Exemplary Advances

2021 October ***"Exemplary Advances"*** is the newsletter for Exemplary Energy Partners, Canberra. Feel free to forward it to friends and colleagues. Click here to subscribe or unsubscribe. Feedback is most welcome.

Past editions of ***"Exemplary Advances"*** are available on our website.

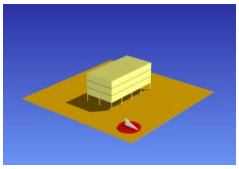
In this issue:

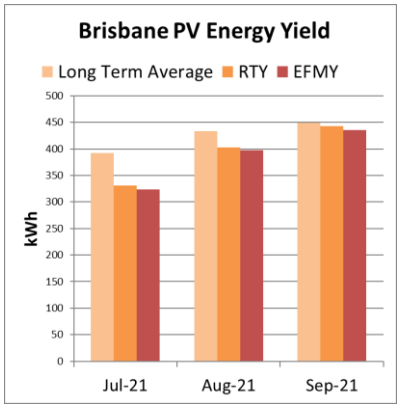
Exemplary Weather and Energy (EWE) Index[i] - September 2021

Monthly tabulation and commentary relative to the climatic norm – the Reference Meteorological Years

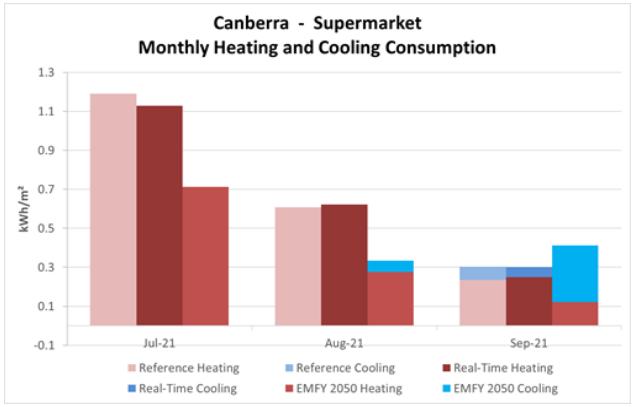
2021 September	Weather Index (monthly means)[ii]						Weather and Energy Index (%)						
	Temperature (°C)			Rel. Humidity (%)			10-Storey		3-Storey		Supermarket		Solar PV
	Min	Avg	Max	Min	Avg	Max	Heat	Cool	Heat	Cool	Heat	Cool	
Brisbane	+0.1	-0.5	-0.5	+55.0	+17.2	0.0	-	-20.5	-	-27.0	-	-100	-1.3
Canberra	+0.1	-0.5	-0.2	+7.0	-1.2	0.0	+4.0	+5.4	-0.9	+2.1	+6.1	-25.1	-1.1
Perth	+1.1	+1.0	+1.1	-7.0	+4.2	-3.5	-26.2	+5.6	-23.7	+6.0	-8.5	+77.3	-10.8
Sydney	+1.3	+1.0	+0.6	-5.0	-10.9	-12.0	-63.2	+0.4	-57.1	-0.2	-93.9	+41.2	+3.8

The Exemplary Real Time Year weather files (RTYs), current Reference Meteorological Year files (RMYs) and Ersatz Future Meteorological Years (EFMYs) used for these monthly simulations are available for purchase to allow clients to simulate their own designs for energy budgeting and monitoring rather than rely on analogy with the performance of these archetypical buildings and systems.



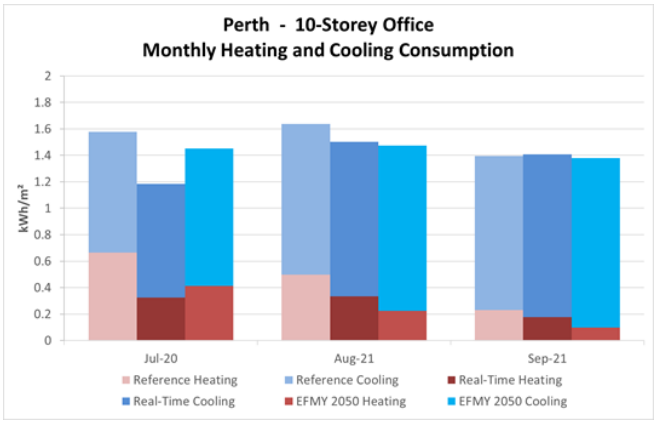


Brisbane had a slightly cooler but more humid September than the average, with the recorded solar irradiation lower than average especially in the mornings. The wind speeds were also generally lower than average. The solar PV simulation output results were 1.3% lower than average, and the cooling energy consumption of all three commercial office building archetypes was lower than average. The cooling consumption of the east-facing zone of the 10-storey building was 0.5% higher than average, and for other zones was 16-42% higher. This difference was due to the lower temperatures and solar irradiation in the mornings. When comparing our EFMY 2050 simulation results with the results for last September, the 3 storey and 10 storey office models are projected to have 33% and 41% higher cooling consumption respectively. The EFMY 2050 solar PV energy output projection was 10% lower when compared to September 2021.

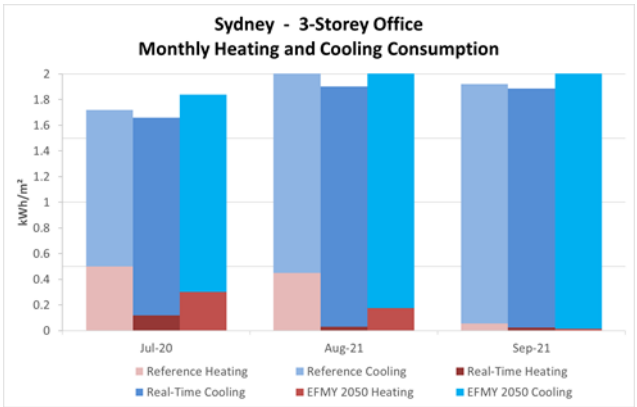


Canberra also saw a slightly cooler and less humid weather than average in September. The solar insolation was largely comparable to the long-term average, with a slight increase in the afternoons. However, the solar PV output was lower by 1.1%, which could be attributed to higher-than-average temperatures recorded in some daylight hours. Both the office building archetypes had higher than average cooling consumption. The north-facing zone of the 10-storey building had 2.9% higher cooling consumption than average, while for all other zones the cooling load was lower than average owing to the generally lower temperatures. When considering the heating consumption, the east- and north-facing zones reported 13% and 2% lower values than average. When comparing our EFMY 2050 simulation results with the results for September 2021, the projected consumption of each of the two office models was around 6-12% higher. The EFMY 2050 solar PV energy output projection was 1% lower than September 2021.

Perth also had a warmer and more humid September than average. Perth generally received lower than average solar irradiation especially around the middle of the day, indicating a high number of cloudy days in September. The windspeed observations were also lower and led to a 10.8% lowering of solar PV output. All the commercial archetypical buildings had higher-than-average cooling energy consumption. All the zones of the 10-storey office building had a lower-than-average heating energy consumption. In the case of cooling energy consumption, the east- and south-facing zone had 11% and 7% higher consumption respectively while the north- and west-facing zone had 3-8% lower consumption. This was attributed to lower irradiation in the afternoons. When comparing the simulation results using our EFMY 2050 climate data with the most recent month, the two office building models are projected to require 4-8% higher cooling consumption than September 2021 and around 70% lower heating consumption. The EFMY 2050 solar PV energy output projection was 4.4% lower than September 2021.



Sydney had a warmer but less humid September than the average. The solar irradiation received in Sydney was higher than average after late morning hours, and the wind speeds were higher than average. This led to 3.8% higher simulated PV output than average. The heating energy consumption of the commercial building archetypes were all lower than average. All zones in the 10-storey office building except the east-facing zone had higher-than-average cooling energy consumption due to the lower irradiation in the mornings. When comparing our EFMY 2050 simulation results with the results for September 2021, the two office models and the supermarket are projected to have around 10% and 68% higher cooling consumption respectively. The EFMY 2050 solar PV energy output projection was 5.6% higher than September 2021.



National Construction Code (NCC) 2022 — public comment draft

Exemplary Energy's submission is set out in full below. Comments from readers are most welcome.

1) **Recommended change to draft:** The calculation method for (1) must use input assumptions and climate data in accordance with AIRAH DA07.

Comment/reason for change: Climate files can, but currently do not, include coincident precipitation data to allow credible façade simulation stress testing for water ingress and interstitial condensation despite the proposed stringency of those building longevity requirements. DA07 in clause 4.5 requires the inclusion of "6. Rainfall". This amendment will prevent expedient or mischievous cobbling together of data without the requisite science.

Disclosure: Exemplary Energy in collaboration with Dr Dong Chen (CSIRO) is preparing such data sets incorporating precipitation data for over 200 Australian locations, including the 69 locations built into NatHERS.

2) **Recommended change to draft:** Table: House energy rating software: Nationwide House Energy Rating Scheme (NatHERS with current and resilience-testing climate data) and its associated NatHERS Certificate.

Comment/reason for change: Relying on weather data ending in 2016 is manifestly deficient in a changing climate and is all the more glaring in the face of BoM's imminent release of superior solar data from 2015 to the present based on finer geographic resolution and with scans at 10 minute intervals. (source David McQueen | Energy Sector Lead (acting), Business Solutions, Bureau of Meteorology, 15 October 2021)

Additionally, continuing failure to publish the 3-decade weather data prevents peer review of the selection of indicative months to comprise the RMY files and there are no extreme climate files (e.g. P10 sunniest and P90 cloudiest 10th and 90th percentiles) for resilience testing.

The low quality of the currently available climate data has an undermining flow-on effect on simulations used for JV3 compliance. The EPW files recently released by CSIRO appear to continue a long-running 30 minute time error in their solar data. This is likely caused by the transcription of NatHERS file solar data instead of its conversion to the TMY2 and EPW time conventions. NatHERS files have solar data for 30 minutes before and after the time stamp whereas TMY2 and EPW have 60 minutes before the time stamp.

Disclosure: Exemplary Energy has been publishing TMY2 and EPW files since 2015 with the correct time convention for their solar irradiation data for over 200 Australian locations, including the 69 locations built into NatHERS (e.g. International Conference on Energy and Meteorology (ICEM), Boulder, Colorado, USA, 2015).

Asia Pacific Solar Research Conference – Sydney, 16-17 December

Exemplary Energy submitted four extended abstracts in support of this year's APSRC and all four have been accepted for presentation at that annual event. The first three will be presented in brief to the November meeting of Renew in Canberra. We will expand on them in future editions.

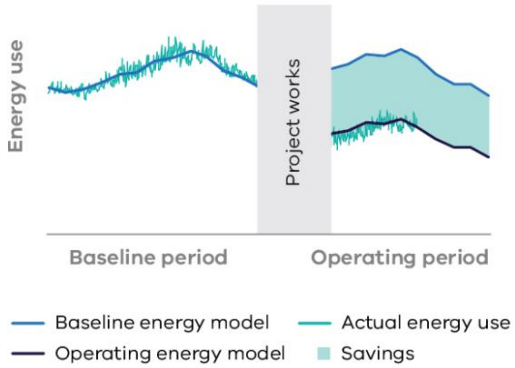
1. Updating Australia's Reference Meteorological Years with the Addition of Hourly Precipitation Data
2. Verification of ClimateCypher Climate Data Outputs with System Advisor Model (SAM)
3. Extending Real-Time Year Weather Data Services with Bureau of Meteorology Data
4. Effect of Energy Efficiency Rating (EER) of Dwellings on Sale Prices in the ACT 1999-2021

Exemplary Measurement and Verification — a Demanding Skill Set

Those involved in energy management know there are many factors that can influence energy use: weather, technology, the hours of operation and the rate of activity to name a few. Because of this, the process for working out how much energy is saved by an efficiency upgrade is not as straightforward as simply measuring the change in energy use.

Measurement and Verification (M&V) is a transparent system of methods used to determine and attribute the savings from a specific process or infrastructure change. Along with energy savings, M&V is used to determine savings in water, peak demand and greenhouse gas emissions, and it is essential for proving the achievement delivered by efficiency projects and programs. As savings cannot be measured directly, they are calculated by comparing measurements taken before and after the implementation of an upgrade program using the following generic formula:

Savings = (Baseline Period Energy – Reporting Period Energy) ± Adjustments



By way of illustration, see the figure above from *"Calculating Savings using Measurement and Verification"* (Non-mandatory manual for participants in the Victorian Energy Upgrades program) 2017.

The Adjustments in that formula require high level applied science such as accounting for differing weather conditions in the Baseline and Reporting periods (often consecutive years of whatever starting month) such as applying Real-Time Year (RTY) weather data in Calibrated Simulations as described in our September edition.

The International Performance Measurement and Verification Protocol (IPMVP) is a standardised, rigorous, internationally recognised approach to M&V which provides certainty that results are real and verifiable. The IPMVP forms the basis for calculating and attributing savings under the generalised "Project-based" methods in the Victorian Energy Upgrades program, the NSW Energy Savings Scheme and the South Australian Retailer Energy Productivity Scheme. Practitioners holding a current Certified Measurement and Verification Professional (CMVP®) certificate are able to have their results recognised by the regulators of those programs.

Exemplary Energy's Managing Director, **David Ferrari**, is a specialist in this area of work and is a qualified CMVP practitioner. We are pleased to offer his services as an independent M&V professional.

Precipitation Data Temporal Disaggregation Project — Update

Regular readers may recall our ongoing work on converting the historical daily precipitation data to hourly values which will be incorporated into this year's ACDB weather file creation for over 250 Australian locations. The Bureau of Meteorology had started installing tipping bucket rain gauges in almost all location in the 2000s, and being automatic in nature this enabled the recording of hourly precipitation data. Prior to this, precipitation was recorded manually at 9 am each day. Exemplary had been investigating methods to distribute these daily values into hourly figures for varied applications including hygrothermal analysis for buildings and other infrastructure design.

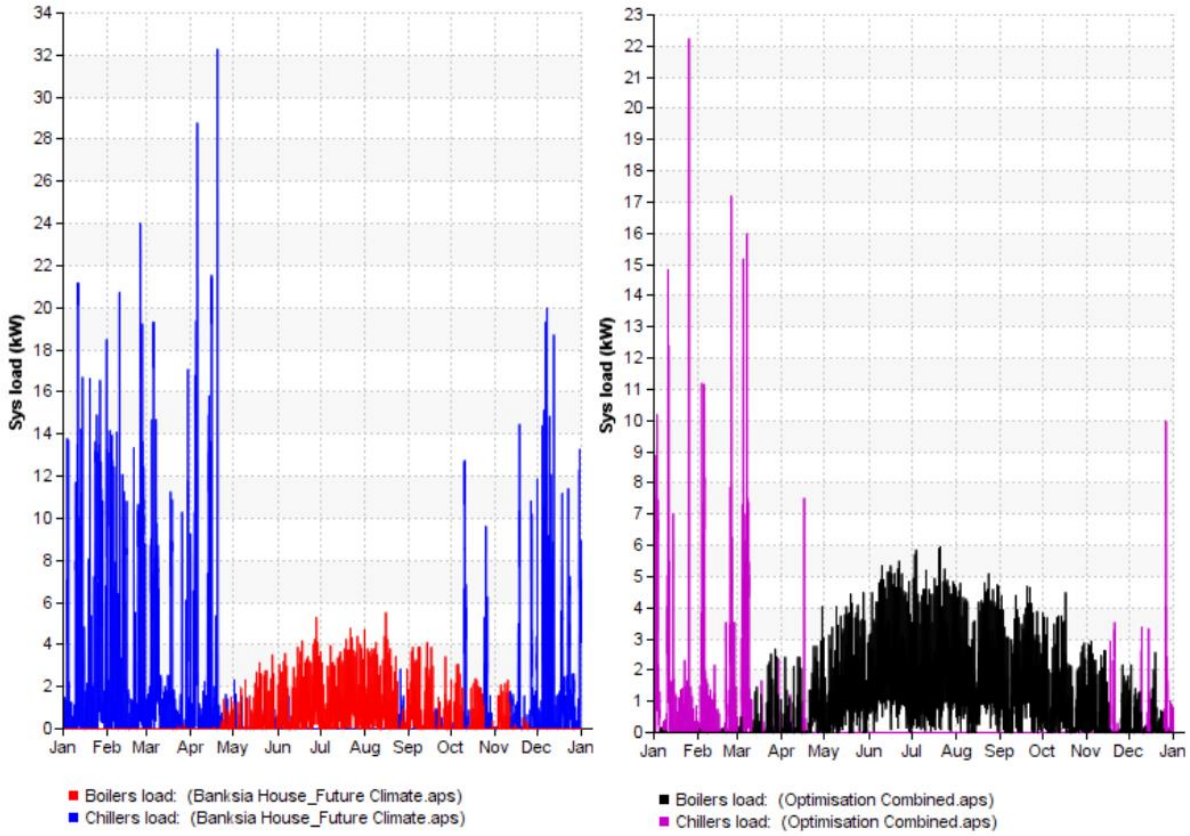
We will be utilising an approach combining Markov Chains with Monte Carlo methods, where the years with both hourly precipitation data (the recent years after the tipping bucket rain gauge has been installed) and the various weather elements like solar irradiation, cloud cover, relative humidity are used as the basis for training the algorithms.

Exemplary will be presenting this work in the Asia Pacific Solar Research Conference on December and further updates will be provided in the coming editions.

RMIT Student Projects with EFMY 2050 — Steve Pettitt

Readers may recall the report in our last edition describing research by RMIT Masters student Brett Munckton using Exemplary's EFMY (Ersatz Future Meteorological Year) data. This month we will be discussing the results of another student from RMIT, Steve Pettit, who performed the same study on Banksia house and its BCA (Building Code of Australia) compatible version. The energy performance with and without space conditioning was simulated with the RMY (Reference Meteorological Year) data and the EFMY data for 2050. Similar simulations were performed for the Banksia house model with design optimisation strategies reflecting the futuristic climate change in the model.

The strategies proposed by Steve included increasing the ceiling insulation, increasing the wall insulation, and providing shutters to the windows to allow passive solar gain during winter while reducing heat transfer in summer. The simulation of the model with each strategy in place and the combination of all three were performed. It was also pointed out that NatHERS-accredited energy rating software currently derives its RMY from the Australian Bureau of Meteorology weather data for the period 1976 to 2004. Given that the Australian Building Codes Board assumes an average minimum design life of residential buildings to be 50 years, achieving compliance under "current" modelling parameters may prove insufficient for even the current climate.



BOM's New Real Time Solar Data Stream — Update

As mentioned in our August Edition, Exemplary Energy is preparing to tap into the Bureau of Meteorology's (BOM) newly inaugurated Real Time Data Service to gain access to real time gridded solar data. This will bolster our ability to geographically expand our "Real Time Year (RTY)" data set and provide the latest weather data to our clients. Moreover, it will also allow us to expand the free public service "Exemplary Weather and Energy (EWE) Index" to cover all the 8 Australian capital cities.

The real time gridded solar data package from the BOM consists of hourly solar irradiance at 5 km resolution and hourly solar exposure at 2 & 5 km resolution. The files will be provided in NetCDF format through the bureau's registered user File Transfer Protocol (FTP) service and will be retained in the bureau's server for 12 hours. As this will require frequent access to the FTP service to download the files, we are developing a "bot" to accomplish this task. The "bot" will access the FTP service to download the necessary files, while also reducing the file size by deleting inutile data which will further help in reducing the storage space needed.

This gridded solar data is produced by the Heliosat-4 radiation model which uses observations from the advanced imager onboard the Himawari satellite. It should be mentioned that data produced is bias-corrected based on comparisons conducted for the calendar year of 2017 between the outputs by Heliosat-4 and BoM's 12 ground stations.

Via our liaison with the Bureau, we were able to gain access to sample data which we are currently examining. We hope to gain access to the full data stream by next month.

Data available for Australian "Capital Region" Sites

Exemplary is pleased to announce the availability of full weather records from 1990-2018 along with Reference Meteorological Year (RMY) and eXtreme Meteorological Year (XMY) climate files for purchase for capital region sites including Canberra and Tuggeranong in the ACT and Braidwood, Cooma, Goulburn and Orange in NSW.

The full weather records from 1990-2018 are a compilation of historical real-time weather data acquired from the Bureau of Meteorology (BOM). This data set includes elements such as Global Horizontal Irradiation (GHI), Direct Normal Irradiation (DNI), Diffuse Horizontal Irradiation (DIF), Humidity, Wind Speed, and Direction, Cloud Cover, Temperature, and Pressure.

The RMY (A, B, or C according to the weighting given to the weather elements, with A having the greatest weighting given to solar irradiation) climate file represent the entire time duration of the weather data in a single synthesized year and provides a convenient way to understand the long-term averaged climatic conditions of a location.

The XMY data set is an extension of the Typical Meteorological Year (TMY) data which contains selected extreme months with the insolation variables to form a set of four extreme representative years: P01, P10, P90, and P99 (sunniest to cloudiest cases respectively). As cited in our August Edition, an investigation conducted by Amin Moazami et al recommends the use of XMY data in addition to the RMY data for the accurate prediction of the range of future building energy performances.

Additionally, as noted in our September Edition, Exemplary Investments has donated these specialized weather and climate data sets to allow the design optimization of community solar farms in Goulburn and Orange (just outside the "Capital Region").

Please contact us if you are interested in acquiring these files for any of the above locations or would like to discuss the creation of similar data sets for other locations of your interest. We provide these data sets in Typical Metrological Year (TMY), Energy Plus Weather (EPW), and Australian Climate Data Bank (ACDB) formats.

New Team Member – Dario Tarquini – Engineer Intern RMIT

Exemplary Energy has recruited three new interns who will be introduced in *"Exemplary Advances"*.

Dario is currently in his final year of a Master of Engineering in Sustainable Energy at RMIT. During his time at the University of Pisa, in Italy – where he studied a BSc and MSc in Chemical and Process Engineering – Dario familiarised himself with different pieces of technology such as LaTeX, ANSYS Fluent, Autocad, Matlab, EnergyPlus and HOMER.

During his studies, Dario also competed as a professional Beach Volleyball athlete and gained technical expertise working as a teaching assistant for Industrial Process Control System Security at the University of Pisa.

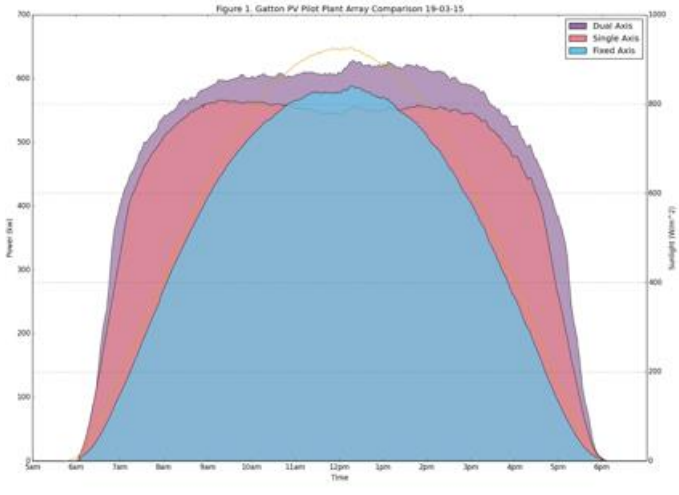
Being passionate about energy efficiency and the energy transition and committed to mitigating climate change, Dario is thrilled to be a part of the Exemplary Energy team as an Intern Engineer and Analyst.

In his spare time Dario loves to cook – as a proud Roman, a particular mention goes to his killer carbonara – and hang out with his adopted shelter pup, Barkley.

Community based Solar Farms – Update

Community Energy for Goulburn NSW

Exemplary Investments has invested in this Co-Op and Exemplary Energy has donated specialised weather and climate data sets to allow the solar farm's design optimisation: the full weather record 1990-2018 along with Reference Meteorological Year (RMY) and eXtreme Meteorological Year (XMY) climate files.



The technical solution most likely to be chosen involves the use of single axis tracking (SAT) and a far bigger battery than originally planned which, combined, will increase annual revenue by around $100,000. The graph shows the increase in electricity generation by utilising single axis tracking (SAT). Blue is fixed, pink is SAT, purple is double axis tracking. SAT not only increases revenue from the project, but also reduces the number of panels to be installed.

The Board intends to raise the extra $600,000 required for the enhanced solution through another share offer, firstly to existing members and then to other local residents and, if necessary, opening the offer to the rest of NSW and the ACT. Contact Ed Suttle at vp@ce4g.org.au.

SolarShare Majura Valley ACT

Exemplary Investments has invested in this solar farm.

The SolarShare Community Solar Farm has now been operating since March this year. Its Board is working on a tool to allow members to view the generation data in real time. The farm has experienced a single-axis tracker (SAT) software issue which intermittently caused a single row to face the wrong direction since May. Lockdowns of the ACT/NSW border delayed farm builder (Epho) and the tracker supplier (Schletter) in rectifying this.

Exemplary's Executive Director, **Trevor Lee**, attended SolarShare's AGM on Friday 22 October virtually.

Energy Democracy Orange NSW

Exemplary Investments has invested in this Co-Op and Exemplary Energy has donated specialised weather and climate data sets to allow the solar farm's design optimisation: the full weather record 1990-2018 along with Reference Meteorological Year (RMY) and eXtreme Meteorological Year (XMY) climate files.

There is only a small window of opportunity left for NSW/ACT residents or enterprises to also invest in this project with expected returns on investment in the community-scale project between 8% and 12% per annum. Initially it was intended to allow members to net-meter their electricity against their investment in the co-operative, but that would involve Energy Democracy acting as the members' electricity retailer which is not currently practicable.

The Board of Orange Community Renewable Energy Park (OCREP) has set a target of selling at least 200 more membership parcels (just under $5,000 each, but stakes as small as $1,000 are available) by 9 December, with webinars, newspaper, and social media advertising, as well as a brochure that is available to pass on to others. Email info@energydemocracy.net to ask about these to distribute. The project is financially guaranteed to proceed, however, as Octopus and IT Power have enthusiastically committed to take up any parcels not sold to the public.

Upcoming Milestones

- Financial Close expected 9 December - when the deal is signed and sealed by all of the parties (Octopus Energy, Central West Energy Co-op and IT Power Development).
- Equipment Procurement: Q4 2021
- Construction to begin: Late Q1 2022
- Commence generation late in 2022.

AIRAH Building Physics Forum

The Australian Institute of Refrigeration, Air-Conditioning & Heating (AIRAH) conducted the Building Physics Forum on 12 October 2021 virtually. The event could be summarised as emphasising building of healthy homes in addition to addressing energy efficiency. AIRAH President Paul Jackson opened the event, and was followed by the keynote speaker Chris Nunn of AMP Capital who discussed the international progression towards carbon reduction. He also noted that carbon emissions associated with the buildings are easier to reduce when compared to other sectors and for this passive house principles will play a major role.

Mark Dewsbury (pictured left) from the University of Tasmania (UTas) next delivered his presentation, citing the importance of understanding the building physics and of shifting the paradigm away from addressing consequences after they have been locked-in by construction. According to Dr Dewsbury, this would require extensive training right from the university level, and later help in issues like mould formation even in code compliant houses.

The next presentation by Jesse Clarke from ProClima discussed how vapour permeability is important for healthy homes. Alex Zeller from the Australian Building Codes Board (ABCB) then talked about the condensation management in the National Construction Code (NCC) that will be updated in 2022 and 2025. He said issues like exhaust ventilation and vapour permeability relevant to energy efficiency improvement in homes will be addressed in 2022 while all other substantial moisture management issue will be handled in 2025. The last presentation before lunch by Jack Tan and Mikael Boulices from UTas and Massey University NZ respectively talked about their research in the area of retrofit design and ventilation analysis.

Post-lunch, Ivi Sims from Building Environmental Wellness Group, shared her experience of finding the causes of different problems including moulds and foul smell that occurred in various houses. Freya Su, from UTas (pictured right) discussed the importance of accurate historical climate data for hygrothermal analysis for understanding the moisture flow in houses. She explained that software like WUFI, with the input of the appropriate weather data file, will be able to simulate the moisture movement through building envelope and therefore can predict condensation formation.

Jack Blackwell (from NDY), Peter Matheson (from Aurecon), Marcus Strang (from Hip v Hype) and James Cornell (from Life Panels) who are industry professionals, then talked about varying topics like underslab insulation, heat pumps, cross-laminated timber (CLT) panels and thermal mass in the building envelope. The event was helpful in providing insights about the passive house building principles for ensuring healthy and energy efficient homes for people with all ranges of expertise.

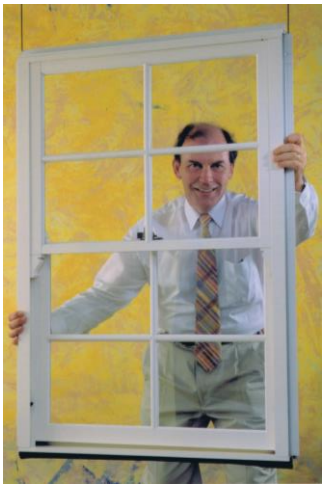
Report by Nihal Abdul Hameed

Vale Professor John Ballinger – Pioneer of Solar Architecture

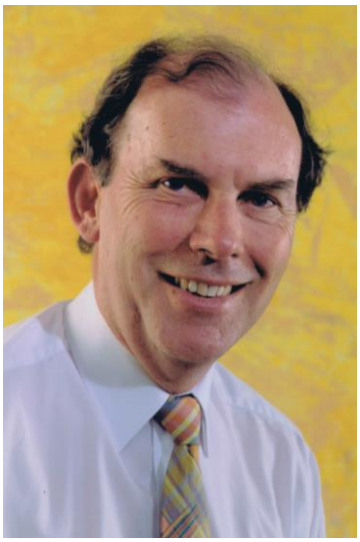
27 March 1941 – 3 October 2021

Tony Isaacs, Sustainable Buildings Specialist, Melbourne VIC

"I don't think people understand just how "touch and go" the early days of NatHERS were. ... If it wasn't for John's dogged determination and skilful behind the scenes diplomacy, there might not have been any NatHERS at all. There have now been millions of Australian houses built that have had a thermal simulation run to verify their performance. While NatHERS is far from perfect (not John's fault), these houses are a lot better than they would have otherwise been. Because of John's efforts, Australia's GHG emissions are millions of tonnes less than they otherwise would have been."



Emeritus Professor John Ballinger B. Arch (Hons. Adelaide), AM, FRAIA, retired in 1997 from a Chair in Architecture at the University of New South Wales. He was the inaugural Chairperson of the Australian and New Zealand Solar Energy Society (ANZSES) in 1985 and, after almost a year chairing the interim management committee, served for two subsequent full year terms as Chairman, having been elected unopposed on both occasions. (The Society's constitution precluded both its Chair and Vice-Chair from serving a third consecutive term with this constraint being modelled on a similar provision in the parent society, ISES (the International Solar Energy Society) which is aimed at ensuring that its governance is fresh and commanding the volunteer energy required for consistent efforts.) Professor Ballinger subsequently served as the Society's Treasurer for a three year term ending in 1996.



In academia Professor Ballinger was responsible for the establishment of the National Solar Architecture Research Unit (SolArch) whose projects included the first experimental solar house in Australia and the first Solar Village in Australia, both in NSW. Through SolArch, and in collaboration with industry, he established the Australasian Windows Council which in turn initiated the Window Energy Rating Scheme (WERS) to complement Australia's Nationwide House Energy Rating Scheme (NatHERS) which he also nurtured. This latter venture was immensely politically challenging due to the low level of inter-state consensus that pervaded the whole process. Before that, he served as chair of the Technical Advisory Committee to its forerunner, the Five Star Design Rating Scheme in the 1980s.

He has over 50 solar efficient buildings and 150 publications to his name and was awarded the Order of Australia in the year 2000.

He is survived by his wife, Dr Susan Ballinger, and two children: Richard and Mary Alice.

Exemplary Energy's Executive Director, **Trevor Lee**, served as the ANZSES Secretary during John's Chairmanship and they remained close friends ever since.

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[i] Exemplary publishes the EWE for three archetypical buildings and a residential solar PV system each month; applying the RTYs to EnergyPlus models developed using DesignBuilder for a 10-storey office, a 3-storey office and a single level supermarket as well as an SAM model of a typical 3 kW_{peak} solar PV system designed by GSES. All values are % increase/decrease of energy demand/output relative to climatically typical weather. Especially during the mild seasons, large % changes can occur from small absolute differences. RTYs are available for purchase for your own simulations.

[ii] 2021 July Temperature/Relative Humidity minus long term average July Temperature/Relative Humidity