Australia's million solar roofs: Disruption on the fringes or the beginning of a new order ?

Bruce Mountain, Director: Carbon and Energy Markets, Melbourne, Australia. +61(3) 96640680, bruce.mountain@cmeaustralia.com.au
Paul Szuster, Consultant, Carbon and Energy Markets, [+61(3) 96640680, paul.szuster@cmeaustralia.com.au

Overview

Between the start of 2010 and the end of 2012, 900,000 rooftop photovoltaic (PV) systems were installed in Australia. Market penetration - more than one in eight household rooftops - is now the highest in the world. Households spent more than $9bn and will receive subsidies over the life of their systems of $8bn. The average cost of electricity from these rooftop systems (around $160/MWh) is about half average household electricity prices.

Excluding feed-in tariffs, claims of cross-subsidy between energy users that do not have PV and those that do, are not conclusive. PV households are paying $252m per year less to monopoly network service providers, but they are avoiding future network expansion. The latter seems to be worth less than the former, but the gap may not be large and the question remains whether monopoly network service providers should recover income lost to competitors, from their remaining captive customers.

Methods

Conventional project investment analysis methods are applied to evaluate the net benefit to the roughly 900,000 households that installed PV in the period from 1 January 2010 to 31 December 2012. Discounted present values of the capital outlay are set against the discounted present value of the capital subsidies, production subsidies, income from retailers and avoided electricity purchases to derive the Internal Rate of Return.

In period from 2010 to 2012, there were significant changes in production and capital subsidies, and also in electricity prices and the capital costs of PV systems. For this reason the relevant inputs in the analysis - the number of installations, feed-in tariffs, capital subsidies and system costs - are specified monthly, and per jurisdiction. The calculation of avoided purchases reflects data on jurisdiction-specific average residential load profiles and average demand, jurisdictions-specific solar radiation profiles and PV system sizes. The calculation reflects the progressive degradation in PV output over time.

Results

The Australia-wide Internal Rate of Return of investments by households in the 899,014 PV systrems is 9.8%. However the IRR varies for different jurisdictions SA (11.5%), NSW (10.7%), ACT (10.5%), Qld (9.7%), WA (9.7%), VIC (7.7%) and TAS (5.5%).

In total around $8.2bn will be paid in capital and production subsidy for the 900,000 rooftop PV systems. As a Present Value - discounting at the IRR - per MW of PV installed, the total subsidy is, $3.7 million/MW. Per MWh produced over the life of the PV, the subsidy is $108/MWh. Energy users – including the households with rooftop PV- are bearing this subsidy.

While the subsidy can be valued with reasonable certainty, it is more difficult to be certain about the benefits that all users would share, as a result of PV's impact on the wholesale electricity market and on networks. We estimate that the 900,000 PV roofs will produce around 3.4 TWh per annum. This is just 1.6% of Australia's centrally dispatched electricity production. Prima facie a 1.6% reduction in average demand is unlikely to have a significant or lasting impact on prices. However, 90% of PV production occurs in just 6 hours from 10am to 4pm, so PV's share of consumption is more appropriately stated as a percentage of consumption during this time, in which case PV's share of the market (half-hourly demand) rises to around 5%.

In South Australia, where PV is installed on 21% of households, PV's share of South Australia's centrally dispatched electricity production between 10am and 4 pm is around 15%. Furthermore this PV production is at the time when the supply cost curve is most likely to be relatively steep which implies that the effective reduction in residual demand - total demand less PV production - can be expected to have a reasonably significant impact on wholesale market prices.

We estimate that the 900,000 PV systems avoid network augmentation that could be valued at between $0.9bn and $2.1bn or between $72m and $168m annualised. The 900,000 PV systems which produce around 3.4 TWh per year,

of which 1.8 TWh displaces electricity in those households that would otherwise be supplied by the grid. This results in around $252m of income that monopoly distribution network service providers have lost from households with PV.

The uptake of PV in Australia, even as subsidies have declined, has sparked debate on whether the economics of PV, installed at the point of use, is such that the established centrally dispatched electricity model is at the beginning of a death spiral. The average cost of electricity produced by the 900,000 PV systems installed between 2010 and 2012 is $162/MWh. This compares to the nation-wide average household electricity of $320/MWh. In other words, for households in Australia that installed PV during the period from 2010 to 2012 it costs, on average, half as much to produce electricity from a PV system than it does to purchase electricity from the electricity grid.

This suggests significant potential for further expansion of PV, and if battery storage can be supplied for less than around $160/MWh, then it would seem to be more economic for households who have the opportunity, to delink from the national grid altogether. The traditional centrally dispatched industry model is facing a serious competitive threat. This is not to suggest that its demise is certain or will happen quickly.

Conclusions

Despite the generous subsidies, contrary to popular perception, households that invested in PV have not received windfall gains.

The cost of electricity supplied by the 900,000 rooftop PV systems installed between 2010 and 2012 averages $162/MWh. This compares to average residential electricity prices of $320/MWh. While many factors may delay the further uptake of PV, the size of this gap suggests that the traditional centrally dispatched industry model is facing a serious competitive threat in Australia, as it has already in Germany.

Arguments of cross-subsidy between energy users that do not have PV and those that do, are not clear. The 900,000 households are contributing around $250m per year less income to monopoly network service providers. But on the other hand they do not seem to be compensated for their contribution to the reduction of future network expansion. While the latter seems to be worth less than the former, the gap may not be large, and the question remains whether network service providers should have the right to recover revenue effectively lost to competitors, from its remaining captive customers.

Much more could and should have been done by Australia's governments, regulators, consumers and academies to understand the public interest impact of distributed generation in general and rooftop PV in particular. Careful construction of economic and equity arguments and a good understanding of the actual circumstances and data is vital.

References (selected)

JORDAN, D. C. & KURTZ, S. R. 2013. Photovoltaic Degradation Rates—an Analytical Review. *Progress in Photovoltaics: Research and Applications,* 21**,** 12-29.

MARTIN, N. & RICE, J. 2013. The solar photovoltaic feed-in tariff scheme in New South Wales, Australia. *Energy Policy,* 61**,** 697-706.

MCCONNELL, D., HEARPS, P., EALES, D., SANDIFORD, M., DUNN, R., WRIGHT, M. & BATEMAN, L. 2013. Retrospective modeling of the merit-order effect on wholesale electricity prices from distributed photovoltaic generation in the Australian National Electricity Market. *Energy Policy,* 58**,** 17-27.

MOUNTAIN, B. R. & LITTLECHILD, S. C. 2010. Comparing electricity distribution network revenues and costs in New South Wales, Great Britain and Victoria. *Energy Policy,* 38**,** 5770-5782.

PENG, J., LU, L. & YANG, H. 2013. Review on life cycle assessment of energy payback and greenhouse gas emission of solar photovoltaic systems. *Renewable and Sustainable Energy Reviews,* 19**,** 255-274.