

A Digital Urban Climate Twin of Singapore to Analyse Green Plan 2030 Scenarios

Dr Heiko Aydt
Head, SEC Digital Twin Lab
Digital Urban Climate Twin R&D Lead, Cooling Singapore

CREATE

(SEC) SINGAPORE-ETH
CENTRE

CAMBRIDGE
CARES

NUS
National University
of Singapore

SMU
SINGAPORE MANAGEMENT
UNIVERSITY

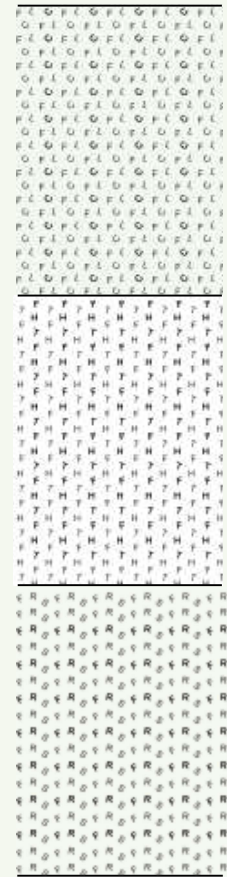
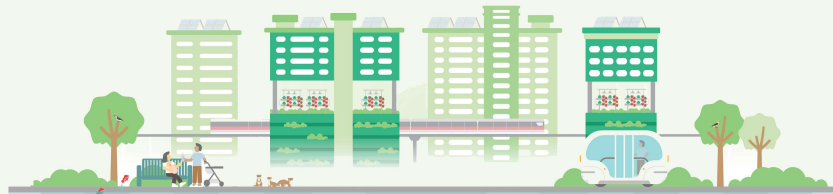
SMART

TUMCREATE

URBAN SOLUTIONS
AND SUSTAINABILITY
R&D CONGRESS 2023

BUILDING SUSTAINABLE, RESILIENT, AND LIVEABLE CITIES OF TOMORROW

4TH - 5TH OCTOBER 2023



COOLING
SINGAPORE

What Is The Singapore Green Plan 2030?

Whole-of-nation movement to advance Singapore's national agenda on sustainable development.

A multi-agency effort spearheaded by five ministries:

- Ministry of Education
- Ministry of National Development
- Ministry of Sustainability and the Environment
- Ministry of Trade and Industry
- Ministry of Transport

What Does The Green Plan Seek To Achieve?

(1) Strengthen Singapore's commitments under the UN's 2030 Sustainable Development Agenda and Paris Agreement.

(2) Positioning us to achieve our long-term net zero emissions aspiration by 2050.

What Are The Green Plan's Key Targets?

Ambitious and concrete targets to advance Singapore's national agenda on sustainable development. For example, this includes:

- Plant 1 million more trees
- Quadruple solar energy deployment by 2025
- Reduce the waste sent to landfill by 30% by 2030
- At least 20% of schools to be carbon neutral by 2030
- All newly registered cars to be cleaner-energy models from 2030



How Can We Help Planners To Better Understand The Impact Of New Policies And Plans – Such As The Green Plan – On The Urban Climate?

By using a digital twin of the city that allows us to simulate what-if scenarios...

What Is A Digital Urban Climate Twin?

A Digital Urban Climate Twin (DUCT) is a **digital representation of the city that integrates computational models of all relevant urban elements** (e.g., land-use and vegetation, buildings, industry, transport) as well as urban climate.

It can be **used to simulate what-if scenarios** and obtains insights to questions such as:

“What would happen if we plant more trees?”

“What would happen if we switch to electric vehicles?”



How Will Planners Be Able To Use The Digital Urban Climate Twin?

Computational models are difficult to use and require scientific modelling expertise and specialised technical skill. Planners usually do not have this background.

We have developed the **DUCT Explorer**, a browser-based application, to enable planners to leverage the capabilities of the Digital Urban Climate Twin (DUCT) for what-if scenario exploration.

The DUCT Explorer **automates all technical aspects of running what-if simulations** and **provides graphical user interfaces that are tailored to specific use-cases.**

Import Data: incorporate new plans into your what-if scenarios.

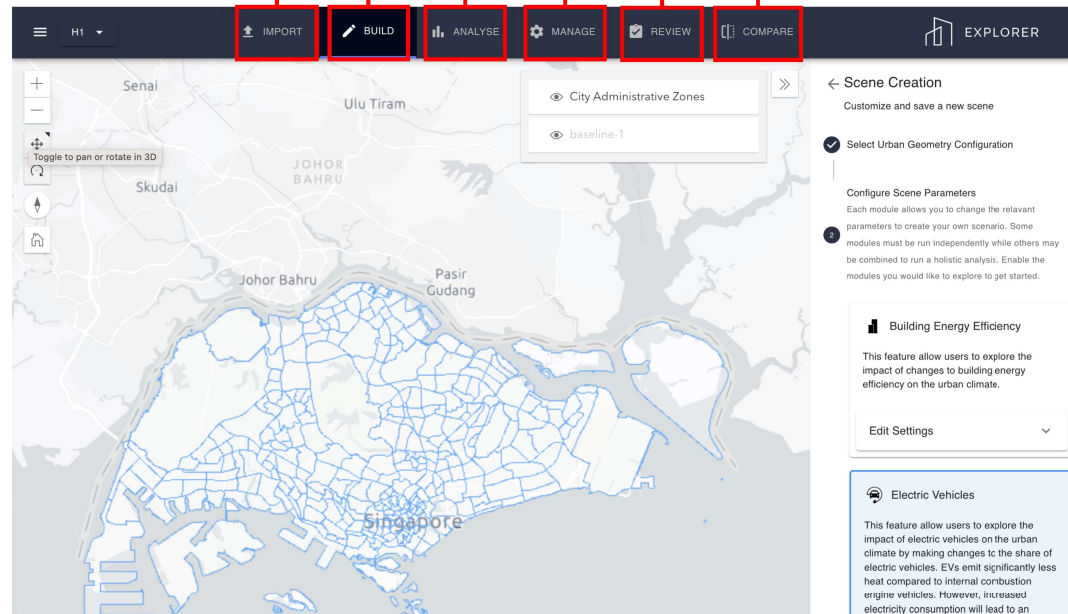
Build Scenes: select data and customise urban parameters.

Analyse Scenarios: adjust selected model settings and trigger simulations.

Manage Analyses: monitor the progress of all your analyses.

Review Results: have a look at the data and export for further use.

Compare Scenarios: look at two scenarios side-by-side or at the delta.





DUCT
EXPLORER

Enabling

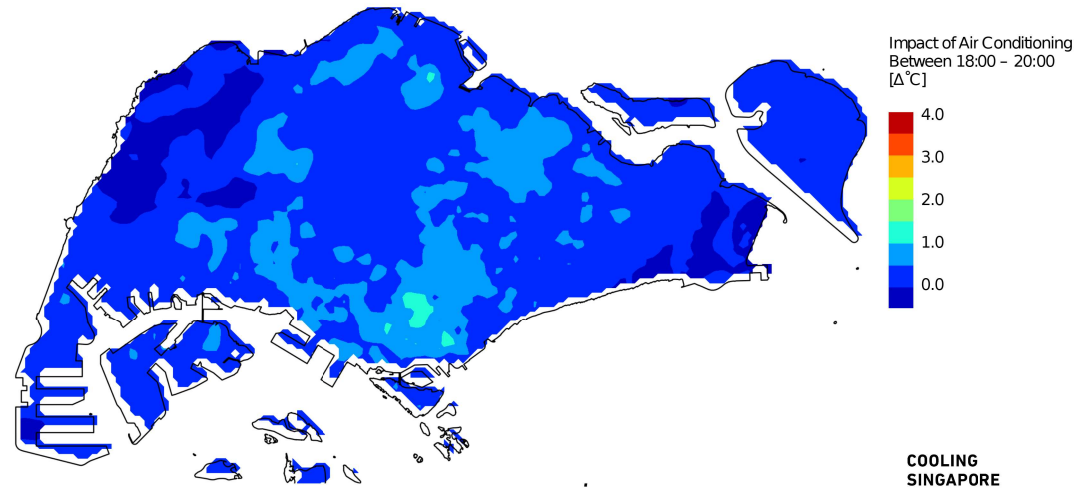
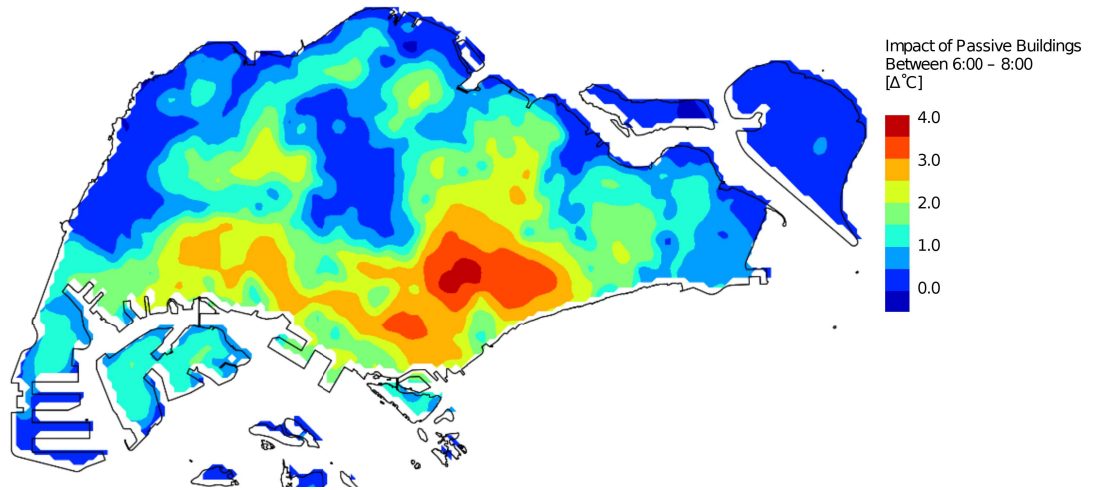
climate-informed

urban planning and decision making

What Are Some Of The Preliminary Findings?

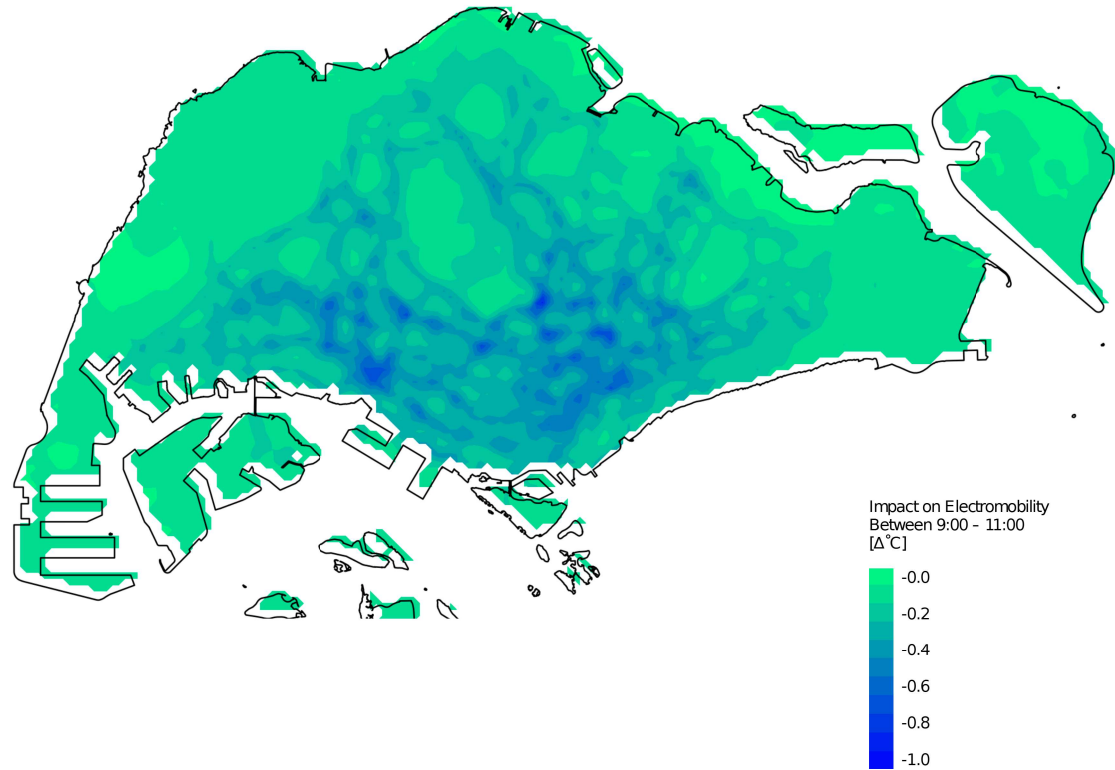
Buildings have a relatively large impact on the UHI:

- In the morning, buildings have passively (no occupants, no equipment) an impact of **up to +3.7°C**.
- In the evening, air conditioning has an impact of **up to +1.4°C**.



What Are Some Of The Preliminary Findings?

Switching to 100% electric vehicles can reduce the air temperature in the vicinity of roads by **as much as 0.9°C during peak hours**, with 24% of Singapore's land area projected to see a mean reduction of at least 0.1°C.



Making The Explorer Relevant For Planners

We are currently preparing guided sessions with users for 2023'Q4 and 2024'Q1.

The goal is to better understand how our technology can help users and to tailor the Explorer to their needs.

Adding Support For More Use-Cases

We are adding support for a variety of use-cases including (but not limited) to:

- City-scale and district-scale urban climate analysis (e.g., UHI, OTC, wind corridors)
- Buildings (e.g., energy efficiency standards, photovoltaics, district cooling)
- Energy policy (e.g., electric vehicles, renewables)

Increasing Robustness And Performance

We are working on improving the maturity of the entire DUCT technology stack.

Our target is to achieve Technology Readiness Level 6+ by August 2024.

Thank you!

<https://sec.ethz.ch/research/cs.html>
heiko.aydt@sec.ethz.ch

CREATE

(SEC) SINGAPORE-ETH
CENTRE

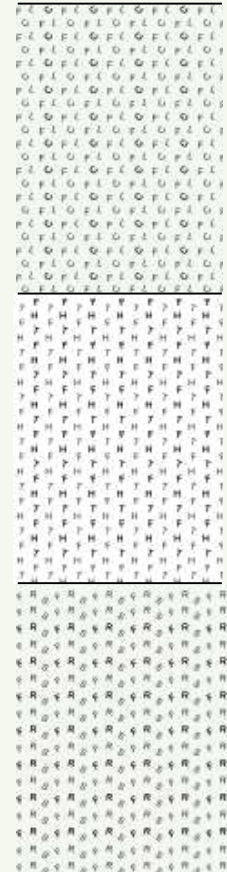
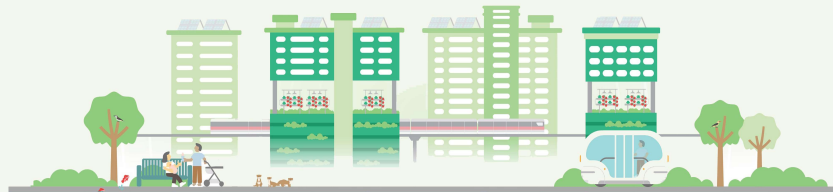


TUMCREATE

**URBAN SOLUTIONS
AND SUSTAINABILITY**
R&D CONGRESS 2023

BUILDING SUSTAINABLE, RESILIENT, AND LIVEABLE CITIES OF TOMORROW

4TH - 5TH OCTOBER 2023



COOLING
SINGAPORE