Exemplary Advances

2021 February ***"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.

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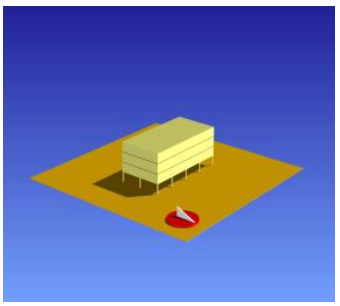
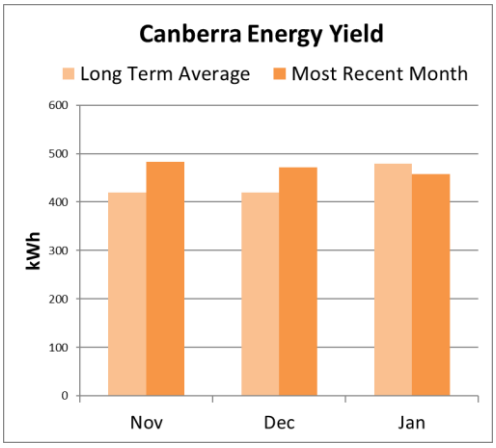
Exemplary Weather and Energy (EWE) Index[i] - January 2020

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

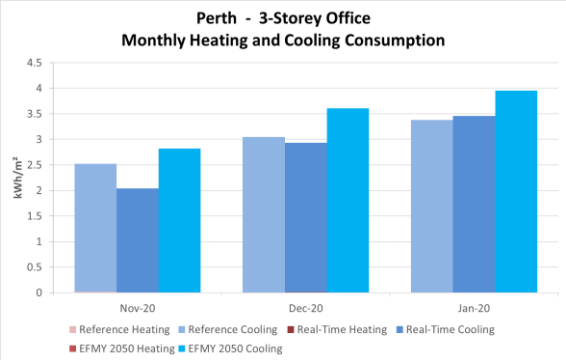
2020 January	Canberra		Perth		Sydney	
	Heat	Cool	Heat	Cool	Heat	Cool
10-Storey	N.A.	-2%	N.A.	11%	N.A.	-9%
3-Storey	N.A.	-3%	N.A.	12%	N.A.	-10%
Supermarket	N.A.	-20%	N.A.	13%	N.A.	-14%
Solar PV	-4.5%		4.4%		4.6%	
PV Farm	-10.2%		N.A.		N.A.	



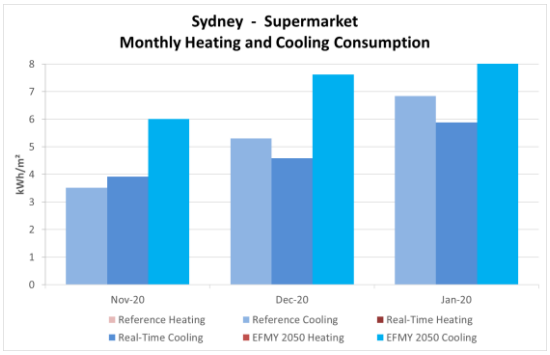
The Exemplary Real Time Year weather files (RTYs) the current Reference Meteorological Year files (RMYs) and the Ersatz Future Meteorological Years (EFMYs) used for these monthly simulations are available for purchase to allow clients to simulate their own designs for energy budgeting and monitoring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



Canberra had a cooler than average January. The mean average, mean maximum, and mean minimum were found to be 0.7°C, 0.5°C and 0.7°C lower than the average. It was generally less sunny than the average but also lower than average wind speeds were seen in daylight hours. Together this caused a 4.5% reduction in the output of the solar PV model when compared to the average January. All the commercial building models had lower than average cooling consumptions with the office buildings having a lower cooling consumption by 2-3%. The east facing zone of the 10-storey office building had 2% reduction in cooling energy consumption than average when compared to 4-6% lower than average in other zones as the solar irradiation was close the average values in the morning hours and deviated more negatively post noon. The temperature at the hour when cooling consumption was at its peak was 37.3°C, which was 12.1°C higher than the average and hence the cooling energy consumption at the time of peak load was 22.3% higher than average. When comparing the simulation results using our EFMY 2050 climate data with the RTY, it is projected that the two office building models would both have around 15-19% higher cooling consumption than for the RTY, and the supermarket would require around 43% more cooling consumption than the RTY in January.



Perth had a warmer than average January. The mean average, mean maximum, and mean minimum temperatures were higher than the averages by 1.4°C, 1.1°C and 1.2°C respectively. Perth in the afternoons received higher than average solar irradiation and the wind speeds were higher than average during the morning hours when the solar irradiation was lower than average. The combination of the above two factors has led to an increase in solar PV energy output by 4.4% when compared to average. All three commercial building models had higher than average cooling consumption with a range of 11-13% higher than usual. The 10-storey office east facing zone had 11% higher than average cooling energy consumption while all other zones had higher than average cooling energy consumption in the range of 13-14% due to very low solar irradiation in the morning and lower wind speeds in the afternoon hours. Overall, the cooling energy consumption of the 10-storey office building was 11% higher than average. At the hour of peak cooling, the air temperature was at 28.8°C which was about 10°C lower than the average. Therefore, the peak cooling consumption of the 10-storey office model was 3.4% lower than the average. When comparing the simulation results using our EFMY 2050 climate data with the current climate, it is projected that the two office building models would have around 6% higher cooling consumption and the supermarket would have 10% higher cooling consumption than this January.



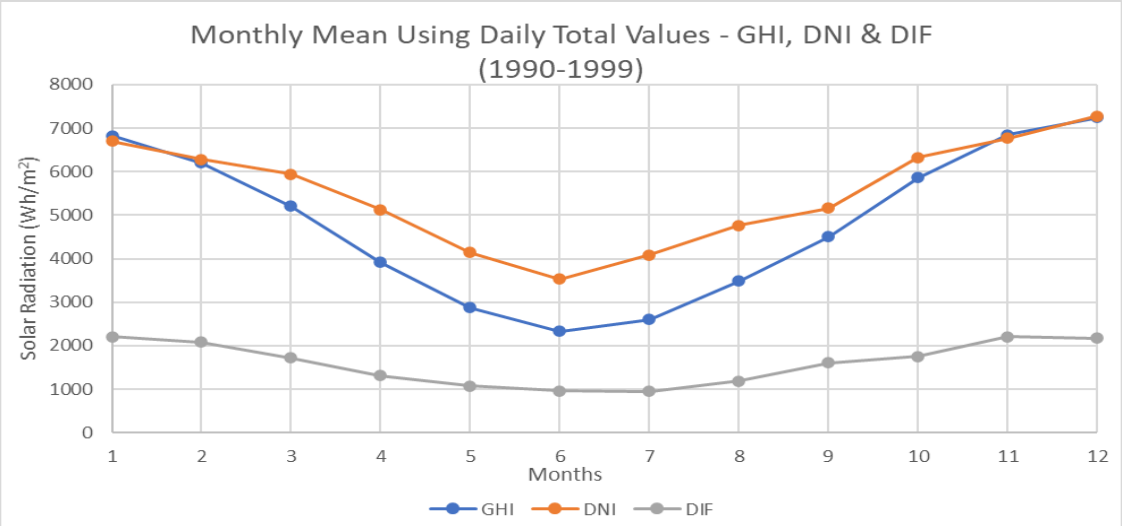
Sydney experienced a cooler than the average January. The mean average, mean maximum, and mean minimum temperatures were lower than the long-term averages by 0.9°C, 0.8°C and 1.0°C. It was generally sunnier in the mornings and the wind speeds were generally higher than average in January, the combination resulting in the solar PV array output being higher than average by 4.6%. The cooling consumptions of all the commercial building models were lower than the average by 9-14%. The west facing zone of the 10 storey office building saw least reduction of 7.1% in cooling energy consumption when compared to the average while other zones saw much higher reduction in cooling consumption ranging between 12-15%; the reason being the higher than average solar irradiation incident on the building in the afternoon hours and also the high wind speed in the morning hours and early afternoon hours. During the hour of peak cooling of the 10-storey office building model, the temperature was 28.8°C which was 2°C higher than the long-term average. The peak cooling energy consumption was therefore simulated to be 8.8% higher than the average. When comparing our EFMY 2050 simulation results with the results for January, it is projected that the two office models would have around 30-33% higher cooling consumption, and the supermarket would also have about 33% higher cooling consumption than for the January just gone.

Weather Statistical Analysis over 3 decades – Canberra first of many

An in-depth study of the weather of Canberra over the last three decades was performed by Exemplary recently, in part for incorporation by Standards Australia in the revised version of AS3634 *Solar heating systems for swimming pools* and the proposed AS5352 *Swimming Pool & Spa Heat Pump Systems* now in progress at the advanced draft stage. Readers can expect a similar analysis in the near future for the other seven capital cities and the Arid and Semi-Arid locations of Alice Springs and Mildura. This analysis will also be useful in understanding the change and trends in weather elements over the period. The study consists of analysing the statistical quantities like mean, maximum, minimum, and standard deviation of different weather elements over the period from 1990 to 2017, the longest record currently

available. Also, these quantities were calculated for each individual 28 years and also for the decadal periods of 1999-1999, 2000-2009 and 2010-2017.

The weather elements under study included the different solar measurements of Global Horizontal Irradiation (GHI), Diffuse Irradiation (DIF) and Direct Normal Irradiation (DNI) and other non-solar measurements like Dry Bulb Temperature, Wind Speed and Relative Humidity. The statistical analyses for the above-mentioned periods were done using the hourly measurements of the non-solar data. However, for the solar measurements, an analysis based on the daily totals was done for a more meaningful study – given that the hourly maximum will always be the clear-sky value and the minimum will always be zero. The following graph represents the average values of different solar measurements for the months during the decade of 1990-1999.



Solar Radiation Data for 2019 and 2020 now Imminent

Production of weather files for the years 2019 and 2020 and climate files incorporating that data is now imminent, potentially with enhanced solar data from the Bureau of Meteorology (BoM). As well as the higher resolution (geographically and temporally) made possible by the Himawari satellite, there is also a clear potential for the cloud cover data from which the BoM infers its solar data to be published as well. Currently, weather and climate data processors, like Exemplary, need to "reverse engineer" (infer) the cloud cover data from the BoM-derived solar data. This is dubious science during daylight hours and complete non-science for the half of all hours with no solar data - leaving processors no better solution than linear interpolation through the hours of dusk, night and dawn.

We will continue to keep you informed of developments in this field, although nothing has been announced over or since the festive season. The hiatus since July 2019 has meant an embarrassing delay to the production of up to date weather files for over two years now. The full one-page statement from the BoM released in November last year is available here for reference in the interim.

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Extending Statistical Capabilities to Produce P01 and P99 Years

Based on our work published at the APSRC 2020 which enabled our in-house software ClimateCypher to produce synthesised P10 and P90 years, we at Exemplary Energy have further enhanced our techniques to now also produce synthesised P01 (best) year and P99 (worst) years for any given period - generally several decades. ClimateCypher does this by selecting indicative actual months from the historical weather record and concatenating them into synthesised climate years. The most common of these is the Reference Meteorological Year (RMY) which in this terminology can be called P50.

Similar to our previous work, we have employed the use of Month Selection Parameters (MSPs) which are iteratively established for each of the 8 climate zones in Australia as defined in the National Construction Code (NCC). In this analysis, 21 locations were used, which include capital cities and other locations like Alice Springs, Tennant Creek, Oodnadatta and Cabramurra to represent all the climate zones and help optimize the value of the MSPs and confirm their robustness.

This process of iteratively establishing and optimizing MSPs is done in such a way that, initially a set of MSPs are used to generate P01, P10, P90 and P99 synthetic years via ClimateCypher for a given period which are then used in the simulation software System Advisor Model (SAM) to produce P00, P10, P90 and P99 test energy outputs. These energy outputs produced with the help of ClimateCypher for the period are then compared via percentage difference with the P01 (best actual year), P10, P90 and P99 (worst actual year) energy outputs produced for the same period by SAM. This process is then repeated several times with the MSPs iterated to decrease the percentage difference of ClimateCypher results relative to SAM energy outputs. An example of our findings for climate zone 2 is in the table below.

Climate Zone	Location	Latitude	Tilt angle	MSP (P01, P10, P90, P99)	Percentage difference			
					P01	P10	P90	P99
2	Brisbane	-27.39°	30°	0.20, 0.35, 0.80, 0.95	-0.08%	0.92%	0.59%	-1.20%
	Mackay	-21.12°	20°		0.54%	0.07%	-0.40%	-0.97%

You can see that MSPs 0.20, 0.35, 0.80 and 0.95 are able to produce satisfactory results for Brisbane and Mackay which are located in climate zone 2 (CZ2 Sub-Tropical) but at substantially different latitudes. By adding this functionality of synthesizing P01 and P99 years to ClimateCypher, we have further enhanced our clients' capability to understand and apply the worst- and best-case scenarios for any given design location for a renewable energy system.

Battery and Hydrogen Storage "pipeline" Jumped by 20 GW in 2020

By Giles Parkinson, RenewEconomy

The number of battery storage and hydrogen electrolyser projects in Australia soared in 2020, with the capacity pipeline now rivalling that of solar PV and wind energy as developers bet on a rapid transition to a renewables-dominated grid.

New data released by the energy consultants Rystad Energy shows that 19.2 GW of battery storage and hydrogen electrolysers (which can also offer storage capabilities) were added to the project pipeline in Australia last year. Read More.

Figure 1: New projects proposed in Australia in November and December 2020

Source: Rystad Energy RenewableCube

[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.