



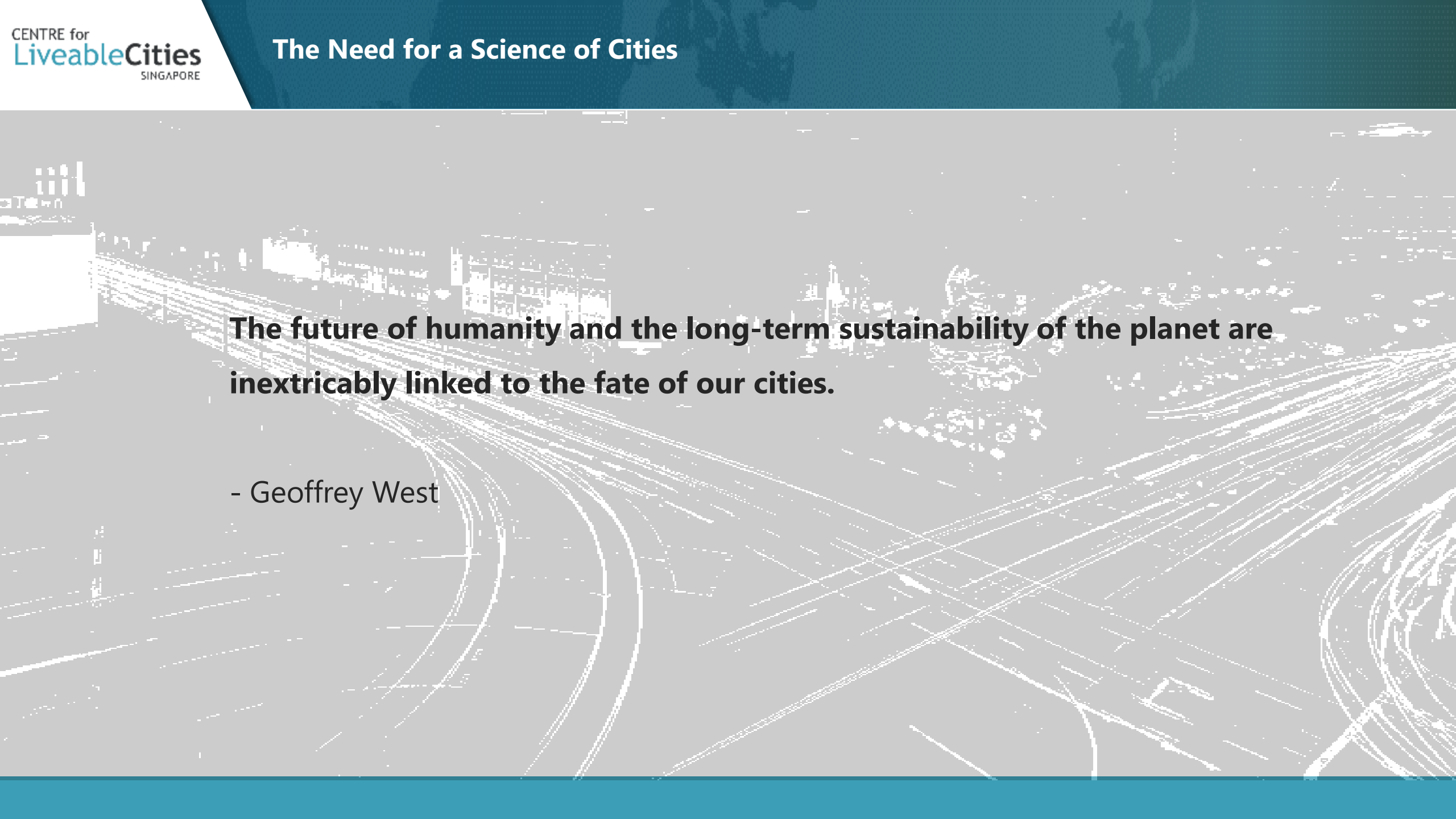
# CENTRE for LiveableCities

SINGAPORE

*ASEAN Australia Smart Cities Trust Fund (AASCTF)  
Guided Learning Programme: Analysis & Decision-Making  
**Leveraging the Science of Cities  
for Liveability, Sustainability & Resilience***

**Dr Limin Hee**  
**Director, Centre for Liveable Cities**  
*1 December 2022*



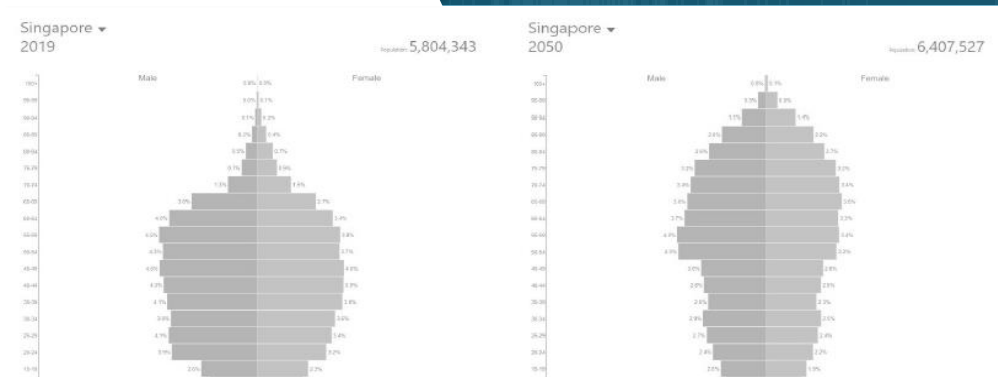


**The future of humanity and the long-term sustainability of the planet are inextricably linked to the fate of our cities.**

- Geoffrey West



# We are living in a VUCA world and cities are complex.



**volatile, uncertain, complex, ambiguous**



In a dense and growing city, We can neither tinker with just one system nor neglect the bottom-up self-organising behaviours from the people.

big data

law of unintended  
consequences

challenge of reductionism

**cities as complex systems**

interdependency

embracing experimentation

**new tools for the science of cities**

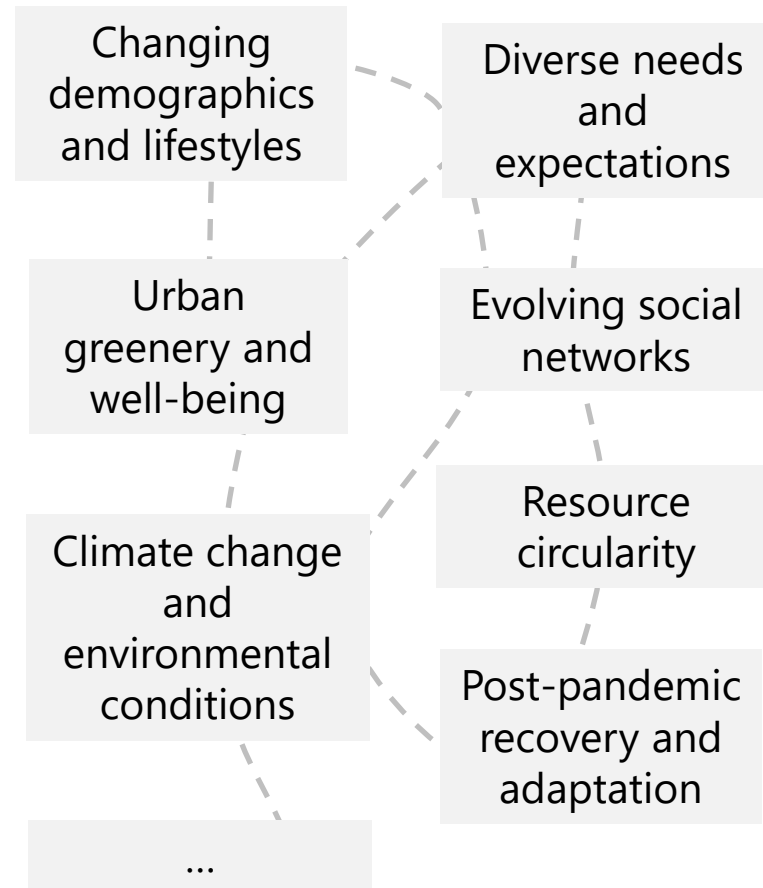
emergence

interdisciplinary

## Cross-cuts Scales

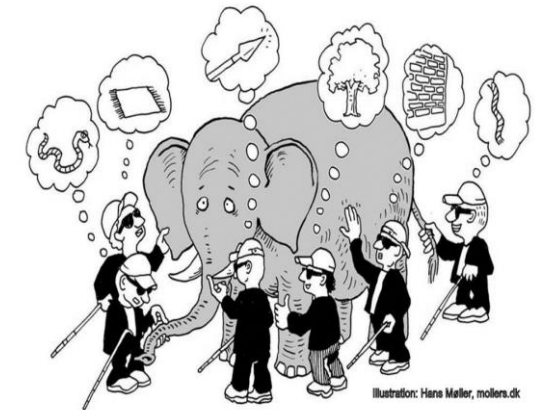


## Interconnection of heterogeneous needs and challenges



## Whole is more than the sum of its parts

Approach urban challenges in a **system of systems approach**



## The “Planner’s Problem”:

Cities are complex but it is impossible to plan the city in detail (*Bettencourt, 2014*)<sup>1</sup>

### Knowledge Problem

We do not have all knowledge required to understand the state of the system



### Calculation Problem

It is impossible to predict and evaluate each possible scenario due to the self-organising nature of large/dense cities



### How City Governments can Respond

- Provide the **necessary conditions** and information for individuals to better self-organise in the everyday.
- Draw upon emerging insights from complexity science, to **identify the weak signals of emerging issues** and **key levers** which influence how cities operate effectively.<sup>2</sup>

\*Note: “Planner” in this case refers to those in the city planning, policy making and urban management space



## Ubiquity of big data

- The last couple of years alone accounted for 90% of the data generated since the advent of the Internet.
- Coupled with high performance computing, unstructured data can be converted to useful content.



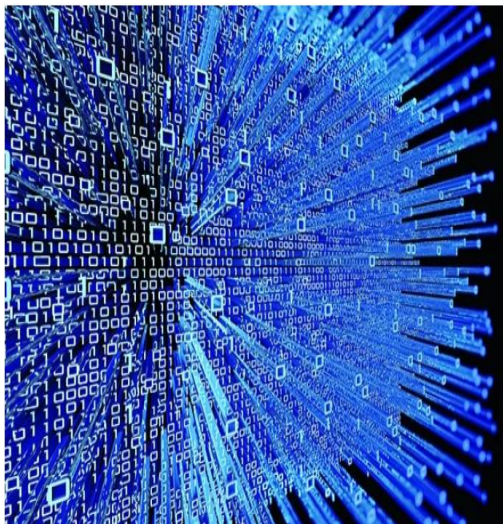
## Rise of artificial intelligence

- The rise of AI allows for analyses of a greater variety of datasets in novel combinations to discover new patterns and trends.



## Scientifically-informed planning

- Better predictive management will bestow upon government agencies the ability to track and monitor sustainability performance in tandem with population and economic growth



## Cuts across Scales



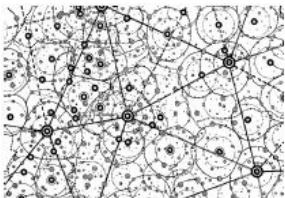
Individual



Neighbourhood

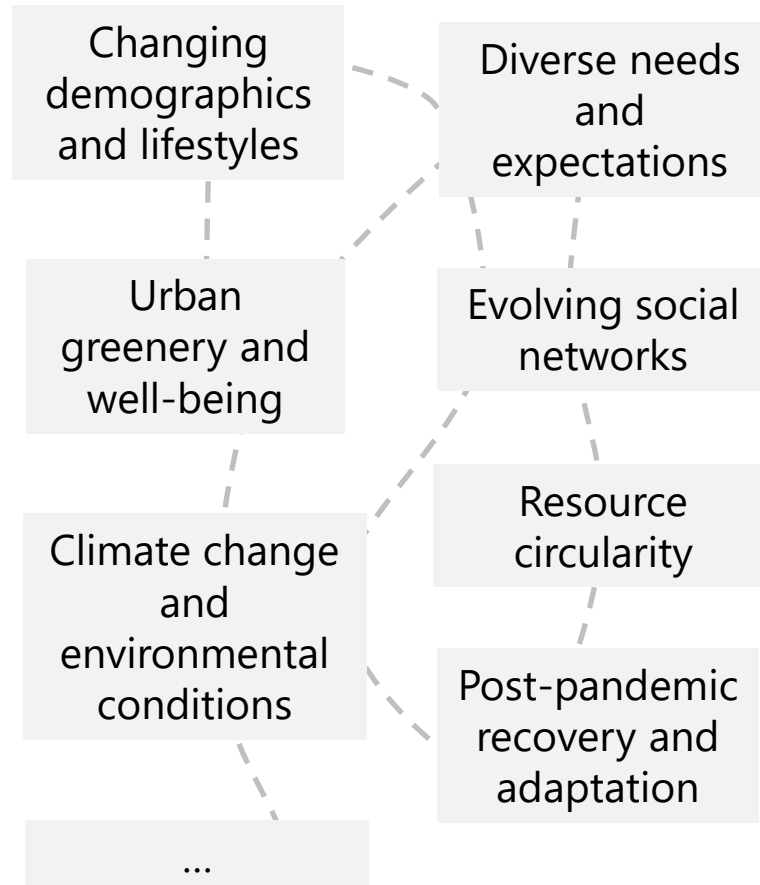


City



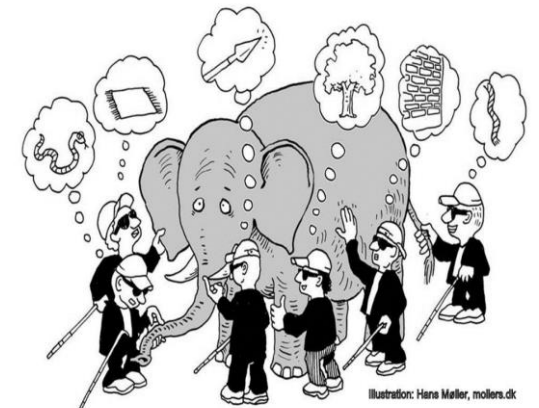
Urban Systems

## Interconnection of heterogeneous needs and challenges



## Whole is more than the sum of its parts

Approach urban challenges in a **system of systems approach**







# Leveraging the Science of Cities for Better Urban Planning

## Support Long-Term Land-Use Planning: URA Digital Planning Tools



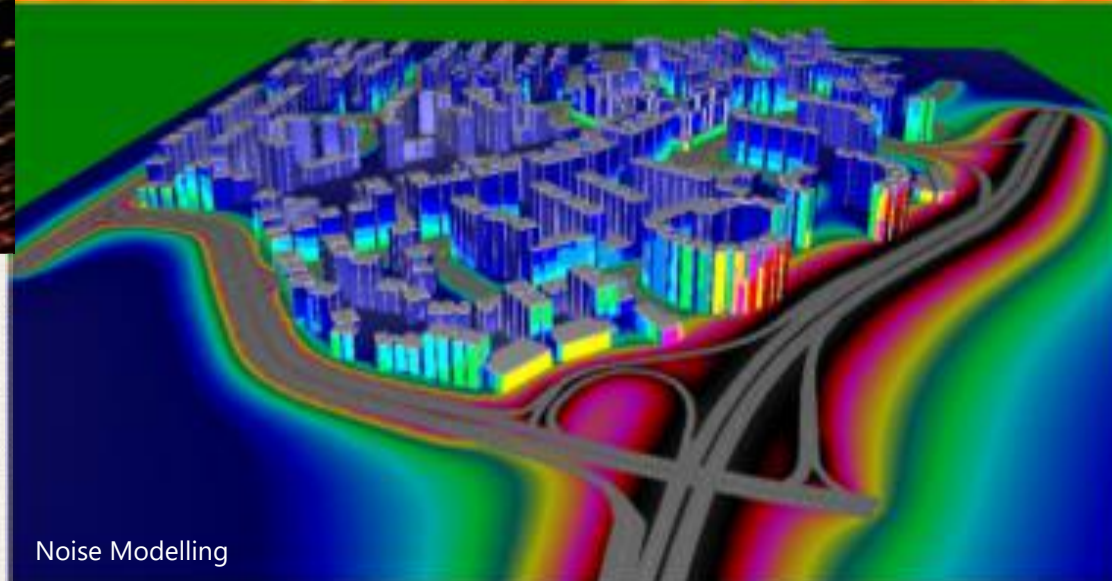
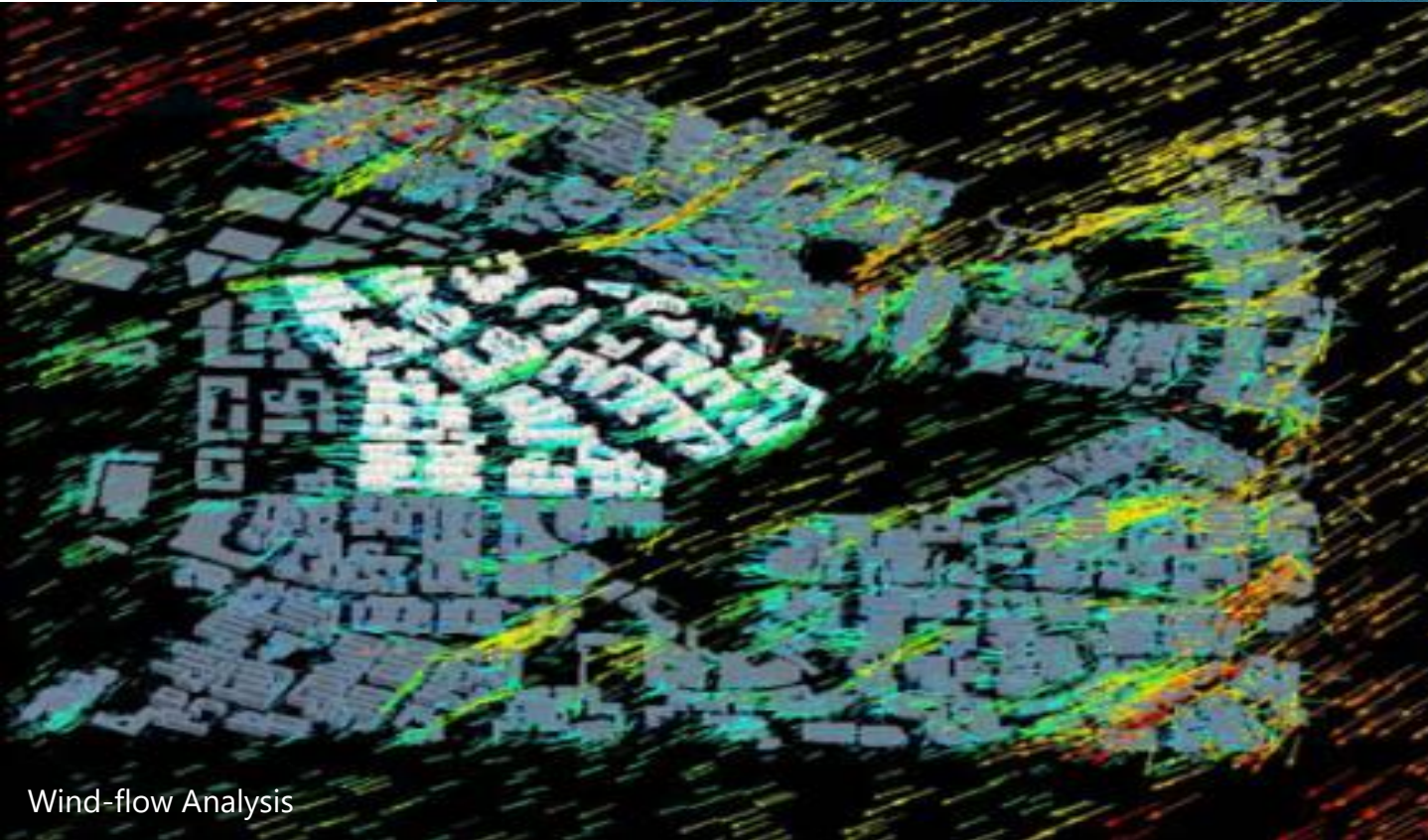
Image source: URA

E.g. ePlanner and 3D Urban Planner Platform – integrative platform that lend insights on holistic design for urban development



# Leveraging the Science of Cities for Better Urban Planning

## Enhancing Liveability: Integrated Environmental Modelling (IEM)



Modelling platform that integrates urban planning and design process with environmental simulation for the town level



# Leveraging the Science of Cities for Better Urban Planning

## Enhancing Liveability: Integrated Environmental Modelling (IEM) at Tengah New Town



**Legend**

- New initiatives for Tengah
- Initiatives tested in Punggol

Smart Integrated Construction System

Smart Irrigation

Smart Rainwater Sump Pump

Pulse of the Heartlands

Smart Lighting

Urban Farming

Smart Water Sub-Meter

EV Ready Car Parks

Centralised Cooling System

Solar PV

Smart Energy Town

Smart Enabled Homes

New Urban Kampung

Rainwater Harvesting

Smart Hub

Smart PWCS

Car-Lite Planning

LED Lighting

Elevator Regen System

Smart Water Pump

Estate Management System

District Landscape Masterplan with Biophilic Features

Integrated Digital Delivery

Chutes for Recyclables

New Lift Sensors

Smart Socket & DB

Urban Water Harvesting

Digital Twin

Urban Environmental Modelling

Water Efficient Fittings

Carpark MV Monitoring

Dual Bicycle Racks

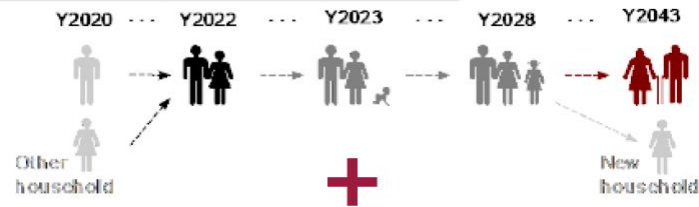
Hybrid PPVC



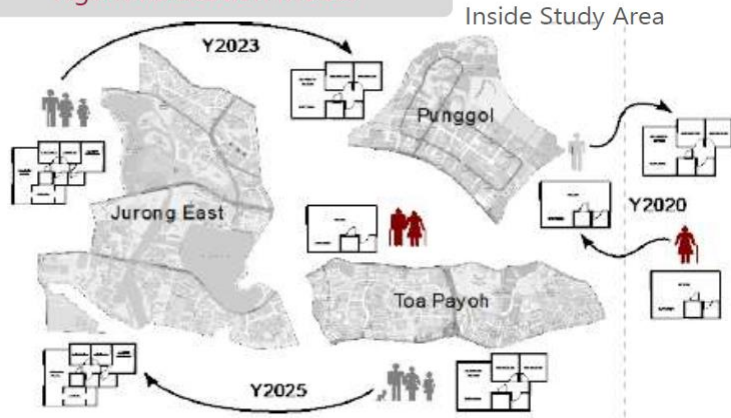
# Leveraging the Science of Cities for Better Urban Planning

## Enhancing Liveability: New Urban Kampung Programme

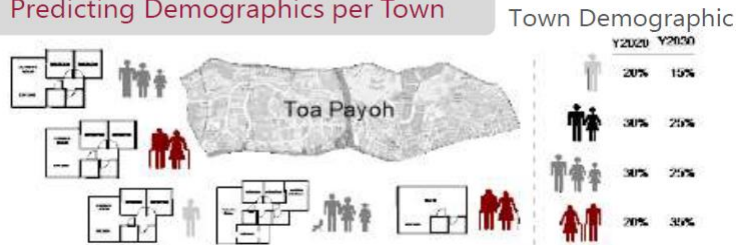
### Agent Demography Change Model



### Agent Relocation Model

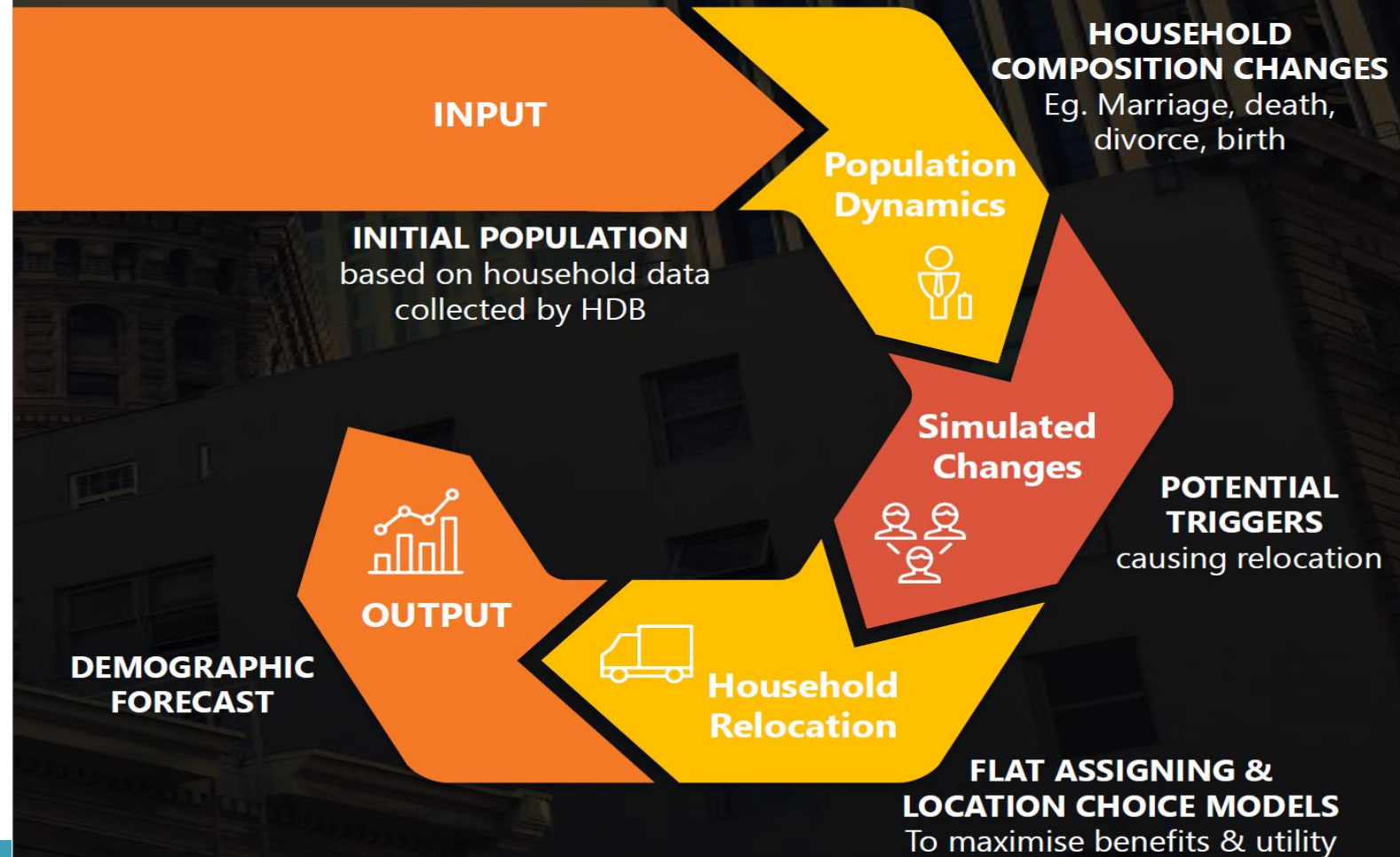


### Predicting Demographics per Town



# VIRTUAL POPULATION FORECAST

Simulating Population Changes, Establishing Life Cycle of Towns



### COMPLEX SYSTEMS MODELLING

Enhancing CAVI Capabilities with Social Dimension

#### ENVIRONMENTAL ANALYSIS

- Noise:**  
Level of noise from traffic
- Ecosystem Services:**  
Services to community from environment
- Urban Heat Island:**  
Temperature and External Comfort

#### ACCESSIBILITY ANALYSIS

- Transport Network:**  
Infrastructure to access amenities
- Walkability:**  
Movement of individuals in precinct

#### POPULATION FORECAST

- Virtual Population:**  
Demographic changes & relocation

#### QUALITY OF LIFE/PLACE INDICATORS



Segment A: Dynamic Young Family

Segment B: Empty Nesters

Segment C: Tech Savvies

Segment D: New Age Single

Virtual population forecast

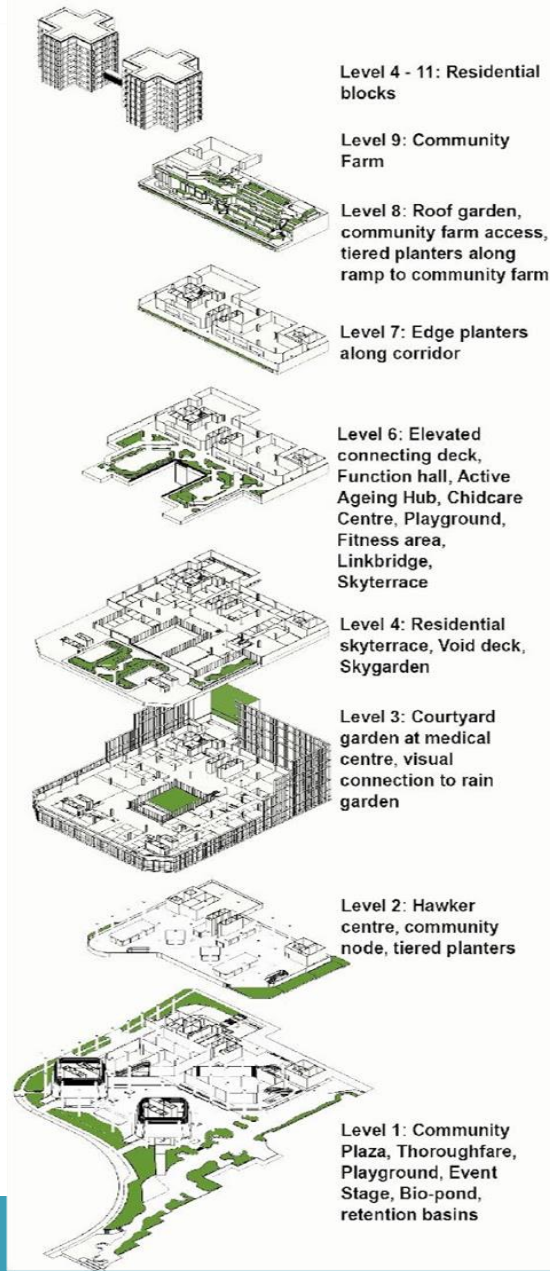
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# Leveraging the Science of Cities for Better Urban Planning

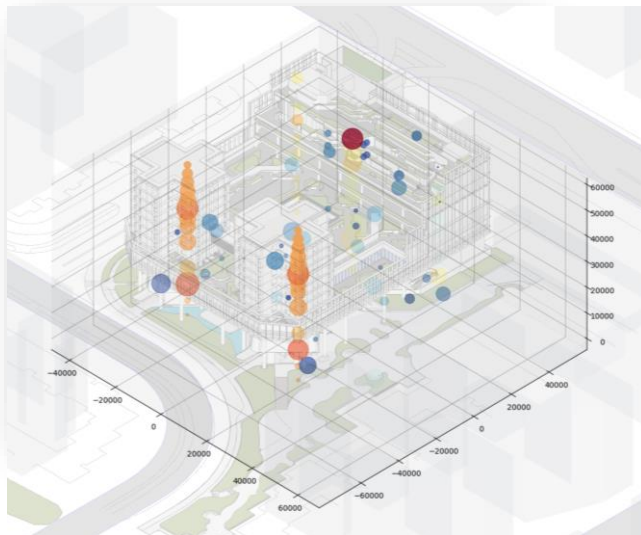
## Enhancing Liveability: Planning for Dense and Green Vertical Cities





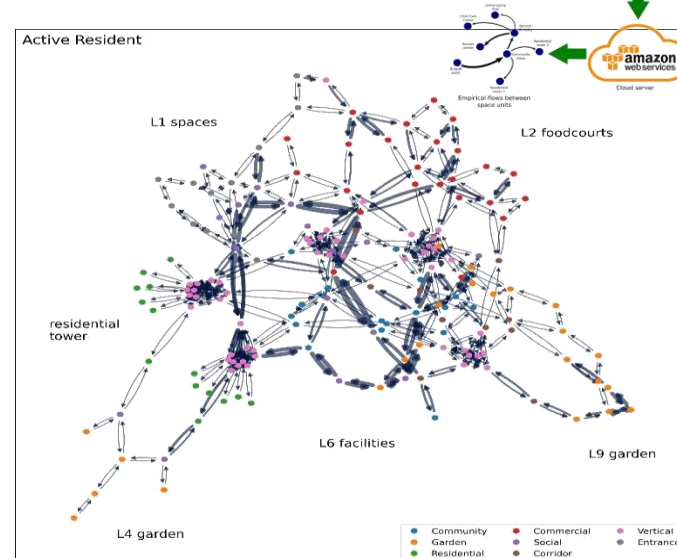
### SPATIAL NETWORK ANALYSIS

- To examine the network structure and centrality measures of Kampung Admiralty
- Identify expected and unexpected performance of landscape nodes



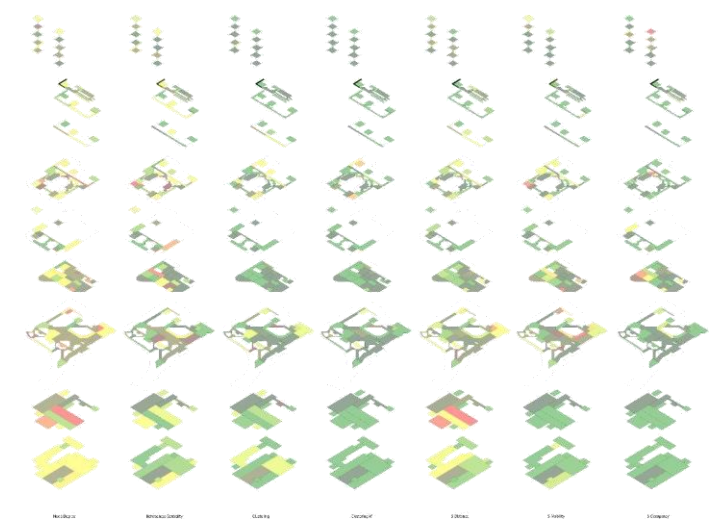
### HUMAN MOBILITY MAPPING

- To understand emergent movement patterns and space use in spatial network
- People counters, Bluetooth tracking and local



### SOCIO-SPATIAL ANALYSIS

- To analyse correlations between mobility patterns, occupancy time, user types
- Analyse nodes/spaces with potential to encourage social interaction





## Leveraging the Science of Cities for Better Urban Planning

**Towards a City in Nature: A science-based approach to integrate nature and greenery**

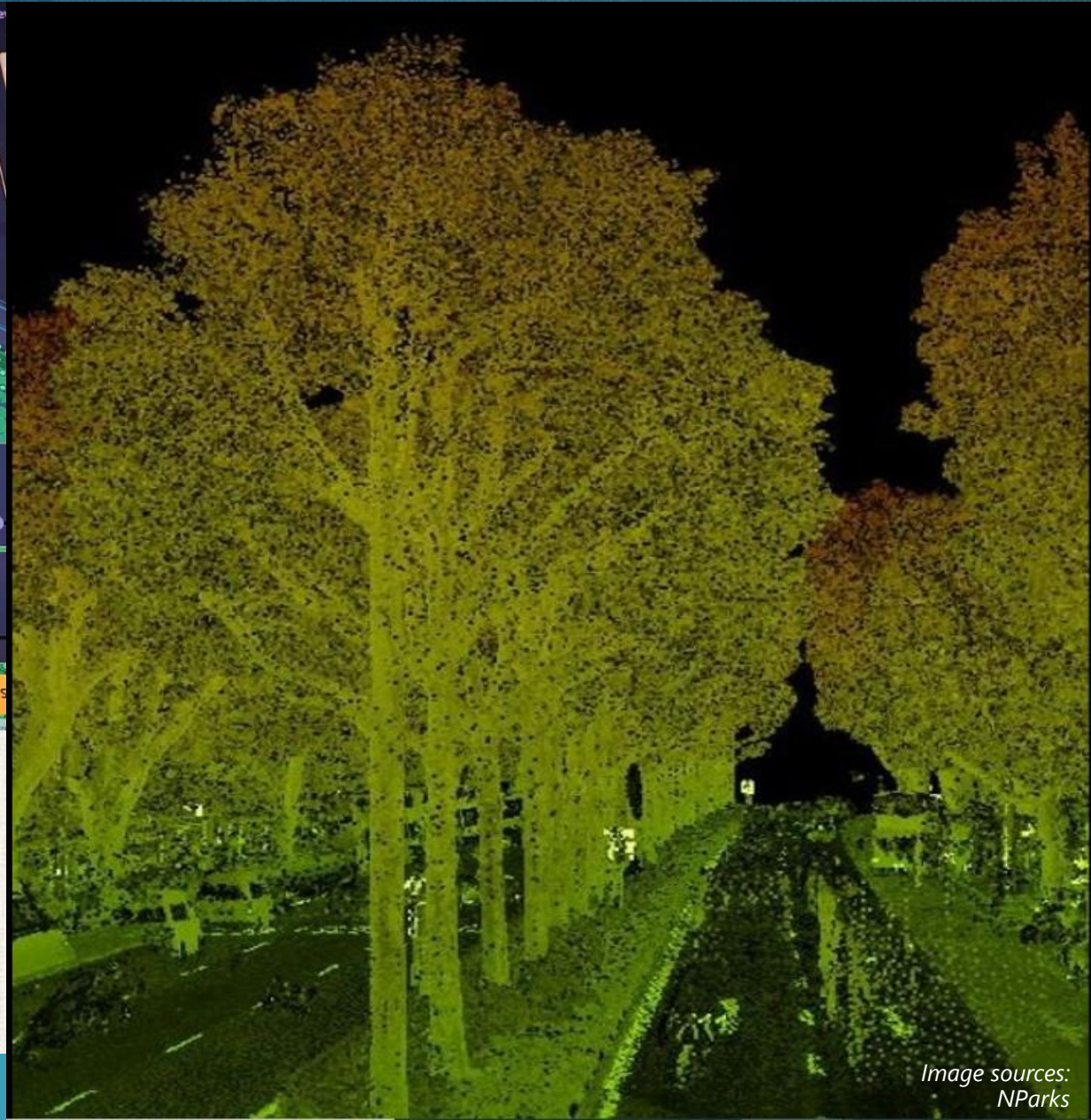




## Leveraging the Science of Cities for Better Urban Planning Towards a City in Nature: NParks' Remote Tree Measurement System (RTMS)

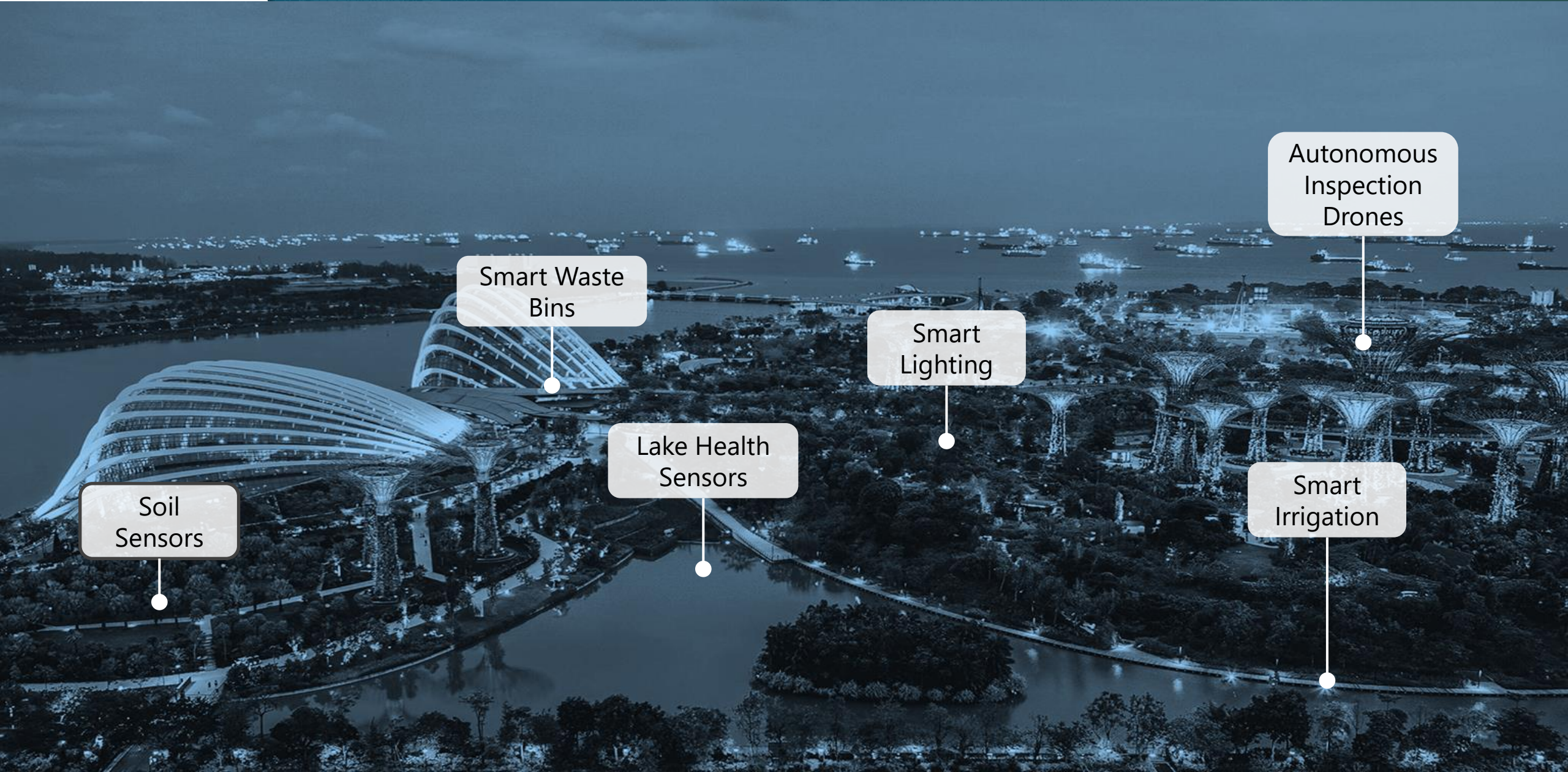


Uses LiDAR scans and machine learning to automatically map the locations of individual trees and extract tree measurement





# Leveraging the Science of Cities for Better Urban Planning Towards a City in Nature: **Smart Gardens@Gardens by the Bay**



Soil  
Sensors

Smart Waste  
Bins

Lake Health  
Sensors

Smart  
Lighting

Smart  
Irrigation

Autonomous  
Inspection  
Drones



## From 1948 - 2016

Annual mean temperature  
rose at an average rate of

**0.25°C**

per decade

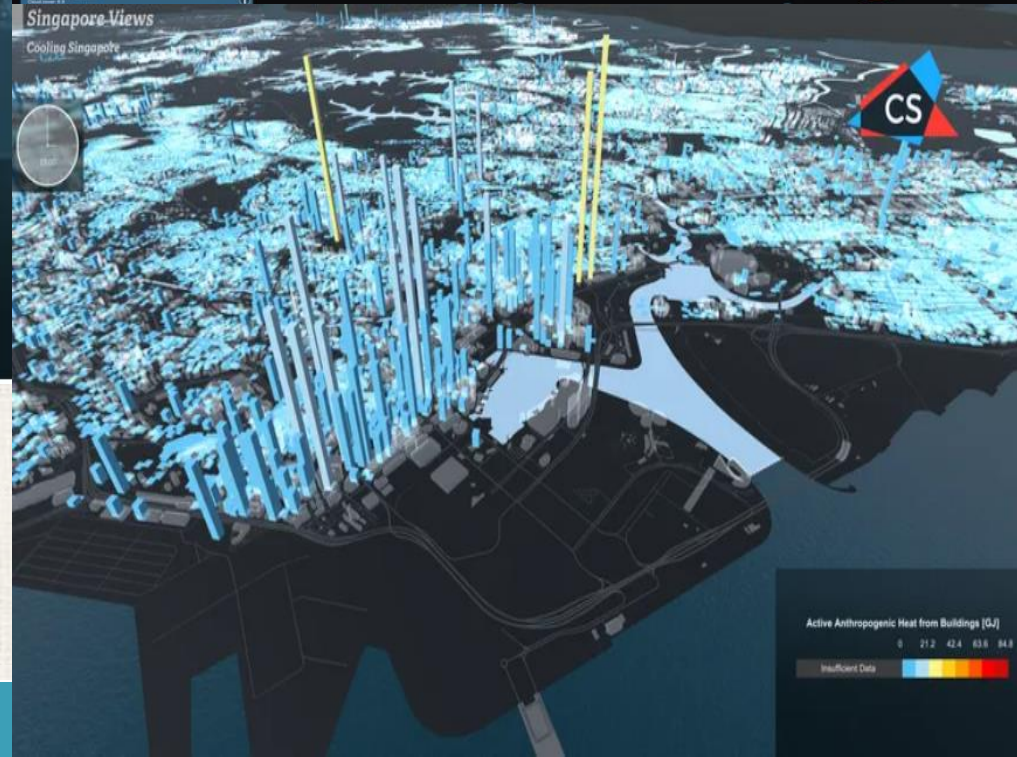
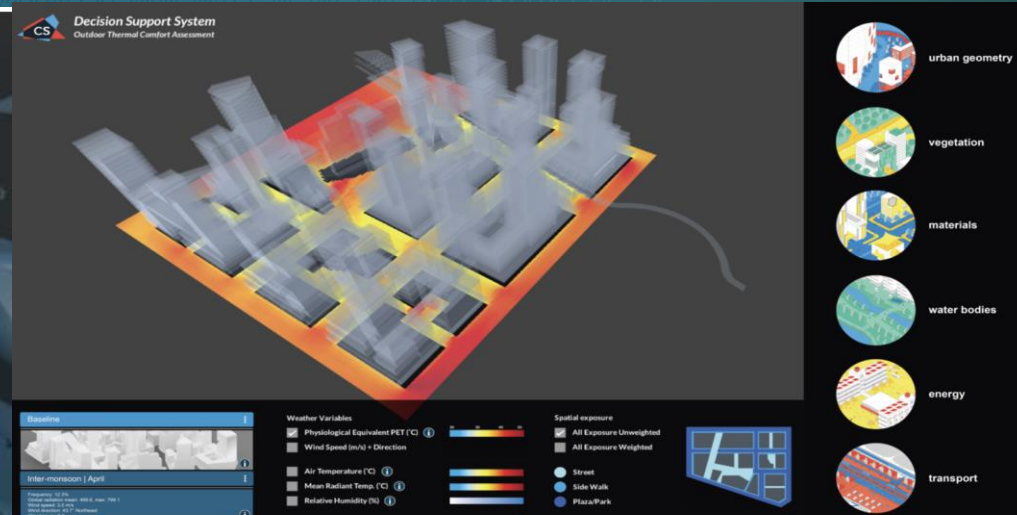
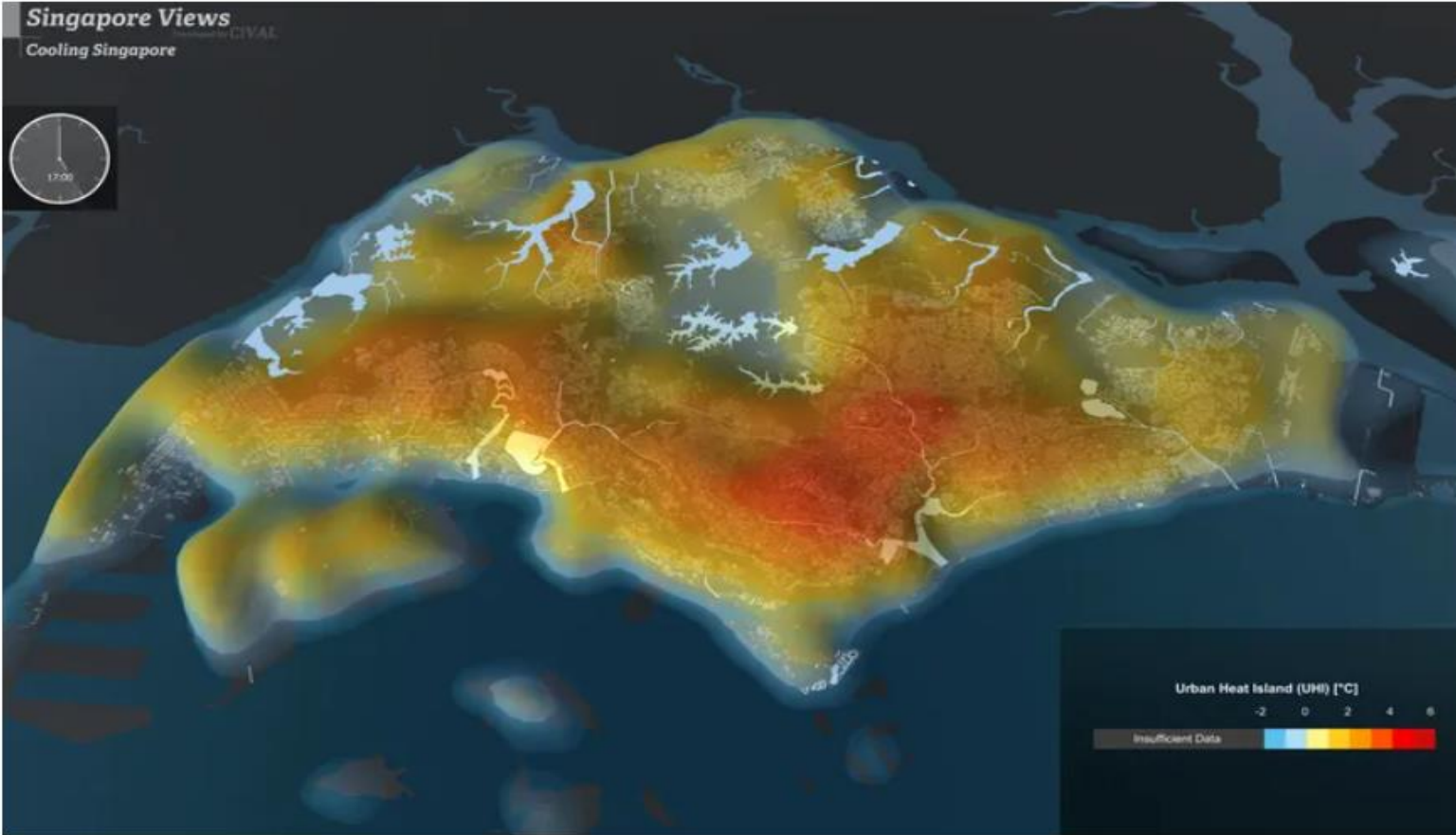
## By 2100

Daily mean temperature projected to increase  
by

**1.4°C – 4.6°C**



# Leveraging the Science of Cities for Better Urban Planning Towards Climate-Sensitive Design: Cooling Singapore



Further scientific knowledge required for climate-sensitive design of the urban environment, to address urban heat challenge in Singapore



# THANK YOU

## Let's keep in touch!

Join our mailing list and follow us on social media!



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