Analysis of the impact of proposals to charge solar homes to export electricity to the grid

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EXECUTIVE SUMMARY

This report critiques the Australian Energy Market Commission's (AEMC) calculation of the impact of the network injection charge that the AEMC proposes that households with rooftop photovoltaics (hereafter "solar homes") should pay when they export surplus rooftop solar generation to the grid. The AEMC's proposal is set out in its Draft Rule Determination[1] published on 25 March 2021.

It would appear to be the case that the AEMC has made an error in its calculations. Once corrected the impact of its proposals on solar homes is likely to be large, not small as the AEMC suggests. The price for network injections that is consistent with the AEMC's $100 average solar home injection price is at least 4 cents per kWh and possibly up to 4.9 cents per kWh. The AEMC presents the case study of a 5 kW solar home to which a $100 network charge applies. But using the AEMC's assumption of solar exports, the $100 charge requires an injection price of 4.8 cents per kWh, not 2 cents per kWh as the AEMC suggests will apply.

Using the corrected injection price means that the typical (median) solar home in Victoria can expect to receive just $32 per year for the surplus solar production that it feeds in to the grid after the revised regulated minimum feed-in rate takes effect from the middle of the year.

For a typical 5 kW solar home in Sydney, the correct network injection charge increases from the $100 per year that the AEMC claims, to $240 per year.

Much lower retailer feed-in rates in all regions of the NEM can be expected soon reflecting large declines in wholesale prices. Taking account of the AEMC's corrected network injection price and much lower retailer feed-in prices, it is likely that at this price the great

[1] NATIONAL ELECTRICITY AMENDMENT (ACCESS, PRICING AND INCENTIVE ARRANGEMENTS FOR DISTRIBUTED ENERGY RESOURCES) RULE 2021

majority of solar homes in the National Electricity Market will receive little or no income for the surplus solar production that they export to the grid.

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1 Introduction

This report critiques the Australian Energy Market Commission's (AEMC) calculation of the impact of the network injection charge that the AEMC proposes that households with rooftop photovoltaics (PV) (hereafter "solar homes") should pay when they export surplus rooftop solar generation to the grid. The AEMC's proposal is set out in its Draft Rule Determination[2] published on 25 March 2021.

This report critiques the AEMC's calculations of the impact of its Draft Decision on solar homes. VEPC has been active in the discussion on the AEMC's proposals, so far mainly drawing attention to broader economic and policy concerns. Our prior commentary in reneweconomy.com.au and on theconversation.com.au can be found here, here and here.

Context

Two social welfare advocates, an environment advocate and a distribution network service provider proposed various changes to the arrangements for network access, in particular to discriminate on the basis of whether (small) customers also export electricity to the grid. Their proposals were all variations on a theme of charging for injections to the grid from the surplus production from roofs of solar homes.

The AEMC substantially agreed with these proposals and in its Draft Rule Determination proposes new rules to allow distributors to charge for grid injections from solar homes if they wish to. The same rules will not apply to large producers who will continue to use the shared grid without charge.

The AEMC's draft decision is framed as consistent with a philosophy of "user pays" where the "user" is defined to be consumers and small producers that inject their surplus

[2] NATIONAL ELECTRICITY AMENDMENT (ACCESS, PRICING AND INCENTIVE ARRANGEMENTS FOR DISTRIBUTED ENERGY RESOURCES) RULE 2021

rooftop solar. Large producers are however not defined to be users of the grid, or at least not in the sense that they should be charged for injections to the shared grid.

The AEMC's decision leaves injection charges to be established by distributors but subject to some level of oversight by the AER with respect to, for example, compliance with broadly defined "tariff structure statements" that the distributors determine.

The AEMC's proposal does not place any constraint on distributors on how they might wish to determine the injection charges that the AEMC's Draft Decision enables. In the AEMC's assessment of the impact of its Draft Decision, the AEMC suggests that "networks" had told the AEMC that injection charges to recover distributed asset integration expenditure could range between $10 and $100 per year.

The bottom end of this range might be suggested to be consistent with network injection charges that seek to recover, from solar homes, the network expenditure associated with their integration into the grid. For example – SA PowerNetworks – which has by far the most generous allowance for "distributed energy integration capital expenditure" ($16.4m capex per year for the next five years covering expenditure related to both big and small distributed energy) would establish a charge of around $16 per solar home per year in five years' time assuming all of the $82m allowance is spent. Powercor in Victoria, typical of other distributors in Victoria, will have an allowance for distributed energy integration capital expenditure of $32m that would establish a charge of around $6 per solar home per year in five years' time assuming all of the $32m is spent.

In other words, an annual charge around the bottom end of what the distributors told the AEMC ($10-$100 per year) might be plausible as an annual charge to solar homes to recover distributed energy integration expenditure.

In fact, as explained in this report, an error in the AEMC's calculations means that the average network injection price is at least twice the 2 cents per kWh that the AEMC has stated it to be. An export price at this level (at least 4 cents per kWh) is more than 10 times a plausible estimate of the annual cost (per MWh injected) of distributed energy integration expenditure.

Contrary to the AEMC's claim that their proposals will have an insignificant impact on solar homes, the AEMC's proposal is a likely to leave existing solar homes with little or no income from rooftop solar exports once much lower feed-in rates are implemented from the middle of this year. In fact we expect that with much lower feed-in rates soon to take effect, after deducting the AEMC's network usage charge many solar homes outside of Victoria are unlikely to obtain any payment from their surplus rooftop PV production that is injected into the grid.

Layout

Section 2 presents our analysis and Section 3 discusses counter-arguments and next steps. Appendix A describes our data. The references cover documents cited and relied on in this report.

2 Analysis

The AEMC says that its solar injection charge (cents per kWh) for solar homes on flat rate feed-in tariffs (as almost all solar homes are) will range between 0 and 2 cents per kWh – the upper end of its range being consistent with an injection charge of $100 per year (see page 246 of the Draft Rule Determination).

The AEMC also presents an analysis of a case study of a 5 kW solar home in Sydney that it says is charged $100 per year, the top end of the range of injection charges that distributors told the AEMC would be appropriate to compensate distributed energy integration expenditure.

The AEMC seems to have made an error in its calculations which means that it has understated the solar injection charge by a factor of at least two. This can be seen in several ways. For example, using our estimate of average annual solar exports per solar home (2530 kWh - see Table 1 in Appendix A) will give an injection price of 4 cents per kWh ($100/2531kWh), twice what the AEMC stated. Alternatively we could use the median annual solar exports per solar home to work out the injection price, this would be consistent with the interpretation of the $100 charge[3] as the typical charge, not the average charge. Dividing $100 by the median exports (2031 kWh per year = see Table 1 in Appendix A) gives an injection price of 4.9 cents per kWh, almost 2.5 times what the AEMC stated.

The AEMC's error can also be seen most clearly in its calculation of the impact of a $100 injection charge to a north facing Sydney solar home with 5 kW solar and that the AEMC assumes will self-consume 5 MWh[4] of its production (and so export 2.1 MWh to the

[3] The AEMC does not specify whether the $100 is an average or a median.

[4] We did consider the prospect that the AEMC had made an error in stating self-consumption of 5 MWh (in the notes to Figure F.1) and that what it had actually meant was *export* of 5 MWh. This would be consistent with a 2 cents per kWh injection price giving an injection charge of $100. But this correction alone would not explain inconsistencies in the AEMC's other calculations. Specifically, Figure F.6 says that the average solar injection charge would be $76, Multiplying this by the 2.73 million households with solar gives an

grid[5]). If we used the AEMC's injection price of 2 cents per kWh, its Sydney case study would only pay an annual injection charge of $42 (2 cents/kWh multiplied by 2,100 kWh annual injections). For the AEMC's case study to pay a $100 injection charge, the injection price would need to be 4.8 cents per kWh ($100/2,100 kWh).

To put it another way, the AEMC can not claim that the injection price is 2 cents per kWh and at the same time that its Sydney case study will pay a $100 injection charge. Instead the AEMC must choose between:

- an injection price of 4.8 cents per kWh (which will result in the AEMC's claimed injection charge of $100); or
- if the AEMC wants to stick with its claim of a 2 cents per kWh injection price then it must accept that the injection charge will be $42, not $100.

We do not know which one of these two competing truths the AEMC actually has in mind but we suggest that a $100 injection charge for the typical solar home is the AEMC's essential proposition. The $100 charge is referenced seven times in the AEMC's report and the $100 assumption is used in the AEMC's calculation of the impact of its proposals on solar homes (see Figures F1, F5 and F6 of the Draft Rule Determination) and the conclusions of the impact of a $100 charge is repeated in their Executive Summary. We therefore proceed with the combination of the $100 typical injection charge and consequently a 4.8 cents per kWh injection price.

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annual total income of $205m. Using 2500 kWh export per solar home on average gives an average injection price of 3 cents per kWh, not 2 cents per kWh. Furthermore the AEMC says that the $76 charge would be $100 were it not for "TOU rebates" that arise under a particular network pricing methodology that the AEMC has assumed (which does not currently apply anywhere) which entails rebates for solar injected to the grid between 10am and after 4pm. But we know that such injection will be inconsequential and so what the AEMC evidently actually means is $100 average charge and this then takes us back to a 4 cents per kWh average injection price (if we assume the $100 charge is an average charge this gives us an injection price of 4 cents per kWh, or if we assume the $100 charge is the median charge, it gives a price of 4.9 cents per kWh. We conclude that the error can not be explained by mislabelling of self-consumption for export in the AEMC's atypical 5 kW case study.

[5] A typical north-facing 5 kW rooftop PV system in Sydney can be expected to produce 7.1 MWh per year - see https://www.solarchoice.net.au/wp-content/uploads/Solar-Choice-Clean-Energy-Council-Solar-PV-Consumer-guide.pdf This is explained in Section 2.2

Having established what the AEMC seems to be actually suggesting, the network injection price to be (i.e. 4.8 cents per kWh), we can now proceed to calculate how such price is likely to affect solar homes.

Taking solar homes in Victoria as an example, the regulated minimum retailer feed-in rate (by far the most widely adopted rate) will be 6.4 cents per kWh from 1 July 2021. For the median household the annual feed-in volume of 2,031 kWh per year gives a median feed-in income of $130 per year before the deduction of the AEMC's injection charge. If an injection price of 4.8 cents per kWh is applied, the annual net injection income will be $33 per solar home ($130-$97) in Victoria.

Finally, we return to the AEMC's 5 kW Sydney case study. The AEMC assumed for this case study that the household self-consumes 5,000 kWh per year. As discussed in footnote 4, a 5 kW solar system on a north-facing roof can be expected to produce 7,100 kWh per year. This means exports of 2,100 kWh. This would be an atypical situation. It is much more plausible that a typical 5 kW solar home in Sydney will self-consume at most 2,100 kWh[6] and export at least 5,000 kWh. Applying the correct network injection price (4.8 cents per kWh) suggests that a typical Sydney solar home with 5 kW on the roof should expect a network injection charge of $240, not $100 as the AEMC says.

Comparing outcomes in Victoria with other jurisdictions

The analysis so far has referenced the findings from our research based on Victorian solar home data. Prior to our Victorian solar home research we previously examined residential solar exports across the NEM using a sample of 10,051 residential electricity bills of which 2,061 were homes that had rooftop solar. These bills were supplied to us by customer group **CHOICE**. That 2,061 solar home sample has a much smaller number of

[6] In our research on 7,212 solar homes in Victoria – see Mountain et al 2020(b) and 2020(a) we found average rooftop solar self-consumption of 1,620 kWh per annum. As such our 2,100 kWh self-consumption assumption in Sydney errs on the generous side and is thus likely to understate the likely the exports and hence the injection charge.

Victorian solar homes (532) but provided estimates of average rooftop solar export and own-use in Victoria that are close to what we found in our subsequent Victoria studies

This provides some confidence that the estimates of rooftop solar production and own use that we estimated from the **CHOICE** data for New South Wales, South Australia and Queensland are plausible. The **CHOICE** data revealed New South Wales' solar homes exports were almost the same as in Victoria but that there were higher exports from solar homes in South Australia and Queensland (and higher self-consumption for solar homes in those states).

This suggests our conclusions of the effect of the AEMC's network usage charge are likely to be similar in New South Wales and Victoria if feed-in rates are similar. However feed-in rates are systematically higher in Victoria than in New South Wales because Victorian regulations require recognition of the emission reduction benefits (at 2.5 cents per kWh). For this reason, we expect that the effect of a 4.8 cents per kWh network injection charge will be worse in New South Wales, South Australia and Queensland. In fact with revised (much lower) feed-in rates likely soon (to reflect the sharp decline in wholesale electricity prices) we expect that the effect of the AEMC's injection charge will mean that many solar homes outside Victoria will effectively receive no income or might even be liable to a net payment to inject electricity to the grid, if the AEMC's recommendation takes effect.

3 Discussion

Our analysis suggests that the AEMC has made an error which means it has understated the network injection price that is consistent with its proposals by a factor of at least two. Accordingly we suggest that if a network usage is adopted along the lines that the AEMC suggests, it is likely to have a large (negative) impact on existing solar homes and is likely to significantly retard future rooftop solar installation by households. Here we consider counter-arguments and identify useful further work.

3.1 Counter arguments

The main counter-argument to our critique is that it really does not matter whatever the AEMC suggests should be the network injection price since these will be established by distributors, and subject to some level of oversight by the Australian Energy Regulator[7].

The AEMC also suggest that distributors will "negotiate" charges with consumers. But consumers and distributors do not have a contractual relationship (consumers have a contractual relationship with retailers). Furthermore, the AEMC has proposed rules that will enable distributors to establish network usage charges for solar homes at the level that it proposes.

The rules do not bind distributors to only cover incremental costs in these charges. Distributors can be expected to set network usage charges that are consistent with the AEMC's intention. Indeed this would be the obvious and legitimate defence that distributors would surely rely upon if their proposed challenges are opposed by solar homes.

The AEMC's proposal therefore plays an important role in anchoring distributor proposals and in setting expectations of what should be expected from the AEMC's Draft Decision.

[7] For example by confirming that whatever network charges the distributors determine are consistent with the distributors' "tariff structure statement".

Therefore we conclude that it is not plausible to suggest, as the AEMC has, that its suggested charge is not determinative or influential because distributors will establish the charge in consultation with consumers.

3.2 Further work

The AEMC says that it has annual solar generation export data for 3,567 solar homes supplied by Ausgrid in New South Wales and 1,586 solar homes supplied by SA PowerNetworks in South Australia. These should be used to establish the median and average export volumes just as we have done with our data (as set out in Appendix A) and from this for the AEMC to state clearly the network injection price that it is suggesting.

We also encourage the AEMC also to make its data publicly available. We see no reasonable basis for any sustainable claim of confidentiality (it is a single data field not attributable to any individual consumer and not commercial-in-confidence). In return we are willing to make our data on residential solar injections available for research purposes, on request.

Our critique of the AEMC's Draft Decision concludes that it will have a significant impact on existing solar homes and also on future rooftop solar uptake. This conclusion suggests that an economic analysis of the costs and benefits of rooftop solar (which the AEMC has not done) is essential in assessing the merits, in economics and in the long term of interests of consumers, of network injection charges.

Our critique also leads to the conclusion that network injection charges to solar homes at the level that the AEMC suggests is likely to greatly distort competition between residential rooftop solar and large generators (whom the AEMC suggests should not be charged for their use of the shared network). The prospect of such distortion is something that the AEMC suggests is "important". We agree and suggest it is essential that the AEMC quantifies the impacts and publishes the calculations underlying whatever conclusion it reaches.

Appendix A: Data sources and methodology for the determination of self-consumption and exports

The data that is referenced in this study is obtained by automatically parsing PDF electricity bills using bills have been provided to us (as described below in A, B, C) and from a smart meter dataset of solar homes in the Citipower and Powergid area in Victoria (provided to us by C4NET):

A. From customer group CHOICE (10,051 households in Victoria, New South Wales, South Australia and Queensland of which 2,062 have rooftop solar - see Mountain and Kars (2018).
B. From the Department of Environment, Land Water and Planning (47,114 households in Victoria of which 7,212 have rooftop solar – see Mountain et al (2020a), Mountain et al (2020b) and Mountain and Burns (2020).
C. From the Department of Environment, Land Water and Planning (24,015 households in Victoria of which 3,422 have solar with non-zero exports – see Mountain and Burns (2020d).
D. From C4NT (half-hourly solar export data for 295 solar homes with non-zero exports in the 2018 calendar year)

A summary of the mean and median in this dataset is show in Table 1 below:

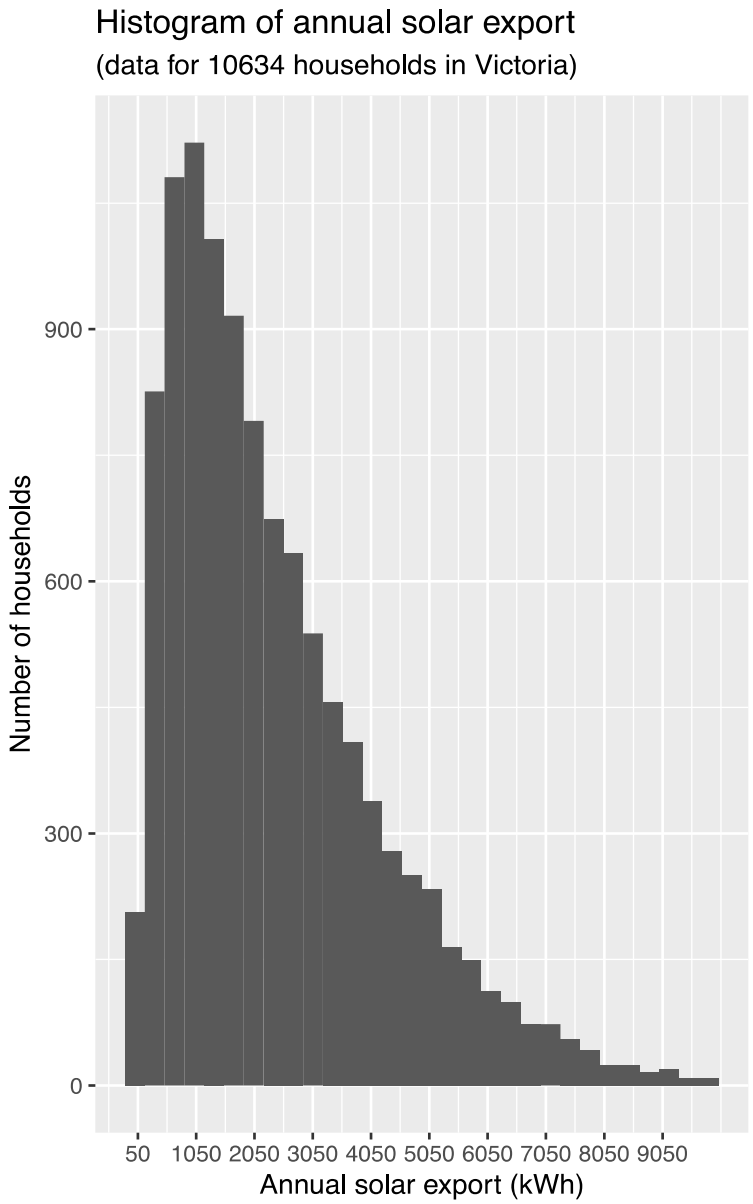
Table 1. Mean and median solar exports (kWh per year)

	Average annual export (kWh)	Median annual export (kWh)
A: CHOICE dataset (467 homes)	2521	1953
B: DELWP dataset 1 (7212 solar homes)	2225	1769
C: DELWP dataset 2 (3422 solar homes)	2816	2262
D: Citipower/Powercor (295 solar homes)	2558	2258
Average of all	2530	2061

Rooftop solar exports are extracted from these bills and the averages calculated as reported. The averages obtained from (B) and (C) combined is the source of the 2,418 kWh per year average. The average obtained from (B) alone is 2,212 kWh per year. The average from (A) alone for Victoria is 2,521 kWh per year. In all these datasets, the median is substantially lower than the mean – typically about 20% lower.

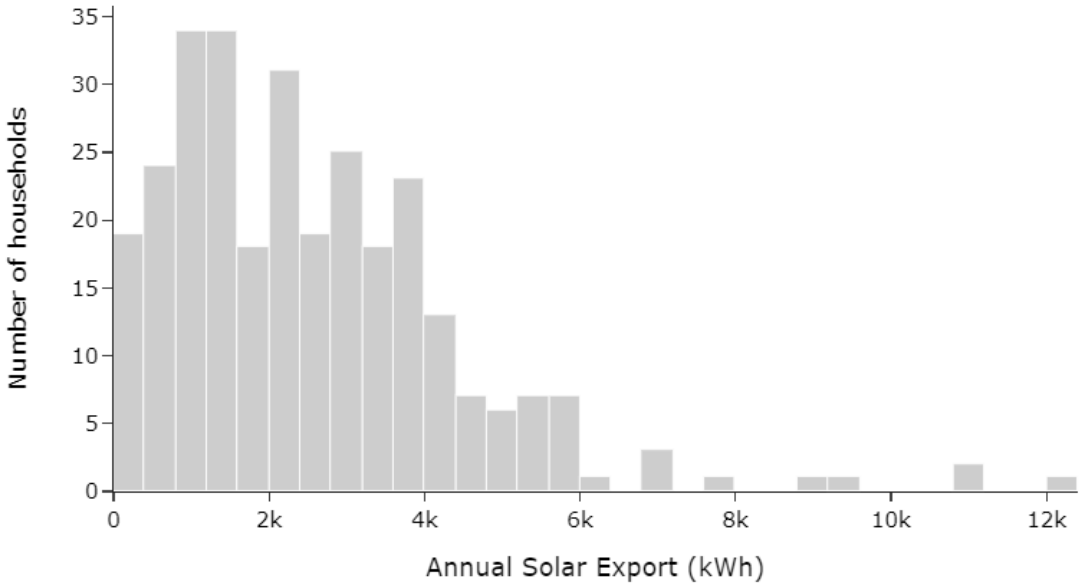
A histogram of the rooftop solar exports obtained from the 10,785 households in (B) + (C) is shown in Figure 1 below:

Figure 1. Histogram of annual solar export using bill data provided to VEPC by the Department of Environment, Land, Water and Planning



A histogram of the annual solar export obtained from the 295 solar home smart meter data in (D) is shown in Figure 2 below:

Figure 2. Histogram of annual solar export using C4NET meter data



Solar used on the premises is much more difficult to establish (it is not directly measured). Our estimates of solar own-use are calculated using the methodology explained in Mountain et al (2020a).

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