ENERGY RATING NEWSLETTER, August 2018

Introduction

Building houses that provide comfort, without needing large quantities of conventional energy, is becoming increasingly important. This is due to growing evidence that climate change will bring a variety of adverse events to Australia, and the concern relating to continuity and affordability of conventional energy sources.

Houses that can provide affordable comfort during extreme events are being recognised as highly valuable - and the work of energy assessors provides the basis for the recognition of that value. Both householders and builders rely on accurate assessments to see that they are delivering or receiving good value in their new or renovated dwelling.

Since accuracy and transparency are important to the market, CSIRO is developing a method to automatically identify and address anomalies in assessments (see article on Sherlock), and also to provide access to the data that we gather from ratings. This method can help us to understand how ratings can better assist the market to deliver quality, comfortable housing for Australians.

Comfortable, affordable housing is the theme for this issue of Energy Ratings – happy reading!

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A consolidated Australian energy database – valuable insights for industry and governments

When a home energy rating is conducted using one of the NatHERS accredited tools, and a certificate is issued, data about the house and its energy rating is stored. This data has the potential to provide valuable insights into Australia's residential building industry.

While BERS Pro and AccuRate data is stored by CSIRO in the HStar portal, FirstRate5 data is stored separately by Sustainability Victoria. This separation of the data has made it difficult to conduct meaningful analyses of new building activity Australia-wide.

CSIRO and Sustainability Victoria are now working together to integrate these two data sets. Once integrated, some of the data will be made accessible to the general public. The data will also be used for research aimed at improving the energy rating system and the energy efficiency of Australian houses.

Further information about the dataset can be found in an article published in Energy Procedia at https://www.sciencedirect.com/science/article/pii/S1876610217334653.

Successful Australian Residential Energy Rating conference 2018

> "An excellent wide range of topics and fantastically organised"
> "Organised, topical and well run. Very impressed."

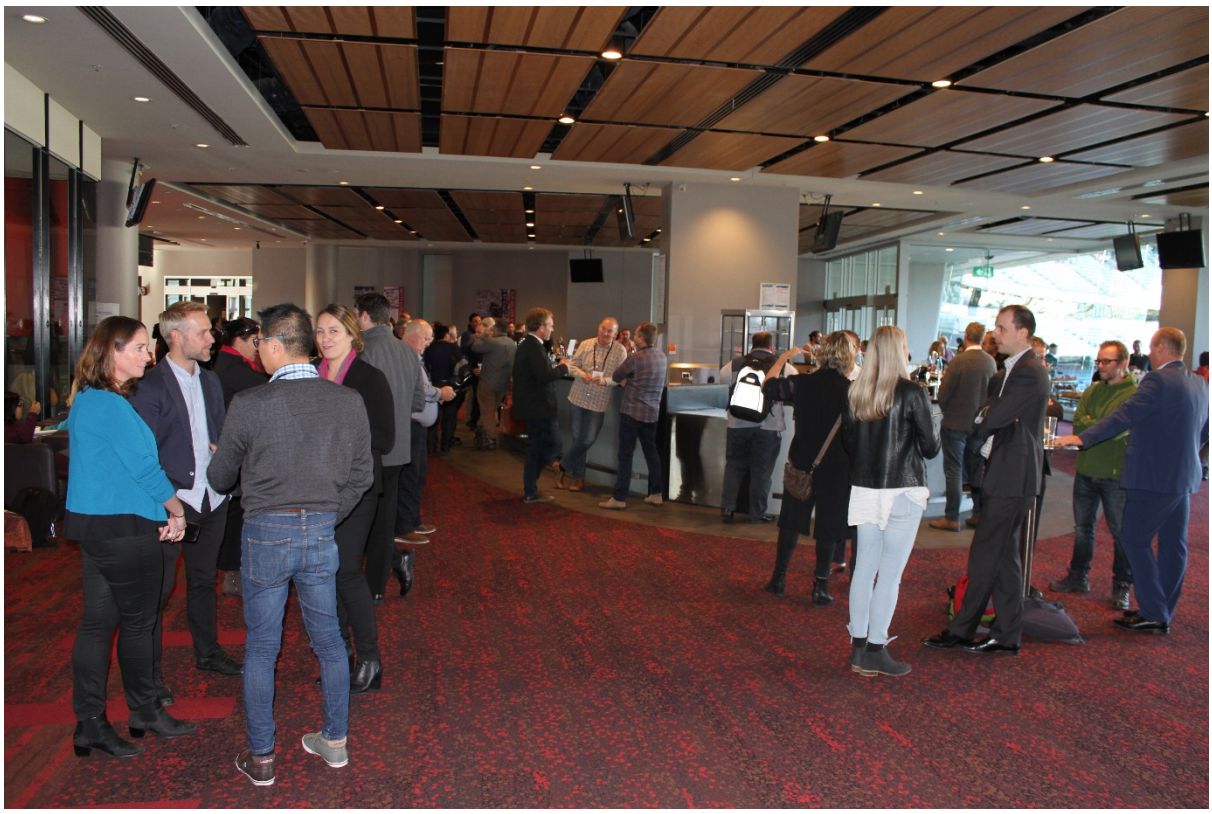
Just two of the feedback responses from more than 280 people who participated in the inaugural Australian Residential Energy Rating conference. Held at the MCG with over 70 persons from around the country participating by webcast and over 200 in person, the conference was a resounding success.
The conference brought together a wide range of participants and presenters from across the building industry to discuss the future of energy rating from the widest perspective. The drivers of international responsibilities, energy poverty alleviation and health set the scene for discussion on existing and new tools, regulations and future regulatory options. Exemplar residential buildings and development proved to be a very popular session showing how highly efficient dwellings are being delivered.
Webcast participants could engage in the Q&A sessions using the conference app and on site participants availed themselves of a multitude of networking opportunities.

Sid Thoo reported on the conference in The Fifth Estate here:
https://www.thefifthestate.com.au/columns/spinifex/how-many-cats-it-takes-to-heat-a-building-and-other-learnings-from-the-residential-energy-rating-conference/99390?mc_cid=74852e5499&mc_eid=cc4900fa75

CSIRO are planning to hold this conference as a biennial event, so look out for it in 2020.
The webcast recording will available for anyone to view soon at
https://events.csiro.au/Events/2018/March/23/Aust-Residential-Energy-Rating-Conf-2018

Josh Byrne provided enthusiasm mixed with deep knowledge as moderator of many plenary sessions

Lively Panel discussions provided the chance for the audience to quiz presenters.



Networking/meal breaks allowed time for and catching up with old friends and making new ones

OR you could catch a bit of fresh air and see the MGC

Before getting back to work!

Impact analysis of thermal comfort on residential energy use

By Zhengen Ren and Dong Chen

Our warming climate increases the challenge for building designers to provide thermal comfort at minimum energy costs.
The acceptable range for indoor temperatures is determined by the comfort temperature band within which the great majority of people are adequately comfortable. Generally speaking, for space heating and cooling less energy is required to maintain a broader indoor air temperature range than for a narrower range.

To date, there has been little critical analysis on the impact of the indoor temperature range (i.e. acceptability limits) on heating and cooling energy requirements for different constructions in different regions - under both current and future climates. This study intends to fill this research gap by investigating the impact of acceptability limits of indoor temperature on energy performance through building simulations using AccuRate.

Three houses with different thermal performance and construction are used in this study: House 1 – medium-weight colorbond slab; House 2- heavy-weight brick cavity; and House 3 – high-set, lightweight constructions. They are evaluated in the seven major Australian NCC climate zones under current and projected future climates (with an assumption of global warming of 2°C).

The main conclusions drawn from the study include:

- For space cooling load under both current and future climates, the acceptability limits have greater impact on House 1 than on House 2 constructions.
- The decrease from 90 to 80 per cent in acceptability limits has a greater reduction in space cooling load than the decrease from 80 to 70 per cent.
- In terms of space cooling energy requirements, and house energy rating for Houses 1 and 2, the impact of reducing the acceptability limit (from 90 to 70 per cent) is minor in heating/cooling balanced regions and heating dominated regions, under the current climate. Tropical regions, such as Darwin, are most impacted -increases of 1 star for House 1 and 0.2 star for House 2 were found, due to the decrease from 90 to 70 per cent in the acceptability limits.
- For the projected future climate, the impact of decreased acceptability limits will still be minor for Sydney. In Melbourne, there were decreased cooling loads of Houses 1 and 2 by around 33 and 18 per cent, respectively.
- For House 3, which are common in warm tropical regions, under the current climate the decrease from 90 to 70 per cent in the acceptability limits reduces cooling load by 45.4 per cent (a 3.6 star increase).
- For House 3, the energy used for space cooling can be minimized in tropical regions (9.7 stars achieved in Darwin) and subtropical regions (reduced to 5.7 MJ/m^2/annum in Brisbane) using 70 per cent acceptability limits. This data is encouraging of proper lightweight construction house design and operation, to reduce space cooling loads in tropical and subtropical regions.
- Global warming will reduce the impact of relaxing the acceptability limits on cooling load reduction and energy star rating of House 3.

Ongoing studies are investigating the extent that thermal comfort acceptability limits could be relaxed and still be acceptable for residential buildings in various Australian climates. With this research, revised thermal comfort acceptability limits can be proposed and implemented in design tools and energy rating schemes for residential buildings in Australia. This may facilitate more energy efficient housing designs, especially for tropical and sub-tropical regions.

Reference: Ren, Z and Chen, D (2018). Modelling study of the impact of thermal comfort criteria on housing energy use in Australia. Applied Energy 210: 152-166.

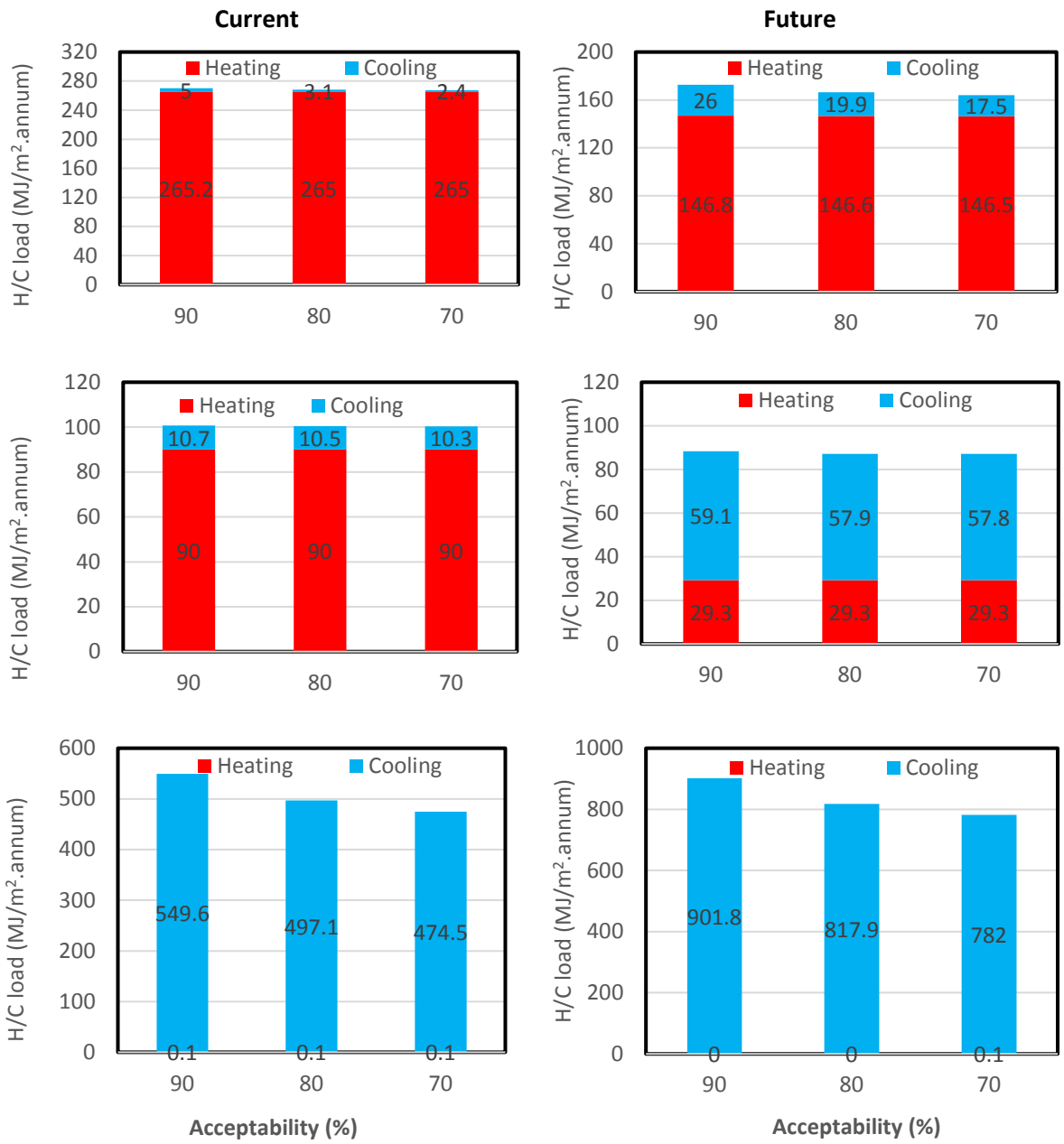


Figure 1 Sensitivity of space heating and cooling loads for House 1 under current and future climates in Melbourne (top), Sydney (middle) and Darwin (bottom)

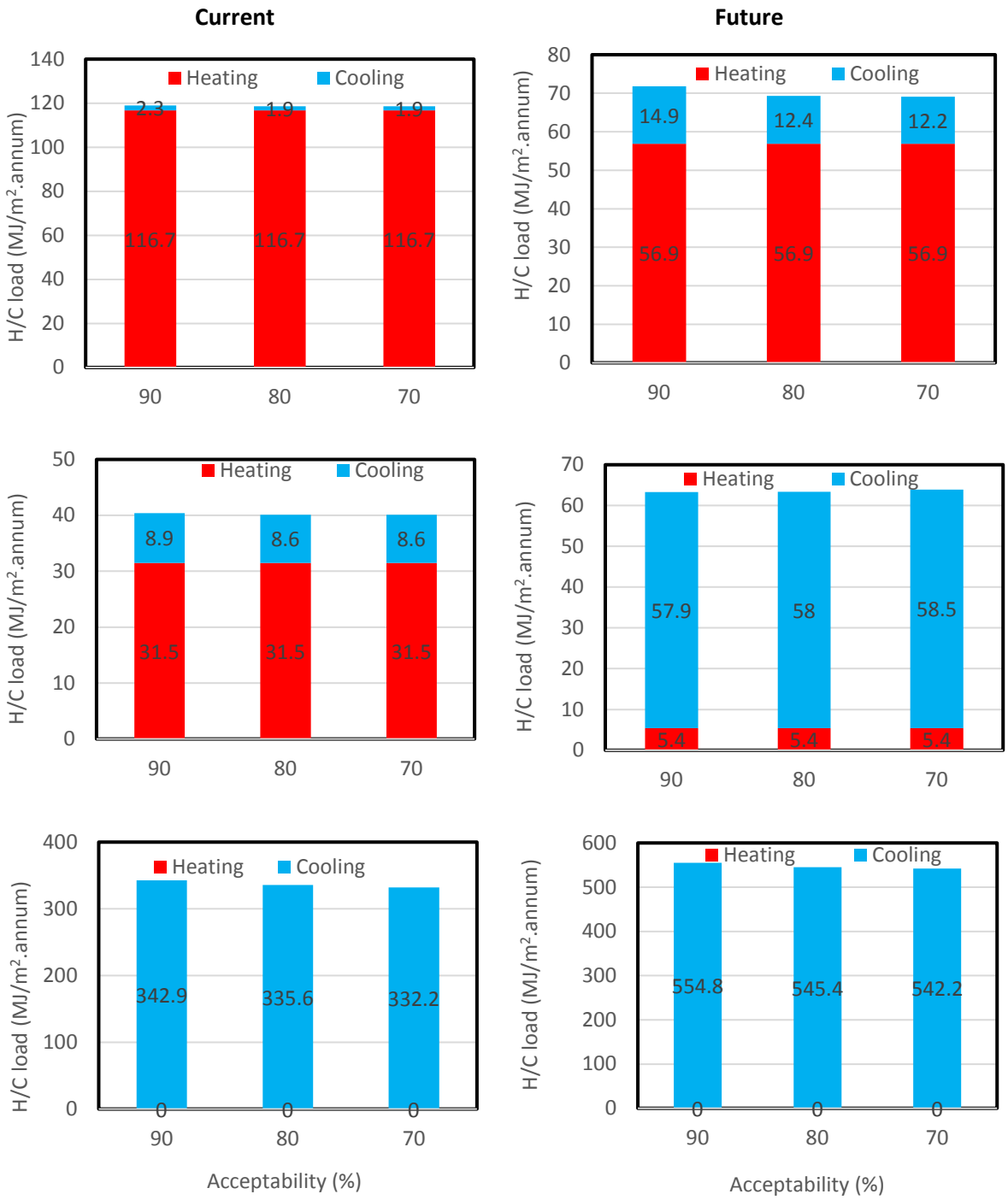


Figure 2 Sensitivity of space heating and cooling loads for House 2 under current and future climates in Melbourne (top), Sydney (middle) and Darwin (bottom).

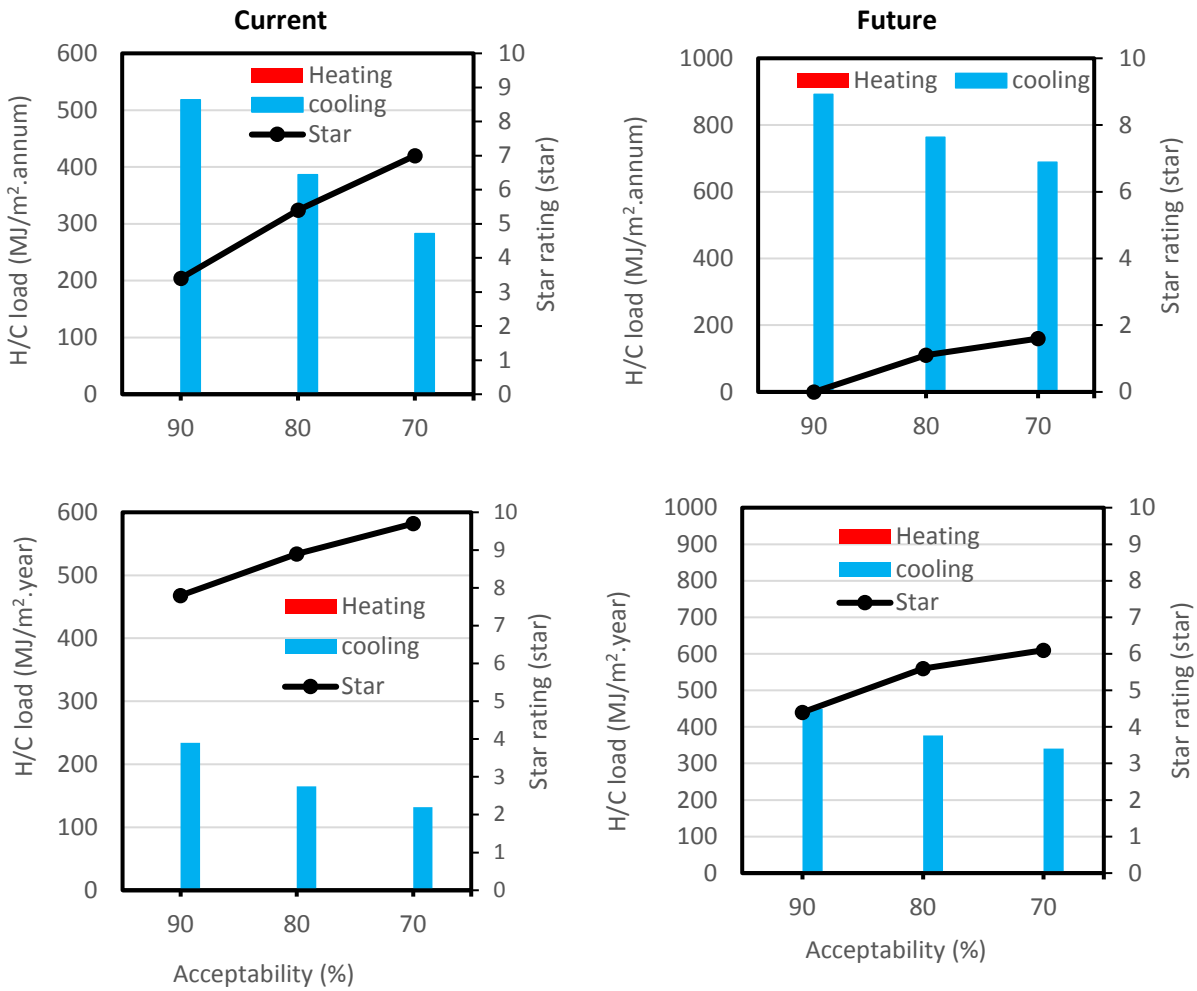


Figure 3 Sensitivity of space heating and cooling loads for House 3 under current and future climates in Darwin for raised construction (top) and insulated construction (bottom)

A design tool for off-grid housing in Australia

By Zhengen Ren, WanYee Chan, Dong Chen and Phillip Paevere

Over the past 16 years in Australia, electricity prices for households have increased at an average annual rate of 8 per cent while the average inflation rate is around 2.8 per cent. This has put a financial strain on households across Australia. With the recent rapid decrease in PV prices and a similar trend for battery storage and increased awareness of environmental impacts, there is growing interest in public and academic discussions about the possibility of "leaving the grid" or "living off- grid" by installing PV-battery systems.

This study presents an integrated tool for off-grid housing design across Australia. The tool has been developed by implementing a solar PV battery system model into the existing Australian Zero Emission House design tool (AusZEH). This is a tool for designing low/zero carbon housing that incorporates technologies and measures to reduce whole-of-house energy consumption, and takes into account local climate, building envelope, equipment and appliances, and occupant behaviour (Ren et al., 2013). The off-grid housing design is evaluated by matching energy supply (predicted by the solar PV battery model) at one-hour time step with the energy demand (as predicted by AusZEH). Figure 1 shows the logic flow of the PV-battery system's charging and discharging algorithm.

To ensure no electricity shortage throughout a whole year at any time step, the size of the PV-battery system is determined by the hourly energy demand of the household. This can be predicted by the model, based on the Typical Meteorological Year (TMY) weather data.

The output power (W) from a PV array can be estimated as

$$W = f \times Y \times \frac{I_g}{I_s}$$

where f is the PV derating factor (around 0.75 to 0.8 for modern PV panels); Y is the peak capacity of the PV array (the amount of power it would produce under standard test conditions of a panel with 25°C and 1kW/m^2 irradiance); I_g is the global solar radiation incidence on the surface of the PV array; and I_s is the standard amount of radiation used to rate the capacity of the PV array (1 kW/m^2).

A case study was conducted for existing houses and showed that with non-electric energy sources (e.g. natural gas) for the four main end-uses (water heating, space heating, cook-top, and oven), households may operate off the grid without considering diesel generators. This is at a PV-battery installation cost of around A$47,000 in Sydney (a balanced heating/cooling region) and A$59,500 in Townsville (a tropical region). In Melbourne (a heating-dominated region), the most cost-effective way to go off-grid is to first retrofit the house to be 6 stars and then install a PV-battery system. The total cost is around A$49,500. This tool provides a cost-effective pathway for off-grid housing design in Australia.

Reference

Zhengen Ren, Greg Foliente, Wan-Yee Chan, Dong Chen, Michael Ambrose, Phillip Paevere (2013). A model for predicting household end-use energy consumption and greenhouse gas emissions in Australia. International Journal of Sustainable Building Technology and Urban Development 4: 210-228.

Table 1 Indicated costs of installing solar PV-battery system for off-grid housing in the three cities

City	Solar PV size (kW)	Battery size (kWh)	Cost of installing PV-battery system (A$)
Melbourne	10	31	71,883
Sydney	10	18	47,061
Townsville	10	30	68,280
	15	22	59,430

Table 2 Indicative costs of PV-battery system for the houses retrofitted to 6 stars to stand off the grid in the three cities

City	Solar PV size (kW)	Battery size (kWh)	Cost of PV - battery (A$)	Cost of house retrofit (A$)	Total cost (A$)
Melbourne	5	17	37,435	17,399	54,834
	10	9	31,933		49,332
Sydney	5	39	76,097	16,839	92,936
	10	10	33,061		49,900
Townsville	10	29	67,680	3,134	70,814
	15	19	57,630		60,448

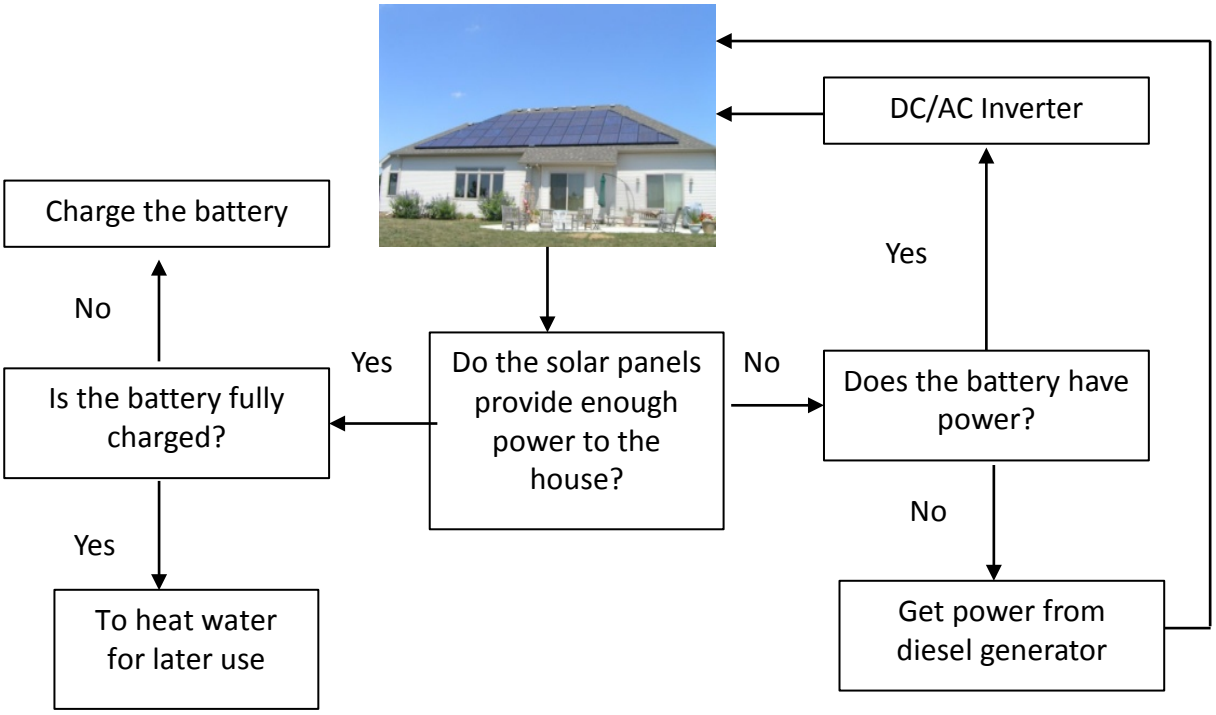


Figure 1 Logic flow of a solar PV-battery system charging and discharging for off-grid house

Researcher Profile: Wan Yee Chan, Senior Software Developer

Wan Yee is a senior software developer in CSIRO's AccuRate Development and Support Team. Wan Yee and the AccuRate team are responsible for the development and maintenance of the commercial and benchmark software tools that underpin residential building energy efficiency.

Wan Yee joined CSIRO in 1995 after working in academia in Hong Kong for five years. She has a Bachelor of Science, majoring in Computer Science and Statistics, as well as a Master of Science, both from the University of Western Australia. Wan Yee is proficient in different programming languages and databases such as Delphi and MS SQL Server, as well as GIS.

Currently, Wan Yee leads a project working on the development of an XML schema representative of the AccuRate data model to allow third party cad tools to interface directly with the software tool. With this methodology implemented, the time taken to enter the details of a house into the software tool is drastically reduced. Wan Yee leads on-going technical support (including validations, bug fixing and documentation) for the software tool and any new added modules. She is also working with other CSIRO project teams to incorporate new features and new capabilities into the software, as well as helping to develop a universal certificate portal, and a new cloud-based version of AccuRate.

Before joining the AccuRate Development and Support Team in 2003, Wan Yee was part of a Corrosion research group that worked closely with the aerospace industry. She helped to develop intelligent applications to analyse and predict material corrosion. The team was awarded the Chairman's Innovation Bronze Medal.

When not at work, Wan Yee likes reading spy novels, especially those thrillers written by Tom Clancy and Robert Ludlum. She likes working in the garden and gets great satisfaction from giving the plants a serious 'haircut'.

HStar update

The HStar portal is the website that provides Universal Certificates that are produced by NatHERS software tools. It allows those tools to be used to demonstrate compliance with the energy efficiency requirements of the NCC. The portal also provides a repository for technical information on the Chenath calculation engine that is used in all NatHERS tools.

As well as general maintenance and support of the portal, there have been a number of HStar Portal enhancements recently implemented including the following:

- A new 'Location Summary' report has been added for assessors. This report shows total current and expired certificates for locations that have more than one certificate.
- The portal is now collecting certificate scratch data for future analysis and enhancement of the NatHERS Engine.
- A secondary database has been developed to enable easier generation of aggregated data - needed for reporting and data visualisations.
- There is now increased precision of more numeric data types. These improvements will future-proof certificate enhancements.
- Improved stability of batch processing.

Sherlock – Automated identification of rating anomalies

At the moment, universal certificates in the HStar portal are randomly selected for manual analysis by Assessor Accrediting Organisations. This can be a time-consuming process that is constrained by human resources. With rapid daily additions of certificates, this manual process is expected to become a monumental undertaking that can, at best, cover a decreasing proportion of certificates.

A web-based solution (a.k.a. Sherlock) is being developed to address these issues by shortlisting certificates that may require revisions through a systematic, repeatable and traceable approach. This is done by analysing all certificates in the HStar database using an extensible collection of checks for specific issues across every certificate. For example, the (unlikely) absence of any exhaust fans in the entire building. By analysing certificates across regular time periods, Sherlock will be able to present trends of potential errors for regulators to identify areas for improved training and/or communication. This may result in more accurate modelling of buildings for thermal assessments.

Sherlock is currently in the early stages of development. The process will involve the verification of identified issues against manual assessments, and expert opinions. Pending outcomes of this verification process, Sherlock will be deployed to analyse HStar certificates at regular intervals possibly starting from July 2018.

Understanding the costs and benefits of high levels of Energy efficiency

Understanding the costs and benefits of high efficiency buildings is vital to setting future standards for dwellings. The Victorian Government wants to find out from building professionals the current practices and costs to better understand the economic value of building new residential dwellings to higher levels of energy efficiency. To that end, the Alternative Technology Association (ATA) is undertaking a survey of the building industry that will be open until the end of August.

They are seeking information on the typical costs and appliances used in Class 1A and Class 2 dwellings for a range of energy performance levels and are collecting data through two separate surveys.

- For designers/builders/developers of **Class 1A** (detached/semi-detached) homes, please click the following survey link: https://streamlineedge.tfaforms.net/318

- For designers/builders/developers of **Class 2** (apartment) buildings, please click the following survey link: https://streamlineedge.tfaforms.net/320

For any questions regarding the survey or the project, contact Damien Moyse at the ATA at Damien.Moyse@ata.org.au.