Singapore as a Sustainable City: Past, Present and Future

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Introduction

- Discuss Singapore's major sustainability challenges and its policy responses
  - Land use
  - Transportation
  - Waste management
  - Water
  - Energy
- Way forward for sustainable and liveable Singapore

Singapore's Land Use Issue and Concept Plans

- Concept Plans (CP) outlines the long-term plans for strategic land use and transportation
- The first CP in 1971, revised in 1991, 2001, and 2011
  - Shift in focus from meeting basic needs towards achieving more balanced and inclusive growth
- Latest CP review lead to Land Use Plan 2030 by MND
  - Providing affordable homes with a wide range of amenities
  - Integrating greenery into the environment
  - Improving mobility with enhanced transport connectivity
  - Sustaining a vibrant economy with good jobs
  - Ensuring room for growth and a good living environment in the future
- Singapore approached land scarcity in three ways
  - Expand horizontally
  - Expand vertically
  - Efficient land use

Horizontal expansion through land reclamation

- Singapore's land area expanded significantly through reclamation
  - 580 km^2 in 1965 to 729 km^2 today
- Plans to expand to 780 km^2 by 2030
  - Reclamation will become increasingly more expensive
  - Most of the sand used for reclamation used to be imported from the neighbouring countries of Malaysia, Indonesia, Cambodia, and Vietnam, but these countries introduced a ban on sand exports for environmental reasons
  - Higher international price of sand
- Singapore seeks alternative ways of land reclamation, such as empoldering

Growing taller: vertical urbanism in Singapore

- Competing needs for land between housing, transport, and commercial uses
  - Vertical urbanism is a practical solution to the problems of land scarcity and urban sprawl
- The HDB plays a critical role in the history of vertical urbanism
  - Over 80% of Singapore's resident population live in a HDB unit
  - Around 90% of HDB units occupied by owners
- More emphasis on sustainability and liveability in recent years,
  - Example: Landscaping for Urban Space and High-Rises (LUSH) by URA from 2009

Improving land use for sustainability and liveableability

- Green Building Masterplan by BCA
  - The first two masterplans published in 2006 and 2009 focused on the roles of developers, designers, and builders to construct eco-friendly buildings
  - The third masterplan in 2014 raised awareness among the occupants of these buildings about the adoption of eco-friendly ways of living
- Examples
  - Elevator Energy Regeneration System in HDB buildings
  - Use of LED lighting in common areas
  - Fitting of solar panels in rooftops and centralized chutes
- Besides buildings, policy objectives have been set to improve sustainability and liveability of Singapore
  - 9 in 10 homes within 10 minutes' walk from a park by 2030
  - Build 400 kilometres of park connectors and 100 km of waterways open to recreational activities by 2030

Policies to manage traffic

- Managing congestion has always been important policy objective in Singapore
- Build more roads
  - Road lengths: 800 km in 1960s to 3,000 km today
- Push factor from private vehicle transportation
  - Disincentivise usage: Area Licensing Scheme (1975), Road Pricing Scheme (1995), Electronic Road Pricing (1998)
  - Disincentivise ownership: Price Policies such as import tax, registration fee, ARF, annual road tax, PARF and quantity policy such as Vehicle Quota System (1990)
- Pull factor into alternative modes of transportation
  - Improvement in bus services through the publication of the White Paper on the Reorganisation of the Motor Transport Service (1970) and the Bus Contracting Model (2016)
  - Introduction of Mass Rapid Transit (1987)

Transport policies and technologies to move forward

- Measures to improve the efficiency and service standards of public transportation
  - Automated vehicle inspection system and automatic track inspection for the MRT system
  - Common Fleet Management System, through which commuters can get information regarding the expected arrival time of a bus
- Measures taken to achieve a car-lite society
  - Sheltered walkways
  - Pedestrian overhead bridges
  - Designated bike paths
- Use of Autonomous Vehicles
  - Test beds at NTU, NUS, and JTC
  - Trials service to public at Jurong Lake Garden and Gardens by the Bay

Managing pollution from vehicles

- Air quality in Singapore needs substantial improvement to achieve the Air Quality Guidelines (AGQ) by the WHO
  - According to Singapore's own Pollutant Standards Index, which uses the measurement of six pollutants (NO_2, CO, SO_2, $PM_{2.5}$, PM_{10}, O_3), only less than 10 percent of the days were with good air quality, while the rest of the days had moderate air quality for both 2016 and 2017
- Measures to raise consumer awareness about fuel efficiency of cars
  - Fuel Economy Labelling Scheme (2012)
  - Carbon Emissions-Based Vehicle Scheme (2013)
  - Revised Carbon Emission-Based Scheme (2015)
- The outdoor sound level: 69.4 decibels. Below the WHO recommendation of 70 decibels but above the NEA's recommendation of 67 decibels

Waste management in Singapore

- Singapore has limited area for landfill
  - Most of the wastes are incinerated, as incineration can reduce the volume of wastes by up to 90 percent
  - The Semakau landfill expected to meet Singapore's solid waste disposal needs up to 2035
- Increasing incineration and landfill capacities do not provide a sustainable solution to the ever-increasing production of waste.
  - Solid waste disposed of in a day: 1,260 tons in 1970 $\rightarrow$ 8,443 tons in 2017
  - While Singapore has achieved a relatively low level of waste emission per person today, further reduction is important for achieving the national goal
  - In particular, recycling of domestic wastes has been low relative to industrial wastes

Difficulties in tackling household waste

- Few measures are in place for source reduction and recycling for household waste
- Typical single rubbish chutes in HDBs and private housing developments are not conducive to recycling
  - Dual chutes in new HDBs and private housing
  - Recycling bins for old developments
- Currently, no source separation policy or a unit pricing system for waste collection and disposal services.
- Mandatory e-waste management system introduced from July 2021, following the Extended Producer Responsibility Approach in Japan and Korea
- Non-economic incentives in terms of a strong moral commitment, belief in the beneficial effects of recycling, and a positive attitude towards environmental policies would also be of paramount importance

Food Waste

- Food waste is increasingly getting attention both locally and globally
  - Around the globe, one-third of the food is estimated to be lost or wasted
- In Singapore, food waste is one of the biggest waste streams
  - 744 million kg of food waste—2 bowls of rice per person per day—was generated in 2019
  - 20 percent increase over 10 years
- Resource Sustainability Act (2019) requires certain premises (e.g., F&B areas and large food manufacturers) to segregate food waste and include on-site food waste treatment systems in certain new buildings

Advocating 3Rs: Reduce, Reuse, Recycle

- Create general awareness about waste management
  - **Clean Plate Campaign**: raise awareness about food waste in schools and hawker centres
  - **Zero Waste SG**: provides information on the 3Rs and runs campaigns to encourage use of recyclable products
- Modern and efficient waste management techniques
  - Development of an Integrated Waste Management Facility to meet the long-term waste management needs
  - Installing Pneumatic Waste Conveyance System in new HDBs

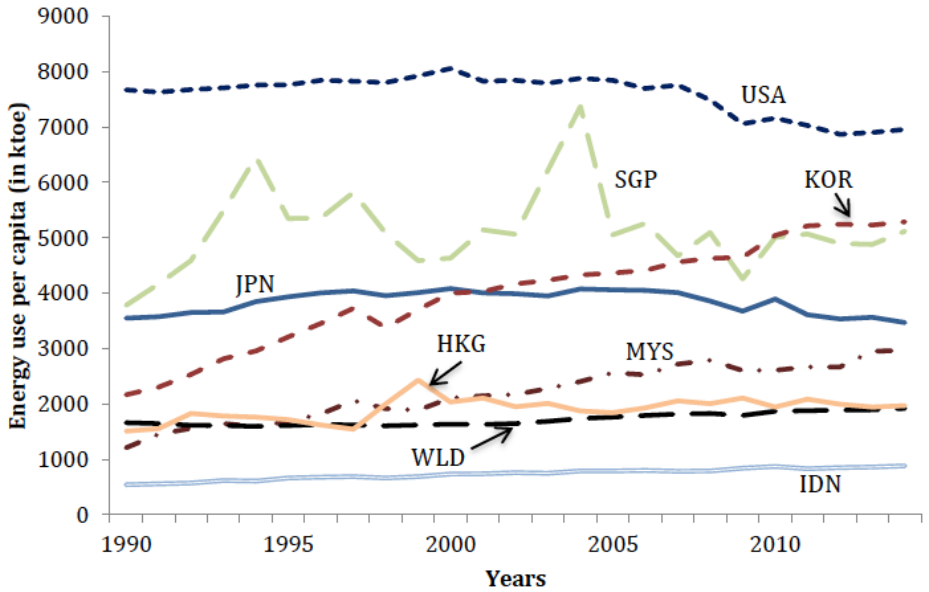
Four national taps

- Singapore projected to be among the worst affected countries due to depletion of surface water between 2020 and 2040
- Singapore has the four national tap strategy to cope with long-term water supply
- **Imported water**: the Johor River Water Agreement to expire in 2061. The other three taps
- **Local catchment**: Rainwater is systematically collected, treated, and used for drinking purpose in the catchment area comprising of two-thirds of total land surface area
- **Desalinated water**: Currently supply 30 percent of water and expected to stay at this level in 2060
- **NEWater**: Currently supply 40 percent of water and expected to supply 55 percent in 2060

Policies to manage water demand

- **Water pricing**: takes into account the national water system's costs
- **Water Efficiency Labelling Scheme**: help consumers distinguish between water-efficient and water-inefficient appliances
- **Water conservation programs**: Encourage HH to adopt good water use practices such as repairing leaks, reusing rinse water, reducing shower time, and being aware of monthly water bills
- **Convenient Information**: A PUB study suggests that smart meter help reduce water usage
- **Other water conservation programs**: Water Efficiency Fund, Water Efficiency Awards, Water Efficiency Building Certification, etc.
- S'pore aims to reduce per day per capita HH water consumption from 141 litres in 2018 to 130 litres in 2030

Energy consumption in Singapore



- Energy consumption in SGP among highest in Asia, much higher than HKG and JPN
- SGP's GDP per unit of energy use is better than some other developed economies such as DEU, JPN and USA

- Singapore's energy consumption primarily depends on fossil fuels, with petroleum products and natural gas accounting for about 61 percent and 9 percent of energy consumption, respectively, in 2016

Electricity market and renewables

- Since early 2000s, the electricity market has been gradually liberalised
  - This has helped to improve the efficiency of electricity market
- However, Singapore's electric generation is heavily dependent on burning of fossil fuels
- Currently Singapore's use of renewable energy is limited to solar power, with its contribution to electricity generation being less than 1 percent
- Tidal and wind generation and even the possibility of hybrid microgrids have been explored in Semakau island
- These alternative renewable sources of energy have the potential to reduce Singapore's dependency on import of fossil fuels and make the electricity supply more sustainable

Policies to promote energy efficiency

- **Mandatory Energy Labelling Scheme** (2008): Create greater consumer awareness by giving ticks to appliances based on their energy efficiency
- **Project Carbon Zero** (2009): competition held among primary and secondary school students to see whether children could nudge their parents to change their energy consumption pattern
- **Energy Efficiency National Partnership** (2010): voluntary program helping businesses consuming a large amount of energy to increase their competitiveness through learning network activities, provision of energy-efficiency related resources, and incentives and recognition
- **Minimum Energy Performance Standards** (2011): It complements the MELS by prohibiting the sale of appliances that do not meet the specified energy efficiency level

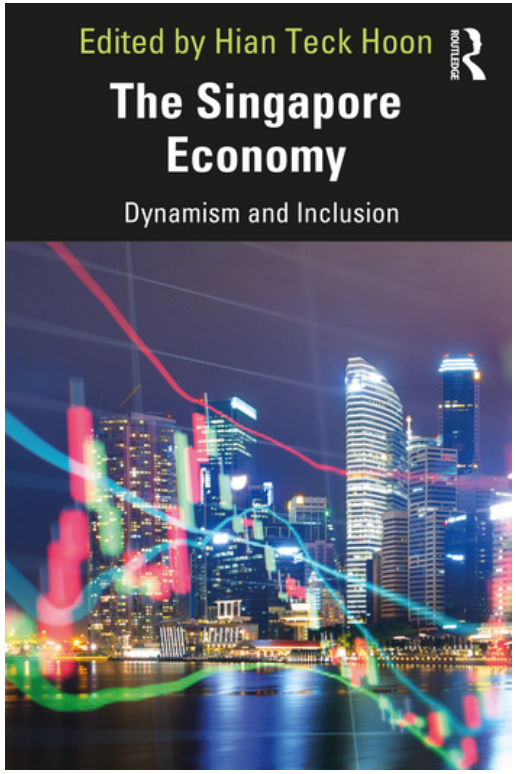
Incentives vs normative messages for sustainable policies

- Singapore has been successful in implementing policies to make the city state more sustainable and liveable
  - Policies are calibrated according to the long-term vision
  - Policies are tweaked quickly as issues arise
- Singapore has endorsed the use of economic incentives to achieve a desirable set of outcomes
- However, normative messages are equally important, since they can complement economic incentives
- Going forward, a mixed usage of economics incentives and normative messages will remain necessary.

Way Forward: challenges and opportunities

- Challenges
  - Need more efforts to contain the emission of wastes
  - Dependence on imported fossil fuels is a potential source of vulnerability
- Opportunities
  - Singapore can judiciously take advantage of automation and artificial intelligence to optimize the allocation of resources
  - New types of offshore technologies (e.g., float solar power generation) can be explored

Thank you!



Today's presentation is based primarily on Chapter 5 of "The Singapore Economy: Dynamism and Inclusion" with some updates and modifications