

Building for the Future: Designing for tomorrow's climate instead of yesterday's

Lessons Learnt



This project is supported with funding from the Australian Government under the National Environmental Science Program

The Climate Systems Hub is a partnership of CSIRO, Bureau of Meteorology, Australian National University, Monash University, University of Melbourne, University of New South Wales and University of Tasmania and the Cross-jurisdictional Community of Practice for Climate Science. For more information visit www.nesp2climate.com.au.

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Please cite as: Dalla Pozza, R, Hoffmann, D, Rauniyar, S, (2026) *Building for the Future: Designing for tomorrow's climate instead of yesterday's: Lessons Learnt*. Climate Systems Hub Report. Climate Systems Hub. National Environment Science Program, Australia.

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Acknowledgements

The hub would like to acknowledge the contributions of the broader project team outside the hub Zhengen Ren and Anthony Wright from CSIRO Energy; Anir Upadhyay from the University of New South Wales; Dörte Jakob from the Bureau of Meteorology, Erica Kenna, from Australian Building Codes Board and Daniel Daly, William Tolis, Tim Le Mesurier, Alex Trinca, Ellen Pearson and Hannah Bubb from the Australian Department Climate Change Energy, the Environment and Water. As well as thanks to the Project Advisory Group members Shane Keating from Housing Industry Australia, Graham Macdonald from WA Department of Housing & Works, Stanford Harrison from the Australian Department Climate Change Energy, the Environment and Water, Anna Schlunke from NSW Department of Planning, Housing and Infrastructure, Ryan Flack from National Australian Built Environment Rating Scheme (NABERS), Jocelyn Dela-Cruz from the NSW Department of Climate Change, Energy, the Environment and Water, Peter Rooks from QLD Department of State Development, Infrastructure, Local Government and Planning, Stuart Fawcett VIC Department of Energy, Environment and Climate Action, Simon Koger from Engineers Australia, and Ruth Robjohns (Nordstrom) from the Australian Institute of Architects.

This project would not have been possible without the generous contributions of the volunteer testers: Chris Lockhart-Smith from Ecodweller, Gerald Turnbull, Govind Maksay and Ian McNicol from Sustainability Victoria, Nazanin Bahadorian from Bera, Warren Li from LCI, Ming Lui from CSIRO Energy, Stephen Greenwood and Shane Keating from Housing Industry Australia, and Steve Watson, Research Education Design Sustainability Consultants.

The Climate Systems Hub acknowledges the Tradition Custodians of the land across Australia where this work occurred. We pay our respects to Elders past, presents and future and recognise the important role traditional knowledge plays in understanding Australia's climate.

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Introduction

The reality of increasing global temperatures, the growing severity and occurrence of heat wave events, is driving policy movement towards addressing the problem of future building resilience. The 2026/27 [Trajectory for Low Energy Buildings Implementation Plan](#) encouraged more work to be done by Australian governments, including joint work under Energy and Climate Change Ministerial Council (ECMC), to progress the development of future climate files including heatwave files and examine their incorporation into NatHERS and other appropriate measures. The Trajectory measure (DCCEE, 2025) is a direct result of the growing concern that a house designed and constructed today is likely to face a warmer climate and more frequent heatwaves over the next 40 to 50 years than the historical climate conditions it was designed for.

This disconnect creates a real risk that homes designed for past conditions could experience increased cooling loads, overheating, reduced comfort and potentially increased health risks for occupants. It also raises broader questions about building standards, energy efficiency policy, cooling demand, thermal resilience and occupant health.

The [Climate Systems Hub Building for the Future project](#) brought together climate scientists, building simulation experts and policy stakeholders to co-design and test a new approach for incorporating future average weather and heat extremes into building energy efficiency modelling.

This report captures the practical lessons from the Building for the Future project for policymakers, funders and future project teams. It focuses on what was learned about translating climate projections into building simulation weather files, testing those files with practitioners, and the need for further co-designed work to develop guidance and capabilities for practitioners for appropriate application of the files.

This work has focused on residential applications using NatHERS-accredited software so limited to a predictive tool for energy use and more work is needed to evaluate if the methods and tools are appropriate to determine human health risks from extreme heat and cold exposure, or the metrics or limits that could apply.

Project overview: What we did

1. Developed prototype future weather files.

The project developed a new data-agnostic methodology that applies high resolution regional climate projections derived from seven Global Climate Models to generate future weather files for use in NatHERS-accredited building energy simulation software.

Two types of prototype files were generated: future Typical Meteorological Year (TMY) files, which represent average future climate conditions, and eXtreme Meteorological Year (XMY) files, which represent heatwaves with three different characteristics: the most intense, most severe and longest. These XMY files do not average out the details of the future climate, but include changes to variability and extremes in the future which provides a more accurate representation of future weather.

Prototype files were developed for eleven representative Australian locations across a range of climate zones, a lower and upper emissions pathways, SSP1-2.6 and SSP3-7.0, and three future periods centred on the 2030s, 2050s and 2070s. Further technical details are provided in Dalla Pozza et al., 2026 and Hoffmann et al, 2026.

Technical challenges:

- Future climate projections cannot be downloaded and plugged directly into building simulation models. Significant processing is required to produce the hourly variables and formats required by building simulation software.
- Several variables needed for the files were not available in the required form and required conversion, derivation and post-processing.
- Inconsistencies and errors in both historical observations and future climate projections had to be systematically identified and resolved. Individually, issues with variables such as solar radiation, cloud cover and wind may seem minor; collectively, they can affect simulation outcomes and the reliability of the final weather files.
- The current NatHERS files could not be replicated as the original computer programming scripts used were not readily accessible, creating additional work and highlighting the importance of accessible methods and documentation.
- Conversion from NatHERS weather-file formats to commercial EnergyPlus .epw format has not been done in this project as it was not straightforward and would require additional variables and methodological development.

2. Tested prototype files with building simulation practitioners.

The aim of testing was to elicit expert feedback from building simulation practitioners, including building designers and NatHERS assessors, on whether the prototype files were fit-for-purpose for residential building assessments.

Nine volunteer practitioners tested the prototype files in NatHERS-accredited residential simulation software, including HERO, FirstRate5 and AccuRate.

Testing confirmed that the files were technically compatible with these tools and could produce meaningful and interpretable building-performance outputs.

The XMY files also provided additional value by enabling heatwave stress-testing, peak cooling demand assessment and evaluation of occupant thermal comfort and resilience under future extreme heat events. More comprehensive testing of heat-stress applications using the XMY files is currently being undertaken by Strategy Policy Research and RED Sustainability Consultants (in preparation).



Key findings from the project

Finding	Implication
Prototype future weather files can be produced for residential simulation.	The project demonstrated that future average and extreme weather files can be generated in NatHERS-compatible formats and used in existing residential simulation software.
Extreme weather files add a new heatwave stress-testing capability.	XY files allow practitioners to explore the potential to assess future heatwave performance, including thermal comfort, peak cooling demand and potential occupant health implications.
Climate model and emissions pathway choices matter.	Estimated building performance outcomes varied substantially across not only emissions pathways, but also across climate models. Differences in the projected weather conditions between climate models (under the same emissions scenario) translated into significantly different predicted heating and cooling loads. Cooling loads for Sydney varied by up to 259% between models (under the same emissions scenario). This means that design responses that would achieve compliance could vary widely depending on the choice of climate model, which introduces a risk of inappropriate outcomes when trying to improve future resilience.
The number of files is a barrier to application	Practitioners requested the “most likely” future climate, but climate-science guidance emphasises a range of plausible futures. Even a simplified coolest, median and hottest model approach was considered difficult to apply routinely.
Guidance is essential for appropriate use.	Practitioners need to be aware when selecting climate models, emissions pathways, time periods differences between climate models translated into significant variations heating and cooling load that influence design decisions. Further work to develop agreed frameworks for file selection and interpretation are needed. Without this supporting framework, the additional information provided by future TMY and XY files will remain difficult to apply in routine practice, despite its clear value for climate-resilient building design.

Lessons learnt

The co-design process provided several practical lessons for future work on future weather files for building simulation.

Lesson 1: Future climate data are not plug-and-play for building simulation.

Future climate projections are not provided in formats that can be directly used by building practitioners. Significant processing, conversion, bias adjustment and quality checking were required to produce NatHERS-compatible weather files. This work requires expertise in both climate science and building simulation. Future climate data services should continue to work directly with practitioners to ensure climate projections are provided in forms that are fit for building performance applications.

Lesson 2: Co-design was essential to producing usable files.

Close collaboration between climate scientists, building simulation experts and policy stakeholders helped identify data issues, refine the methodology and ensure the prototype files were technically compatible with residential simulation tools. This collaboration and co-design process was critical to producing files that were both scientifically credible and practically usable but still and some challenges remain.

Lesson 3: The range of possible future climates creates a major implementation challenge.

Testing showed that building performance results can vary substantially depending on the climate model, emissions pathway and future time period selected. This means file choice matters. However, practitioners found the number of possible files difficult to apply in routine assessment workflows, even when models were simplified into coolest, median and hottest categories. Further work is needed to develop agreed frameworks for file selection and interpretation.

Lesson 4: Extreme weather files provide important new capability, but require interpretation support.

The XMY files allow practitioners to explore building performance under future heatwave conditions, including potential implications for thermal comfort, peak cooling demand and occupant health. This is a capability that current NatHERS TMY files do not provide.

The XMY files are based on a heatwave definition that had proven utility for building simulation, which is different to the Bureau of Meteorology's Excess Heat Factor approach. Users will need clear guidance on how to interpret and communicate the results as they are not directly comparable with historical records or other heatwave projections.

Lesson 5: Volunteer testing was valuable but not sufficient for full implementation.

The volunteer testers provided important expert feedback and helped demonstrate that the prototype files are technically fit-for-purpose. However, because testers were contributing alongside other priorities, the project could only go so far in assessing applications across dwelling types, software tools, climates and design decisions.

More structured, funded and systematic testing will be needed before the files can inform broader policy or industry practice.

Lesson 6: A long-term national capability is needed.

The project demonstrated the potential value of future weather files to inform climate-resilient building design, but also highlighted that this cannot be treated as a one-off exercise. Future co-designed work is needed to practically apply the extra information, expand the coverage, maintain and update files, document methods, support users, develop practical guidance and expand the work to commercial applications. A long-term national capability linking climate science, building simulation, software development, policy and industry practice would help ensure Australian buildings are designed for tomorrow's climate instead of yesterday's.



Limitations and future work

The prototype files and testing provide a strong foundation, but several limitations and future work priorities remain.

Area	Future work required
Geographic coverage	Prototype weather files were developed for 11 of the 69 NatHERS locations only. Future work would be needed to expand national coverage – however next step should be to work out how to practically apply the files rather than create files for more locations.
Residential focus	The prototype files were developed for residential building simulation applications. Commercial building applications require additional work.
NatHERS tool Development	Future development of NatHERS tools to make heatwave/heat stress metrics readily available as outputs. As well as the development of associated heat stress indicators and thresholds.
File formats	Commercial applications generally require EnergyPlus .epw files. Converting the methodology to .epw format is not straightforward and requires additional variables (precipitation)
Precipitation	Commercial and hygrothermal applications may require precipitation data to assess condensation, mould risk and HVAC considerations. Including future precipitation requires further methodological development because rainfall projections vary widely across climate models and regions.
Extreme event types	Feedback from practitioners identified the need to represent cold snaps and humid heat events, in addition to dry heatwave conditions. This is technically possible using the new methodology but would benefit from additional work to improve observations and projections of humidity.
Urban heat island effects	Urban heat island effects are not represented in the current prototype files. The reason for this is two-fold, (i) the weather observations are often recorded some distance from the urban centres (e.g., airports) and (ii) the resolution of the climate projections (17km grid) doesn't resolve urban characteristics. Applying the methodology to higher-resolution projections, such as 4 km grids, could improve local climate representation, however, this may still be limited by the underpinning observations.
Guidance and governance	Further co-designed work is needed to develop practical guidance on file selection, use cases, interpretation and governance before any future policy or regulatory application.

Guidance note for the Prototype files

Important: These files are prototype datasets generated for research, testing and feedback purposes only. They should not be used to inform building design, regulatory compliance, policy, NatHERS assessments or operational energy efficiency assessments or to assess current regulations.

- The future weather files were produced as part of the Building for the Future research project under the National Environmental Science Program Climate Systems Hub.
- The objective of the prototype dataset is to explore the use of regional climate model projections to generate future climate weather files compatible with the NatHERS simulation framework.
- The prototype files support testing of workflows for generating NatHERS-compatible weather files from climate model simulations, bias-correction approaches suitable for building simulation variables, and potential future climate datasets for building performance modelling.
- These files are not approved NatHERS weather files and are not suitable for operational or regulatory use. A more comprehensive process would be required before they could be considered for inclusion in any Australian Government policy or regulatory application.
- The prototype files will be accessible for research purposes on the National Computational Infrastructure Data Catalogue until March 2031.
- Access is open and free. There are no restrictions or controls on who can download the files.
- Metadata and the technical report will be provided. However, without future funding, there will be no resources from the NESP Climate Systems Hub project team, including Bureau of Meteorology staff, to support use of the files or further develop them.
- In using the files, researchers acknowledge that projected building performance can vary significantly depending on the climate model and emissions pathway selected. The choice matters.
- More testing and ongoing collaboration are needed to develop guidance on how this additional climate information should be used in practice and which aspects are most useful for informing design responses.

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