APPENDIX 4.9

Energex solar PV connections forecast

Energex

Solar PV Connections Forecast

Revised Regulatory Proposal

Asset Management Division

energex

positive energy

Energex

Solar PV Connections Forecast 2015/16 - 2019/20

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Version control

Version	Date	Description
1	23/06/15	For submission with revised regulatory proposal

Energex Limited (Energex) is a Queensland Government Owned Corporation that builds, owns, operates and maintains the electricity distribution network in the growing region of South East Queensland. Energex provides distribution services to almost 1.4 million domestic and business connections, delivering electricity to a population base of around 3.2 million people.

Energex's key focus is distributing safe, reliable and affordable electricity in a commercially balanced way that provides value for its customers, manages risk and builds a sustainable future.

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Executive Summary

In its preliminary decision the AER stated that it *"expects Energex will take AEMO's latest forecast into account when preparing its revised proposal*".

The latest available AEMO forecast is the updated 2015 National Electricity Forecasting Report published in June 2015, which notes the *"uptake of residential PV installations continues over the short to medium term, then slows as it begins to reach saturation levels. Commercial PV continues to grow across the entire forecast period, with small commercial installations displaying the strongest growth".*

A comparison of the Energex and AEMO forecasts for energy generated from solar PV is shown in Figure 1. Although the updated June 2015 AEMO forecast is lower over the 2015-20 period than their June and December 2014 forecasts, all are significantly higher than Energex's June 2015 solar PV forecast.

In March 2015 the Queensland Government announced a target of one million solar roof tops by 2020. Given consultation is still ongoing and the final form of the targets is uncertain, no allowance has been made in Energex's revised solar PV connections forecast at this time. However it is more likely than not that additional inverter capacity will be connected to the network in the future that is not currently accounted for in Energex's revised forecast.

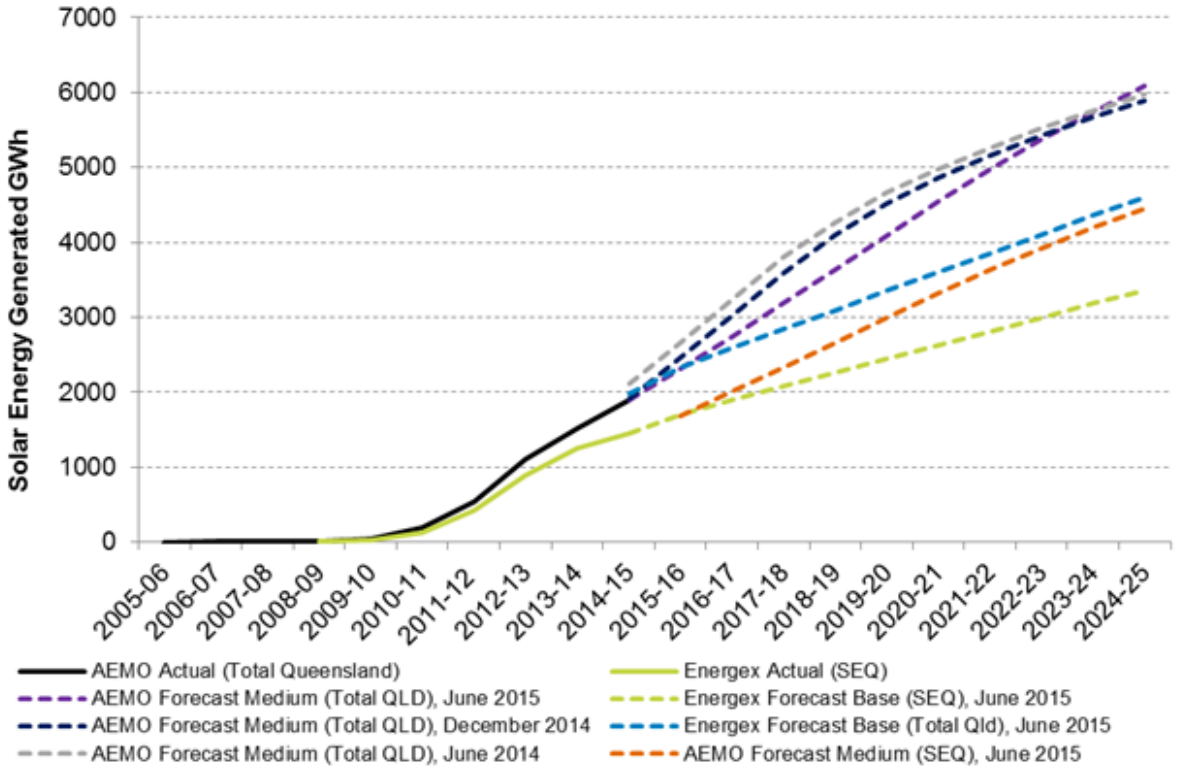


Figure 1: Total solar PV generation for Queensland (GWh)

Contents

1 Introduction

This report provides details on Energex's revised solar connections forecast and provides the rationale and market conditions supporting the forecast. This forecast is an input into Energex's Power Quality capex program.

Reference is also made to the December 2014 AEMO update of energy consumption for Queensland and its reference to a softening of solar growth.

2 AER key issues

In making its preliminary decision on Energex's power quality expenditure forecast, the AER considered that the projected increase in solar panel connections was not supported by any evidence that Energex relied upon (e.g. forecast models for growth in solar connections). On this basis the AER considers that the projected increase in solar connections is likely overstated because it does not account for the expected softening of solar growth.

3 Solar PV forecast (Original proposal)

The solar PV forecast used to develop the power quality expenditure forecast was provided in Table 1, Appendix 29 of Energex's Original Proposal. It should be noted that the figure included for installed capacity in 2018-19 has a typographic error that was not previously detected. The figure should have been 1,300,000 and is shown in the corrected table in Table 2.

The error in installed capacity in 2018-19 although material did not have an impact on Energex's power quality forecast, as Energex based its forecast increase in PV penetration levels on the percentage increase in connections, with average capacity per installation held constant. This is further explained in the Power Quality Augex Forecast (Appendix 4.8 of the Revised Regulatory Proposal).

Table 1: Solar PV cumulative connections forecast – regulatory proposal

Actual		Forecast					
2012-13	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Number of connections							
221,000	262,000	294,000	324,000	354,000	384,000	404,000	419,000
Installed capacity (kVA)							
666,000	822,000	924,000	1,026,000	1,129,000	1,231,000	1,390,000	1,352,000

Source: Energex Regulatory Proposal, Appendix 29

Table 2: Solar PV cumulative connections forecast – regulatory proposal (with error corrected)

Actual		Forecast					
2012-13	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Number of connections							
221,000	262,000	294,000	324,000	354,000	384,000	404,000	419,000
Installed capacity (kVA)							
666,000	822,000	924,000	1,026,000	1,129,000	1,231,000	1,300,000	1,352,000

4 AEMO forecast (June 2015)

In its preliminary decision, the AER stated that it *"expects Energex will take AEMO's latest forecast into account when preparing its revised proposal"*. The AER noted that a recent update to the AEMO 2014 National Electricity Forecasting Report (NEFR) suggested that solar generation was less than forecast between October and December 2014.

In the 17 December 2014 update for Queensland, AEMO referred to a slower increase in rooftop PV output (26.2% average annual increase, down from 29.2%) driven by incorporating an additional six months of actual installed capacity data from the Clean Energy Regulator (CER) and a reduction in Queensland's feed-in tariff from 8 cents/kWh to approximately 6 cents/kWh.

The latest available AEMO forecast is the updated 2015 National Electricity Forecasting Report published in June 2015, which notes the *"uptake of residential PV installations continues over the short to medium term, then slows as it begins to reach saturation levels. Commercial PV continues to grow across the entire forecast period, with small commercial installations displaying the strongest growth".*

A comparison of the Energex and AEMO forecasts for energy generated from solar PV is shown in Figure 2.

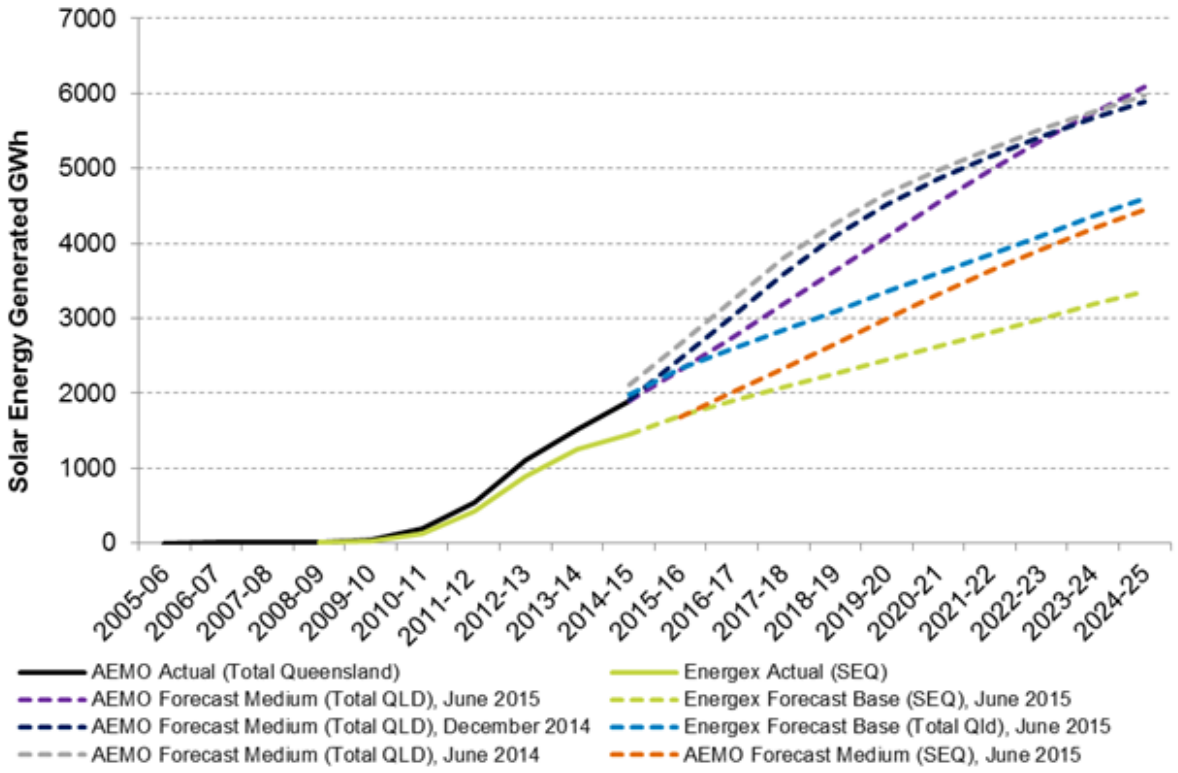


Figure 2: Total solar PV generation for Queensland (GWh)

The light blue line shows an estimated Queensland equivalent solar PV generation based on the Energex forecast of solar PV generation using a standard ratio. AEMO have reduced the forecast for solar PV generated energy in June 2015 (purple line) from the forecasts in December 2014 (dark blue line) and June 2014 (grey line).

The annual growth rates in generated energy from solar PV between the adjusted AEMO forecast and the Energex forecast is shown in Table 3.

Table 3: Comparison of energy forecast growth rates

Year	AEMO growth rate, June 2015	Energex growth rate Revised proposal
2015-16	22.0%	17.9%
2016-17	18.9%	11.0%
2017-18	16.1%	9.8%
2018-19	14.0%	8.9%
2019-20	12.4%	8.5%

AEMO have not provided a comparison of either customer numbers or generated MW that they are using following the review in June 2015.

The general conclusions from the comparison between the AEMO solar PV generated energy forecast and the Energex solar PV generated energy forecast are that:

- The AEMO forecast is still considerably higher than the Energex or estimated Queensland energy generated forecast.
- The annual energy generated growth rates are lower in the Energex forecast.
- The equivalent Energex kVA solar PV capacity forecast is also lower although this cannot be compared directly as AEMO did not publish the capacity forecast.
- The lower Energex solar PV energy generated forecast implies that the solar PV connections over the next five years will also be lower than those projected by AEMO for Queensland.

5 Queensland aspirational target

The Queensland Government has commenced engagement with Energex on its aspirational target of a million solar rooftops by 2020. To achieve the 1 million solar rooftop target, an estimated 650,000 PV installations in Energex's network will be required by 2020 (assuming 2/3 allocation to Energex) representing an additional 230,000 installations to Energex's original forecast in its regulatory proposal.

Two issues need more investigation by the Government in consultation with Energex and Ergon Energy and key solar industry stakeholders. One is how to achieve the aspirational target in an efficient and equitable way for all Queenslanders; and second how to mitigate potential technical problems due to high penetration of PV in the most reliable and economic way. More detailed investigation is required to identify proper solutions for the two above mentioned issues.

Given consultation is still ongoing and the final form of the targets is uncertain, no allowance has been made in Energex's revised solar PV connections forecast at this time. However it should be recognised that is more likely than not that the Government will pursue its proactive solar policy agenda, and that this will result in some level of increase in the levels of connected solar PV at LV over what Energex is currently forecasting.

6 Revised solar PV forecast

Energex revised solar PV forecast is shown in Table 4 and is based on an econometric model and the most up to date historical trends and underlying market fundamentals. Appendix A provides more information on the model and the supporting rationale.

Table 4: Solar PV cumulative connections forecast – revised regulatory proposal

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
	Number of connections					
Revised proposal	292,909	322,519	347,791	372,317	396,142	419,382
	Installed capacity (kVA)					
Revised proposal	987,000	1,111,362	1,217,504	1,320,514	1,420,579	1,518,187

7 Comparison

Tables 5 and 6 provide a comparison of the per annum growth and cumulative growth in solar PV connections over the next regulatory period 2015-20 between the original and revised forecast. Although there are some differences in the per annum growth in connections, overall there is a slight increase of less than 1% over the five year period. Of greater significance is the increase in the inverter capacity between the revised and original forecast. This is accounted for by the increasing trend towards larger inverter systems, with the average size installed now around 4kVA compared to the previous figure of around 3kVA.

Table 5: Comparison of original and revised forecast growth – per annum

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	Total
	Number of connections						
Original proposal	32,000	30,000	30,000	30,000	20,000	15,000	157,000
Revised proposal	31,455	29,610	25,272	24,526	23,825	23,240	157,927
% Difference	-1.7%	-1.3%	-15.8%	-18.2%	19.1%	54.9%	0.6%
	Installed capacity (kVA)						
Original proposal	102,000	102,000	103,000	102,000	69,000	52,000	530,000
Revised proposal	144,000	124,362	106,142	103,009	100,065	97,608	675,187
% Difference	41.2%	21.9%	3.1%	1.0%	45.0%	87.7%	27.4%

Table 6: Comparison of original and revised forecast growth - cumulative

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
	Number of connections					
Original proposal	294,000	324,000	354,000	384,000	404,000	419,000
Revised proposal	292,909	322,519	347,791	372,317	396,142	419,382
% Difference	-0.4%	-0.5%	-1.8%	-3.0%	-1.9%	0.1%
	Installed capacity (kVA)					
Original proposal	924,000	1,026,000	1,129,000	1,231,000	1,390,000	1,352,000
Revised proposal	987,000	1,111,362	1,217,504	1,320,514	1,420,579	1,518,187
% Difference	6.8%	8.3%	7.8%	7.3%	9.3%	12.3%

8 Conclusion

Energex has reviewed the basis for the forecast and found it to be well supported by the PV market's fundamentals. Although the revised forecast does not materially alter the number of new connections over the five year period it does account for the increase seen in the average size of inverters, which is now above 4kVA and expected to be sustained at this level into the future.

In its preliminary decision the AER stated that they "expect Energex will take AEMO's latest forecast into account when preparing its revised proposal". A comparison with AEMOs June 2015 forecast shows that their forecast for energy generated is significantly higher than Energex's solar PV generation forecast. This would indicate that Energex if anything has understated the growth in solar PV.

In March 2015 the Queensland Government announced a target of one million solar roof tops by 2020. Given consultation is still ongoing and the final form of the targets is uncertain, no allowance has been made in Energex's revised solar PV connections forecast at this time. However it is more likely than not that additional inverter capacity will be connected to the network in the future that is not currently accounted for in Energex's revised forecast.

9 APPENDIX A: Rationale supporting forecast

Background

The number of new Photovoltaic (PV) connections has been subject to more volatility over its regulatory environment than any other type of customer initiated work for Energex, with changes (both expected and unexpected) to the solar credits multiplier, the size of system allowed to be connected, and the rate of payment for the Feed in Tariff, the opening and closing of overlapping state and Federal government schemes, cost of the installation and the community's desire to be more environmentally friendly, etc.

The number of PV connections is an important metric to measure however, as the electricity distribution system was never designed to have energy flowing from the household to the network. This flow creates multiple technical hurdles. The benefits of PV reducing coal fired generation need to be weighed against increases in PV penetration creating its own need for network investment. This is particularly the case in Queensland, where there is a large and growing number of very small PV systems.

The scale of investment required to rectify the impact of increasing PV generation is being questioned by the AER (detailed above), on the basis that there will not be as many PV connections as forecast. This document sets out to support that the number of PV connections over the next 5 years is not about to drop dramatically below forecast, it is well supported by a number of fundamental drivers.

Details of modelling Photovoltaic connections

The photovoltaic connections model is based on a photovoltaic capacity forecast, which is then translated into monthly connections figures. The capacity figures are relatively stable, in comparison to connections which gyrated as a result of changes in government policy which have changes the incentives for installing systems[1]. Capacity provides a clear indication of connections, as the average size of a PV system has a stable trend.

The capacity forecast[2] is based on an segmented S-curve type model, as these types of models are useful for modelling and forecasting developing markets. They segment history, to better account for the different phases of growth. The relative size and duration of these phases, provides key insights into how the market will develop in the future.

In Energex's photovoltaic market, there were five clearly different segments of unique growth identified. The differential growth was largely caused by government policy changes impacting the upfront cost, and return, of owning a PV system. The modelling process uses data from the five segments differentially to be able to account for external impacts on growth within each of the segments individually, thereby providing a more robust coefficient estimation.

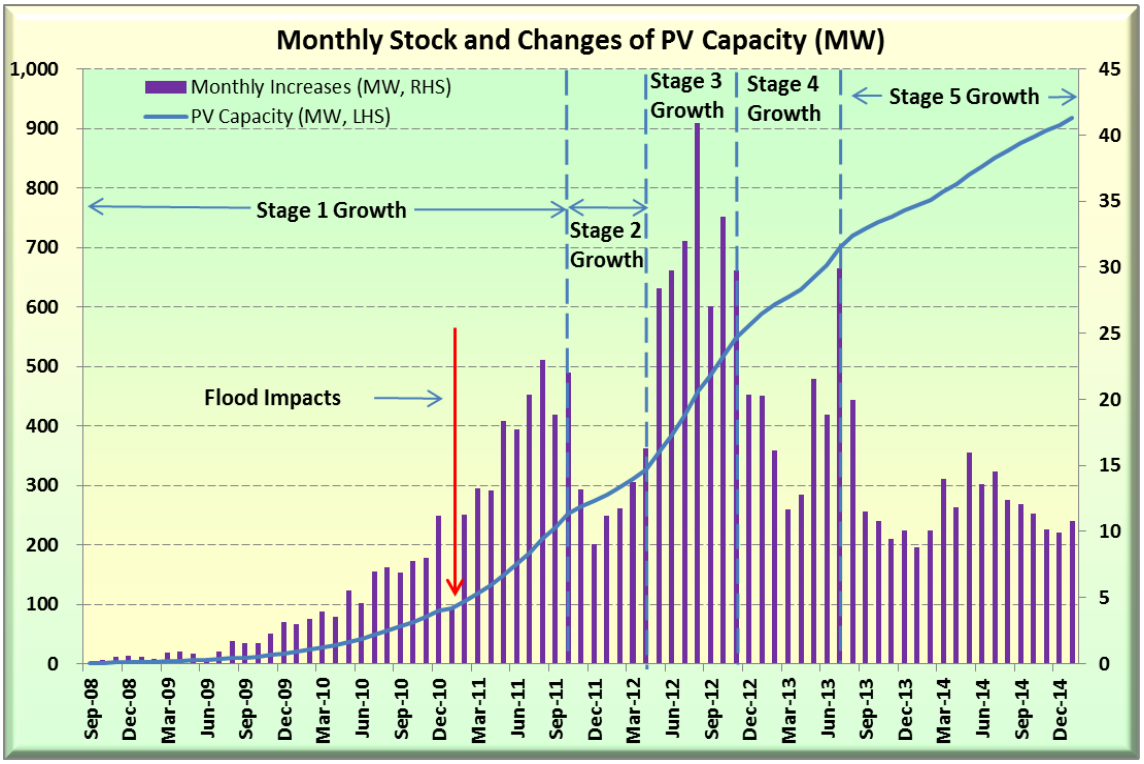
This enabled Energex to identify a clear longer term trend that was not distorted by changing incentives, which reinforced that the recent stability seen in the market is consistent with the expected

[1] To a large extent, the changes in government incentives have changes the timing rather than the number of connections.
[2] The capacity forecast includes commercial systems, however the s curve model is only based on residential with the commercial systems modelled separately.

longer term growth. Formally, the model projects a decreasing percentage growth rate for the next few years, which is consistent with many markets which experience substantial growth in infancy before turning to more moderate growth as the market matures in the medium to long term. This indicates that the penetration of PV will continue to increase modestly, in addition to a proportion of new customers installing PV systems.

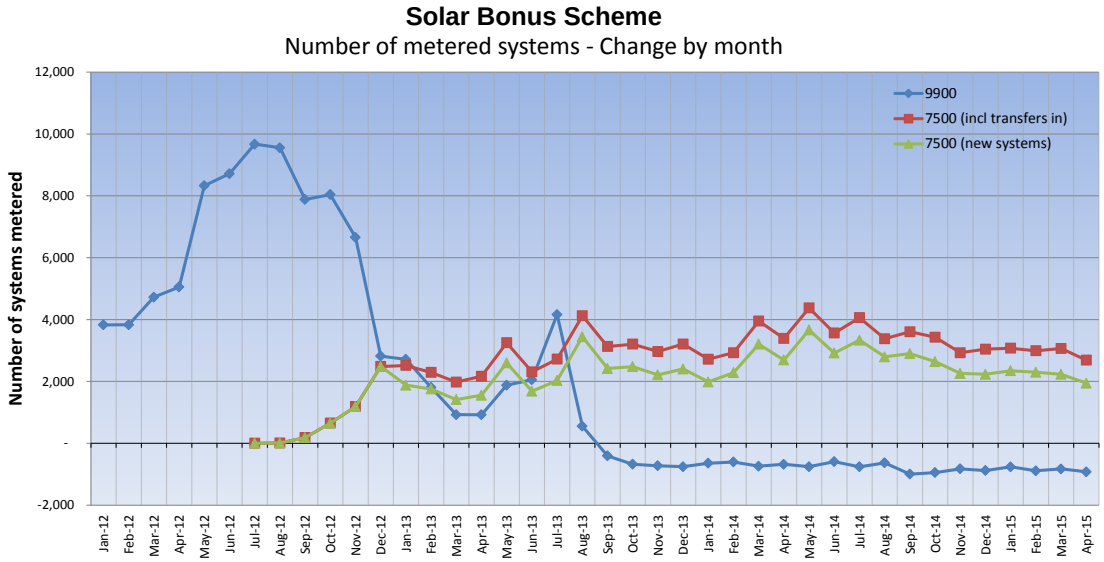
Another factor taken into account within the modelling process is the trend increase in the size of residential systems, which are now larger than 4kW for new connections. Clearly, there are limits on the size of a system that can be installed in a residential area. To account for this Energex has placed a constraint on the model which limits the size of residential connections to 5kW by the year 2020 – after which they remain at an average size of 5kW for new systems.

As a final step, for the specific purposes of forecasting network impacts, the derived connections forecast has been reconverted to an installed inverter capacity forecast by assuming a flat average inverter capacity of 4kW for the five year period to 2020 rather than the inclining average capped at 5kW. This has further limited the forecast growth in installed capacity upon which the network impacts were based.



Supporting factors

The graph below shows the number of new solar PV systems being connected to Energex's network each month. This shows that, even though the 44 cent feed-in tariff ended in July 2012, the number of new connections per month has remained fairly constant since July 2013.



While there are already large numbers of customers with systems, the economics of owning a PV system are still improving, the efficiency of the panels improves, and the cost of panels is decreasing.

Upfront system cost

In August 2009, the Government implemented the Renewable Energy Target (RET) scheme, which was designed to deliver on the Government's commitment to ensure that 20 per cent of Australia's electricity supply came from renewable sources by 2020.

The federal government's mechanism to support the solar (wind and hydro) industries is the Small-scale technology certificates, or STCs. When you install an eligible system, you may claim a set number of these STCs, where the number of certificates you can claim may vary depending on your geographic location and the size of the system you're installing. Currently, homeowners can surrender the certificates to the clearing house for $40 each (eg, a 1.5 kW PV system installed on a Brisbane home would generate around 30 certificates).

Even if the government were to remove the householder's ability to surrender the certificates to the clearing house, the householder's capital subsidy for a PV system from the certificates is well supported by the secondary market as they are currently trading at $38 each.

Tax advantages

PV systems are easy, relatively low risk, small, scalable investments. The relative attractiveness of a PV system has been boosted post GFC by extended periods when the share and property markets have been subdued. While it is an investment which has a large component of indirect returns (i.e. offsetting a future expense rather than generating an income) customers who purchase a PV system are relatively certain that they will be using the investment's returns (electricity) in the future. The return is further bolstered by tax advantages, as any output from the system that is used internally does not involve income tax.

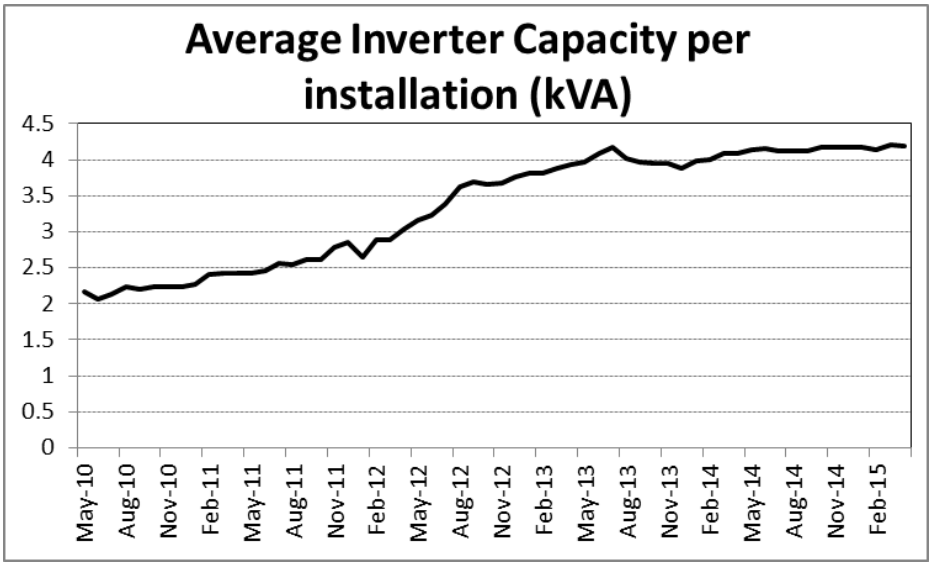
Net Present Value estimates

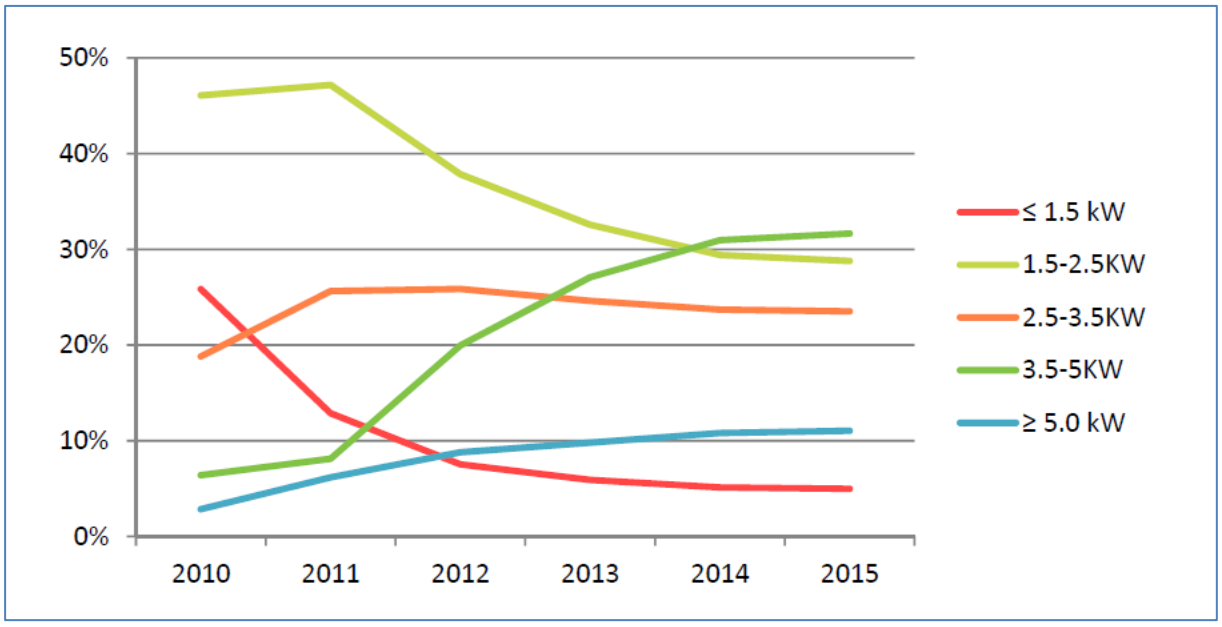
While most consumers would not carefully calculate the Net Present Value of an investment in a PV system, it does not necessarily need to involve this level of effort. Many installers may estimate a customer's payback period for them via their website or sales people. However, indications from the

industry suggest that many customers are actually focussed on sizing their system to completely offset their bill, rather than sizing their system for the Net Present Value.

Grid parity

Grid parity is a situation where the total cost[3] of a PV system matches the cost of grid supply. As the $/kW price of systems falls, and the cost of electricity increases, more systems will achieve grid parity. If customers were making their PV investment decision purely on the basis of Net Present Value, then the end of the 44c FiT should have seen the average size of systems fall – with the erosion of benefits for installing a system big enough to export. However, the average size of PV system installations has continued to increase.





As mentioned above, anecdotal evidence from installers suggests that this is because customers are sizing their PV systems so that they will go close to entirely offset their electricity bills, not sizing according to NPV.

[3] In this case, the cost is the unsubsidised cost.

Another indication that PV systems are approaching Grid Parity, is the growing market for commercial systems. This market has not been supported by the subsidies like the residential market has, so growing investments in this space indicate that the investment is financially viable on its own.

Battery storage

Another future supporting mechanism will be battery storage. The economics of storage are improving rapidly, particularly for those customers who already have significant amounts of PV generation above consumption and do not have the benefit of a large feed in tariff.

There are currently around 800 PV systems a month[4] that are losing their eligibility for the 44c feed in tariff, and are dropping back to the tariffs available from the retailers – typically around 6c-10c kWh. Because of the relative price differences, in these instances a customer's incentive shifts from trying to avoid any consumption during PV generation to trying to shift consumption to times of excess generation.

While we are not currently forecasting the magnitude of battery storage uptake into the future, it would appear reasonable to assume that this uptake will accelerate at some point – given that people tend to own homes for an average of 10 years before moving. That number may also increase dramatically with little ramp up, as it is likely that not only did people in similar situations purchase PV systems, (e.g. a family with young children, in an established house), which would mean that they also decide to change homes at similar points in their lives, but the entire "cohort" of customers with PV systems were installed within a relatively small timeframe – our first records of PV connections is for March 2009 when 252 systems were connected. As such, there may be a flood of new home owners with PV systems generating exports without the benefit of a generous feed in tariff. These customers will be searching for a return, and it is likely that battery systems will be spurred by this market.

The improved market for battery systems will then improve the costs and return for storage systems, creating an additional incentive to install/upgrade a PV system for customers who are not on the premium FiT 44c tariff - by enabling customers to utilise their own excess PV generation instead of exporting it back into the network. For these customers, generation above their demand will be exported back into the network[5]. The amount paid for exports is far lower than the amount a customer pays for importing electricity[6], which creates an incentive for customers to either shift their use of electricity to the times of excess PV generation, or to store the electricity itself to a time when they can use it. Obviously, the benefit of doing so will depend on the relative prices of the exports and imports, the cost and longevity of a battery system, and the relative efficiency of the batteries charge/ discharge cycle.

Over the longer term, it is likely that technological changes will open up new opportunities to boost the number of installations for new uses.

Being green

Domestic PV systems are an easy way for householders to be part of the renewable energy scheme. While the attraction of the environmental factor will vary from one household to then next, the fact that

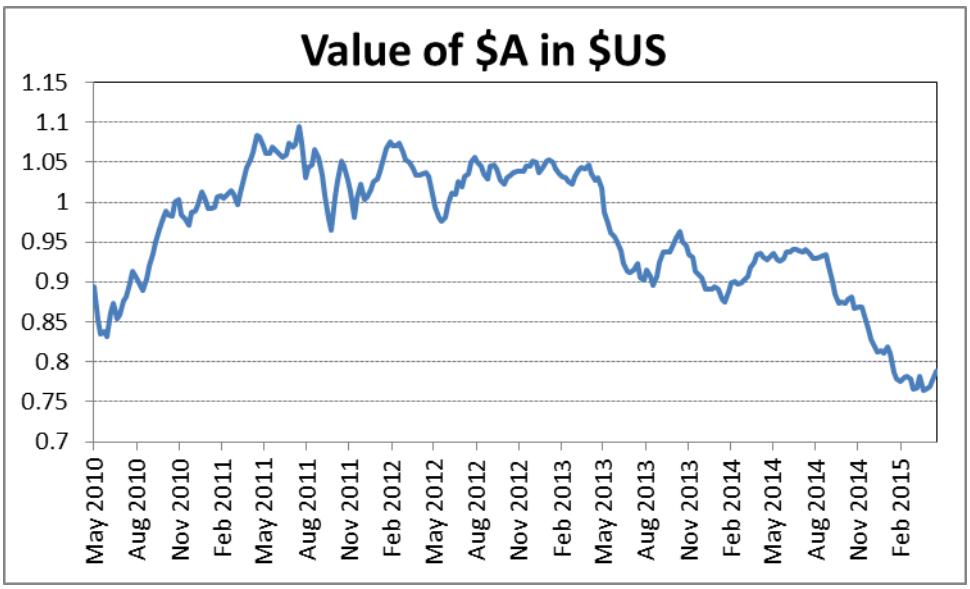
[4] There are approximately 200 000 systems on the 44c tariff.
[5] Provided that the customer is set up to do so. It is believed that there are a number of commercial systems are not set up to, or not expected to, export to the network – as all PV generation is used by the customer.
[6] As both are "post generation" The cost difference is driven by the transmission, distribution and retailing components.

solar PV systems have an environmental benefit in addition to their financial performance, can only increase their attractiveness as an investment.

Potential detracting factors

Currency valuations

The $A maintained a relatively high value during the time of the greatest number of PV connections – see "Value of $A in $US" chart below. It could be argued, that the PV market was boosted by the high value of the $A pushing down the domestic cost of the imported components of the PV systems – lowering their overall cost.



While the $A has since depreciated in value, the cost of installing a PV system has not increased dramatically – the market is very competitive and the cost of systems has remained attractive. As a result, unless the $A depreciates even more significantly in the future than it has over the last few years, then it's unlikely to have a major impact on PV connections.

Saturation

Energex currently has around 290,000 customers with PV connections. Energex's preliminary estimates are that there are over 900,000 homes suitable for PV systems (based on dwelling type and home ownership). This suggests that the market is far from being saturated. If PV systems have similar potential to air conditioning in terms of penetration, then there is still a long way to go as as PV's current penetration of just under 30% is well behind air conditioning at around 80%.

Conclusion

It is clear that the forecast for the number of PV connections is well supported by the PV market's fundamentals.

Appendix: Significant dates to note

- 25 June 2012: Government announced changes to the Solar Bonus Scheme.
- July 2012: Applications for the 44 cent feed-in tariff closed.
- July 2012: The 8 cent feed-in tariff scheme began.
- 23 November 2012: Amendments to the Electricity Act 1994 and Electricity Regulation 2006 became effective.
- 23 November 2012: Legislation change—entitlement to the 44 cent feed-in tariff rate ceases if the name on the electricity account changes.
- 30 June 2013: Deadline for the connection of systems to the 44 cent feed-in tariff.
- 6 March 2014: Government announces changes to the scheme to end the cost of the 8 cent feed-in tariff.
- 30 June 2014: 8 cent feed-in tariff expires.
- 1 July 2014: new feed-in tariff arrangements commence to replace the 8 cent feed-in tariff.
- 1 July 2028: 44 cent feed-in tariff expires.

https://www.dews.qld.gov.au/energy-water-home/electricity/solar-bonus-scheme/current-eligibility