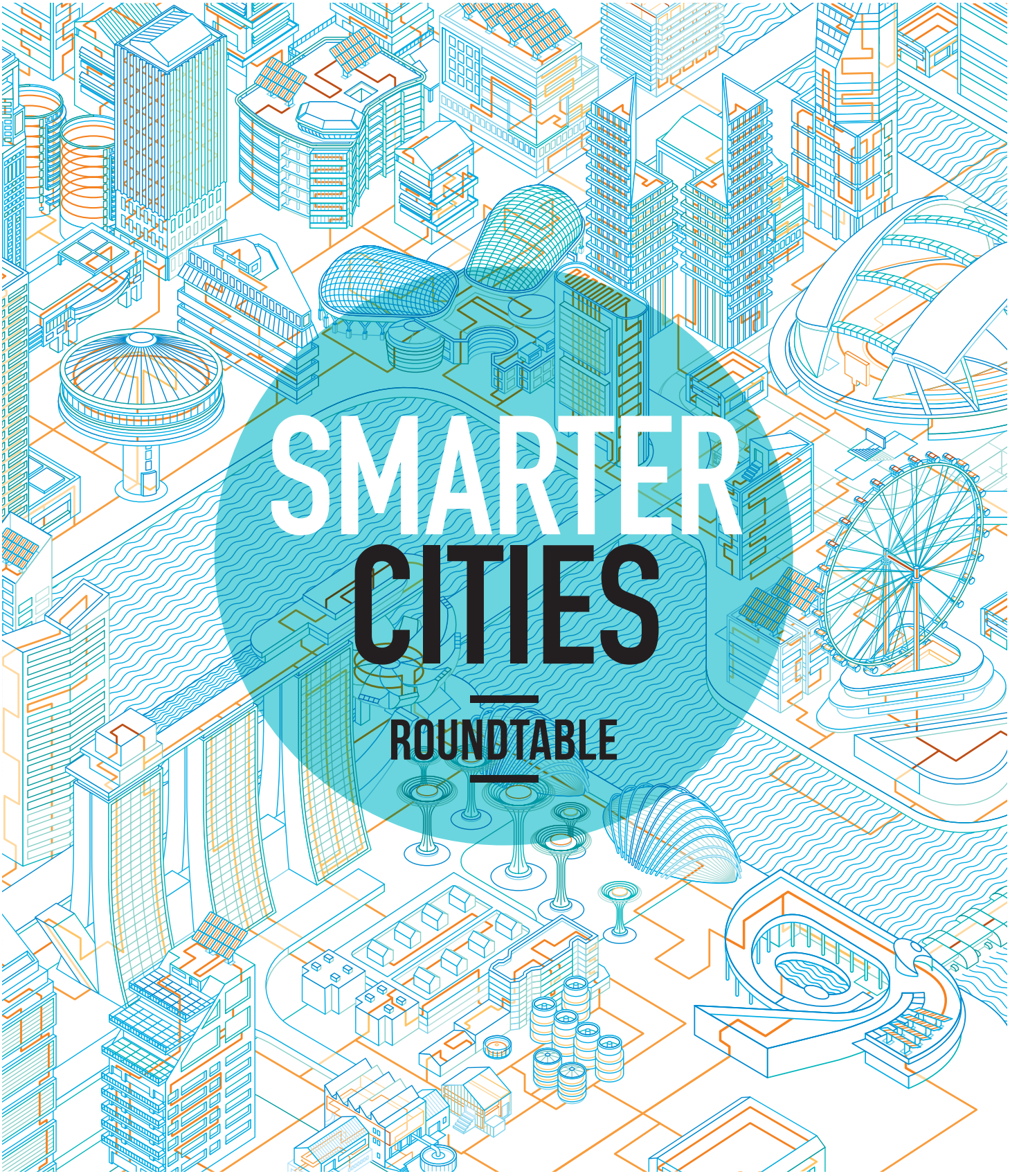

SMART CITIES AND SUSTAINABILITY

THE HALIA AT SINGAPORE BOTANIC GARDENS, 14 JULY 2015
OUTCOME REPORT

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Urbanisation is one of the key megatrends of the 21st century. Today, half the world's population already live in cities, and this figure is expected to rise to 66 per cent by 2050. As more people, goods, and services cluster around urban centres, problems such as pollution, congestion, over-crowding and socio-economic inequality will inevitably arise.

Climate change is another stress factor on cities worldwide. Rising global temperatures and erratic weather patterns are affecting food, water and energy supply, while more frequent and intense natural disasters are displacing populations and undermining national security.

To address these challenges, city leaders across the globe are turning to smart technology solutions to decarbonise their economies, manage the pressures of rapid urbanisation, and improve the quality of life for their people.

Singapore's Prime Minister Lee Hsien Loong in November announced an ambitious vision for Singapore to become the world's first 'Smart Nation', in order for the city-state to maintain its competitiveness, raise its resource efficiency, generate new economic opportunities and deliver a better living standard for citizens.

That same month, he also unveiled Singapore's new sustainable master plan, the Sustainable Singapore Blueprint 2015 – a S$1.5 billion effort that will see the country becoming a zero-waste, car-light nation, and a leading green economy by 2030.

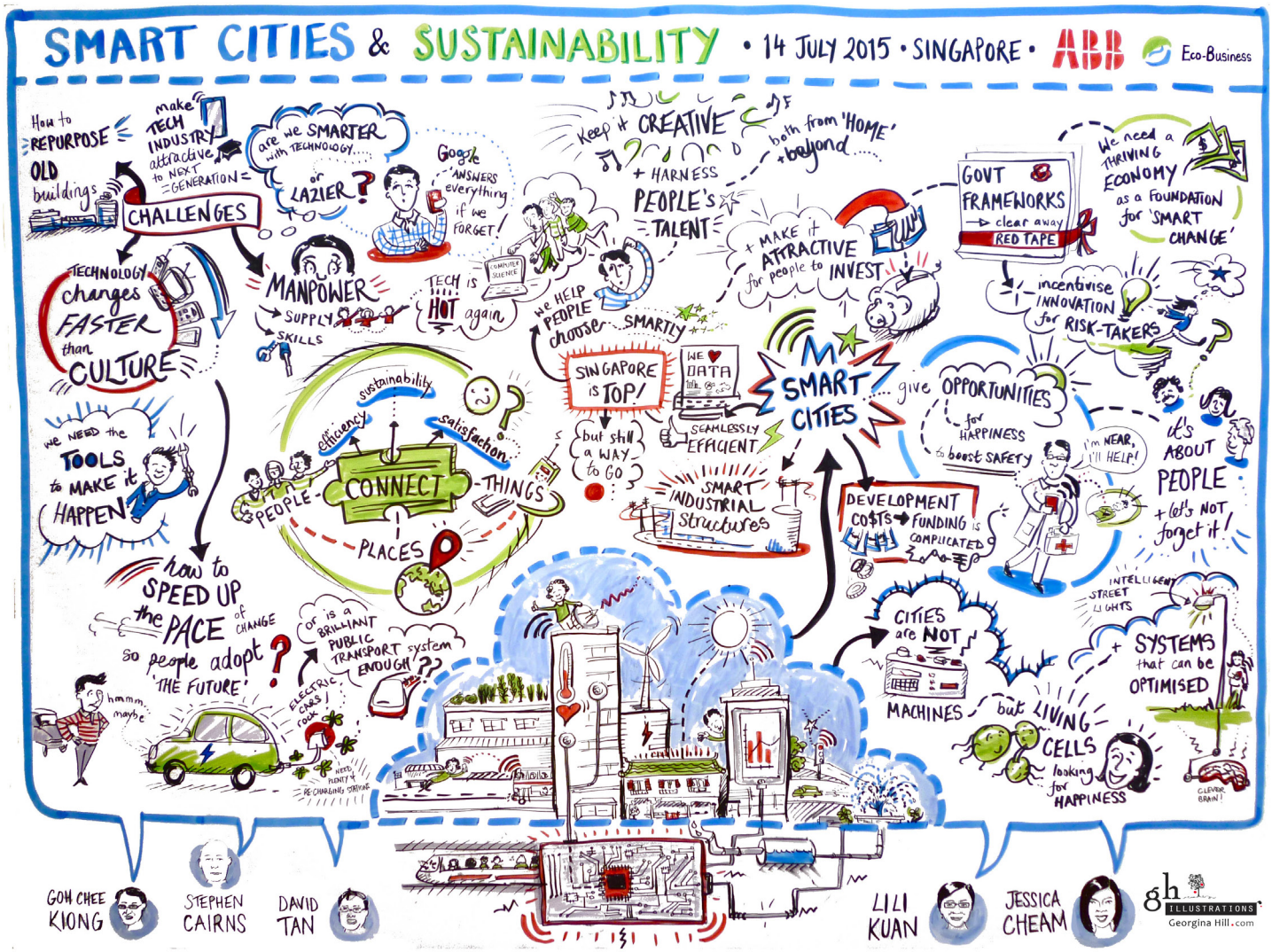
The policies and investments required to realise these two ambitions can sometimes seem to pull in different directions. But with careful, integrated planning and open collaboration between the public, private, and people sectors, cities can unleash many areas of synergy between the two goals and create new economic and social opportunities.

The question is: How? This is exactly what 40 senior leaders from government, business, civil society, and academia gathered to discuss at the inaugural Smarter Cities Roundtable held at The Halia at the Singapore Botanic Gardens on July 14.

The event, organised by Swiss technology giant ABB and Eco-Business, was held in partnership with the Singapore Economic Development Board and Future Cities Laboratory.

Participants noted that in addition to driving efficiency, productivity, and improving the standard of living, the expertise Singapore develops in areas such as ICT and engineering urban solutions will also create economic opportunities as this know-how can be exported to other cities. But to make these outcomes a reality, government policies need to keep pace and support innovation in the private sector.

The roundtable participants unanimously agreed that technology is an enabler, and a means to an end, not for its own sake. Ultimately, smart cities are less about the technologies, and more about how to deploy these solutions to improve the lives of citizens. All 'smart' initiatives should be guided by these principles: They should be efficient, sustainable, and about people.



"TODAY, HALF THE WORLD'S POPULATION ALREADY LIVE IN CITIES, AND THIS FIGURE IS EXPECTED TO RISE TO 66 PER CENT BY 2050."

Johan de Villiers

WELCOME ADDRESS BY JOHAN DE VILLIERS, MANAGING DIRECTOR FOR SINGAPORE AND SOUTHEAST ASIA, ABB

Opening the discussion, Johan de Villiers, Managing Director for Singapore and Southeast Asia, ABB, explained that sustainable growth has always been a priority for the company.

Over the last 120 years, ABB's innovations - from circuit breakers to collaborative robots, transport systems, and software - have helped drive modernisation and energy conservation.

Its technologies are behind the smooth operations of many iconic projects in Singapore. For example, ABB's power and automation systems run the Marina Bay Sands hotel's district cooling system, and its motors drive the gates that keep seawater out of the Marina Barrage, as well as the retractable roof of the new Sports Hub.

Elsewhere, cities around the world are deploying ABB solutions to green its infrastructure. In the Netherlands, ABB has installed the world's largest fast-charging network for electric vehicles; and in Geneva, it has built a public transport network which allows electric buses to 'flash-charge' at each stop they make, shared de Villiers.

But perhaps the most exciting project ABB has ever been involved in is the Solar Impulse – the solar plane attempting to break world records by flying around the world powered only by the sun. It has captured the imagination of ordinary people, and "is an incredible example" of what's possible with a pioneering spirit, he added.

The plane seeks to raise awareness on the possibilities of clean technologies, but energy efficiency is the real star of the show, explained de Villiers. Almost all of the light absorbed by the panels on the plane's wings is used for propulsion. In comparison, only about 30 per cent of the energy consumed by a typical car engine is used for driving. This disparity hints at "the savings that are possible if you really leverage energy efficiency".

Noting that many infrastructure investments span multiple decades, de Villiers said it was of utmost importance that decision-makers have a strong understanding of which technologies to invest in today, and that business, governments and relevant stakeholders must make these decisions together.

As Singapore embarks on its Smart Nation journey, it must also keep a close eye on its energy use, noted de Villiers, who highlighted that by 2030, an estimated 14 per cent of all electricity produced in the country will be used by data centres.

Still, the city-state is well-poised to be a global leader and pioneer of solutions for smart and sustainable cities. Its levels of efficiency are already global benchmarks: "It is already a great example to the world, and (there will be) much more to come", he said.

Vivian Balakrishnan

KEYNOTE ADDRESS BY DR VIVIAN BALAKRISHNAN, MINISTER FOR THE ENVIRONMENT AND WATER RESOURCES AND MINISTER-IN-CHARGE OF SMART NATION INITIATIVE

In his keynote address, Dr Vivian Balakrishnan, Minister for the Environment and Water Resources and Minister-in-Charge of the Smart Nation Initiative, highlighted that a sustainable environment, a dynamic and prosperous economy, and a smart nation are "three dimensions of a tightly interconnected nexus".

If Singapore manages to succeed in these areas, it can help the world confront some of its biggest challenges, such as climate change, "painful and gut-wrenching" economic restructuring, and ensuring cohesion amid widening social diversity.

The city-state has always recognised the importance of balancing sustainability with economic progress. This was evident when in Singapore's early post-independence years, its first Prime Minister Lee Kuan Yew rejected cheap but dirty coal power stations in favour of cleaner but costlier natural gas.

This was because he "instinctively understood the value of blue skies to the people", explained Balakrishnan, and this should serve as a reminder that protecting the environment and growing the economy are not trade-offs, but "parts of a virtuous cycle".

The Sustainable Singapore Blueprint – which outlines the country's plan to create smart and liveable towns and a 'car-light', zero-waste country with a green economy – is the latest effort to continue driving this virtuous cycle.

While smart technology is required to achieve these objectives, it is only a means to an end. A smart city is about people, quality of life, opportunities and communities, he said.

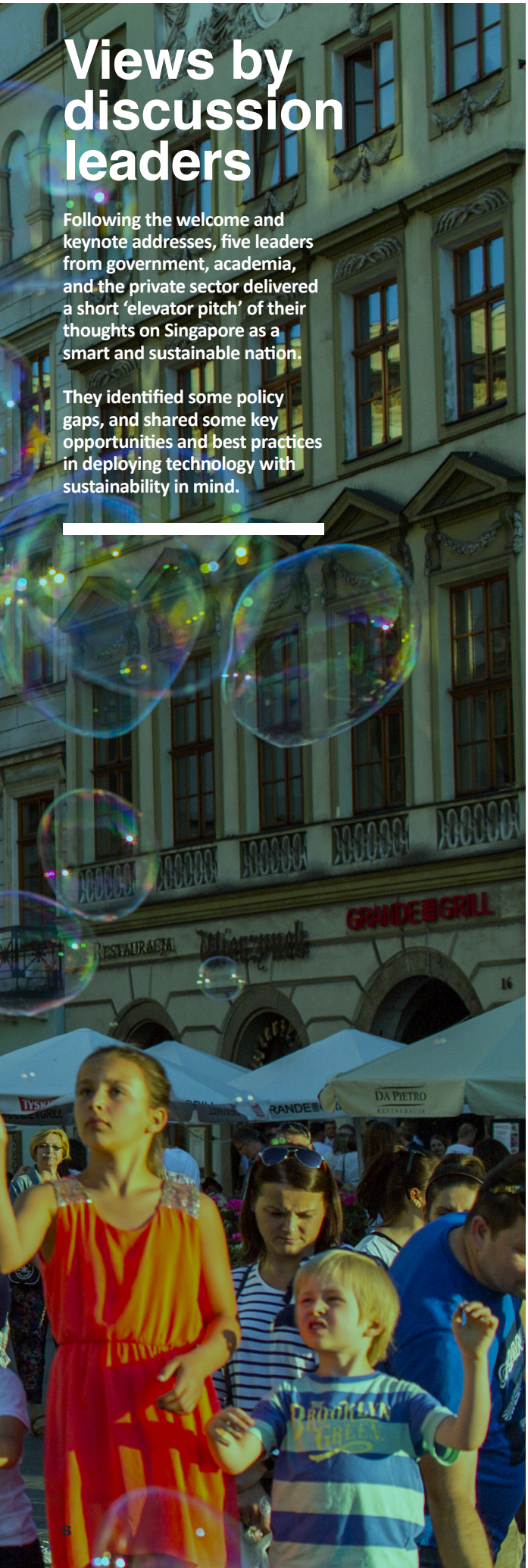
Citing British economist and futurist Stephen Aguilar-Millan's theory, Balakrishnan observed that every fifty years, a major technological wave sweeps through society and completely transforms the way people do things, organise themselves, and interact with one another.

The first such wave occurred in the 1770s, when the advent of mills and canals boosted England's manufacturing output and income. Subsequent waves included the rise of the steam engine in the early 1800s; the age of steel and electricity in the late 1800s; and the age of oil in the 1900s, which paved the way for automobiles, aviation, and mass production.

The most recent wave has been the information and communications revolution, which began in the mid-1900s with the invention of the transistor radio. This has seen the development of mobile and internet communication technologies, which have had a profound impact on society.

Now, Singapore is on the cusp of a new wave, which will see the use of technologies like sensors, Internet of Things, 3D printing, and big data, among others, playing a bigger role in society, he noted.

The country is in a good position to take advantage of these opportunities, thanks to its technologically-savvy political leadership, strong understanding of the value of engineering, and appreciation of the importance of sustainability, said Balakrishnan. It needs to be a place, he added, citing the words of Indian industrial magnate Anand Mahindra, "where a visitor will say 'I have seen the future, and it works!'"



Views by discussion leaders

Following the welcome and keynote addresses, five leaders from government, academia, and the private sector delivered a short 'elevator pitch' of their thoughts on Singapore as a smart and sustainable nation.

They identified some policy gaps, and shared some key opportunities and best practices in deploying technology with sustainability in mind.

01 MAKING CITIES 'OPTIMISED' AND HAPPIER

Jacqueline Poh, Managing Director, Infocomm Development Authority of Singapore

Jacqueline Poh, Managing Director of the Infocomm Development Authority of Singapore (IDA), shared that when the government began exploring smart city applications three years ago, a key goal was the improvement of processes and systems.

Some examples she cited included putting sensors on streetlights in the Singapore Botanic Gardens to spare maintenance crews from having to conduct manual checks for faults, and at traffic junctions to adjust signal timings based on the number of cars at a red light.

But beyond making systems more efficient, smart nation efforts can also create opportunities to improve the quality of life and overall happiness of citizens, Poh noted. This realisation spurred IDA and other government agencies to explore more people-centric solutions, such as a mobile application which alerts first aid providers if someone nearby needs help, or schemes that make it possible for healthcare providers to deliver medical advice and therapy to the elderly at home via video conferencing.

Making a city work smarter and ensuring that the needs of its citizens are fulfilled are both key goals of a smart nation, she said.

02 SINGAPORE AS A LIVING LAB FOR URBAN SOLUTIONS

Goh Chee Kiong, Executive Director, Clean Technology and Cities, Infrastructure & Industrial Solutions, Singapore Economic Development Board

As a small, resource-constrained nation, Singapore has had to work hard to become the sustainable and liveable city it is today. And while there are still many areas for improvement, Singapore's capabilities in areas such as water and waste management solutions provide an opportunity for it to share its expertise with the world.

Furthermore, Singapore has positioned itself as a "living lab", where companies can develop, test, and commercialise innovative urban solutions in the country before taking them to the region, said Goh Chee Kiong, Executive Director Clean Technology and Cities, Infrastructure & Industrial Solutions, Singapore Economic Development Board (EDB).

The Republic is now on the cusp of the mass adoption of smart solutions such as big data, sensors, and the Internet of Things, shared Goh. These emerging technologies are driving rapid changes in Singapore's urban landscape, and government agencies such as EDB, IDA, and JTC, are working closely with private sector companies to deploy them across the country.

These 'smart and sustainable urban solutions' have been identified by the government as a key economic growth area, Goh noted, and Singapore is now working to integrate these sustainability concepts into its national development narrative.

03 FINANCING A SMART AND SUSTAINABLE CITY

Lili Kuan, Country Head and Chief Operating Officer, Barclays

There is no question that Singapore does well in areas such as delivering key government services electronically, communication networks and infrastructure, and economic competitiveness. But Lili Kuan, Country Head and Chief Operating Officer of investment bank Barclays, said that areas where the country can improve include cultivating a home-grown pool of skilled talent, a vibrant technology industry and start-up ecosystem, and improving the way data is shared among government agencies.

Innovations in banking technology can also help achieve the goals of a smart city and improve life for citizens, shared Kuan. Internet banking, replacing passwords with biometric security measures and video banking are just a few examples of emerging industry solutions.

Banks can also bridge the gap that exists between the funding needs of infrastructure projects and availability of loans. Current regulations that require banks to set aside large amounts of capital when making long-term loans makes it difficult for much-needed infrastructure projects to get funding, noted Kuan. She suggested: Why not match infrastructure projects with other long-term sources of funding such as pension funds, sovereign wealth funds, insurance companies, or even a standalone infrastructure fund?

04 A QUESTION OF SATISFACTION

Stephen Cairns, Scientific Director, Future Cities Laboratory

Taking the discussion to a more philosophical level, Stephen Cairns, Scientific Director of the urban research institute Future Cities Laboratory, presented a smart city framework that highlighted the complex and interconnected nature of the issues that city planners need to consider.

People frequently say that smart cities connect people, places, and things, said Cairns. But measures taken to make a city smart may simply connect people to people, or things to other things, without bridging the disconnect between people, places, and things. Improving how people interact with their surroundings and technology is important, and efforts to do this have "paradigm-shifting potential", he added.

When thinking about why people aspire towards a smart city, three motivating factors are efficiency, sustainability, and satisfaction. Here, too, all three outcomes are not necessarily mutually affirming. That is, a sustainable solution may not always be efficient or bring people satisfaction, and a satisfactory solution may not be efficient or sustainable, and so on.

Singapore is very good at thinking about efficiency and sustainability, "but the big challenge in Singapore is the question of satisfaction", observed Cairns. It is important to study this crucial issue of whether a smart city is serving the needs of its people, he added.

05 INNOVATIVE INDUSTRIAL SOLUTIONS

David Tan, Assistant Chief Executive Officer, JTC Corporation

As the lead agency in Singapore for developing a dynamic industrial landscape, JTC is constantly pushing the boundaries of innovation to create solutions that are not only smart, sustainable, and liveable, but also help improve economic competitiveness and productivity, said David Tan, Assistant Chief Executive Officer, JTC Corporation.

To do so, JTC integrates sustainability into the entire value chain of developing industrial infrastructure, from designing buildings to constructing them to choosing tenants.

All new JTC buildings must achieve the two highest tiers in Singapore's national Green Mark building certification scheme, which evaluates the environmental impact of buildings. Similar to EDB's efforts, JTC is also using industrial estates and buildings as 'living labs', so that researchers and industries can work together to try out new solutions. An example of this is the Cleantech Park at NTU which is fitted with a variety of clean energy technologies.

The agency also works with industries and partners to develop green business practices and policies, including the use of automation and robotics in factories, and green leases - where tenants agree to sustainable energy and waste management practices - in several JTC estates, shared Tan.

Roundtable dialogue: Challenges, opportunities, recommendations

Roundtable participants, in four separate groups, then gathered to discuss the challenges and opportunities Singapore faced in achieving its smart and sustainable city vision, and made recommendations on how to address these issues.

ENERGY CHALLENGES OF A SMART NATION

CHALLENGE

From sensor networks and data centres to personal computers and mobile phones, Singapore's ambition to become a Smart Nation will drive technology use on a massive scale, along with energy demand. This should be a central concern, especially given Singapore's recent commitment to reduce its emissions intensity (that is, the amount of emissions per dollar of gross domestic product) by 36 per cent by 2030, compared to 2005 levels.

Participants noted that balancing technology expansion with energy conservation will be a key challenge. While much has been done to tackle Singapore's energy efficiency levels, getting the industrial sector to accelerate the pace of change is an uphill task. Participants noted that some industries prioritise operations above energy efficiency, making it difficult to encourage them to invest resources needed to reduce energy use.

OPPORTUNITIES AND RECOMMENDATIONS

- Although the proliferation of technology will lead to greater energy use, the ultimate purpose of such tools is to drive energy efficiency. For example, energy meters in a home can provide insights into where energy is wasted or can be used more efficiently. **The key is to measure energy consumption patterns, track and set energy benchmarks.**

- **Sticking to a policy of not subsidising energy** will allow market forces to drive down Singapore's energy consumption and make renewable energy economically viable in the long run.

- Although the government will not subsidise energy – whether conventional or renewable – participants said it should **support investment in energy efficient technologies through targeted incentives or schemes** to help shorten the payback period for investors.

- **Retrofit old petrochemical refineries** with new heat integration, co-generation, and tri-generation technology.

KEEPING PACE WITH INNOVATION

CHALLENGE

Technology today is moving at a tremendous speed, and businesses need to move quickly to keep pace with these changes. But rules and regulations can sometimes lag behind and hamper innovation, efficiency and productivity.

One participant shared how securing internet connectivity on a construction site – so that workers could use sophisticated building information modelling software onsite – was a painful and bureaucratic process. Other participants cited the slow pace of adoption of electric vehicles (EVs) as another example. They have remained largely confined to the domain of test-bedding since 2011 despite the favourable conditions in Singapore for EVs.

In a lively debate about the potential of Singapore's EV market, participants noted that a dearth of public charging infrastructure and the high cost of owning an EV in Singapore posed barriers for the sector. A public official said the government has already begun the next phase of EV testing, which will see 1,000 cars deployed in Singapore and several thousand charging points built across the island. The government is currently evaluating proposals for this trial, and expects the initiative to help scale up EV use in Singapore. But ultimately, the government's top priority will always be to promote mass transit options over private car ownership, he said.

OPPORTUNITIES AND RECOMMENDATIONS

- **Adopt an approach of inter-operability and public-private collaboration.** Government agencies need to collaborate with one another and the private sector to understand how technologies fit into existing policy frameworks.
- Participants recommended **a new platform or agency be created** to coordinate efforts between multiple ministries to resolve uncertainties surrounding the adoption of new technologies and practices in Singapore.
- To kickstart smart technology innovations such as EVs, **additional incentives** for consumers to invest in these products and solutions would be welcome.

SKILLED TALENT, HAPPY CITIZENS

CHALLENGE

Leaders at the roundtable noted the lack of homegrown expertise in areas such as information technology and engineering, which are key to driving Singapore's smart and sustainable city vision. The government and the private sector will need to look at innovative ways to grow a local workforce to reduce their high reliance on foreign manpower.

Separately, despite the promise of smart city solutions to raise sustainability and productivity, there is visible discomfort among citizens involving, for instance, the loss of privacy; a growing disconnect between residents due to technology proliferation; and widening inequality fuelled by a 'data divide' where segments of society who cannot afford or access technology get marginalised.

There are also concerns that a smart city will be overly IT-centric or technocratic, and that creative and cultural opportunities will suffer as a result.

OPPORTUNITIES AND RECOMMENDATIONS

- **Create a tripartite alliance between educators, government, and businesses to make technical subjects attractive.** Engineering and computer science have for a long time been overshadowed by other disciplines such as medicine, law, and business. Career opportunities in these areas should be showcased and the alliance could also make more scholarships and internships available to students.

- **Embed sustainability into curriculum.** It is important for future engineers, IT professionals, and designers to have a strong appreciation for how their work helps make cities more sustainable.

- **Foster diversity and creativity.** To ensure that a smart city is also vibrant and harnesses the capabilities of all its people, urban planners and policymakers must offer opportunities and spaces for creative professionals such as artists and musicians to flourish in a smart city.

- **Some decisions need to be based on what is the right thing to do, rather than what market forces dictate.** For example, one participant shared that when The Netherlands decided to invest in creating the world's largest fast-charging infrastructure for electric vehicles, it was driven by people's demands, rather than economics.

- **Embrace the consultative approach.** Major planning decisions should be made after extensive consultations with citizens on their needs and desires. For example, one participant shared how officials and private sector companies behind smart city efforts in Songdo, South Korea conducted a series of public consultations, asking citizens what they wanted from the city from the get-go.

- **Look at the big picture to harness the full potential of smart solutions.** A smart technology can have benefits beyond the intended purpose. For example, street lights can be fitted with sensors to detect when they are faulty, but the same technology can also be used to make lights shine brighter when they detect an individual in the area.

CONCLUSION

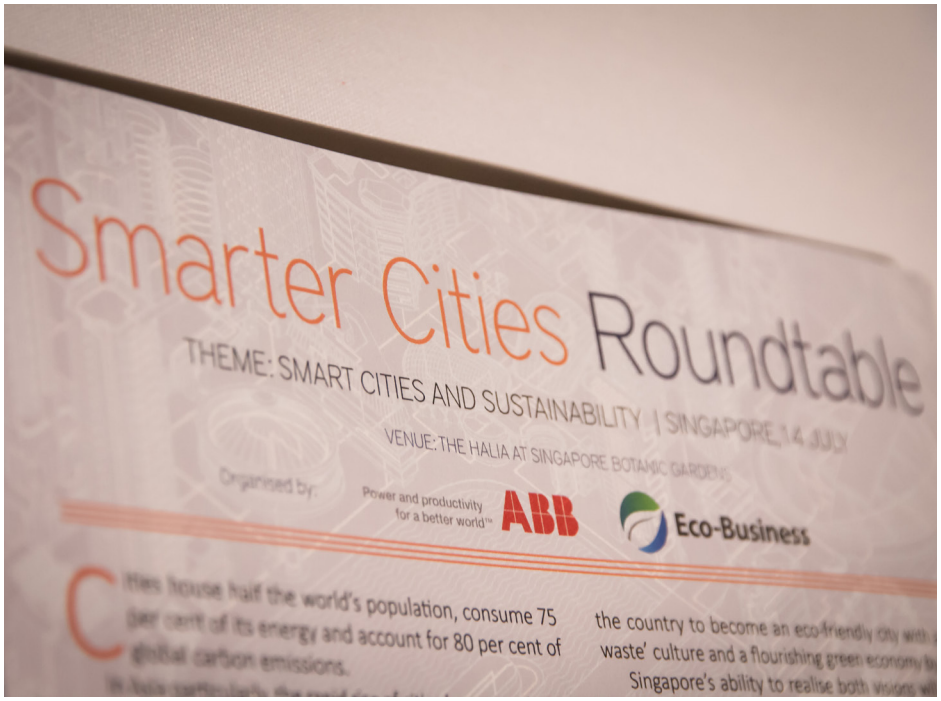
Roundtable participants agreed that successfully achieving the goals set out in Singapore's Smart Nation vision and Sustainable Singapore Blueprint would deliver many environmental, social, and economic benefits to citizens. It would also create international economic opportunities for Singapore and consolidate its status as a regional – if not global – leader in sustainable urban solutions.

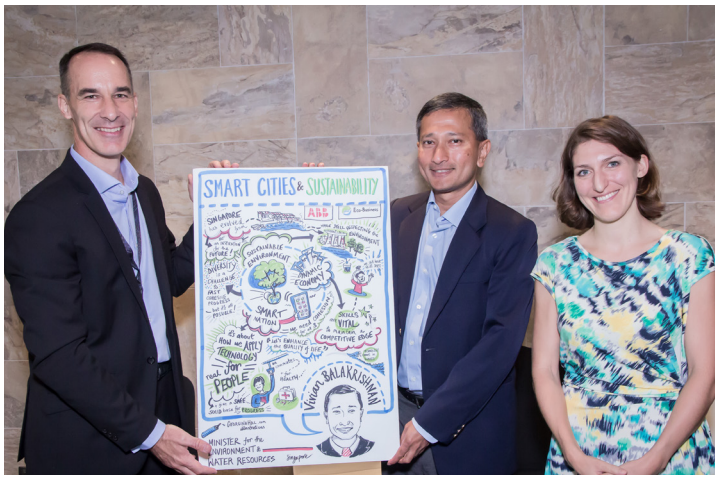
The hardware and software that are at the heart of these two aspirations are rapidly evolving, along with how people and organisations interact with and relate to these new concepts, devices, and business models. To successfully harness these tools to make Singapore a smart, sustainable, and liveable country, the following three strategies are essential:

1 **Understand the nexus:** The environment and economy are not parts of a zero-sum game. Rather, a sustainable environment, dynamic economy and smart nation are parts of a tight nexus, and it is important to approach all outcomes as interrelated and part of the same virtuous cycle. This approach will be key to addressing pressing challenges like climate change, economic restructuring and increasing societal diversity.

2 **A people-first approach:** Technology is a means to an end, not a goal unto itself. Ultimately, it should be viewed by policymakers and businesses as an enabler for improving the lives of people. Sometimes, meeting the needs of citizens may also require making decisions that go against market forces; this is where political leadership can play a huge role in creating the ideal environment to achieve these outcomes.

3 **Collaboration and multidisciplinary planning:** Whether it is adapting regulations, changing business practices or equipping the next generation with the right skills, all segments of society need to work together closely to embrace a holistic and interdisciplinary approach in developing Singapore into a smart and sustainable city for the 21st century.





For more photos of the event, please visit: https://www.flickr.com/photos/eco-business

"Cities have the capability of providing something for everybody, only because and only when they are created by everyone."

– JANE JACOBS, AMERICAN-CANADIAN URBAN STUDIES JOURNALIST, AUTHOR, AND ACTIVIST

"The best way to predict the future is to invent it."

– ALAN CURTIS KAY, AMERICAN COMPUTER SCIENTIST

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