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What is going on with solar PV? Grid-parity and other observations

Introduction

Following on from the previous Insider on declining NEM demand we focus on solar PV and its rapid uptake over the past few years and potential growth into the future from a bottoms up approach. There have been many sources commenting at a very high level the economics of solar PV and the so-called 'grid-parity' threshold. In this Insider we attempt to draw our own conclusions based on anecdotal evidence and our experience with a real commercial and industrial client (NSW) who has been looking at installing a rooftop PV system. Once again this piece will be NSW-centric and other states will vary depending on their specific PV economics primarily driven by state-based feed-in and consumption tariffs as well as site specific characteristics.

As part of the changing energy landscape the NEM has seen unprecedented growth in solar PV installations due to domestic market dynamics (mainly government regulatory policy) and a global oversupply of solar PV panels. Based on our previous analysis rooftop PV contributed approximately 700GWh with NSW solar PV installations totalling 521MW at the end of Dec 2012 which has again increased by 55MW in the most recent 6 months to June to a total 2,376MW's of capacity across the NEM.

Through this experience we also share some of our observations relating to the solar industry, issues of misleading quotes, the significant growing number of installers, lack of reporting standards and general observations after attending the Clean Energy Council sponsored Clean Energy Week in Brisbane in July. All of this experience has made us firmly of the view the solar industry lacks a clear, accurate and system performance/quality message which the customer can understand in order to provide them with the best solution for their specific circumstances.

Customer requirement and current economic factors

The drop-off of state-based subsidies which artificially inflated the value of rooftop PV makes it fairer to compare the actual system costs against traditional purchases of electricity from the grid. Another dynamic with the change of feed-in tariffs is the preference to opt for a smaller sized system to minimise exports to the grid due to the drop in feed-in rates[i].

The client runs a beverages business at 2 sites, the smaller of which they own and operates around the clock. It has a traditional peaky load profile with maximum peak capacity of 15kW and a capacity factor of 55% with little seasonality. The annual energy requirement is approximately 70MWh's a year and after initial engagements with solar installers has enough space for 13 to 20kW of rooftop PV depending on panel manufacturer (kW/m^2 efficiency). Depending on the technology and installer, this can provide approximately 30% of its annual energy requirement. It is from this initial quote and subsequent contacts which start to highlight the economics of rooftop PV, nuances relating to sales, the lack of information and general communication issues affecting installers representing the industry.

[i] Change from gross to net basis (and lower tariffs) means the end-user is better off offsetting usage than exporting into the grid

Quotes and financial analysis

For purposes of making an informed investment decision we engaged several installers to provide initial and subsequent quotes after inspection of the installation premises. This helped us refine inputs and point out possible deviations away from initial estimates which include some form of financial analysis of the system economics. We provide a high level snapshot of two quotes provided; names are withheld for obvious reasons.

Table 1: Summary of 2 quotes received for small customer site from different installers

Summary	Quote 1 (post-site visit)	Quote 2 (initial quote)
System Size	15kW	13kW
Capacity Factor	17.50%	19.50%
System Cost ($)	30,000	43,000
Warranty Terms	Panel 10yrs, Output 25yrs, Inverter 10yrs, Workmanship 10yrs	Panel 10yrs, Output 25yrs, Inverter 10yrs, Workmanship 5yrs
Financial Metric	Simple Payback 3.4 yrs, $73k Return on Investment (10 yrs)	Cost Savings of $336k (25 yrs)
Comments	No time value of money, included tax benefits against pre-tax tariffs, energy output based on CEC guidelines	No time value of money, inflated tariffs, escalation rates and output, lack of transparency regarding make and model of panels

The following focuses on Quote 1 as it is more representative of the quotes received:

- Proposed system size was based on panel efficiency and rooftop estate available. System costs are net STC rebate (implied certificate price was significantly out of the money, $30 against $38 per certificate at the time of quote);
- Initial load-weighted electricity tariff of $0.26/kWh (defined here as demand-variable charges) and a 10% pa projected increase throughout the 10 year project horizon; and
- Headline payback period of 3.4 years with net return on investment showing +$73k for the first ten years (extrapolated over 25 years this would easily exceed +$200k).

Improvements to the analysis in the next section are also based on Quote 1.

IES brief comparison summary

We have calculated the savings benefits based on our own interpretation and communications with the installer tailored to the client characteristics. These changes include:

- Factoring time value of money, or the opportunity cost of buying the system;
- An attempt to reflect the daily generation profile of energy and weighted average cost of electricity offset by the solar PV system;
- Assessing benefits over a longer horizon reflecting warranty periods (up to 25 years);
- Removing any tax benefits associated with the system for pre-tax comparison[ii];
- Including additional costs over the life of the project (replacement of inverter);
- Shocking input assumptions to derive sensitivities; and

[ii] Including tax benefits of the system against pre-tax electricity tariffs is not a fair comparison. Analysis at the pre-tax level also removes any tax concerns specific to the customer.

- Using proper financial valuation metrics for making capital decisions.

After the above adjustments and using discounted payback period and net present value metrics the economics of the system is still favourable but not to the extent marketed by the installer. The charts below highlight some of these differences.

Figure 1: Projected cost of electricity against the cost of rooftop PV

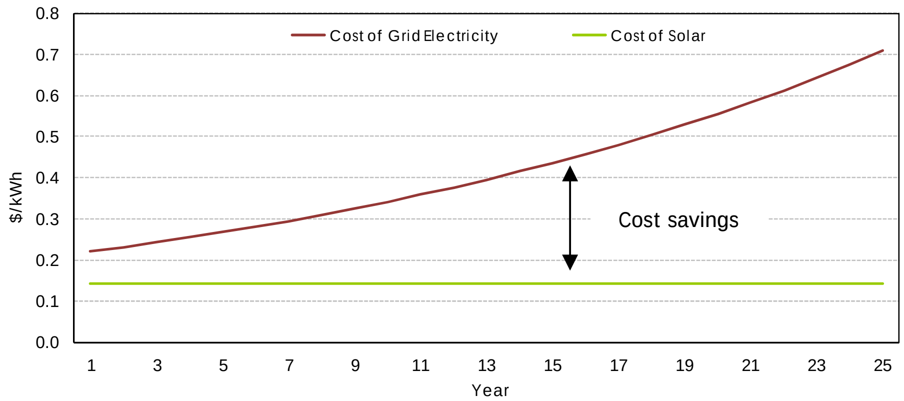


Figure 1 show the difference in costs ($/kWh) based on a Base case ($30k net cost of the 15kW system @ 10% pa and no exports, and $0.22/kWh base tariff escalating at 5% pa). The provided capacity factor of 17.5% is hard to verify but was in line with Clean Energy Council consumer guidelines[iii], however, we also saw much higher questionable numbers from cheaper lower quality panel manufacturers.

It is apparent rooftop PV is immediately beneficial because of the gap between current and future electricity prices and the relatively fixed cost of rooftop PV. As we discuss below installers have the tendency to focus on future cost savings driven by much higher escalation of grid-delivered electricity costs inflating the economics of rooftop PV. The economics based on an already high tariff will be favourable however we question the value placed on using uncertain assumptions in an attempt to sell the project.

Figure 2 (below) shows the time required for the system to breakeven by charting the total upfront cost of the system against the cumulative cost of purchasing electricity from the grid[iv].

IES were never presented an equivalent dotted line, i.e. the present value of the firm red line, as it isn't as favourable (for closing a deal) and/or is slightly harder to understand. The correct payback using the dotted line extends it from 5 to 7.5 years – this can be thought of as taking into account the opportunity cost of money.

[iii] http://www.cleanenergycouncil.org.au/resourcecentre/Consumer-Info/solarPV-guide.html, accessed 15 August 2013
[iv] Using the expected output of the solar PV system, provided by the installer

Figure 2: Annual system costs and energy cost savings for discounted payback period

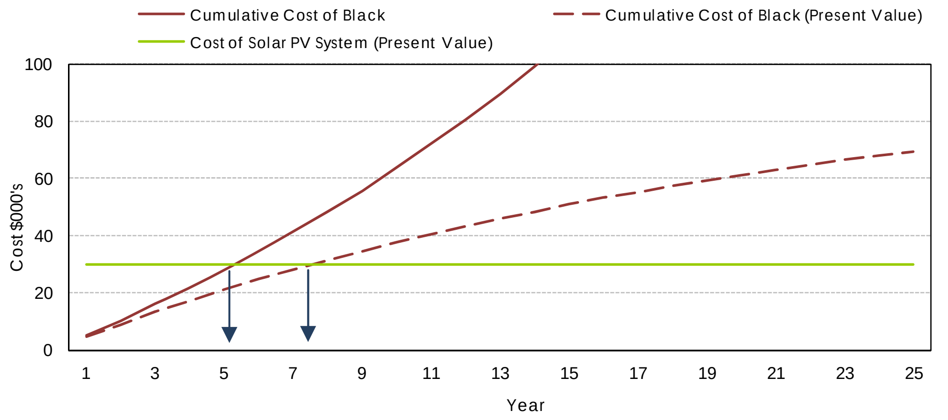
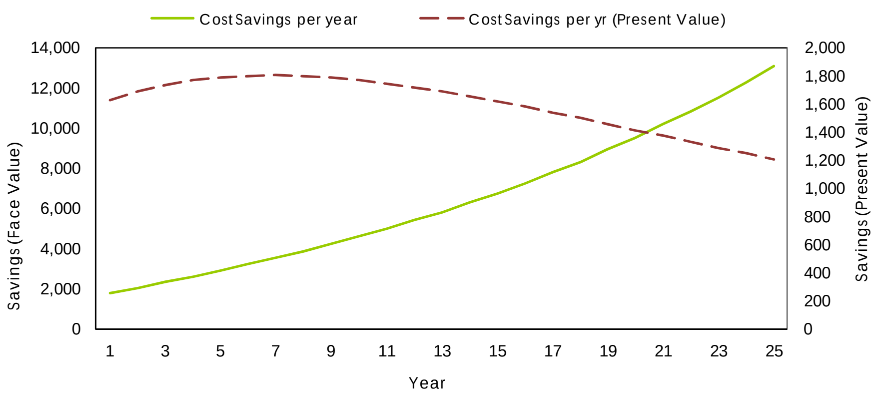


Figure 3 shows the same story using annual cost savings (the financial metric used in Quote 2). The green line, a standard curve in quotes, shows the annual savings over a 25 year period; the dotted line is the same line discounted back to present day terms generated by IES. By not factoring in time value of money, many quotes overstate the benefits of savings towards the back end of the project when we all know how uncertain electricity prices are (amongst other inputs). In proper financial valuation the savings of up to $12,000 by year 25 are really only worth $1,200 in today's terms (and arguably less if you were to factor in the risks associated with uncertain electricity prices).

Figure 3: Cost savings per year on a nominal and present value basis for $ savings

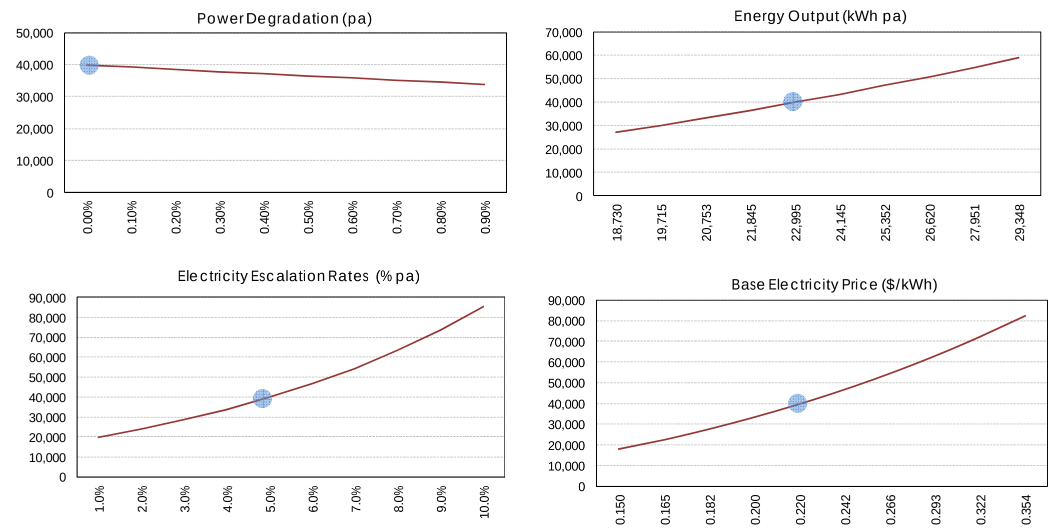


Grid-parity assessment

To be clear we will define grid-parity as when the NPV of the project is above 0, an indication the project should be taken on, barring any other issues not considered here (such as liquidity and competing capital priority). Based on the above data and analysis the system is highly economic relative to the cost of grid electricity, however, there are also highly uncertain inputs into the modelling process.

As noted earlier, quotes were always one-dimensional and the financial risks of incorrect assumptions were never properly communicated whether intentional or unknowingly. Here we shock the important inputs (one at a time using the base case) to show how the economics and/or grid parity threshold may be affected.

Figure 4: Net Present Value ($, y-axis) and input sensitivities (blue dot indicates base NPV analysis)



We can make the following observations from the above:

- Power degradation factors aren't expected to affect the NPV of the system (most of the better manufacturers provide degradation factors between 0.2 - 0.7% per annum, and have output warranties or performance guarantees);
- Energy output and the base electricity tariff inputs are highly sensitive. For a 10% shift in the underlying base assumption, the NPV of this rooftop system shifts 15%;
- The NPV is highly sensitive to the electricity tariff escalation rate given the uncertainty over a 25 year period, with installers quoting up to 10% inflating the benefits of rooftop PV;
- The NPV seems resilient and should remain above grid-parity for any adverse assumption change (within reason) - all lines are significantly above 0 for all major assumption shocks[v]; and
- The base electricity tariff makes a large difference given this was at the small site. At the client's other larger site the weighted-average cost of electricity would be much closer to $0.16/kWh[vi]. This starting price includes a carbon component ($0.02/kWh) and regulated renewable energy charges ($0.01/kWh) which we'd expect changes to in the next 12 months or so.

Figure 5 charts the NPV against % shocks to the underlying assumptions[vii] including simultaneous shocks to both the output and escalation rate. Commentary is provided within the chart, but clearly shows as per the sensitivities above that the project economics are highly favourable for the customer.

[v] Shocks were done one at a time only
[vi] Calculation of a weighted electricity tariff based on estimated rooftop PV profile
[vii] Base electricity tariff has the same sensitivity as energy output and is not shown

Figure 5: Grid-parity scenarios for this particular customer

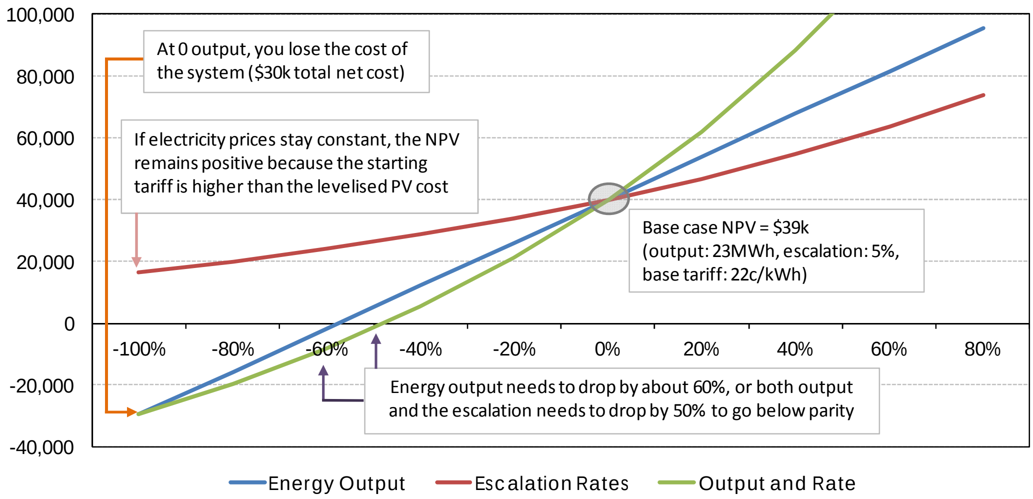
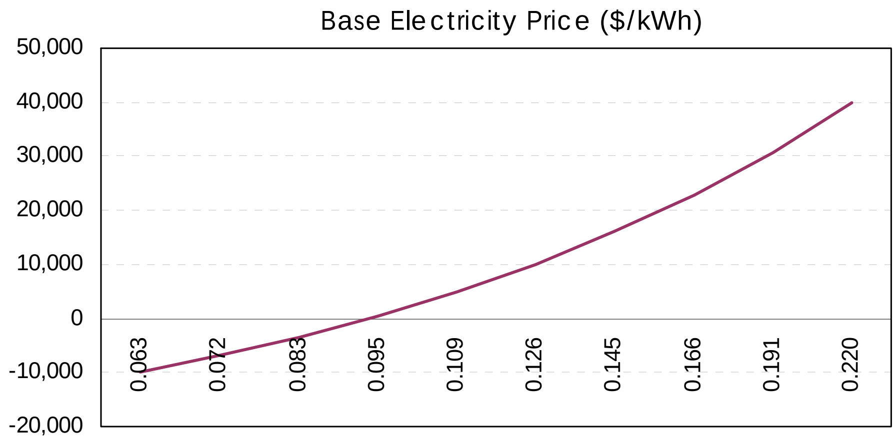


Figure 6 shows the NPV across different base electricity prices using the previous set of assumptions (note the other assumptions would have a significant impact on this). The NPV falls below 0 below approximately at $0.095/kWh, but tariffs are at or well above this level for both SME and residential customers indicating grid-parity. The other point worth noting are the current retailer feed-in tariffs, around $0.06/kWh, are well below this level indicating there is no reason to install a system that can output more than consumption levels[viii].

Figure 6: NPV against base electricity price (all other assumptions constant) - $'s



[viii] NSW feed-in tariffs are now based on net exports and are significantly lower than the electricity tariff

What we learnt in the process

An attempt by us to properly quantify the benefits of a rooftop system and it's deviation from quotes highlights several aspects worth noting:

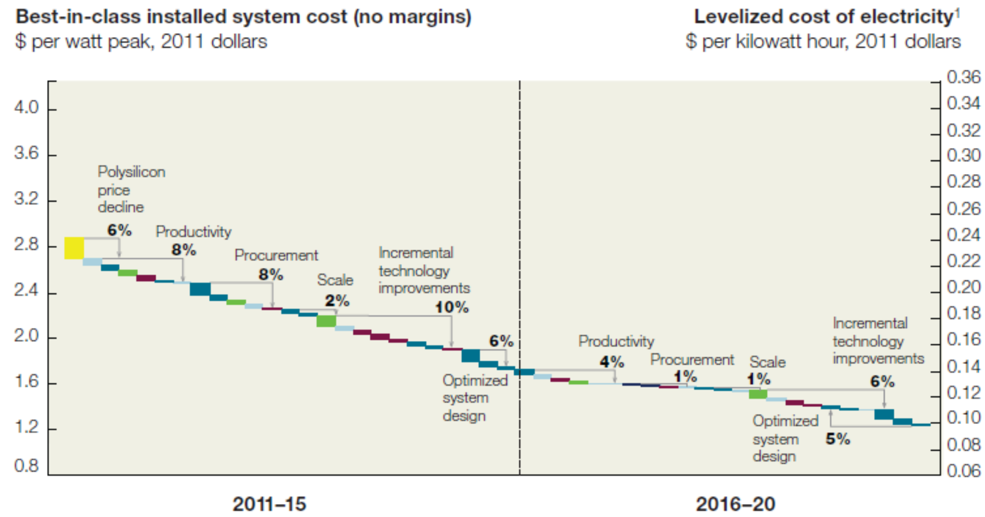
- There is no consistent standard for solar PV panel quality, output and reliability. Given system output is a major driver in the economics we found it highly difficult to obtain underlying assumptions or modelling behind the provided output numbers (or useful power curves). We would imagine it would be equally difficult to verify the installed system is performing as marketed;
- Quotes can be highly misleading. This could have been to simplify the analysis but the proposed metrics (inflated) relative to IES analysis would lead us to believe it was misleading marketing material and/or installer lack of financial understanding;
- Installation costs can be up to 50% of the net system cost confirmed by research of individual panel and inverter costs[ix], our quotes suggested hourly installation rates of somewhere between $500 to $1000 per hour assuming 1-2 days for installation. This also does not take into account significant margins from the STC rebate[x];
- Uncertain inputs which have a large bearing on the NPV were never properly communicated to the customer. The financial ramifications of putting in the wrong assumptions could determine whether the rooftop system was worth installing in the first instance. Most customers lack the expertise to assess the quote let alone sensitivities;
- Communication could be improved. In one case we received a quote for a lower quality panel and one for a higher quality panel from the same installer, with no difference to input assumptions except for a 65% higher net system cost. On further investigation efficiency gains and benefits of a reliable warranty were not properly communicated; and
- Warranties are fairly similar across the manufacturers however given where we are at in the industry cycle (see below), choosing cheaper but less reliable equipment may impact purchasing decision amongst different panel and inverter manufacturers (workmanship is also important).

Other observations of the solar industry

During the process IES spoke to various stakeholders in the industry ranging from manufacturers, retailers to the end-use customer. Here we present charts and figures we found useful in highlighting certain aspects of the small-scale solar industry.

[ix] Also confirmed by a major panel manufacturer
[x] Margin would presumably cover administration and price risk. In this instance we calculate this margin to be in excess of $2,000

Figure 7: Cost of solar PV over time including projections to 2020

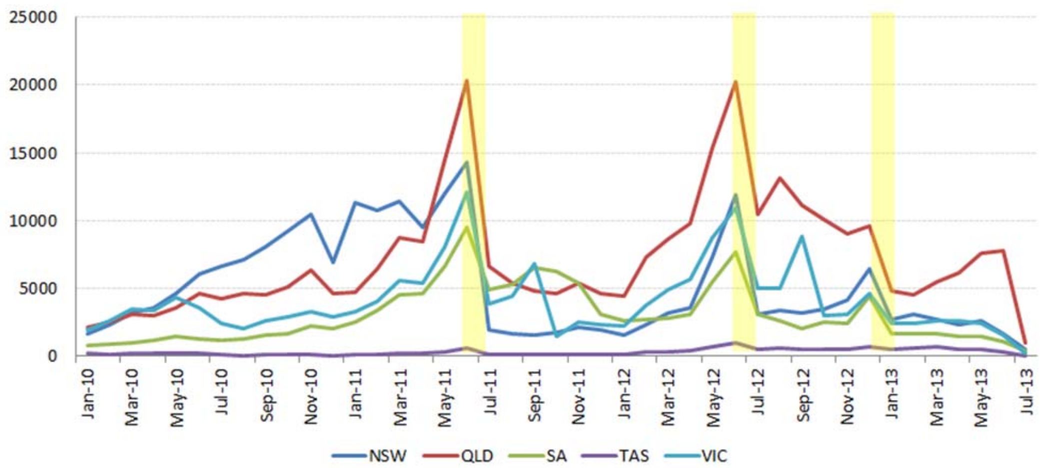


Source: Solar Power: Darkness Before Dawn, McKinsey 2012

Figure 7 shows the continued drop in panel prices across the global industry[xi]. The continued decline is consistent with our experience over a 12 month period from speaking to the client. We have seen considerable drops in prices most likely due to surplus inventory being dumped into the Australian market and the high AUD over that period. We have also heard of installers going around international distribution agreements to parallel import available brands directly from China - these products aren't supported under local warranty terms.

As for future trends it is worth noting the cost of PV has come down tremendously over the past 10 years and the declining trend is likely to slow down with the weakening AUD and absorption of excess stock. We have found installers implicitly favour the cheapest PV panels because the additional selling points do not translate to dollar savings in the provided quotes.

Figure 8: Weekly installation of solar PV systems by state

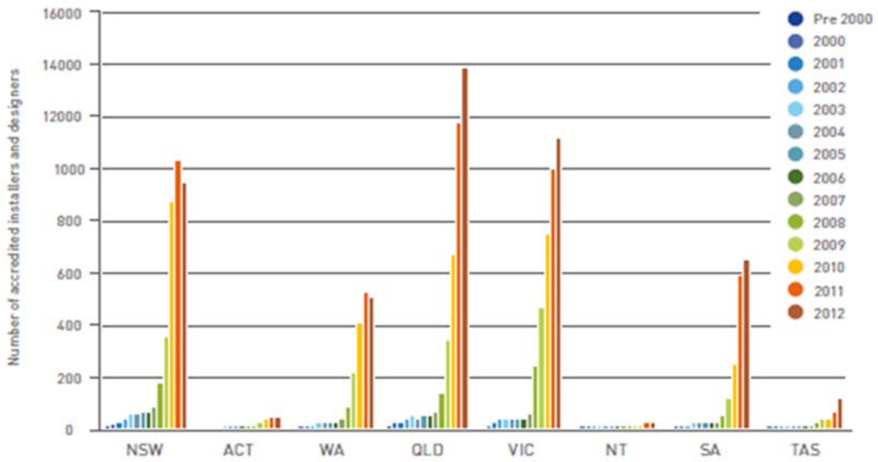


Source: ORER data as of July 2013, data is dependent on system registration and is a major factor in the July drop

[xi] Absolute price levels are indicative only

Figure 8 shows solar PV installations and the volatile nature of state-based installations and reason for government concern regarding installer dependence on federal and state-based subsidies. The highlighted yellow periods show significant activity change as a result of the gradual drops in the solar credit multiplier. We expect the solar industry to be less volatile going forward however it is worth noting there is not much change expected in the wholesale market or policy direction to warrant rapid increases to current installation numbers yet the numbers of solar panel installers have increased significantly (see below). There is also a surplus of solar panel inventory that will take time for the market to absorb.

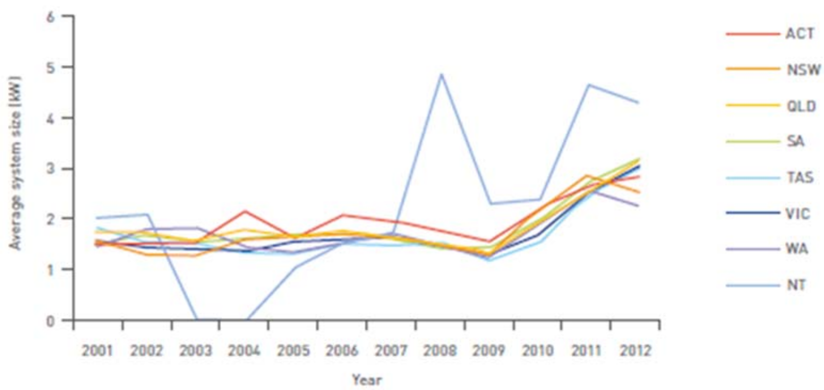
Figure 9: Accredited solar panel installers and designers by state



Source: Clean Energy Report 2012, Clean Energy Council

Figure 9 shows significant increases in accredited installers over the past few years consistent with the solar boom. The installer is responsible for marketing the product and holding the relationship with the customer meaning the reputation of the brand is directly affected by installer integrity. As noted above there are a lot more accredited installers but the number of systems being installed aren't expected to grow as rapidly (nothing on horizon such as increased subsidies to drive an installation frenzy) leading us to believe installation margins will decrease and a maturing of the market to normalised levels.

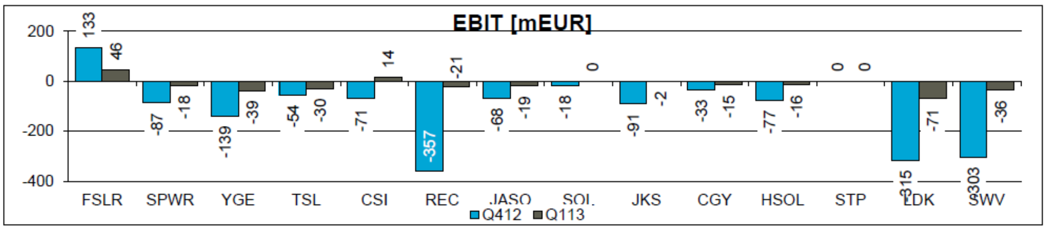
Figure 10: Average solar PV system size by state



Source: Clean Energy Report 2012, Clean Energy Council

We question whether the system size would keep increasing given currently low net tariffs as exporting energy to the grid is less economic and decreases the viability of the system – this should create an upper bound for system size. Also larger systems would generally be adopted by larger sites but these would have lower tariffs making the project less favourable (if net present value and discounted payback was sole decision driver). The trend going forward needs to be balanced with the recent price drop, availability of rooftop estate and increasing efficiency (based on kW per square metre). Based on quotes received this site could cater for 30% more kW of capacity but came at a cost increase of 65% using one of the premium solar panel brands. This additional cost was more than enough to cover replacement costs for a mid-range panel.

Figure 11: Profitability of major solar panel manufacturers from Q4 2012 to Q1 2013



Source: Q Cells presentation, Clean Energy Week 2013

Figure 11 shows the losses currently being sustained by the major panel manufacturers. As a result there is surplus production capacity entering the Australian market (most likely from anti-dumping policies in the US and Europe) driving prices down. Warranty should be a customer concern because of financial strain for many manufacturers and there is already consolidation activity amongst the sector indicating the possible bottoming of panel prices as a result of less price competition.

Conclusion

We expect uptake to continue albeit at a normalised pace as the industry starts to mature with prices to slowly bottom out (new supply counteracted by exchange rate trends) and the continued sustainability push across the broader community. The larger installed system sizes is consistent with the price reductions, however this should eventually cap out due to a move to low net feed-in tariffs.

The rooftop PV industry can improve its marketing and communication strategy to adequately distinguish the range of products available to the customer. The customer is totally unaware of the quality of the system they are installing, particularly energy yield and the project economics because installers don't promote this correctly or transparently combined with the lack of a uniform reporting standard. As for comparisons across products there is no standardised approach like a simplified appliance energy efficiency rating labelling system to make it easy for the consumer to compare products where they lack technical consumption understanding. Installers are the point of contact between the customer and the rest of the market which panel manufacturers need to be aware of.

Depending on customer energy usage patterns and the electricity tariff grid-parity has been reached with government policy support no longer required. The solar industry should normalise after consolidation amongst the large manufacturers and the industry shedding its historical reliance on regulatory outcomes will certainly help it reach more sustainable outcomes. Currently low interest rates and system prices combined with high forecast electricity prices (as provided by installers) will assist homeowners with a lack of cash flow and presents a large opportunity for growth in both industrial and commercial, and the residential space. As seen with declining demand patterns this has large implications for the NEM and its participants.

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