Climate Change Adaptation Research Grants Program
- Settlements and Infrastructure Projects

Project title:
Pathways to Climate Adapted and Healthy Low Income Housing

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Objectives:
- Model the vulnerability of public housing assets and tenants to selected climate change impacts;
- Identify and evaluate key engineering, behavioural and institutional climate adaptation pathways;
- Scope the potential co-benefits of climate adaptation action for human health and well-being; and
- Develop typologies and climate analogues for national generalisation to other low income housing.

Project design and methods:
The project has been designed as 'participatory action research'. This is a mode of science that ensures DHS and QDoC are active research participants and responsible for the co-development of adaptation knowledge. Pathways for improving the standard of public and social housing portfolios in Victoria and Queensland will be identified, thereby reducing the impacts of climate change on vulnerable populations. By involving DHS and QDoC in the research, the aim is to couple the 'hard science' outputs of climate change vulnerability with the 'soft science' of engagement with public housing decision-makers in a process for mainstreaming climate change adaptation into business planning to assure service quality and client health and well-being.

Housing typologies
A fundamental aspect of the project design, is to use the public and social housing portfolios of DHS and QDoC (comprising 160,000 properties) as a microcosm of low income housing within Australia. A housing typology approach will be utilised to generalise the results, where appropriate, to other low income housing types in Australia. DHS has identified 12 core housing types and QDoC has a similar housing typology. Spatially explicit national datasets (e.g. ABS) will be used to determine their level of representativeness.

Climate scenarios and analogues
The climate focus is on extreme heatwave events and changes in temperature, radiation, humidity and wind. Future local climate will be modelled using 'morphing techniques' combining Typical Meteorological Year (TMY) weather files with climate change projections from multiple GCMs, as developed by X Wang et al (2010). The frequency and severity of future extreme heatwave events will be established using a similar approach, but drawing on long-term weather files using methods developed by C-H Wang and X Wang (2009) for wind. Climate scenarios will be prepared for 2030 and 2070 and a baseline used for comparison. Scenarios will be spatially explicit and national, enabling identification of climate analogues. Projections of extreme heatwaves will be further refined in the cities of Melbourne and Brisbane with the use of LandSat thermal imagery (resolution of 60-120m) acquired for previous events to provide a local measure of land surface temperature and influence of urban heat island effect that can be integrated into TMY weather files.

Modelling housing performance
Building performance in this project is defined as thermal performance, indoor environment, serviceability and durability. The thermal performance and indoor environment of each building type will be simulated using AccuRate software. AccuRate is a national energy efficiency assessment tool developed by CSIRO for energy requirement calculation of residential buildings, taking into account local climate (described by TMY weather files) and building fabric and design. AccuRate can also be modified to assess indoor climate which determines indoor thermal comfort and quality by considering

occupants' metabolism and behaviour. The serviceability and durability of housing under changing climate will be assessed using the Property Standard Index (PSI) developed by CSIRO for QDoC and stochastic modelling of housing material/structure deterioration in relation to changing climate using Monte-Carlo simulation techniques (Wang et al. 2010).

People/place interactions and health
This part of the project has a focus on people and their indoor/outdoor human-environment interactions. It will profile the demographic and health characteristics of housing occupants, through access to DHS and QDoC tenant information, using agreed methods for preserving confidentiality and privacy in combination with standard ABS census data. Spatial analysis using GIS and remote sensing will be used to define the social-ecological context of neighbourhood to identify the role of place. For instance, permeability of the neighbourhood for accessing shops, schools, work, etc, will influence outdoor exposure to heat, as will the proximity and availability of 'cool places' for respite, and the distribution and access to services. Multi-level modelling will be used to assess the impact of changing indoor and outdoor environment on human health.

Development of adaptation pathways
Analysis of the climate change vulnerabilities of people, housing and place will enable robust, multi-level exploration of the 'opportunities for adaptation' and the role of change drivers and barriers. This part of the project will be highly participatory, with strong reliance on DHS and QDoC in combination with detailed simulations. AccuRate and other spatial analytical tools will be used to test adaptation options with DHS and QDoC, and to collectively identify adaptation pathways and their risks to and co-benefits for human health. Adaptation options to be explored include retrofits, rebuilding, relocation, behavioural and other support.