ANNEX

‘SHAPING A HEAT RESILIENT CITY’ EXHIBITION HIGHLIGHTS

1. Climate change leads to rising temperatures globally and in Singapore

According to the Intergovernmental Panel on Climate Change, human activities have warmed the Earth’s climate by more than 1°C since the late 19th Century.

Similarly, evidence of this warming trend can be seen in the long-term climate station records kept by the Meteorological Service Singapore (MSS) since 1929. These rising temperatures are largely a result of:

Climate change

Singapore's air temperatures are set to increase from between 1.4 to 4.6°C by 2100, based on the Second National Climate Change Study conducted by the Centre for Climate Research Singapore, MSS.

Urban heat island (UHI) effect

The UHI effect is a phenomenon where urban areas, which are more built-up and densely populated, tend to be warmer than rural areas. As a city-state with limited land, our densely developed infrastructure results in increasing temperatures being exacerbated by the UHI effect.

Some factors that contribute to the UHI effect:

- Waste heat emissions from vehicles, appliances and industrial equipment;
- Building materials that retain heat;
- Aerosols that form an urban pollution dome above cities, trapping heat.

Climate patterns

Singapore’s climate is characterised by two monsoon seasons separated by inter-monsoon periods. During the inter-monsoon period of April to May, temperatures in Singapore are typically at their highest due to strong sunlight resulting in radiative heat, in addition to light wind conditions.

Climate drivers such as the El Niño-Southern Oscillation also affect temperatures in Singapore.

2. Improving outdoor thermal comfort

To reduce the impact of heat stress and enhance outdoor thermal comfort, Singapore has implemented various cooling strategies over the years, from intensifying urban greenery to reducing waste heat from vehicles and appliances.

Beyond these initiatives, government agencies are also working to develop innovative solutions driven by data, analytics and research.

Providing shade to reduce heat gain

Through the use of 3D building datasets to conduct shade analysis, urban planners can propose appropriate interventions, such as shelters or increased vegetation cover, to improve shade provision for key pedestrian routes and public spaces.

Enhancing wind flow

Conducting wind flow simulations to study how wind corridors can be best placed and aligned to optimise wind and air flow enables planners and architects to design precincts that are naturally cooler.

Improving our models through research

Cross-sector collaborations with research institutions to testbed advanced techniques to measure and collect environmental data allow agencies to improve existing modelling methodologies and obtain more accurate results through the use of higher quality data. For example, as part of a five-year strategic collaboration, URA and the Department of Architecture under NUS CDE are exploring the use of Doppler Wind LiDAR technology to retrieve more robust wind data in Jurong Lake District and the Central Business District.

Such efforts will serve to guide practitioners in the use of environmental models in planning and designing new developments and districts.

Simulating interactions of wind, sunlight and other microclimatic conditions

While urban planners can carry out wind flow and sun shading analysis separately, developing smart tools and technologies that integrate the interactions of various microclimatic conditions will enable better designs to be developed. Such tools are poised to support the designing of housing and infrastructure with maximum thermal comfort for occupants.

Assessing optimum urban forms for thermal comfort

Computational models use algorithms that aim to help planners consider a variety of design parameters, and conduct scenario testing to evaluate and sieve out the best urban configurations based on various factors, such as the UHI effect. Tapping on these technologies allows for the retrieving of data-informed results to shape cities that are more thermally comfortable.

Validation of environmental modelling simulations

To ensure the accuracy of environmental modelling results, simulations must be taken out of the labs and validated with real-world measurements through sensor deployment and on-site studies with property owners.

3. Achieving optimum indoor thermal comfort

Urban solutions are also being developed to ensure that our indoor spaces are thermally comfortable.

Reducing heat gain within buildings

- Passive building design

  Sustainable design strategies such as self-shading building forms and natural ventilated corridors can reduce solar heat gain and improve air flow within buildings.

- Utilising cool materials

  Researchers and industry stakeholders are also championing R&D to develop and advance the efficacy of innovative products such as cool paints, cool films,

and tiles that employ biomimicry to provide a cooling effect in rooms. When scaled-up and implemented, these products have the potential to improve indoor thermal comfort and reduce reliance on air-conditioning.

Sustainable indoor cooling systems

To achieve thermal comfort for building users in Singapore, indoor cooling systems are often used to complement passive building designs and cool materials.

To reduce warm temperatures indoors in a more efficient manner, several cooling systems that use less energy to cool spaces have been developed. Some examples include:

- Distributed District Cooling Networks;
- Desiccant assisted dehumidification;
- Enhanced Passive Displacement Cooling System.

4. Planning for cooler spaces and environments

To create a heat resilient city, a wide suite of appropriate heat management strategies should also be implemented on a larger scale.

Incorporating cooling strategies in estates

Thermal comfort can be improved at a district level by incorporating various microclimatic strategies into the master plan for the estate, ranging from sustainable design strategies, such as increased greenery, to the use of cool materials and efficient cooling equipment.

Modelling combined heat management strategies at nationwide level

In future, policy makers will be able to assess the combined impact of multiple heat management strategies at an island-wide scale. The Cooling Singapore 2.0[1] research team is developing a Digital Urban Climate Twin, which seeks to integrate

[1] The interdisciplinary Cooling Singapore project, which is funded by the National Research Foundation, seeks to mitigate the UHI effect in Singapore by advancing the scientific knowledge required for climate-sensitive design of the urban environment.

computational models of all relevant urban elements such as buildings, traffic, and greenery as well as urban climate models, to accurately represent Singapore's urban climate for more robust analysis.

5. Creating a heat resilient Singapore together

Rising temperatures may result in increased risk of heat stress when the human body is not able to cool itself sufficiently. The excess heat that builds up may cause damage to the body.

General tips to build a more heat resilient community

The Ministry of Sustainability and the Environment (MSE) and the National Environmental Agency (NEA) launched a Heat Stress Advisory[2] to help the general population make more informed decisions on undertaking prolonged outdoor activities to minimise the risk of heat stress and heat-related illnesses. To protect ourselves and our loved ones from heat-related illnesses, individuals can check the myENV app to stay informed on the latest heat stress levels.

Collectively, individuals can also contribute to a cooler climate by making conscious and simple sustainable choices in our daily lives, such as:

- Using public transport and electric vehicles;
- Using the fan instead of the air-conditioner (to be set at no lower than 25°C if used);
- Using more energy-efficient appliances.

[2] More details on the Heat Stress Advisory can be accessed here.