Exemplary Advances

2021 September ***"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.

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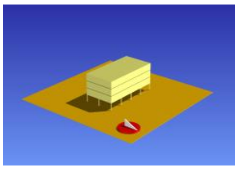
In this issue:

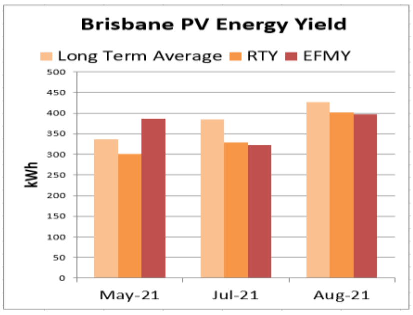
Exemplary Weather and Energy (EWE) Index[i] - August 2021

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

2021 August	Weather Index (monthly means)[a]						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	+2.1	-1.5	-4.7	+47.0	+20.3	-2.0	+218	-21.4	+236	-27.5	+45.1	-100	-5.8
Canberra	-0.4	-0.5	-0.1	+13.0	+1.9	+1.0	+10.5	-6.2	+7.5	-7.3	+4.6	-	+11.7
Perth	+0.5	-0.6	-1.0	+17.0	-2.6	-12.0	+19.5	-9.9	+14.5	-3.5	-44.9	-100	+3.2
Sydney	+2.3	+1.9	+0.9	-4.0	-10.4	-19.0	-65.9	+12.0	-63.2	+14.4	-77.0	+130	+4.2

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.

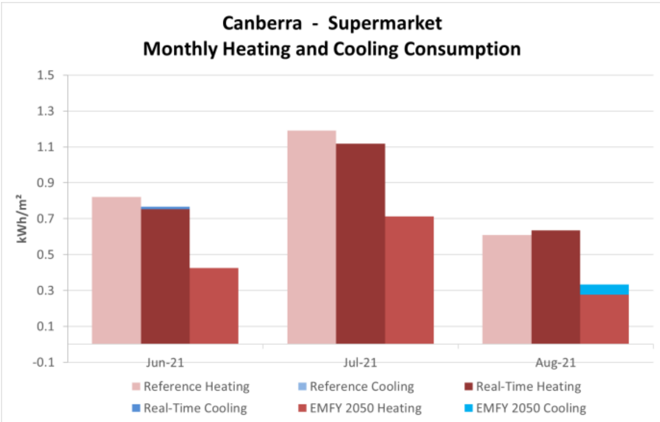




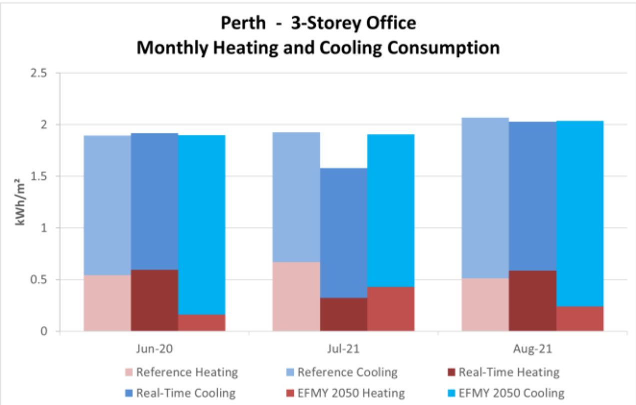
Brisbane had a cooler but more humid August than the average, with lower than average solar irradiation, particularly in the mornings. The wind speeds were also generally lower than average. The solar PV simulation results showed a 5.8% lower output than average, and the cooling energy consumption of all commercial office building archetypes were lower than average. The heating consumption of all office building types was higher than average, with large margins resulting from a combination of low solar irradiation and low temperatures – although readers should note that these margins come from a base of very low heating requirement in an average August, resulting in a high

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

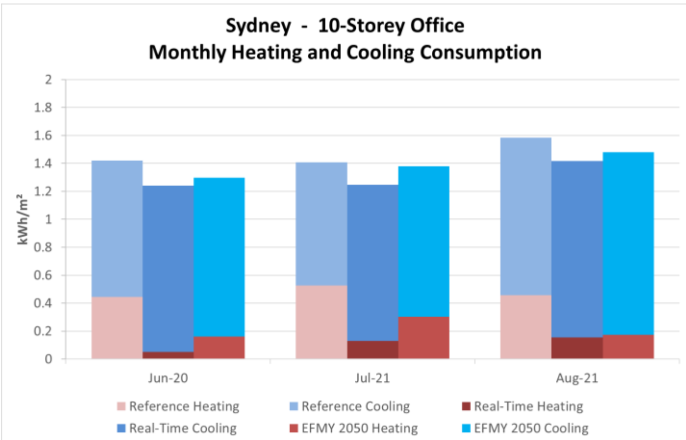
relative difference. The heating consumption of the east-facing zone of the 10 storey building was 115% higher than average, largely attributable to the lower than average solar irradiation in the mornings. When comparing our EFMY 2050 simulation results with the results for August 2021, the 3-storey and 10-storey office models are projected to have 41% and 33% higher cooling consumption (respectively). The EFMY 2050 solar PV energy output projection was 5.8% lower compared to this August.



Canberra saw slightly cooler but more humid weather than average in August. Solar irradiation was comparable to the long-term average except for an increase around the middle of the day. Solar PV output was 12% higher than average, driven by a minor overall increase in solar irradiation, but largely also due to lower than average temperatures throughout. Both office building archetypes saw lower than average cooling energy consumption. For the 10-storey office building, the east facing zone had the highest relative difference in heating energy consumption when compared with the average. This 38% higher consumption was largely due to lower than average temperatures seen predominantly in the mornings. When comparing our EFMY 2050 simulation results with the results for August 2021, the projected consumption of each of the two office models was around 12% higher. The EFMY 2050 solar PV energy output projection was 11% higher than August 2021.



Perth also had a slightly cooler and less humid August than average. Perth generally received solar irradiation comparable to the long-term average but it was slightly higher in the afternoons on a typical day. With higher-than-average morning winds and lower temperatures, the solar PV output was 3% higher than average. All three commercial building archetypes had slightly lower than average cooling energy consumptions, and all zones of the 10 storey office building had a lower than average cooling energy consumption. The north facing zone had the least deviation of cooling energy from average as the temperature was typically lower than average 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 14-20% higher cooling consumption than August 2021. The EFMY 2050 solar PV energy output projection was 3.4% lower than August 2021.



Sydney had a warmer but less humid August than the average. The solar irradiation received in Sydney was higher than average especially during the late morning hours, and wind speeds were higher than average during the same hours on a typical August day. This led to a 4% higher PV output than average. The heating energy consumptions of all the commercial buildings were lower than average. All the zones in the 10 storey office building had higher than average cooling energy consumptions. The east and south facing zone had higher cooling consumption when compared to the long term average. When comparing our EFMY 2050 simulation results with the results for August 2021, the two office models are projected to have slightly higher heating and cooling consumption. The EFMY 2050 solar PV energy output projection was 5.1% lower than August 2021.

New Exemplary Team Member – Associate – Hongsen Zhang

Hongsen Zhang, M. Eng., M.AIRAH, is an energy efficiency consultant with 20 years of academic and industry experience and is one of Australia's leading building energy simulators. He utilises simulation techniques to support energy audits, energy monitoring programs and control and operational reviews, and contribute to energy efficiency policy.

With significant expertise in simulation packages including IES, TAS8.5, DOE2, Ecotect and AGI32, Hongsen has completed over 60 high quality simulation projects for both new and existing buildings across the commercial, educational, and residential sectors. His policy development projects including leading a team to develop over 1,200 models to inform the revision of Section J – Energy Efficiency in the National Construction Code (NCC) Australia 2019, the building code energy efficiency trajectory, and various other follow-on projects.

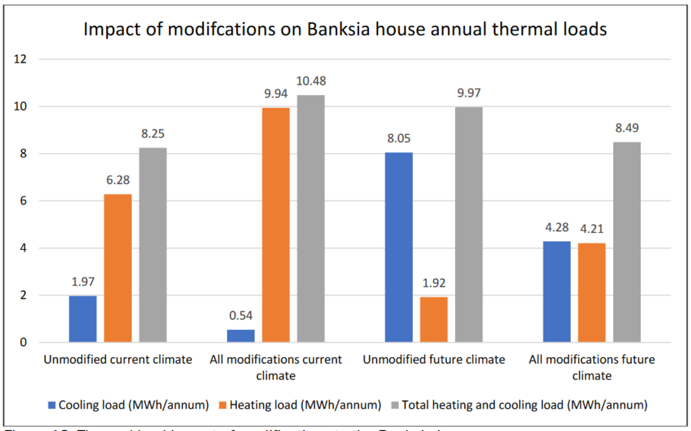
Hongsen has a strong interest and expertise in calibrated simulation, a complex but very powerful tool to accurately model the energy consumption of existing buildings. He has completed a number of calibrated simulation projects since 2010 and has recently been reviewing various calibration methodologies proposed by academia to identify suitable solutions for industry.

He has published 17 peer reviewed papers in the field of HVAC and energy efficiency in buildings and was awarded the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) W.R. Ahern Award for the Best Technical Paper in 2018.

RMIT Student Projects with EFMY 2050 — Brett Munckton

Brett Munckton, Master of Energy Efficient and Sustainable Building student at the RMIT has done a case study as part of his masters. This involves simulating the energy performance of Banksia house (depicted on the side), which is an energy efficient house design that was developed by the Australian government to encourage sustainable construction. With the Victorian temperatures forecasted to increase by an average of 2.4°C by 2050, this case study focuses on recommending modifications to the house design to improve performance in the future anticipated warmer climate. The Ersatz Future Meteorological Year (EFMY) data for 2050 was used to simulate the building performance in the futuristic climatic conditions

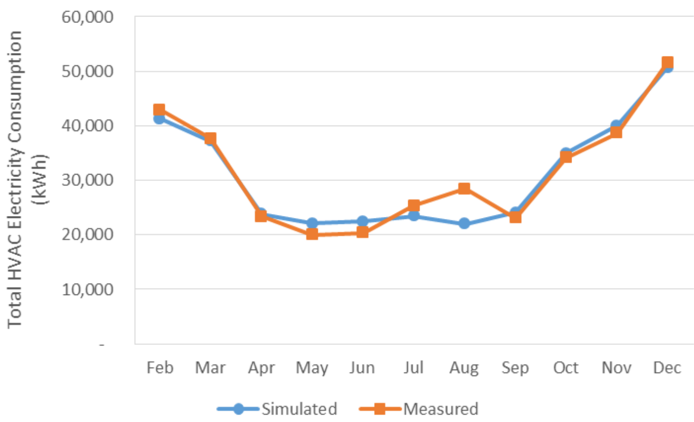
Munckton first modified the Banksia house to incorporate the recommendation of the National Construction Code 2019. The house model as per the designs of the Australian government and the NCC compliant model of the Banksia house was simulated in Integrated Environmental Solutions Virtual Environment (IESVE) software. It was found that the Banksia house performed better than the NCC compliant version. Therefore further modification was proposed to the Banksia house to improve its performance during the warmer temperatures in the future.



According to the literature survey conducted by Munckton, some of the viable modifications are increasing the shading especially along the northern elevation of the house, reducing the area of fenestration and reducing the heat transfer rate by reducing the U value of the windows. The simulation results using EFMY 2050 data found that by making these modifications, the annual thermal load of the Banksia house in the future climate could be reduced by 15 per cent. The modifications for the future climate however caused a 21 per cent increase in annual thermal load in the current climate. This indicates that design modifications for the future climate must be chosen with care to limit any adverse impacts in the current climate. The results demonstrate, to achieve optimal outcomes, buildings may need to be modified over time as the climate changes.

Calibrated Simulation of Buildings – an Introduction

Building simulation has been widely used in new building design and construction in Australia for design optimization, code compliance, NABERS commitment agreements and Green Building Council of Australia's Green Star submission. Simulation has made significant contributions to the evaluation of design options, verifying building code compliance and predicting the potential of the operating energy consumption for new buildings.



However, much of the opportunity for energy efficiency comes from tuning or retrofitting existing buildings. Design models or performance prediction models – such as the simulations used for NABERS commitment agreements – cannot be directly used as the baseline model to test the tuning or retrofit options. This is because of discrepancies between existing buildings and designs due to the degradation of HVAC equipment, changes in building controls, occupancy profiles and behaviours, the introduction of large plug loads and other sources. As a result, it is quite common to find that the simulated energy performance does not match the measured energy consumption.

Where accuracy is needed, it is necessary to calibrate the simulation to the available measured data for the building. ASHRAE Guideline 14-2002 defines evaluation criteria for this purpose. Once calibrated, the model can be used as a reliable baseline to examine the retrofit options or tuning measures, and for monitoring and evaluation using Exemplary Energy's Real-Time Year (RTY) weather data. The Exemplary Weather and Energy (EWE) Index is a simplified application of this technique, carried out every month to its three stylised archetype buildings to quantify the effects of recent weather on expected building energy consumption.

Calibrated simulation is very useful but is made challenging by a range of uncertainties. It relies on the simulator having sophisticated simulation skills, attention to detail and extensive experience in building operation. There are many calibration methods, which fall into four categories – (1) manual calibration methods; (2) graphical-based calibration methods; (3) calibration based on special tests and analysis procedures; and (4) automated techniques for calibration. In industry we usually apply manual calibration methods. The other three calibration categories are still in the academic research stage. See *"A Calibrated Simulation Case Study for an Office Building in Canberra"* for more details.

Exemplary Energy Associate Hongsen Zhang is an award-winning specialist in this area of work. Read more about Hongsen in this month's "Exemplary Advances".

XMYs Available — eXtreme Meteorological Years

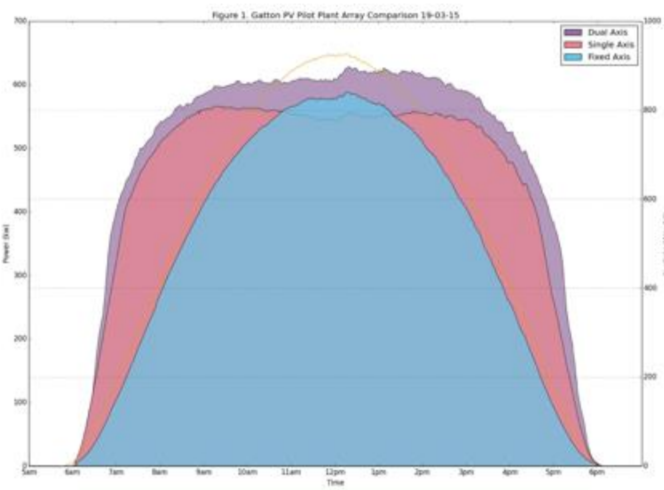
eXtreme Meteorological Year (XMY) data produced by Exemplary is a representative year data of the extreme weather perceived in a period with 4 percentiles. The P01, P10, P90 and P99 months are generated by our in-house software, ClimateCypher and this would represent the weather that would be expected 1%, 10%, 90% and 99% of the time in that given period. Apart from the application it has for design requirements, which were discussed in previous editions of "Exemplary Advances", it can be used effectively in the financial risk analysis. Renewable energy plants are capital intensive projects and the feasibility of these projects highly depend on the profitability of the project once it is commissioned. And the cash flow of these plants is highly dependent on the weather it experiences. These plants are also often subject to penalties in case of non-adherance to the power export into the grid prescribed in the contract.

Accordingly, financial analysts and investors in renewable energy projects need to appreciate worst case scenarios in order to allow for the impacts of cloudy weather on cash flow and ensure relevant policies are in place to survive the period of lower than typical output. XMY data would be helpful in analysing these aspects. Exemplary currently produces the XMY of all the Australian capital cities and other major locations. Please contact us for a prompt quote if you are in need of the XMY data.

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 Community Energy for Goulburn (EC4G) Board unanimously endorsed Komo Energy to proceed with the Early Contractor Involvement (ECI) and expects the contract for the Engineering, Procurement, Construction (EPC) to be signed by the end of November.

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 is experiencing a single-axis tracker (SAT) software issue which intermittently causes a single row to face the wrong direction since May and they are working with the farm builder (Epho) and the tracker supplier (Schletter) to rectify this.

The Annual General Meeting will be held on Friday 22 October at 12 noon both virtually and in person (depending on how the ACT lockdown and health directions evolve). If unable to meet in person, then the event will be held virtually. They will issue the Annual Report by Friday 1 October.

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 has set a target of selling at least 200 more membership parcels (just under $5,000 each) by the end of October, 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.

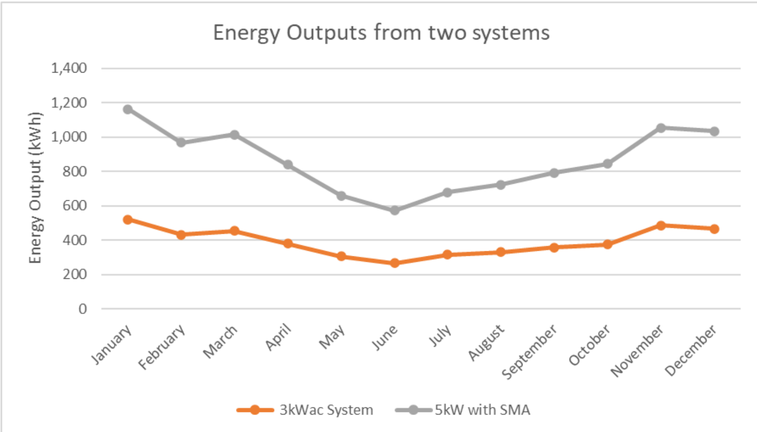
Upcoming Milestones

- Financial Close expected 31st of October - 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.

Rooftop solar systems are getting bigger, so will our EWE PV analysis

In our July edition of "Exemplary Advances", we reported on recent market analysis showing that the average size of rooftop solar PV systems currently being installed in Australia rose to 8.7 kW in June. Continuing our partnership with Global Sustainable Energy Solutions (GSES) to update the system used in our simulations for the Exemplary Weather and Energy (EWE) Index to better reflect the current Australian market. According to GSES, while the average system size has pushed upwards of 8 kW in recent years, the figure is skewed by a relatively small number of high-powered 3 phase systems. As most residential customers are connected to a single-phase power supply, a more representative system would be a 6.6 kW_{DC} array paired with a 5 kW_{AC} inverter. This power capacity has been the default limit for a single-phase inverter in order to limit the effects of phase imbalance. This limit is imposed by AS/NZS 4777.1 and also by network operators, who have the ability to provide exceptions where they see fit.

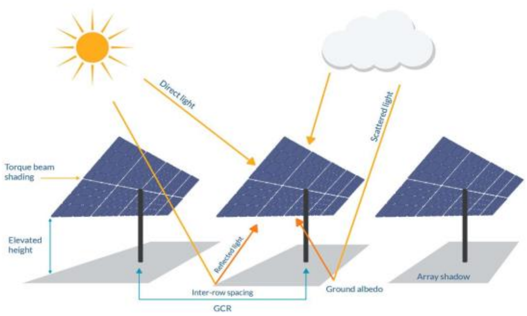
GSES proposed two candidate inverters: the SMA 5000TL and the Solaredge SE5000H, both having a rated AC power output of around 5 kW. The SMA inverter was selected on the basis that it is currently more cost effective and has wider operational limits. The first step we took was to simulate the power outputs with the latest RTY on the existing model (the 3 kW model used previously) and the 5 kW model designed by GSES. The results obtained are graphically shown here.



With the availability of more efficient solar panels and inverters, along with the common technique of "oversizing" of the DC array compared to the inverter capacity, the expected energy output is more than doubled when compared with the previous 3 kW model.

To ensure that our benchmarks reflect common practice, Exemplary Energy will update the PV model for the EWE Index, with the changes to be introduced in the coming editions of "Exemplary Advances".

ANU scientists set new record with bifacial solar cells



Scientists at the Australian National University (ANU) including Dr Kean Fong and Dr Marco Ernst have developed dual-sided solar cells with record breaking efficiency. These 'bifacial' solar cells generate power from both sides, thus taking advantage of ground- or roof-reflected solar rays to substantially improve their output (see image on the side).

This cell will have a conversion efficiency of 24.3% on the front side and 23.4% on the rear – an almost symmetrical power generation capacity, or a 'bifacial factor' of 96.3%.

The team has used a cost-effective, industry-compatible manufacturing process known as laser doping, and is hoping their newly developed cell can contribute to increasing the market share of bifacial solar cells in future solar farms.

Click here to read more about this Australian Renewable Energy Agency (ARENA) and Australian Centre for Advanced Photovoltaics (ACAP) supported work.

New energy and disaster solutions leads announced at ANU

The Institute for Climate, Energy and Disaster Solutions (ICEDS) at ANU has announced two key appointments to its executive team to lead its work on energy and disaster mitigation and responses.

The newly appointed Head of Energy, Professor Frank Jotzo, (left image) is the director of Centre of Climate and Energy Policy in the Crawford School of Public Policy at ANU and a senior author with the Intergovernmental Panel on Climate Change (IPCC), and is a joint editor-chief of the journal Climate Policy.

The post of Head of Disaster Solutions will be filed by Dr. Roslyn Prinsley (right image), whose expertise as the head of Strategic Research Initiatives in the ANU's Office of the Deputy Vice Chancellor will see her in good stead to make a significant contribution in her new role.

The ICEDS has the primary aim to collaborate research on climate change, energy and disaster preparedness and responses. The two appointments will help in the institute's ability to address the ANU's strategic goals relevant to these areas. Dr Jotzo said that the shift to decarbonized energy systems will provide major economic and environmental opportunities and is a vital part of an effective climate change response. Dr Prinsley will be key in working with experts across ANU to understand the nature of disasters and to develop innovative solutions. Click here to read more on this.

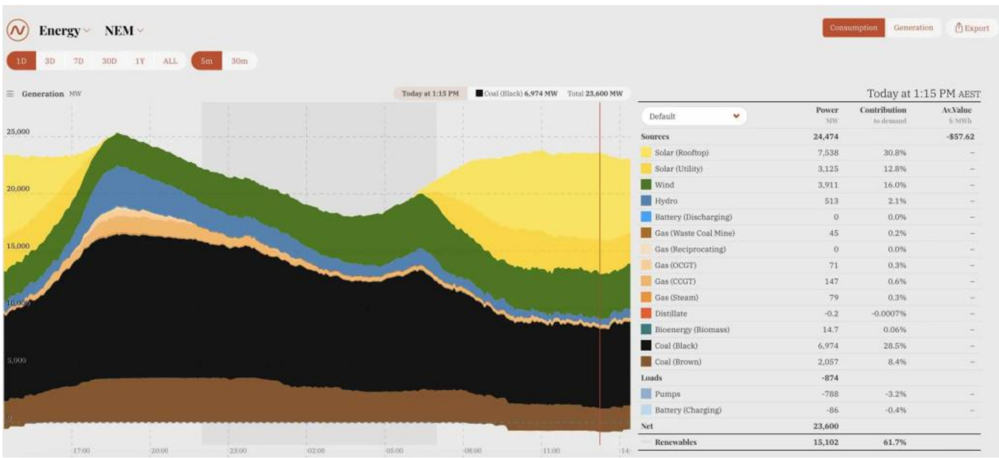
Renewables contribute a record 61.7% of power to the Australian grid

By Giles Parkinson

The share of renewable energy in the Australian electricity grid reached 61.7% momentarily on Friday 24th of September at 1.15pm — exactly 4 days after the prior highest peak of 60.1%.

At the start of this month, the record for a share of renewables was 57.1 per cent, so it has jumped 4.5 percentage points in less than four weeks. At the same time, the combined output of brown and black coal was just 9031 MW, a share of just 36.9 per cent, and 20 minutes later it even reduced to 8986 MW.

"Spring is the seasons for records to bloom", said the Australian Energy Market Operator (AEMO) as mild temperatures and sunny weather could be expected which lead to rooftop solar systems building space conditioning lowering the demand from the grid. Therefore higher records can be expected in the next month or so.



AEMO is expecting 75% of the grid demand to be met by solar several times over the span of the next 5 years and is forecasting times at which 100% of the grid to be supplied by wind and solar by 2025.

Click here to read more.

Australia can achieve rapid, deep and cheap emission cuts

By Andrew [Blakers](#)

There is a superhighway to rapid elimination of 80% of Australian greenhouse gas emissions. It uses mature, low-cost, reliable technology from vast production runs. Neither new technology nor taxes are needed. And it will cost approximately nil.

To get onto this superhighway, we need to electrify everything: we accelerate the already-rapid growth of solar and wind to displace coal and gas from electricity generation; we move to electric vehicles to displace oil; and we use electric heating to displace gas.

The deployment of solar and wind needs to double from 7 gigawatts in 2020 to 15 gigawatts per year. This is relatively straightforward considering that the deployment rate of solar and wind in 2015 was only 1 Gigawatt, and that prices continue to fall.

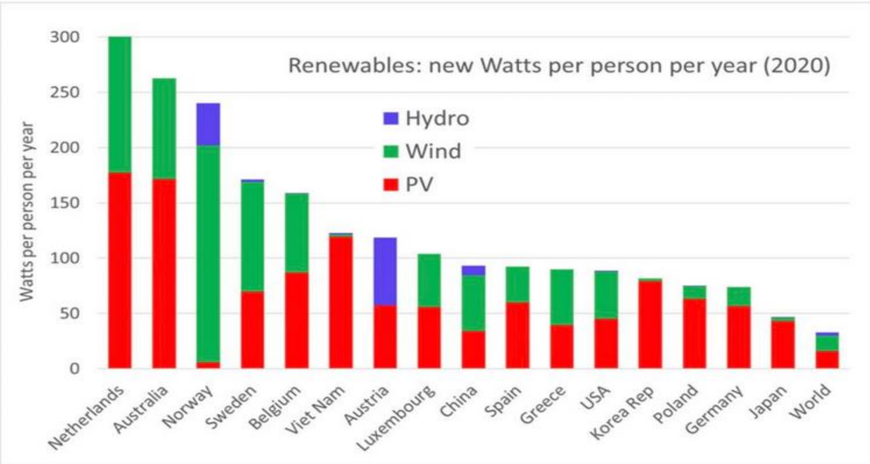


Figure 1: Deployment speed of solar and wind in 2020 in terms of Watts per person per year [IRENA].

No new technology is required to reduce emissions by 80%, although continuing technical development will yield ever lower energy costs. However, eliminating the last 20% of emissions will require substantial research, development and industrialisation. These stubborn areas are aviation, shipping, the chemical and metals industry and the land sector. Read On

Vale Alan Major – Energy Visionary in Central Western NSW

By Jane Lawrence

As well as the challenges of trying to build a project like the Orange Community Renewable Energy Park (OCREP) in the midst of a pandemic, Alan Major, the visionary man who gave life to Energy Democracy, choosing to commit his efforts to improve the uptake of renewable energy and to help reduce the impact of climate change, passed away at the end of July.

Alan was passionate about ensuring fair access to renewable energy for all and established the Energy Democracy Central West Co-operative to provide a means for people to contribute to the transition to a low carbon future.

The Co-Op's Board is committed to carrying on his vision and to see that his initiative thrives.

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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.