

# Cooling Singapore 2.0

## Singapore's Digital Urban Climate Twin: Analysis of measures from island to neighborhood scale

K Orehounig, J Acero, AS Adelia, H Aydt, J Ivanchev, I Nevat, M Wong, A Zozaya



(SEC) SINGAPORE-ETH  
CENTRE

DIGITAL TWIN, URBAN CLIMATE, THERMAL COMFORT



## THE URBAN HEAT CHALLENGE

“The city is warmer than its surrounding – by up to 7°C – due to the Urban Heat Island (UHI) effect.”

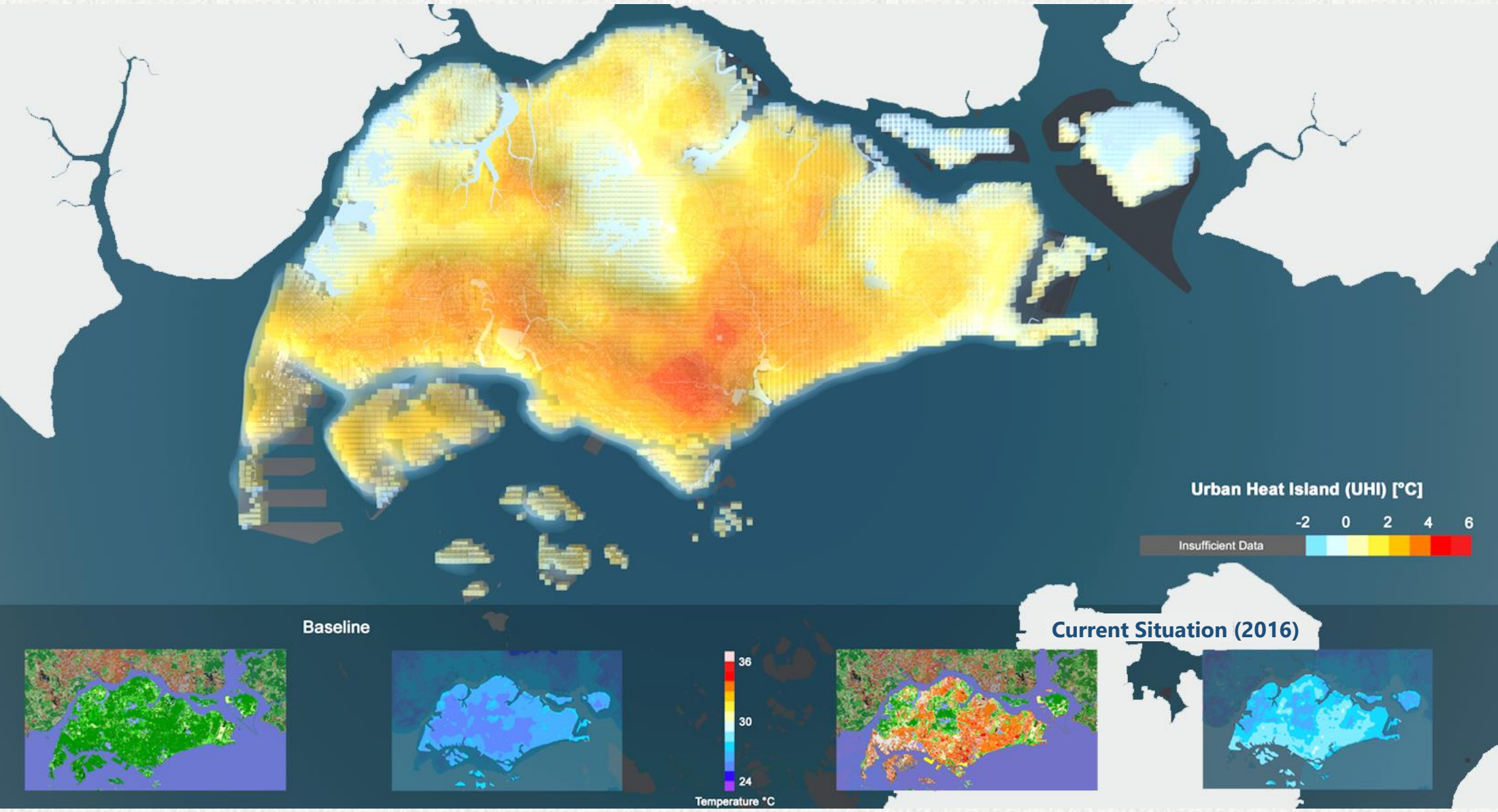


Figure 1: UHI representation from CS1.5 Final presentation 2021.

The Digital Urban Climate Twin (DUCT) is developed to allow Singapore to conduct comprehensive meso-scale and micro-scale urban climate simulations, facilitating the assessment of various what-if scenarios.

## SG 2030 GREEN PLAN

### SG GREEN PLAN

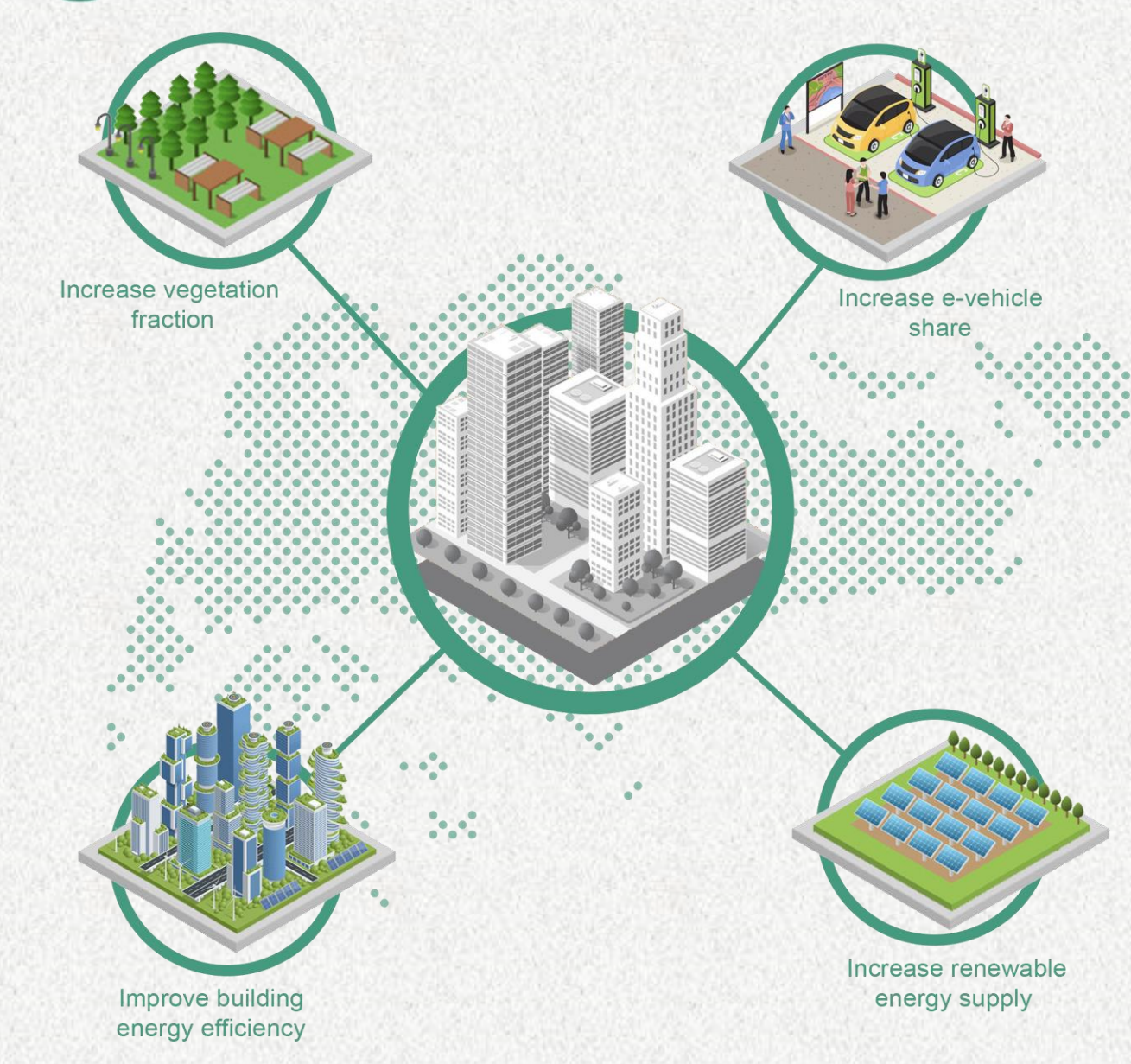


Figure 3: Singapore 2030 Green Plan scenario.

To demonstrate the capability of the DUCT, we simulate a potential 2030 scenario in Singapore. This scenario implements several measures from the Singapore 2030 Green Plan:

- Modified land use with new parks incorporated and increased urban vegetation fraction
- Improved building energy efficiencies
- 18% of electric vehicle share
- Increase import of energy supply (30%) and increase renewable energy supply (3%).

## MULTISCALE ANALYSIS TOOL

The DUCT is accessible through the ‘DUCT Explorer’, a user-friendly browser interface. This allows systematic analysis of the UHI effect and Energy Efficiency under different future what-if scenarios, such as :

- Changes to traffic demand and electromobility
- Improvements in building properties, building geometries, energy efficiency and district cooling.
- Land use and vegetation change, such as placement of parks.

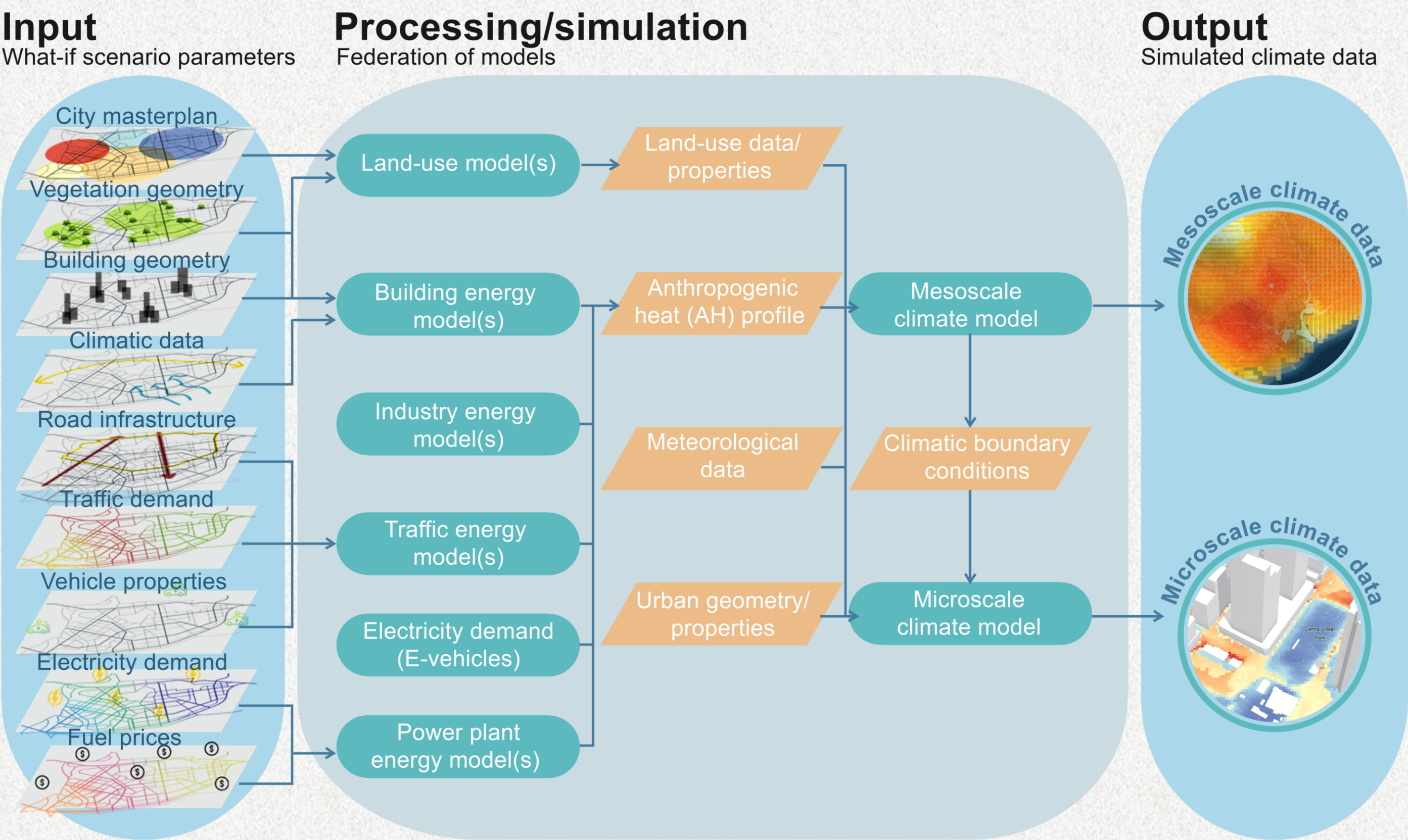


Figure 2: Digital Urban Climate Twin (DUCT) infrastructure.

## FINDINGS

- Results show a potential whole-island cooling effect of up to 0.13°C, particularly during the peak morning hours from 0600 to 0800 hrs.
- However, the effectiveness of different strategies vary by district. The sensitivity of each district to various strategies must be carefully assessed to inform targeted policy decisions at the district level.

Change in 24hr average 2m temperature  
Green Plan 2030 - Baseline

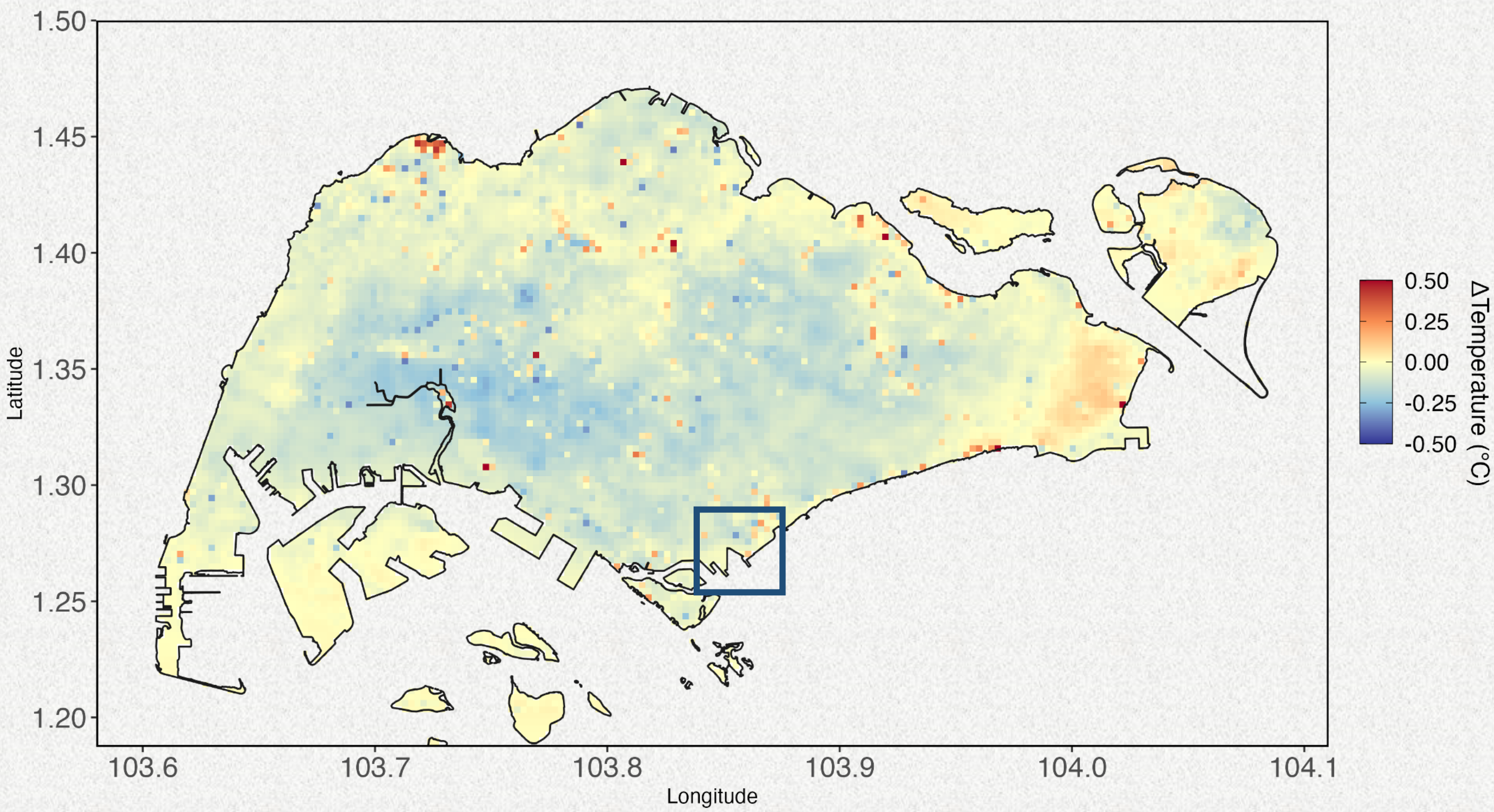


Figure 4: Change in the average 2m Temperature using an approximate Green Plan 2030 scenario on a heat-wave day.

## CONCLUSION

The DUCT enables project stakeholders, urban planners and urban designers to:

- Evaluate what-if scenarios in a holistic manner.
- Visualize the implications of potential future developments and policies.

### Future application:

The flexible setup of the DUCT allows for additional model onboarding and extension to other domains and could be adapted for other cities or climatic regions such as Zurich, Vienna or Jakarta, Indonesia.

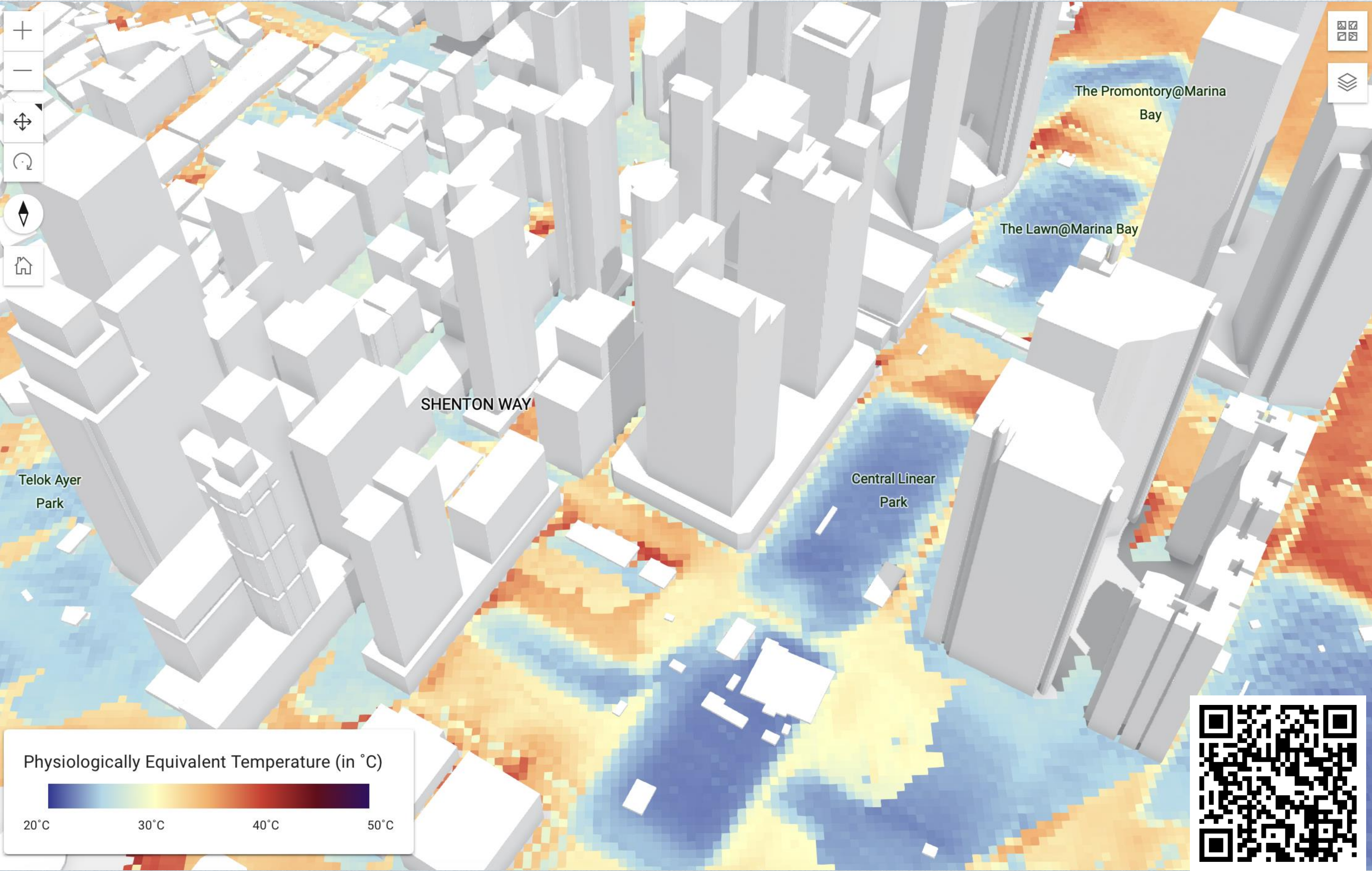


Figure 5: (left) DUCT explorer interface. (right) Microscale analysis on DUCT.

### Contact

Ander Zozaya, Singapore-ETH Centre,  
Cooling Singapore project, [ander.zozaya@sec.ethz.ch](mailto:ander.zozaya@sec.ethz.ch)

### Acknowledgements



Ministry of Sustainability  
and the Environment



URBAN  
REDEVELOPMENT  
AUTHORITY

### Funded by

NRF CREATE  
CREATE