APVI Discussion Paper on SA Power Network's Pricing Proposal - July 2015

Summary

This Discussion Paper is written in response to South Australia Power Network's (SAPN's) Pricing Proposal of 21 May 2015. **Although it does focus on specific aspects of their Pricing Proposal, our comments on PV-specific tariffs and Cost-Reflective Pricing are relevant to all DNSPs**. The APVI intends to release a more broad-ranging Discussion Paper on the complexities of cost-reflective pricing in due course.

There are two aspects of SAPN's Pricing Proposal that the APVI wishes to comment on.

1. The proposal to apply a compulsory 'residential solar tariff' only to households with solar photovoltaics (PV).
2. The 'Low voltage residential actual demand tariff', which is meant to be cost-reflective.

The Australian Energy Regulator (AER) has now released its response to SAPN's Pricing Proposal and has determined that the residential solar tariff is not consistent with the pricing principles in the National Electricity Rules, but has not objected to the design of SAPN's cost-reflective tariff.

Residential Solar Tariff

SAPN wanted to move households with PV onto a tariff that has a higher usage rate (c/kWh) than the normal residential tariff. They justified this on the grounds that PV households have a different load profile compared to non-PV households because; (i) they have a different load factor, and (ii) they have a higher demand during the network's annual peak.

APVI considers that:

- Any difference in load factor is not caused by the PV system per se, but by the net metering that SAPN requires them to use
- SAPN's claim of greater evening demand because of load shifting could only apply to 44c/kWh FiT households, since all other FiT households would tend to have the opposite response, since their FiTs are less than the prevailing tariff
- During the time of the likely network peak, the PV and non-PV household demands shown by SAPN are essentially identical, and in fact lower for some of the PV households
- SAPN admit that batteries will reduce network peaks but still wish to charge PV households that install batteries as if they are increasing the peak
- Load profiles can differ for many reasons and the variation between households (either with or without PV) is greater than between households with PV and households without
- There is a large amount of well-documented evidence that PV can reduce network demand peaks – including from 7 of Australia's distribution networks' own Distribution Annual Planning Reports (DAPRs).

Cost-reflective Tariff

SAPN included the 'Low voltage residential actual demand tariff' in its Pricing Proposal as an example of a cost-reflective tariff.

- APVI considers that this tariff is not cost-reflective because:
  - The demand charge is based on the monthly peak every month of the year, rather than on the annual peak
  - The demand charge is based on the peak load of that customer, rather than the customer's demand at the time of the peak on the sections of the network that service them
  - The demand charge is applied over a very broad time period (5 hours every day)
- APVI analysis shows that:
  - Although residential demand is generally higher between 6 and 9pm, the annual distribution network peak generally occurs between 4.30 and 6.30pm
  - Although the network demand peak may occur in summer, in two separate datasets analysed, less than a third of the household peaks occur in summer, with about half of the peaks occurring in winter
  - The network peak occurs in summer because the household's times of generally high demand are more tightly clustered in summer than they are in winter
  - Application of SAPN's cost-reflective demand tariff to household loads shows very little correlation between the costs charged to the customer and the customer's demand at the time of the network peak
  - Many households on SAPN's cost-reflective demand tariff would be paying for augmentation costs at times when their demand is not affecting the cost of augmentation
- APVI proposes a "real cost-reflective tariff" with a demand charge/reward component that would be applied only over the peak demand months and only for 3 hours a day – which would create a better incentive for households to implement options that actually reduce their demand during the time of the network peak.

SAPN's Residential Solar tariff

SAPN aimed to move customers with PV onto a tariff that has a higher usage rate than the normal residential tariff. They provided a number of justifications for doing this. The following lists these justifications along with the APVI's responses.

SAPN Claim 1. Customers with solar have a different load profile

The Revised National Principles on Feed-In Tariffs states "assignment of network tariffs to micro generation consumers should be on the basis that they are treated no less favourably than customers without micro generation but with a similar load on the network". [1]

SAPN sought to make the case that the load profile of customers with PV is different to that of customers without PV, and so they should be able to move them onto a different tariff. They stated

[1] https://www.coag.gov.au/node/507

that PV customers loads are different because they have a different average load factor and because they have a higher annual demand peak.

Different load factor

SAPN stated "customers with solar have a different load profile to other residential customers, with an average load factor over 20% less favourable than customers without solar. This is primarily caused by lower usage during the day when the sun is shining".

APVI Response: The difference in load factor, if any, is likely because PV customers in South Australia are required to use net metering, and so some of their demand is met by the PV system. Thus, the difference in load factor is not caused by the PV system per se, but by the metering that SAPN requires them to use. A gross metered system would not show an underlying difference in load profile.

Higher demand peak

SAPN provided charts of the average load profiles of residential customers with and without PV during the January 2014 heatwave. The charts showed PV customers having a higher evening peak, and SAPN implied they would place more strain on the network. SAPV contended that this may be because customers on the 44c FiT prefer to self-consume their PV generation and so shift loads to the evening.

APVI Response: There is now a mix of FiTs on the SAPN network, with no new customers eligible for the 44c FiT which was closed to new entrants on the 30 Sept 2011. All PV systems installed between then and 30 Sept 2013 would be on the 16c FiT, with all PV installations from then on receiving an even lower FiT (6-8c). Therefore, to the extent that PV households on the 44c FiT do defer load to the evening, all the other households on the other FiTs, since they are all net metered, would tend to move loads to the middle of the day to take advantage of the PV output – which would serve to decrease evening demand. Thus, if the 44c FiT households are to pay a penalty, then by this logic the other FiT households should be rewarded. Of course, if the structure of the FiTs is actually causing a change in load shape, from a network's perspective, the profiles of the high FiT customers should cancel out those of the low FiT customers, with the latter becoming the predominant customer group over time.

<u>Demand at time of network peak is the important factor</u>

When assessing a household's contribution to the network peak, it is not the household's demand peak that is important, but their demand at the time of the network peak. Most residential networks' annual demand peak is between 4.30pm and 6.30pm and, during this time, the demand for the residential and residential-PV customers during the January 2014 heatwave, as shown by SAPN's charts, is essentially identical. In fact sometimes the residential-PV customers' demand is actually lower, meaning PV could be providing network support.

<u>Impact of battery storage</u>

SAPN stated that: "The next development coming is battery storage, and perhaps electric vehicles. The battery storage has the potential to soak up a lot of the excess energy being generated during sunshine and shift that to later in the day when the network peaks".

APVI Response: Given that the most immediate market for batteries is likely to be people who also have PV, will they be charged for increasing network peaks even though, according to SAPN, they will likely be reducing them?

<u>Differences in load profiles can be for many reasons</u>

Differences in load profiles between different customers and customer groups can be for a variety of reasons, and it is possible that in the sample used by SAPN, customers with PV simply had more electricity demand in the evening because they represented a particular demographic[2] or had more or

[2] For instance, predominantly double-income working families with no-one at home during the day, rather than a mix of retirees, people at home with young children etc.

larger appliances. What is important is the impact that PV itself has on the customer's load at the time of the network's annual demand peak, and this is discussed in the next section.

SAPN should also be very careful about claiming that an individual PV-household's load profile is not similar to a non-PV household's load profile. Figure 1 shows the load profile of 20 randomly selected houses on a peak load day.[3] It is clear they are all very different and no single house can be targeted as having 'a dissimilar load'.

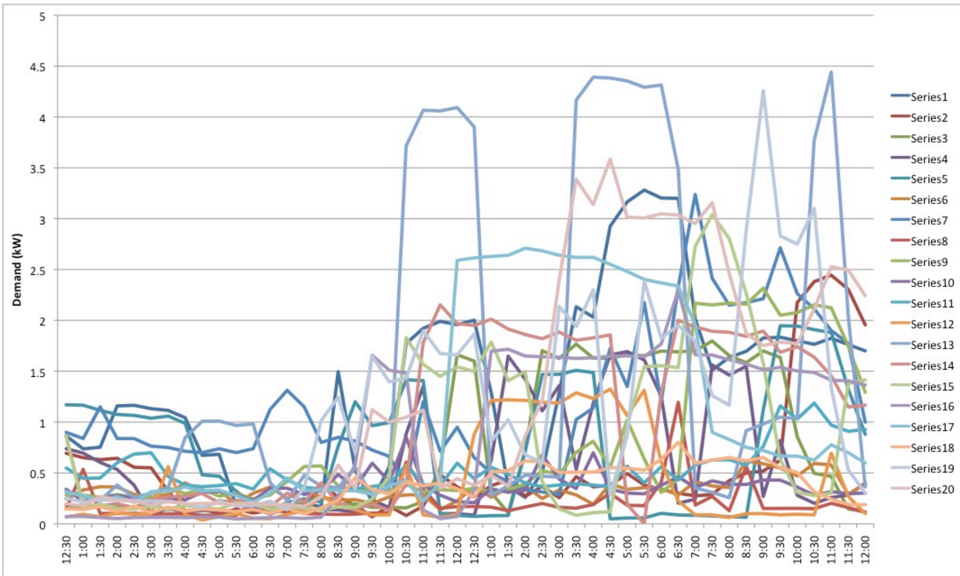

Figure 1

SAPN did say that a Residential Solar customer can elect to adopt the Residential actual demand tariff and receive an "actual cost-reflective tariff". However, as discussed below, their Residential actual demand tariff is anything but cost-reflective.

SAPN Claim 2. Customers with solar don't have reduced demand during the summer peak

SAPN claimed that PV systems do not generate during the time of the network peak, and so can make no contribution to meeting demand peaks.

However, in their Pricing Proposal SAPN states: "Over the last five years, the new development has been solar PV systems, especially within the residential networks. We now have over 23% penetration of these systems and there can be in excess of 500 MW of generation occurring near midday for over half of the year when the sun is shining. The network challenges are different today, with problems of low load during days with mild but sunny weather. In summer, the peaks that used to occur between 2pm and 5pm have moved to become **slightly lower peaks** between 5pm and 8pm." (our emphasis added)

Two things can be taken from this: i) that PV delays and reduces demand peaks, and ii) that because demand peaks have reduced, there is no need to augment the network and so (from an augmentation cost point of view) whether PV customers increase or decrease their demand peaks is irrelevant, until such time as demand exceeds previously installed grid capacity.[4]

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[3] Data is for households with gross metered PV for the period 1 July 2010 to 30 June 2011 in the Greater Sydney area and is available from http://www.ausgrid.com.au/Common/About-us/Corporate-information/Data-to-share/Data-to-share/Solar-household-data.aspx#.VYnrKShxLYM. We removed 29 of the households due to uncertain data quality. These data were used for the other charts in this Submission.

[4] At this point, it will be important to ascertain what has caused the new peak, and not to attribute any increase automatically to PV.

Regardless, there is a large amount of well-documented evidence that PV can reduce network demand peaks. According to data provided by Ausgrid, the amount of PV capacity available on different distribution network peaks has been shown to vary from 11.8% to 48.5% of rated capacity.[5] An assessment of the correlation between PV output and state-wide demand peaks (transmission networks) in NSW, Queensland, Victoria and South Australia over the summers of 2011/12 and 2012/13, showed PV output at between 21% and 58% of its rated capacity (Burke, 2014).[6]

In addition, information provided by other distribution network service providers (DNSPs) in their Distribution Annual Planning Reports (DAPRs) showed that PV may in fact reduce network demand peaks. For example:

Ausgrid DAPR 2014 "The historical load data includes the impact of downstream embedded generation that was generating at the time of peak, consequently, the forecast includes the impact of small scale generation (such as rooftop solar installations)". The impact of PV during the annual peak is incorporated into all their Sub-transmission Substation and Zone Substation load forecasts in their DAPR.

Endeavour DAPR 2014 "Endeavour Energy continues to monitor the impacts of solar panels which, in some areas, have materially reduced demand. Areas with demand that peaks later in the afternoon or evening have little effect from PV generation on peak demand. What it does do is to reduce the duration of the peak and reduce the thermal heating of some parts of the network during the day".

Essential DAPR 2014 The impact of PV during the annual peak is incorporated into all their Sub-transmission Substation and Zone Substation load forecasts in their DAPR.

Ergon DAPR 2014 Ergon state that PV has reduced their system-wide annual demand peak and annual load factors. In part due to PV, "Ergon Energy has revised downwards its system-wide maximum demand from previous forecast estimates".

Energex DAPR 2014 "Solar PV has also had a small but increasing influence in summer day peak system demand. Importantly, in comparison with prior years, decline in peak demand has resulted in network limitations being deferred and this is reflected in the analysis contained in Volume 2. It has also resulted in reduced capital expenditure"

United Energy DAPR 2014 "Hence the level of uptake of micro-generators has a downward influence on UE's growth in maximum demand. UE incorporates the uptake of micro-generators into the maximum demand forecast. During the 2013-14 summer, the UE network had approximately 87 MW of installed roof-top solar photovoltaic panels connected to the system. It is assessed that the contribution of this generation to reducing the UE maximum demand was approximately 13 MW".

Jemena DAPR 2014 Their model used to forecast maximum demands incorporates the impact of PV, which decreases peak demand forecasts to levels below what they otherwise would be.

Of course, all these DAPRs, including SAPN's, identify air conditioning as the main culprit for increases in peak demand and consequently in augmentation costs. If any technology were to be targeted, it would be air conditioners, not PV. However, it is the APVI's long-standing position that tariffs should be technology-agnostic, and to do so need to be truly cost-reflective. As discussed below, SAPN's "cost reflective tariff" is certainly not cost-reflective.

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[5] Calculated from Ausgrid, 2011, 'Effect of small solar Photovoltaic (PV) systems on network peak demand', Research Paper, *Ausgrid*, Oct 2011. From http://www.ausgrid.com.au/Common/About-us/Newsroom/Discussions/~/media/Files/About%20Us/Newsroom/Discussions/Solar%20PV%20Research%20Paper.ashx

[6] Burke, K. B., 2014, 'The reliability of distributed solar in critical peak demand: A capital value assessment', *Renewable Energy*, 68, p103–110.

SAPN's Cost-reflective Pricing

In Nov 2014 the Australian Energy Market Commission (AEMC) released the Rule Determination 'National Electricity Amendment (Distribution Network Pricing Arrangements) Rule 2014'. It requires network prices to reflect the efficient cost of providing network services to individual consumers so that they can make more informed decisions about their electricity use.

The pricing principles are that:

i) Each network tariff must be based on the long-run marginal cost of providing the service.
ii) The revenue to be recovered from each network tariff must reflect the network business' total efficient costs of providing services to the consumers assigned to that tariff.
iii) Distribution businesses must consider the impact on consumers of changes in network prices, and such prices to be reasonably capable of being understood by consumers.
iv) Network tariffs must also comply with any jurisdictional pricing obligations imposed by state or territory governments.

The first two principles should not only ensure that end-users pay the full costs of their use of the network (and so encourage them to reduce the requirements they place on the network and any cross subsidies required from other customers), but also mean that DG and energy efficiency are rewarded to the extent that they provide network support – in turn driving their uptake. This, however, depends on how network operators interpret the pricing principles. The pricing principles don't specify the structure that a network tariff must have in order to be cost-reflective, they only prescribe the process through which this should be achieved.

SAPN's Pricing Proposal included the 'Low voltage residential actual demand tariff' shown in Table 1. It was established in 2014/15 under a trial tariff program. They stated that "It plays an important role in indicating to customers and the electricity industry the sort of tariff structures and incentives around which new housing and new technology considerations should be made".

Table 1. SA Power Network's Low voltage residential actual demand tariff (incl. GST)

Component	**Residential Actual Demand Tariff**	**Residential Single Rate Tariff**
Capacity - peak	4 – 9pm (Nov – March) **Rate:** $9.966/kW/month	NA
Capacity – off peak	4 – 9pm (April – Oct) **Rate:** $4.983/kW/month	NA
Energy	5.313c/kWh any time	8.195c/kWh, up to 333.3kWh/month 10.89c/kWh over 333.3 kWh/month
Fixed	None, but minimum 1.5kW monthly capacity charge (=$127.07/year if demand does not exceed 1.5kW)	$103.19/year

This tariff is highly unlikely to be cost-reflective. The demand charge should not be based on the monthly peak but on the annual peak, because this best correlates with the network determination process and resultant costs. Critically, the demand charge should not be based on the customer's peak but on the customer's demand at the time of the annual peak on the sections of the network that service them.

Note that the different sections of the network, from low voltage distribution to transmission will actually have quite different load characteristics and annual demand peaks. Thus, for network charges to be truly cost-reflective, they should include separate demand charges for each section of the network. Since this is impractical, the demand charge seen by the customer should at least attempt to aggregate these cost impacts – which would bring the time of the demand charge to earlier in the day than the low voltage distribution network peak.

Although residential demand is generally higher between 6 and 9pm, the annual distribution network peak generally occurs between 4.30 and 6.30pm. Figure 2 and Figure 3 show the times and seasons of the annual demand peaks for two different datasets (a total of 361 houses).[7] Although the demand peak for each aggregated dataset (representing the network that services them) occurs in summer (one between 4.30pm and 5pm and the other between 6pm and 6.30pm), less than a third of the individual household peaks occur in summer, with about half of the peaks occurring in winter. Each aggregate peak is in summer because the times of generally high demand are more tightly clustered in summer than they are in winter.

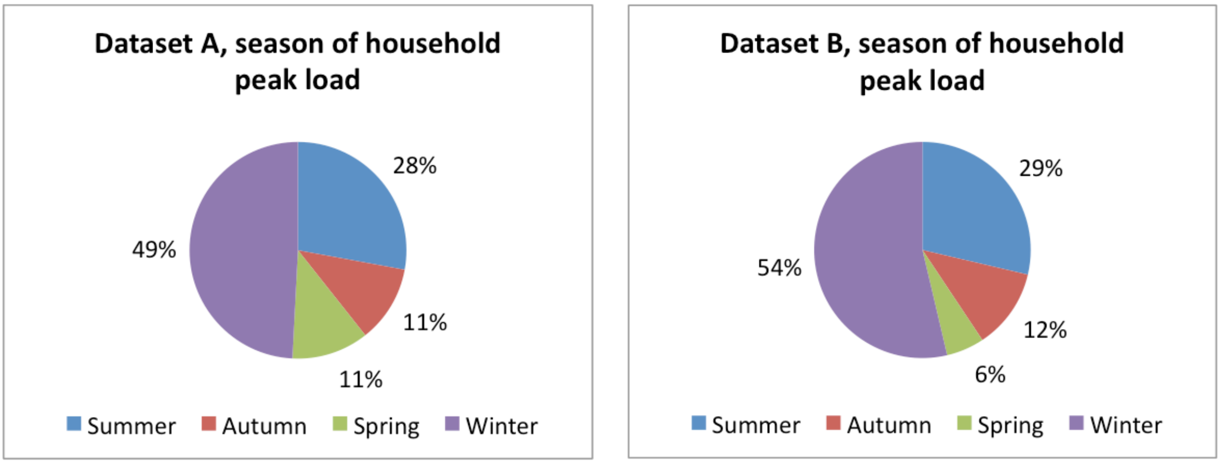

Figure 2 Season of peak load for individual households

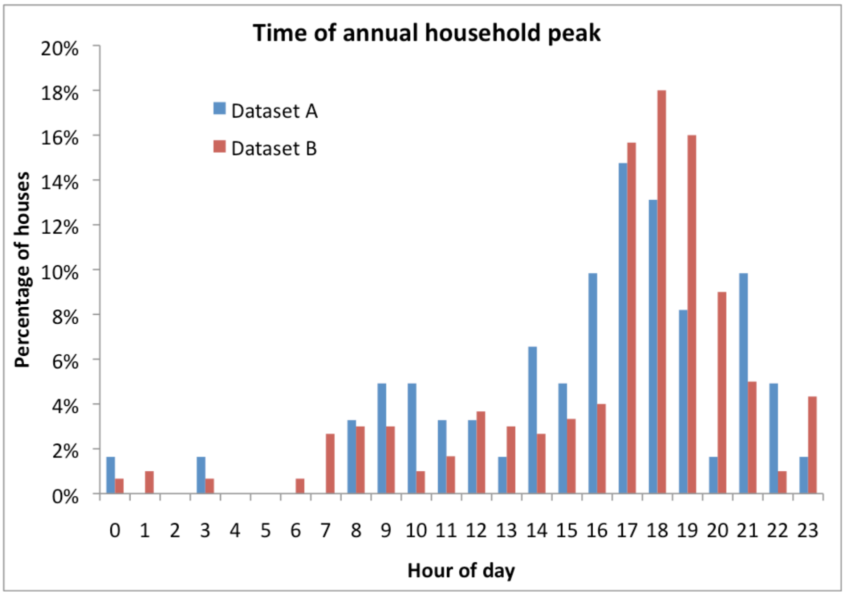

Figure 3 Time of annual household peak

[7] Although these houses are in the Sydney area and so would have a different average load profile to South Australian houses, they are used here to illustrate the variation between individual houses and the combined average.

Figure 4 compares each household's annual peak with their demand during the time of the network peak. All the households above the red line have an annual peak that is greater than their peak during the network's annual peak – which is all but one. For example, the red marker has an annual peak of 14.15kW but was contributing only 0.36 kW during the network peak.

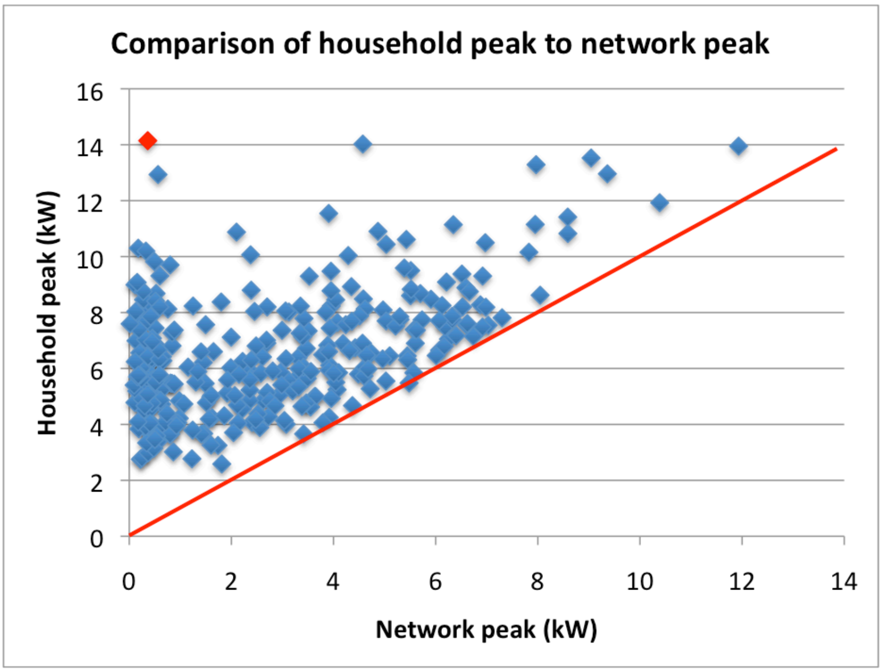

Figure 4 Comparison of household and network peaks

The peak demand periods in SAPN's Low voltage residential actual demand tariff span 5 hours, which will most certainly capture customer demand peaks that are not contributing to the annual network peak. Thus, the use of such broad time bands, the use of monthly peaks and the use of off-peak demand charges will mean that customers are paying for augmentation costs at times when their demand is not affecting the cost of augmentation. Thus, these tariffs will not be cost-reflective.

Figure 5 compares the annual DUOS charges for 100 customers under SAPN's Low voltage residential actual demand tariff to their demand at the time of the network peak. Figure 6 shows the same comparison but for SAPN's flat Residential single rate tariff. No correlation is expected for the flat tariff, but a truly cost-reflective tariff should show a direct correlation between the amount a customer is charged and their contribution to the network peak. The line of correlation should cross the y-axis above zero to account for the sunk network costs. It can be seen that there is very little difference to the outcomes for customers between the two tariffs – meaning that SAPN's cost-reflective tariff is no more cost-reflective than their flat tariff.

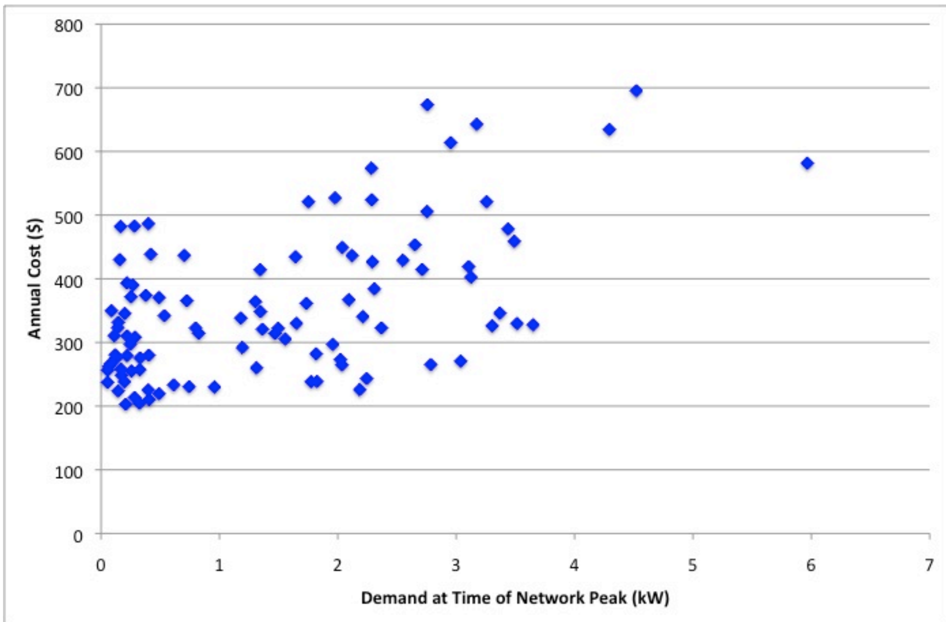

Figure 5 Application of SAPN's Low voltage residential actual demand tariff to household data

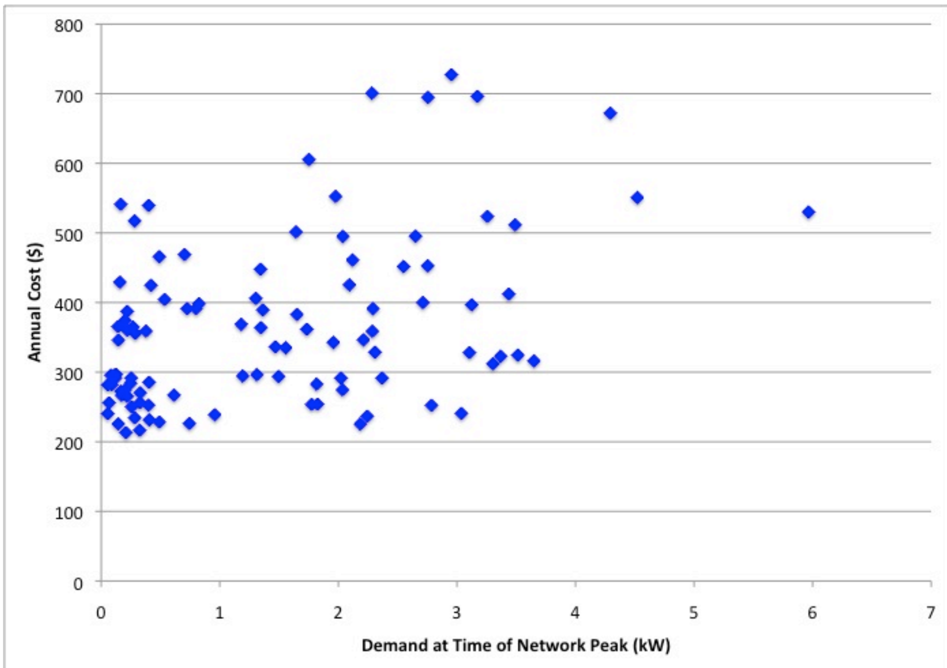

Figure 6 Application of SAPN's Residential single rate tariff to household data

The use of such broad time bands will also reduce the degree to which PV can reduce a customer's network charges, even when it helps to reduce the network peak. This will reduce the financial viability of PV, thus potentially reducing its uptake. However, with PV output being negligible after 7.00pm in summer and with many customers' annual peaks occurring between this time and the end of the proposed tariff's peak period, PV will not be able to reduce these customers' demand charges, despite potentially reducing the network peak.

It is relatively straightforward to apply a charge to a customer's demand at the time of the network peak ex post (see Table II). Network operators should be able to review load data for regions of the grid to see when the annual peak occurs and how often this occurs at the same time and month. Customers connected to that part of the grid could then be provided with a relatively narrow period (say 3 hours) during particular months when a demand charge may be applied. This demand charge would be applied only to their demand at the time of the annual peak of their region of the network (not to their peak during the daily or monthly peak period). Over time, as customers use DG and EE to alter their demand, and therefore the network peak, the target peak period may need to be shifted and/or broadened.[8]

Note that what we refer to as a 'demand charge' could take a variety of forms, including some sort of critical peak pricing charge with customer notification or even a reward-based tariff where customers are rewarded for reducing their demand.

All demand charges proposed by DNSPs are also applied ex post. With the APVI's approach, new customers that move onto the demand charge tariff before the summer period could simply pay a default average demand charge value until they record their actual peak demand in summer. In keeping with point 3 of COAG's pricing principles, that "Distribution businesses must consider the impact on consumers of changes in network prices, and such prices to be reasonably capable of being understood by consumers", the demand charge should not reflect the full LRMC of augmenting the network. Thus, customers would have time to accustom themselves to the new type of charge.

The bottom line is that if SAPN's tariffs were truly cost-reflective, they shouldn't need to apply any technology-specific charges at all, whether they are for PV, air conditioning or other technology.

Table II Comparison of SAPN's and the APVI's Proposed Demand charge tariff

SAPN	APVI Proposed
Charged on customer peak demand	Charged on customer demand during network peak
Every month of year	Selected months (eg. summer only)
4-9pm, 5 hr period	e.g. 4.30-7.30pm, 3 hr period
$/kW charge would be lower because is applied 12 times a year	$/kW charge would be higher because is applied only once a year
Billed each quarter based on 3 monthly demand peaks in that quarter	Billed each quarter, initially based on default demand charge
	True-up period after network peak season
	Use actual demand for new default demand charge

[8] Note however that as load patterns flatten out and as demand is reduced due to distributed generation, batteries and energy efficiency, network upgrades caused by increasing peaks will not be required, and so the use of peak load and increases in peak load as the basis for network investment funding will be inappropriate.

Attachment A: Background on the APVI

The APVI is an independent Institute comprising companies, government agencies, individuals, universities and research institutions with an interest in solar photovoltaic electricity. In addition to Australian activities, we provide the structure through which Australia participates in the International Energy Agency (IEA) PVPS (Photovoltaic Power Systems) and SHC (Solar Heating and Cooling) programmes, which in turn are made up of a number of activities concerning PV and solar system performance and implementation. Further information is available from www.apvi.org.au.

APVI Objective

The objective of the APVI is to support the increased development and use of PV via research, analysis and information.

APVI subscription provides:

Information

- Australian PV data and information
- Standards impacting on PV applications
- Up to date information on new PV developments around the world (research, product development, policy, marketing strategies) as well as issues arising
- Access to PV sites and PV data from around the world
- International experiences with strategies, standards, technologies and policies

Networking

- Opportunity to participate in Australian and international projects, with associated shared knowledge and understanding
- Access to Australian and international PV networks (PV industry, government, researchers) which can be invaluable in business, research or policy development or information exchange generally
- Opportunity to meet regularly and discuss specific issues which are of local, as well as international interest. This provides opportunities for joint work, reduces duplication of effort and keeps everyone up to date on current issues.

Marketing Australian Products and Expertise

- Opportunities for Australian input (and hence influence on) PV guidelines and standards development. This ensures both that Australian products are not excluded from international markets and that Australian product developers are aware of likely international guidelines.
- Using the information and networks detailed above to promote Australian products and expertise.
- Working with international network partners to further develop products and services.
- Using the network to enter into new markets and open new business opportunities in Australia.

The International Energy Agency Programmes

PV Power Systems (IEA PVPS)

- **Mission:** *To enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems*
- **Focus** (26 countries, 5 associates)
  - PV technology development
  - Competitive PV markets
  - Environmentally & economically sustainable PV industry
  - Policy recommendations and strategies
  - Neutral and unbiased information

Australia currently participates in:

PVPS Task 1: Information Dissemination

PVPS Task 13: PV System Performance

PVPS Task 14: High Penetration PV in Electricity Grids.

Solar Heating & Cooling (IEA SHC)

- **Mission:** *International collaboration to fulfil the vision of solar thermal energy meeting 50% of low temperature heating and cooling demand by 2050*
- **Focus** (21 countries, 2 associates)
  - Components
  - Systems
  - Integration into energy system
  - Design and planning tools
  - Training and capacity building

Current Australian participation:

- SHC Task 51 – PV in Urban Environments
- SHC Task 48 – Quality Assurance Support Measures for Solar Cooling Systems
- SHC Task 47 – Solar renovation of non-residential buildings
- SHC Task 46 - Solar Resource Assessment and Forecasting
- SHC Task 43 - Solar Rating & Certification Procedures
- SHC Task 42 - Compact Thermal Energy Storage
- SHC Task 40 - Net Zero Energy Solar Buildings

For further information on the Australian PV Association visit: **www.apvi.org.au**

For further information on the IEA PVPS Programmes visit **www.iea-pvps.org and www.iea-shc.org**