Exemplary Advances

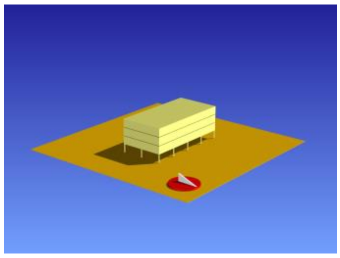
2020 August ***"Exemplary Advances"*** is the newsletter for Exemplary Energy Partners, Canberra. Feel free to forward it to friends and colleagues. Click here to subscribe or unsubscribe. Feedback is most welcome.

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

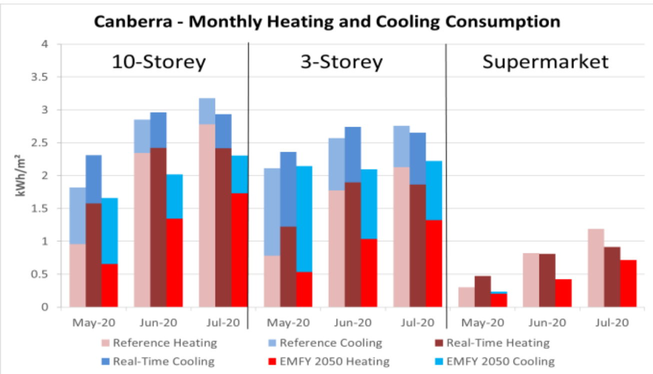
Exemplary Weather and Energy (EWE) Index[i] - July 2020

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

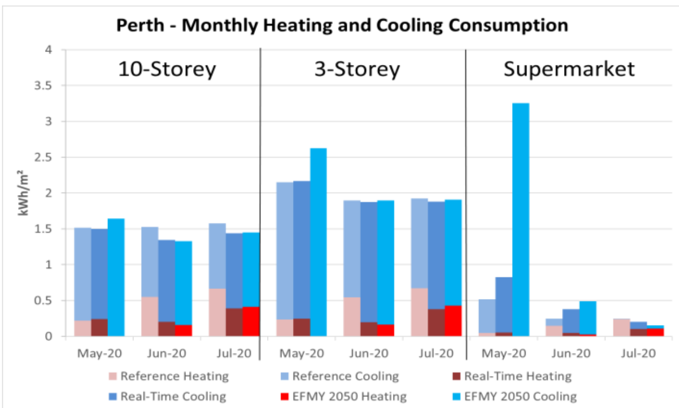
2020 July	Canberra		Perth		Sydney	
	Heat	Cool	Heat	Cool	Heat	Cool
10-Storey	-13.1%	31.4%	-41.7%	15.3%	-46.6%	13.6%
3-Storey	-12.3%	24.6%	-43.4%	19.2%	-48.0%	18.2%
Supermarket	-23.4%	N.A.	-56.1%	N.A.	-45.1%	N.A.
Solar PV	2.4%		2.3%		-2.3%	



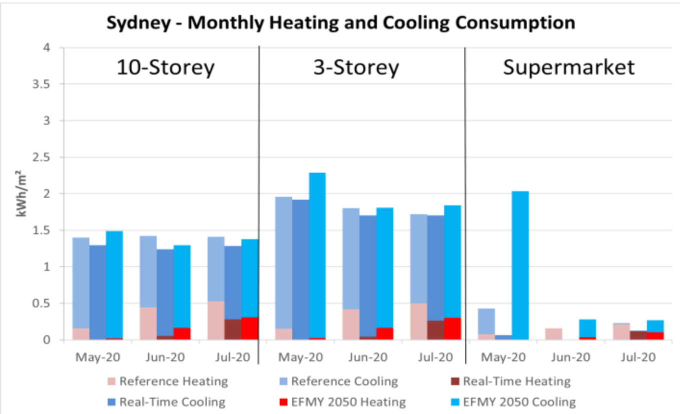
The Exemplary Real Time Year weather files (RTYs) the current Reference Meteorological Year files (RMYs) and the Ersatz Future Meteorological Years (EFMYs) used for these monthly simulations are available for purchase to allow clients to simulate their own designs for energy budgeting and monitoring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



Canberra had a warmer than average July. The mean average, maximum and minimum were higher than the average by 1.0°C, 1.2°C and 1.6°C respectively. It was sunnier overall; therefore the solar PV array had an energy yield of 2.4% higher than the average. All the commercial building models had lower than average heating consumptions. The heating energy consumption of the 10-storey office East and West facing zones were 8.3% and 10.1% lower than the averages respectively under this warmer and sunnier weather. The North facing zones also had lower heating consumption than the average but by a lesser amount of 6.2% due to the relatively lower temperatures generally in the afternoon. The temperature at the hour when heating consumption was at its peak was -1.1°C, which was 0.4°C lower than the average. The peak heating consumption of the 10-storey office model was therefore 0.2% higher than the 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 over 40% less heating consumption than the RTY, and the supermarket would require 20% less heating consumption than the RTY in July.



Perth had a warmer than average July. The mean average, mean maximum and mean minimum temperatures were higher than the averages by 1.9°C, 1.7°C and 2.0°C respectively. All three commercial building models therefore had lower than average heating consumption. It was sunnier; however, the solar PV array had an energy yield of 2.3% less. This was due to the warmer weather but more importantly, lower than average wind speeds which reduced the modules' efficiency. The 10-storey office West facing zones had over 40% lower than average heating energy consumption due to the warmer, sunnier and less windy weather. The South facing zones also had over 40% less heating energy consumption due primarily to the warmer air temperatures. At the hour of peak heating, the air temperature was at 6.5°C which was 0.1°C lower than the average. The peak heating consumption of the 10-storey office model was 10.7% lower than the average due to the slightly cooler temperature during the hour of peak load. 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 6-11% higher cooling consumption and the supermarket would have 54% lower heating consumption than for the July just gone; confirming just how extraordinarily warm this July was.



Sydney also had a warmer than average July. The mean average, mean maximum and mean minimum temperatures were 1.9°C, 0.2°C and 2.7°C higher than the averages. The heating consumption of all the commercial building models were lower than the average. The 10-storey office West facing zones had relatively larger heating consumption reduction – around 47% less than the averages due to the generally warmer weather during the late afternoon. It was sunnier; therefore the solar PV array had an energy yield of 3.6% higher. During the hour of peak heating of the 10-storey office building model, the temperature was 9.9°C which was 3.8°C higher than the average. Also, the wind speed was over 40% lower, hence the peak heating consumption of the 10-storey office model was close to 40% lower than the average due to the warmer and less windy conditions at the hour of peak demand. When comparing our EFMY 2050 simulation results with the results for July 2020, it is projected that the two office models would have around 7%-14% higher heating consumption, and, the supermarket would have 44% higher heating consumption than the July of the RTY; confirming just how extraordinarily warm this July was.

Passive Ventilation to Decarbonise Commercial Buildings in Australia

As described in "*Exemplary Advances*" 2020 July, Jack Wardale, a doctoral candidate in engineering for sustainable development at Cambridge University, UK, has partnered with Exemplary Energy to work on his dissertation project on prospects to shift to solutions involving passive ventilation to decarbonise commercial buildings in Australia. He will be presenting his dissertation on Wednesday 26 August and hopes to make his work accessible to our readers shortly thereafter. See our next edition for details.

Climate Change – Impact on Building Design and Energy

DeltaQ, led by engineer **Grace Foo** (pictured), has undertaken a research project entitled *Climate Change – Impact on Building Design and Energy* on behalf of the Department of Industry, Science, Energy and Resources (DISER) to better understand the impact of climate change on commercial building energy consumption and any HVAC and building design changes. Simulation expertise for the project came from Northrop's **Michael Smith** while the Ersatz Future Meteorological Years (EFMYs) and climate change expertise were provided by **Trevor Lee** of Exemplary. The report from this research has now been published and can be accessed here.

Delays to Solar Radiation Data for 2019

Regular readers might recall that Dr Ian Grant, the scientist at the Bureau of Meteorology (BoM) who processed the satellite data into estimated gridded solar irradiation data, died late last year (see "*Exemplary Advances"* 2019 December). Sadly the BoM has yet to restore that service, which has stalled with the data to the end of July, 2019, to the renewable energy and building simulation community. The Australian PhotoVoltaic Institute (APVI) is working with other interested groups and the BoM to restore that service as soon as possible. As usual, we hope to provide an update on their progress in the next edition as there has been no progress over the past month.

Exemplary Climate Data for APVI's SunSPoT Web-based Design Tool

In light of the ongoing delays with the BoM processing the satellite data into estimated gridded solar irradiation data, Exemplary is proceeding to supply climate data to the APVI's SunSPoT project based on our data 1990-2017 inclusive. This allows the solar potential of many Australian local government areas to be graphically available to industry and consumers alike even though it is not quite as current as we would like.

Precipitation Data being Added to Weather and Climate Files

Adding hourly data to the input files for the anticipated version of NatHERS software used for modelling the energy performance of dwellings will allow accurate prediction and avoidance of condensation issues for enhanced building healthiness and durability. Currently this is required by the 2019 edition of the NCC but is only possible with specialised software packages like the German Wärme Und Feuchte Instationär WUFI and its British competitor JPA. Also, because 30-year time series of recorded hourly precipitation data (mostly rainfall) do not exist for many Australian locations, it is necessary to synthesise hourly precipitation data from the daily data (precipitation to 9am) which is available for all our locations of interest from well before 1990.

By analysing data from sites and years that do have hourly precipitation data, our research has found that, where there is some rain in the 24 hours to 9am, the four recorded meteorological elements that most correlate with the advent of precipitation and ongoing precipitation are cloud cover, change in humidity, change in temperature and pressure change. While the coefficients for the four variables appear weak, they are reasonably consistent across locations and across the eight climate zones of the NCC. The next stage of analysis will use machine learning to produce a set of rules based on the correlations of these four elements to distribute recorded daily precipitation across the 24 hours on a 'most likely' basis. Those results will then be used for comparison with coincident actual hourly precipitation to evaluate how reliable and robust a distributive algorithm we have achieved and obtain feedback for the further refinement of the algorithm.

Effect of Wind on Building Energy Performance

After the severe hailstorm in Canberra in January, many of CSIRO's weather station instruments were damaged as reported in the February edition of *"Exemplary Advances"*. Since then, the apparatus records calm weather (zero wind speed). As an interim measure, we are concatenating the RTY data with RMY wind data. As an opportunity for ad hoc research and to validate this, we have compared the two conditions of no wind (actual weather readings) with indicative wind (incorporating RMY wind data) for the end energy consumptions for the three types of buildings as a sensitivity analysis. Also the solar PV output for both conditions were analysed through System Advisor Model (SAM). All the comparisons were made for annual, summer (month of February) and winter (month of May) data.

The simulated annual end energy consumption was found to be higher for the no wind condition by 0.16%, 0.11% and 0.06% respectively for 3 storey office building, 10 storey office building and supermarket indicating the relative insensitivity of annual energy use to wind speed. For the chosen winter month, the end energy consumption was lower for no wind condition by 0.89%, 1.05% and 0.04% respectively for the above mentioned types of buildings and for the summer month it was found higher by 1.51%, 1.4% and 0.51% respectively. For the solar PV output, the no wind condition gave lower output by 4.8% for the annual comparison while for winter and summer examples the output was lower by 8.6% and 9.2% respectively. This comparison confirms the higher relevance of wind for cooling and thereby improving the efficiency of solar panels throughout the year.

Asia Pacific Solar Research Conference – APSRC Melbourne 2020

Exemplary has offered three papers for consideration at this year's APSRC at the end of November:

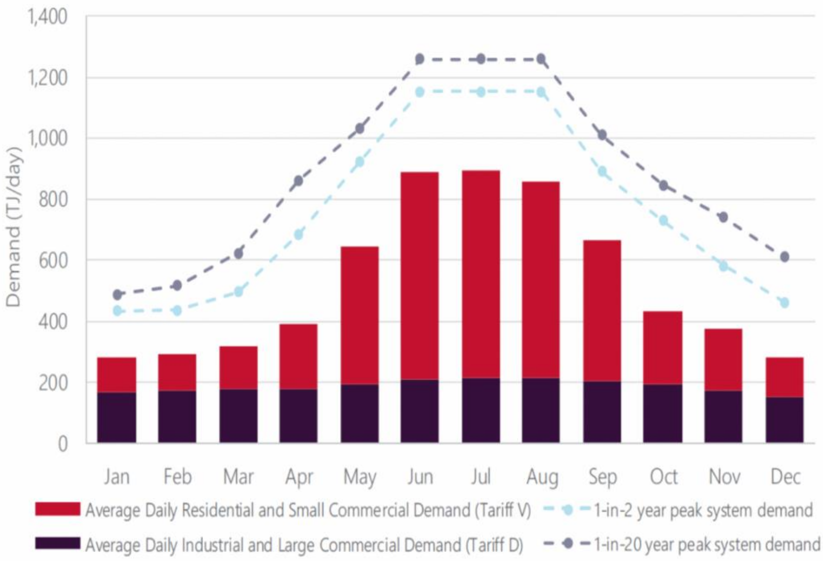
1. Updating Australia's Reference Meteorological Years (RMYs) with the addition of Hourly Precipitation Data
2. Effect of Energy Efficiency Rating (EER) of Dwellings on Sale Prices in the ACT 1999-2020
3. Verification of ClimateCypher Climate Data Outputs with System Advisor Model (SAM)

More details will be provided in future editions of "Exemplary Advances".

We must do something about gas – but there are smarter options

By Alan Pears

When it comes to gas, Victoria is very different from other states. As the Australian Energy Market Operator has pointed out, Victorian winter gas demand is about three times summer demand. And on very cold days, it is more than four times average summer demand. The Australian Energy Market Operator, AEMO, in its 2019 Victorian Gas Planning Report expects Victorian gas production to decline in coming years, though it would still produce more than Victorians use.



Victoria has been and still is a significant net exporter of gas, which is not the impression gained from the federal government or the gas industry. So Victoria has a winter gas supply problem, as daily production now averages around 950 TJ, and AEMO expects this to drop to around 670 TJ/day on average by 2023 – well below winter seasonal demand. Read more here.

Figure: Average daily demand by month with 1-in-2 and 1-in-20 peak day demand forecasts (TJ/d)

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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.