Australian Energy Market Commission Rule Change ERC3011 Consultation: Access, Pricing And Incentive Arrangements For Distributed Energy Resources

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Dear AEMC Consultation Personnel,

Thank you for the opportunity to make a submission to the Consultation regarding proposed Rule Change ERC3011: Access, Pricing And Incentive Arrangements For Distributed Energy Resources. This submission is made on my behalf only, and I am happy for it to be made public at the Commission's website under my name. I ('the writer') am an Australian citizen (born and lived in NSW for some decades) who moved to Queensland's Wide Bay region in 2002.

Summary

1. It may be reasonable for a power retailer/distributor to decrease Feed-In Tariffs paid for power exported to the grid from a customer's own "behind-meter" generating equipment (generally an array of solar panels, but possibly also a domestic-scale wind turbine), or possibly even set such Feed-In Tariffs to $0.00 per kWh.
2. It would be unreasonable and counter-productive to charge consumers for any such exported power; in particular any such measure would discriminate against customers who cannot afford the behind-meter energy storage devices ("batteries").
3. Instead, power distributor/retailers can and should invest in community-scale energy storage devices ("batteries", such as Vanadium Redox Flow Battery installations) installed in subnetworks where prevalence of behind-meter generating installations are sufficient to produce excessively high voltages in the affected subnetwork.
4. Such storage devices would decrease excessively high voltages by withdrawing energy from the grid ("charge"), then discharge when there is high demand and low "behind-meter" generation (eg early evening; see Figure 1 below), thus recovering their costs by supplying demand at times when NEM wholesale power prices are high.

Submission in Detail

Australia's energy supply system – which has served the National Electricity Market (NEM) well for decades - is undergoing major transformations as aged, clapped-out and expensive coal-fired power stations are rightfully shut down, to be replaced by a plethora of widely distributed variable, intermittent power generating installations of varying size and capacity. The vast majority of installations will be domestic, "behind the meter" arrays of solar panels on home rooftops, and the vast majority of owners of such installations will remain dependent on metered services via the power transmission and distribution grid, because whereas they can afford solar panels they generally cannot afford the battery storages they would need to avoid exporting excess power to grid through their local distribution subnetwork.

This problem may be temporary; as and when Australians can replace their petroleum-powered vehicles with battery electric vehicles, recharging the battery in their electric vehicles will greatly decrease the problem of destabilisingly high voltages in grid subnetworks; in fact such vehicle batteries may provide power to the household on still nights when "behind-meter" generating equipment (solar panels and domestic wind generators) is not operating.

Nevertheless, Rule Change ERC3011 may give energy retailers and distributors latitude to impose charges on their customers when the customers' solar panels are producing sufficient power for some to be exported to the grid.

In general, I am strongly opposed to imposing a cost on exporting unused solar power into the grid. Imposing charges on exported solar power

1. discriminates against householders who can't yet afford behind-meter storage devices such as home batteries or battery electric vehicles. On this point, I am not just strongly opposed, I am bitterly opposed to any such stunt being attempted.
2. would be a major disincentive to continued installation of residential rooftop solar power, and could even be a disincentive to commercial rooftop solar;
3. will, by discouraging installation of solar power, leave the National Electricity Market unprepared for the surge in demand that will accompany the adoption of battery electric vehicles in Australia. Numerous models are to be released onto the Australian market in 2021 alone [1].

Instead, the issue of excessively high voltages during the day when the sun's shining in suburbs with lots of rooftop solar can be addressed by installing community-scale energy storage facilities ("batteries") at appropriate locations such as substations. That way, evening peak power demand can be met with minimum call for 'peaking' gas generation, which happens to compose the most expensive production technologies in the Australian market; in the long run this will save everyone money.

The following calculations are intended to demonstrate the feasibility of this argument, using power production data for various technologies and fuel types supplying the National Energy Market.

Data were downloaded for 30 minute periods for the 7 days (168 hours) to 2200 (10 pm) on 17 May 2021 from OpenNEM.org.au. A summary of these data sufficient for our purposes is given below in Table 1, and a downloaded graphical representation of these data is shown in Figure 1.

Before the advent of behind-meter photovoltaic power production, power generation and demand followed similar sinusoidal variations over any 24 hour period, with maximum demand and generation in the early afternoon and minimum demand and generation around 0330 (3.30 am). Rooftop solar production has largely eliminated this early afternoon peak in demand to the extent that exported power from behind-meter solar panels is significantly depressing demand for utility generation until the late afternoon, when demand rises to such extent that there gas and distillate-fired

[1] In the next several years major car-makers will be releasing battery electric vehicles onto the market; Hyundai, Mercedes-Benz, Kia, Nissan, Audi, Volvo, BMW, Porsche, Mazda, and Lexus all plan to release one or more models in calendar 2021 - https://www.caradvice.com.au/938814/new-electric-cars-australia-2021/, viewed on 10 May 2021.

peaking power generators can set a high price in order to satisfy the surge in demand that occurs in late afternoon and early evening.

During the middle of the day when rooftop solar is exporting power to the grid, the subnetwork in suburbs that have particularly high proportions of rooftop solar experience excessively high voltages due to the surplus of locally generated power.

These are the circumstances in which AEMC rule change ERC3011 is proposed.

Community-scale batteries would, as well as helping regulate distribution network voltages in the subnetwork of the substation at which they are installed, they would also have the benefits of smoothing power demand fluctuations in the transmission lines supplying such substations.

Battery storage overcomes the central problem that power system planners once had: to ensure as best possible, minute by minute, that power generation at any given moment matches demand at that same instant. Battery storages effectively relax this constraint by allowing generated power that is momentarily surplus to demand to be stored for later moments when there may be a generation deficit, and it is through use of batteries that it is possible to harness highly variable, albeit meteorologically predictable, energy sources such as wind and direct sunlight to variable, albeit predictable, grid demand.

As well as helping stabilise the transmission network (the'grid') community-scale batteries also have potential as emergency power supplies to their localities in the event of blackouts or loss of supply in the bulk transmission.

Given that in the long run there is no role for coal-fired power in this climate-constrained world, then it is preferable that there be minimal impediments to citizens and enterprises helping themselves and the rest of the nation by installing as much of their own power generating equipment as they may choose, and it is therefore inevitable that the power transmission system be transformed from a soon-to-be outdated centralised production and radial distribution to a system that allows multi-directional transfers and storage.

Flow battery technology, such as Vanadium Redox Flow Battery (VFRB) developed by Professor Maria Skyllas-Kazacos at UNSW in the 1980's[2] would be appropriate for such applications, with notable advantages over other battery types; notably, they cannot catch fire, can be fully discharged if necessary and do not degrade over repeated charge/discharge cycles.

The Australian Renewable Energy Agency (ARENA) is funding the trial of a 2MW/8MWh VFRB to be co-located with a 6 MW solar array in South Australia, and will be connected to the NEM grid [3]. Project cost will be about $20 million. The 6MW solar farm would be the equivalent of 1,000x 6 kW installations, a typical domestic installation size; however, a further benefit of flow battery installations is that they can be sized appropriately for any application.

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[2] "Vanadium redox battery", https://en.wikipedia.org/wiki/Vanadium_redox_battery, viewed 10 May 2021.

[3] "First grid scale flow battery to be built in South Australia", https://arena.gov.au/news/first-grid-scale-flow-battery-to-be-built-in-south-australia/, viewed 10 May 2021.

Utility renewables include batteries, which consumed 2,828 MWh while charging, and discharged (dispatched) 2,316 MWh to the grid. Charge-discharge ('round-trip') cycle efficiency for batteries is therefore estimated as (2,316 ÷ 2,828) = 81.9%.

Total power supplied to the grid from biomass, distillate and various types of gas-fired power generators is 241.8 GWh, so if 295.6 GWh of energy could be found from some other technology (241.8 = 81.9% x 295.6) then it should be possible to replace these high-cost generating technologies altogether. Australia could profitably export the additional gas and it would need to import less distillate or petroleum; the unburnt biomass could be utilised for fibre for paper manufacture, or mulched to be used for soil improvement in regenerative agricultural operations.

The difference between "theoretical" and "supplied" energy for brown and black coal is 468 GWh (100.3 GWh and 367.7 GWh respectively for each coal type); that is, 468 GWh of power could be available if relatively low-cost brown and black coal-fired generators were operated at estimated maximum rate, a substantial surplus over the 296 GWh required for charging of batteries to replace gas-, distillate- and biomass-fired generation.

Finally, there is no need to develop gas-fired power generation anywhere in the NEM, despite the apparent determination of our elected Federal Government that as large a proportion of NEM demand as possible be met by even more expensive, environmentally destructive mineral (Coal Seam and/or Shale) gas. This determination is surprising when it is realised that with Australia's extensive sunlit plains and wind-blown coastlines, with a little thoughtful ingenuity there is ample opportunity to avoid burning gas for power generation.

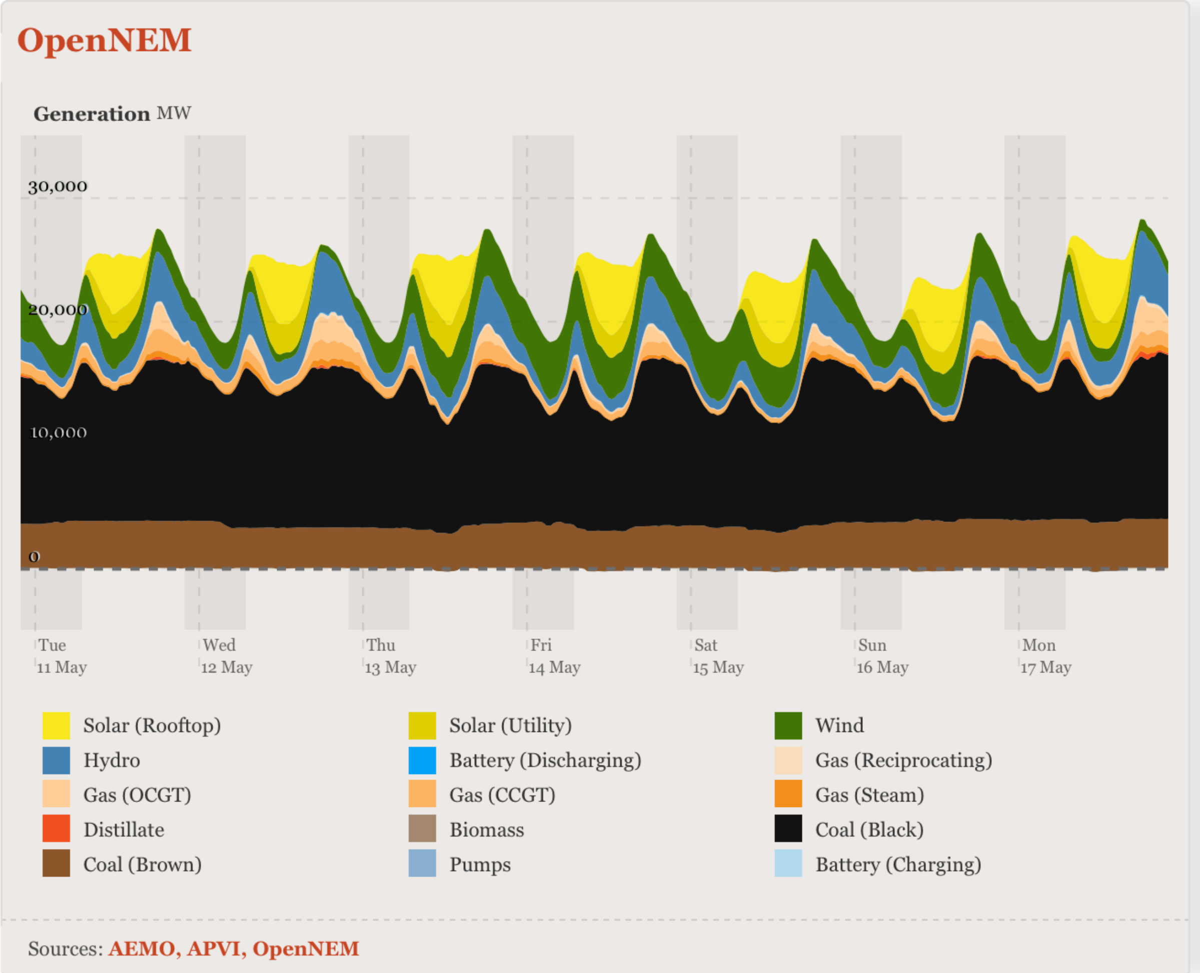
Of course, there may be demand for gas use in industrial processes; however, this could be satisfied by methane production by anaerobic digestion of municipal and agricultural wastes, and sewage sludge.

According to Deloitte in the 2017 report "Decarbonising Australia's gas networks", the total estimated biogas potential in Australia is 371 PJ per annum [4]; this is well in excess of all forecast scenarios for residential and commercial annual consumption to 2040 (Figure 12 of Australian Energy Market Operator's Statement of Opportunities for eastern and south-eastern Australia, March 2021) remain consistently around 200 PJ per annum [5].

Figure 1: power generated by various technologies in the National Electricity Market (NEM) for the 168 hours (7 days) to 2200 (10 pm) 17 May 2021.

[4] Deloitte, "Decarbonising Australia's Gas Networks", November 2017. 0 Accessed from https://www2.deloitte.com/au/en/pages/economics/articles/decarbonising-australias-gas-distribution-networks.html# on 31 March 2017

[5] Australian Energy Market Operator 2021 Gas Statement of Opportunities, 29 March 2021. Accessed from https://aemo.com.au/en/energy-systems/gas/gas-forecasting-and-planning/gas-statement-of-opportunities-gsoo on 31 March 2021.



(Downloaded from https://opennem.org.au/energy/nem/?range=7d&interval=30m on 17 May 2017).

From the data illustrated in Figure 1, total energy supplied the 168 hours to 2200 17 May 2021using each technology can be estimated, with data shown in Table 1.

Also shown in Table 1 is the alternative scenario if sufficient storage is installed to completely replace non-coal thermal generation ie gas plus distillate plus biomass [6].

The scenario employs sufficient storage to complete replace non-coal thermals, which means it requires sufficient additional coal generation to charge it (81.9% 'round trip' efficiency assumed for charge-discharge cycle). It is assumed that the additional demand on coal generation is within the capacity of installed coal-fired generators on the basis that the "possible" coal power output is if each of black and brown coal operated at the maximum output observed in the week.

Table 1: power generated by various technology classes in the National Electricity Market (NEM) for the 168 hours (7 days) to 2200 (10 pm) 17 May 2021.

[6] Biomass is a small enough contributor that it could be included in what I term Utility Renewables", and therefore not excluded by installation of community-scale batteries.

Technology	Supplied (GWh)	Possible (GWh)[7]	With Storage (GWh)
Utility Renewables[8]	911.6		911.6
Biomass+ Gas + Distillate	241.8		0.0
Coal (black and brown)	2,519.2	2,997.2	2,814.4
Rooftop solar	227.0		227.0
Community Storage Charging	0.0		-295.2
Community Storage Discharging	0.0		241.8
Total supplied energy	3899.6		3,899.6

It is argued that wholesale power prices would be lower because the most expensive thermal generation class has been made redundant, as well as which coal-fired generation would be operating at closer to full capacity and hence at lower cost per supplied GWh.

Thus it is that gas-fired power is not necessary[9] for the National Energy Market.

Thank you for considering my submission.

Yours sincerely,

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[7] Theoretical Maximum Energy from each of brown and black coal generation is estimated by assuming that the maximum observed energy production in a 30 minute period in the week is 100% of what is possible; this figure is then multiplied by 336 to estimate that maximum energy production for a 168-hour week.

[8] Utility renewables include utility-scale solar farms and windfarms, hydroelectric power net of power consumed by pumps to return water to upper reservoirs to be allowed to pass through hydroelectric generators when hydroelectric power is next required. It also includes batteries, which consumed 2,828 MWh of power in the week for charging, and 2,316 MWh was dispatched to the grid when discharging; batteries are therefore estimated to have 'round-trip' efficiency = (2,316/2,818) = 81.9%.

[9] It is asserted and assumed in this submission that gas-fired power generation is generally the most expensive power-producing technology in Australia. It is proposed that ascertaining the veracity of this assertion be an exercise for the reader, for which the remarks of Energy Security Board chair Kerry Schott as reported in *The Guardian* of 30 April 2021 may be a guide (https://www.theguardian.com/environment/2021/apr/30/australian-energy-board-chair-says-gas-fired-power-plant-in-hunter-valley-doesnt-stack-up).