Time for solar to pay its way

SHOULD WE RESTRUCTURE NETWORK TARIFFS?

Consumers in Australia have experienced sharply rising retail electricity tariffs in recent years. This has been largely driven by the need to fund major investments in network infrastructure. But one group of consumers has some immunity from these tariffs. An article by Rajat Sood from Frontier Economics (Australia) published in the Summer 2013 issue of Policy magazine examines how current network tariffs combined with the widespread installation of solar photo-voltaic (PV) panels are shifting the burden of previously-incurred network costs to consumers without PV panels. This has led to substantial inefficiencies that call for a policy response.

Retail electricity tariffs have risen sharply in recent years, partly due to the introduction of the Gillard government's carbon pricing scheme in July 2012, but largely due to the enormous rise in charges for using low voltage 'poles and wires' distribution networks. A decade ago, distribution and transmission network charges in NSW comprised 45% of customer tariffs compared to approximately 55% of tariffs now (excluding the carbon price effect) and about half of current tariffs including the carbon price.[1] Network costs have also risen rapidly in other states.

This need to fund major investments in network infrastructure can, in turn, be attributed to a confluence of factors: tighter reliability standards mandated by state governments in response to a string of high-profile blackouts like the one in southeast Queensland in 2003; the rapid take up of domestic air conditioning units over the last decade, which caused peak demand to soar by 36% from 1999 to 2009;[2] ongoing growth in population and dwelling numbers; the need to replace ageing infrastructure installed in the 1960s and 1970s; and a regulatory regime made deliberately generous to asset owners in response to concerns about infrastructure 'bottlenecks' and exemplified by the queue of coal ships at Queensland's Dalrymple Bay port in 2005.

Electricity consumers now face the risk of retail tariffs rising further as the large-scale installation of solar photo voltaic (PV) panels reduces the contribution of the growing number of solar households to the recovery of previously incurred network costs. This highlights the need to ensure solar households make an efficient contribution to recouping the cost of investments from which they benefit and which cannot be reversed. With the overall loss of economic welfare to date from the installation of solar panels likely to exceed $5 billion across Australia, it is time for solar to pay its way.

The impact of solar

Since around 2009, growth in electricity demand has moderated and even fallen as the rise in air conditioning penetration has slowed, energy efficiency measures have taken hold and higher prices have reduced industrial and household consumption. This has occurred at the same time as the huge wave of network investment due to the earlier growth in demand is starting to abate. But despite these more benign conditions, the network tariff component of electricity bills may continue to rise for the majority of customers. The reason lies in the ongoing growth in power supplied by domestic solar PV panels, combined with the largely volumetric structure of regulated network tariffs applying to residential and small business customers. As more solar panels are installed and produce more energy, the demand for grid-supplied electricity falls. This means the cost of the network investment undertaken in recent years needs to be recovered from a smaller base (in kilowatt hours (kWh)) of grid-supplied electricity. As network and retail tariffs rise to reflect the declining base of consumption, more customers find it worthwhile to install solar panels, perpetuating the cycle. This leads to what AGL colourfully calls the electricity market 'death spiral'.[3] The 'death' refers to merchant energy businesses (such as AGL) that earn profits by selling power, rather than the network businesses who are guaranteed a regulated return on their capital expenditures.

Higher network tariffs are likely to exert regressive distributional effects. Poorer consumers seldom have the wherewithal to finance the large upfront costs of PV installations, even with relatively short payback periods. In addition, poorer households are more likely to rent rather than own, making it much harder to invest in PV units.[4]

How did we get here?

There is, of course, nothing inherently wrong with incumbent electricity businesses losing money or with technological advances leading to radical changes in industry organisation. Indeed, it is the hallmark of a dynamic market economy. From a public policy perspective, problems arise only when change occurs due to unwarranted government interventions. In this context, domestic solar PV installation has benefited (and continues to benefit) from several forms of subsidy.

First, all domestic renewable electricity sources benefit from subsidies through the federal government's Small-scale Renewable Energy Scheme (SRES) and its predecessor, the Renewable Energy Target (RET).[5] The current SRES subsidises the installation of a typical 2kW PV unit in Sydney[6] by approximately $1,500, lowering the price from $5,300 to $3,800.[7] While still significant, the subsidy used to be five-fold in absolute terms on the first 1.5 kW, offering up to $7,500 for a PV installation.[8]

Second, state and territory governments offered extremely generous feed-in tariffs (or FiTs) for:

- the total energy produced by a domestic PV unit ('gross' FiT, which applies in New South Wales, the Australian Capital Territory, and the Northern Territory), or
- the energy produced by a domestic PV unit not consumed by the resident household or small business and is exported back into the grid ('net' FiT, which applies in all other states).[9]

The most egregious case was the NSW gross FiT, which continues to apply to PV units of up to 10 kW and purchased before 28 October 2010.[10] It offers a payment or rebate of 60c/kWh for all energy produced by such units up to the end of 2016. This rate compares to a typical retail electricity tariff of approximately 28c/kWh.[11]

Under this policy, an average Sydney household consuming 6,500 kWh of electricity per annum with a standard 2 kW PV unit that produces 2,850 kWh per annum would face a retail tariff that is a small fraction of what non-PV households pay for power. Well-informed customers who installed larger units can receive from their supplier net payments of up to thousands of dollars per annum. The enthusiasm with which this offer was taken up led to the FiT being dramatically reduced for new installations, to the point where customers installing PV units are now facing a net FiT as low as 6.6c/kWh. This is a rate that is recommended by the NSW regulator, Independent Pricing and Regulatory Tribunal (IPART), to reflect the true value of power injected back into the grid.[12] Other jurisdictions also have substantially cut FiTs, with Victoria's net FiT dropping from 60c/kWh to 8c/kWh,[13] South Australia's from over 44c/kWh to 9.8c/kWh,[14] and Queensland's from 44c/kWh to 8c/kWh (unregulated for Energex customers from 1 July 2014).[15]

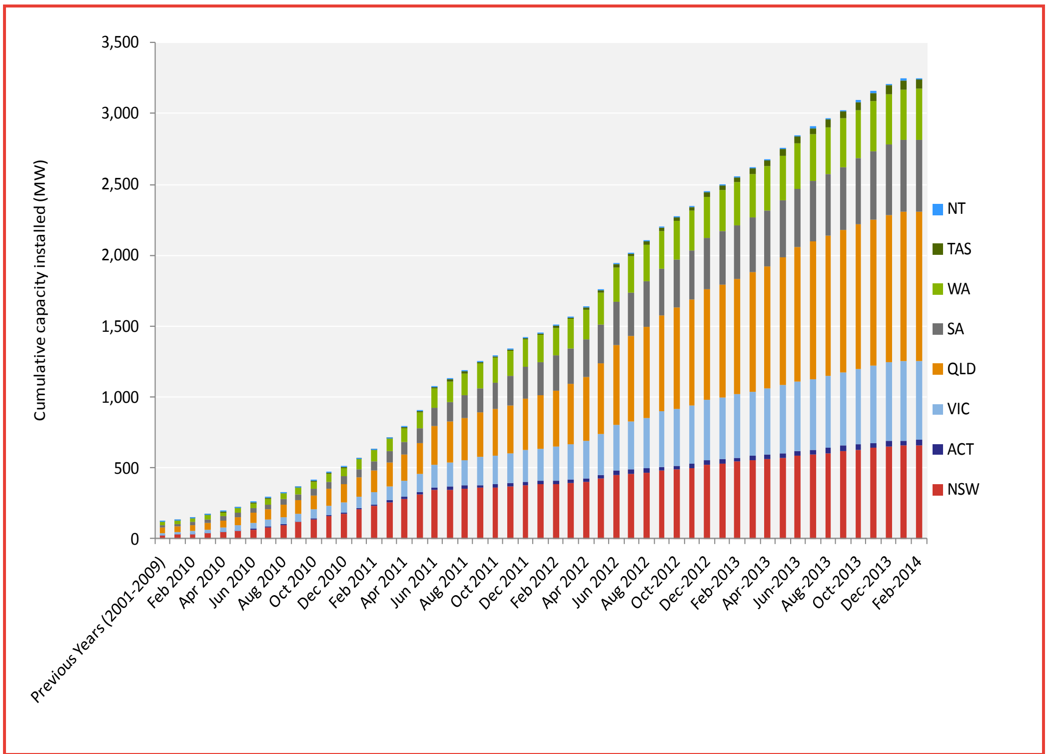
While the generosity of FiTs has been wound back in recent years, the wholesale price of PV units has fallen substantially over the same period. The fully installed cost of domestic PV units (excluding the RET/SRES subsidy and GST) was approximately $12,000/kW in 2008, $9,000/kW in 2009 (when PV take up began in earnest), and $2,600/kW in 2013. This has been partly due to more efficient, larger-scale manufacturing processes. However, it is also the result of major plant investments in China and elsewhere leading to substantial global excess capacity.[16] Falling panel prices have partly offset the decline in FiTs (see Table 1).

Table 1: Solar PV subsidies and unsubsidised installed costs

Year (August)	NSW FiT[17] (gross then net)	Qld FiT[18] (net)	Vic FiT[19] (net)	SA FiT[20] (net)	RET/SRES subsidy Sydney[21] (2kW unit)	Installed PV cost[22] (based on 2kW unit) (excl. STC subsidy and GST)
2009	-	44c/kWh	-	44c/kWh	$6,600	$9,000/kW
2010	60c/kWh gross	44c/kWh	60c/kWh	44c/kWh	$6,600	$6,000/kW
2011	6.5c/kWh net	44c/kWh	60c/kWh	44c/kWh	$2,060	$3,900/kW
2012	7.7c/kWh net	8c/kWh	25c/kWh	25.8c/kWh	$1,900	$3,000/kW
2013	6.6c/kWh net	8c/kWh	8c/kWh	25.8c/kWh	$1,500	$2,600/kW

While the Australian Energy Market Operator (AEMO) forecast a short-term slowdown in the rate of PV installation, it expected the total capacity of installed rooftop PV to rise from 1,240 megawatts (MW) in February 2012 to 5,100 MW by 2020 and 12,000 MW by 2031.[23] The latest figures from the Clean Energy Regulator show that over 3,200 MW of PV had already been installed by the end of February 2014 (see Figure 1).[24]

Figure 1: Cumulative solar PV installations (MW)



Source: Clean Energy Regulator, Frontier Economics

'Grid parity' or grid subsidy?

The holy grail for the PV industry is achieving what is misleadingly called 'grid parity,' which means PV-produced power is available—without any subsidy—at the same amortised per-unit cost as the retail price of grid-supplied electricity.[25] If power supplied from solar PV truly incurred lower costs than power supplied from the grid, it would be efficient for households to avoid connecting to, or to disconnect from, the network. However, this definition of grid parity ignores two important considerations.

The first consideration is that the energy supplied by a single household's PV unit will not by itself enable the household to be self-sufficient in power. Solar PV units produce significantly less power on cloudy winter days than on sunny summer days, and they produce no power at all at night. This means households wanting a continuous supply of power need to rely on either the grid for overnight and backup power or a combination of oversized PV units and battery storage. For example, a typical Sydney household consuming 6,500 kWh per annum would need at least 5 kW of installed PV (and more likely 6–7 kW or more) to generate its full electricity requirements on average, plus sufficient storage capacity to meet peak demand and maintain supply over a number of consecutive cloudy/dim days and nights. Batteries large enough to support normal domestic usage are currently prohibitively expensive. A report by the Australian PV Association showed that in 2012, the cost of off-grid systems (which include storage) was more than triple the cost of grid-connected PV systems, at $10,000/kW compared to $3,000/kW.[26] A recent report prepared for the Clean Energy Council suggested that based on existing tariff structures, the demand for residential storage is likely to remain a minuscule part of the market even by 2030.[27]

The second consideration is that virtually all network investment, once made, is irreversible and therefore considered a 'sunk cost' from an economic perspective. This means the avoidable or 'opportunity' cost of using existing grid infrastructure is relatively low. Even if all existing premises in a network were able to become self-sufficient in power and disconnect from the grid, it would not mean that the resources expended in building the network to serve those premises could somehow be redeployed to serve other purposes. Premises in potential new developments are in a different position, because the network may not have already been extended to cater for their power needs.

Taken together, these considerations have several implications:

- **For existing premises without energy storage facilities:** It is *only* efficient to install solar PV units if the amortised cost of power from the units is below the (undelivered) wholesale cost of power produced by grid-connected generators. So PV units must be able to generate electricity more cheaply than conventional coal- and gas-fired generators. Comparing the amortised cost of PV power to the full electricity retail tariff (in line with the common meaning of grid parity) is inappropriate because a large share of the retail tariff serves to help recover sunk network costs. Customers at existing premises (already connected to the grid) without storage should not be able to avoid contributing towards sunk network costs by installing PV units. Allowing such avoidance artificially subsidises PV installation

- **For premises in new developments or existing customers acquiring storage:**

  It *may* be efficient to install solar PV units if the amortised cost of power from PV *plus* adequate storage is below the full retail price of power. This is a more robust definition of grid parity than the common one and reflects a more appropriate comparison of the economic benefits and costs involved in a solar PV investment.

  However, it may not be efficient to install solar PV units if customers who can acquire power from solar PV plus storage at a lower cost than the retail tariff are willing to contribute to sunk network costs, even if this is less than the contribution made by existing customers. That is, it could be efficient for network businesses to price discriminate in favour of customers who can credibly demonstrate their ability to bypass the network. Such 'prudent discounts' are already a feature of the regulatory regime governing high voltage transmission networks.

Any solar PV installation that occurs despite a failure to meet these conditions is likely to be inefficient. Such installations would benefit from an implicit subsidy from customers who continue to obtain their full power needs through the existing network. As none of the 3,200 MW of solar PV installed to date would have met these conditions, the loss in overall economic welfare so far due to domestic solar PV is likely to be substantial. The broad magnitude of the welfare loss can be estimated by conservatively assuming that the weighted-average cost of PV installed from 2009 to 2013 (inclusive) has been about $3,600/kW[28] and PV units have a life of 25 years. Further assuming that a PV unit in most Australian capital cities produces approximately 1,500 kWh/kW/year,[29] and the true value of the electricity produced by PV panels is about 8c/kWh (in line with recent revised FiTs and escalated at 2% per annum in real terms), the weighted-average excess cost of power from PV has been at least $2,100/kW. With 3,200 MW installed as at early 2013, the value of the inefficiency is likely to be well over $6 billion so far and rising.

Table 2: Economic welfare losses due to solar PV

Average subsidy-free cost of installed PV 2009-2013[30]	Annual average capital city PV output[31]	True value of PV based on escalated 8c/kWh, 25 year life and 8% discount rate	Installed domestic PV to Feb 2014[32]	Excess cost of power from solar PV ($2.1 million/MW * 3,200 MW)
$3,600/kW	1500 kWh	$1,500/kW	3,200 MW	$6.7 billion

What is the solution?

The obvious first step to stopping the inefficient installation of solar PV is to cease offering the direct subsidies outlined above. As noted, the generosity of the SRES and jurisdictional FiTs has already been reduced markedly in recent years. The current solar PV subsidy provided through the SRES is at least now comparable to the subsidy offered to large-scale renewable plant such as wind farms. FiTs now generally offer PV customers a reward for exporting power to the grid based on the estimated avoided cost of grid-connected generation. This leaves the structure of network tariffs as the primary remaining factor encouraging inefficient PV installations.

The source of the problem with domestic network tariffs is they mostly seek to recover sunk network costs through consumption-based tariffs. So to the extent that customers who install PV units can reduce their consumption of grid-connected power, those customers can avoid contributing towards sunk network costs.

Network businesses, which are in most cases guaranteed to recover their costs, should be encouraged to adopt more cost-reflective pricing approaches. This should be subject to grandfathering provisions that insulate customers who installed PV in good faith on the basis of previous tariff structures. For all other customers who choose to install or increase PV units in the future, revised network pricing arrangements should apply.

Economic theory generally supports setting prices at marginal cost to promote allocative efficiency, that is, allocating resources and final goods and services to their most valuable uses. When electricity demand was rising strongly, much debate about efficient pricing focused on determining the 'long run marginal cost' (LRMC) of the network. LRMC is a forward-looking measure of opportunity cost that takes into account the present value of incremental capital costs incurred to meet increased demand. However, with sluggish or falling demand, notional LRMCs for most network businesses would have fallen significantly. This means tariffs should focus on recovering sunk costs in ways that minimise disincentives to use existing network infrastructure. This could be done by using two-part tariffs, or Ramsey pricing, which involves setting higher prices for consumers less likely to reduce their consumption. Given their current reliance on the existing grid for overnight and backup power, solar households are not likely to be much more inclined to reduce their consumption in response to higher network charges than non-solar households.

The application of more cost-reflective tariffs can be as simple or complex as political circumstances and customer data availability permit. At a minimum, it would make sense for a greater proportion of network sunk costs to be recovered through fixed per-premises or per-meter charges than through volumetric consumption-based tariffs. For example, rather than paying a volumetric network tariff of 15c/kWh (out of a full retail tariff of 28c/kWh) on their 6,500 kWh of typical consumption, Sydney customers could face retail tariffs that incorporated:

- a fixed monthly charge of $50 that would recover the bulk of sunk network costs, *plus*
- a variable tariff of 5.8c/kWh on consumption volume to signal the current relatively low LRMC of increased network usage.

The fixed monthly charge could vary on variables not directly related to consumption, such as meter type (premises with high-capacity three-phase meters could be levied a higher charge than customers with more common single-phase meters) or even rateable property value.

Such a shift would radically alter the public's and industry's understanding of the concept of grid parity and deter a great deal of inefficient PV investment. This is because rather than comparing the amortised per-unit cost of solar PV against a retail tariff of 28c/kWh, existing customers without storage options would compare the cost of solar PV against an avoidable volumetric tariff of 18.8c/kWh (reflecting a 5.8c/kWh network charge plus a 13c/kWh retailer charge).

Where potential customers in new housing developments are concerned, or where the availability of cheaper storage makes disconnection by existing customers viable, the situation may be more complicated. It may be efficient for network businesses to price discriminate in favour of customers who can credibly demonstrate their ability to bypass the network altogether through a combination of sufficient PV and storage capacity.

To see why, consider the example of a residential property developer who estimates that across its new estate, the cost of sufficient PV and storage is less than the present value of the lifetime network charges for supplying estate homes from the existing grid. In these circumstances, and assuming the developer acts in the interests of the future purchasers of its houses (a big 'if'), the developer may choose not to connect its estate to the grid. This would be a perfectly rational decision but may not be economically efficient. This is because so long as the developer was willing to contribute to the costs of the existing network, it could be least-cost overall for the developer to connect an estate to the network and not install PV.

Based on the figures cited above, even if a developer could install solar PV and adequate storage for its estate at an amortised per-unit cost of 25c/kWh (less than the 28c/kWh retail tariff), it could be more efficient for the network business to offer the developer a lower tariff to induce the developer to connect to the grid. If the network business succeeded, the developer would save money and the network would obtain a contribution to its sunk network costs. The contribution would be less on a per-customer basis than the $600 per annum paid by its existing customers, but it would be more than what the network would receive if the estate bypassed the grid altogether. Of course, such approaches raise difficult public relations issues for network businesses and the regulators that oversee and approve pricing strategies. Nevertheless, they offer the hope of stemming the losses to the Australian economy—particularly poorer customers who cannot finance PV installation—that are accruing under the existing pricing arrangements.

Conclusion

The falling cost of solar PV installations highlights the weaknesses of existing distribution network tariff-setting methodologies. If nothing is done, electricity bills for the majority of households will continue to rise as wealth is either lost or transferred from customers without PV panels to those with panels. More cost-reflective network tariffs could help deter inefficient PV investment. As regulated networks have relatively weak incentives to stem these inefficiencies, it is up to policymakers to step in to advance the interests of non-PV electricity customers and the Australian economy as a whole. Fortunately, the Australian Energy Market Commission has indicated that it sees problems with the current network pricing arrangements applying to solar PV customers, and the Standing Council on Energy and Resources has submitted a proposal suggesting changes to network pricing. Prompt changes are necessary to curb further rises in electricity bills caused by a costly boom in subsidised solar power.

This article is an updated version of an article that first appeared in the Summer 2013 issue of the Centre for Independent Studies' Policy magazine (Vol.29 No.4). See http://www.cis.org.au/images/stories/policy-magazine/2013-summer/29-4-13-rajat-sood.pdf

ENDNOTES

[1] See IPART (Independent Pricing and Regulatory Tribunal of New South Wales), *Review of Regulated Retail Prices for Electricity—From 1 July 2013 to 30 June 2016*, Electricity: Final Report (Sydney: IPART, June 2013), Figure 2.1, 18.

[2] See Australian Energy Regulator, *State of the Energy Market 2010* (15 December 2010), 19.

[3] Tim Nelson and Paul Simshauser, 'The Energy Market Death Spiral—Rethinking Customer Hardship,' *AGL Applied Economic and Policy Research*, Working Paper No. 31 (June 2012).

[4] Tim Nelson, Paul Simshauser, and Simon Kelley, 'Australian Residential Solar Feed-in Tariffs: Industry Stimulus or Regressive Form of Taxation?' *Economic and Policy Research* 41:2 (North Sydney, NSW: AGL Energy Ltd, September 2011).

[5] For some history about the Small-scale Renewable Energy Scheme (SRES), see Clean Energy Regulator: Renewable Energy Target, 'Small-scale Renewable Energy Scheme (SRES)'; see Climate Change Authority, *Renewable Energy Target Review*, Final Report (Government of Australia, December 2012), Chapter 5.

[6] See Trade in Green, Small Generation Unit STC Calculator, website.

[7] Solar Choice, Solar PV Price Index—September 2013, website.

[8] See Wayne Swan (Deputy Prime Minister and Treasurer) with Penny Wong (Minister for Climate Change) and Peter Garrett (Minister for the Environment, Heritage and the Arts), 'Building Australia's Low Pollution Future with Renewable Energy and New Solar Credits,' joint media release (Canberra: 17 December 2008).

[9] See ESAA (Energy Supply Association of Australia), Energy & You: Feed-in Tariffs, website.

[10] See NSW Trade and Investment, Solar Bonus Scheme, website.

[11] For example, retailer EnergyAustralia currently offers a discounted electricity tariff ranging between 25.4-29c/kWh (depending on usage) throughout most of Sydney. See the EnergyAustralia, website.

[12] See IPART (Independent Pricing and Regulatory Tribunal of New South Wales), *Solar feed-in tariffs—The subsidy-free value of electricity from small-scale solar PV units from 1 July 2013*, Energy: Final Report (2013).

[13] See Government of Victoria, Energy and Earth Resources: Victorian Feed-In Tariff Schemes (Department of State Development, Business and Innovation).

[14] See Government of South Australia, Solar Feed-in Scheme.

[15] See Government of Queensland, How the Solar Bonus Scheme Works (Department of Energy and Water Supply).

[16] See, for example, Platinum Asset Management, *The Platinum Trust Quarterly Report* (30 June 2012), 18.

[17] For various years, see IPART (Independent Pricing and Regulatory Tribunal of New South Wales), Reviews: Retail Pricing.

[18] See Government of Queensland, Solar Bonus Scheme: Current Eligibility for the Scheme (Department of Energy and Water Supply).

[19] See Government of Victoria, Energy and Earth Resources: Victorian Feed-In Tariff Schemes, as above.

[20] See Government of South Australia, Solar Feed-in Scheme. As of 1 October 2013, the SA FiT has been reduced to 9.8c/kWh. The SA regulator has made a draft decision to reduce this further to 7.6c/kWh in 2014.

[21] Based on prevailing STC multiplier applied to 31 STCs plus STC of 1 applied to 10 STCs. Assumed August STC prices of $40 in 2009 and 2010, $20 in 2011, $27 in 2012, and $37 in 2013.

[22] For prices up to and including 2012, see Australian PV Association, *PV in Australia 2012* (June 2013), Table 13, p 27, available for a fee. For 2013 price, see Solar Choice, Solar PV Index–August 2013, website. The 2013 price is grossed up for an STC subsidy of approximately $1,500 and then 10% is subtracted for GST.

[23] AEMO (Australian Energy Market Operator), *Rooftop PV Information Paper 2012* (20 June 2012), iii, 11, 12.

[24] See the Clean Energy Regulator website (accessed 26 March 2014).

[25] Australian PV Association, *PV in Australia 2012* (June 2013), Table 13, p 27.

[26] See Australian PV Association, *PV in Australia 2011* (May 2012), tables 12 and 13, 27.

[27] Marchmont Hill Consulting, *Energy Storage in Australia, Commercial Opportunities, Barriers and Policy Options, Clean Energy Council*, Version 1 (2 November 2012).

[28] Based on the installed PV prices from Australian PV Association, *PV in Australia 2012* (June 2013), Table 13, p 27 and Solar Choice, Solar PV Index–August 2013, website; weighted by installed PV figures of 83 MW in 2009, 381 MW in 2010, 872 MW in 2011 and 933 MW in 2012 from Clean Energy Council, *Clean Energy Australia, Report 2012*, 49 plus 949 MW installed in 2013 and to the end of February 2014 derived from Clean Energy Regulator website (accessed 26 March 2014).

[29] Clean Energy Council, *Consumer Guide to Buying Household Solar Panels (Photovoltaic Panels)*, Volume 14 (26 August 2011), 4.

[30] Australian PV Association, *PV in Australia 2012* (June 2013), Table 13, 27 and Solar Choice, Solar PV Index–August 2013, website.

[31] Clean Energy Council, *Consumer Guide to Buying Household Solar Panels (Photovoltaic Panels)*, as above.

[32] Clean Energy Regulator website (accessed 26 March 2014)

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