

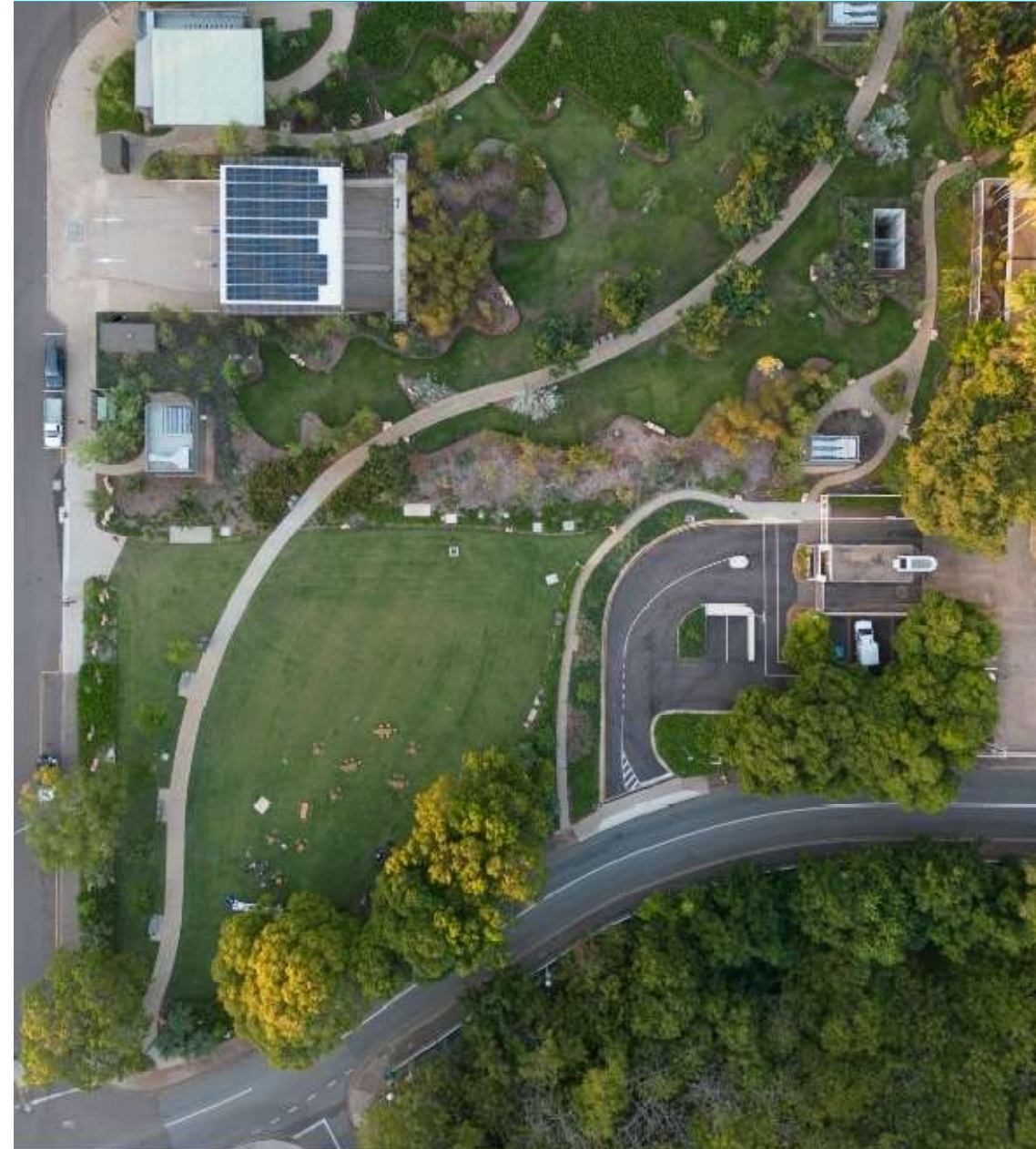


# Darwin Living Lab

Progressing a cooler and thriving city

Dr Tim Muster | 27 July 2023

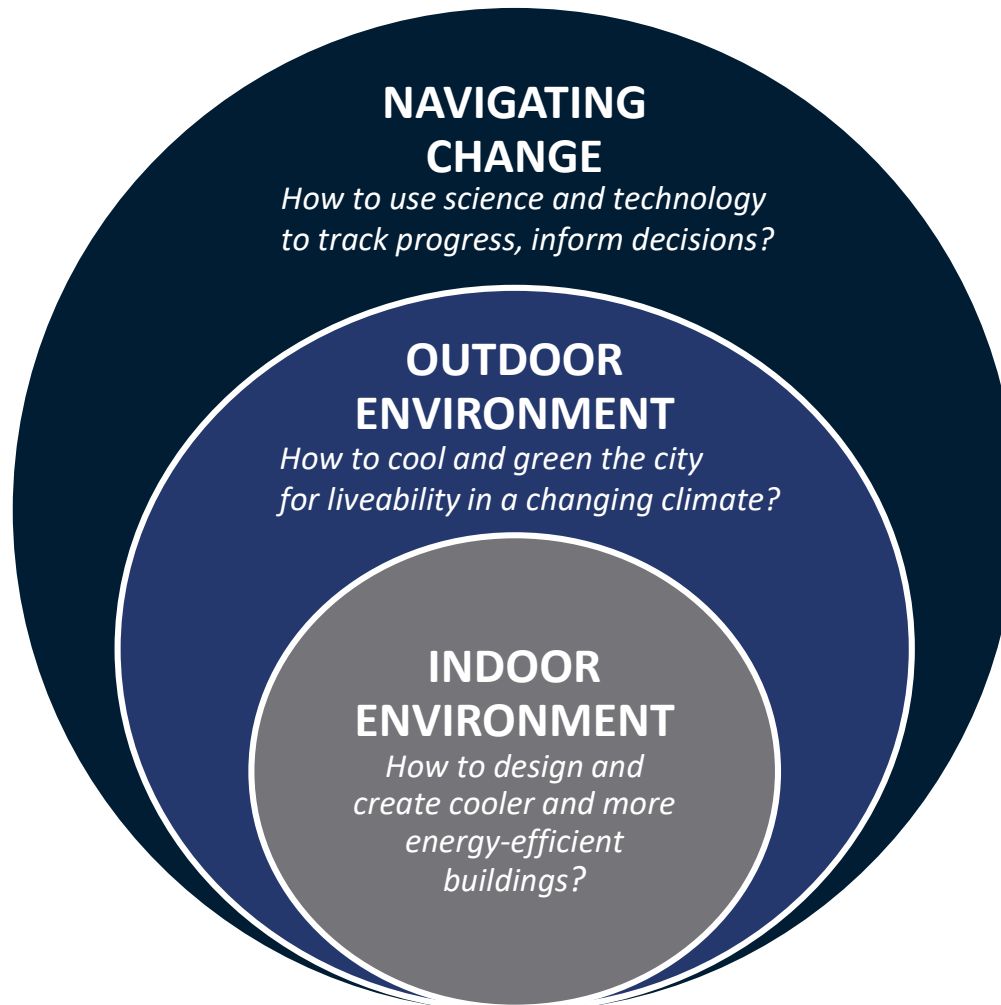
We acknowledge the Larrakia people as the Traditional Owners of the Darwin region and pay our respects to Larrakia elders past and present



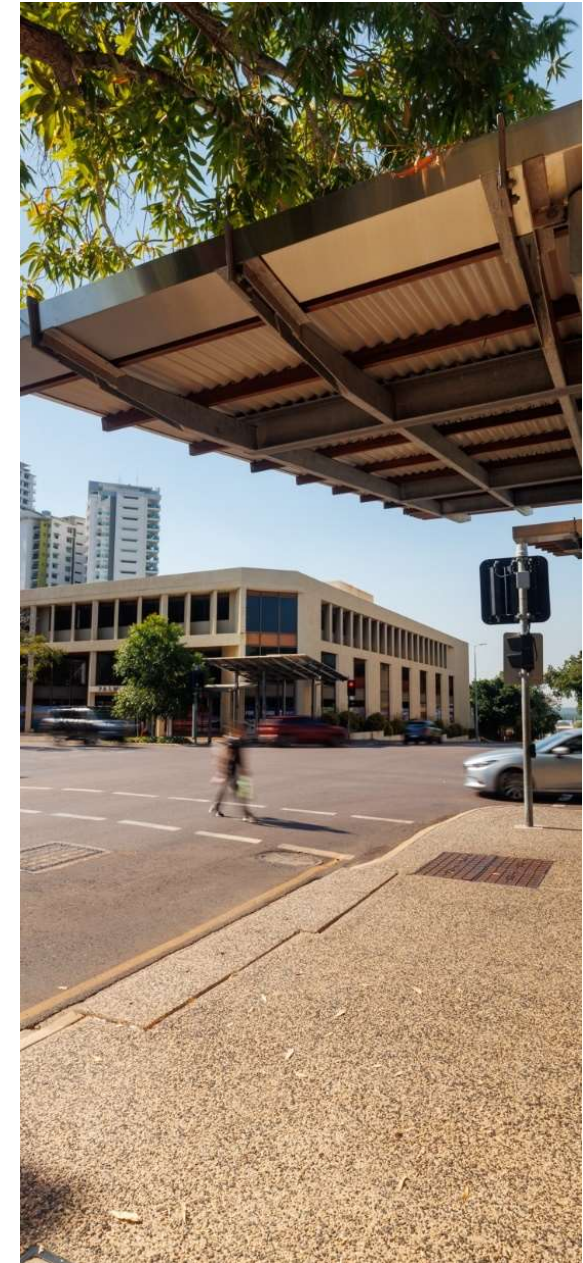




# Darwin Living Lab research areas

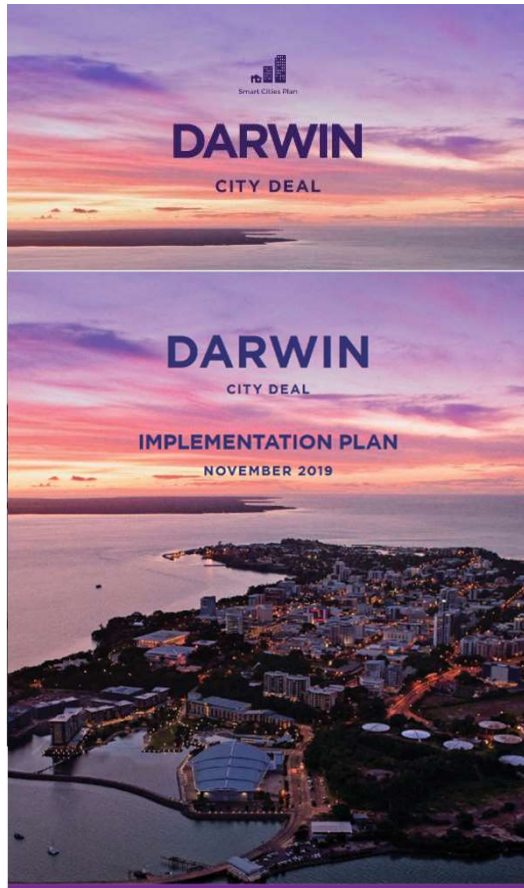


<https://research.csiro.au/darwinlivinglab/>





# Underpinning strategies and policies



## FEELING COOLER IN DARWIN

Darwin Heat Mitigation and Adaptation Strategy





# Important Stories for Darwin: ‘Tracking Darwin’

Preamble: Darwin is hot and is getting hotter – this creates many challenges, and there is need for change (in Darwin).

1. **Urban Heat Island** – there are a number of initiatives underway to reduce temperature and improve the liveability of Darwin – what works and what doesn’t?

2. **Healthy outdoor environments** are an important part of liveability – how do the people of Darwin interact with the outdoor environment and how does that outdoor environment return benefit?

3. **Water** is a key resource **for cooling**. How much is needed for a cool and liveable Darwin, and how much pressure does that put on a sustainable and resilient water supply for Darwin?

4. **Sustainability towards net-zero**. What is the situation, and how can Darwin, with all its challenges, adapt to a net-zero future?

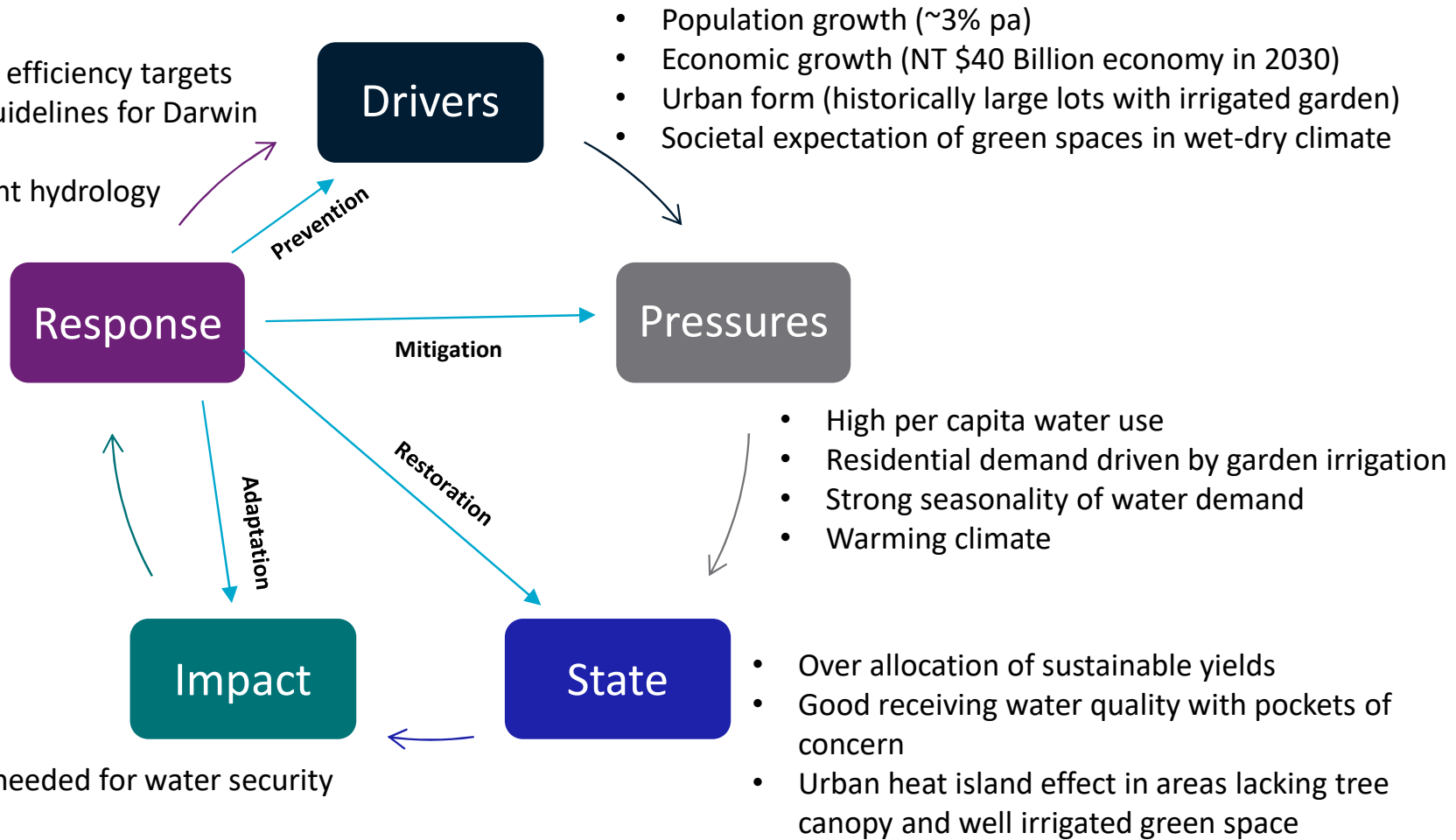
5. Creating **indoor liveability** – how can improvements in tropical design lead to more liveable and sustainable indoor environments?



# Research Framework (DPSIR)

## Water for Cooling example

- NT Water plan including water efficiency targets
- Updating WSUD targets and guidelines for Darwin
- Changing urban form
- Restoration of pre-development hydrology







# Mapping the System

## Drivers (social needs)

### Health Risks

Heat and humidity.  
Sedentary lifestyles due to hot outdoors.  
Poor drinking water quality.  
Biting insects (mosquitoes) and dangerous animals.  
Poor air quality.

### Liveability

Cost of living.  
Infrastructure services delivered affordably.

### Security

Darwin important for national security.  
Safety at night.  
Public transport safety.

### Culture

Maintaining the 'Darwin' lifestyle.  
Larrakia.  
Boating and shooting.  
Outdoor 'tropical' lifestyle.  
Expectations to be green all year.

### Economic Growth

A Bigger population.  
Urban land expansion.

## Pressures at play

- Population growth (material, energy and water requirements; waste generation)
- Defence aspirations and expansion
- Land use and urbanisation
- Increased compact development (reduced green space in lots) and competition for greenspace (pressure on biodiversity)
- Cultural expectation for large homes
- Warming temperatures (climate and urban heat)
- Increased water demand to cool and green
- High water demand in tropical climate (high per capita use)
- Wet-dry seasonal variations
- Climate: Seasonal change (dry season shrinking)
- Green spaces becoming more expensive to maintain compared to other land uses (i.e. concrete)
- Loss of canopy (shade) during cyclones
- Energy demand for AC to maintain thermal comfort
- Rising household energy costs (cost of living)
- Night-time use of outdoors limited (safety)
- Night-time lighting and energy (cost and emissions)
- Isolated (oil for transport, high infrastructure costs)



# Communication products

## Community

Short scroll through and interactive stories



### We speak for the trees:

Tree canopy cover data from 2011, 2016, and 2021 shows Darwin lost a third of its tree cover in just a few hours due to Cyclone Marcus.

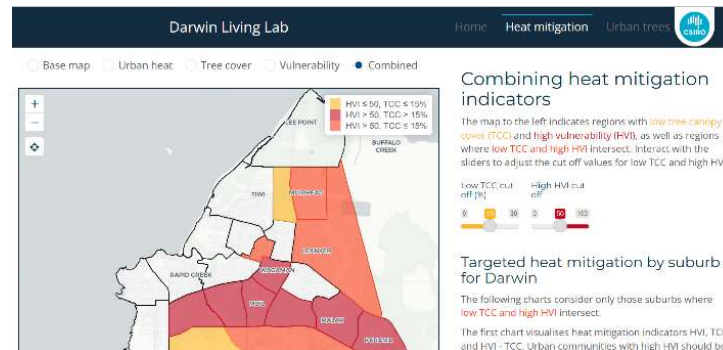
16 June 2023

storymaps.arcgis.com

## Practitioners/Learning

Resource material  
Cross-sector knowledge

- E-book with links to further resources
- [Research.csiro.au/darwinlivinglab](https://research.csiro.au/darwinlivinglab)
- Web-accessible digital twin layers



## Scientific/expert

DPSIR Framework  
Systems analysis

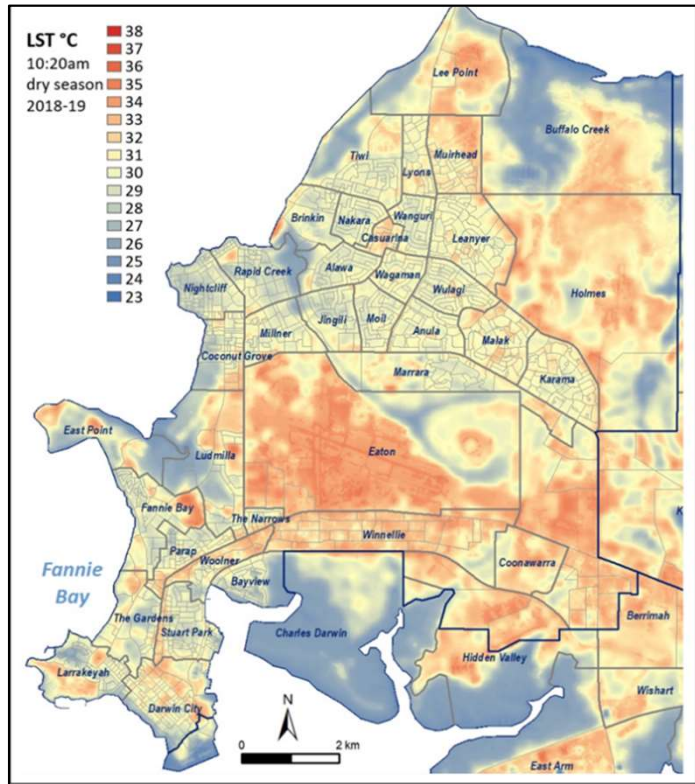
- Peer reviewed journals
- Detailed reports
- Public data release [CSIRO Data Access Portal](https://data.csiro.au)
- [//yourtropicalcity.com.au](https://yourtropicalcity.com.au)



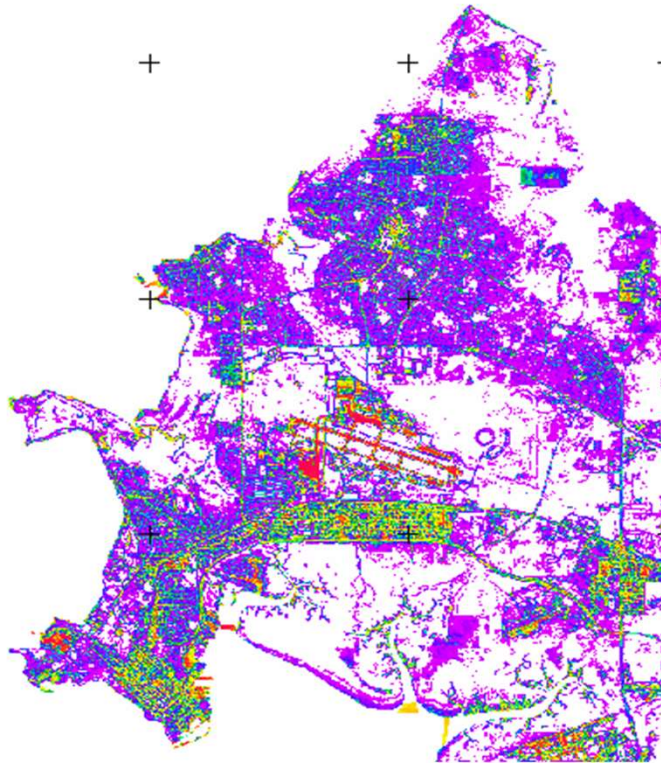


# Urban Heat Island

Satellite data  
LST maps 2011-16-18-21



Digital aerial photography  
Reflectance 2011-16-(21)



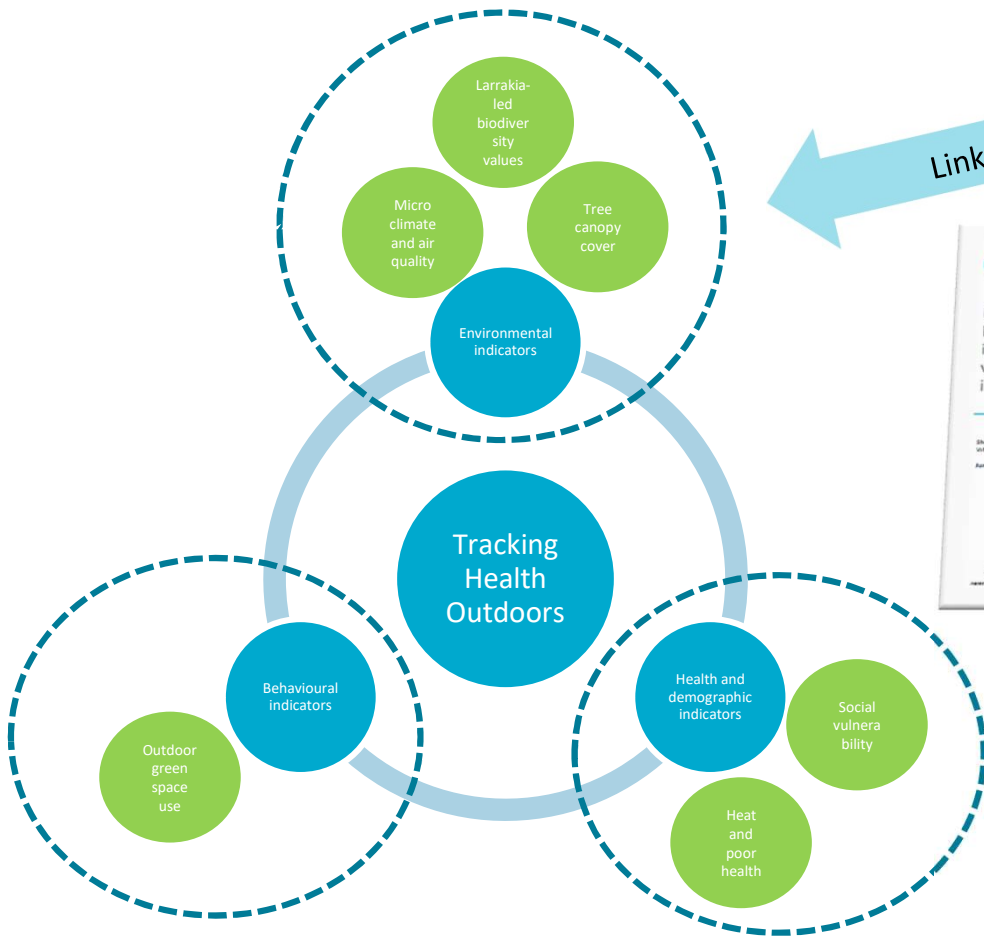
UAV (drone) mapping  
UNSW 2017  
CDU 2021-23







# Healthy Outdoors



● Elements of Health outdoors    ● DLL Research Projects



Healthy Outdoor Strategies



# Water for cooling

## Analysis of irrigation demand across Darwin







# Toward net zero – the role of urban buildings



**3D building footprint**

## **Modelling environmental impacts of buildings**

Based on CSIRO-Urban Monitor high-resolution imagery, a 3D generated model has allowed the quantification of:

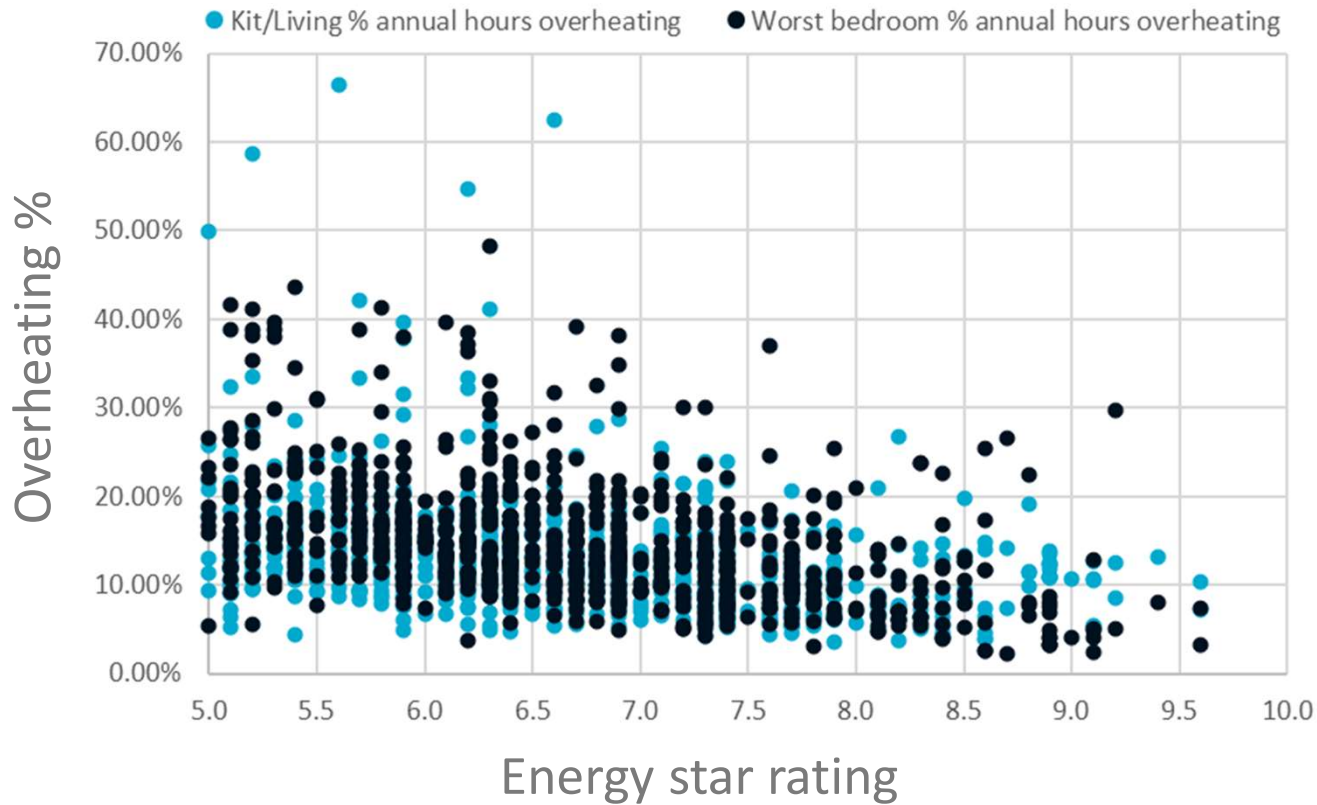
- Building material stocks by material type
- Embodied carbon emission
- Embodied energy
- Embodied water.



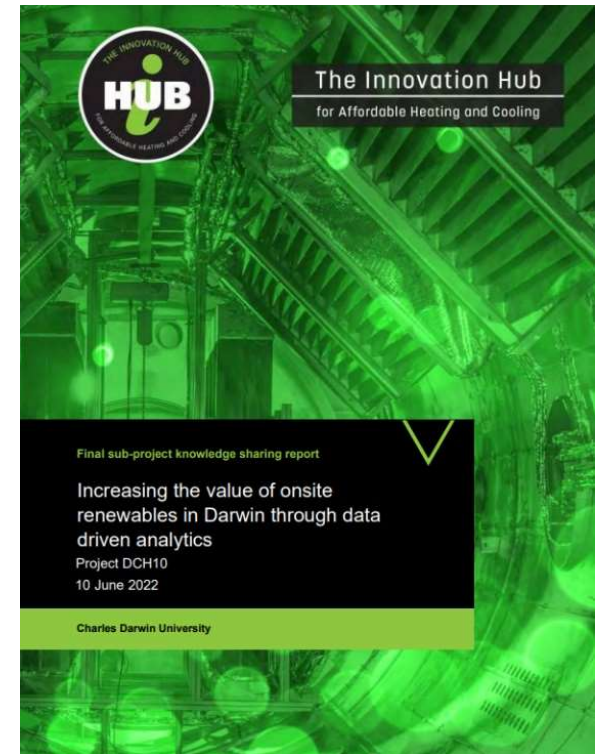


# Indoor liveability and sustainability

## Residential Energy and Thermal Comfort



## Commercial Energy Efficiency and Integration of Renewables





# Acknowledgements

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- NT Government, DCMC
- City of Darwin

## Collaborators

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\*Apologies if these lists are not comprehensive





# Thank You

<https://research.csiro.au/darwinlivinglab/>

Australia's National Science Agency

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