 21% of car owners who say they are "contented car users".

One group that bears closer monitoring are the 18% of non-car owners who are "grudging captives" (*stage 2*). Like *stages*

Policymakers can find ways to cushion unmet expectations, shift preferences and transform grudging users into contented, voluntary users of public transport.

3 to 5, they aspire to own cars but unlike them, they feel trapped by circumstances to use PT. While there are a myriad of reasons why cars remain more desirable than PT, policymakers can find ways to cushion unmet expectations, shift preferences and transform grudging PT users into contented, voluntary users of public transport.

Self-reported Stages of Adoption (Towards Private Transport)
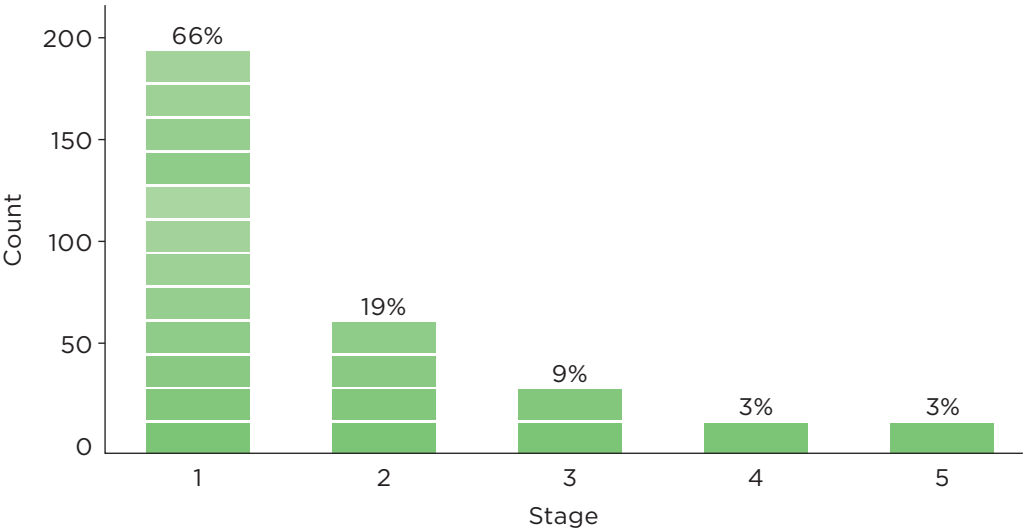
Non-car Owners, n=289

Figure 3. Stages of Adoption of Private Transport among Non-Car Owners

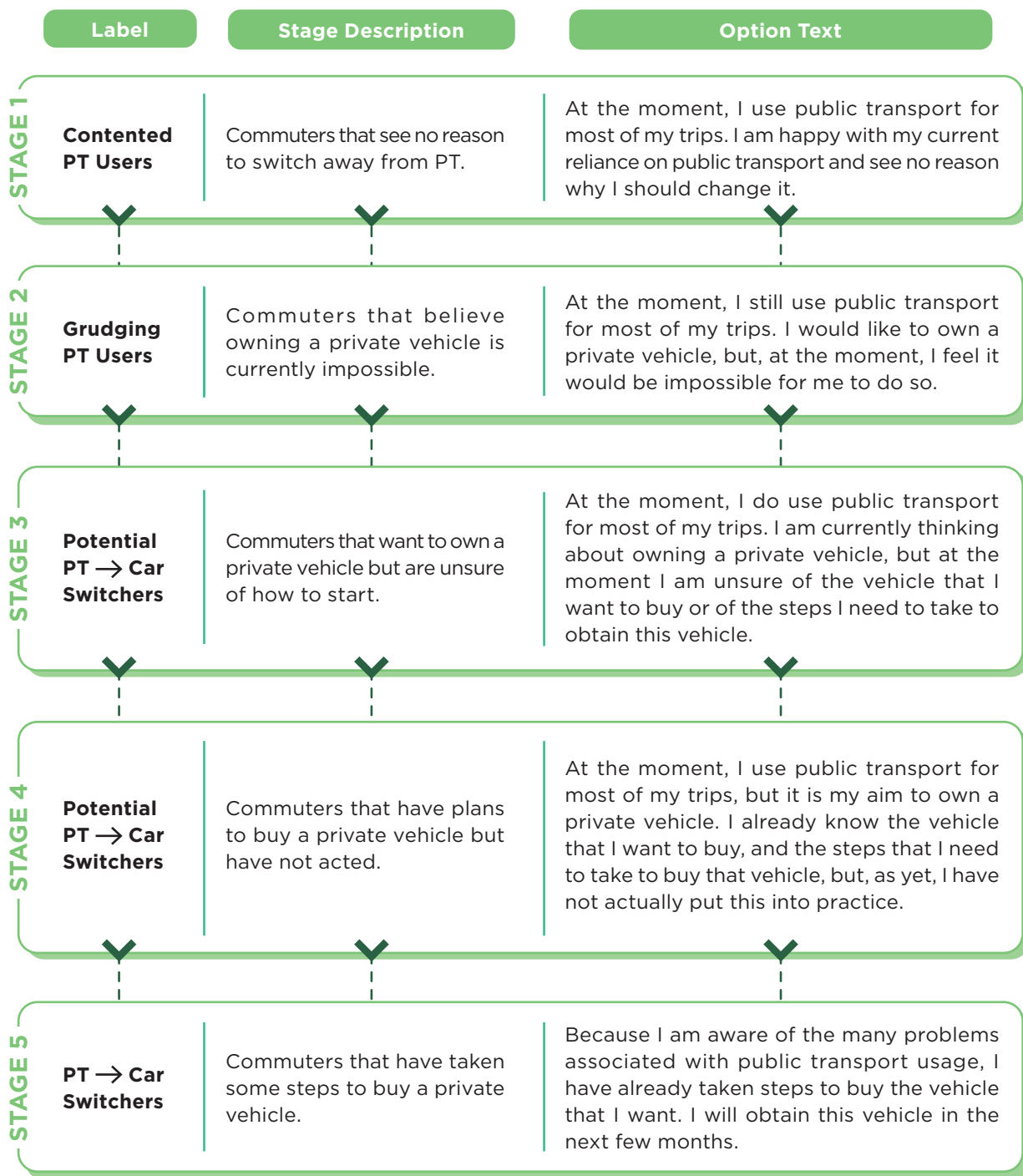| Label	Stage Description	Option Text
STAGE 1 **Contented PT Users**	Commuters that see no reason to switch away from PT.	At the moment, I use public transport for most of my trips. I am happy with my current reliance on public transport and see no reason why I should change it.
STAGE 2 **Grudging PT Users**	Commuters that believe owning a private vehicle is currently impossible.	At the moment, I still use public transport for most of my trips. I would like to own a private vehicle, but, at the moment, I feel it would be impossible for me to do so.
STAGE 3 **Potential PT → Car Switchers**	Commuters that want to own a private vehicle but are unsure of how to start.	At the moment, I do use public transport for most of my trips. I am currently thinking about owning a private vehicle, but at the moment I am unsure of the vehicle that I want to buy or of the steps I need to take to obtain this vehicle.
STAGE 4 **Potential PT → Car Switchers**	Commuters that have plans to buy a private vehicle but have not acted.	At the moment, I use public transport for most of my trips, but it is my aim to own a private vehicle. I already know the vehicle that I want to buy, and the steps that I need to take to buy that vehicle, but, as yet, I have not actually put this into practice.
STAGE 5 **PT → Car Switchers**	Commuters that have taken some steps to buy a private vehicle.	Because I am aware of the many problems associated with public transport usage, I have already taken steps to buy the vehicle that I want. I will obtain this vehicle in the next few months.

Figure 3 (cont'd). Stages of Adoption of Private Transport among Non-Car Owners

Among the non-car owners of today, it is important to take the pulse of what youths think of car ownership and relatedly, their environmental attitudes, as some of them will desire cars in the future as they form families and progress in their careers. A study such as the GCY will help address this question.

Declining Car Ownership Aspirations and Rates among Youths

From the GCY study, half of the respondents (47%) say that they plan to own a car before they turn 35 years old (see Figure 4). While cars have attractive instrumental benefits (e.g., privacy, ease of travelling), most agreed that alternatives such as ride sharing services are adequate substitutes for instances when PT does not meet their travel needs. These findings corroborate with SBPS findings that most non-car owners are happily captive to PT.

It is further significant that youth opinion is mixed on the symbolic value of car ownership, since this cultural attitude contributes to the inelastic demand of cars in a way that is difficult for public policy to resolve.
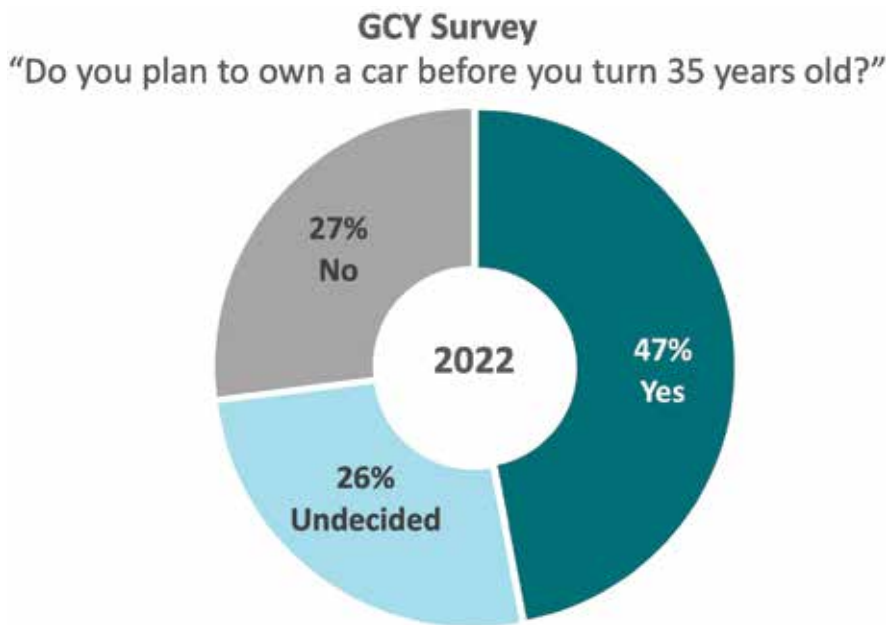

GCY Survey
"Do you plan to own a car before you turn 35 years old?"

27% No

2022

47% Yes

26% Undecided

Figure 4. Car Ownership Aspirations among Youths from GCY Survey

This result corroborates with the survey conducted by *The Straits Times* which also finds that around 50% of today's youths aspire to own a car. Although an analogous GCY study from previous years is not available, we may reference another finding from *The Straits Times* survey that car ownership aspirations among youths have been declining between 2016 and 2022. This insight syncs with an internal LTA study in 2020 which finds a falling trend in car ownership rates among young adults (see Figure 5), despite the car population remaining relatively stable in the same period.

What might explain this diminishing desire for car ownership? From the GCY study, we find that most youths see cars as a nice-to-have, but not a must-have (see Figure 6). Although the instrumental benefits of cars (e.g., privacy, ease of travelling) are readily apparent, most also agree that alternatives such as ride-sharing services are adequate substitutes for instances when PT does not meet their travel needs and that they would be able to live the life they want even without a car. These findings corroborate with SBPS findings that many non-car owners are contented PT users, suggesting that efforts to invest in and promote PT are bearing fruit.

We further find that youth opinion is mixed on the symbolic value of car ownership (see Figure 6). Likewise, *The Straits Times* study also picks up a decline in the status symbol of a car. This is significant since this cultural attitude contributes to the inelastic demand of cars in a way that is difficult for public policy to influence.
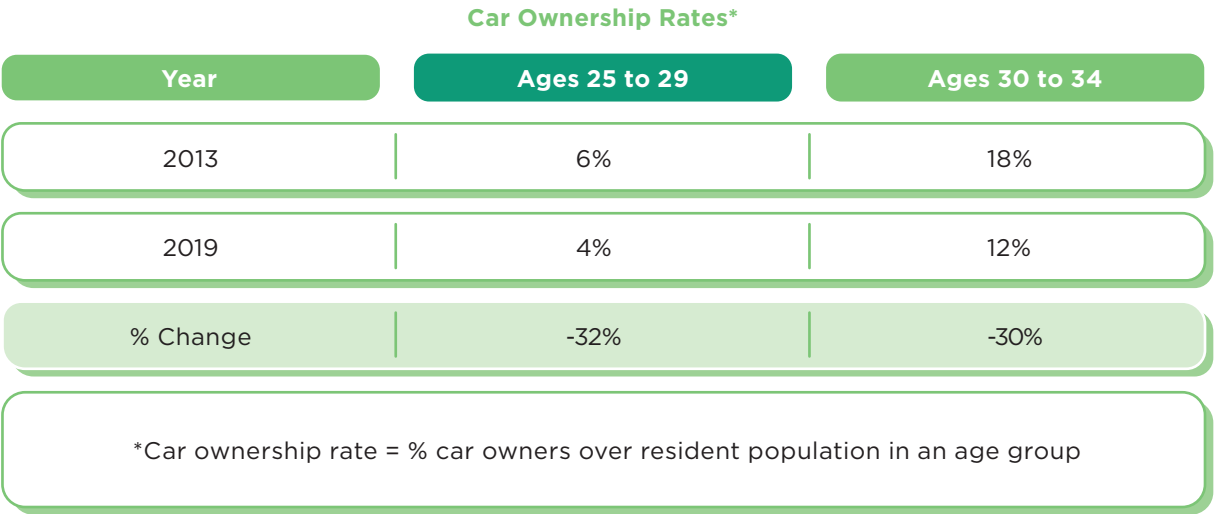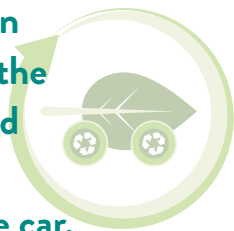
Car Ownership Rates*

Year	Ages 25 to 29	Ages 30 to 34
2013	6%	18%
2019	4%	12%
% Change	-32%	-30%

*Car ownership rate = % car owners over resident population in an age group

Figure 5. Car Ownership Rates among Singapore Youths

We must persist in efforts to ensure the availability of good car-lite transport alternatives to the car.

While we remain optimistic about current trends, we note that youths are not outright rejecting car ownership. Around half still plan to own a car and in response to another question in the GCY, some 70% indicate they would buy a car if they could afford one in the next 10 to 15 years. This serves to remind us that we must always persist in efforts to ensure the availability of good car-lite transport alternatives to the car, so that we continue to keep more of our PT users in the "contented" category.

Environmental Attitudes towards Private and Public Transport

What about environmental attitudes among youths? There is consensus about the environmental harms of driving, but interestingly, not everyone perceives the same degree of environmental impact from their personal travel mode choice (see Figure 7). While most youths believe that cars are one of the biggest contributors to carbon emissions, they also appear divided on whether transport decisions (e.g., choosing to drive a car or taking PT) make a difference in protecting our climate, or whether it necessarily reflects one's environmental values or their concern for the environment. On the question of whether they are the type of person who acts in environmentally friendly ways, 67% of car aspirants agree with the statement, compared to only 53% of non-aspirants, which seems like a paradox.

Category	Statements	Response
Instrumental benefits of a car	One can travel to more places with a car.	Youths largely agree with these statements (Above 80% agreement for each statement)
	Helping with family needs (e.g., bringing seniors to medical appointments, young children to school) is a good reason to own a car.	
	Travelling is so much easier with a personal/private car.	
	I enjoy the privacy a car would offer.	
	It is much faster to travel by car.	
Necessity of a car	Where public transport does not meet my travel needs, car sharing (e.g., BlueSG), private hire car and ride sharing services (e.g., Grab) will adequately do the job.	
	I would be able to live the life I want even if I do not own a car.	
Symbolic values of a car	Owning a nice car lets other people know that I am successful in life.	Youths are divided (Below 50% agreement and below 50% disagreement for each statement)
	Having a car would allow me to express myself.	
	I would love to drive the latest car models	

Figure 6. Summary of General Attitudes among Youths in GCY Survey

Category	Statements	Response
Environmental considerations	Fewer cars on the roads will be a huge benefit for the environment.	Youths largely agree with these statements (Above 70% agreement for each statement)
	I believe one of the biggest contributors to air pollution/carbon emissions come from cars.	
Transport decisions and environmental values	My friends will perceive me as being concerned for the environment if I take public transport.	Youths are divided (Below 50% agreement and below 50% disagreement for each statement)
	I am emotionally involved in environmental protection issues in Singapore.	
	It does not matter whether I take public transport as it makes no difference to protecting our climate.	
	Taking public transport does not express my concern for the environment.	
	When more models of cleaning energy vehicles are available, my decision to buy a car would not depend on environmental considerations.	

Figure 7. Summary of Environmental Attitudes among Youths from GCY Survey

Beyond building up our collective understanding of the environmental harm of driving, it is timely to begin imbuing a sense that every individual action matters.
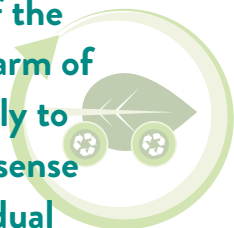
We speculate that this paradox could have arisen due to pre-existing environmental tendencies being overshadowed by an overwhelming functional need for car ownership. It may also be a case of cognitive dissonance—a discomfort that arises when one's awareness of the negative environmental impact of driving clashes with one's personal desire for a car. Hence, those with stronger car aspirations may attempt to justify their personal desire for a car by claiming to behave (or even behaving) in a more environmentally friendly way in other domains, akin to a licensing effect.

Regardless, these findings suggest that beyond building up our collective understanding of the environmental harm of driving, it is timely to begin imbuing a sense that every individual action matters. Among all our lifestyle actions, one of the best things we can do for the environment, that chalks up carbon savings very quickly, is to not drive. In this regard, virtue signalling, can in fact be a virtue.

EVAS: ATTITUDES TOWARDS ELECTRIC VEHICLES

Car-lite travel is the most environmentally friendly way to travel in terms of carbon emissions. However, for those who still need to drive, EVs have emerged as a solution to cut down emissions due to driving. But how might we convince current and aspiring car owners to switch over to EVs?

Demand for Cleaner Energy Vehicles

From EVAS, we find that Singaporeans have generally positive sentiments towards EVs: 65% of respondents recognise that they provide environmental benefits, and close to 7 in 10 would support services that offer greener transport options (e.g., JustGrab Green). Furthermore, the transition to EVs appears to be gaining traction as 45% of respondents state that they would consider buying an EV for their next vehicle purchase. This preference for EVs is stronger among existing vehicle owners (48% plan to buy an EV) than non-vehicle owners (41% plan to buy an EV).
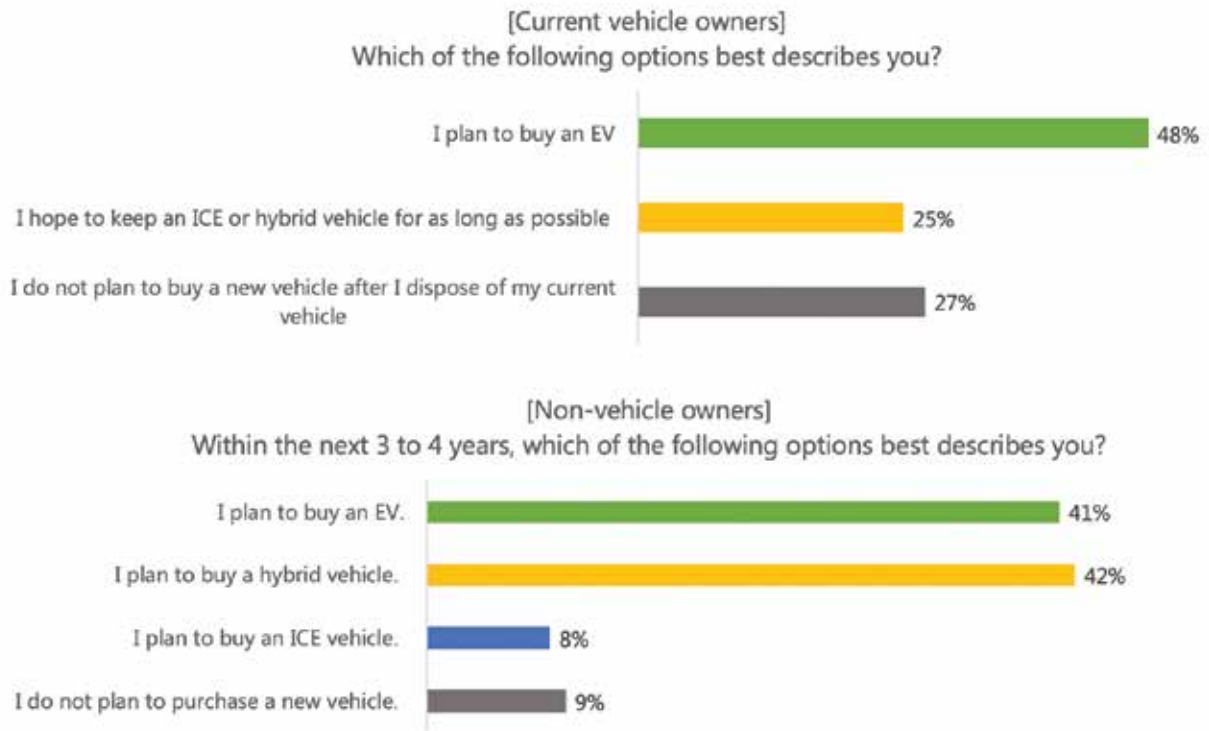
[Current vehicle owners]
Which of the following options best describes you?

I plan to buy an EV — 48%
I hope to keep an ICE or hybrid vehicle for as long as possible — 25%
I do not plan to buy a new vehicle after I dispose of my current vehicle — 27%

[Non-vehicle owners]
Within the next 3 to 4 years, which of the following options best describes you?

I plan to buy an EV. — 41%
I plan to buy a hybrid vehicle. — 42%
I plan to buy an ICE vehicle. — 8%
I do not plan to purchase a new vehicle. — 9%

Figure 8. EV Purchase Intentions among Vehicle Owners and Non-Vehicle Owners

While these findings suggest stronger demand for EVs, we also find a substantial proportion of individuals who are still hesitant to go for fully electrified vehicles. About 1 in 4 vehicle-owning respondents say they hope to keep an ICE or hybrid vehicle for as long as possible. Among non-vehicle owners, around 40% would consider a hybrid or ICE vehicle. These findings are robust even in a hypothetical scenario in which the driving time to the nearest petrol station is doubled from their current experience.

The strong current preference for hybrid vehicles is perhaps not surprising given that the EV charging infrastructure is in its nascent stage and the number of EV models available in Singapore is limited today. Once the EV charging network expands and more vehicle manufacturers ramp up EV production in the years ahead, we can expect EV adoption to pick up as well.

Barriers to EV Adoption

Not unexpectedly, we find the high purchase cost of EVs to be one of the top barriers of EV adoption, with 56% of respondents selecting it as a main deterrent (see Figure 9). Several measures to help improve price parity between EVs and conventional vehicles have been introduced, including the introduction of the EV Early Adoption Incentive, and revising the road tax framework for EVs. Over time, we expect the cost of an EV to fall as battery technology matures.

Other oft-indicated factors relate to the EV charging infrastructure, including insufficient charging points and uncertainty over the location of these facilities. Many disagree that fitting 1 in 10 parking lots with slow (overnight) chargers would be sufficient; in fact, 41% of respondents feel that more than half of the parking lots should have EV charging capabilities by 2030. This is much higher than LTA's estimates of a 5 to 1 vehicle to charger ratio as being sufficient to meet EV charging needs by 2030, as estimated from typical usage patterns that result in the need for overnight charging only once every 5 to 7 days. Nevertheless, even as we seek to calibrate public expectations regarding the EV charging infrastructure, we are also ramping up the number of EV charging points across the island to about 60,000 by 2030.

Promoting car-lite living based on environmental reasons may have limits, as not all may feel the same urgency to tackle these concerns.

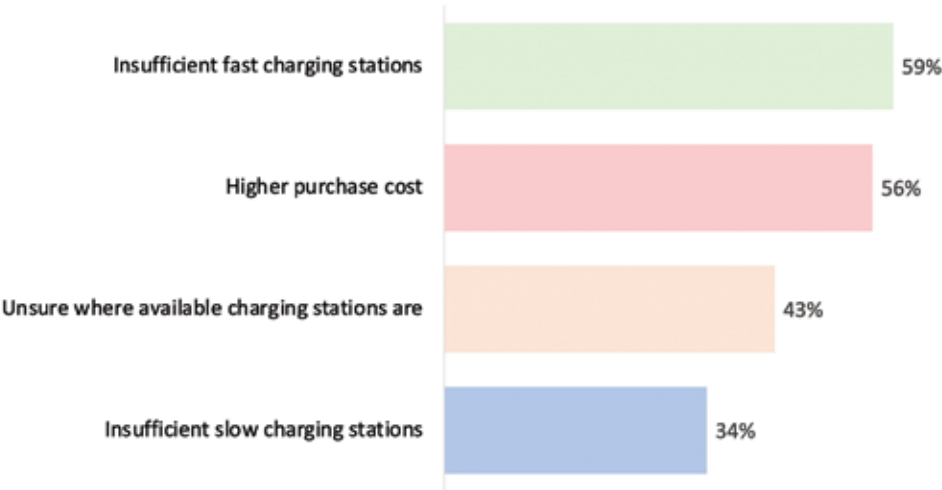## Compared to an ICE vehicle, which of the following reasons would deter you from buying an EV for your next vehicle purchase?

Reason	Percentage
Insufficient fast charging stations	59%
Higher purchase cost	56%
Unsure where available charging stations are	43%
Insufficient slow charging stations	34%

Figure 9. Main Deterrents of EV Adoption (as identified by respondents to be among their top 3 deterrents)

The following initiatives make me want to own an Electric Vehicle (EV) in the next 10 years:

- More mass market EV options,
- All HDB towns to be EV-ready with charging points in nearly 2,000 HDB car parks by 2025.

Do you plan to own a car before you turn 35 years old?

Response	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Yes	33%	46%	19%	1%	
No	13%	30%	42%	12%	4%
Undecided	17%	41%	38%	5%	

Figure 10. EV Adoption Due to Infrastructural Improvements—Breakdown by Car Ownership Aspirations

Striking a Balance Between Encouraging EV Adoption and a Car-lite Lifestyle

LTA has rolled out a public education campaign titled "Power Every Move" in March 2022 to raise awareness of EVs—both cars and buses—and their benefits to the environment such as cleaner air and quieter roads. While widespread adoption of EVs is necessary to curb the harmful emissions from ICE vehicles, we also need to be mindful that our pro-EV initiatives and messaging do not inadvertently fuel car ownership desires. More or equal emphasis to encourage the use of public transport modes must be maintained in our overall messaging.

We observe in our GCY survey that 43% of youths with no initial car ownership aspirations agree that pro-EV initiatives would encourage them to own an EV (see Figure 10). In addition, 58% of those initially undecided about car ownership feel the same way. Combined, this is a substantial group of people whom we would risk swaying into desiring to own an EV even though they did not plan to own cars to begin with.

WHERE WE MIGHT GO FROM HERE

How should policymakers respond to the insights gleaned from these studies into public attitudes towards greener transport options?

We propose three approaches to influencing transport behaviour, based on *behavioural science*—a field that encompasses holistic interventions to educate, empower, excite, and entrench behaviour.

1

Time policy interventions right.

This is vital when tackling ingrained habits. For instance, at significant temporal landmarks (e.g., at the start of a new year), people become more sensitive to new information and open to change: what has been called the fresh start effect.[1] Travel behaviour, being habitual in nature, can become more malleable during certain 'fresh starts'.

The upcoming opening of several new rail lines in Singapore could serve as valuable 'fresh starts' to harness, especially for residents staying near these new stations. As a general principle, the government should use these timing opportunities to multiply the effects of car-lite interventions or policies.

2

Help drivers commit to car-lite goals.

Our findings show that a substantial number of drivers want to reduce car use but face an intention-action gap. They could benefit from a range of self-control and commitment techniques drawn from behavioural science.

One highly promising technique is gamification. Countries such as Japan have used gamification to create exciting and novel experiences that draw commuters to PT.[2] In Singapore, LTA has used gamification to promote car-lite travel to school among primary school students in small-scale trials (e.g., the Kids Smart Travel Challenge),[3] with highly encouraging results. Private firms have also created gamified travel experiences for adults, while commercial apps have turned habit formation into an enjoyable 'quest'. Policymakers could make use of these innovations to attract and habituate drivers to a car-lite lifestyle, while maintaining the loyalty of existing PT users.

3

Design for different people.

Population segmentation is a valuable tool for behavioural scientists and policymakers alike. By recognising the heterogeneity within a population, we gain a more precise view of stakeholders and can then tailor interventions to better cater to different preferences and needs.

One data-driven approach to segmentation is to cluster people along several dimensions to form nuanced archetypes. For instance, in GCY, we segment our youth respondents into three distinct archetypes: namely the pro-environmentalists, ambivalent personas, and car lovers (see Figures 1 and 2 on the next page). One insight we find is that while further environmental messaging may encourage ambivalent personas to go car-lite, a different approach—potentially focusing on other negative externalities (e.g., traffic congestion)—may be needed to reach the pro-environmentalists who still plan to own a car.
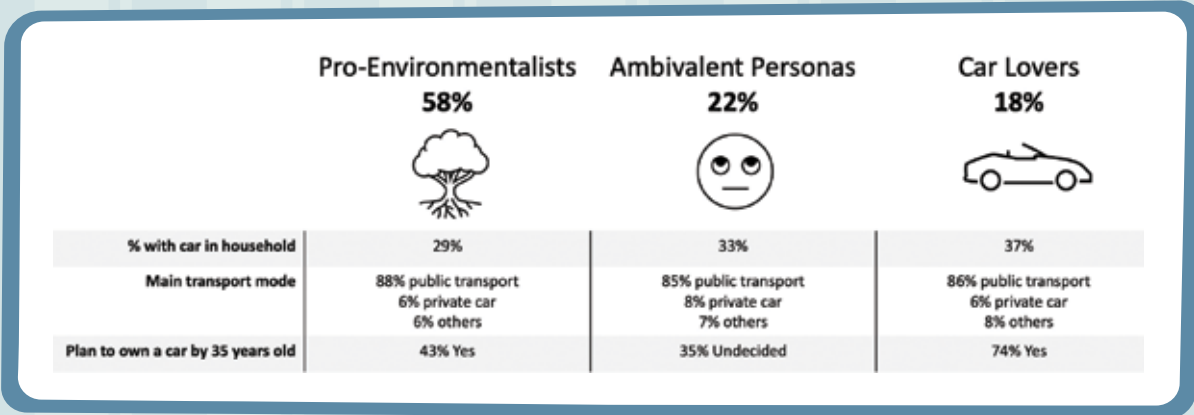
Figure 1. Archetypes of Youth Non-Vehicle Owners and Car Ownership Aspirations
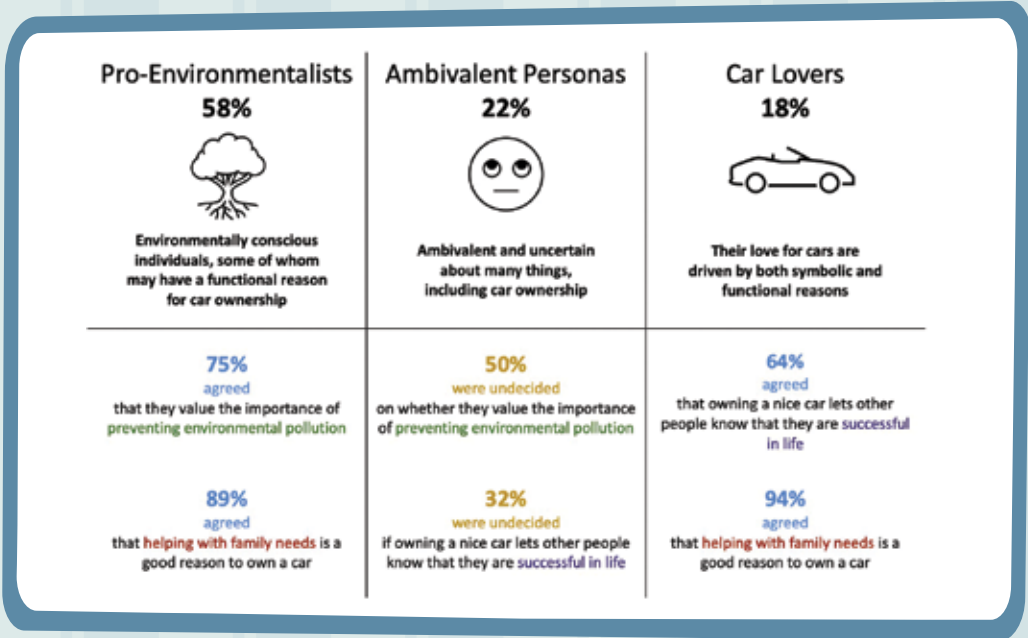

Figure 2. Archetypes of Youth Non-Vehicle Owners and Characteristics

Notes

1. Hengchen Dai, Katherine L. Milkman, and Jason Riis, "The Fresh Start Effect: Temporal Landmarks Motivate Aspirational Behavior", *Management Science* 60, no. 10 (June 2014), https://pubsonline.informs.org/doi/abs/10.1287/mnsc.2014.1901.

2. "Tokyo Metro—The Underground Mysteries 2019" Puzzle-Solving & City Exploration Game event, https://www.tokyometro.jp/lang_en/news/202971.html?width=816&height=650.

3. Do Hoang Van Khanh and Low Weijian, "Encouraging Car-Lite Travel through Gamification: The Kids Smart Travel Challenge", *Ethos Digital* 5 (November 2019), https://www.csc.gov.sg/articles/encouraging-car-lite-travel-through-gamification-the-kids-smart-travel-challenge.

CONCLUSION

Sustainability, in its many forms, has always been a central theme running through Singapore's land transport story. While environmental sustainability has been more strongly emphasised in recent years, we should be mindful that promoting car-lite living based on environmental reasons may have limits, as not all groups may feel the same urgency to tackle these concerns. For those who are contented car users, there are fundamental issues (e.g., cost and charging infra-availability) that must be addressed before they can be persuaded to switch to EVs. We need more innovative thinking informed by research, to break the car habit and move people from intention to action.

Nevertheless, we are optimistic that Singaporeans, and especially our next generation, are prepared to embrace green transport by making car-lite choices every day. With continued focus on green plans in the coming decades, our goal to cut peak land transport emissions by 80% by 2050 is looking achievable. Through a collective effort, we look forward to an even greener land transport for Singapore in the years to come. ◼

Notes

1. Singapore has not been, and will not be, spared. Average temperatures in our coastal city-state have risen by more than 1°C over the past 40 years. By the end of the century, the National Climate Change Secretariat projects a further increase of 4.6°C in temperature and a 1 m rise in sea levels.

2. National Climate Change Secretariat, "Singapore's Emissions Profile", accessed May 2, 2022, https://www.nccs.gov.sg/singapores-climate-action/singapore-emissions-profile/.

3. SG Green Plan, "Singapore Green Plan 2030 Green Targets", accessed May 2, 2022, https://www.greenplan.gov.sg/key-focus-areas/key-targets.

4. Land Transport Authority, "Reducing Peak Land Transport Emissions by 80%", accessed May 2, 2022, https://www.lta.gov.sg/content/ltagov/en/newsroom/2022/3/news-releases/reducing-peak-land-transport-emissions-by-80-.html.

5. While this study is currently unpublished, the National University of Singapore (NUS) has granted us permission to reveal some of the highlights.

6. Sebastian Bamberg, "Changing Environmentally Harmful Behaviors: A Stage Model of Self-Regulated Behavioral Change", *Journal of Environmental Psychology* 34 (2013): 151–159.

Sustainability as Behavioural Change:

NUDGING THE GOOD, DISCOURAGING THE BAD

by **Charmaine Lim**

Intentional habit formation can help to drive the adoption of more sustainable eco-friendly behaviours.

Charmaine Lim is Lead Researcher at the Institute of Governance and Policy, Civil Service College. Her research interests include evidence-based policymaking and behavioural economics.

Singaporeans can do more to adopt eco-friendly habits, particularly in recycling and reducing waste. Perceptions that the governments and/or businesses have a larger role to play help explain why some individuals do not do more. In a Kantar Public study, 83% of respondents from Singapore said they would accept stricter rules and environmental regulations.[1] The assumption underlying this sentiment is that people expect governments and businesses to take the

lead, compared to individuals. Short of regulation and legislation, there is a limit to what governments and businesses can do to change individual behaviours.

The gap between people's beliefs and actions, and their expectations that governments and the private sector play a bigger role, should inform our approach to tackling climate change problems. It is laudable that we have achieved the first step to changing behaviour—recognising the importance of fighting climate change. But we next need to convince individuals to adopt more demanding individual eco-friendly habits, and to find ways to make these habits easier to adopt. The end goal is to see people adopting sustainable and impactful behaviours as part of their regular lifestyle.

People expect governments and businesses to take the lead, but there is a limit to what they can do to change individual behaviours.

Room for Improvement

Singapore's low recycling rate for certain materials (such as paper/cardboard, plastic and food) suggests there is still room to inculcate good eco-friendly habits in Singapore.[1]
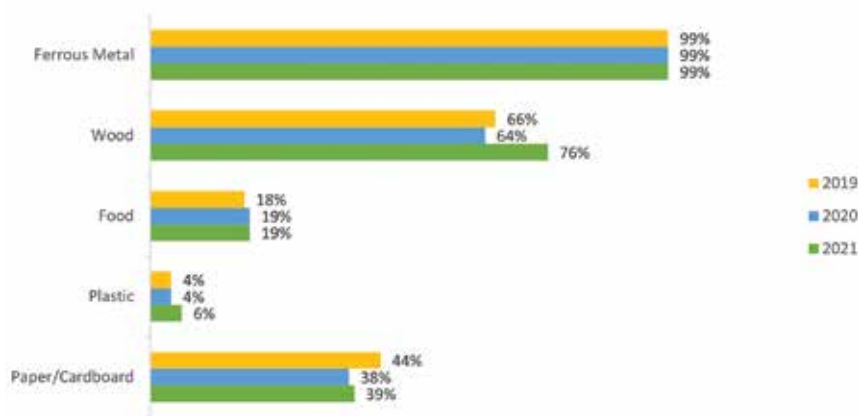
Note

1. The National Environment Agency, "Waste Statistics and Overall Recycling", accessed May 24, 2022, https://www.nea.gov.sg/our-services/waste-management/waste-statistics-and-overall-recycling.

Figure 1. Recycling Rate of Selected Waste in Singapore (2021)
Source: National Environment Agency

LESS TALK, MORE ACTION NEEDED

In the National Climate Change Secretariat's 2019 climate change public perception survey, 60.9% strongly believed that individual action makes a difference in fighting climate change.[1] Yet, only 34% of respondents from Singapore rated themselves between 8 and 10 in terms of their commitment to preserving the environment and planet, according to a Kantar Public study on environment and climate change in 2021.[2] An inaugural Climate Index research by Overseas-Chinese Banking Corporation Limited, in partnership with Eco-Business, also found that Singapore residents scored only 6.5 on a 10-point scale in adopting green practices.[3] In addition, the same Kantar Public study showed that 40% of respondents from Singapore did not think they needed to change their habits.[4]

Singapore's domestic recycling rate is at a 10-year low of 13%.[5] A study conducted by the Ministry of Sustainability and the Environment (MSE) in 2021 with youths in Singapore also found that while the majority of respondents were already practising certain eco-friendly behaviours like switching off electrical appliances, turning off the tap when soaping hands and using fans instead of air-conditioners, fewer than 50% of respondents took up other habits like recycling, using reusable food containers for takeaways and composting food waste.[6]

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WHAT DOES IT TAKE TO MAKE A BIGGER IMPACT?

Some behaviours and actions are more environmentally friendly than others because they reduce the carbon footprint to a greater degree. These impactful behaviours often demand more effort. For such behaviours to be sustained, habits need to be formed.

A defining feature of a habit is when people behave automatically without much deliberation. Psychologist Wendy Wood has found that 43% of what people do every day is repeated in the same context and people slip back into their (good and bad) habits when they are distracted and/or overwhelmed.[2]

According to Wood and Neal, sustaining behaviour change requires a two-pronged approach: forming good habits while simultaneously breaking existing bad habits.[3]

Wood and Neal also identify several elements crucial to forming lasting habits.[4]

i. *Opportunities for the repetition of the same good habit, so that the behaviour becomes automatic*. E.g., interventions in school requiring students to recycle all food waste.

ii. *Context cues such as the physical environment or times of day to prompt the first step required of the desired behaviour.* E.g., setting up a recycling corner next to the waste bin at home.

iii. *Rewards to encourage repeated positive behaviours.* E.g., receiving a small monetary incentive from recycling a glass bottle.

For recycling, forming good habits alone will not be sufficient, because efforts can be marred by bad habits like incorrect recycling. According to the Ministry of Sustainability and the Environment (MSE), 40% of the contents in recycling bins cannot be recycled because of contamination (e.g., plastic bags with food waste) and/or non-recyclable materials (e.g., styrofoam, tissues, reusables).[5] Similarly, SembWaste has reported that approximately 60% of what they handle in their facility cannot be recycled.[6]

Wood and Neal recommend three strategies to help break bad habits:[7]

i. *Remove context cues that trigger bad habits by leveraging key moments in life*, such as recycling interventions targeting those who have just shifted into new housing estates.

ii. *Alter the environment by making it difficult to continue with the bad habit.* E.g., requiring recyclables to be sorted by waste type before placing it in the recycling bins.

iii. *Vigilant monitoring of behaviour, so that timely feedback can be provided to halt automatic undesired behaviours.* E.g., visual cues on the covers of recycling bins to remind what can be recycled.

For habit change to happen, we need to change the context within which we make decisions and act.
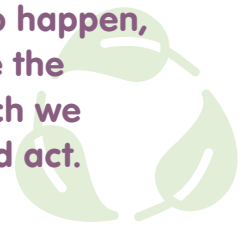
GOVERNMENT'S ROLE IN SUPPORTING HABIT CHANGE IN SINGAPORE

The physical environment around us—homes, shopping malls, the workplace—influences how we behave every day. Our actions are also influenced by other contextual cues like the time of the day, what others do in the same environment, and incentives shaped by government or corporate policies. For habit change to happen, we need to change the context within which we make decisions and act.

In this regard, governments can play an important role in promoting recycling habits by shaping incentive systems through regulations and/or working with businesses to reward positive behaviours, and influencing context cues (e.g., design and location of recycling bins).

RECYCLE RIGHT!

The National University of Singapore (NUS) Zero Waste Taskforce conducted a study on contamination for recycling bins between January and March 2020. They found that the proportion of non-recyclables compared to all items in plastic recycling bins (i.e., contamination rate) was at a high of about 57% for University Town (Utown) and 46% for College for Design and Engineering.[1]

Seeking to lower contamination in recycling bins, the Taskforce conducted a trial to test a new "Recycle Right" bin design for the recycling of bottles, cans, and notes and cardboard.

The "Recycle Right" bins were designed with a number of features to help break incorrect recycling habits and encourage new habits:[2]

1. A display showcase was installed at the top of each recycling bin, showing actual non-recyclable items from each bin.

2. A lid was installed for each recycling bin as a timely prompt to disrupt automatic incorrect recycling habits.

3. Bins were made transparent to reinforce positive behaviour; it showed people whether their actions were aligned with others who recycled right.

At the end of the trial, they found that the new Recycle Right bins was effective in reducing the contamination rate of plastic bottle recycling bins from about 60% to 27% in UTown.[3]

Following these promising results, the Taskforce collaborated with the National Environment Agency to trial the bins at two shopping malls. Results showed that the bins were effective in lowering the contamination rate of plastic bottle recycling bins in these malls from 79% to 29%.[4]

Prototype of the Recycling Right Bins
Source: NUS

Close-up of Display Showcase
Source: NUS

Notes

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MAKING IT EASY TO RECYCLE FOOD WASTE

In 2018, the Environmental Behavioural Sciences and Economics Research Unit (EBERU) of MSE, together with NEA, the People's Association and Tampines Town Council, launched a *Food Waste? Don't Waste!* pilot programme at the Tampines GreenLace HDB estate to gather insights on households' food waste disposal behaviours and inculcate a habit of segregating food waste from general waste. Food waste was transported to Our Tampines Hub for recycling into fertiliser, liquid nutrient, and non-potable water.

The programme incorporated several behavioural science principles:

Make It Easy

All Radio Frequency Identification (RFID) access-controlled bins were coloured bright red and clearly labelled as "Food Waste Recycling Bin". These bins were placed near the ground floor lift lobby to maximise their visibility, convenience, and accessibility for both residents and waste collectors. Directional signs were placed at eye-level on every wall surface, to be visible to residents the moment they exited the lifts. A simple step-by-step bin operation guide was attached to each bin to ensure ease of use.

Food Waste
Recycling Bin
Source: MSE

Make It Timely

Each household was given a starter kit to guide them in starting on food waste segregation at home and disrupt existing food waste disposal behaviours.

1. An infographic on the types of acceptable and unacceptable food waste was placed on the food waste kitchen caddy as a timely visual reminder for residents to 'recycle right' at the point of food waste segregation.

2. Residents were given an information kit, which included a handbook and a fridge magnet, highlighting the purpose and impact of food waste segregation and recycling.

One kitchen caddy

Pack of 65 food waste bags
(topped up monthly)

Two radio frequency
identification
(RFID) tokens

One information kit (magnet and info card)

Food Waste Segregation Starter Kit given to households
Source: MSE

3. Residents received customised monthly updates on the amount of food waste they recycled, through card letters and their estate's Facebook group. Drawing attention to their contributions, these messages reinforced the saliency of their efforts, and affirmed their identity as food waste recyclers.

4. Fertiliser recycled from the food waste was distributed back to Tampines GreenLace residents. This was a tangible incentive to further encourage residents to participate in food waste segregation.

Example of monthly feedback card on residents' participation
Source: MSE

Fertiliser recycled from food waste in Our Tampines Hub
Source: MSE

The pilot programme was successful in encouraging at least two-thirds of households who never recycled food waste before to do so at least once. It was also effective in encouraging a third of households to recycle food waste at least once a week.

(Contributed by Alice Lee, Environmental Behavioural Sciences and Economics Research Unit, Ministry of Sustainability and the Environment)

EMPOWERING INDIVIDUALS TO NUDGE THEMSELVES AND OTHERS

While governments and businesses can shape the external environment and context cues to encourage good habits and sustain behavioural change, they have more limited influence on habit formation in individual homes. Empowering individuals with the ability to nudge themselves as well as others seeks to resolve this.

Self-nudging is an approach that helps people change their behaviour by getting individuals to design their own environments.[8] The appeal of self-nudging lies in customising interventions based on individual contexts, which could bring about better results and afford individuals greater autonomy. A 2018 qualitative study by Torma et al. on driving sustainable consumption behaviour found that self-nudging was effective in helping consumers better align their actions with their intentions to be environmentally friendly.[9] When consumers changed from purchasing at supermarkets to preorder organic grocery delivery services, most believed that they made less impulsive decisions due to the lack of context cues in the supermarkets.

One challenge of self-nudging is that it assumes individuals are effective choice architects, meaning that they can (i) assess their behaviours to identify behavioural barriers and enablers; (ii) understand their environment and context; and (ii) design effective nudges. While this seems to imply that only trained behavioural scientists are qualified to self-nudge, it does suggest that individuals need help in designing effective self-nudges. The public sector can play a role in this effort (see box story on *How Self-Nudges Can Encourage More Recycling*).

Inspiration for such interventions can be taken from how smartphone applications are often designed to help people with their personal habits such as exercising, healthy eating, and taking care of mental wellbeing. Many habit-forming apps make use of behavioural change techniques such as reminders, goal setting, progress tracking, peer support and incentives. However, Stawarz et al. pointed out that many of these apps primarily focus on tracking behaviours, which is not enough to support habit formation.[10] Instead, apps could be designed to help users to select trigger events and set reminders to reinforce intentions.[11] For instance, users could choose to sort their recyclables (intention) after dinner (trigger event) and choose to receive a daily notification on the application before the trigger event.

The benefit of empowering individuals need not stop at changing one's own behaviour. A greater impact could be achieved by involving citizens to play an active role in influencing others to adopt green habits. Through this approach, citizens will see themselves as agents of change. There will also be more problem-solvers in society and they might have a better understanding of the behavioural barriers to adopting eco-friendly behaviours. Like self-nudging, the role of the government here is to equip individuals with the necessary know-how to encourage others around them to adopt green habits.

HOW SELF-NUDGES CAN ENCOURAGE MORE RECYCLING

While officers from MSE might be expected to be among the savviest about recycling, many of them still express uncertainty on how to recycle right.

To address this, behavioural researchers from the Ministry started a recycling campaign for the Ministry family (MSE, NEA, Singapore's National Water Agency, PUB, and Singapore Food Agency) called "Sustainability Starts with Me" in 2021. It aimed to empower every officer to be an ambassador for recycling.

"Sustainability Starts with Me" Campaign Logo

The campaign incorporated behavioural elements like simple self-nudges to help officers form common recycling habits such as bagging recyclables to avoid contamination, rinsing drink bottles and cans, and starting a recycling corner.

Participants of the campaign adopted a self-nudge by starting a recycling corner in their homes. The recycling corner was a constant prompt for officers to separate recyclables from non-recyclables. It also made it easier to consolidate their recyclables over time before taking them to the recycling bins.

Another self-nudge that officers adopted was to create a reminder on what can be recycled. Using information from the campaign, these reminders were customised based on what they aimed to recycle, which not only reinforced their recycling knowledge but also enabled the interventions to be targeted to address behaviours specific to their lifestyles.

Example of a Recycling Reminder
Source: MSE

Example of a Recycling Corner
Source: MSE

These self-nudges helped many officers to recycle more, and to have greater confidence in sharing about recycling with their family and friends.

(Contributed by Chng Yee Siang, Environmental Behavioural Sciences and Economics Research Unit, Ministry of Sustainability and the Environment)

NURTURING YOUNG ECO-AMBASSADORS TO HELP OTHERS ADOPT MORE SUSTAINABLE BEHAVIOURS (ECO AVENGERS UNITE!)

In 2022, behavioural researchers from MSE and NEA will pilot "Eco Avengers UNITE!" with selected primary schools: a programme to nurture students to become effective eco-ambassadors. It will equip students to identify sustainability issues in their environment and to create solutions that encourage eco-friendly behaviours in those around them. Students will be taught behavioural insights and design thinking to identify behavioural barriers, and then to design and test interventions to nudge the behaviours of their target audience. As young "Eco Avengers", students will learn to:

• Investigate and solve environment challenges using the UNITE (Understand, Ideate, Test, Exhibit) framework tailored to primary school students;

Diagram of the UNITE framework
Source: MSE

• Identify behavioural motivations and barriers and design targeted interventions using the EAST (Easy, Attractive, Social, Timely) framework developed by the UK's Behavioural Insights Team (BIT)[1]; and

• Employ simple data collection methods and controlled trials to understand the problem and test interventions.

In becoming Eco Avengers, students learn to take the initiative to address sustainability issues, without waiting for others to do so.

(Contributed by Vivian Lai, Environmental Behavioural Sciences and Economics Research Unit, Ministry of Sustainability and the Environment)

Note

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A greater impact could be achieved by involving citizens in influencing others to adopt green habits.

CONCLUSION

Sustaining eco-friendly behaviours is not merely about raising awareness about climate and environmental issues and increasing the adoption of easy habits. But awareness and acceptance do mean that half the battle is won.

Nevertheless, the gap between what we intend to do and how we act must be closed. This will depend on us forming appropriate habits to sustain a change in our day-to-day behaviours. In particular, the challenge is encouraging people to form good but difficult habits (e.g., cutting down on unnecessary car trips, walking or taking public transportation, recycling), and to reduce eco-unfriendly behaviours (e.g., incorrectly identifying materials for recycling).

Because the environment and context affect whether a good habit is formed and/or bad habit is disrupted, the responsibility of habit formation should not fall squarely on individuals. The public and private sectors have roles to play in making it easier for people to adopt eco-friendly habits and to see the value in doing so. Governments could also explore empowering individuals to design their own nudges to form green habits and influence others around them. If implemented properly, these have the potential to achieve more than first intended: individuals can apply the same knowledge to other eco-friendly habits with minimal assistance from governments and businesses.

While these approaches may not be straightforward to implement, they can help ingrain important eco-friendly behaviours for the long term, as part of how we address issues of climate action and environmental sustainability as a society. ∎

Notes

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Sustainable Urban Development:

ESPOO, FINLAND

by **Helena Kyrki**

The small but dynamic Finnish city is a leader in promoting development that brings together residents, businesses and other stakeholders, for the long-term benefit of all.

Helena Kyrki is Manager for Sustainable Development, City of Espoo. She works at the Centre of Excellence for Sustainable Development and has nine years of experience supporting the Sustainable Espoo Programme in various positions. She has nurtured collaboration between different city units, RDI actors, and businesses in topics such as climate neutrality, sustainable development goals (SDGs), urban development, sustainable lifestyle, and Fair trade. She also has experience with projects funded by Horizon Europe and European Regional Development Fund, and works with various regional, national, and international sustainability and climate networks.

ESPOO'S SUSTAINABLE DEVELOPMENT APPROACH

We need big changes in our societies, economy, daily habits, and all levels of government to tackle today's big global challenges such as climate change. For me, sustainable development means that the policies we pursue are just, and that no one is left behind in our green transition. In my work, I have become convinced that local actors such as cities play a key role in this shift.

Sustainability is deeply embedded in our city strategy—the Espoo Story—which we have co-created together with residents, companies, and other stakeholders.[1] As Manager for Sustainable Development, I work at the Mayor's Office Centre of Excellence for Sustainable Development that contributes to delivering the city's key strategic goals, such as becoming climate-neutral by 2030 and being a forerunner in implementing the Agenda2030 at the local level.[2]

Espoo's sustainable development effort is based on working with partners and citizens to create, test, and implement future-proof sustainable urban solutions. Our key priorities are further guided by the Sustainable Espoo Programme, a cross-administrative development programme that supports the implementation of the Espoo Story. Its focus areas are energy solutions, transport and mobility, circular economy and sustainable lifestyle, land use and construction,

and nature and biodiversity. The work is carried out in a cross-sectoral and multi-level cooperation and aims at systemic changes.

Priorities and Goals

Espoo has seen rapid growth in population within the last 50 years—from fewer than 100,000 inhabitants in 1972 to 300,000 inhabitants in 2022. It continues to be the fastest growing city in Finland. Keeping our citizens and the environment onboard in this growth is very important in order to keep the growth sustainable.

Creativity, trust and collaboration are essential ways of how we are developing Espoo. We want to be a leading city in combining technological innovations with ambitious sustainability goals and inclusive development of city services.

Climate neutrality by 2030 is one of Espoo's top seven strategic goals for the term 2021–2025. In April 2022, we were chosen by the European Commission as one of the cities to deliver a new EU Mission for 100 Climate-Neutral and Smart Cities by 2030.

We are working to implement these climate goals in a way that is beneficial to people, businesses, and the planet. Espoo wants to increase the size of the urban community's carbon handprint:[3] in other words, we want to contribute to the reduction in global emissions with the help of innovations developed in Espoo. Businesses in Espoo will first pilot solutions locally and then export the best solutions globally. In this way, Espoo's impact can exceed its physical size.

> We want to contribute to the reduction in global emissions with the help of innovations developed in Espoo. In this way, Espoo's impact can exceed its physical size.

URBAN SUSTAINABILITY IN PRACTICE IN ESPOO
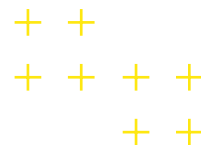
Espoo has managed to find impactful ways to cut CO_2 emissions at a rapid pace while building a unique innovation ecosystem for piloting emerging smart and sustainable solutions.

The climate solutions in Espoo focus on reducing the emissions from energy, transport, construction, and land use. Despite its rapid urban growth, Espoo has already managed to bend the curve downwards, beginning to cut not only the CO_2 emissions per capita but also total emissions. Two years ago, Espoo's total emissions went below 1990 levels for the first time.

Being a Nordic city in a cold climate, heating constitutes nearly half of our total emissions. Using district heating with 250,000 end users, we plan to abandon coal by 2025: the whole district heating system will be climate neutral by 2030. This involves replacing fossil fuels with smart and flexible solutions such as excess heat from wastewater, renewable electricity, heat pumps and bioenergy. To achieve this change, the city is working in close strategic cooperation with the state-owned energy provider Fortum.

Our second largest source of emissions is transport. Espoo is a network city with five city centres. The city is investing heavily in public transport: a new metro line, improved rail connections and a new light trail. We are directing city growth to be in tandem with excellent public transport routes. A city bike system will bring added co-benefits of cleaner air, health, and wellbeing.

Espoo and its adjoining areas have already reached a 50% recycling rate. Several circular projects are being implemented to promote sustainable lifestyles, job creation, and the growth of circular businesses. In addition, environmental and sustainable development education is part of curricula at all levels of education.

In 2021, the world's leading environmental reporting organisation, CDP, ranked 95 cities worldwide on its A list.[4] Despite stricter assessment requirements than before, Espoo retained its A rating for climate change mitigation and adaptation.

Espoo's Sustainability Advantages

In 2016, Espoo was named most sustainable city in Europe by an international benchmark study. Among the distinctive qualities of the city, the report highlighted Espoo's knowledge capacity and access to nature.

Espoo has the largest innovation community in the Nordic countries. It is home to highly ranked Aalto University, VTT Technical Research Centre of Finland, and headquarters of many of the biggest companies in Finland like Nokia, Kone, Fortum and Neste. Almost 50% of the value of the Helsinki Stock Exchange comes from businesses located in Espoo.

The Finnish workforce is also the second most skilled in the world, and Espoo has the most skilled workforce in Finland. Over half of the residents over 25 years old have a university-level degree. Espoo has also been recognised for its efforts in driving lifelong learning.

As Espoo has quite a large surface area (encompassing some 528 square
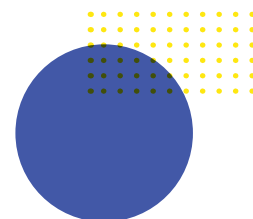
We believe that sustainable city solutions require a close collaborative relationship between the city, companies, universities, research actors, and residents.

kilometres in size, including 312 square kilometres of land), its networked city structure helps at keeping the whole city vital but also close to nature. According to citizen surveys, the residents in Espoo place nature and sustainability high on their values.

What's Next for Espoo's Sustainability Efforts

Globally, the main challenge is to find ways to tackle climate change and to make cities enablers and regional innovation ecosystems. This is also a priority in Espoo.

In April 2022, Espoo was selected to implement EU Mission on 100 Climate-Neutral and Smart Cities by 2030. Participating in the Mission is a way for Espoo to strengthen our role as one of the leading innovation hubs for low-carbon solutions, which are in high demand in the EU and globally.

This spring, Microsoft and Fortum announced a globally unique cooperation project, in which Microsoft will build a new data centre in Espoo and Fortum will build a connected large-scale waste heat unit for the district heat network. It is set to become the world's largest recovery project for data centre waste heat. This will reduce our emissions from heating on a massive scale, while supporting further digitisation of businesses and the whole society and creating local jobs.

SUSTAINABLE DEVELOPMENT: CO-CREATION IS KEY

Sustainability in essence means using our resources in a more efficient way. No actor—be it big or small—can solve these challenges alone. In Espoo, we believe in collaboration and sharing, and learning with our community. This is something that requires more of a change of an attitude from merely seeking and applying massive resources to the problem.

Espoo's approach to service development and sustainability is based on co-creation, building trust, and engaging the whole community. We believe that sustainable city solutions require a close collaborative relationship between the

city, companies, universities, research actors, and residents. Espoo wants to participate in that collaboration as a platform, but also as an actor that brings together different stakeholders to build effective ecosystems for solving common challenges.

For instance, the city has signed strategic agreements and collaborates closely with Aalto University and VTT Technical Research Centre of Finland to build a sustainable future through science, technology, business, art, and design. Here, forms of collaboration include shared RDI (Research, Development and Innovation) and student projects,

and developing the area as a place that attracts talent.

Citizen participation is a major cross-cutting theme in the Sustainable Espoo programme. We are testing new ways of engaging citizens in the green transition. For example, in 2022, we have launched an open invitation to residents from different backgrounds, including vulnerable groups, to come together to develop and test a new model of resident inclusion, and to resolve sustainability challenges together with the city.[5]

One of Espoo's biggest ongoing city development projects is to transform the old industrial and logistics area of Kera into a sustainable residential and working area, and a home for 14,000 people. In 2021, in addition to traditional land use agreements, the city and local landowners, builders and other developer partners signed a development commitment for the area that steers the development of the Kera area in accordance with Espoo's climate neutrality and sustainable development goals. This commitment was prepared through multi-stakeholder collaboration and is unique in Finland. It is one example of public-private cooperation that Espoo wants to promote.

Putting People at the Centre of Development

Urban systems are extremely complex. Developing sustainable urban centres requires improving liveability and reducing environmental impacts while maximising economic and social co-benefits. This requires building a shared vision and commitments with a multitude of actors. These are challenges that no one can solve alone. Technology is helpful, but it is only a tool, not an end in itself.

I would like to encourage all cities to engage in an open and honest dialogue with the different stakeholders and actors in their cities. Everything starts with putting the residents and their needs at the centre of development. ■

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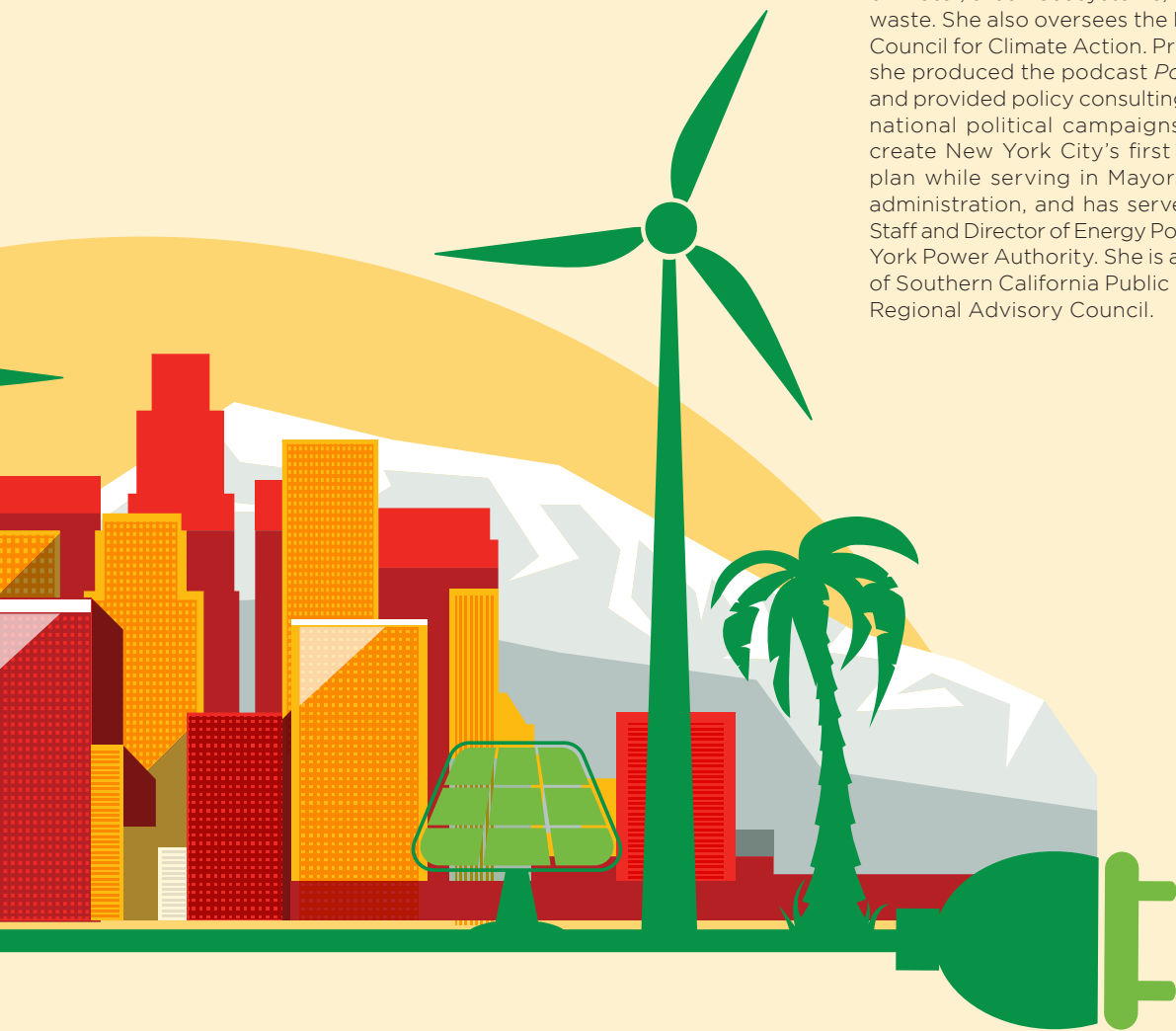
Sustainability through Inclusive and Innovative Development:
Los Angeles, United States

by **Victoria Simon**

The city's strategy focuses on the needs of its most vulnerable groups and the aspirations of its residents for a more liveable, equitable, and prosperous future.

Victoria Simon is the Executive Officer for Los Angeles Mayor Eric Garcetti's Office of Sustainability. She supports the implementation of LA's Green New Deal, the City's sustainability plan to aggressively address the climate crisis, with a specific focus on water, urban ecosystems, resilience, and waste. She also oversees the Mayor's Youth Council for Climate Action. Prior to this role, she produced the podcast *Political Climate* and provided policy consulting for state and national political campaigns. She helped create New York City's first sustainability plan while serving in Mayor Bloomberg's administration, and has served as Chief of Staff and Director of Energy Policy at the New York Power Authority. She is also a member of Southern California Public Radio (KPCC) Regional Advisory Council.

Cities Lead the Way on Climate Action and Sustainability

Cities are truly on the frontlines of the climate crisis. We witness the impact of climate change every day because our residents are the ones fleeing fires and floods, and grappling with drought and heat. There are tragic consequences to inaction, and we, as city leaders, can and should respond with specific policies and programmes tailored to meet the needs of our population.

We are seeing cities around the world become laboratories for progress. They are demonstrating what is possible—from electrifying transportation systems and decarbonising buildings to cleaning their electric grid—because they control many of the key climate levers: building codes, urban planning, public transit, and in many cases electricity generation. Cities are modelling what a sustainable future looks like for not just other cities but also national governments, raising the bar for what's possible politically, economically, and technologically. In truth, no one is doing more than cities on this issue.

A Green New Deal for Los Angeles

In 2015, Los Angeles (LA) released its first-ever Sustainable City pLAn. This was accompanied by Executive Directive 7, which institutionalised sustainability within City government by establishing Chief Sustainability Officers in 18 key departments. Mayor Garcetti made a commitment that not only would the city report annually on its progress towards achieving the pLAn objectives, but every four years, the city would re-evaluate its goals and ambitions.

Just a few short years later, the Trump administration announced the US would withdraw from the Paris Climate Agreement. In response, Mayor Garcetti began working with mayors across the country and the world—through Climate Mayors and the C40 Cities Climate Leadership Group—to show that cities are still committed to meaningfully address climate change. At the same time, we began working closely with local stakeholders and community leaders to develop a more expansive and ambitious roadmap to protect our environment, strengthen our economy, and build a

Prioritising historically neglected communities is fundamental to ensuring that the long-term success of our work is felt by all Angelenos.

more equitable future. In 2019, after a year of stakeholder engagement and quantitative analysis, LA's Green New Deal was released—one of the first city sustainability plans in the world to be compatible with the goals of the Paris Agreement.[1]

LA's Green New Deal defines the city's path to carbon neutrality and is deeply rooted in equity and resilience. The Five Zeros—zero carbon grid, zero carbon buildings, zero carbon transportation, zero waste, and zero wasted water—are backed by 445 initiatives that will not only get us to carbon neutrality but will prevent 1,650 premature deaths, save US$16 billion dollars, and create 400,000 jobs by at least 2050.

To succeed, departments across city government and Angelenos alike must work towards achieving the initiatives in the plan. In my role as Executive Officer for Sustainability in the LA Mayor's office, I help oversee the implementation of the Green New Deal and coordinate this effort both internally and externally.

Because climate change impacts are disproportionally felt by low-income people of colour, environmental justice is a cornerstone of LA's Green New Deal. Prioritising historically neglected communities in the policies, plans, and investments we make is fundamental to ensuring that the long-term success of our work is felt by all Angelenos. For instance, we know that the urban heat

island effect is worst in low-income neighbourhoods. Hence, in 2019, Mayor Garcetti launched the Cool Neighborhoods programme which combines a mix of strategies including planting trees, installing cool roofs and shaded bus shelters, and using cool street pavement in 13 neighbourhoods most vulnerable to heat. This is just one example of how we are making it a priority to implement proven programmes in the neighbourhoods that need them most.

LA's Sustainability Efforts in Action

Under Mayor Garcetti's leadership, the city has come a long way. In 2013, the city was powered by 40% coal and 20% renewable energy—and today, those numbers have been flipped to 16% coal and 43% renewables. We are the #1 Solar City in America for the eighth time in nine years, with over 35,000 solar rooftops dotting our skyline. After committing in 2019 to not repower three in-basin natural gas power plants, we undertook the groundbreaking LA100 study, the most comprehensive, globally-recognised study of an electric grid as complicated as LA's, which proved that a 100% renewable energy grid is achievable, affordable, and reliable, and this emboldened us to accelerate by 10 years our 100% clean energy grid goals. We are now building more renewable energy projects than any other city in the US and helped bring online the largest renewable energy plant in the country. Because of LA's commitment to clean energy, our greenhouse gas emissions have dropped a remarkable 36% from our 1990 baseline, and we are on track to achieve the Paris Climate Agreement by, if not before, 2050.

Fundamental to LA's Green New Deal is environmental justice and equity. The first and worst effects of the climate crisis are felt by the most vulnerable populations, including communities of colour, those who are low-income, and those in historically polluted areas. Through the Mayor's leadership, LA has worked to prioritise community-led programmes to address this inequity. With the city's support, the Green Together Coalition and the Watts Rising Collaborative were awarded US$56 million in the State of California's Transformative Climate Communities funding. This investment is going towards workforce development, affordable housing, green spaces, tree planting, clean mobility, and other community initiatives in the San Fernando Valley and South Los Angeles, bringing positive change to these neighbourhoods for generations to come.

> **The first and worst effects of the climate crisis are felt by the most vulnerable populations.**

In 2021, LA launched the first-ever Climate Emergency Mobilization Office to amplify the voices and needs of those most affected by climate change in developing policy and programme solutions. And in April 2022, the Mayor announced a US$21 million Climate Equity Fund that will support mitigation and adaptation programmes like cool roofs for seniors and green job training for under-represented workers. These are some examples of our work to connect community needs to city action.

Urban Sustainability in the Wake of the Pandemic

The devastating COVID-19 pandemic and the fragile economic landscape it engendered, coupled with the environmental crisis, put a significant strain on LA's resources and slowed some of the city's sustainability work. However, in some ways it also opened the door to accelerate other sustainability initiatives.

The city expanded bike lanes, put into service more electric buses, installed energy efficiency measures in shuttered schools, significantly expanded affordable housing and rental protections, and deployed air quality monitoring in vulnerable communities. LA also introduced Slow Streets, a community-led programme to open streets for recreational use which has now become permanent in many neighbourhoods.

Beyond LA, when Mayor Garcetti was the Chair of C40 Cities Climate Leadership Group, he worked with C40 mayors from around the world to develop the C40 Mayors Agenda for a Green and Just Recovery, to set the stage for a post-COVID-19 recovery that is sustainable and equitable in cities like LA and globally.

While LA is in a transition with Mayor Garcetti at the end of his administration and an election in Autumn 2022, there are a number of significant policy measures underway that will fundamentally shift our greenhouse gas emissions and make this city healthier and more environmentally just. We are actively building decarbonisation policies, developing a policy to phase out oil drilling, creating equity strategies to implement our 100% clean energy grid plan (LA100), and embarking on a transformative water supply resilience and reliability initiative called Operation NEXT. Angelenos care deeply about ensuring a healthier, more sustainable, and prosperous LA, and the work of LA's Green New Deal to initiate these policies has set this city up for success in achieving those goals.

LA's residents, recognising the fragility of their natural environment, have stepped up in response, taking their leadership on this issue seriously.

Engaging Youth and the Broader Community

While we all share the responsibility for addressing climate change, the impact most heavily falls on the next generation, and these young people are stepping up to respond. Mayor Garcetti saw the importance of these youth voices—leaders in their own right—and put together LA's first Mayor's Youth Council for Climate Action (MYCCA) in 2019. The group brings together youth environmental and community advocates aged 15 to 22 years that represent the diversity of LA both in their geographic location and their lived experience. MYCCA's charge is to develop plans and objectives to help inspire ambitious climate action, raise awareness, and engage Angelenos on solutions.

These youth are turning to their own schools and classrooms and have participated in a movement to encourage climate action in the LA Unified School District (LAUSD)—the largest public school system in the US. With youth advocacy, LAUSD has committed to 100% clean renewable energy by 2030, has installed hydration stations across their campuses to support replacement of plastic water bottles, and is integrating climate change curriculum for its students.

These youth have also worked with elected leaders and city officials from around the world, including a featured presentation at the United Nations Climate Change Conference (COP26) LA Exhibit and incorporation of their recommendations on zero waste events in a recently passed LA City Council motion.

This is a powerful platform for young people to engage, and city leaders are eager to connect with them on it.

LA's natural environment—a globally recognised hotspot for biodiversity—lends itself to an awareness and appreciation of the outdoors, but its vulnerability to smog, wildfires, extreme heat, and droughts also underscores the urgency of climate change. Angelenos have translated that awareness into action.

For instance, LA's dependence on imported water, which fundamentally transformed LA into the major metropolis it is, has been significantly strained due to the record droughts experienced by the Western US. Angelenos have responded by dramatically reducing water consumption by taking shorter showers, limiting outdoor watering, and replacing water consuming appliances. In 2018, they voted to create the Safe, Clean Water Program and dedicate nearly US$300 million per year to increase local water supplies, improve water quality, enhance the public right of way, and protect public health.

This is one example of how LA's residents, recognising the fragility of their natural environment, have stepped up in response, taking their leadership on this issue seriously.

So many of our biggest challenges are highly interconnected. Treating each as a one-off project creates an endless cycle that doesn't adequately address any of them.

Balancing Urban Sustainability and Development

The pursuit of both sustainability and development is not an either/or proposition. So many of our biggest challenges are highly interconnected. Treating each as a one-off project—trying to tackle public health one day, then creating good paying jobs the next, then turning to air quality issues when you get to it—creates an endless cycle that doesn't adequately address any of them. Designing programmes that take a holistic approach, for example building more affordable housing close to public transit lines or repaving roads with cool pavement, addresses both the immediate and long-term needs of the community. We can walk and chew gum at the same time and that's exactly the approach we're taking here in LA.

For other cities looking to pursue these aspirations, I won't lie: it is a daunting and arduous task to develop a sustainability agenda that is an effective roadmap towards your end goals. The only way to ensure your plan is ambitious—yet achievable— is to work closely with internal and external stakeholders. Feedback is fundamental to striking the right balance while setting up programmes that the community actually wants. Without buy-in and support, even the most perfect plan will fail, so I would encourage any leader to listen to allies and critics alike, and work to build a coalition around an agenda that reflects community needs and environmental ambitions.

It is important to set up goals that are as concrete as possible with specific departments or offices responsible for reporting on the progress. By using clear metrics, measurements of success or challenge areas are made more easily identifiable to all involved. This also requires very careful consideration of how one defines success and establishes goals that push cities to aim high. Making this information publicly available in an easily accessible format is critical to holding everyone accountable. Empowering residents with the data is how sustainability plans become tangible climate action.
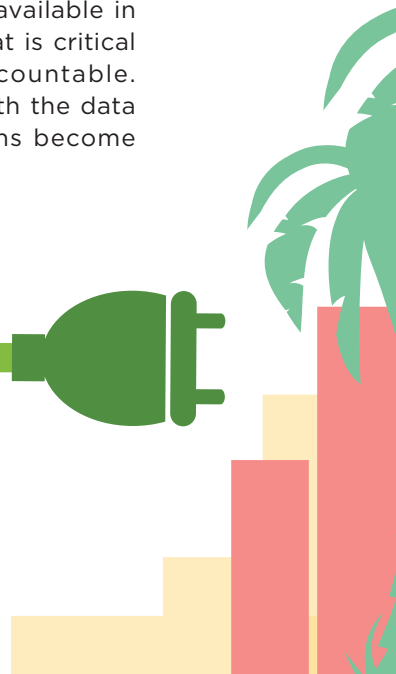
Empowering residents with the data is how sustainability plans become tangible climate action.

It is also important to set an agenda that will stretch beyond one's comfort zone, not only because of the urgency of this issue but because what's possible in this space is constantly evolving. What might seem impossible one day is entirely within reach the next, as this climate emergency pushes technology, and public and political support, towards new frontiers. As leaders, your agenda should reflect a vision for not just what is attainable, but what is needed to build a more sustainable and resilient city. ◼

Note

1.   See "L.A.'s Green New Deal", https://plan.lamayor.org/.

CLARIFYING COMPLEXITY, COORDINATING CHANGE :

THE VALUE OF CITY INDICES

by **Milton Friesen**

Urban indices and frameworks help those seeking to improve the health of cities better navigate complex, interrelated systems—facilitating coherent conversation, action and change.

Milton Friesen is Managing Director at CitiIQ, which works to measure the health and wellbeing of cities. A former elected municipal councillor, he is a member of the Program Committee for the Computational Social Sciences Society of the Americas, and has served on the steering committee of the Thriving Cities Project at the Institute for Advanced Studies in Culture (University of Virginia). He is completing a PhD at the University of Waterloo School of Planning, focusing on new ways to measure the social fabric of neighbourhoods.

If you don't have data about your city, you are largely invisible to the rest of the world.

URBAN INDICES MAKE CITIES VISIBLE

Cities are like herd animals—they watch each other, and they relate to and interact with one other, whether in a regional or even global sense. Cities want to be compared with one another. To do all that, you need common measurements: you want to establish some sense of where you are and how that is changing.

If you don't have data about your city, you are largely invisible to the rest of the world. Without consistent, reliable data about how a city is performing, investors, whether foreign or domestic, would find it harder to know if their investments in a city are doing anything and so they will be reluctant to pour in resources. Cities also need to demonstrate that they are thinking about their own performance in a disciplined way that is transparent, visible and comparable to others. Indices, such as CitiIQ, do that for cities.[1]

What we have done at CitiIQ is to develop a measurement approach that takes

114 different indicators for each city or community and then puts those into a scoring framework that allows those scores to be measured on a scale from 0 to 100, regardless of what the item is. For instance, if you measure air quality, you might use parts per million—most people won't know what a good parts per million value is. At CitiIQ, we convert it into a scale where 0 is bad and 100 is great—you don't have to know what your air quality parts per million is. A higher score indicates a better outcome. This lowers the cognitive load for people who need to use the measurements. Indices translate data into a form simple enough for cities to make comparisons with each other and with themselves over time.

CitiIQ takes those 114 indicators, puts them into 35 sub-themes (Considerations) and then plugs those into five core areas (Dimensions) which becomes a single CitiIQ score at the top of the pyramid. We do this because some people don't want to know about their specific wastewater score, they just want to know, on a broad level: is my city better this year than it was last year? That is a surprisingly difficult question to answer, because of the complexity of the moving parts: you could be better in one area but worse in another. We developed an algorithm that takes those 114 inputs, normalises them, standardises them so they can be compared city to city, and then weaves them into our scoring system.

CitiIQ also gives more weight to basic needs, such as water supply, food and security, than we do to things like tourism. Tourism might be very important for a city, but if it only focuses on tourism at the expense of clean water for citizens,

the city cannot be said to be doing well. With the CitiIQ scoring system, a city can't just pick and choose its improvements here and there in order to bump its score up.

But the core idea is comparability—a city with itself over time and then with other cities to understand whether it is getting better or not. Someone has to stand outside the city as a third party and take stock in a way that is reliable and useful. For our client cities, we normalise, clean and verify the data, score them, and we update the data every quarter. We try to provide a picture of where they are, an empirical reflection of what is going on in their city, as clearly and consistent as possible. It is then up to cities to determine the priorities for improvement that work in their context.

UNDERSTANDING INTERRELATIONSHIPS IN SUSTAINABLE DEVELOPMENT

In terms of sustainability, we need to constantly ask ourselves: what is it we want to sustain? Do we want to sustain the degradation of the environment? No. What we generally mean by sustainability are practices that, while they may extract or use a resource, also put something back so that the resource will be available again in future. Sustainability is about systems that feed back into themselves in helpful ways. You cannot have these loops by focusing only on a few sub-themes or indicators. Sustainability

Sustainability is about systems that feed back into themselves in helpful ways. You cannot have these loops by focusing only on a few sub-themes or indicators.

is a valuable concept, but it is not an isolated, discrete entity.

For instance, a city's drinkable water supply depends significantly on a range of different factors, including the state of the environment; the water supply engineering getting it to people safely; how it is monitored, managed, owned, sold; who pays attention to the upstream flows, and so on. There are no closed systems in a city. They are all open to each other in varying degrees.

There is also the question of scale. A small community of 5,000 people may have various agricultural practices that work on that smaller scale, but which would be destructive to the environment with 500,000 people (or vice versa). There is usually also a cost to any kind

Avoid the mistake of thinking that any measurement represents the city fully. Such tools can provide an important point of reference, but do not give you definitive direction.

of development. You may have to cut down trees to grow food. To turn farmable land into natural wilderness, you may have to give up farmable land that could be used to feed thousands in order to support the natural ecosystem.

Therefore, there is value in having a more comprehensive measure across the whole function of a city that reflects that these are not isolated elements. We might measure and gather particular data but when it comes to evaluation, we have to integrate our approaches and avoid being reductive. The CitiIQ system takes all this into consideration and does the scoring of indicators in an intricate, interconnected way. For CitiIQ's 114 Indicators and 35 sub-themes, it is not as if a few indicators simply plug into one sub-theme. Instead, a single indicator could plug into 10 or 15 different ones, because a city is functional and complex, not discrete in its parts.

What we do is to take the complexity out of interpreting the data, providing feedback in a dashboard that is useful for navigating a city. This then helps people in policymaking and planning positions make decisions that support human wellbeing.

PUTTING URBAN FRAMEWORKS TO REAL WORLD USE

One thing to avoid is the mistake of thinking that any measurement represents the city fully. A measurement may be a useful construct, like how a car dashboard can provide useful information, but it will not tell you where your city should go, what rate of change is useful, or how your city

Such frameworks can bring coherence to those working at the more granular levels, giving them something to aim for and a common language to build on.

should relate to its environment, or to other cities. Such tools provide an important point of reference, but do not give you definitive direction. You may be gaining in certain aspects of your city, but it could be at the expense of something else that is not measured, or what residents want.

Cities must make compromises, and they do not operate in a linear fashion. Some things may have to get worse for a time for there to be improvement in the long term. Physical infrastructure like public transit is a good example of this, as they cost a lot and are under construction for a long time. You should not look at an index and expect to get better in every area by 1% each year—it does not work like that. This is why it is important to keep the data updated across interrelated dynamics.

Another point to bear in mind is that any overview of a city is going to be an average—like measures of GDP—so a particular neighbourhood or area could be decimated while another thrives, and the overall numbers may not show this. We should not assume that just because we have made some gains on an averaged measurement that everyone in a city has benefited equally. This is where local community representation becomes very important.

Any approach or measurement framework we use must be sensitive to the reality of living in specific communities and cities. And we must be realistic that political sensitivities and priorities are going to play a role in what gets communicated—there may be pressure to accentuate the positive, for instance. Even with something like sustainability, we have to be careful not to politicise it, or carry out only one type of dialogue about it so it becomes a bandwagon everyone jumps on, and nobody digs into the more substantive implications where one sustainable practice is carried out at the expense of another. We do need to figure out how it is going to work practically.

What such frameworks can do, however, is bring coherence to those working at the more granular levels—say, those leading a department or working in a neighbourhood or a district, trying to improve water quality. They need to have an honest picture of what the situation is, so they can see how the improvements they work on—when they clean up their streets or take garbage out of the stream—contributes to the overall improvement of the city. This helps to link the agency of local efforts, of local communities and leaders, to the bigger picture, giving them something to aim for and a common language to build on. While we can think about the city in all sorts of ways, and consider different priorities, frameworks such as CitiIQ can bring coherence to the conversation and allow us to think about

and coordinate how we can progress together.

We may measure in the particular, but we must relate that to the comprehensive. If we focus on sustainability, let's identify the things that are highly relevant for sustainability but also recognise that we must connect that to a more coherent whole picture. Otherwise we will have limited progress, or we may find ourselves falling behind despite our efforts or investments, because of hidden elements or unintended effects impacting what we are doing, and then we stand little chance of making any real and lasting change.

We must also pay attention to the intermediary or secondary cities. Less prominent communities—including the middle-tier urban centres in which most people actually live—will significantly impact our future trajectory. We need to ensure that the urban solutions we develop will work there, and not just in the boutique, superstar cities. This is the real-world test: if our ideas can't work in these places, they are not going to change the game; we would just be changing an instance. If we want to make a difference globally, we will have to develop sustainable solutions that will work systematically in these places. ■

Note

1. CitiIQ, "A Measurement System for the Health and Wellbeing of A City", https://www.citiIQ.com.

POON King Wang is Director of the Lee Kuan Yew Centre for Innovative Cities at the Singapore University of Technology and Design (SUTD). He is concurrently SUTD's Senior Director of Strategic Planning. His teams' research is recognised in Singapore's National AI Strategy for contributing to a trusted and progressive AI environment. Collaborating with IMDA/PDPC, they launched Singapore's first human-centred industry-agnostic guide to *Job Redesign in the Age of AI*. He received the Public Administration Medal (Silver) in 2021.

THE CITY OF THE FUTURE NEEDS A DATA CULTURE THAT SEES THE VISIBLE AND INVISIBLE

by **Poon King Wang**

The Director of the Lee Kuan Yew Centre for Innovative Cities reflects on how city planners and policymakers can make more thoughtful use of data to improve decision-making and better people's lives in meaningful ways.

DATA MATTERS

Technology and data have the capacity to make what is happening in a city more apparent, but they can also make things less visible. Very often, data can tell us that something is happening, but it may not tell us why. Even as data makes something more evident, it may also suggest other elements we have yet to uncover. For data to support the pursuit of more liveable and sustainable cities, we need to look at both sides: we need to be clear what is being made visible, and what is being made invisible.

This is where integration becomes important: bringing together big data, small data and thick data, across siloed boundaries. It is only in combining these that we can begin to see the fuller picture of things as a system and are better able to make the right decisions and set the right policies.

A HEALTHY DATA CULTURE IS ONE WHICH UNDERSTANDS THAT DATA COMES FROM ALL PERSPECTIVES AND DIRECTIONS.

This also involves not just looking at outputs and outcomes, but also identifying and understanding the processes that are leading to them, and understanding what it all means in terms of how people live and the impact on their lives.

VERY OFTEN, DATA CAN TELL US THAT SOMETHING IS HAPPENING, BUT IT MAY NOT TELL US WHY.

This is an aspirational ideal that everyone is striving for, but no city can be said to have fully mastered it. The relevant question is whether we are taking concrete steps towards it, and whether we have the prerequisites to do this well. These prerequisites include the will to organise data and to use it for good and being system-oriented in approach. In these regards, Singapore looks to be in a good position, given our history and track record. How can Singapore build on these strengths to embed and deepen a strong data culture?

WHAT MAKES FOR A HEALTHY DATA CULTURE

A healthy data culture is one which understands that data comes from all perspectives and directions. It is about pulling all kinds of data together—whether descriptive, predictive, modelling, quantitative or qualitative—and asking: "How do we decide what to weigh or prioritise? And given the totality of the insights, how do we make good analyses and decisions?" A good data culture has the capacity to understand what the right balance between all these considerations is.

It is also important to understand both the limitations as well as the possibilities of data. A healthy data culture also calls for the humility to say that the more the data tells us, the more we don't know and need to find out. This may also mean what we know today is correct now, but it may not be correct

A VITAL PART OF DATA CULTURE IS HAVING AN ITERATIVE, FEEDBACK LOOP.
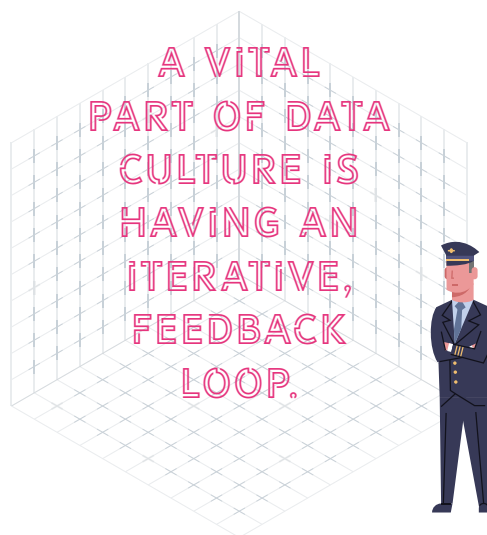
tomorrow. To adapt a phrase from the Institute of the Future, we should have strong beliefs, weakly held. We need to have convictions about our analyses, but be open to changing our minds when new data comes in.

THE MORE THE DATA TELLS US, THE MORE WE DON'T KNOW AND NEED TO FIND OUT.

A vital part of data culture is having an iterative, feedback loop. This means that it is important to make a constant, daily effort to improve. One of the things we tell foreign delegations who come to Singapore is that the solutions and successes they see took us decades to get to. It was the outcome of people at all levels working conscientiously, assiduously, day in, day out, to just make things better; to make a city more liveable day by day. Sustaining a city is a long game.

This also means changing course, or policies, when the data calls for it.

A healthy data culture is about not judging people on the rightness of their decisions alone, but also how they react once they realise they have made a mistake. The latter tells you about their capacity to change, which means that even if they get things wrong, they will eventually get it right. Just as with driving, sometimes, you may need to make a U-turn because you realise you need to go the right way. And changing course is better than keeping to the wrong direction, or worse, crashing. Besides, going the wrong way initially can sometimes lead you to discover new places.

NURTURING A DATA CULTURE FOR URBAN SUSTAINABILITY

There are a number of ways to facilitate a conducive data culture. One is to encourage a willingness to experiment, with the capacity to accept that not all experiments will succeed: some will fail, but the important thing is to keep trying because there will be new data points, new technologies, new techniques, different ways of stacking the data, and different ways of interpreting the data. If we do not keep trying, we will not develop the muscles to be able to do better in future when something new arises.

WE NEED TO ALWAYS LINK BACK TO SOMETHING THAT BENEFITS PEOPLE, SO THAT THEY FEEL IT IS MEANINGFUL TO THEM.

Look at social media platforms: whenever new ones emerge, people try them out and come up with interesting ways of using them. This has to do with the nature of data and digital technology at large: it is general purpose, which means that it can be appropriated to achieve many different outcomes. Digital data is an intangible sort of capital, which means we must expect the unexpected, both positive and negative. If you don't experiment and you think you can sit down and write out all the potential uses and outcomes, you will miss out on all the other ways it could be used. So, we need to leave room for experimentation, within the public sector as well as in the private and people sectors.

We also need to always ask ourselves, that given all the data we collect and the analyses we do: what does it mean for the individuals at the end of it? We need to always link back to something that benefits people, so that they feel it is meaningful to them. For instance, one of our industry fellows working in Shenzhen took the basic GPS data already available to officials—data that had been collected

but not used—and, with a simple matching of supply and demand, was able to help taxi drivers increase their revenue. He also looked at the electric vehicle (EV) charging infrastructure and realised that instead of charging them for a few hours to get to 100%, EVs could be charged for just an hour with enough charge most of the time—which meant queues for charging points could be shortened, and the charging infrastructure could be optimised.

MAKING A MATERIAL DIFFERENCE WITH DATA

Another aspect of building a data culture is to develop the right talent: we need enough people who can do what is needed to get involved. Our research has found that in the digital age, one's ability to master something and to be good at it depends on the interactions that we have.

Nobody has all the expertise needed, so you must complement your own skills with those of people from other disciplines, as well as those from other backgrounds and generations, because they have different perspectives and understand the system differently. For instance, in a power plant or large infrastructure facility, someone who's only been in the control room looking at data will have a very different view from someone who has had to walk the facility, knock the pipes and smell the place.

Data culture is not just about whether you understand the statistics, but whether you can relate the numbers to what is happening on the ground. In the same vein, the nursing schools have said that it is easier to get someone with a nursing background to pick up health informatics and know what the data means, than it is to get a data scientist to understand what nursing is about.

The design of these technologies, down to what kind of gauge or display is used and how people interact with them, also matters. Is your data infrastructure in fact helping you to understand what is going on? We need people who not only understand the technology and the data, but also how all these line up at the systemic level, and then what it means at a material level.

OUR PUBLIC SECTOR CAN BE A ROLE MODEL FOR THE DATA CULTURE THAT WE WANT TO SEE IN THE REST OF SINGAPORE.

After all, a city is a cyber-physical setting. It is not just made up of digital data or technologies. It is made up of people, infrastructures, cars, roads, trees and so on. The ability to operate at the interface between the cyber and the physical, and to traverse them, becomes quite critical.

The risk is that sometimes we want something to happen, but it is not felt on the ground. And when it isn't felt, it becomes harder to convince people to change. It is already inherently challenging on issues of climate change and sustainability, where what we need to do today will only show benefits in the future. It's a long game. But all the more, it becomes important to find those gradations and small improvements that people can see and feel on a regular basis.

This is where Singapore can take the lead. Never in history have we been able to gather, store and analyse data like we are able to today. And if there's any place that can pull all the data at different levels together in a meaningful way, it is Singapore. To do this well requires a certain administrative ability as well as the will to organise towards policy outcomes and public benefits.

Our public sector can be a role model for the data culture that we want to see in the rest of Singapore. It can show that it is open to experimentation; that it trusts but verifies data; that it has strong beliefs but is prepared to let go of them once the data shows otherwise, and that it can do this in a way that is mature and sophisticated. We should remember that at the end of every data point is a human being. The task is to try and make that human being's life a little bit better all the time. ■

USING DATA TO IMPROVE SUSTAINABILITY AND SOCIAL IMPACT

Lee Kuan Yew Centre for Innovative Cities adjunct fellow Dr Andy Zheng[1] worked with a team of researchers along with PAIR CITY, a big data company, on a number of innovations to benefit taxi drivers in the city of Shenzhen, China.

Matching Taxi Supply with Demand

Real-time supply-demand data (already collected by the city government) was provided to taxi drivers, improving their efficiency and earnings by 8% while also reducing passenger wait times in hotspots that often faced a taxi shortage.

Optimising EV Charging

EV taxi drivers, carrying over petrol car routines, used to charge their EVs to 100% so they could change shift with a full tank. This led to long queues at charging stations near shift-changing locations. The researchers and PAIR CITY were able to show that most of the time, only 70% of the charge was needed for

the night shift. EV taxi drivers therefore only needed to charge their taxis for less time, at any station wherever and whenever was convenient (e.g., during their lunch break). This greatly reduced queues and saved the drivers time which could be used to increase earnings or to rest. It also improved the overall use of the charging network without requiring more infrastructure to be built.

Rows of faster chargers (total 637) inside China's largest EV charging station as of 2019 (near Shenzhen North Railway station)
Source: PAIR CITY
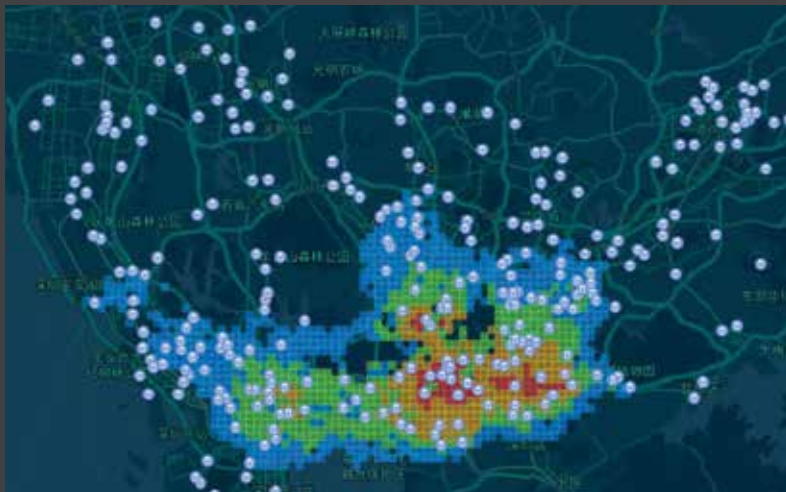
Data mining showing where Shenzhen EV taxis go for charging
Source: PAIR CITY

Note

1. See https://lkycic.sutd.edu.sg/people/adjunct/andy-zheng/.

CONVERSATION

Rahul Mittal is Director at the urban consultancy Cistri. He has more than 20 years of consulting experience in master planning, urban design and landscape architecture, and has worked on major projects around the world, including transit-oriented and mixed-use developments, urban infill and redevelopments, business and industrial parks, redevelopment of waterfronts, new town planning, golf course and resort developments, and airport cities. In addition to his consulting work, Rahul speaks regularly at real estate related conferences in the region and teaches in the Master of Urban Planning programme at the National University of Singapore.

SUSTAINING PASSION

and

WELLBEING

in the City of the

FUTURE

by **Rahul Mittal**

Veteran urban designer and planner Rahul Mittal reflects on key trends in the evolution of urban life, and how planners can engage with community aspirations and energies.

The traditional definitions and boundaries of what it means to live, work and play are now getting blurred. Play is becoming quite central to everything that we are doing.

What are some of the most significant shifts happening in the way people in cities are choosing to live, work and play?

The traditional definitions and boundaries of what it means to live, work and play are now getting blurred. And the pandemic has not just reinforced but accelerated this. Play is becoming quite central to everything that we are doing.

When you think about living: people want connectivity, convenience, access to transport and so on. But along with functionality, they also want access to nature and places of recreation, where you can go and destress. So the notion that you live here, you work there, you learn in this place and you play somewhere else, is passé now.

Something else that is now coming to the forefront, that many policymakers and planners are deliberating, is the idea of owning your own property versus renting your residence. The convention, especially in Singapore, has been that you own your own property and home: it becomes part of your stability and your growth as an individual, as a family, as a professional. And now a lot of the millennial generation and the younger population are challenging this. For them, it may be more important where they live, and whether they rent or own their home is secondary. They may feel no need to own property when they could be doing other things with their time and resources. This change in attitude obviously has a lot of implications

from a societal standpoint and from an urban planning perspective.

The same thing is happening at work. Since the pandemic obliged more people to work from home, many no longer want to be in the office every day. And when they do come to the office, they want the experience to be more than just about work; it has to have an element of play: which is also about socialising, catching up with colleagues or partners and friends, and talking about things. So play is also seeping into work.

Taking reference from Singapore, we are also seeing a shift in the Central Business District (CBD). Over the next decade, it's going to evolve quite significantly from a CBD to a CAD: a "Central Activity District". When you come here, your primary goal might be to work, but you may also end up watching a show, going to evening classes, having fun, networking. And this is facilitated by the infrastructure: there's the Mass Rapid Transit (MRT) system, heritage buildings and everything else. So the district could be a place where you don't only spend your 9-to-5 on Mondays to Fridays, but is somewhere you may want to be 18, 24 hours a day, even on weekends.

There are great examples of this around the world: one of my favourites is Melbourne, Australia, where you've got offices, residences, sporting facilities, universities, museums, everything's there. You just need to show up and something interesting will be happening that you can get involved in. To make this work, we need a push not just from the public sector but also the private sector, to make our city centre more vibrant and liveable.

The public, in all age groups, in all income levels, are becoming very vocal. People want to be heard and to contribute.

How can planners respond to these shifts in lifestyles, norms and mindsets ?

One of the areas to pay attention to in future is mental wellbeing and happiness. Even with wonderful infrastructure and support systems, people are experiencing a lot of societal stress. This has been heightened by the pandemic and uncertainties because of geopolitical risk or supply chain disruptions.

So, we will need to make sure that our places of living, working and playing should also be opportunities for destressing. Just as sustainability is

becoming a mainstream consideration for planning, so too should mental wellbeing and happiness also be a part of that. A stressful place is not a sustainable place.

We need to make sure that for generations to come, people have the same passion, excitement and ideas to make Singapore successful. In my team, we are constantly being challenged by our younger staff: Why should I do this? How does this help the environment? How does this benefit society? And eventually how does it benefit me? Because if I can't see the organisation striving towards a vision I care about, then it's meaningless to me. I'm going to find somewhere else to work.

In fact, the public, in all age groups, at all income levels, are becoming very vocal. People want to be heard and to contribute. We are concerned for what's going to happen, we are concerned about our families and friends. And more importantly, how can we help? Like it or not, if you are not involved, we will go ahead and do it ourselves.

I have seen beautiful examples of people taking over spaces to carry out urban farming on their own, with the requisite permissions. I don't think that their intent is to feed the masses: they want to raise awareness and get the issue noticed by the public and later the policymakers and politicians, so that something significant might be done about it later.

So, while there is a general increase in nervousness about the future, social media has also allowed people to

> **For policymake it is important to listen to these voices and try to engage with them—whether or not something comes of their efforts.**

connect in ways that were not possible before. It has led to people coming together to try and make a difference, and do something, even if it is a small effort, rather than watch the world go by helplessly. We are going to see more of these efforts: some of them may be disruptive, others may be groundbreaking and innovative. For policymakers, it is important to listen to these voices and try to engage with them—whether or not something comes of their efforts.

In Singapore, there are many strategic parcels of land, owned by the Government, which lie vacant for many years. They are good opportunities to test out ideas and experiments. Perhaps some of these can be activated for community-driven activities, as a living lab or a showcase.

The idea is not to have commercial gain from these, but to make the most of spaces in a land-scarce city. Some of these grassroots ideas may fail, which is fine: we can still learn from the effort. This approach gives us a way to safely test these ideas, and gives the community a way to build trust, and show that the Government is prepared to involve them in co-creating solutions. Whether or not they are successful, it will be a great experience for those involved. Even if they were successful, it should be made clear that these are temporary sites, which were never meant to be there for a long time.

Bangkok's Artbox project is perhaps a close example of how this was done elsewhere: they had shipping containers dropped into the city centre, strung up some lights, opened for the weekend and thousands of people came. Some of the most amazing spaces around the world are successful because they allow people to get involved and at the same time sit back and watch life happen.

To what extent is inclusiveness an important consideration in planning for a sustainable urban future?

A couple of years ago, when faced with a plan to rezone and develop Emerald Hill, the alumni of the school in that area banded together and carried out extensive community engagement and lobbied the Government not to proceed. This level of community activism is quite healthy, because it shows that a place has a strong relation to a community's sense of identity and heritage. People are passionate about their memories of a place. That physical connection still matters.

Will growing digitalisation change this? It may be that we end up with a hybrid situation where we have a digital life and a physical life. There will be individuals who are able to cross over easily. And there will be individuals who might struggle in the metaverse. There might be others who will completely avoid entering the digital sphere and just want to stay in the physical. The metaverse may further challenge the notion of owning physical property or assets. People may have a more fluid physical footprint but a more permanent digital presence. I can see a segment of the population who will be comfortable with that and even aspire to it. But there are others who will not be. So this potential divide is something that we'll need to address.

But the metaverse could also help planners better understand how people interact, especially those who may be a bit reclusive in the physical world, or have difficulties navigating the physical environment, such as the elderly or those with mobility challenges. They may find the digital sphere more liberating, which is great. For policymakers and planners, this can help us understand where we fall short in engaging them in the physical world.

I think the key is to allow for both: to give the virtual world a presence for the people who want to engage more intently with it, while also making the physical world better.

The combination of high density, high liveability, high affordability is going to be key.

Singapore is a good example of this. It has a unique system, with cohesive government that allows it to do many things. But it could also have gone very wrong. One thing that I've admired is that Singapore is always looking long term: having a 40-, 50-, 60-year view and then working backwards from there: it's not just the next five years or the next election cycle. It is about having that courage, commitment and vision

for the long term, with the financial wherewithal to see it through.

The other point is that a lot of Asia cities must pay special attention to the rapid urbanisation they are undergoing. The challenge is to make sure people can live in high density environments that are also very liveable. And not only liveable, but also affordable: so that they don't push out the middle-income and low-income populations that are equally important to any city. The combination of high density, high liveability, high affordability is going to be key. And the cities which can crack the combination and use that to their advantage, harnessing the power of having many living well in a city—rather than borrowing from incompatible Western models—are going to be the winners.

In pursuing liveability, affordability and sustainability in urban development, what should we never forget?

That it's the people that we are working for and making decisions for at the end of the day. It will be paramount to make sure we are as inclusive as possible; that we are listening, consultative, and communicative.

This is a very scientific process in some ways. It is also an art in some ways. And we have a lot of tools now to help us, by allowing us to understand consumer preferences, behaviours, patterns and so on. Keeping people at the centre and at the core is going to be important.

In this regard, what has been happening with the high level of public engagement in Singapore in the last few years, across all interest groups, irrespective of income and age, is heartwarming and necessary. It's about understanding people. ◼

LIVEABLE DENSITY:

A CONVERSATION WITH

HENG CHYE KIANG

An NUS Professor of Architecture explains how thoughtful planning, good design, and inclusive choices can enable residents to thrive in dense urban environments.

Heng Chye Kiang is the Provost's Professor at the College of Design and Engineering, National University of Singapore, where he teaches and researches urban history, sustainable urban design and planning, and publishes widely in these areas. He has served on the boards of government agencies including the URA, HDB, CLC, JTC, and BCA, and advises academic institutions such as SIT, NAFA, CUHK and HKU. He has been a visiting professor at a number of varsities in Asia, a jury member in numerous international design competitions, and on the editorial boards of several international journals. Urban planning and design projects for which he has consulted have won awards such as the Architecture MasterPrize 2020 (Urban Planning) and the Cityscape Global Master Plan Project 2018.

Why does density matter in urban development and how does it relate to sustainability and liveability?

There are a few different measures of urban density. These include persons per hectare—the number of persons living in one place—and the number of units per hectare, say of dwellings. Other measures include the average plot ratio and site coverage. Now, density of persons per hectare does not tell us what kind of urban form it is. Likewise, dwellings per hectare could refer to very small units: so Hong Kong dwellings may take up very little area, as these are much smaller than housing in Singapore. Plot ratios can give us a rough sense of how much a site is built up, how many storeys there are, but it doesn't indicate how many people live there: so a 5-room flat could have fewer occupants than a 4-room flat. Therefore, all these different measures are necessary to give a fuller sense of the different aspects of urban density: the urban form, the number of units, and the number of people living on a site and the open space available.

The same density can result in very different kinds of cityscape and urban form. London and Paris are in fact rather dense—equivalent to Singapore's Orchard Road—but they are very different kinds of cityscape. To an extent, these are the result of different cultural choices, leading to a significant difference in terms of the experience of place. Paris and London are very built-up, with high site coverage of about 70%. There's little greenery, and any courtyards they have are small. Whereas in Singapore's HDB, we have lower site coverage, about 40% or less, and there is a lot of greenery, with the positive values associated with this, including heat mitigation, visual relief, psychological wellbeing, and so on.

Different cities have different environmental needs, and this has implications for energy use, such as for heating. So in Singapore's equatorial climate, we want buildings to have cross-ventilation. In Europe, we hear about heatwaves of merely 32°C causing distress, such as to seniors there. That's because many of their buildings are not designed to be cross-ventilated, but to retain heat in a cold climate. So when there's a heatwave, the indoor temperatures keep going up. And in a pandemic, this lack of ventilation in a high-density setting makes things worse. So even with the same density, the way we design at the smaller scale, such as buildings, makes a lot of difference.

Urban density is related both directly and indirectly to sustainability and liveability. For instance, you need a certain level of density in order for certain kinds of more efficient forms of infrastructure to make sense, such as the Mass Rapid Transit (MRT). But even in terms of basic infrastructure, such as plumbing, low-rise, low density areas differ from high-rise, high density sites.

Of course, we do want more space, and more privacy for ourselves, but it is not necessarily the case that lower density settings offer a better quality of life. Most indices of liveability include components such as safety and security,

as well as access to amenities, be it shops, schools, cultural centres or social facilities. You need a certain density to have enough of a catchment area. It's not even always about economic viability, or infrastructural investment. It is very difficult to have social groups in an area of very low density: it's harder to form a badminton club or line dancing group with only five families per hectare. You need density for a lot of things to be possible.

What is the right balance to strike, between achieving a practical, sustainable, efficient urban density, and providing a liveable urban environment?
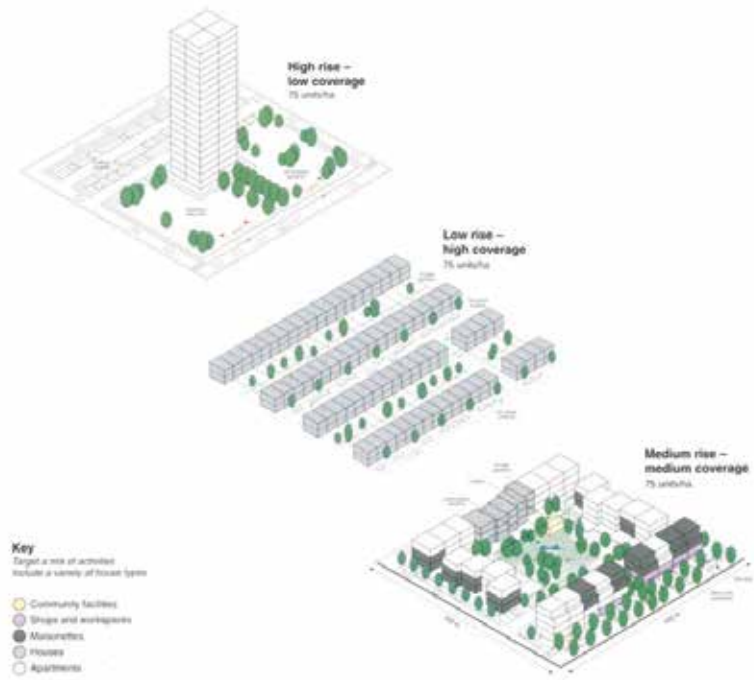
My team carried out a research project to look into this question: what is the threshold of density that we can sustain and afford, while providing a decent quality of life? We looked at about a hundred different typologies across the world, from European-styled courtyard residences to high-rise apartment blocks and their equivalent around the world, and found that the answer to this question is not so straightforward.

One aspect of this has to do with environmental performance parameters. For instance, how much of the sky can you see? If you're walking in Singapore, you don't have to lift your head very much to see the sky. If you're walking in Hong Kong, you've got to raise your head more to see the sky, because the buildings are actually taller. In our study, we looked at sky exposure and sky view, and also ventilation and daylight exposure.

GOOD DESIGN MAKES A GIVEN DENSITY MORE LIVEABLE THAN A NOT-SO-GOOD DESIGN.

Some of these parameters are proxies for energy consumption. For example, the more solar radiation you get, the hotter your interior spaces will be, and therefore the more you need to cool down your building. But then again, the more daylight you have, the less you need to light up the space. You can have buildings, or rather typologies of the same density, in this case plot ratio, performing vastly differently because of the way they are designed.

For instance, the European courtyard typology can have quite poor performance beyond a certain plot ratio, in terms of ventilation, daylight, sky view and so on: all you see is your courtyard or the street in front of your apartment. With the same density, you get much better performance with your HDB tower blocks. So design does matter: at the same plot ratio, good design makes a given density more liveable than a not-so-good design.

High rise –
low coverage
75 units/ha

Low rise –
high coverage
75 units/ha

Medium rise –
medium coverage
75 units/ha

Key
Target a mix of activities
Include a variety of house types

⬤ Community facilities
⬤ Shops and workspaces
⬤ Maisonettes
⬤ Houses
⬤ Apartments

Same Density, Different Urban Form
Source: Andrew Wright Associates

To be fair, we have not looked at many examples beyond a certain plot ratio of say 5 and above . In Singapore, a notable example is the Pinnacle@Duxton, which is at a very high plot ratio of 9 or so. But because of its location in Chinatown, surrounded by conserved low-rise properties, Pinnacle@Duxton is still very liveable, because it isn't obstructed. Density is very contextual. So in our research, we took the Pinnacle and simulated putting it in the middle of a field, as well as in the middle of other similar developments, and the results were very different. The Pinnacle works very well in its current context, but if it is surrounded by eight other Pinnacles, it will work less well.

So there is no one-size-fits-all formula: it is context and an interplay of factors that make a certain density efficient and liveable, or less so?

Density is about the entire environment, and it is not only about a single function. You can see how the different HDB new towns work differently, even though the basic idea of town centres,

neighbourhoods and precinct centres, with amenities within walking distance, is quite effective. Based on our research, the residents of these new towns behave quite differently.

In Sengkang, for instance, a resident might shop during the weekends because the nearest shopping centre with broader offerings is a distance away. Whereas people in Clementi shop locally a lot more. Doctors in these mature estates, based at the ground floor of HDB blocks, report that they have more walk-in patients and charge lower fees than the same doctors in clinics located in malls, where the rents are usually higher. So the typologies

IT'S NOT JUST ABOUT HOW MANY PEOPLE LIVE IN A SPACE. IT IS ABOUT HOW WE CAN MAKE THE SPACE INTO A COMMUNITY, SO THAT PEOPLE WOULD WANT TO LIVE THERE.

"Village Square" near 6@Holland
Source: Heng C. K.

and distribution of amenities make a difference in resident behaviour.

Planners may also want to bear in mind that particular amenities and spaces may serve very different needs throughout the day. A coffeeshop in a neighbourhood or precinct centre, for instance, may serve residents and nearby workers in the daytime. In the evenings you may get families coming down for dinner. And then later at night, it suddenly becomes a place where mainly older men gather to drink beer and socialise, while the women might be at home watching TV dramas. In the case of 6@Holland, there is even an open space with a tree nearby where some of them might go to smoke from time to time. One French professor I took to see it described it as being like a village square together with a row of first-storey shops. So the coffeshop becomes like a beer garden, a safe place for social gatherings, for a group of people who might otherwise be restless and lacking interaction.

FOR US WHO ARE PLANNERS, WE ALWAYS TRY TO MAKE ONE PLUS ONE MORE THAN TWO.

Without places like these, mental wellbeing and life satisfaction would go down.

It is important for us to continue to provide for places like that. For this to happen, a certain density needs to be in place. When we talk about density, we must not forget that it is not just a numbers game. It's not just about how many people live in a space. It is about how we can make the space into a community, so that people would want to live there, even when they are 70 or 80 years old—not because they have no choice, but because they enjoy living there.

There will be contrarian views: for instance, arguing that people don't want to live above a coffee shop because there's noise and smell. But you can design these out. If you anticipate these problems from the start, from the beginning, you can make designs that filter the noise out; you can use technology to help resolve these problems too.

Climate also eventually affects the way we should design: for instance, in Singapore's climate, it is easy for us to design for outdoor, *al fresco* dining, even if it takes over some public space.

Bishan Park gets it right, in my view, because they have turned what used to be a mono-functional canal into an asset that not only has infrastructural uses, but also greenery, increased biodiversity, commercial amenities, recreational uses, and so on. It is a solution that addresses multiple objectives and

AMENITIES WE PROVIDE SHOULD NOT ONLY BE ACCESSIBLE PHYSICALLY, BUT ALSO ACCESSIBLE ECONOMICALLY.

needs at the same time. For us who are planners, we always try to make one plus one more than two.

So the public sector should think across boundaries to consider how to achieve these synergies in planning and multiply their benefits. What should planners bear in mind when doing so?

It is important that whatever amenities we provide should not only be accessible physically, but also accessible economically. For instance, in some of the newer towns, amenities are mostly restricted to shopping malls, where the real estate economics are very different. This changes the balance of what is available to residents and at what prices. From a sustainability point of view, shopping malls are all air-conditioned, compared to say a coffeeshop which is naturally ventilated.

In an estate like Clementi, for instance, there is a mix of uses—the MRT is connected with a smaller mall, with HDB flats above it and the coffeeshops and hawker centres still intact alongside restaurants and cafes. So there are options, other than one big mall that dominates the estate. This mix is also what makes Tanjong Pagar interesting, with its shophouses and HDB flats alongside commercial skyscrapers and some of the most expensive properties in town, as well as an open public space, a park where people can mingle.

Culture is always part of the mix, as well as residents' choices: some people will only have coffee at Starbucks, and others at a coffeeshop, not just because of the cost, but because they prefer it. It is in providing these combinations of possibilities that we get liveability and sustainability within urban density. ■

Note

1. Andrew Wright Associates, cited in Urban Task Force, *Towards an Urban Renaissance* (2002), 35.

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