Cool roofs: Your roof materials can improve the efficiency of solar panels and air-con

PROJECT FACTSHEET

LOW CARBON LIVING CRC

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KEY POINTS

- **The heat that your roof absorbs from the sun affects the building's overall energy efficiency.**
- **The air temperatures above your roof can also have an effect by reducing the efficiency of rooftop air conditioning and solar panels.**
- **These 'above-roof effects' are generally unaccounted for in building efficiency performance calculations.**
- **Our research will identify the energy efficiency improvements of 'cool roofs' on large-footprint buildings, to help building owners and developers assess their value.**

THE OPPORTUNITY / CHALLENGE

'Cool roofs' use roofing materials with high solar reflectance and thermal emittance, reducing the heat absorbed from the sun and increasing the heat radiated out to the sky.

Cool roof technology reduces the amount of heat transmitted into buildings on hot days, and thus the amount of air-conditioning required for cooling. Their widespread use across a neighbourhood or precinct can mitigate the urban heat island effect.

Building energy models estimate the reduced heat flow into a building through the use of a cool roof. However, they typically do not quantify additional benefits that arise from the reduction in air temperature above cool roofs. These temperature reductions have the potential to improve the efficiency of roof-top air-conditioning systems and solar panels.

A small number of previous studies have attempted to quantify the effects of cool roofs on above-roof temperatures and the performance of rooftop equipment, but these studies have been relatively small in scope and haven't produced conclusive results. Previous studies have suggested that the value proposition of cool roofs on large footprint (>15,000 m^2) buildings may be greatly understated by current energy modelling methods.

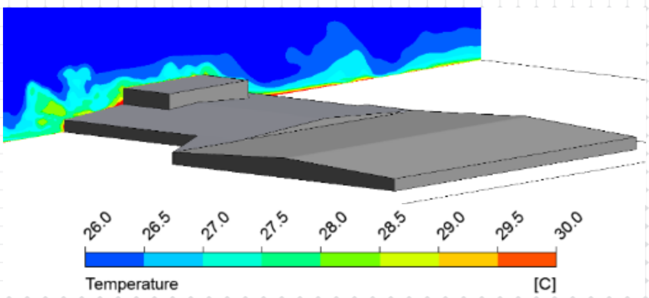

Figure 1: Simulated temperature field above a shopping centre roof.

OUR RESEARCH

Our project involves:

- In-situ monitoring of air and surface temperatures above three large-footprint buildings.
- Point-in-time detailed measurements of surface temperatures, wind profiles and surface optical properties around the buildings.

- Computational fluid dynamics (CFD) simulations of above-roof temperatures.
- Building performance simulations with a custom-built above-roof temperature model, to assess the benefits of cool roofs.
- Cost-benefit analyses.
- Development of prototype design-support tools, to guide building owners in assessing the value proposition of cool roofs.

Figure 2: Detailed mapping of air and surface temperatures above the case study buildings using 15 environmental sensors.

OUTCOMES

The project will deliver:

a) A rigorous experimental and simulation evidence-base of the benefits of cool roofs, including the effects of the above-roof temperature field.

b) A comprehensive set of cool roof design and cost-benefit calculation resources, focussed on air-conditioned large-footprint Australian buildings.

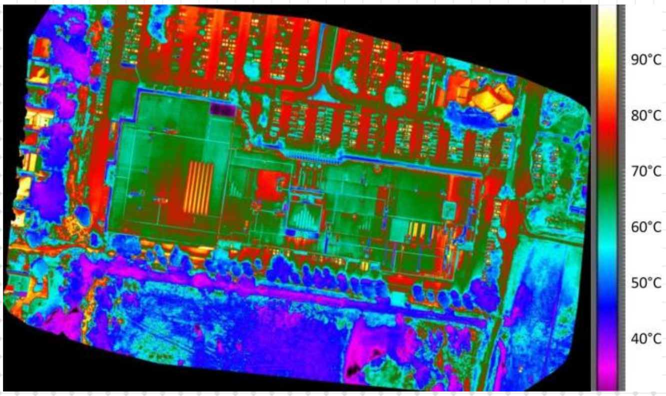

Figure 3: Thermal image looking down at one of the case study buildings, with a metallic coated steel roof.

PRELIMINARY RESULTS

Experimental data from the first case-study building indicates that roof surface temperatures can exceed 80°C on hot days, and the air near rooftop HVAC equipment and PV panels routinely rises several degrees above the ambient temperature.

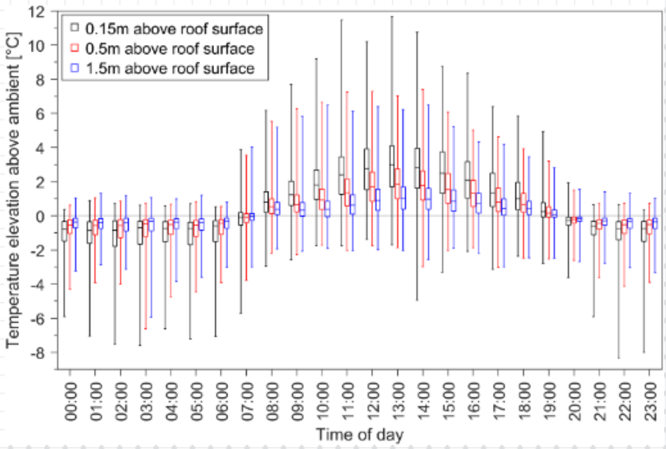

Figure 4: Air temperature over two months at a case study building.

The project will determine whether such temperatures affect building energy use. New design-support tools, which are under development, will allow building owners to accurately assess whether the investment in a cool roof is worthwhile.

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