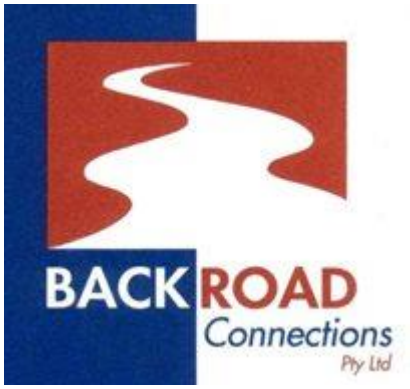


Determining a fair value for distributed generation

Research Report and Bibliography

Backroad Connections Pty Ltd

10 April 2017

This report and other project outputs can be downloaded from
http://backroad.com.au/?page_id=97

Comments, additions and suggestions would be welcome. Please contact
jack.gilding@backroad.com.au

This project was funded by Energy Consumers Australia as part of its grants process for consumer advocacy projects and research projects for the benefit of consumers of electricity and natural gas. The views expressed in this document do not necessarily reflect the views of Energy Consumers Australia.

Contents

Introduction

Context of this Research Report

This Report was prepared as part of the project "*Research review and advocacy on the fair value of distributed generation*" funded by Energy Consumers Australia. The project's aim was to summarise existing research and undertake advocacy on the value of distributed generation, particularly in relation to the setting of feed-in tariffs for solar customers in Australia, with particular reference to review processes that were underway in Queensland, Victoria and Tasmania.

This report is intended for use mainly by participating organisations and people undertaking detailed advocacy work. Progressive drafts of this document were also used to inform the preparation of submissions to regulatory bodies, in particular for government initiated reviews of feed-in tariffs in Tasmania, Victoria, South Australia and Queensland.

Shorter and more accessible advocacy materials informed by this project have been made available through the project website, and the Solar Citizens Fair Price for Solar campaign.

The project included involvement from:

- Solar Citizens
- Alternative Technology Association
- Australian Solar Council
- Total Environment Centre
- Clean Energy Council
- Tasmanian Renewable Energy Alliance

Much of this report focusses on how the value of distributed generation can be assessed and rewarded through feed-in tariff arrangements. However the scope of the project is broader than this. We have attempted to identify values of distributed generation that are additional to those that can be effectively compensated by feed-in tariff arrangements. We also discuss other mechanisms that exist or could be developed to recognise the value of distributed generation.

Structure of this report

The section *Policy context* (p5) addresses some general issues that explain the context in which subsequent discussion of detailed FiT methodology takes place.

The section *Defining a value in c/kWh* (p14) explains the basis on which we have derived a national value for distributed generation of 10-18c/kWh. Note that that this value range is based on only some of the benefits described in more detail in this report.

The case study on transmission costs (p18) summarises one particular component of our calculation that highlights how the current market rules fail to fully recognise the value of distributed generation. This argument is made in more detail in a separate fact sheet available from the project website.

The section *Components of a fair FiT* (p19) deals in turn with each of the various factors that make up the cost of electricity and addresses what benefits distributed generation can bring to reducing this cost. For each of these factors we provide a brief description of what it is and what value distributed generation brings. This is followed by more detailed arguments, relevant references and quotations from previous advocacy materials, and in some cases addresses the main arguments that have been used against recognising this factor in setting FiTs.

Not all the benefits of distributed generation can or should be recognised through feed-in tariff payments. In the section *Other values of distributed generation* (p31) we describe these benefits.

The Annotated Bibliography (p34) provides a comprehensive listing of resources used in this project.

Glossary

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
ARENA	Australian Renewable Energy Agency
ATA	Alternative Technology Association
c/kWh	Cents per kilowatt hour, the measure used to set the price charged for the energy component of electricity bills (as distinct from the fixed charges or demand based charges). Wholesale energy market prices are generally quoted in $/MWh. $100/MWh = 10c/kWh.
DER	Distributed Energy Resources. Used to describe a range of resources spread throughout the electricity network. Includes storage (batteries) as well as demand management systems and distributed generation such as solar pv.
distributed generation	This refers to electricity generation connected to the distribution network (rather than large power stations which are connected to the transmission network). Solar pv is by far the most common form of distributed generation in Australia but other forms include small wind and gas co-generation which is used in commercial and industrial settings.
DUoS	Distribution Use of System
ESC	Essential Services Commission (Victoria)
ESCoSA	Essential Services Commission of South Australia
FiT	Feed-in tariff
ghg	greenhouse gases
IPART	The NSW Independent Pricing and Regulatory Tribunal
LGNC	Local Generation Network Credits See {AEMC 2015a}
MOE	Merit order effect (see page 28)
NEM	National Electricity Market
OTTER	Office of the Tasmanian Economic Regulator
pv	Photovoltaic – technology for directly converting sunlight to electricity (rather than heating hot water, or in larger installations, generating steam to drive turbines).
TUoS	Transmission Use of System
QCA	Queensland Competition Authority
QPC	Queensland Productivity Commission

Policy context

Mechanisms for supporting distributed generation

Feed-in tariffs are the simplest and best known mechanism for supporting distributed renewable energy generation, but there are other ways that are increasingly being explored to better reflect the different benefits of distributed generation.

In this section we explain some existing and proposed mechanisms and look at their advantages and disadvantages. Over time it is likely that some of the more market based mechanisms will provide alternatives to regulated feed-in tariffs.

Feed-in tariffs

Feed-in tariffs (FiTs) are a price paid to solar owners for energy fed back into the grid. In some states FiTs are set at the state level and all retailers required to pay them to customers ("regulated FiTs"). In other states they are left to retailers to decide how much to offer solar owners ("retailer FiTs"), typically with regulators claiming that competition will ensure that solar owners are offered a fair price.

Gross vs net feed-in tariffs. Most FiTs in Australia are paid for just the surplus energy fed into the grid – this is sometime called a "net feed-in tariff". The benefit of energy generated and used on the premises is the saving on purchased energy.

In some places a payment is made for all electricity generated by solar panels, whether it is used on the premises or exported to the grid (a "gross feed-in tariff"). Consumers are then charged for all the electricity they use, whether they generated it themselves or bought it from the grid, so they are only better off if the gross FiT is higher than the cost of purchased electricity. One argument in favour of gross FiTs is that they better reflect some of the benefits, for example in reducing CO_2 emissions. A disadvantage of a gross FiT is that it does not encourage owners to use the energy they generate at the time it is generated.

Time and location specific FiTs

One of the arguments against FiTs is that they do not reflect the fact that, for retailers and networks, the value of energy fed back into the grid is highly dependent on both the time and location. The Essential Services Commission in Victoria investigated these issues in detail and recommended that FiTs should be based on both the time of day (to reflect varying wholesale electricity prices) and location (to reflect greater line losses in remoter parts of the state).

Implementing time-based FiTs requires communicating smart meters that record and report import and export of energy in half hour intervals. Victoria is the only Australian jurisdiction in which this infrastructure is widely implemented, although it is currently being rolled out in other states on an incremental basis.

Location based payments are discussed further on page 12 and the role of distributed generation in reducing investment at particular locations in the network is discussed on pages 24 and 25.

RECs (STCs)

As part of Australia's Renewable Energy Target (RET) legislation, solar owners are entitled to create and sell "Small-technology certificates" (STCs) that reflect the first 15 years anticipated renewable energy generation from their systems. STCs are typically signed over to the solar installation company and used to reduce the up-front cost of the system. From January 2017 STCs reduce to 14 years output and will be progressively reduced by one year's output each year until they are completely phased out by 2030.

Network support payments

Distributed generation has a high value when it can reduce the demand on distribution networks at times they are running at close to capacity. Additional local generation (or demand reduction) can potentially avoid the need for multi-million dollar upgrades to the network. Current regulatory arrangements allow network operators to offer "network support payments" as a way of avoiding or postponing costly network upgrades. These payments are likely to become a viable additional financial benefit of distributed generation in specific locations due to the advent of battery systems and smart software that can control when locally stored energy is fed back into the grid. While these payments have the potential to be quite high (around $1/kWh), the fact that they will only be paid at limited times and specific locations mean that they are likely to be a useful supplementary financial benefit for some distributed generation systems, rather than the main justification for installing them.

Payments based on wholesale market prices

In the NEM, wholesale electricity prices are set every half hour and can vary widely from a few cents a kWh to a (very occasional) maximum of $14/kWh. Regulated FiTs are typically based on annual average wholesale prices. Paying distributed generators for exported energy that reflect wholesale market prices at the time of export would potentially provide benefits to solar owners, particularly when high wholesale prices match times of peak solar production as is often the case in heatwaves. This can also benefit retailers if they can buy energy from their customer more cheaply than from the wholesale market. These arrangement works particularly well if solar is combined with storage allowing energy to be fed into the grid at time of maximum value. This is the basis of the GridCredits100 product offered by retailer Diamond Energy in conjunction with software control systems supplied by Reposit Power.

For more information on time-based FiTs see the section on wholesale energy (p19).

Small generation aggregation

Rather than sell energy back to their retailer, small generators have the theoretical possibility of selling their surplus power directly on the wholesale market. A business called a "small generation aggregator" can pool electricity bought from individual generators and sell it on the wholesale market. As with other options described above, this option requires smart metering infrastructure and is more viable if battery systems allow control of the time of export.

Network rule changes

Current electricity market structures do not reward the fact that distributed generation makes less use of the transmission and distribution networks than centralised power stations. Various rule changes have been proposed to address this disadvantage. In particular a rule change promoted by the Total Environment Centre, the City of Sydney and the Property Council of Australia proposes "Local Generation Network Credits" (see {AEMC 2015a} {Oakley Greenwood 2015} and {Byrne 2015}). These would be payments from distribution networks to owners of distributed generators that reflect the long term benefit of reduced network investment. The AEMC decided not to implement this rule change.

Rule change processes are complex and incumbent businesses can lobby effectively against changes. Even successful changes can take years to come into effect.

Why FiTs should be regulated

What is it?

Should feed-in tariffs be set by regulators rather than being left to the market and set by individual retailers?

Case for regulation

Minimum feed-in tariffs should be set by regulators to ensure all benefits are recognised and all solar owners are treated equitably.

Setting of regulated minimum FiTs in Australia has always been a state responsibility.

The current situation in the NEM states is that:

- regulated minimum tariffs are set in Victoria, Tasmania and regional Qld,
- there is no regulated FiT set in SA (as of 1 January 2017), NSW, ACT and SE Qld
- in NSW, IPART sets a recommended benchmark, with retailers free to pay below or above the range suggested.

In areas where a regulated minimum FiT is not set, governments and regulators argue that, in a competitive retail market, retailers will offer an attractive FiT to entice customers.

There are several problems with this argument:

- Many of the benefits do not accrue to retailers, but to networks, society and the environment so retailers have no incentive to reward them.
- Retail electricity offerings are so complex that it is difficult for consumers to assess which offer is best for them and the FiT rate paid is only one small part of this consideration.
- Vertically integrated businesses (ie that are both generators and retailers "gen-tailers") have a vested interest in discouraging decentralised generation. {ATA 2013 p4}

Research by the Total Environment Centre {TEC 2015} showed that there are a variety of ways in which retailers discriminate against solar customers, with the result that solar customers can pay hundreds of dollar per year more than non-solar customers for purchasing the same amount of electricity from the same retailer. This discrimination can be far more significant than the amount received as a feed-in tariff.

A regulated minimum FiT should be set in in all jurisdictions because:

- Distributed generation has real value to retailers but without a regulated FiT retailers will pocket this benefit rather than reward households that export solar energy.
- Distributed generation at times of peak demand drives down wholesale energy prices which benefits all consumers.
- There are social and environmental values that are reasonably consistent across all locations and a FiT is the most practical way of recognising these values.

"The New South Wales approach of not regulating minimum feed in tariffs payments to customers has failed. Not one electricity retailer is paying the amount that IPART has determined is the financial gain to Standard retailers." {CEC 2013e}

The current situation *"is demonstrably unfair and unjust, given the market failures which comprise disproportionate power relationships based on massive information asymmetry" {ASC 2015 p3}*

"A classic example of the NEM preventing benefits from being realised is the fact that distributed solar cannot trade directly into the wholesale market – thereby preventing the monetisation (to the solar proponent) of merit order wholesale price reductions that occur from reduced demand on supply side generators at times of peak demand. FiTs redress this situation by offering part of the wholesale price savings back to solar owners." {ATA 2012 p4}

"Specifically ATA would like to draw attention to the phrase "... and require market participants to provide payment for that export which is at least to the value of that energy...". The phrase from COAG's national principles indicates that under no circumstance could the payment for solar energy be zero when it is clear that the exported energy has value to the energy market." {ATA 2012 p11}

Alternative approaches to setting a FiT

What is it?

What methodology should be use to set a FiT?

In this project we have adopted the approach of looking in turn at a variety of factors and components that might go into making up a FiT. This is a common approach from both regulators and researchers, however it is not the only way a FiT could be determined. Distributed renewable energy generation has many economic, social, industry development and environmental benefits. Not all of these can readily be translated to a cents/kWh figure, and even when they can, this involves a large number of assumptions so the final results are not as objective as the plethora of acronyms, the arcane economic language and mathematical formulas might suggest.

Problems have been created in the past through legislated FiTs at figures as high as 60c/kWh which have proved unsustainable and have created perverse incentives. However even in these cases we would argue that the problem was not so much the high rate as the long periods for which they were locked in and the failure to review the arrangements as solar panel and installation prices dropped and take-up boomed.

Setting a FiT involves the difficult task of assessing the value of the multiple benefits of distributed generation and working how to pass this on to solar owners as an incentive to install solar so that these benefits are achieved. This needs to be done in a way that does not place undue burden on other customers of the electricity system. An additional requirement is the need for some stability in the FiT so that prospective solar purchasers can estimate the financial payback from their investment. These decisions need to be made in a context where both the cost and the nature of available technology is changing rapidly. Governments have traditionally not handled these decisions skilfully with the result that the industry is constantly going through boom and bust cycles. For example, In Tasmania, the change from a 1:1 FiT to the current arrangement resulted in halving the size of the industry, with an estimate loss of over 200 jobs[1].

The reductionist approach of setting the FiT based only on identified component benefits that can be quantified results in a figure that does not recognise the full range of benefits from distributed renewable energy generation.

[1] http://tasrenew.org.au/boombust/ accessed 1 Mar 2016.

Alternative methodologies for setting a FiT rate might include:

- Starting at the retail rate and deducting components. This effectively reverses the onus of proof and suggests that retailers and regulators should make the case for why exported energy is worth less than energy bought at the same location.
- Setting the FiT to match the lowest discount tariff used by the customer. This has the advantage of being below the average retail price, automatically following tariff changes and providing an easily understood equity between energy purchased and sold by the solar owner.

As an example of the second approach, Tasmanian domestic users buy energy at two tariffs, 26c for light and power and 15.7c for heating and hot water. There is a long standing problem[2] that solar owners in Tasmania using both these tariffs do not get the full value of their solar generation because it offsets only their light and power usage. Setting the FiT at 15.7c instead of 6.7c would solve this problem without requiring expensive meter changes. For solar owners on a time of use tariff, the FiT could be set at the off-peak rate.

Basis for setting a FiT including fairness

What is it?

What should be taken into account in setting a FiT?

Case for

Feed-in tariffs should reflect the long term benefits to the electricity system and the wider social and environmental benefits of distributed renewable energy generation.

The COAG National Principles for FiTs state that:

> *"…market participants should provide payment for exported electricity which reflects the value of that energy in the relevant electricity market and the relevant electricity network it feeds in to, taking into account the time of day during which energy is exported." {COAG 2013 p1}*

In practice, regulators who set FiTs take into account only the costs that can be avoided by retailers, rather than the broader benefits to the electricity networks as stated in the COAG principles. No Australian regulators to date have taken into account health and environmental benefits of distributed renewable energy in setting a FiT. However this will change from July 2017 when the regulated FiT in Victoria will take into account the 'social value of carbon' (see subsequent sections for a discussion of health and environmental benefits.)

Many regulators claim their methodology is based on a 'fair and reasonable value' for exported energy. In most cases fairness is not defined.

The QPC Issues Paper {QPC 2015b p10-12} does have a good discussion of aspects of fairness.

The solar industry in Australia has been characterised by repeated boom and bust cycles caused by sudden changes in government policy. These cycles make it difficult for the solar sales and installation industries to maintain a skilled workforce delivering a quality product.

We believe the definition of fairness used in setting FiTs should include:

- fair treatment of people who have already invested in solar pv

[2] See http://tasrenew.org.au/metering for details. Accessed 27 Apr 2016.

- as much certainty as possible for people and businesses making future investment decisions
- avoiding sudden changes in policy which undermine the growth of a solar industry that is able to deliver a quality product to the public.

"Feed-in tariffs should be based on the system-wide economic benefits of distributed generation and storage and not merely the financial benefits that may be enjoyed by an electricity retailer. The Essential Services Commission (ESC, 2013b) has outlined the limitations of basing a feed-in tariff on the financial benefits enjoyed by electricity retails, stating that,

> *'One limitation of this approach is that it is contingent on the structure of financial settlements in the wholesale electricity pool and of transactions between retailers and distributors or other input suppliers… the structure of transactions between retailers and distributors may not yet fully reflect principles established or proposed by relevant regulatory agencies. For example, the Australian Energy Market Commission has stated that there remain shortcomings in the existing arrangements relating to passing-on avoided Transmission Use-of-System charges to embedded generators under the National Electricity Rules. The Productivity Commission has recommended changes to the arrangements by which embedded generators are reimbursed by network businesses for savings in network costs.' "* {CEC 2013h p3}

Definition of eligible systems

What is it?

Which distributed renewable energy projects (size and technology) should be eligible for a regulated FiT?

Case for

Feed-in tariffs should be available for all renewable energy generation up to 100 kW connected to the distribution network.

Which systems are eligible for a regulated FiT is set at the state level. Eligible system sizes vary enormously, 5kW in regional Queensland[3] to 100 kW in Victoria.

In the days of premium FiTs there was a case for limiting the size of eligible systems. Once the FiT is calculated to reflect the benefit of the energy exported there is no logical reason to set a low limit on the size. Some cut-off point between eligibility for a FiT and generators that fall within the NEM rules is necessary. Given that eligibility for RECs for solar projects is capped at 100 kW it would be logical to use the same level for FiT eligibility.

Larger embedded generators can cause problems for network operation in some locations but the logical mechanism for addressing this is at the connection agreement stage with the distribution company, not by a blanket limit on the size of eligible systems.

If the FiT methodology includes consideration of health and environmental benefits, it would be logical that only renewable energy sources (wind, solar, hydro) should be eligible rather than other embedded generators (eg gas co-generation).

[3] https://www.dews.qld.gov.au/electricity/solar/installing/benefits/regional accessed 24 Feb 2016 but increased to 30 kW from mid 2017 see {QldGov 2016b}

Eligibility should be for any embedded generator connected to the distribution network (rather than the transmission network).

References

"… the fair and reasonable feed-in tariff should apply to projects of up to 100 kW capacity to support commercial, community and on-farm projects who are otherwise unable to sell energy for a reasonable price on the energy market due to the many barriers to entry for such systems. As there is no net cost to other consumers for a fair and reasonable FiT there is absolutely no impact on other consumers in raising the FiT eligibility to 100 kW." {SSTATA 2013a p3}

"In the days of incentive-based, 1:1 feed-in tariffs it was reasonable to place an upper limit on the capacity of eligible systems. However, now that Tasmanian feed-in tariffs are based on the wholesale price of electricity there is no economic rationale for capping eligibility at several kW. In Victoria, for example, the 8 cent per kWh feed-in tariff is available to systems with a capacity up to 100 kW." {CEC 2013h p5}

Counter arguments

"Customers investing in large systems are better placed to negotiate a favourable outcome with a retailer and should not need to be protected by the regulated FiT 'safety net' that is provided to small customers." {TasGov 2013c p20}

This has not proved to be that case. Even projects up to 500 kW connected to the distribution network are offered only wholesale energy prices which are lower than the regulated FiT.

Cross subsidy arguments

What is it?

Are feed-in tariffs a cross subsidy from poorer customers to wealthier customers?

Case for

Although the claim is often made that solar customers are wealthy and are cross subsidised by poorer non-solar customers, this is not supported by any statistical analysis. When SA Power Networks tried to impose an additional charge on solar owner the Australian Energy Regulator found that solar and non-solar households did not have substantially dissimilar patterns of consumption.

"We have compared the uptake of solar pv in Tasmania with household income at the local government area (LGA) level using figures supplied by Aurora and the ABS statistics on household income (ABS 2012)… there is no significant correlation between income and the uptake of solar pv, if anything the trend line is slightly downwards (ie wealthier areas are slightly less likely to install solar pv)." {SSTATA 2013a p4}

"This Tasmanian analysis confirms national figures with similar findings conducted by the REC Agents Association: "A broad range of communities have accessed solar under the RET scheme and the … figures explode the myth that the RET is supporting metropolitan middle class welfare" (quoted in Parkinson 2012)." {SSTATA 2013a p5}

"Contrary to popular belief, the rapid uptake of rooftop solar has not been limited to urban greenies (see Figure 13). In fact, uptake (defined in this instance as the percentage of dwellings with rooftop solar installed) has been much higher outside urban areas." {Eadie 2013 p35}

"The electricity network is a public good which provides benefits to all users in excess of the cost of using it. …

Total avoidance of 'cross subsidy' between individual customers is an unobtainable goal, and is not applied in any other area of electricity pricing. For example there has never been any serious suggestion that customers in remote or hard to service locations should pay the full cost of having access to the grid. Yet the cost difference between servicing these customers and customers in urban locations is far greater than any difference between the network costs retrieved from solar and non-solar customers." {TREA 2016a p6}

The argument that solar customers as a class cost networks more than non-solar customers was tested when SA Power Networks (SAPN) proposed a $100/year additional charge for solar customers. The AER found that:

"We are not satisfied that SA Power Networks has demonstrated that pv and non-pv retail customers have sufficiently dissimilar load profiles. A pv specific tariff of the type proposed by SA Power Networks would therefore constitute less favourable treatment of retail customers with micro-generation facilities in contravention of clause 6.18.4(a)(3)." Quoted in {Orme 2015}

Location based payments

Within the NEM the principle of 'postage stamp pricing' applies, this is, that customer pay the same for their electricity wherever they are located. There are good social justice and efficiency reasons for this but it is at odds with the principle of 'cost reflectivity' that operates in many other aspects of electricity pricing.

The cost of providing electricity varies enormously depending on location. Customers in remote or sparsely populated locations are much more expensive to service that those in densely populated urban areas because:

- network infrastructure is more expensive per customer, and
- loses increase with distance from the energy source.

In addition, when parts of the network are at close to capacity, the incremental cost of meeting new load can be very high if it requires new lines or transformers. Conversely anything which reduces demand in these locations can save considerable expenditure.

The varying value of distributed generation based on network costs is addressed in the sections on reduced or avoided transmission and distribution costs.

The Essential Services Commission in Victoria recently recommended that future FiTs should be adjusted to reflect different line losses in different locations. They recommended assuming a line loss of 5% for Melbourne, Geelong and eastern Victoria and 13% for western and northern Victoria. {ESC 2016c, p56}. The Victorian Government has rejected the recommendation for a location based FiT component as it would "unduly complicate the FiT scheme" {VicGov 2016}.

References

"The QCA also estimated a range [for a fair and reasonable FiT] *of between 7.064 c/kWh and 14.053 c/kWh for other areas covered by Ergon Energy's distribution network reflecting the differential loss factors applying across the state."* { OTTER 2013a}

The impact of new tariff structures on distributed generation

Throughout the National Electricity Market, tariffs (the way electricity bills are calculated) are being changed. The theory is that if tariffs are more 'cost reflective' consumers will be motivated to use the network more efficiently and costs will be constrained. New tariffs will tend to have higher fixed charges and lower consumption charges. This will discourage energy conservation and make exported solar energy less valuable. There is also a trend to time-of-use tariffs and demand-based tariffs (a charge based on peak consumption during a billing period). These tariff structures can also reduce the value of exported solar energy, but potentially increase the financial benefit of systems that combine solar with local storage. Stored energy can used to avoid purchasing energy at peak price times (on a time of use tariff) or reduce a customer's peak demand (on a demand based tariff).

The impact of tariff changes is further complicated by the fact that 'cost reflective tariffs' are being introduced into the network tariffs that network businesses charge retailers in order to recoup the cost of running networks. Retailers then set tariffs they charge to customers to cover all their costs, including the network tariffs they pay network operators. Typically retail tariffs match the structure of underlying network tariffs (for example the balance between fixed and variable charges, and the times of the day and week that time of use bands operate). However retailers have additional costs to recoup including energy charges. Decisions about recouping energy charges and other discounts, charges and conditions introduced for marketing reasons can mean that tariffs that customer are offered can dilute the intention of network tariffs.

Defining a value in c/kWh

The aim of this project was to identify and describe the various values of distributed generation. As described on p5, there are various ways in which the value of distributed generation can be recognised and monetised. A premium or regulated minimum feed-in tariff (along with STCs) has traditionally been the main mechanism for supporting solar pv. However other mechanism will become increasingly significant in the future as a result of:

- the increasing push for 'cost reflective' tariffs
- advanced metering, smarter control software and storage making it more practical to make payments that reflect the time-varying value of energy and local network conditions.

Despite these factors there is a natural desire to seek to answer the question 'what is distributed generation worth' with an answer in cents per kilowatt hour. In recognition of this, we have developed a national fact sheet which seeks to answer this question (as well as describe some of the benefits of distributed generation that are less readily quantified).

Defining the components of electricity costs

In order to derive a value for distributed generation based on the various benefits it was necessary to make assumptions about the proportion of residential electricity bills that contributes to various elements of the value chain (wholesale energy, transmission, distribution, retailing and environmental and regulatory costs).

The main data source we used was the AEMC 2015 Residential Electricity Price Trends {AEMC 2015d} which provides a breakdown of cost components by state and nationally.

Details of the methodology and the actual calculations are contained in the document *NEM residential supply chain cost components* available from the project website.

In reducing all the many variables of a residential electricity bill to a single c/kWh figure there are necessarily a lot of assumptions. The source documents have detailed methodology sections. The main points to be aware of are:

- Residential bills are based on the most common household type (usually 2 people, no swimming pool) and not average of all consumers.
- Fixed charges are incorporated into the c/kWh figure. This methodology was used by AEMC in accordance with terms of reference provided by the COAG Energy Council (see AEMC 2015d p224)
- As a result the derived c/kWh figures are unlikely to bear a close relationship to the consumption tariffs in c/kWh for that jurisdiction.

NEM supply chain components of residential electricity bills

% of most common retail bill

	SA	Qld	NSW	Vic	ACT	Tas	NEM
Generation	13.8%	12.6%	20.7%	17.6%	25.4%	24.0%	17.7%
Transmission	8.6%	8.5%	5.8%	4.9%	11.0%	15.0%	6.3%
Distribution	42.3%	49.2%	37.9%	37.8%	31.2%	44.0%	40.8%
Retail	24.3%	22.1%	30.5%	33.5%	21.1%	17.0%	29.0%
Environmental	11.1%	7.7%	5.0%	6.2%	11.4%	0.0%	6.2%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

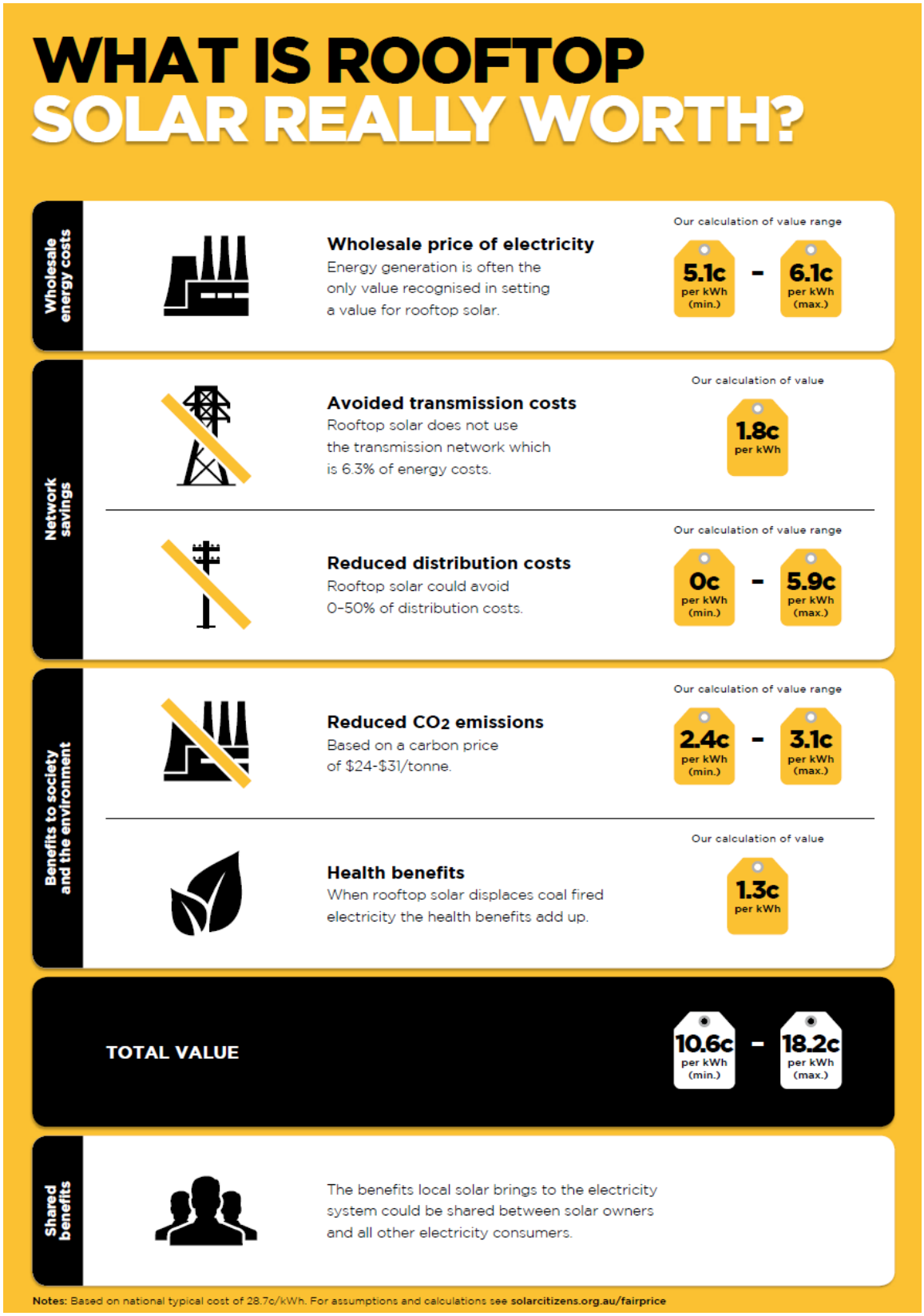
c/kWh for most common retail bill

	31.77	27.04	28.39	31.62	20.08	21.29	28.72

Allocation of c/kWh for most common retail bill

	SA	Qld	NSW	Vic	ACT	Tas	NEM
Generation	4.38	3.41	5.87	5.57	5.09	5.11	5.08
Transmission	2.73	2.29	1.66	1.55	2.20	3.19	1.80
Distribution	13.43	13.30	10.77	11.95	6.26	9.37	11.73
Retail	7.71	5.96	8.66	10.59	4.25	3.62	8.32
Environmental	3.52	2.08	1.43	1.96	2.28	0.00	1.79
	31.77	27.04	28.39	31.62	20.08	21.29	28.72

Infographic – What is rooftop solar really worth



Assumptions behind component values

In the national fact sheet, the following assumptions are made about the value of distributed generation in order to derive a c/kWh value based on the above prices and components. For

some items we specify a range of values for components to recognise both uncertainty about the value and its variability in particular situations.

Wholesale value of energy: We use the average national 2014-2015 wholesale value of 5.1c for the bottom of the range. We add 20% for the top of the range as an estimate of the additional value because solar exports are typically at times when wholesale energy prices are higher than average (see p19) and in recognition of the merit order effect (see p28). These estimates are quite conservative. Wholesale prices have increased significantly since 2014-2015 and are projected to continue rising. For example the Victorian ESC projects an average wholesale price of 7.7c for 2017-2018 {ESC 2017a}.

Avoided transmission costs: We count the total cost of transmission as an avoided cost. See pages 18 and 22 for discussion of this issue.

Reduced distribution costs: The value of solar pv in reducing costs for network operators is highly dependent on time and location, as well as the capacity and asset life cycle of local distribution infrastructure. The bottom of the range assumes no savings, the top of the range assumes local solar avoids using the high voltage and sub-transmission parts of the distribution network, which account for over 50% of costs.

Reduced CO_2 emissions: See page 26 for the basis of this range of values.

Health benefits: See page 29 for the basis of this value.

The following values were not included in the above calculation to simplify the presentation and because they would have a relatively small impact on the result:

- Allowance for avoided transmission and distribution losses (see pages 21 and 21)
- Avoided NEM fees (see page 22)

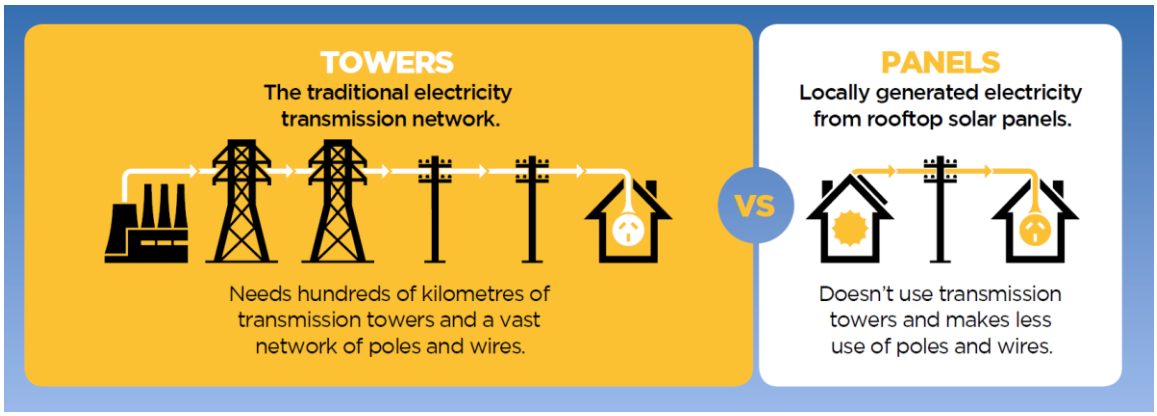
The above calculations also do not make any allowance for the possibility of local generation to avoid retailing costs which make up over a quarter of the typical residential electricity bill nationally (see page 4).

Case study – transmission costs

While transmission costs constitute only 6.3% of a typical residential electricity bill, they provide a particularly useful opportunity to explore and discuss some of the methodological issues around valuing distributed generation. For this reason we have produced a separate fact sheet on this topic which is available from the project website.

Transmission charges are levied on all the electricity used, but a small but increasing proportion of electricity consumed comes from local generation (mainly household solar) which makes no use of the transmission network.

We argue that customers should not pay transmission costs for the proportion of their energy that is sourced locally.



One way of implementing this would be that the transmission component of network tariffs paid by retailers could be based on the amount of electricity they buy from generators connected to the transmission network. (Currently the charge is based on the total amount of electricity they sell.) This would be analogous to the fact that retailers pay NEM fees based on the amount of electricity they buy from the NEM rather than the amount they sell. It is an accepted part of the FiT methodology used by Australian regulators that they recognise savings to retailers from distributed generation.

The benefits would be:

- Solar owners would receive a higher price for their exported energy.
- In the longer term, costs would be reduced for all consumers because a lower cost method of supplying energy would be supported.

Network operators and regulators will argue that because networks receive a regulated return on their investment, recognising avoided transmission costs for distributed generation would simply increase costs for other consumers.

While this is true with existing regulatory arrangements, it highlights the problem of these arrangements which encourage networks to invest in network infrastructure, rather than seek out more efficient ways of meeting the energy demand.

In the fact sheet on transmission charge we argue that changing the rules so that consumers do not pay transmission charges for locally generated energy would be one small step towards a fairer and more cost effective electricity system. This would provide a range of benefits that come from moving to a more decentralised energy system even under existing regulatory arrangements.

Components of a fair FiT

In this section we consider in turn the various factors which are often considered in setting a FiT by regulators, researchers and advocates.

Avoided wholesale purchase of energy by retailers

What is it?

The wholesale value of the energy fed back into the grid.

Case for including in FiT

Solar exports are worth more than the average wholesale price of electricity because they are typically fed in during times when wholesale energy prices are higher than average. The wholesale price used as a basis for FiT calculations should reflect the average value of energy at the time it is exported.

Fed-in energy reduces the amount of energy that retailers have to purchase from generators or the national electricity market.

Solar exports are worth more than the average price because (except in Tasmania) they are fed in during times of high demand when wholesale energy prices are higher than average. This is in line with the COAG principle that FiTs should take into account "the time of day during which energy is exported" {COAG 2013}

The methodology used by regulators in determining a wholesale energy value can make a substantial difference to the level of FiT set. Key factors include:

- whether the energy value is based on historical or projected prices (historical prices will understate the value at times of rising prices, projected values are very dependent on assumptions)
- whether an allowance is made for the time of export.

Jurisdictions that currently have a regulated minimum FiT:

Tasmania: OTTER sets the regulated FiT using the wholesale price calculated by OTTER as part of the Standing Offer Determination for Aurora Energy. {OTTER 2016b}

Regional Queensland: The QCA uses a wholesale energy price forecast developed by ACIL Allen as estimates of the avoided wholesale energy costs in regional Queensland. {QCA 2016 p4}

Victoria: for the 2017-2018 regulated FiT the ESC used projected wholesale electricity prices from ACIL Allen Consulting's proprietary PowerMark model. A solar weighting is applied (see below). {ESC 2017}

Of the jurisdictions that no longer have a regulated minimum FiT the following methodologies are notable:

South Australia: The most recent regulated FiT was for the 2016 calendar year. It was based on ACIL Allen modelling of projected wholesale prices for 2016. ESCOSA sets the FiT at the lower end (90th percentile) of the projected range of values of exported pv output. The mean value is 9.05c but the FiT is set at 6.8c. {ESCoSA 2015b}

New South Wales: IPART sets a benchmark (suggested) rate for retailer payments. For 2016-2017 the wholesale component is based on forward market contract prices. A 'solar premium' is applied to reflect how much solar PV exports occur at high or low price times. {IPART 2016a and 2016b}

The Essential Services Commission (ESC) in Victoria recently recommended that future FiTs include a component based on the time of day in three bands, as well as an additional 'critical peak' payment at times of very high wholesale prices {ESC 2016c, p53, p57}. This arrangement will not be used for the 2017-2018 Victorian FiT, but may be applied in future years.

The FiT scheme proposed by the ESC and accepted by the state government {VicGov 2016} includes a critical peak payment when the wholesale price is above 30c/kWh. The critical peak payment would be set by the ESC each year and is anticipated to be around 30c/kWh. Over the three years 2013-2015 Victorian wholesale prices only exceeded 30c/kWh for an average of 7 hours a year {ESC 2016c, p52} so critical peak payments on this scheme would be quite limited.

The Queensland Government has announced that it will introduce a time varying (peak and offpeak) FiT for regional Queensland {QldGov 2016b p1} but the details of this have not been announced at the time of writing.

Paying individual consumers time-based FiTs based on the actual time of export and the corresponding wholesale price of energy would require communicating smart meters that record and report import and export of energy in half hour intervals. Victoria is the only place where this infrastructure is widely implemented, although it is currently being rolled out in other states on a voluntary basis.

However it is possible to correlate the likely solar generation in a state or region with the wholesale price at that time to come up with a weighted average wholesale value of energy at the time of solar generation which could be used as an input for setting a FiT value for exported energy. This is the approach that has been taken by the ESC in Victoria in setting the FiT rate for 2017-2018. In calculating this rate, a solar weighting has been applied to projected wholesale prices. This increased the wholesale value component of the FiT from an average projected wholesale price of 7.7c to a solar weighted price of 8.1c {ESC 2017a}.

Paying a higher price for exported solar energy at times of peak demand and high wholesale prices would provide an incentive for owners to export energy at these times. This has multiple benefits for the energy system and other consumers. It can drive down wholesale prices through the merit order effect (see p28) and it can reduce the need for upgrades to the network to meet peak demand (see p25). Solar owners currently have little ability to control the time at which they export energy but this will change rapidly as more home install local storage and associated control systems that can manage self-consumption and time of export.

References

"Net exports from pv systems depend on the size of the system relative to load, with estimates of typical net exports of around 26% for a 1.5 kW system to 33% for a 2 kW system and larger systems even more. The data suggests that most of the exports occur in mid morning to mid afternoon, when wholesale market prices are typically higher than average." {ASC 2015 p5} and following paras.

Arguments against a time based wholesale price

"A simple comparison of flat feed-in tariffs available in the market compared to a time-of-export price based on the Queensland wholesale price, suggests that solar pv owners would not receive more under a time-varying market price." {QPC 2016e p143}

"With respect to time of day FiTs, as discussed in previous sections, the Regulator considers the single regulated FiT is more appropriate for Tasmania at this time based on the regulated price." {OTTER 2013b p33}

Transmission network losses

What is it?

Losses in the transmission network.

> *"Traditionally, electricity is transported from central generation to load centres over long transmission and distribution lines. Along the way, some electricity is lost. One of the key benefits of embedded generation, such as solar pv, is avoiding the transport of energy over long transmission lines. Some losses in the distribution network could also be avoided, but it will depend on the characteristics of the network, times of day and the level of penetration of embedded generation on a particular feeder."* {QPC 2015b p16}

Case for including in FiT

All avoided transmission costs should be recognised when setting FiTs.

Distributed solar energy is used close to the point of generation. As a result it avoids losses that would otherwise occur in the transmission network.

Most Australian regulators include an allowance for the value of distributed generation in avoiding transmission and distribution losses when calculating FiTs.

Note that in the section on use of the transmission system (p22) we argue that distributed generation does not use the transmission network and this avoided cost should be compensated. If this was implemented the argument on transmission losses would be irrelevant.

References

> *"There is no question significant value from rooftop systems comes about because of the close proximity to loads. Australian grids typically see average network losses of around 8%, although some segments within the NEM, the South West Integrated System (SWIS) and other grids can be much higher than this – more than 20% in some cases. Net exports provide value in terms of the costs avoided if that electricity were supplied from distant generation sources." ASC 2015 p4*

Distribution network losses

What is it?

Losses in the distribution network.

Case for including in FiT

FiTs should include an allowance for the fact that exported solar energy avoids almost all losses in the distribution network because the energy is used in the immediate vicinity.

Distributed solar energy is used close to the point of generation. As a result it makes less use of the distribution network. Energy exported by solar pv is almost invariably used close by in the same distribution feeder so there are minimal distribution losses.

Most Australian regulators include an allowance for the value of distributed generation in avoiding transmission and distribution losses when calculating FiTs.

References

> *"Marginal network losses are averaged over the whole year under current market arrangements, and may not reflect the real loss value at times when pv generation is occurring when network elements are heavily loaded."* {ASC 2015 p5}

"Further, ATA would highlight the approach taken in the Western Australian Market (WEM) with respect to avoided losses from distributed generation. In WA, a higher value is attributed within the FiT to distributed generation systems that are installed in more remote parts of the electricity network. Given Queensland's significant geographic area, ATA would suggest this is a logical economic basis upon which to incorporate values within a future FiT to remunerate for avoided losses." {ATA 2012 p6}

"Electricity from solar pv is often exported at times when network elements are likely heavily loaded, meaning that customers in a region may benefit from lower network loss factors. This should be taken into account when appropriating a value using standard network loss factors." {ATA 2012 p4}

NEM fees

What is it?

Costs paid by retailers for participation in the National Electricity Market (NEM) consisting of participation fees and ancillary services charges.

"There are two market costs incurred by retailers operating in the National Electricity Market (NEM); NEM participation fees and ancillary services charges. Both the NEM participation fees and ancillary services fees are paid based on net energy purchased from the wholesale pool. As exported solar pv displaces purchases from the wholesale market, retailers will avoid NEM and ancillary services fees." {QPC 2015b p16}

Case for including in FiT

FiTs should include an allowance for the NEM fees which retailers avoid as a result of purchasing less energy on the national market.

Retailers pay NEM fees based on net energy purchased from the wholesale pool. Because exported solar energy displaces wholesale market purchases this will reduce retailer NEM charges.

Regulators generally include this in existing FiT calculations.

Avoided transmission usage costs

What is it?

The cost of the use of the transmission network included in electricity prices (known as Transmission Use of System or TUoS).

Case for including in FiT

FiTs should include an allowance equivalent to the transmission charges in that jurisdiction to reflect the fact that energy from local solar does not require and does not use transmission networks.

Rooftop solar is fed in and used within the distribution network. It does not make use of the transmission network.

Retailers pay network charges for all the electricity they sell, irrespective of whether the energy is sourced via the transmission networks or locally from solar pv. These network costs are passed on to customers. As a result, the benefits of local generation are not recompensed, costs to consumers are not reduced and network operators receive payment for services they did not provide.

For more information and discussion of this issue see the case study (page 18) and the "Towers versus panels" fact sheet on the project website.

References

"Given the strong move towards cost reflective tariffs we believe that the FiT should include an allowance for avoided transmission charges. The rationale for cost reflective tariffs is that users should pay for the actual costs of the components of the electricity network that their consumption necessitates. Charging retailers, and ultimately customers, is doubly unfair:

- *Customers pay for a service that is not provided (use of the transmission network for the proportion of their energy that comes from distributed generation), and*
- *A lower cost method of supplying electricity is not rewarded which ultimately increases costs for all customers."*

The most transparent way for these savings to be acknowledged would be for TasNetworks to provide an avoided TUoS credit to retailers in proportion to the percentage of the energy they sell which comes from distributed generation by their customers. {TREA 2016a p10}

"Based on a TasNetworks estimate that transmission costs contribute 15% to a typical residential bill and the current Aurora tariff 31 charge of 25c/kWh this benefit would be of the order of 3.7c/kWh." {TREA 2016a p10}

"The Proponents of this Rule change consider that local generators provide two types of benefits to distribution and transmission businesses that local generators typically cannot currently monetise, and therefore, everything else being equal, that this will lead to under-investment in smaller-scale embedded generating units and a less economically efficient electricity supply chain.

The benefits provided by local generators take the form of:

- *Capacity support, if, as a result of the export of energy from these facilities, a network business (whether distribution or transmission or both) can be expected to incur a reduction in its future capital expenditure costs, most notably, as a result of being able to defer and/or reduce the size of its future network augmentation projects, and*
- *Avoided transportation costs, if, as a result of the export of energy from these facilities, a network business can be expected to incur lower on-going operation and maintenance costs."* {Oakley Greenwood 2015 p12}

Avoided distribution usage

What is it?

The cost of the use of the distribution network included in electricity prices (known as Distribution Use of System or DUoS).

Case for including in FiT

FiTs should include an allowance for reduced distribution charges to reflect the fact that energy from solar pv makes less use of distribution networks.

Network operators charge retailers a network tariff for each customer and these network charges are passed on to the customer by the retailer. The network tariffs include components for use of both the transmission network (TUoS) and the distribution network (DUoS).

Solar pv avoids use of transmission networks and makes reduced use of the distribution network because exported energy is used very close to the point it is exported – typically in the same street.

A significant proportion of the cost of the distribution network is the transformers which convert higher voltages down to 230V. Solar inverters have this capability built in and export power at 230V.

The value of solar pv in reducing costs for network operators is highly dependent on time and location, as well as the capacity and asset life cycle of local distribution infrastructure. For these reasons a regulated FiT may not be the most effective way to recognise these benefits. It is likely that these benefits in specific locations will be recognised in other ways such as network support payments (see p5).

References

> *"There are at least two ways in which distributed generation makes less use of the distribution network and reduces its costs. Exported energy from solar pv is typically used close to the point of export and therefore makes significantly less use of the 'poles and wires'. Also a significant proportion of the cost of the distribution network is the transformers which convert form 11 or 22 kV to 230/415V. Solar inverters have this capability built in and export power at 230V single phase or 415V three phase."* {TREA 2016a p11}

Counter arguments

High penetrations of solar pv can increase costs of the distribution system in order to maintain power quality and voltage levels when additional energy is fed into the distribution network. However, the level of bidirectional flow beyond which distributed solar causes a need for additional infrastructure investment by networks is variable according to a range of factors and is seldom quantified by networks.

Distributed storage and the capabilities built into solar inverters will increasingly be able to assist with voltage regulation and other power quality issues. This is discussed more in the section on ancillary services (p32).

Reduced or avoided transmission infrastructure investment

What is it?

The reduced need for investment in transmission infrastructure because load growth is reduced by distributed generation.

Case for including in FiT

We have argued above that distributed generation should not pay for the use of the transmission network. This would cover both the use of the transmission network as it currently existing and capital expenditure to expand it.

The cost of upgrading electricity networks has been a major factor in the increasing cost of retail electricity since 2009 {Hill 2014}. Distributed generation can reduce the need for investment in new network infrastructure. To the extent that distributed generation reduces the required investment in network capacity this lowers future costs for all customers.

Networks and regulators have argued that solar pv reduced overall energy consumption but does not reliably reduce network peaks. Since network investment is driven by the necessity to meet peak demand, regulators argue that solar cannot be counted on to reduce investment. Research by the national electricity market operator {AEMO 2012 piii} shows that solar can be counted on to reduce mainland peak demand by 28%– 38% of its rated capacity.

The challenge in estimating the extent of reduced investment is that network investments are very 'lumpy'. In some locations and at some times, increased distributed generation can delay or avoid the need for very expensive upgrades. At other time and locations there is no immediate benefit or saving.

Networks are required by existing rules to test whether there are cost effective alternatives to network investment. These are called 'non-network solutions'. As part of the planning process for a new investment, networks are required to explore alternatives[4].

The problem with the existing arrangements is that they are based on an assessment of a particular investment, and there are almost never alternative proposals that can fully and reliably replace the need for a specific investment, even though the cumulative effect of distributed generation can be shown to reduce the need for network investment over time.

A value could be calculated for the long term average reduction in network investment resulting from distributed generation rather than attempting to identify the short term benefit related to specific network investments and specific distributed generation investments.

References

> *"In the mainland regions, summer maximum demand typically occurs in the late afternoon, when rooftop pv generation is declining from its midday peak and is operating at an estimated 28%– 38% of capacity. Maximum demand in Tasmania typically occurs on a winter evening, when rooftop pv generation is negligible." {AEMO 2012 piii}*
>
> *"In areas with a higher penetration of commercial and industrial development, where generation and load curves do more closely match, asset deferral is likely to be an economic benefit provided by solar that warrants remuneration through a FiT." {ATA 2012 p5}*

Reduced or avoided distribution infrastructure investment

What is it?

Distributed generation reduces the need for investment in distribution networks.

Case for including in FiT

FiTs should include an allowance for the average long term value of reduced distribution network investment required as a result of the reduction in peak demand resulting from distributed generation.

The case for the benefit from distributed generation in reducing distribution network investment is similar to the case for transmission network investment. Distribution costs are a greater component of electricity costs than transmission costs.

References

> *"A report released by the Victorian Government in 2013 (Langham et al, 2011) indicated that distributed generation, 'was found to save consumers $437 million per annum relative to BAU, more than half of which was due to reduced expenditure on electricity delivery (networks)'"* {CEC 2013h p3}

[4] These are called the Regulatory Investment Test for Transmission (RIT-T) and the Regulatory Investment Test for distribution (RIT-D).

Retailing costs

What is it?

Costs incurred by retailers in marketing, billing and customer service.

Retailing costs make up 29% of typical residential electricity bills nationally or about 8.3c/kWh. Under current regulatory arrangements it is not possible for consumers to avoid these costs except by going off-grid. New technology such as local storage and system such as peer-to-peer trading provide the potential for new models that could avoid or substantially reduce the retailing components of the electricity prices. However this would require significant regulatory change.

Regulatory change is needed so that rooftop solar owners can sell, share or gift their electricity on the grid paying an appropriate cost for using the local grid.

References

> *" … for almost all households in Victoria the charge for retail services is much larger than the charge for generation. Distributed generation avoids central generation and it also avoids at least some part of retail costs and profits. These are not counted in the ESC's report or in the Victorian regulated minimum feed-in charge. A reasonable argument can be made that at least some of these retail costs and profits can be avoided by local production and so should be counted in the regulated value of distributed generation."* {Mountain 2016}

Avoided capital cost of new generation

What is it?

Distributed generation is paid for by its owners, reducing the need for state or private investment in new central power stations.

Solar owners invest their own capital in generating electricity. This avoids the capital cost of new infrastructure to generate both the electricity for self-consumption and the electricity exported.

The cost of wholesale electricity covers the capital cost of the generation infrastructure so this argument should not be used to double count this benefit.

Reduction of CO_2 emissions

What is it?

The value of the reduction in CO_2 emissions that result from solar pv displacing fossil fuel based electricity.

Case for including in FiT

Each kWh of solar pv that displaces coal fired electricity creates a reduction in CO_2 emissions that is worth a minimum of 2.4c to 3.1c using current carbon pricing estimates. Carbon pricing that met the global objective of keeping global warming well below 2°C would translate to a much higher value.

The COAG Energy Council has recognised the need to better integrate energy and environment policies:

"The successful integration of carbon and energy policies will be critical to meeting Australia's emissions reduction target of 26 to 28 per cent below 2005 levels by 2030. Ministers will develop a national approach to connect environmental outcomes and energy policy in the interests of consumers." {COAGEC 2015 p2}

In the absence of a carbon pricing mechanism, the contribution that increased use of solar pv can contribute to reducing greenhouse gases (ghg) emissions should be reflected in FiT calculations.

One reference points is the fixed price period under the previous Australian Government's CPRS of $24.15/tonne of CO_2. Another reference point is the figure of €19/t CO_2 used in the European ExternE methodology. The ATSE study {ATSE 2009 p34} converts this to $A31/tonne CO_2.

We have not been able to identify a source for a suggested carbon price that would meet the internationally agreed goal of limiting global warming to 1.5C but it is likely to much higher that these figures.

Assuming that in terms of marginal impact, solar pv displaces electricity with a ghg intensity of 1 tonne CO_2/MWh[5] this equates to values of 2.4c/kWh or 3.1c/kWh for exported solar.

Note that only a proportion (typically around half) of the energy generated by a residential solar pv system is exported but the total amount generated reduces consumption of centrally generated energy so arguably the benefit could be doubled when translating the ghg abatement into a c/kWh FiT.

The Victorian ESC has announced a FiT for 2017-2018. This includes an allowance of 2.5c/kWh for the "avoided social cost of carbon" {ESC 2017a}. The figure is calculated using a methodology specified by the Victorian Government {VicGov 2017c} which is based the average market spot price of one tonne of CO_{2e} under the Victorian Energy Efficiency Target.

"With regard to the environmental cost of CO_2 emissions there is a wide range of estimates. This Academy study adopts a figure used in much of the ExternE calculations equivalent to $A31/tonne CO_2. On that basis greenhouse gas damage costs for currently deployed fossil fuel technologies in Australia range from $A18/MWh for natural gas to $A39/MWh for brown coal. An indicative figure for the average wholesale price of electricity in Australia is $A40/MWh, so these quantified external costs are very significant." {ATSE 2009 pi}

"The Commonwealth Government has been very clear in its intention to remove carbon pricing at soon as possible. In the past some state governments have referenced the existence of the national carbon price as a reason why state governments no longer need to provide leadership to encourage reduction of greenhouse gas emissions. That rationale no longer stands. Under the Commonwealth's 'Direct Action' framework there will clearly be an important role for states and territories in dealing with climate change policy, including support for the increased uptake of small scale renewable generations." {CEC 2013h p13}

"Conservative studies suggest that every ton of carbon dioxide released into the air causes $37 of economic and social damage." {Frontier 2015 p12} quoting Peter Howard, Environmental Defense Fund, Institute for Policy Integrity and the Natural Resources Defense Council, *Omitted Damages: What's Missing from the Social Cost of Carbon*, 13 March 2014.

[5] Emission intensity is higher than this for brown coal, about 1 tonne/MWh for black coal and lower for gas.

"The Commission has concluded that the most readily identified, quantified and valued area of environmental value is the reduced emission of greenhouse gases. The electricity produced by distributed generation may displace more emissions-intensive generation, and thereby contribute to the abatement of greenhouse gases. This benefit is provided by the total electricity output produced by a distributed generator (that is, the gross output), not just the portion that is exported. The Commission has not sought to place a monetary value on the environmental value of avoided emissions. Instead, we propose a method for calculating the volume of greenhouse abatement for various forms of distributed generation, to which a value for that abatement may be applied." {ESC 2016c, p3-4}

Counter arguments

"Investors in solar pv receive a subsidy from the national Small-scale Renewable Energy Scheme (SRES). This subsidy reduces the up-front cost of purchasing and installing a solar pv system by around 30–40 per cent on average. Based on average solar pv system prices, the level of the SRES subsidy is between 2.8 and 2.9c/kWh generated. For energy exported, households receive around 7.1c/kWh. The inquiry has found that the SRES provides at least a fair value to solar pv owners for emissions reduction." {QPC2016b}

"It could be argued that the RET covers avoided GHG emissions, but the RET is a) a fixed in time amount and is un-indexed so a depreciating value, and b) relates only to the first 15 years of production on a 25 to 30 year generation life." ASC 2015 p6 footnote 4

Downwards pressure on wholesale electricity prices

What is it?

Distributed generation drives down the wholesale price of energy through the merit order effect.

The merit order effect from distributed generation is the downwards pressure on the wholesale price that comes from consumers supplying their electricity needs from their own distributed generators, and purchasing less electricity from wholesale market generators.

This short animation from Powershop {Powershop 2014} explains how the merit order effect works (although it doesn't refer to it by name).

Case for including in FiT

{ATA 2012 p7} has a description of the merit order effect including both immediate and medium to long term impacts through cost of hedging contracts.

"Retrospective modelling of the merit-order effect on wholesale prices from pv in the Australian energy market found for 5 GW of capacity the reduction in wholesale prices would have been worth in excess of A$1.8 billion over two years. The higher penetration of pv in Queensland means a higher proportional benefit." {ASC 2015 p7}

"The MOE occurs for all energy generated by solar pv, regardless of whether it is used on site or exported as surplus. The reason for this is that all of the solar pv generation is seen by the wholesale market as a reduction in demand. It should also be noted that while the MOE can occur for all distributed generation technologies, the value of the MOE produced by solar pv is higher than for most other distributed generators. This is because solar generation lowers the demand from the wholesale market during periods of higher electricity use and higher wholesale prices – being during the daytime and during the hotter and sunnier seasons." {ATA 2012 p7}

After quoting McConnell, ATA says:

> *"Based on this wholesale market estimated saving …, energy from solar PV generation is worth 20c per kWh in the first year after installation. Over a number of years, the value of the MOE from a particular installation would be expected to reduce in magnitude, eventually nearing zero. From our own investigations and understanding of the energy market, ATA are of the view that the period over which the MOE for new solar PV reduces to zero is likely to be in the order of 5 to 15 years."* {ATA 2012 p8}

Counter arguments

> *"The lower spot price is a normal part of the competitive market process which occurs when the supply of a good or service increases. In the electricity sector, this could occur through additional solar pv systems, additional wind farms or additional hydro supply. In a competitive market, no individual firm can seek compensation for causing lower spot prices. The Regulator also considers this to be the most appropriate outcome for the Tasmanian electricity market."* {OTTER 2013a p24}

Health benefits

What is it?

Public health benefits from renewable energy replacing generation from coal-fired plants.

Case for including in FiT

The best available research suggests that each kWh of solar pv that displaces coal fired electricity contributes 1.3c in reduced health costs.

Burning of fossil fuels to generate electricity has significant negative health impacts. The Australian Academy of Technological Sciences and Engineering attempted to estimate the cost of a range of 'external' impacts from electricity generation using the European ExternE methodology adapted to Australian conditions.

> *"Combining greenhouse and health damage costs for Australia gives representative total external costs of $A19/MWh for natural gas, $A42/MWh for black coal and $A52/MWh for brown coal."* {ATSE 2009 pii}

Looking just at the health costs (since the environmental costs are arguably covered by the ghg emission estimates above), the study concluded that:

> *"For the main emissions PM10, SO_2 and NO_x, the mid-range estimates of health damage costs of Australian coal-fired power stations are $1.40/MWh, $7.60/MWh and $4.20/MWh respectively. The mid-range total is $13.20/MWh. The large, cumulative uncertainties in the underlying calculations need to be kept in mind."* {ATSE 2009 p46}

This would equate to a health benefit of 1.3c/kWh for generation from renewable energy that displaces coal fired electricity.

> *"… these costs are disproportionally borne by low-income and other vulnerable members of the Australian community"* {ASC 2015 p6} quoting Armstrong et al.

> *"With its lower population density, Australian health damage costs per unit of emission are between seven and 20 per cent of costs in Europe if the same health impacts were to be assumed. On that basis, the total health damage cost of these three coal-fired power station emissions [fine particles, sulphur dioxide and nitrogen oxides] is about $13/MWh, equivalent to an aggregated national health burden of around $A2.6 billion per annum."* {ATSE 2009 pii}

Recent Victorian legislation {VicGov 2017b} makes provision for future FiTs to include a component based on the "avoided human health costs attributable to a reduction in air pollution". In its determination of the 2017-2018 Victorian FiT, the Essential Services Commission concluded that "the necessary data to quantify those benefits with sufficient reliability to include them in a FiT are not available at present" {ESC 2017a}.

Other values of distributed generation

In this section we summarise some of the additional values of distributed generation which cannot readily be valued in monetary terms.

Energy literacy

What is it?

Installation of solar pv gives homeowner a strong interest and motivation to better understand and manage their energy consumption.

This increased energy literacy will be an important driver of the uptake of new technologies such as local storage, demand management and integration of electric vehicle charging which ultimately can lead to a more flexible and economical electricity system.

References

> *"Solar consumers are more actively engaged in managing their energy use than other consumers. They are therefore likely to respond well to incentives to minimise their own consumption and maximise their electricity export at times of local peak demand."* {Eadie 2013 p34} with two references.

Energy security and price stability

What is it?

Distributed renewable energy generation increases the security on energy supply and the stability of energy prices.

References

> *"Electricity prices could unexpectedly spike due to fuel price volatility and water scarcity, if fossil fuels continue to dominate our electricity system. The price of electricity from gas-fired power plants is now exposed to international fuel price volatility. … Coal-fired power plants are exposed to water scarcity, as they need cooling water to operate efficiently. … Looking forward, the size of these risks for household electricity bills could be similar to the jump in prices driven by network investment over the past few years …"* { Eadie 2013 p24}

Support for islanding and microgrids

What is it?

The possibility that with sufficient uptake of local renewable energy generation combined with storage it become practical for local areas to maintain their own power supply at times when centralised networks are not operating.

Situations in which this might be beneficial include times of high fire danger when feeder lines are de-activated as a precautionary measure, as well as unplanned outages caused by fires, storms or network failure.

{EY 2015} explains current anti-islanding provisions but also the possibility with appropriate planning:

> *"… intentional islanding of DERs can be beneficial to a range of stakeholders in the network. For example, during a storm where customers may normally lose supply for several hours due to network outages, DERs may be able to provide power to a newly formed 'micro-grid',*

which will ensure that customer reliability levels are maintained, even during adverse conditions." {EY 2015 p37}

Employment

What is it?

Support for the solar industry generates significant employment opportunities in design and installation. These are highly skilled jobs that are spread across the whole country, in rural as well as urban locations.

According to the Clean Energy Australia Report, in 2014-2015 the renewable energy industry employed 14,020 people and over half of these were in the rooftop solar section of the industry.

Research by Ernst & Young {Climate Council 2016} has shown that generating 50% of our electricity from renewables by 2030 would lead to over 28,000 new jobs and over 50% more employment than a business as usual scenario.

Ancillary services

What is it?

Distributed generation will increasingly be able to provide ancillary services that are currently purchased from large generators in the NEM.

The National Electricity Market is mainly a market in energy. However to ensure the safety, stability and reliability of the network there is also a market in a range of what are called "ancillary services". These include services that keep the voltage and frequency of the network within design limits as well as adjusting what is called the "power factor". To date these services have been provided almost exclusively by central generators. There is increasing capacity for these services to be provided by distributed generators as a result of functionality that is required in new solar inverters (see below) as well as the installation of batteries in conjunction with solar pv.

The ARENA *Networks Renewed* project is exploring this potential in detail including some trial projects. See {ARENA 2016}, {ISF 2017a} and {ISF 2017b} for details.

The rules governing the NEM will need to be updated to ensure that distributed generation is able to contribute to providing these services and be paid for them.

Because these services require a range of technical capabilities and are required at very specific times and locations, they are likely to be paid for through mechanisms other than a feed-in tariff.

References

The potential for distributed generation to provide ancillary services is discussed in detail in section 4.3 of the ESC draft report on network value {ESC 2016d}.

"Distribution businesses have justified the limitations placed on grid connection with reference to concerns relating to the perceived impact of generation on network parameters such as voltage. CEC acknowledges that very high penetration by a large number of small, 'simple' generating systems on a single transformer can cause over-voltage and voltage fluctuation issues. However, what is less well understood is that newer and larger, more sophisticated generating systems can assist with grid management. For example, inverters

with reactive power capability can assist with voltage management. These technologies are available now, but have never been required by the relevant standards or distributors and there are no incentives for their utilisation." {CEC 2013h p8}

The ESC provides details of the capabilities that need to be available in all solar inverters installed from 9 Oct 2016 as a result of the implementation of AS/NZS 4777.2:2015:

"The updated standards also require inverters to have Demand Response Mode (DRM) capabilities. DRM capabilities allow a remote operator to alter the inverter system to operate in a certain way, such as disconnecting from the grid, preventing generation of power, or increasing power generation. These functionalities for new inverters make it distinct from older generation inverters, and have been referred to as "smart" inverters. The updated standard requires inverters to have the capability for eight different modes of operation (referred to as DRM0 to DRM8). However, only one of the modes (DRM0) is required to be functional at the time of the installation. DRM0 allows a remote operator to disconnect the inverter from the grid. Disconnection from the grid may occur when the network is disrupted, when frequency and voltage levels are outside the set limits and when the DRM0 mode is activated (potentially by a network business)." {ESC 2016d, p64}

{EY 2015 p33-34} provides descriptions of the issues of voltage regulation and power quality.

"… advanced inverters such as those contemplated by the forthcoming revision of AS4777 are capable of responding to unacceptable voltage levels and can operate actively to rectify the local voltage range. DERs with battery storage can have an enhanced ability to provide voltage support." {EY 2015 p33}

"While in some cases, high levels of DER penetration may adversely impact reliability, the characteristics of newer DER technologies could also offer many grid support benefits. DERs may be able to assist with supplying energy and maintaining healthy levels of voltage and frequency support during network contingency events. This can result in increased levels of reliability for the customer by maintaining the system during an event that may have normally caused power outages." {EY 2015 p36}

Bibliography

Jack Gilding, Backroad Connections Pty Ltd

Version 2.0, 10 April 2017

This bibliography was produced as part of the project "*Research review and advocacy on the fair value of distributed generation*".

The project's aim is to summarise existing research and undertake advocacy on setting a fair feed-in tariff for solar customers in Australia, with particular reference to review processes in Queensland, Victoria and Tasmania.

The project includes involvement from:

- Solar Citizens
- Alternative Technology Association
- Australian Solar Council
- Total Environment Centre
- Clean Energy Council
- Tasmanian Renewable Energy Alliance

This bibliography and other project outputs can be downloaded from http://backroad.com.au/?page_id=97

Comments, additions and suggestions would be welcome. Please contact jack.gilding@backroad.com.au

This project was funded by Energy Consumers Australia as part of its grants process for consumer advocacy projects and research projects for the benefit of consumers of electricity and natural gas. The views expressed in this document do not necessarily reflect the views of Energy Consumers Australia.

This annotated bibliography is intended to provide a guide to the most relevant sources in relation to the setting of feed-in tariffs in Australia. It includes:

- Official documents arising from the processing of setting FITs in various jurisdictions, including terms of reference, interim and final reports and determinations.
- Submissions to jurisdictional processes, focussing particularly on those which make specific arguments about components that need to be taken into account to determine a fair and reasonable FiT.
- Policy and documents which provide detailed research and information on methodology for determining FiTs. Selected overseas documents have been included where they usefully address methodological issues, but the emphasis is on research and information in the context of the Australian electricity market.

ACIL Allen 2017, *Wholesale Electricity Spot Price, 2017-18 Projections*, ACIL Allen Consulting, 22 Feb 2017
Explains the methodology used to provide projections of spot wholesale electricity prices for Victoria for financial year 2017-18. The projections were prepared using PowerMark, ACIL Allen's proprietary model of the National Electricity Market (NEM). This report provides an overview of the approach taken to prepare the projections and the results from the modelling.
http://www.esc.vic.gov.au/document/energy/52973-wholesale-electricity-spot-price-2017-18-projections-acil-allen-consulting/

AEMC 2015a, *Local Generation Network Credits, AEMC*
Webpage for the proposed rule change. See also the Information Sheet {AEMC 2015b}, the Consultation Paper {AEMC 2015c}, the original proposal {Oakley Greenwood 2015} and the summary article at {Byrne 2015}.
http://www.aemc.gov.au/Rule-Changes/Local-Generation-Network-Credits [accessed 8 Apr 2017]

AEMC 2015b, *Local Generation Network Credits Information Sheet*
2 page summary by AEMC of proposed rule change {Oakley Greenwood 2015}.
http://www.aemc.gov.au/getattachment/2f203e91-ea96-48a4-baa1-201f5d4e9ca1/Information-sheet.aspx

AEMC 2015c, *Consultation Paper: National Electricity Amendment (Local Generation Network Credits) Rule 2015*, AEMC, 10 Dec 2015
The Consultation Paper provides a summary of the rule change request {Oakley Greenwood 2015}, describes the assessment framework that the AEMC will use in assessing the rule change request and identifies a number of questions and issues to facilitate public consultation.
http://www.aemc.gov.au/getattachment/ab1269b8-cde9-4610-b819-747a47267558/Consultation-paper.aspx

AEMC 2015d, *2015 Residential Electricity Price Trends, Final Report*, AEMC 4 Dec 2015
http://www.aemc.gov.au/Markets-Reviews-Advice/2015-Residential-Electricity-Price-Trends

AEMO 2012, *Rooftop pv Information Paper: National Electricity Forecasting 2012*
Developed as input to AEMO's National Electricity Forecasting Report, this paper provides current and projected pv installed capacity, energy production and maximum demand for each of the 5 NEM regions. In the mainland states solar pv is estimated to be operating at 28%-38% of capacity at times of maximum network demand.
http://www.aemo.com.au/Reports-and-Documents/Information-Papers/Rooftop-pv-Information-Paper-National-Electricity-Forecasting

AEMO 2016, *2016 National Transmission Network Development Plan*, AEMO, 12 Dec 2016
"AEMO's assessment of options for national transmission grid development finds potential value in developing a more interconnected National Electricity Market (NEM) over the next 20 years to remove network congestion, lower the overall cost of generation dispatched to consumers, and improve the power system's resilience to unexpected events."
http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan

AEMO 2017a, *Visibility of Distributed Energy Resources*, Australian Energy Market Operator, Jan 2017
"AEMO has developed the Visibility of Distributed Energy Resources (DER) report to outline the need for visibility of increasing penetrations of DER data to maintain power system security. The report details the potential impact DER has on market efficiency and reliability if their existence and behaviour is not visible or predictable to the operators. The report notes that regulatory changes may be required to address information gaps to either make data available or consider opportunities to manage the power system in new ways."
https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/FPSSP-Reports-and-Analysis

AER 2016a, *State of the energy market 2015*, Australian Energy Regulator, updated 4 Feb 2016
Provides a comprehensive overview and statistical information on electricity and gas markets in Australia including electricity generation, networks and retailing.
https://www.aer.gov.au/publications/state-of-the-energy-market-reports/state-of-the-energy-market-2015

ARENA 2015, *Investigating local network charges and local electricity trading*, (website)
"Five virtual trials of local network charges and local electricity trading will be conducted in NSW, VIC, and QLD to support two potential NEM rule change proposals." The lead agency is the Institute for Sustainable Futures, University of Technology, Sydney
http://arena.gov.au/project/investigating-local-network-charges-and-local-electricity-trading/ [accessed 29 Mar 2017]

ARENA 2016, *Networks Renewed* (website)
This project seeks to increase the amount of renewable energy in Australia by paving the way for small-scale solar photovoltaic (pv) and battery storage installations to improve the quality and reliability of electricity on our national distribution networks. With a focus on voltage management, Networks Renewed will show that residential solar can make a significantly positive impact on both the technical and business characteristics of the electricity networks.
http://arena.gov.au/project/networks-renewed/ [accessed 29 Mar 2017]

ASC 2015, *Submission to the Queensland Productivity Commission: Inquiry into Solar Feed-in Pricing*, Australian Solar Council & Energy Storage Council, 27 Nov 2015
Argues for factors that should be considered by the QPC in setting a "Fair Export Price" including externalities such as health benefits.
http://www.qpc.qld.gov.au/files/uploads/2015/11/Solar-Inquiry-Submission_Australian-Solar-Council-Energy-Storage-Council.pdf

ASC 2016a, *Solar Feed-in Tariff Inquiry: letter to Queensland Productivity Commission*, John Grimes, Australian Solar Council, 20 Apr 2016
http://backroad.com.au/wp-content/uploads/2016/04/ASC2016-04-20-ASC-QPC-submission.pdf

ATA 2012, *Submission by Alternative Technology Association on QCA's Issues Paper on Solar Feed-in Tariffs: 'Estimating a Fair and Reasonable Solar Feed-in Tariff for Queensland'*, ATA, 14 Sep 2012
Provides a rationale for why FiTs should be regulated and discusses the components of a 'value stack' that add up the various benefits of exported solar energy. Detailed discussion of merit order effect and suggested mechanism for including it in a FiT.

ATA 2013, *Submission by Alternative Technology Association on IPART's Review of Solar Feed-in Tariffs 2013 to 2014*, ATA, 7 Jun 2013
Argues that the impact of solar pv in reducing wholesale prices via the merit order effect is well documented and should be taken into account in setting a FiT. Notes that under the current voluntary arrangements, NSW retailers are offering either no FiT or a FiT below or at the lower part of the range recommended by IPART. Vertical integration of retailers (retailers also owning generation facilities) provides a motivation for retailers to keep FiTs low and wholesale energy prices high. Argues for reintroduction of mandatory regulation of FiTs.

ATA 2014, *Submission by Alternative Technology Association on the ESC Draft Determination – Victorian Feed-in Tariff 2014,* ATA, 4 Jul 2014
Provides examples from SP AusNet and AusGrid of existing methodology used to calculate avoided Transmission Use of System charges as a result of distributed generation. Also references AEMO finding that pv contributes about a third of nameplate rating during the highest demand period. On the basis of this, ATA refutes the ESC's statement that "benefits of this kind have not been substantiated".

ATA 2016a, *Life after FiTs – Executive Summary*, ATA, Jul 2016
http://www.solarcitizens.org.au/life_after_fits

ATA 2016b, *Life after FiTs – Final Report*, Alternative Technology Association, Jul 2016
Report of a project that developed advice for the over 275,000 solar owners in NSW, SA and Vic whose premium feed-in tariffs were to end in 2016. Advice covers:

- getting the right meter
- increasing self-consumption of generated solar energy
- considering electricity rather than gas as an energy source
- getting the best electricity deal
- considering additional solar panels or adding batteries.

http://www.solarcitizens.org.au/life_after_fits_find_out_more

ATSE 2009, *The Hidden Costs of Electricity: Externalities of Power Generation in Australia*, Australian Academy of Technological Sciences and Engineering, Mar 2009
This Academy study addresses the external social and environmental costs – the externalities – that accompany all electricity generating technologies. These are costs not accounted for in the market price of electricity arising from impacts on, for example, climate, human health, crops, structures and biodiversity. Until identified, and then if possible quantified in monetary terms, they remain hidden, playing a limited role in technology selection. The ATSE study builds on the methodology of the European ExternE project and applies it to Australian conditions.
http://www.atse.org.au/content/publications/reports/energy/hidden-costs-electricity.aspx

Byrne 2015, *A call to value local energy in Australia's future grid*, Mark Byrne 11 Dec 2015
An explanation of the rule change request to the AEMC from the Total Environment Centre, the City of Sydney and the Property Council of Australia which would recognise the benefits to networks and consumers of energy generated and consumed in the same area, avoiding the infrastructure costs and line losses from long transmission lines and big zone substations.
http://reneweconomy.com.au/2015/a-call-to-value-local-energy-in-australias-future-grid-65757

Carter 2013, *Rooftop solar is growing up*, Lucy Carter, Business Spectator, 25 Apr 2013
Argues that the end of premium FiTs is a sign of maturity in the solar industry. Future policy should focus on encouraging solar owners to implement the technology in ways which reduce network costs, for example by different orientation and using battery storage to export when energy is most valuable.
http://www.businessspectator.com.au/article/2013/4/25/solar-energy/rooftop-solar-growing
[accessed 8 Apr 2017]

CEC 2013a, *CEC Supplementary Submission to the QCA Draft Report: Estimating a Fair and Reasonable Solar Feed-in Tariff for Queensland*, Clean Energy Council, 1 Mar 2013
Revises the calculations of the fair and reasonable retailer payments to solar pv owners using the new data available in the Draft Determination.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/Submission-to-QCA-Draft-Report-Supplementary-1-March-2013/submission%20to%20QCA%20Draft%20Report%20-%20supplementary%20-%201%20March%202013.pdf

CEC 2013b, *Clean Energy Council submission to the Tasmanian Govt Position Paper: Tasmanian Energy Market Reform: Market and Regulatory Frameworks*, Clean Energy Council, 22 Mar 2013
Argues for the continuation of existing FiTs and the protection of existing solar owners in the context of introducing retail competition to Tasmania.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/Submission-re-Sale-of-Aurora-22-March-2013/Submission%20re%20sale%20of%20Aurora%2022%20March%202013.pdf

CEC 2013c, *Clean Energy Council submission to the ESCoSA 2013 Determination of Solar Feed-in Tariff: Draft Price Determination*, Clean Energy Council, April 2013
Argues that the proposed basis for calculating a South Australian FiT is too narrow and would result in solar owners subsidising electricity retailers and/or other customers.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/Submission-to-ESCoSA-Draft-FiT-Determination-April-2013-v3/submission%20to%20ESCoSA%20Draft%20FiT%20determination%20-%20April%202013%20v%203.pdf

CEC 2013d, *Clean Energy Council submission to the Tasmanian Government Issues Paper: Feed-in Tariffs: Transition to Full Retail Competition*, Clean Energy Council, 7 Jun 2013
Argues that the current FIT is not regressive. Argues for a 5 year grandfathering of existing 1:1 tariff. Suggests safeguard for the closure of the existing 1:1 scheme. Identifies metering problem for solar owners in Tasmania. Suggests factors that should be included in the terms of reference for the FiT review.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/Submission-re-Tasmanian-FiTs-Transition-to-FRC-7-June-2013/Submission%20re%20Tasmanian%20FiTs%20%20transition%20to%20FRC%207%20June%202013.pdf

CEC 2013e, *Clean Energy Council submission to the IPART review of solar feed-in tariffs*, Clean Energy Council, 7 Jun 2013
"The New South Wales approach of not regulating minimum feed in tariffs payments to customers has failed. Not one electricity retailer is paying the amount that IPART has determined is the financial gain to Standard retailers." Calls on the NSW Government to mandate a minimum legal feed in tariff.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/CEC-Submission-New-South-Wales-FiTs-7-June-2013/CEC%20Submission%20New%20South%20Wales%20FiTs%207%20June%202013.pdf

CEC 2013f, *Clean Energy Council submission to the ESCoSA Issues Paper: Review of the Solar Feed-in Tariff Premium*, Clean Energy Council, 12 Jul 2013
Argues against the deregulation of FiTs in South Australia. "In summary, the approach considered by the Issues Paper would be unfair to solar households and more expensive for other electricity consumers."
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/Submission-to-ESCoSA-Review-of-Solar-FiT-Premium-12-July-2013/submission%20to%20ESCoSA%20Review%20of%20solar%20FiT%20premium%20-%2012%20July%202013.pdf

CEC 2013g, *Clean Energy Council submission to the ESC Draft Decision: Minimum Electricity Feed-in Tariffs*, Clean Energy Council, 18 Jul 2013
In the context of imminent completion of smart meter rollout in Victoria, the CEC argues for an opt-in experiment with a time-varying FiT based on wholesale electricity prices. Argues for a mandated FiT that is technology neutral, time-varying and location specific.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/CEC-Submission-to-Victorian-ESC-Draft-Decision-on-Feed-in-Tariffs-18-July-2013/CEC%20Submission%20to%20Victorian%20ESC%20draft%20decision%20on%20feed-in%20tariffs%2018%20July%202013.pdf

CEC 2013h, *Clean Energy Council submission to the Tasmanian Economic Regulator: A Fair and Reasonable Feed-in Tariff for Tasmanian Small Customers*, Clean Energy Council, 2 Oct 2013.
A submission in response to the OTTER draft report on FiTs. Argues that the Tasmanian government should:
- Recognise the benefits of distributed generation and storage and that aligning incentives with costs and benefits will encourage efficient investment and reduce electricity costs for everyone.
- Base the feed-in tariff on the system-wide benefits of distributed generation and storage.
- Support the staged introduction of smart meters, commencing with solar customers and others who choose to opt in.
- Regulate for benefit-reflective feed-in tariffs.
- Regulate to allow distributed generation and storage to compete on fair terms, especially at critical peak periods.
- Provide access to information for early adopters of time of use pricing.
- Reduce or remove barriers to competition by distributed generation and storage.

CEC 2014a, *Clean Energy Council submission to the IPART 2014/15 review of solar feed-in tariffs*, Clean Energy Council, Jan 2014
Argues for benefit-reflective feed-in tariffs to improve network utilisation and ultimately reduce costs for consumers. Argues that it is not in gentailers' financial

interest to open up competition for the supply of electricity at critical peak periods and that therefore a regulated minimum FiT is required.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/CEC-Submission-to-2014-15-Review-of-Solar-Feed-in-Tariffs-Jan-2014/CEC%20Submission%20to%20IPART%202014-15%20Review%20of%20Solar%20Feed-in%20Tariffs%20Jan%202014.pdf

CEC 2014b, *Clean Energy Council submission to IPART Draft Report on solar feed-in tariffs*, Clean Energy Council, 1 May 2014
Recommends policy approaches that would allow distributed generation to achieve a more competitive market.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/CEC-submission-to-IPART-draft-report-on-FiTs-May-2014.pdf

CEC 2014c, *Clean Energy Council submission to ESC Draft Decision on feed-in tariffs 2015*, Clean Energy Council, 4 Jul 2013
Quotes multiple sources supporting or requiring the implementation of time of day based FiTs. Calls on the Victorian state government to implement time of day based FiTs as required by its own policy.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/CEC-Submission-to-Victorian-ESC-Draft-Decision-on-Feed-in-Tariffs-18-July-2013/CEC%20Submission%20to%20Victorian%20ESC%20draft%20decision%20on%20feed-in%20tariffs%2018%20July%202013.pdf

CEC 2015a, *Terms of Reference for IPART review of solar feed-in tariff, letter to NSW Minister for Energy*, Clean Energy Council, 22 May 2015
The CEC welcomes the terms of reference provided to the Independent Pricing and Regulatory Tribunal (IPART) in relation to setting the retailer contribution for the NSW Solar Bonus Scheme, in particular the reference to time of day based FiTs.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/solar-feed-in-tariffs/Letter-to-Anthony-Roberts-re-ToR-for-IPART-review-May-2015.pdf

CEC 2015b, *Fact Sheet: Calculating the value of small-scale generation to networks*, Clean Energy Council, 2015
2 page summary of *Calculating the value of small-scale generation to networks* {EY 2015}
http://fpdi.cleanenergycouncil.org.au/reports/value-of-small-scale-generation.html

CEC 2016a, *Submission to the Essential Services Commission's Distributed Generation Inquiry Stage 1 Draft Report: The Energy Value of Distributed Generation*, Clean Energy Council, 6 Jun 2016
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/2016/submission-to-esc-draft-report-on-fits.pdf

CEC 2016b, *Submission to the Essential Services Commission's Distributed Generation Inquiry Stage 2 Discussion Paper: The Network Value of Distributed Generation*, Clean Energy Council, 1 Aug 2016
Makes recommendations on issues such as the scope of the review's approach, definitions, components and characteristics of the network value of distributed generation, conceptual frameworks and methodologies for analysis of the network benefits, and sources of data for analysis.
http://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/2016/draft-report-on-network-value-submission-august-2016.pdf

CEC 2016c, *Clean Energy Council submission to the ESCoSA Review of the retailer feed-in tariff*, Clean Energy Council, 9 Sep 2016
ESCoSA is considering whether to deregulate the feed-in tariff paid by electricity retailers to their South Australian customers. The Clean Energy Council has called on ESCoSA to consider adopting the approach currently under development by the Victorian Essential Services Commission.
https://www.cleanenergycouncil.org.au/dam/cec/policy-and-advocacy/submissions/2016/escosa-feed-in-tariff-submission.pdf

Climate Council 2016, *Renewable Energy Jobs: Future Growth in Australia*, Ernst & Young and the Climate Council of Australia, May 2016
Key findings:
1. This report compares two scenarios for the national energy sector - business as usual renewable energy growth (34% renewable electricity in 2030) and 50% of

electricity derived from renewable sources in Australia by 2030. Both scenarios show increased uptake of renewable electricity will create employment nation-wide.
2. The net effect on jobs of 50%RE is positive across Australia and each individual state: every state will experience net job growth.
3. Unlike other industry transitions such as in automotive manufacturing and steel smelting, which have seen many jobs move offshore, a transition to 50RE will create jobs in Australia.
https://www.climatecouncil.org.au/renewablesreport

CME 2015a, *Write-downs to address the stranded assets of electricity networks in the National Electricity Market: evidence and argument*, Carbon + Energy Markets, Apr 2015
Examines the valuation of the regulated assets of twelve electricity distribution network service providers that together distribute electricity to a little over 9 million connections in the NEM. The context is the significant expansion of the value of the regulated assets of some distributors at the same time that there has been declining demand for electricity provided by these distributors; and the rise of distributed generation.
The report provides information and analysis to inform a few questions:
1. How does the regulated asset value of Australia's distributors compare to each other and to distributors in other countries?
2. Are differences in regulated asset values explained by the starting valuation, differences in capital expenditure or other factors?
3. Is there evidence that distributor assets are stranded?
4. What is the basis on which regulated asset values have been established and how do these compare in Australia with those in other countries?
5. What is the possible quantification of stranded assets?
6. If regulated assets are to be revalued how might this be done?
http://cmeaustralia.com.au/wp-content/uploads/2015/05/150329-FINAL-REPORT-TEC-STRANDED-ASSETS.pdf

CME 2015b, *Rooftop solar pv and network tariffs: Information and discussion*, Carbon + Energy Markets, Jun 2015
This report prepared for UnitingCare Australia:
- examines network charges for households with rooftop PV compared to those that have not installed PV.
- examines the impact of rooftop PV on network services business' income.
- discusses the equity and fairness issues associated with rooftop PV. The focus of the section is to conclude whether, and if so how, network tariffs for households that have installed rooftop PV should change.

The report concludes that the problem of reduced network revenues resulting from distributed generation cannot be solved by tariffs that better reflect costs. "To the contrary, tariffs that better reflect costs, will simply make stranded assets more obvious. … it is clear that policy makers and the industry would be making a bad mistake if they tried to protect network service providers through higher fixed charges. Such charges are inefficient and regressive. The problem of stranded assets will need to be shouldered by consumers and shareholders in some other way, including the revaluation of assets. Economic efficiency and fairness, not the preservation of the incumbents' rents, must be the guiding objectives."
http://cmeaustralia.com.au/wp-content/uploads/2013/09/150601-FINAL-Rooftop-pv-tariffs-and-economic-theory-.pdf

CME 2016, *Australia's retail electricity markets: who is serving whom?*, Carbon and Energy Markets, Aug 2016
Analyses the retailing component of electricity costs in the NEM, comparing regulated and de-regulated jurisdictions. Also includes international comparison of electricity prices. Concludes that:
- The Big Three retailers (AGL Energy, Energy Australia and Origin Energy) are charging two to three times more to sell electricity in NSW, VIC, SA and QLD than the regulated retailer in the ACT is charging.

- in Australia's deregulated retail markets, the retail charge is around twice as high as a proportion of the bill and about three times as high, stated as an amount, as the charge in Britain.

http://cmeaustralia.com.au/wp-content/uploads/2013/09/160815-FINAL-getup-retail-report-.pdf

COAG 2008, *National Principles for Feed-in Tariff Schemes*, 29 November 2008
This is replaced by the updated version at {COAG 2013}.
http://www.coag.gov.au/node/243

COAG 2013, Revised National Principles for Feed-In Tariff Arrangements, Council of Australian Governments, 17 July 2013
As part of a package of energy market reforms endorsed by COAG on 7 December 2012, COAG agreed that the National Principles for Feed-in Tariff Arrangements be amended to provide for all forms of micro generation technologies to be offered a fair and reasonable tariff and to close premium schemes to new participants by 2014. The revised principles state that consumers with grid-connected micro-generation equipment should receive "*payment for exported electricity which reflects the value of that energy in the relevant electricity market and the relevant electricity network it feeds in to, taking into account the time of day during which energy is exported.*" The principles to ensure fair treatment of micro generation provide that customers should be subject to "*minimum terms and conditions for retail contracts such that they are no less favourable than the terms and conditions for customers without micro generation*" and that the assignment of network tariffs to them "*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.*"
https://www.coag.gov.au/node/507

COAGEC 2015, *Meeting Communique*, Council of Australian Governments Energy Council (COAGEC), 4 Dec 2015
https://scer.govspace.gov.au/files/2014/05/Energy-Council-Communique-4-Dec-2015-FINAL.pdf

DEA 2013, *How coal burns Australia: The true cost of burning coal*, Doctors for the Environment Australia, April 2013
Description and links to seven key studies that calculate the true cost of coal. The true cost means taking into account certain externalities such as healthcare and pollution.
https://www.dea.org.au/how-coal-burns-australia-the-true-cost-of-burning-coal-healthy-planet-healthy-people-dea/

DEA 2016, *Failure to include health risks grossly distorts true costs of climate change*, Peter Brooks and John Willoughby, Doctors for the Environment Australia, 22 February 2016
"Last week, DEA presented its concerns in a submission to the Climate Change Authority, which is reviewing whether Australia should have an emissions trading scheme, and what action Australia should take to implement outcomes agreed at the Paris climate change meeting last year. We argued that by being required to focus on the economic issues of transitioning away from fossil fuels, the CCA will be unable to consider the true costs to society of inadequate action to mitigate change."
http://reneweconomy.com.au/2016/failure-to-include-health-risks-grossly-distorts-true-costs-of-climate-change-55658 [accessed 31 Mar 2017]

Dufty 2016, *The National Energy Market – A hazy retail maze: Observations from the Vinnies' Tariff-Tracking Project*, Gavin Dufty, St Vincent de Paul Society and Alviss Consulting, Dec 2016
Analyses changes to electricity and gas prices across Australia from July 2009 to July 2016. Includes analysis of changes in the components of retail electricity prices. In 2016 for the first time the Tracking Project compared solar offers available to new customers across the NEM.
https://www.vinnies.org.au/page/Our_Impact/Incomes_Support_Cost_of_Living/Energy/VINNIES_NATIONAL/

Eadie 2013, *Going Solar: Renewing Australia's electricity options*, Laura Eadie and Cameron Elliott, Centre for Policy Development, April 2013
Going solar, the latest report from CPD's Sustainable Economy team, takes an open-minded look at the economics of rooftop solar. It finds that all Australians can

benefit from high levels of rooftop solar and provides policy recommendations to maximise these benefits.
http://cpd.org.au/2013/04/going-solar/

ECA 2106a, *Energy Consumer Sentiment Survey July 2016 – Full Report*, Energy Consumers Australia, Jul 2016
Methodology and findings on an online survey of 2,020 consumers and 280 small businesses conducted by Essential Research for Energy Consumers Australia with a focus on three areas of satisfaction, confidence and activity. Findings include that:
- Consumers are looking to energy management technologies to manage their electricity costs.
- Households have made significant investment in rooftop solar panels and solar hot water systems to manage their electricity costs.
- Survey results suggest that the proportion of households with rooftop solar and solar hot water systems could double in most jurisdictions in the next 5 years.
- 59% of those who were considering getting solar panels were also considering getting battery storage.

http://www.energyconsumersaustralia.com.au/research/energy-consumer-sentiment-survey-findings

ENA 2016, *Energeia Modelling - Roles and Incentives for Microgrids and Stand Alone Power Systems*, Energeia for Energy Networks Australia, Oct 2016
Key findings:
- Without better incentives, up to 10% of customers are likely to leave the grid by 2050, increasing average bills to other customers by $132 per year.
- Innovative network incentives, like a Stand Alone Power System tariff, would encourage over 1 million customers to choose to stay on-grid to sell energy using their own Distributed Energy Resources, resulting in lower costs for themselves and other grid customers.
- Introducing appropriate incentives for SAPS customers saves other customers around $1 billion in network bills compared to the base case.

http://www.energynetworks.com.au/energeia-modelling-roles-and-incentives-microgrids-and-stand-alone-power-systems

ENYRPC 2016, *Shining Rewards: The value of rooftop solar power for consumers and society*, Frontier Group for the Environment New York Research and Policy Center, 29 Nov 2016
"A review of 16 recent analyses shows that individuals and businesses that decide to 'go solar' generally deliver greater benefits to the grid and society than they receive through net metering."
http://www.environmentnewyorkcenter.org/reports/nye/shining-rewards-0

ESA 2013, *Who pays for solar energy?* Energy Supply Association of Australia, May 2013
"This paper discusses the need to look at the way we charge consumers for the cost of the networks to make sure everybody pays their fair share."
http://www.esaa.com.au/policy/who_pays_for_solar_energy

ESC 2015a, *Terms of Reference for the Inquiry into the true value of distributed generation to Victorian Consumers*, Robin Scott, Minister for Finance, letter to Chair, Victorian Essential Services Commission, 4 Sep 2015
http://www.esc.vic.gov.au/getattachment/0a3f1608-ac62-43a1-83e4-7123262a9851/Terms-of-Reference.pdf
http://www.esc.vic.gov.au/Energy/Inquiry-into-the-true-value-of-distributed-generat

ESC 2015b, *Inquiry into the true value of distributed generation – Proposed Approach Paper*, Victorian Essential Services Commission, 22 Dec 2015
The ESC is proposing to define three elements of public benefit that could flow from the investment in distributed generation:
- The economic benefit of distributed generation to the electricity market and distribution network.
- Any environmental benefit that can be attributed to distributed generation.
- Any other benefits that can be attributed to distributed generation.

The Commission is seeking evidence from stakeholders as to the public benefits and how they can be quantified. Submissions are sought by Fri 12 Feb 2016.

http://www.esc.vic.gov.au/getattachment/fb536622-1a8e-4b2c-83d7-e25c93915f94/Inquiry-into-the-true-value-of-distributed-generat.pdf

ESC 2015c, *Amendments to the Terms of Reference for the Inquiry on the true value of distributed generation to Victorian consumers*, ESC, 24 Dec 2015
The amended terms of reference split the inquiry into two part, investigating energy value and network value.
http://www.esc.vic.gov.au/document/energy/30389-terms-of-reference-inquiry-into-the-true-value-of-distributed-generation-to-victorian-consumers/

ESC 2016a, *The Energy Value of Distributed Generation, Distributed Generation Inquiry Stage 1 Draft Report*, Victorian Essential Services Commission, April 2016.
The report includes draft recommendations that the current single tariff should be replaced by a framework that allows for a time and location varying feed-in tariff that more closely reflects the underlying wholesale price of electricity. This would be based on time blocks used for retail pricing (peak, shoulder and off-peak) plus a critical peak tariff that would be paid when the wholesale price of electricity exceeds $300/MWh. It also recommends a location based tariff reflecting average line losses based on dividing the state into two regions.
http://www.esc.vic.gov.au/document/energy/32219-distributed-generation-inquiry-draft-report-energy-value/

ESC 2016b, *The Network Value of Distributed Generation, Distributed Generation Inquiry Stage 2 Discussion Paper*, Victorian Essential Services Commission, June 2016
The Discussion Paper provides a framework to: identify and quantify the network value of distributed generation, assess the extent to which the current regulatory framework takes this value into account, and recommend any changes to the regulatory framework necessary to better account for the network value of distributed generation.
http://www.esc.vic.gov.au/document/energy/32219-distributed-generation-inquiry-draft-report-energy-value/

ESC 2016c, *The Energy Value of Distributed Generation, Distributed Generation Inquiry Stage 1 Final Report*, Victorian Essential Services Commission, 21 Aug 2016
The report recommends that the energy value of distributed generation should recognise the varying value of energy based on time and location. It recommends a FiT with peak, shoulder and off-peak rates supplemented by a critical peak tariff at times that the wholesale price exceeded $300/MWh. It recommends that the greenhouse gas reduction benefits should be recognised by a 'deemed output tariff' (based on the estimated total output of a system, not just the exported energy).
Not all of these recommendations were accepted by the state government. See {ESC 2017a} for the actual implementation.
http://www.esc.vic.gov.au/document/energy/36002-distributed-generation-inquiry-final-report-energy-value/

ESC 2016d, *The Network Value of Distributed Generation, Distributed Generation Inquiry Stage 2 Draft Report*, Victorian Essential Services Commission, Oct 2016
The findings of the draft report are very similar to findings 1 to 9 of the Final Report {ESC 2017b}.
http://www.esc.vic.gov.au/document/energy/36400-distributed-generation-inquiry-draft-report-network-value/

ESC 2017a, *Minimum Electricity Feed-In Tariff to Apply From 1 July 2017 – Decision (Final)*, Essential Services Commission of Victoria, 28 Feb 2017
Sets the FiT rate for Victoria for 2017-2018 at 11.3c consisting of 8.1c for the forecast solar-weighted average wholesale electricity price, 0.7c of avoided losses and market fees, and 2.5c for the value of the avoided social cost of carbon. As a result of decisions of the state government (see {VicGov 2016}, {VicGov 2017a, b &c}) the FiT rate does not include a time or location varying component or a deemed output tariff.
http://www.esc.vic.gov.au/document/energy/52970-minimum-electricity-feed-tariff-apply-1-july-2017-decision-final/

ESC 2017b, *Distributed Generation Inquiry Stage 2 Final Report – Network Value*, Essential Services Commission of Victoria, Feb 2017
Key findings:

1) Distributed generation can and does provide network value. The value is primarily derived from reductions in network congestion.
2) Network value is highly variable depending on location, time, asset life-cycle, capacity and optimisation.
3) 'Firm' distributed generation has significantly more network value than 'intermittent' generation.
4) Technology can transform intermittent generation into firm generation.
5) Social and environmental benefits: Distributed generation may provide a benefit if it provides a lower cost alternative to network projects undertaken for the purposes of bushfire mitigation.
6) Sources of grid services: Reducing network congestion is a form of "grid service". Network congestion can be reduced by a number of means, of which distributed generation is only one.
7) Distributed generation in Victoria could be remunerated for its network value through a well-functioning market for grid service.
8) A broad-based feed-in tariff is unlikely to be an appropriate mechanism to remunerate network value.
9) There may be opportunities in Victoria for the development of a well-functioning market for grid services that are not currently available in other jurisdictions.
Finding 10 sets out a proposed way forward to progress the development of a market for grid services consisting of:

- a focus on promoting the availability of appropriate information for market participations
- a review of the means by which customers can access the market for grid services
- an investigation of the design of potential market mechanisms
- a focus on promoting the establishment of technical standards to support the interoperability of relevant technologies
- a review of existing customer protections to ensure customers are empowered to provide grid services
- facilitation of grid services market trials and pilots in Victoria.

http://www.esc.vic.gov.au/document/energy/53210-distributed-generation-inquiry-stage-2-final-report-network-value/

ESCOSA 2015a, *Retailer-paid solar feed-in tariff to rise in 2016*, Media Release, Essential Services Commission of South Australia, 2 Dec 2015
"ESCOSA has determined a minimum retailer-paid feed-in tariff (R-FiT) of 6.8 cents per kWh for 2016, compared with 5.3 cents per kWh in 2015."
http://www.escosa.sa.gov.au/projects/projectdetails.aspx?p=69&id=236

ESCOSA 2015b, *Retailer feed-in tariff 2016: Decision pursuant to clause 2.1 of the retailer feed-in tariff price determination of December 2014*, Essential Services Commission of South Australia, 2 Dec 2015
Detailed description of the methodology for setting the Retailer FiT for 2016. The decision is informed by independent modelling and advice received from ACIL Allen and is based on:

- the projected wholesale spot price of electricity
- weighted by the net system load profile
- adjusted for avoided network losses, and
- adjusted for market and ancillary services fees.

Note that ESCOSA deliberately sets the FiT at the lower end (90th percentile) of the projected value of exported pv output. The mean value is 9.05c but the FiT is set at 6.8c. The rationale is described on p2 and p6.
http://www.escosa.sa.gov.au/ArticleDocuments/496/20151202-RetailerFeed-inTariff2016-Determination.pdf.aspx

ESCoSA 2016a, *Retailer feed-in tariff - Review of regulatory arrangements, Draft decision*, Essential Services Commission of South Australia, Jul 2016
"Following a review of the evidence as outlined in the body of this report, and having regard to the content of submissions to the Issues Paper, the Commission's draft finding is that a regulated minimum R-FiT does not improve the outcomes for customers, relative to allowing the competitive market to determine the R-FiT."

http://www.escosa.sa.gov.au/projects-and-publications/projects/electricity/electricity-retailer-feed-in-tariff-review-of-regulatory-arrangements

EY 2015, *Calculating the value of small-scale generation to networks*, Ernst & Young for Clean Energy Council, July 2015
For this work the Clean Energy Council engaged EY to examine international examples and look at the real-world application of methodologies to calculate the value of the contribution of household solar and storage to distribution networks. See also fact sheet at {CEC 2015b} and 'Valuation aggregation tool' on website.
http://fpdi.cleanenergycouncil.org.au/reports/value-of-small-scale-generation.html

Farrell 2015, *Economies of scale: Why small solar is better than big solar*, John Farrell, Institute for Local Self-Reliance, 25 Aug 2015
While utilities continue to imply that large-scale solar projects are more economical than small ones, the data is telling another story. In fact, costs for transmission and distribution of utility-scale solar energy may largely undermine the modestly better economics at the point of generation. In other words utility solar may cost less, but it's also worth less.
http://reneweconomy.com.au/2015/economies-of-scale-why-small-solar-is-better-than-big-solar-15602

Frontier 2015, *Shining Rewards: The Value of Rooftop Solar Power for Consumers and Society*, Lindsey Hallock, Frontier Group; Rob Sargent, Environment America Research & Policy Center, Frontier Group, 2015
Reviews 11 recent analyses of the costs and benefits of distributed pv and concludes that pv owners generally delivers greater benefits to the grid and society than they receive through net metering. Identifies 9 categories of benefit and summarises the methodology used in each analysis under each category of benefit.
http://frontiergroup.org/reports/fg/shining-rewards

Gilding 2015, *Methodology for determining a fair solar price in Queensland: A response to the QPC issues paper from the advocacy project on the fair value of distributed generation*, Tasmanian Renewable Energy Alliance, 30 Nov 2015
http://backroad.com.au/wp-content/uploads/2016/04/2015-11-30-QPC-isssues-reponse.pdf

Gilding 2017a, *Victoria solar FiT: A turning point in recognising value of solar*, Jack Gilding, 28 February 2017
"The new Victorian feed-in tariff announced today marks an important turning point in the struggle for recognition of the real value of distributed renewable energy. The new rate of 11.3c/kWh more than doubles the existing Victorian rate of 5c. As well as now being the highest regulated state FiT in Australia, the methodology behind the decision sets some important precedents that will have national implications."
http://reneweconomy.com.au/victoria-solar-fit-turning-point-recognising-value-solar-79109/ [accessed 30 Mar 2017]

Grant 2016a, *Assets or Liabilities? The Need to Apply Fair Regulatory Values to Australia's Electricity Networks*, Hugh Grant ResponseAbility, 5th May 2016
Describes the history and calculation of the Regulated Asset Base (RAB) which is the major determinant of network costs within the NEM. The report concludes that the value of electricity network regulatory assets bases are much higher than efficient levels, particularly for government owned networks. Setting RABs at an efficient level would result in a significant reduction in electricity prices. Implementing the required RAB reductions would result in the prices of those networks with the most excessive RABs (e.g. the Queensland and NSW networks) reducing by 32-40%.
http://euaa.com.au/entries/general/major-report-indicates-significant-scope-for-electricity-prices-to-fall

Grant 2016b, *Is it ok for the regulator to ignore electricity networks' extraordinary profits?* Hugh Grant, 6 Dec 2016.
"ResponseAbility performed an analysis of the actual returns that the Queensland government has realised from its investment in two electricity networks (Powerlink Queensland and Energex) over the previous 15 years; and compared those returns with the returns that it would have realised if it had invested the same dollars in blue-chip ASX 50 companies in other sectors of the economy. … The analysis confirmed … that Australia's monopoly electricity networks are achieving many multiples of the returns being achieved by Australia's best performing ASX 50 companies."

http://reneweconomy.com.au/ok-regulator-ignore-electricity-networks-extraordinary-profits-54813/ [accessed 30 Mar 2017]

Hill 2014, *Power Corrupts: How network companies lined their pockets and drove electricity prices through the roof*, Jess Hill, The Monthly, July 2014.
"Since 2009, the electricity networks that own and manage our 'poles and wires' have quietly spent $45 billion on the most expensive project this country has ever seen. Allowed to run virtually unchecked, they've spent vast sums on infrastructure we don't need, and have charged it all to us, with an additional fee attached. The spending was approved by a federal regulator, and yet the federal government didn't even note it until it was well underway."
http://www.themonthly.com.au/issue/2014/july/1404136800/jess-hill/power-corrupts [accessed 8 Apr 2017]

IPART 2016a, *Fact Sheet: Solar feed-in tariffs in 2016-17*, NSW Independent Pricing and Regulatory Tribunal, 9 Jun 2016
Summary of the final decision {IPART 2016b}.
https://www.ipart.nsw.gov.au/Home/Industries/Energy/Reviews/Electricity/Solar-feed-in-tariffs-from-1-July-2016

IPART 2016b, *Solar feed-in tariffs in 2016-17: Retailer contribution and benchmark range from 1 July 2016*, NSW Independent Pricing and Regulatory Tribunal, 9 Jun 2016
Formal determination setting the benchmark range and retailer contribution. The benchmark range is the suggested range for a voluntary payment by retailers for solar energy. It is 5.5-7.2c/kWh. The retailer contribution is what retailers must contribute to towards the 20 or 60c/kWh payments paid to customers on the NSW Solar Bonus Scheme. The retailer contribution is 6.1c/kWh.
https://www.ipart.nsw.gov.au/Home/Industries/Energy/Reviews/Electricity/Solar-feed-in-tariffs-from-1-July-2016

ISF nd, *Facilitating Local Network Charges and Local Electricity Trading*, Institute for Sustainable Futures, no date
Summary information and extensive links to resources in support of ISF work on the Local Generation Network Credit (LGNC) rule change and related issues.
https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/our-research/energy-and-climate-2 [accessed 8 Apr 2017]

ISF 2014, *Calculating the network value of local generation and consumption*, Report prepared for Total Environment Centre and City of Sydney, E. Langham, J. Rutovitz, C. Cooper and C. Dunstan Institute for Sustainable Futures UTS, Apr 2014.
Describes four methodologies for assessing the network value of distributed generation. Discusses the advantages and disadvantages of mechanisms for monetising this value via either a Local Use of System charge (LUoS), analogous to existing TUoS and DuOS charges, or via a Virtual Net Metering (VNM) credit. Discusses the metering and billing logistics of implementing these in the context of current NEM arrangements.
http://www.advocacypanel.com.au/media/docs/Calculating-the-Network-Value-of-Local-Generation-and-Consumption---Stage-1-Final-Report-70870cf6-ac81-4be3-96f1-25c63e569141-0.pdf

ISF 2017a, *Crisis, what crisis? How smart solar can protect our vulnerable power grids*, Lawrence McIntosh & Dani Alexander, Institute for Sustainable Futures, 8 Feb 2017
"A new report from our Networks Renewed project aims to show how technologies such as 'smart inverters' can help to manage voltage at the household scale, rather than at substations. This would improve the quality of our power and flip the potential problem of household renewables into a solution."
https://theconversation.com/crisis-what-crisis-how-smart-solar-can-protect-our-vulnerable-power-grids-72487 [accessed 30 Mar 2017]

ISF 2017b, *Networks Renewed: Technical Analysis*, Institute for Sustainable Futures, Jan 2017
Description of the history of voltage regulation in electricity networks and the complications for voltage management introduced by distributed generation. Explanation of how the new solar inverter standards that came into effect in October 2016 as a result of AS/NZS 4777.2:2015 can be used to assist with voltage management. Description of pilot scale demonstrations undertaken in conjunction

with Essential Energy in NSW and United Energy in Victoria and proposed market scale demonstration trials.
https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/our-research/energy-and-climate-8#resources

Labrador 2015, *Why rooftop solar may be worth three times price of grid power*, David Labrador, RMI, 30 July 2015
A study by the Maine Public Utility Commission {Maine PUC 2015} valued distributed solar at $0.33 per kWh. This article summarises the methodology of the study and the political debate about how to implement the findings.
http://reneweconomy.com.au/2015/why-rooftop-solar-may-be-worth-three-times-price-of-grid-power-52898

Maine PUC 2015, *Maine Distributed Solar Valuation Study*, Maine Public Utilities Commission, 1 Mar 2015
"A recently released study commissioned by the Maine Public Utility Commission dropped a bombshell on the electricity world earlier this year, valuing distributed solar at $0.33 per kWh, far above the state's prevailing price."
"The Maine Public Utilities Commission commissioned the study last year at the request of the state legislature. The evaluation included avoided energy costs, avoided generation capacity costs, avoided transmission costs, and avoided natural gas pipeline costs. It also included the added costs of integrating distributed solar power to the grid."
The study concludes (p6) that the 25 year levelised benefits of $0.33 per kWh from solar pv consist of 13c of benefits to the electricity system and 20c of environmental and other social benefits.
Volume III contains detailed consideration of implementation options – the policies and mechanisms that could be used to encourage solar pv. It summarises lessons learnt from other states' experiences with implementing support measures for pv to set out a strategy for least-cost implementation of support measures.
http://www.nrcm.org/wp-content/uploads/2015/03/MPUCValueofSolarReport.pdf
RMI blog summary at http://blog.rmi.org/blog_2015_07_29_what_is_solar_power_really_worth_to_maine

McConnell 2013, *Retrospective modeling of the merit-order effect on wholesale electricity prices from distributed photovoltaic generation in the Australian National Electricity Market*, McConnell et al. Energy Policy Volume 58, July 2013
"We calculate that for 5 GW of capacity, comparable to the present per capita installation of photovoltaics in Germany, the reduction in wholesale prices would have been worth in excess of A$1.8 billion over 2009 and 2010, all other factors being equal. We explore the implications of our findings for feed-in tariff policies, and find that they could deliver savings to consumers, contrary to prevailing criticisms that they are a regressive form of taxation."
http://www.sciencedirect.com/science/article/pii/S0301421513000797
audio interview and other related material at
http://bze.org.au/media/radio/dylan-mcconnell-merit-order-effect-how-renewables-are-reducing-electricity--130427

McConnell 2015a, *Submission to Essential Service Commission Draft decision paper: Minimum Electricity Feed-In Tariff to apply from 1 January 2016*, Dylan McConnell Melbourne Energy Institute, July 2015
Argues that the ESC has previously acknowledged that the environmental benefits of reduced carbon emissions from renewable energy were important and were taken into account as the carbon tax was factored into the price of electricity. Since the carbon tax has been abolished an updated methodology for determining a FiT is required which provides credit for the environmental benefit of reduced carbon emissions.
http://figshare.com/articles/Submission_to_Essential_Service_Commission_Draft_decision_paper_MINIMUM_ELECTRICITY_FEED_IN_TARIFF_TO_APPLY_FROM_1_JANUARY_2016/1495555

McConnell 2015b, *Without a carbon price, we need a fairer price for solar*, Dylan McConnell The Conversation, 30 Jul 2015.
Provides an overview of changing mechanisms to support distributed renewable energy and their impact on solar pv installation rates.
https://theconversation.com/without-a-carbon-price-we-need-a-fairer-price-for-solar-45368

Mountain 2016, *Are retailers failing to properly value rooftop solar generation?* Bruce Mountain, 16 Sep 2016
Article in response to ESC final report on energy value. Includes information on retailer costs and margins.
"A reasonable argument can be made that at least some of these retail costs and profits can be avoided by local production and so should be counted in the regulated value of distributed generation."
http://reneweconomy.com.au/2016/retailers-failing-properly-value-rooftop-solar-generation-10536 [accessed 8 Apr 2017]

Muro and Saha 2016, *Why rooftop solar – and full retail feed in tariffs – benefits all consumers,* Mark Muro and Devashree Saha, 30 May 2016
Summary of study by the Brookings Institute which analysed a number of PUC and research studies on the costs and benefits of net metering (effectively a feed-in tariff equal to full retail electricity price). The study concludes that in most situations there is a net benefit to all consumer, not just to solar owners.
http://reneweconomy.com.au/2016/rooftop-solar-net-metering-is-a-net-benefit-28170 [accessed 30 Mar 2017]

NAGA 2016, *Northern Alliance for Greenhouse Action submission to ESC Inquiry into the true value of distributed generation*, Northern Alliance for Greenhouse Action, 12 Feb 2016
Argues that the methodology to calculate a minimum FiT should be updated to include social and environmental benefits and that there is a need to identify and address existing barriers to distributed generation beyond fair payment structures.
http://www.naga.org.au/uploads/9/0/5/3/9053945/escinquiry_nagasubmission__1_.pdf

Oakley Greenwood 2015, *Local Generation Network Credit Rule Change Proposal*, Oakley Greenwood, 14 Jul 2015
This submission to the Australian Energy Market Commission proposes a change in the National Electricity Rules (NER) to require electricity distribution businesses to establish posted tariffs (credits) that reflect the economic benefits that local electricity generation delivers to or imposes on the distribution system. The credit would be based on a measure of the long-term benefits (in the form of capacity support, and avoided energy transportation costs) that the export of energy from an embedded generator provides to customers of distribution businesses. The rule change is proposed by the City of Sydney, the Total Environment Centre and the Property Council of Australia.
http://www.aemc.gov.au/getattachment/70a314d9-adf6-4d2f-9493-5f53d4f3b6eb/Rule-change-request.aspx
http://www.aemc.gov.au/Rule-Changes/Local-Generation-Network-Credits

Orme 2015, *Solar cross subsidy theory put to the test*, Simon Orme, 14 Sep 2015
Discussion of the AER response to SAPN tariff application for a $100/year additional tariff for solar owners. Includes references to additional data from Vic, SA and WA.
https://www.linkedin.com/pulse/solar-cross-subsidy-theory-put-test-simon-orme [accessed 8 Apr 2017]

OTTER 2013a, *Regulated Feed-in Tariff for Tasmanian Small Customers, Draft Report,* Office of the Tasmanian Economic Regulator, Sep 2013
Provides the terms of reference and background to the proposed FiT determination for Tasmania to operate from 1 January 2014. Includes review of approach in other jurisdictions. Discusses the direct and indirect impacts that might be considered in setting a FiT. Proposes excluding all indirect impacts.
http://bit.ly/ter-draft
http://www.economicregulator.tas.gov.au/domino/otter.nsf/8f46477f11c891c7ca256c4b001b41f2/b713302decf91d0cca257bb8000a655f?OpenDocument#2013%20Feed-In%20Tariff%20Investigation

OTTER 2013b, *Regulated Feed-in Tariff for Tasmanian Small Customers, Final Report,* Office of the Tasmanian Economic Regulator, Oct 2013
This final report is similar in structure, content and findings to the draft report {OTTER 2013a}. It includes additional comments in response to stakeholder submissions to the draft report.
http://bit.ly/ter-draft

OTTER 2013c, *Regulated feed-in tariff determination for standard feed-in tariff customers*, Office of the Tasmanian Economic Regulator, 6 Dec 2013
The Determination provides the methodology and formula for setting the FiT but not the actual c/kWh rate.
http://bit.ly/ter-draft

OTTER 2015, *Notice of intention to conduct a Regulated Feed-in Tariff Rate pricing Investigation*, Office of the Tasmanian Economic Regulator, 2 Jul 2015
Announced of intention and terms of reference for a Regulated Feed-in Tariff Rate pricing investigation and determination for the period 1 July 2016 to 30 June 2019.
http://www.energyregulator.tas.gov.au/domino/otter.nsf/a08b00d12c2fae17ca256c4c0020929e/9c46ee94059b20d4ca257d020083a373?OpenDocument#2016%20Regulated%20Feed-in%20Tariff%20Rat
direct:
http://www.energyregulator.tas.gov.au/domino/otter.nsf/LookupFiles/15_1788%20FiT%20notice.PDF/$file/15_1788%20FiT%20notice.PDF

OTTER 2016a, *Regulated Feed-in Tariff Rate for Standard Feed-in Tariff Customers: Draft Investigation Report*, Office of the Tasmanian Economic Regulator, 5 Feb 2016
Sets out the process and proposed methodology for setting the Tasmanian FiT for the period July 2016 to June 2019. Under the regulations OTTER is required to review the methodology each three years and recalculate the FiT each financial year based on the methodology. The report reviews the methodology used in other Australian jurisdictions. The report comments on each component of the electricity value chain. It proposes that indirect impacts, including network benefits and security of supply not be included in the FiT determination.
http://www.energyregulator.tas.gov.au/domino/otter.nsf/LookupFiles/16245%20Feed%20in%20Tarriff%20Draft%20Report.PDF/$file/16245%20Feed%20in%20Tarriff%20Draft%20Report.PDF

OTTER 2016b, *Regulated Feed-In Tariff Rate For Standard Feed-In Tariff Customers: Draft Determination*, 5 Feb 2016
Draft determination of the methodology to be used to set the Tasmanian FiT for the period July 2016 to June 2019. The methodology takes into account only:
- the regulated wholesale energy price used in the Aurora Standing Offer determination
- network loss factors
- avoided AEMO charges.

The determination does not set an actual FiT rate in c/kWh.
via http://www.energyregulator.tas.gov.au/domino/otter.nsf/elect-v/30

OTTER 2016c, *Feed-in-Tariff Rate Investigation: Media Release*, 5 Feb 2016
Includes an indicative FiT rate of 6.535 c/kWh for the period from 1 July 2016 to 30 June 2017
http://www.energyregulator.tas.gov.au/domino/otter.nsf/8f46477f11c891c7ca256c4b001b41f2/d0863dd8ca11692cca257f860080dfc6?OpenDocument

Parkinson 2015a, *QCA lifts solar feed in tariff after RenewEconomy points out error*, Giles Parkinson, 2 Jun 2015
The Queensland Competition Authority is to revise its proposed feed in tariff affecting more than 30,000 solar households in the Ergon Energy network after conceding errors in its calculations pointed out by RenewEconomy on Monday.
http://reneweconomy.com.au/2015/qca-lifts-solar-feed-in-tariff-after-reneweconomy-points-out-error-34434 [accessed 30 Mar 2017]

Parkinson 2015b, *Networks to spend another $50bn on Australia's dumb and dumber grid*, Giles Parkinson, 30 Oct 2015
Overview of revenue determinations approved by the AER for networks in the NEM and commentary on impact on customer bills.
http://reneweconomy.com.au/networks-to-spend-another-50bn-on-australias-dumb-and-dumber-grid-26649/ [accessed 31 Mar 2017]

Parkinson 2016a, *Queensland smashes myths about renewables, and South Australia*, Giles Parkinson, 13 Oct 2016
Summarises some of the findings from the draft report of the Queensland Renewable Energy Expert Panel.
http://reneweconomy.com.au/2016/queensland-smashes-myths-about-renewables-and-south-australia-34734 [accessed 31 Mar 2017]

Parkinson 2016b, *Network Lobby Proposes Special Tariff To Keep Households On Grid*, Giles Parkinson, 27 Oct 2016
"A new report commissioned by the Energy Networks Association predicts that by 2050 some 10 per cent of consumers – or 1.25 million households – will leave the grid because solar and battery storage will offer a cheaper solution."
"However, the forecast of a 10 per cent defection rate by 2050 contrasts sharply with recent work by the CSIRO through its Future Grid scenarios, which suggested that one-third of consumers could leave the grid by 2040 unless the network operators changed their business models."
http://reneweconomy.com.au/network-lobby-proposes-special-tariff-to-keep-households-on-grid-98073/ [accessed 30 Mar 2017]

Parkinson 2016c, *City of Sydney in new push to make rules fairer for sharing energy*, Giles Parkinson, 14 Nov 2016
Reactions to the AEMC's rejection of the Local Generation Network Credits rule change – see {AEMC 2015a}.
http://reneweconomy.com.au/city-sydney-new-push-make-rules-fairer-sharing-energy-10083/ [accessed 31 Mar 2017]

Parkinson 2016d, *Network value of solar? Not much, says Victoria regulator*, Giles Parkinson, 15 Nov 2016
Commentary on the ESC's draft report on network value of distributed generation {ESC 2016d}. Makes comparisons with the methodology adopted by the New York Department of Public Service which puts a much higher value on distributed generation.
http://reneweconomy.com.au/network-value-of-solar-not-much-says-victoria-regulator-43395/ [accessed 30 Mar 2017]

Parkinson 2017a, *Victoria solar feed-in tariff more than doubles to 11.3c/kWh*, Giles Parkinson, 28 Feb 2017
Summary of the recommendations of the ESC's final report on energy value of distributed generation {ESC 2017a}.
http://reneweconomy.com.au/victoria-solar-feed-in-tariff-more-than-doubles-to-11-3ckwh-87581/ [accessed 30 Mar 2017]

Powershop 2014, *Renewable Energy Target Explained*, Powershop, 17 Jun 2014
This video says it is about explaining the RET but it is actually an explanation of how NEM bidding works and how renewables reduce the wholesale cost for all consumers due to the merit order effect.
https://www.youtube.com/watch?v=WxMvrKsVwzo [accessed 30 Mar 2017]

Pears 2015, *Submission on Victoria's Renewable Energy Roadmap*, Alan Pears, 29 Sep 2015
Includes the suggestion of a levy on pv exports to fund clean energy developments, including costs of grid upgrades to facilitate high penetration of distributed generation.

QCA 2016, *Solar feed-in tariff for regional Queensland for 2016–17 – Final Report*. Queensland Competition Authority, May 2016
Uses the existing methodology to set the regulated FiT for regional Qld at 7.448c for 2016-2017 (compared with 6.348c for 2015-2016).
http://www.qca.org.au/Electricity/Consumer/Solar-Feed-in-Tariffs/Final-Report/2016-17-Regional-Feed-in-Tariff#finalpos

QldGov 2016a, *Queensland Government response to the Queensland Productivity Commission Electricity Pricing Inquiry*, Queensland Government, Nov 2016
This sets out in detail the state government response to the recommendations of the inquiry into electricity pricing which covered many issues apart from solar and distributed generation. Of particular note is the rejection of the QPCs recommendation to consider earlier termination of the Solar Bonus Scheme which pays a premium tariff for some solar owners until 2028. The government also decided to expand the eligibility for the regional FiT from 5 kW to 30 kW to help small business take advantage of solar power.
https://www.dews.qld.gov.au/__data/assets/pdf_file/0005/939983/qps-response-outline.pdf

QldGov 2016b, *Queensland Government response to the Queensland Productivity Commission Solar Feed-in Pricing in Queensland Inquiry*, Queensland Government, Dec 2016
In response to the final QPC report {QPC 2016e} the government accepted many of the recommendations but decided that no change should be made to the arrangements for regulated minimum FiT for regional Queensland.
https://www.dews.qld.gov.au/__data/assets/pdf_file/0010/983710/qpc-fair-price-solar-response.pdf

QPC 2015a, *Terms of Reference, Queensland Productivity Commission, Public Inquiry into a Fair Price for Solar Exports*, Queensland Productivity Commission, 2015
The terms of reference are notable for the fact that a fair price "is to be determined based on an assessment of public and consumer benefits from solar generated electricity" rather than just benefit to retailers as has been the case to date in other jurisdictions. The terms of reference also acknowledge the state government's target for "one million rooftops or 3000MW of solar panels by 2020" and the potential contribution of battery storage at the household level to reducing peak demand.
http://www.qpc.qld.gov.au/files/uploads/2015/08/Terms-of-Reference-Fair-Solar-Price.pdf

QPC 2015b, *Issues Paper, Solar feed-in Pricing in Queensland*, Queensland Productivity Commission, 15 Oct 2015
Contains extensive background on the cost and impact of the (now closed) Solar Bonus Scheme and its 44c FiT. Contains a good discussion of reasons a FiT should be regulated and consideration of factors including fairness, neutrality and simplicity. Identifies 9 factors that might be taken into account in setting a FiT.
http://www.qpc.qld.gov.au/inquiries/solar-feed-in-pricing/

QPC 2016a, *Draft Report, Electricity Pricing Inquiry*, Queensland Productivity Commission, 3 Feb 2016
This comprehensive 314 page report provides a detailed analysis of the Queensland electricity industry. Of particular relevance to solar feed-in tariffs are the analysis of the Queensland government's election commitments of a 50% renewable electricity by 2030 target and one million solar rooftops by 2020. The draft report also contains an analysis of the Solar Bonus Scheme. The recommendation in the draft report that the government should consider an earlier end to the SBS than 2028 was promptly rejected by the state government.
http://www.qpc.qld.gov.au/inquiries/electricity-pricing/

QPC 2016b, *Draft Report: Fair price for solar pricing - Overview*, Queensland Productivity Commission, Mar 2016
Fact sheet summarising the draft report. See summary of Final Report {QPC 2016e}.
http://www.qpc.qld.gov.au/files/uploads/2016/03/Fact-Sheet-Solar-Draft-Report-Revised.pdf

QPC 2016c, *Draft Report: Solar Feed-in Pricing in Queensland*, Queensland Productivity Commission, Mar 2016
See summary of Final Report {QPC 2016e}.
http://www.qpc.qld.gov.au/files/uploads/2016/03/Solar-Draft-Report-FINAL.pdf

QPC 2016d, *Draft Report: Fair price for solar pricing - Your questions answered*, Queensland Productivity Commission, Mar 2016
FAQ on the draft report. See summary of Final Report {QPC 2016e}.
http://www.qpc.qld.gov.au/files/uploads/2016/03/Solar-FAQs-20160203.pdf

QPC 2016e, *Final Report: Solar Feed-in Pricing in Queensland*, Queensland Productivity Commission, Jun 2016
In summary the report recommended little change to the existing arrangement that there is no regulated minimum FiT for SE Queensland. Findings include that:
- Retail competition in SE Qld means that there is no case to mandate FiTs to address market power.
- In regional areas, Ergon Energy possesses significant market power, which provides a basis for some form of continued regulation.

Recommendations include that:
- No regulated minimum FiT be set for regional Qld but that retail offers be subject to approval by the QCA to ensure that they are "consistent with efficient pricing

principles". (but this recommendation was not accepted by the state government – see QldGov 2016b})
- The Queensland Government should not increase feed-in tariffs to pay solar investors for reducing carbon emissions. Investors already receive a subsidy from the SRES for emissions reduction.
- The Queensland Government should not increase feed-in tariffs to induce industry development, wholesale market and network infrastructure effects, or other social impacts.

http://www.qpc.qld.gov.au/files/uploads/2016/12/DOC16-2388-Solar-Final-Report-FINAL2.pdf

RMI 2013, *A Review of Solar PV Benefit & Cost Studies*, eLab, Rocky Mountain Institute, 2nd Edition, Sep 2013
"The objective of this e-Lab discussion document is to assess what is known and unknown about the categorization, methodological best practices, and gaps around the benefits and costs of distributed photovoltaics (DPV), and to begin to establish a clear foundation from which additional work on benefit/cost assessments and pricing structure development can be built."
http://www.rmi.org/elab_empower
summary of first edition at http://blog.rmi.org/blog_2013_07_22_devil_in_the_details

Saddler 2013, *Power Down: Why is electricity consumption decreasing?*, Hugh Saddler The Australia Institute Paper No 14, 18 Dec 2013
Analyses the reduction in electricity demand in the National Electricity Market between 2006 and 2013 and attempts to identify the factors leading to the reduction compared with the historical growth trend of the previous 20 years. The three largest factors are identified as the impact of (mainly regulatory) energy efficiency programs, structural change in the economy away from electricity intensive industries and the response of electricity consumers, especially residential consumers, to higher electricity prices. Solar pv make a relatively small contribution, accounting for only 7% of the demand reduction (p59).
http://www.tai.org.au/content/power-down

Sioshansi 2015a, *Distributed solar: evil drag on network or misunderstood blessing?* Fereidoon Sioshansi on 27 August 2015
References several recent US studies on the value of distributed solar pv. Taking into account financial, social and environmental benefits, the studies find that the value of distributed solar pv is greater than prevailing retail tariffs.
http://reneweconomy.com.au/2015/distributed-solar-evil-drag-on-network-or-misunderstood-blessing-99680

Sioshansi 2015b, *Solar pv: How to achieve net gain and no pain*, Fereidoon Sioshansi, 21 Sep 2015
Describes the boom in distributed solar pv and the results of studies on the value of exported solar energy. Discusses the challenges these pose for utility rate setting.
http://reneweconomy.com.au/2015/solar-pv-how-to-achieve-net-gain-and-no-pain-98782

SKM-MMA 2011,*Value of Generation from Small Scale Residential PV Systems*, Walter Gerardi and Hope Stevens SKM-MMA, 14 July 2011
Estimates the wholesale value of exported pv electricity by assessing the time and volume weighted wholesale value. This approach allows the value to be captured based on the time of generation (i.e. during the day, at typically higher than average prices) and the volume produced. Concludes that in NSW, the electricity produced by solar had a weighted wholesale value of 7.8c/kWh.
Referenced at:
http://apo.org.au/resource/value-generation-from-small-scale-residential-pv-systems

Solar Citizens 2015a, *Submission to Queensland Solar Feed-In Pricing Inquiry & Submission to Queensland Electricity Pricing Inquiry*, Solar Citizens, 23 Nov 2015
Response to the QPC Issues Paper based on a survey of Solar Citizens members.

SSTATA 2013a, *Feed-in tariffs for Tasmania, A joint submission in response to "Feed-in Tariffs: Transition to Full Retail Competition – Issues Paper"*, Save Solar Tasmania and Alternative Technology Association, *7 June 2013*
A response to the state government paper {TasGov 2013a}. Critiques a number of points in the Issues Paper and makes the case for greater support for distributed

generation in Tasmania. Provides detailed statistical analysis to refute the argument that the FiT is a cross subsidy from poorer to wealthier customers. Includes suggested changes to the terms of reference for Tasmanian Economic Regulator review to set a FiT to come into effect from January 2014.
http://www.solarcitizens.org.au/tas_docs
direct:
http://d3n8a8pro7vhmx.cloudfront.net/solarcitizens/pages/110/attachments/original/1381291445/2013-10-02-TER-SST-submission-v04.pdf?1381291445

SSTATA 2013b, *Fair feed-in tariffs for Tasmania, A joint submission in response to the Tasmanian Economic Regulator Draft Report of September 2013*, Save Solar Tasmania and Alternative Technology Association, 2 Oct 2013
Provides responses to specific questions raised in the draft report {OTTER 2013a}. Also makes a detailed case for consideration of location specific FiTs.
http://www.solarcitizens.org.au/tas_docs

TasGov 2013a, *Feed-in Tariffs: Transition to Full Retail Competition – Issues Paper*, Energy Reform Project, Tasmanian Government, May 2013
Sets out proposed arrangements to replace the 1:1 FiT offered by Aurora with a regulated FiT that would apply to all retailers, in preparation for the introduction of full retail competition. Counters various arguments in support of a premium FiT.
http://www.electricity.tas.gov.au/issues-paper-feed-in-tariffs-under-full-retail-competition/
http://www.premier.tas.gov.au/media_room/media_releases/public_consultation_on_feed_in_tariff

TasGov 2013b, *Supplementary Paper: Feed-in Tariffs under Full Retail Competition*, Energy Reform Project, Tasmanian Government, 3 Jun 2013
Additional examples of impact of feed-in tariff arrangements under different scenarios.
http://www.electricity.tas.gov.au/supplementary-paper-feed-in-tariffs-under-full-retail-competition/

TasGov 2013c, *Feed-in Tariffs: Transition to Full Retail Competition – Response to Consultation*, Energy Reform Project, Tasmanian Government, Aug 2013
Provides detailed responses to various points made in public submissions to the Issues Paper.

TasGov 2013d, *Feed-in Tariffs: Transition to Full Retail Competition – Final Position Paper,* Energy Reform Project, Tasmanian Government, Aug 2013
Final report following consultation process. The major change was the extension of the legacy tariff from 3 to 5 years. Sets out transition arrangements.
http://www.treasury.tas.gov.au/domino/dtf/dtf.nsf/LookupFiles/Feed-in-Tariffs-Transition-Full-Retail-Competition-Position-Paper.pdf/$file/Feed-in-Tariffs-Transition-Full-Retail-Competition-Position-Paper.pdf

TEC 2015, *What Price Solar?* Total Environment Centre, Oct 2015
Leaflet produced as part of the Green Electricity Guide project. Provides advice for solar owners on getting the best deal from retailers. Summarises detailed analysis which shows that in many cases solar owners can pay hundreds of dollar more a year than non-solar customers for purchasing the same amount of electricity from the same retailer.
http://greenelectricityguide.org.au/wp-content/uploads/2015/11/What-price-solar-factsheet-2015-V2.pdf

Than 2015, *Estimated social cost of climate change not accurate, Stanford scientists say*, Ker Than Stanford News, 12 Jan 2015
The "social cost" of carbon dioxide emissions may not be $37 per ton, as estimated by a recent U.S. government study, but $220 per ton.
http://news.stanford.edu/2015/01/12/emissions-social-costs-011215/ [accessed 30 Mar 2017]

TREA 2015b, *Initial Submission to OTTER: Regulated FiT investigation*, Tasmanian Renewable Energy Alliance, 18 Dec 2015
Argues that the Regulator should use a broad interpretation of its terms of reference and sets out benefits of distributed generation that should be taken into account in setting a FiT.
http://tasrenew.org.au/wp-content/uploads/2016/04/2015-12-18-Tas-FiT-submission.pdf

TREA 2016a, *Valuing Solar for Tasmania's Future: TREA Submission to the Office of the Tasmanian Economic Regulator in response to the Draft Investigation Report on the Regulated Feed-In Tariff Rate*, Tasmanian Renewable Energy Alliance, 15 March 2016
http://tasrenew.org.au/wp-content/uploads/2016/03/2016-03-15-TREA-FiT-submission.pdf

USEPA 2015, *The Social Cost of Carbon*, US EPA Fact Sheet, Dec 2015
Webpage describing the EPAs Social Cost of Carbon methodology.
"EPA and other federal agencies use the social cost of carbon ($SC\text{-}CO_2$) to estimate the climate benefits of rulemakings. The $SC\text{-}CO_2$ is an estimate of the economic damages associated with a small increase in carbon dioxide (CO_2) emissions, conventionally one metric ton, in a given year. This dollar figure also represents the value of damages avoided for a small emission reduction (i.e. the benefit of a CO_2 reduction)."
https://www3.epa.gov/climatechange/Downloads/EPAactivities/social-cost-carbon.pdf

VicGov nd, *Victorian Feed-in Tariff* (webpage), Victorian Government, no date
Official description of Victoria FiT arrangements, including closed schemes and future ESC processes.
http://delwp.vic.gov.au/energy/renewable-energy/victorian-feed-in-tariff (accessed 12 Mar 2017)

VicGov 2016, *Victorian Government Response to the Essential Services Commission's Energy Value Of Distributed Generation Final Report*, Victorian Government, Oct 2016
In response to the ESC's final report {ESC 2016c} the state government decided:
- to support a multi-rate FiT (but implementation was subsequently delayed until July 2018)
- that a location-based tariff would unduly complicate the FiT scheme
- that social and environmental benefits should be recognized as part of the FiT rate rather than via a 'deemed output tariff'

http://www.delwp.vic.gov.au/energy/electricity/victorian-feed-in-tariff/esc-enquiry-into-energy-value-of-distributed-generation

VicGov 2017a, Energy Legislation Amendment (Feed-in Tariffs and Improving Safety and Markets) Bill 2016, Victorian Government, 2017
The actual legislation as explained in {VicGov 2017b}
http://www.legislation.vic.gov.au/domino/Web_Notes/LDMS/PubPDocs.nsf/ee665e366dcb6cb0ca256da400837f6b/7957db34acd6995dca258057007ab675!OpenDocument

VicGov 2017b, *Energy Legislation Amendment (Feed-in Tariffs and Improving Safety and Markets) Bill 2016 Explanatory Memorandum*
"Subclause (4)(c) inserts new subsection (c) into section 40FBB(3) of the Electricity Industry Act 2000 to require the ESC, in determining a rate or rates for the purpose of substituted section 40FBA, to have regard to the avoided social cost of carbon and the avoided human health costs attributable to a reduction in air pollution."
The terms 'avoided social cost of carbon' and 'avoided human health costs attributable to a reduction in air pollution' are explained with examples.
The legislative changes also provide for FiT rates to be set by financial year rather than calendar year, and make provision for multi-rate FiTs to be set.
http://www.legislation.vic.gov.au/domino/Web_Notes/LDMS/PubPDocs.nsf/ee665e366dcb6cb0ca256da400837f6b/7957db34acd6995dca258057007ab675!OpenDocument

VicGov 2017c, *Order specifying a methodology and factors for the determination of the avoided social cost of carbon*, Victorian Government Gazette, 21 Feb 2017
An order by the Governor in Council setting out the methodology for calculating the 'avoided social cost of carbon' component of the Victorian feed-in tariff to operate from July 2017.
http://www.gazette.vic.gov.au/gazette/Gazettes2017/GG2017S036.pdf

Wood 2014, *Fair Pricing for Power*, Tony Wood & Lucy Carter Grattan Institute, Jul 2014
Argues that Australian electricity prices are unnecessarily high and are unfair because some users (in particular owners of air conditioners and solar pv) do not pay the cost their usage imposes on the network. Suggests that it would be fairer to introduce critical peak pricing for all domestic consumers and locational pricing for areas of network constraint. Discusses the practical problems of introducing these

changes including the cost of smart meters and the issues around customer education and political acceptability.
https://grattan.edu.au/report/fair-pricing-for-power/