Submission to Queensland Solar Feed-in Tariff Inquiry

November 2015

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1 Introduction

1.1 Document purpose and scope

This document is a submission to the Queensland Government's public inquiry into a fair price for solar exports.

The scope of this submission includes solar power that is produced at the home or business premises of a 'small customer' i.e. those consuming less than 100 MWh of electricity per year.

1.2 Background

The Queensland Government is considering opportunities to grow the renewable energy sector, in particular, the uptake of solar PV installation for both households and businesses. The Government has set a target for one million rooftops or 3,000MW of solar panels by 2020.

According to the Queensland Productivity Commission Solar Issues Paper there were 396,036 solar PV systems in Queensland as at 30 June 2015.

In order to reach the target of 1,000,000 rooftops by 2020 the uptake of solar PV needs to increase from around 4,000 systems per month at present, to at least 11,000 systems per month.

A fair price for solar exports is an essential element in increasing the rate of uptake of solar PV, thereby ensuring that the Government's targets are achieved.

1.3 Document terminology and acronyms

Term	**Acronym**
ATA	Alternative Technology Association - a not-for-profit organisation that enables, represents and inspires people to live sustainably in their homes and communities. The ATA publishes two market-leading sustainable living magazines, *Sanctuary: modern green homes* and *ReNew: technology for a sustainable future*. The magazines have a combined readership of over 120,000.
FiT	Feed-in Tariff
FOB	Free on board
GST	Goods and services tax
kWh	Kilowatt hour - a thousand watt hours
GWh	Gigawatt hour - a billion watt hours
MOE	Merit Order Effect Generation at or near the location of demand reduces the demand for electricity from the wholesale market. This in turn translates into downward pressure on wholesale electricity prices.
MWh	Megawatt hour – a million watt hours
NEM	National Electricity Market
PV / Solar PV	Photovoltaic – a technology that converts sunlight into electricity

2 A Framework for Assessing Solar Export Pricing

2.1 Is there evidence of significant and enduring market failures in the solar export market in Queensland?

In 2008 grid access charges were $75.07 (inc GST) per annum. In 2015 these charges have risen to $506.01 (inc GST) per annum. This is an increase of about 675%.

Year		Per Day (inc GST)	Per Year
2008	Service fee	$0.205658	$75.07
2015	Supply Charge	$1.280180	
	Solar Meter Service	$0.074360	
	Off Peak Meter Service	$0.031790	
		$1.386330	$506.01
	Percentage Increase		**674.09%**

During the period 2008 to 2015 there were also large increases in retail prices.

Year		per kWh (inc GST)
2008	Peak Electricity (T11)	$0.162910
2015	Peak Electricity (T11)	$0.244530
	Percentage Increase	**150.10%**

Year		per kWh (inc GST)
2008	Off Peak Electricity (T31)	$0.097790
2015	Off Peak Electricity (T31)	$0.136840
	Percentage Increase	**139.93%**

During the period of dramatic price rises, the price of coal[1] fell from a peak of $AU142.00 per tonne in January 2011 to $AU81.00 per tonne in September 2015 (FOB Newcastle/Port Kembla). It is presumed that the National Electricity Market would ensure that such price decreases would be passed to electricity consumers.

Market Failure – No Competition

Commercial entities subject to competition respond to a fall in revenue by cutting costs / increasing productivity and then using lower prices to attract more customers and/or increase sales volume.

Ergon and Energex are not subject to competition. Hence, they choose to act as a monopoly by increasing prices when revenues fell. When this fuelled a spectacular uptake in solar PV and efficient appliances the response was to again increase prices by far more than the inflation rate year after year.

It is counter-productive when any move by a consumer to contain their cost of living by being more efficient or self-reliant results in a price increase for other consumers.

If there was competition:

- Ergon and Energex would bury power lines in storm / cyclone areas to save maintenance costs.
- Ergon and Energex would not clear vegetation from the same power lines every summer.
- Customers would see Ergon and Energex investing in innovation e.g. customers should have the ability to read their meter and submit the results via an app or a web site and receive a discount on their electricity bill equivalent to the Solar and Off Peak Meter Service fees.

[1] http://www.indexmundi.com/commodities/?commodity=coal-australian&months=60&currency=aud

- Customers would see services being advertised that lower the cost of the grid by reducing peak loads e.g. the two controlled load tariffs.

None of the above happens.

Ergon and Energex are each a monopoly in their respective geographical areas, and economic theories about competition driving improvements do not apply to a monopoly. The prevailing economic theory seems to be "use less, pay more". Ergon and Energex have the market power to preserve business-as-usual unless forced to change by legislation. Commercial ownership of the grid or parts thereof will not change this fact.

Market Failure – Discriminatory Fee

In 2015, a new Meter Service Fee was introduced. It is worth noting that the Solar Meter Service fee is $0.07436 per day (inc GST) which is more than double the Off Peak Meter Service fee of $0.0317 per day (inc GST). It is discriminatory that it costs more than twice as much to "service" Solar given that all tariffs are measured by just one single smart meter.

This directly discourages uptake of solar, contrary to government direction.

Market Failure – Customer Churn

The retail price of electricity is regulated and includes the retailer's component. A form of "pseudo competition" occurs where a retailer might offer a limited time loss leader to encourage customers to swap. It is hardly competition when the cost of the loss leader (called marketing) is built into the cyclic determination of the regulated retail price. It is difficult to see what value is added by electricity retailers operating in Queensland.

Market Failure – Discriminatory Offer

AGL offers a number of discounted electricity plans in order to attract customers. The fine print states that such plans are not available to solar owners. AGL goes on to state that the prerequisite for buying green power is to be signed up for one of the discounted electricity plans. As a result, if a solar owner wishes to source renewable energy during times of low solar generation e.g. at night or on a cloudy day, via the grid, they cannot purchase green power from AGL.

This also stymies a steady source of investment in renewable energy via electricity bills and directly discourages uptake of solar, contrary to government direction.

Market Failure - Market Exclusion

The National Electricity Market prevents benefits from being realised because 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.

This directly discourages uptake of solar, contrary to government direction.

Summary

Solar owners export electricity to a market riddled by market failures and dominated by monopolies that are used to having their own way, that see energy efficiency and/or solar as a threat to their revenue, to be stopped or discriminated against. The monopolies themselves are owned by the Queensland Government which gains massive profits from the status quo, an obvious conflict-of-interest.

The electricity industry's game plan has been to undermine the solar business case by increasing network costs and lowering feed-in tariffs. The next step is to introduce Demand Based Tariffs that lower the volume price of electricity during daylight hours while ambushing disadvantaged customers who cannot avoid peak electricity usage at night.

It is anticipated that the price of storage will fall dramatically as early as 2016. A blocking manoeuvre aimed at disabling the uptake of cheap energy storage has already been floated by the electricity industry. This includes:

- Increasing the speed of depreciation which will markedly increase network costs.

- Introducing exit fees to discourage or prevent any exodus from the grid.
- Continuing to charge consumers even after their connection to the grid is terminated.

Refer Attachment 1 - Energy Network Association – Future Network Cost Recovery and Depreciation – Regulatory and policy options – August 2015 – page 9.

This does not constitute a fair market. In fact it directly discourages uptake of solar, contrary to government direction.

2.2 Where market failures are present, how are they best addressed?

In order to consider what needs to change there needs to be a vision for the electricity industry spanning the next twenty years. For example:

> In the near future many households and businesses will meet much of their energy needs from onsite renewable generation and storage including charging electric vehicles. Any surplus will be exported to the grid. The grid will act as a backup when the sun is not shining by transmitting other sources of renewable energy to consumers. Numerous micro-grids will use local generation and storage coupled with greater use of load control to smooth peaks in demand and increase reliability.
>
> The grid remains central to energy distribution because any grid exodus would be a waste of solar panels and storage. The grid will be entirely neutral to the generation technology of the day.

The vision must address the conflict-of-interest caused by Government ownership of Utilities versus the Government in the role of regulator.

It is time to consider a radical overhaul of the Queensland electricity industry to take advantage of, rather than block, renewable energy generation, energy storage and other innovations.

The vested interests have shown their hand by discriminatory pricing and reactionary policies to solar and are resisting any change to their business-as-usual. A blocking manoeuvre aimed at disabling the uptake of cheap energy storage has already been floated.

It is recommended that the overhaul of the electricity industry be undertaken by an **independent** party external to both the Queensland Government and the Queensland electricity industry, with the powers of a **Commission of Inquiry**.

2.3 Do solar PV exports produce positive environmental and social impacts that are currently not paid for through existing programs and rebates?

Refer to Section 6.3 for positive environmental and social impacts produced by solar / renewable energy exports.

2.4 If so, is the investment in solar PV suboptimal (from a societal point of view)?

It is obvious that renewable energy including solar PV should be given strong encouragement whether through FiTs or other mechanisms because it has **by far the least adverse impacts** on human health and the environment.

Refer to Section 6.3 for positive environmental and social impacts produced by solar / renewable energy exports.

2.5 Would a regulated solar feed-in tariff be an effective and efficient tool to address environmental externalities?

The author is unable to research this topic in the time available for lodging a submission to the Inquiry.

The Queensland Productivity Commission should research how electricity markets outside Australia address environmental externalities and include options in the second round of consultation.

2.6 What are the objectives of a solar export pricing policy?

The Government is focused on two themes with respect to solar PV:

- **Encouraging solar investment.** *Solar industry development and job creation and improved environmental outcomes* are natural consequences of encouraging solar investment.
- **Lowering electricity prices**. Solar generated electricity is already cheaper than electricity sourced from the grid and solar PV prices continue to fall as mass production ramps up.

It is difficult to call the above "objectives" as there is no mention of a quantity or timeframe. However the government has related solar targets for 2020 and renewable energy targets for 2030 which may suffice.

It is unrealistic to expect a solar export pricing policy to solve all of the electricity market failures on its own. This document lists several market failures that can only be solved by legislation.

2.7 What objectives are in conflict, which objectives take priority and why?

There is no tension between the two themes outlined in the previous section.

The challenge for the Queensland Productivity Commission is to come to grips with the prevailing economic theory which seems to be "use less, pay more". This theory is endemic in Government Owned Corporations that are a natural monopoly and this goes beyond the electricity industry.

When demand falls, increasing prices will create a death spiral for any organisation. For a monopoly, all it needs is a disruptive technology to come along. For the electricity industry, solar PV was the first disruptive technology in more than 40 years. The next disruptive technology is cheap storage which is expected to arrive as early as 2016.

It is **incorrect** to say that a disruptive technology, in this case solar PV, imposed unreasonable price rises on customers; particularly vulnerable customers. Instead, management within the monopoly and regulatory incompetence failed to respond to an **entirely foreseeable** fall in demand by being more efficient. The Queensland Government as owner is complicit. Management and regulatory incompetence is being **incorrectly portrayed** as an equity issue.

The sentence *"For example, if supporting solar power job creation increases employment in the solar energy sector, but this is achieved by shifting employment from other sectors and leaves aggregate employment unchanged, the Queensland community is no better off"* (refer to page 9 of the Issues Paper) has an unstated assumption *"all things being equal"* that cannot go unchallenged. In fact, all things are not equal. The community is **clearly better off** when the sector with falling employment has a limited life. In such circumstances surely a solar job is better than being unemployed.

2.8 What principles should be used to guide solar export pricing policy and any regulation of feed-in tariffs?

The following principles are proposed to guide solar export pricing:

- To address market failure – where the Queensland energy market cannot capture, or is actively preventing the realisation of the benefits that solar generation can provide to all electricity consumers.
- To require **no subsidy**.
- To support innovation and ongoing development of the solar industry.

Needless to say, subsidies take funds away from vital services such as health and education. This ultimately hurts everybody but even more so, low income or disadvantaged members of the community.

Every year the coal industry receives billions of dollars in subsidies from State and Commonwealth Governments with no end in sight to the generosity. These subsidies are funded from the taxes everybody pays. Refer Attachment 2 – The Australia Institute - Outclassed - How Queensland's schools and social services are affected by mining industry assistance and lobbying – June 2015.

If a *"no subsidy"* principle is adopted then it must apply across the entire electricity industry in Queensland. It would be a **market distortion** to continue to subsidise the coal or water used in power stations while preventing solar PV / renewable energy from being similarly subsidised. This would discourage uptake of solar, contrary to government direction.

It is worth noting that the Solar Bonus Scheme has been incorrectly portrayed as a subsidy. However, the Scheme is able to be **fully funded from its cashable benefits – not a subsidy**. Refer to Section 6.1 for the rationale. That said, participants in the Solar Bonus Scheme are decreasing (from 265,000 as at June 2015) by about 12,000 per year. The Scheme is legislated to come to an end in 2028.

2.9 How should fairness be defined?

A fair solar feed-in tariff (FiT)…	**Rationale**
…**must** ensure the efficient use of energy.	The Solar Bonus Scheme FiT of $0.44 is greater than the retail electricity price $0.24453 (inc. GST). This entices load shifting from the day time when solar output is high into the night time peak. This is not efficient use of energy. If the FiT (Gross or Net) is less than the retail price of electricity there is no incentive to load shift into the night time peak.
…**should** avoid the need for replacement or reconfiguration of electricity meters and/or associated re-wiring.	A decision was made in 2009 to introduce a Net FiT. Since then about 400,000 solar PV systems have been installed in Queensland. Retrofitting a different method of calculating the FiT would result in rework which may be of the order of $1,000 per customer. That said, the introduction of a Gross FiT may still be advantageous for reasons related to transparency or for businesses or unit blocks that install solar, albeit at a different rate. If implemented, transition to the Gross FiT should be optional for pre-existing installations.
….**should** be transparent and simple for the consumer to both manage energy and verify return on investment.	A Gross FiT is the ideal in transparency and simplicity for the consumer to both manage energy and verify return on investment. A Net FiT is inherently **less transparent** and **more complex** because only a portion of the energy used or generated during the day is recorded by the electricity meter i.e. net import and net export. The amount and value of unmeasured energy is unpredictable as it reflects the individual's usage pattern. Refer to Appendix A for a cost model that calculates Gross and Net FiTs for a variety of solar PV systems, assuming a breakeven timeframe of 10 years. The Net FiT needed to breakeven varies between $0.13 per kWh and $0.23 per kWh. The wide range of Net FiTs demonstrates the lack of transparency and complexity as well as the inherent bias of a Net FiT. A consumer is faced with the difficulty of guessing their electricity usage, electricity prices, and grid related charges for 10 years ahead in order to determine if it is feasible to breakeven.
...**should not** be used as a policy lever to achieve energy related equity objectives.	A Net FiT is inherently biased towards premises that are occupied during the day e.g. retirees, social security recipients, people who work from home, businesses to name a few. It is inherently biased against premises that are left vacant during the day e.g. people who commute to work. The assumption seems to have been in 2009 that if premises are occupied during the day then the occupants are in some way disadvantaged. Even if there was evidence to support the assumption, the many people who can't afford solar generation or who rent, are overlooked and as a result, get **NO** relief for their electricity bills. If the original intent of the Net FiT was to assist disadvantaged people, it is clearly poorly targeted when compared with, for example, the government providing a means-tested concession. In addition it is difficult, if not impossible, to use solar to reduce cost of living in the following situations: ➢ Lessees as tenants don't control the premises. ➢ Owners / lessees of premises with poor rooftop orientation and/or extensive shading. The government should use policy levers other than a FiT to remedy such situations (e.g. means-tested concessions, legislation, and incentives for landlords).
…**should** reflect: ➢ fair value for exported electricity; and ➢ fair value for community benefits.	The Utilities should pay for exported electricity as they are the direct beneficiary in terms of smoothing grid peaks and on-selling to customers. The Queensland Government should cover the value of community benefits.

3 Feed-in Tariffs: What should be regulated and how

3.1 What are the costs and benefits of exported solar electricity?

Refer to Section 5 for a methodology for setting a FiT.

Refer to Section 6 for benefits of solar PV / renewable energy.

3.2 Who incurs the costs and accrues the benefits from exported solar electricity? How will future market developments impact on costs and benefits?

Refer to Section 5 for a methodology for setting a FiT.

Refer to Section 6 for benefits of solar PV / renewable energy.

3.3 Where there is a case to regulate feed-in tariffs, is the existing approach to pricing solar exports appropriate? If not, what alternative approach would be the most effective and efficient way to price solar exports?

Refer to Section 5 for a methodology for setting a FiT.

3.4 How should the price be structured and paid? Should feed-in tariffs account for variations in value due to location and time?

Refer to Section 5 for a methodology for setting a FiT.

The Issues Paper identifies pros and cons of Gross FiT versus Net FiT. The Gross FiT has several advantages - the first two advantages below are not listed in the Issues Paper:

- It may assist owners or renters of premises with a group title e.g. units, office blocks, shopping centres to have solar PV installed in a body corporate controlled area and then share the income from the sale of exported energy equally among the occupants. This is problematic under a Net FiT.
- A Gross FiT may simplify the inclusion of the Merit Order Effect in calculating the FiT. The Merit Order Effect 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 means that a solar PV customer would pay their full share of network costs because they would be charged for all of their consumption the same as other non-PV customers. The network cost increases must be unwound in conjunction with the introduction of a Gross FiT.
- It is simple for a solar PV customer to both manage energy and verify return on investment.

In order to materially lower electricity prices, it would seem necessary to mandate a Gross FiT for all solar PV customers including participants in the Solar Bonus Scheme. It is expected that funds would be set aside to cover the cost of reconfiguring meters and wiring changes for existing customers, as well as some form of buy-back for Solar Bonus Scheme participants.

The Queensland Productivity Commission should provide a concrete proposal as part of the second round of consultation that includes a firm price for a Gross FiT, and shows what effect it would have on the network and volume prices.

The Issues Paper proposes that as gross energy is largely dependent on the size of the inverter and panels, a payment by size of the inverter could be considered in lieu of a KWh measure.

The Queensland Productivity Commission should provide a concrete proposal as part of the second round of consultation that includes firm prices for typical inverter sizes, whether payments would be in arrears or in advance, the payment timing e.g. quarterly or annually in June. There may be some merit if the concept includes abandoning the Solar Service Fee - as no meter reading is required to determine the payment.

3.5 Would market, regulatory or policy changes be required to implement feed-in tariffs? If so, what changes would be required?

The Queensland Productivity Commission is in the best position to identify the appropriate mechanism to address the market failures outlined in this document.

The benefits of solar extend beyond the network. There are high value cashable benefits across the economy that could be fed into a central fund to cover specific policy costs such as incentives, regular reviews of the FiT, and change costs e.g. meter reconfiguration if a Gross Fit is adopted. This would remove any need to charge electricity consumers for solar PV policy costs.

This is **NOT** to say that all of the benefits of solar should flow back to solar owners. It is expected that there would be a substantial surplus of harvested benefits over costs which should be used to benefit the wider community.

3.6 When should the FiT be reviewed or updated?

The FiT requires periodic review in response to **material** changes in the electricity market. Criteria or materiality thresholds would need to be developed.

Triggers for a review may include but are not limited to:

- Variation in grid charges - electricity meter or access.
- Variation in electricity prices.
- Variation in the price of solar PV systems.
- Significant uptake of energy storage.
- Falling behind on the governments solar targets for 2020.
- Changes to the tax treatment of solar / energy storage.
- Introduction of a Demand Based Tariff.
- Introduction of an Emissions Trading Scheme.

There are significant changes to the electricity industry in the pipeline so an annual review would seem appropriate, at least until 2020.

3.7 How should the FiT be reviewed or updated?

It is recommended that the FiT be reviewed using an established methodology that is publicly available. This is the approach used in Tasmania. Solar owners must have an opportunity to provide feedback on both the methodology and any new FiT.

A level of stability is need in the value of the FiT. A FiT that varies wildly at each review would discourage the uptake of solar by lowering the probability that breakeven on the initial investment could be achieved. As a result the achievement of the Governments' solar targets for 2020 and renewable energy target for 2030 would be put at risk.

4 Barriers to a Market for Solar Exports

4.1 What are the main barriers to pricing solar exports? How significant are these barriers ?

Further to the below COAG principle, an important reason to put in place a legislated minimum rate is the extreme imbalance in market power and information between owners of small solar systems and the other entities that make up the electricity industry.

> *"Governments agree that residential and small business consumers with small renewables (small renewable consumers) should have the right to export energy to the electricity grid and require market participants to provide payment for that export which is at least equal to 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 majority of electricity retailers now have some level of vertical integration – i.e. they own some degree of centralised generation assets that trade directly into the wholesale market.

As vertically integrated businesses, part of their vested interest is to ensure that the wholesale market trades as high as possible (with respect to price) to ensure that they get the best return for their generation assets as is possible.

As the evidence from 2009 now suggests, the prevalence of solar PV in the National Electricity Market is leading to demand reductions and a lowering of wholesale electricity prices. As such, the increasing prevalence of distributed generation such as solar is in direct conflict or competition with gen-tailers business models – and will ensure that as solar proliferates, gen-tailers will become increasingly resistant towards offering fair and reasonable FiT rates.

Therefore, a **regulated FiT is mandatory** for all owners of small solar systems i.e. not just those in regional Queensland.

4.2 How may broader market changes (e.g. metering) impact barriers?

Demand based tariffs, discriminatory metering fees, and shifting costs from the volume charge to the daily access charge all discourage uptake of solar PV. Coupled with a low FiT, installations of solar PV have plummeted during the past year.

That said, all of the above provides almost perfect encouragement for hybrid solar i.e. solar plus storage. Given the sentiment in the solar community at the way it has been treated, some level of grid exodus would not be surprising.

It is important to note that shifting costs from the volume charge to the daily access charge also discourages other forms of energy efficiency e.g. solar hot water, efficient lighting and appliances to name a few.

4.3 Can these barriers be overcome in an effective and efficient way?

The demand based tariff consultation that is underway would need to be abandoned. Discriminatory metering fees and shifting costs from the volume charge to the daily access charge would need to be unwound.

4.4 Are there other barriers to a well-functioning solar export market?

Bipartisan support is essential for continued investment in solar PV beyond the election cycle. A boom-bust cycle is bad for any industry. It results in unemployment, consumers ripped off by shonky operators, unsafe work practices, all of which have electoral consequences.

4.5 Are there examples where efficient investments in solar did not proceed because of technical, market or regulatory barriers?

Regulated limits on the initial capacity of a solar installation (or expansion) are both anticompetitive and constrain efficient investment in solar PV systems because the cost per watt is more favourable as system size increases.

The only constraints on initial system capacity (or expansion) should be the available surface area and the owner's funds.

AGL offers a number of discounted electricity plans in order to attract customers. The fine print states that such plans are not available to solar owners. AGL goes on to state that the prerequisite for buying green power is to be signed up for one of the discounted electricity plans. This stymies a steady source of investment in renewable energy capacity via electricity bills.

Both of the above directly discourage uptake of solar, contrary to government direction.

4.6 Are there cost-effective ways to remove or address those barriers?

Replace the constraints on maximum capacity imposed by the grid with a mandatory requirement to inform the grid owner prior to initial installation or capacity expansion. The grid owner should have no right of veto for small customers.

The Queensland Government must amend the state's Electricity Industry Act and other legislation to forbid all participants in the electricity industry from placing restrictions on customers who have rooftop solar or other renewable energy generation from taking up an offer available to other customers and/or engaging in discriminatory pricing against such customers. The penalties for such behaviour should be **severe**.

There should still be flexibility to make electricity sale offers that are specific to solar or renewable households, but not the power to exclude them from the offers made to other customers.

5 Methodology for Setting a FiT

The below is sourced from a submission by the Alternative Technology Association (ATA) to the Queensland Competition Authority in September 2012. The full submission is included as Attachment 3.

5.1 Value stack approach

…. ATA suggest that fair and reasonable value for solar and other distributed generation technology be based on a value stack – i.e. the components of value that distributed generation offer to the market.

A number of energy market economists recognise that net exported energy from solar has an inherent value within the energy market. As an example, SKM MMA in a recent report[2] attribute the following value components to solar generation:

> *- "Energy value, comprising the value that the net exports would earn if it was traded on the wholesale market or if the equivalent amount of electricity had to be purchased from the wholesale market. This value comprises not only the spot value on the wholesale market but, at low levels of installation within a region, the avoided losses from central supply sources and any costs incurred by retailers in contracting for wholesale energy.*
>
> *- "Network savings mainly in the form of deferred investment in fixed cost assets. The magnitude of this value depends on the correlation between PV generation and peak demand at the regional level.*
>
> *- "Ancillary savings, such as avoided market fees."*

SKM MMA go on to state that:

> *"Other benefits are also possible such as a reduction in the wholesale price to other customers during peak periods, reduced network losses faced by customers in regions with a high level of uptake, and environmental benefits through reduced emissions and reduced water use."*

Given that typically solar PV generation and residential load curves are not aligned, ATA do not believe that the deferral of distribution network assets represents sufficient value to warrant recognition within a FiT rate.

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 do contend that the energy value, avoided distribution and transmission losses and avoided market fees, as described by the SKM MMA analysis, are absolutes economic values that are delivered by solar PV generation and should be remunerated through any FiT arrangement.

ATA also contend that the reduction in the wholesale price to other customers during peak periods – known as the merit order effect – is a material economic benefit that is delivered by distributed solar.

In line with the above, a 'value stack' can then be developed upon which the design of ongoing FiT arrangements in Queensland should be based:

c/kWh	Wholesale energy value
	Avoided distribution and transmission losses
	Avoided market fees
	Reduction in wholesale prices – "Merit Order Effect'

In recognising this value stack, the question then becomes, by what methodology to quantify the value of each of these benefits, and to ensure that part of their value is returned to all electricity consumers in the form of lower retail prices.

[2] SKM MMA, 2011. 'Value of Generation from Small Scale Residential PV Systems'. A Report to the Clean Energy Council, Melbourne.

Wholesale Energy Value

The approach taken by Queensland Competition Authority for the calculation of wholesale energy value in their retail electricity price determinations has more recently been a market-based approach including hedging costs. This approach has merit in reflecting the value of energy purchase costs by retailers and ATA agrees that it is an appropriate method for calculating the value of wholesale energy.

ATA is also comfortable with the methodology put forward by a number of energy market economists in attributing wholesale energy value in the form of a regulated FiT – that is, broadly based on a volume weighted price of energy for Queensland, which based on a recent study[2] is expected to fall in the range of 8c to 10c/kWh.

Avoided Distribution and Transmission Losses

The value of avoided transmission and distribution losses also needs to take into account, and at the time at which net exports from a solar generator are taking place.

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.

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.

Avoided Market Fees

ATA is also comfortable with typical energy market estimates of the value of avoided market fees and costs. This generally represents a value less than 1c/kWh.

Reduction in Wholesale Prices – Merit Order Effect

Solar generation at or near the location of demand reduces the demand for electricity from the wholesale market. This in turn translates into downward pressure on wholesale electricity prices.

This effect is known as the 'merit-order effect' (MOE) and it results in a benefit for all electricity consumers through lower wholesale electricity prices.

The downward pressure on energy prices due to the MOE occurs through the following mechanisms:

- A reduction in the need to dispatch the next (more expensive) market generator which sets the price for wholesale energy traded on the spot market. This effect occurs immediately after each new Distributed Generation system starts to generate, the value of which is generally considered to slowly reduce in magnitude over the course of a number of years as market bidding behaviour is adjusted in response to the reduction in energy spot prices.
- The lowering of the value of price hedging instruments, and thus the retail cost of energy, in the medium to longer term. This comes in to effect as existing hedging arrangements expire and are renewed, typically over the course of three years following the installation of new system, and is also generally considered to slowly reduce in magnitude over the course of a number of years.

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.

Therefore, it is important to recognise, and furthermore remunerate, a value in recognition of the MOE that is provided by solar PV generators as a benefit to all other electricity consumers in the form of lower electricity prices.

Ignoring this benefit, on any basis, would be short-changing solar PV and other distributed generation owners, and therefore cannot be considered to be fair and reasonable.

Estimating the MOE for Solar PV Generation

While it may be difficult to confidently predict or accurately measure the value of the MOE in the longer term, the MOE caused by solar PV is generally agreed be of a material value – to the extent that concern over this materiality has previously been raised by coal fired generators[3].

Research (refer Attachment 4) by the Melbourne Energy Institute (MEI) at the University of has estimated the installation of solar PV above the current installation penetrations would have been worth, all other factors being equal, 'in excess of $1.8 billion over 2009 and 2010'. This amount represents potential savings to all consumers brought about by the effect solar PV has on the wholesale market.

Based on this wholesale market estimated saving of the $1.8 billion, 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.

After this time, the value of solar PV generation would continue to include the average volume weighted wholesale electricity price at the times of solar generation, as well as avoided network losses and market fees, as outlined above.

ATA suggest that for the purposes of estimating the value of the MOE over time, it would be appropriate that the MOE reduces linearly from 20c/kWh generated down to 0c over the course of 10 years.

Apportioning the Merit Order Effect

In light of the benefit that the solar PV provides to all electricity consumers through the MOE, ATA are of the view that it should be remunerated as part of FiT arrangements.

In keeping with the lessening of the effect with time, the remuneration in the FiT based on merit order value should apply a for fixed time period following the installation of each new system, after which FiT remuneration reverts to the value of the remaining energy market components identified earlier in this submission.

As noted earlier, the merit order effect is caused by all energy generated by a solar PV generator, regardless of whether it is exported by the generator or used on site. This also needs to be considered in the calculation of the MOE for a net feed in tariff.

ATA are of the view that at the household scale it is reasonable to assume that the value of the MOE for all energy generated be monetised via the FiT. For a net FiT, this requires the value of MOE for the portion of generation used on site (i.e. not exported) to be applied to the FiT for exported energy.

If we assume:

- an average system export rate of approximately 50%;

[3] During considerations of an expansion to the former Victorian Renewable Energy Target (VRET), brown coal generators expressed concern that a larger share of renewable energy, including distributed systems in the electricity market, would negatively impact their revenue due to downwards pressure on the wholesale price.

- a ten year merit order effect as described above; and
- 2012 value of money (i.e. non-discounted cash flows);

then ATA recommend that a value of:

- 20c/kWh be remunerated in any net FiT; or
- 10c/kWh be remunerated in any gross FiT;

for 10 years from the installation of each new system up to 5kW, after which time the system qualifies for a FiT simply based on the value of the remaining energy market components as identified earlier.

ATA's proposed methodology aims to achieve this sharing of benefits, the 20c/kWh value included in the FiT value stack below is the estimated value of the MOE for solar PV on the NEM.

ATA also believe this is an emerging area of understanding within the energy market, and through the course of this review, Queensland Productivity Commission should seek to work closely with those academic institutions and energy market consultants who have developed comprehensive modelling to analyse and assess the benefits of the MOE for solar PV.

<u>Completed Value Stack for Solar PV</u> (*bearing in mind that this is taken from the 2012 ATA submission*)

Taking into account all of the benefits of solar PV outlined above, the value stack under a net metering arrangement results in the remuneration values outlined below.

Wholesale energy value	8c to 10c per kWh
Avoided distribution and transmission losses	Needs calculation
Avoided market fees	0c to 1c per kWh
Reduction in wholesale prices – "Merit Order Effect'	20c per kWh for 10 years

This results in a minimum FiT payment of 29 cents per kWh for the first 10 years after installation, falling to 9c per kWh after that.

The above analysis represents a fair and reasonable value for solar PV payment, taking into account the economic benefits of solar PV and passing back to this form of generation some of the benefit that it produces in the wholesale electricity price for all consumers.

End of extract from a submission by the ATA to the Queensland Competition Authority in September 2012.

The above methodology for setting a solar FiT was provided by the ATA to the Queensland Competition Authority in 2012.

Since 2012 the Queensland Competition Authority's estimates of the regional Net FiT in Queensland are:

- 2013-14 of 7.553 per kWh made up as follows:

Wholesale energy value	6.858c per kWh
Avoided distribution and transmission losses	0.624c per kWh
Avoided market fees	0.070c per kWh

- 2014-15 of 6.534 per kWh made up as follows.

Wholesale energy value	5.575c per kWh
Avoided distribution and transmission losses	0.864c per kWh
Avoided market fees	0.095c per kWh

- 2015-16 of 6.348c per kWh made up as follows.

Wholesale energy value	5.570c per kWh
Avoided distribution and transmission losses	0.695c per kWh
Avoided market fees	0.083c per kWh

The Queensland Competition Authority continues to disregard the Merit Order Effect in setting the regional Net FiT. This directly discourages uptake of solar, contrary to government direction.

To reiterate:

- … it is important to recognise, and furthermore **remunerate**, a value in recognition of the MOE that is provided by solar PV generators as a benefit to all other electricity consumers in the form of lower electricity prices.
- Ignoring this benefit, on any basis, would be short-changing solar PV and other distributed generation owners, and therefore **cannot be considered to be fair and reasonable**.

As a general principle, solar customers are willing to pay their fair share of network costs as long as they also receive their fair share of benefits and are not discriminated against.

6 Solar / Renewable Energy Benefits

This section quantifies some of the benefits of solar / renewable energy using publicly available information.

The most significant benefit is avoiding the production of greenhouse gases. This is unable to be quantified without an emissions trading scheme being in place in Australia.

6.1 Water and coal savings fund the Solar Bonus Scheme

Coal fired power stations use copious quantities of water and coal to generate electricity at a significant cost. In contrast, solar PV uses only the sun to generate electricity which is free.

Starting in about 2008, increasing solar generation displaced coal fired generation. As a result, power station purchases of coal and water would have fallen and the value can be quantified.

It is presumed that the National Electricity Market would ensure that such decreases in power station operating costs would be passed to electricity consumers.

Water Savings

In December 2014 the Australia Institute published research entitled *"Solar energy in Australia: Health and environmental costs and benefits"*. The report is included as Attachment 5 to this submission. The report includes the reference *54 Environment Victoria. Coal and water use*[4] which is the source of water use statistics for a coal fired power station.

Water cost per gigalitre 2015	$2,681,000
* Gigalitres of water per gigawatt of generation	17
Solar generation as at 2015 GW	1.328
Gigalitres saved by solar per annum	23
Value of water savings per annum in 2015	**$60,526,256**
Solar generation target as at 2020 GW	3
Gigalitres saved by solar per annum	51
Value of water savings per annum in 2020	**$136,731,000**
Notes.	
This does not include water used in coal mining.	
* Closed cycle wet cooling, subcritical coal (eg Loy Yang A & B, Yallourn in Victoria)	

To put the 2020 water savings in perspective, Lake Wivenhoe has a capacity of 1,165 gigalitres, so 51 gigalitres represents 5.1% of the dam's capacity. This is a per annum water saving that continues to grow as solar generation increases and coal fired generation decreases.

The water saved is available for alternative higher value economic purposes such as farming and business for example, or delaying the onset of water restrictions in times of drought. Solar generation of electricity puts downward pressure on water prices and delays investment in expensive water infrastructure such as dams or desalination plants. This flows through the economy meaning cheaper food, housing, lower taxes to name a few.

The value of water freed for other economic purposes has not been considered in the FiT.

Note. It is a concern that the prevailing economic theory "use less, pay more" will result in water Utilities (all Government Owned Corporations) increasing water prices.

[4] http://environmentvictoria.org.au/index.php?q=content/coal-and-water-use#.U7UgScKKDZ4

Coal Savings

Coal cost per tonne in 2015	$82
Power station thermal efficiency	33.3%
Coal used to make 1 GWh (tonnes)	179
Coal use taking into account thermal efficiency	538
Solar installed as at 2015 GW	1.3280
Solar generation per day (ave 4.2 hours per day) GWh	5.5776
Solar generation per annum GWh	2,035.8240
Tonnes of coal not needed to be burnt per annum	1,095,075
Value of coal savings per annum in 2015	**$89,796,163**
Solar installed target as at 2020 GW	3.0000
Solar generation per day (ave 4.2 hours per day) GWh	12.6000
Solar generation per annum GWh	4,599.0000
Tonnes of coal not needed to be burnt per annum	2,473,814
Value of coal savings per annum in 2020	**$202,852,778**
Notes.	
Coal price is $AU82.00 per tonne FOB Port Kembla.	
5KW system gross yield is 21 kWh per day averaged over a year (suboptimal installation - shaded AM and PM, 10 degrees NE, flat on roof). This equates to 4.2 hours peak sun per day.	

This is a per annum saving that continues to grow as solar generation increases and coal fired generation decreases, that has not been considered in the FiT.

Conclusion

The total value of water and coal savings in 2015 is $150,000,000 per annum. This represents 46% of the annual cost of the Solar Bonus Scheme in 2015 ($324,000,000).

By 2020 the total value of water and coal savings rises to $339,000,000 per annum. This represents 135% of the projected annual cost of the Solar Bonus Scheme in 2020 ($252,000,000) assuming a further 60,000 or 22% of participants leave the Solar Bonus Scheme by 2020.

Without doing the mathematics, it is reasonable to speculate that by 2028 the accrued value of water and coal savings from 2010 to 2028 would **greatly exceed** the lifetime cost of the Solar Bonus Scheme.

The previous Queensland Government decided that grid owners would pay for the Solar Bonus Scheme. As a result, the full cost of the Solar Bonus Scheme was added to network costs and passed on to consumers. This decision was made without considering, or perhaps understanding, the benefits of solar and how those benefits could be cashed in to fund the Solar Bonus Scheme.

The point is the cost of the Solar Bonus Scheme is capable of being recouped by a small levy on the volume price offset by the value of water and coal savings that naturally feed into the National Electricity Market. The volume price to consumers would remain largely unchanged initially and fall noticeably when the breakeven point is reached, again without doing the mathematics, from about 2023 onwards.

6.2 Land use

	Number of Systems	Ave Size (KW)	Metres Squared Per KW	Area (Metres Squared)	Area (Hectares)
Installed (Jun 2015)	396,036	3.35	9	11,940,485	1,194
Target (2020)	1,000,000	3.35	9	30,150,000	**3,015**

FERNVALE LAND	**List Price**	**Block Size (Hectares)**	**Value Per Hectare**	**Land Value Covered by Solar**
Installed (Jun 2015)	$890,000	254	$3,504	$4,183,870.87
Target (2020)				**$10,564,370.08**

BRISBANE LAND	**Unimproved Capital Value**	**Block Size (Hectares)**	**Value Per Hectare**	**Land Value Covered by Solar**
Installed (Jun 2015)	$395,000	0.0984	$4,014,228	$4,793,182,655.49
Target (2020)				**$12,102,896,341.46**

Notes

Metres squared per killowatt assumes ZERO gap between panels.

5KW system uses 45 square metres of roof = 9 square metres per KW.

Unimproved capital value is for land in Stafford Heights

Assuming the 2020 targets are reached, the above shows that 3,015 hectares of land would be needed for 1,000,000 3.35 kW systems. A real estate agent's list price is used to estimate the cost of 3,015 hectares of land at Fernvale. The unimproved capital value of land is used to estimate the cost of 3,015 hectares of land at Stafford Heights in Brisbane.

Placing solar on rooftops will result in 3,015 hectares being kept free for alternative economic purposes such as farming, residential, business, water storage, national parks to name a few. To put this into perspective Lake Wivenhoe has a surface area of 1,094 hectares.

Land use may be a concern for large scale solar power plants but is not applicable to rooftop solar. Rooftop solar puts no pressure on land prices. This flows through the economy meaning cheaper food, housing to name a few.

The value of land freed for other economic purposes is not considered in the FiT.

6.3 Health and environment benefits

In December 2014 the Australia Institute published research entitled *"Solar energy in Australia: Health and environmental costs and benefits"*. The report is included as Attachment 5 to this submission.

The research examines in detail the life cycle impacts of solar versus fossil fuels on human health and the environment.

Below are extracts of key points made in the report. Refer to the report itself for more context and any associated references.

Page 13	*Most of the health concerns with solar energy relate to the production of the semiconductors used in PVs, which involves several potentially hazardous materials. Nearly all of these health risks affect overseas workers rather than the general population, except in cases where materials are incorrectly disposed of.* *The materials used and the hazards faced are often the same as those found in the microelectronics industry more generally. This means that there is considerable information regarding the health implications of PV manufacture. However, the interest in new materials and processes—particularly nanoparticles and technologies—has introduced some uncertainties.* *Despite remaining concerns, technological advances have been steadily improving the health impacts of solar. This is demonstrated in the difference between an earlier study estimating that producing solar power had "30 per cent higher health impacts than natural gas", while follow-on studies showed health impacts reduced to "about 0.1-0.2 cents per kWh [$1 - $2 per MWh], primarily caused by GHG, lead, and particulate matter emissions". Solar in Australia has elsewhere been estimated to have health impacts of approximately $5 per MWh, compared to gas at $19 per MWh*
Page 26	*It is obvious that the technologies currently providing the majority of Australia's energy needs place a considerable burden on human health. A review of the international evidence for coal's effects found that there "are clear indications …that there are serious health and social harms associated with coal mining and coal-fired power stations for people living in surrounding communities". While conventional gas is somewhat less impactful, the negative effects are also substantially higher than any renewable energy alternative. The impacts of extracting coal seam and shale gas using fracturing is beset with uncertainty, however there are several serious concerns.* ***Comparing the externalities generated by coal, gas and renewable energy, the Australian Academy of Technological Sciences and Engineering estimated costs of "$A19/MWh for natural gas, $A42/MWh for black coal and $A52/MWh for brown coal" compared to "$A5/MWh for solar photovoltaic electricity and $A1.50/MWh for wind power".*** *These figures are likely to underestimate the health impacts of solar that occur in the manufacturing stage, and do not include a consideration of the potential impacts of land and water use.* ***However, even if a true reflection of the externalities of solar requires a substantial increase in these figures, it is highly unlikely they would approach externalities of fossil fuels, which are estimated at four to ten times as high.*** *These figures are indicative of the substantial health benefits that would attend the replacement of coal and gas with the adoption of large-scale solar and wind technologies.*
Page 27	*The level of risk associated with toxic materials used in the production of materials for solar PV cells is largely determined by the degree to which best practice and environmental health and safety guidelines are adhered to.* ***As an importer of PV materials, Australia has a moral obligation to support efforts to improve conditions, and ensure its imports come from manufacturers that hold to such guidelines.***

The figures quoted, from page 26 of the attachment, may be interpreted as indicative costs that the health sector would need to recover for treating the human health impacts of each type of energy generation:

- $A1.50/MWh for wind power
- $A5/MWh for solar photovoltaic electricity
- $A19/MWh for natural gas
- $A42/MWh for black coal
- $A52/MWh for brown coal

The below extrapolates the health cost avoided via solar PV based on installations in 2015 and assuming the 2020 installation target is achieved.

	Health Cost per MWh
Black coal health costs	$42
Solar PV health cost	$5
Health cost avoided via solar PV	**$37**
Solar installed as at 2015 MW	1,328
Solar generation per day (ave 4.2 hours per day) MWh	5,578
Solar generation per annum GWh	2,035,824
Value of health cost avoided in 2015	**$75,325,488**
Solar installed target as at 2020 MW	3,000
Solar generation per day (ave 4.2 hours per day) MWh	12,600
Solar generation per annum MWh	4,599,000
Value of health cost avoided in 2020	**$170,163,000**
Notes.	
5KW system gross yield is 21 kWh per day averaged over a year (suboptimal installation - shaded AM and PM, 10 degrees NE, flat on roof). This equates to 4.2 hours peak sun per day.	

It is obvious that renewable energy including solar PV should be given strong encouragement whether via FiTs or other mechanisms because it has **by far the least adverse impacts** on human health and the environment.

The value of health and environmental benefits are not considered in the FiT.

7 Summary

Despite electricity market failure, 400,000 families in Queensland and a further 1,000,000 Australian families have voted with their hard earned cash to install solar PV.

The below tabulates the benefits identified in this document, which are only a small subset of the benefits of solar PV.

Per Annum	**2015**	**2020**		**Reference**
Merit Order Effect	?	**?**		
Value of water savings	$60,526,256	$136,731,000		Page 20
Value of coal savings	$89,796,163	$202,852,778		Page 21
Value of health cost avoided	$75,325,488	$170,163,000		Page 23
Total	**$225,647,907**	**$509,746,778**		
Once off				
Land use (Fenvale)	$4,183,871	$10,564,370		Page 22
OR				
Land use (Brisbane)	$4,793,182,655	$12,102,896,341		Page 22

One significant benefit not considered in this submission is the avoidance of greenhouse gas emission. This is unable to be quantified without some form of carbon price being put in place.

It is obvious that renewable energy including solar PV should be given strong encouragement in light of the benefits. A **fair** and **mandatory regulated FiT** is an essential element in increasing the rate of uptake of solar PV, thereby ensuring that the Government's targets are achieved.

In order to consider what further changes are needed, a vision for the electricity industry is required spanning the next twenty years. For example:

> In the near future many households and businesses will meet much of their energy needs from onsite renewable generation and storage including charging electric vehicles. Any surplus will be exported to the grid. The grid will act as a backup when the sun is not shining by transmitting other sources of renewable energy to consumers. Numerous micro-grids will use local generation and storage coupled with greater use of load control to smooth peaks in demand and increase reliability.
>
> The grid remains central to energy distribution because any grid exodus would be a waste of solar panels and storage. The grid will be entirely neutral to the generation technology of the day.

The vision must address the conflict-of-interest caused by Government ownership of Utilities versus the Government in the role of regulator.

It is time to consider a radical overhaul of the Queensland electricity industry to take advantage of, rather than block, renewable energy generation, energy storage and other innovations. Such an overhaul should be undertaken by an **independent** party external to both the Queensland Government and the Queensland electricity industry, with the powers of a **Commission of Inquiry**.

Appendix A – Solar Breakeven Net FiT Over 10 Years

Below is a **very simple** model for calculating a breakeven FiT for four different systems based on July 2015 prices taking into account three daytime electricity usage patterns and a **10** year breakeven timeframe.

The cost model is useful for making a decision to invest in solar at a point in time.

The cost model does not take into account price decreases e.g. solar systems and price increases e.g. electricity that occur in future years.

Recent statistics suggest that consumers are mainly purchasing 4kW and 5kW systems. However, the 2kW and 3kW systems are included as there are many rooftops with only a small area suitable for solar.

The daytime electricity usage patterns used in the cost model are:

Scenario	Daytime Electricity Usage Pattern
Scenario 1 - Premises is vacant during the day - only fridge running.	10% of electricity generated during the day is used for import avoidance and the rest (90%) is exported to the grid.
Scenario 2 - Premises is occupied during the day - two people, no air conditioner, gas stove, efficient.	25% of electricity generated during the day is used for import avoidance and the rest (75%) is exported to the grid.
Scenario 3 - Premises is occupied during the day - more than two people, air conditioner, electric stove, pool, bar fridge etc.	40% of electricity generated during the day is used for import avoidance and the rest (60%) is exported to the grid.

The following assumptions were made in calculating the breakeven point.

- Inflation is excluded to simplify calculations.
- An average 5% reduction in yield is allowed for suboptimal shade / tilt /orientation – systems are rarely installed on the perfect roof.
- An average 10% reduction in yield is allowed to cover the fall in electricity output from solar panels with age. They are typically warranted to produce at least 80% of the manufacturer's specification after 10 years.
- The electricity meter cost and solar related meter charges are included.
- The grid access charge is excluded. All premises bear this "fixed" cost regardless of solar being installed.
- Income tax implications depend on an individual's circumstances and are therefore excluded.
- GST is included in prices paid by solar owners.
- System information was sourced from a solar supplier's price list as at July 2015.

Breakeven timeframe (years)	**10**					
2015-16 Electricity Price (inc GST)	$0.24453					
SYSTEM SIZE (kW)		**4.93**	**4.06**	**3.19**	**2.03**	
Capital Cost						
Standard Price after STCs (inc GST)		$10,849	$8,764	$6,799	$5,397	
Electricity Meter		$366	$366	$366	$366	
Total (Capital Cost)		**$11,215**	**$9,130**	**$7,165**	**$5,763**	
Ongoing Cost						
Capital to recoup each year		$1,122	$913	$717	$576	
Solar meter charge (inc GST)	$0.074437	$27	$27	$27	$27	
Maintenance		$50	$50	$50	$50	
Total (Ongoing Cost)		**$1,199**	**$990**	**$794**	**$653**	
Electricity Generated						
Rated Yield (kWh/day)		8,012	6,599	5,183	3,300	
Subopt Shade / Tilt / Orientation	-5%	-401	-330	-259	-165	
Derating	-10%	-801	-660	-518	-330	
Realistic Yield (kWh/year)		6,810	5,609	4,406	2,805	
Breakeven Methods						
(A) via Gross Fit		**$0.17602**	**$0.17652**	**$0.18015**	**$0.23299**	
(B) via Import Avoided (% Realistic Yield)		**71.98%**	**72.19%**	**73.67%**	**95.28%**	
Import Avoided (kWh/day)		**13.43**	**11.09**	**8.89**	**7.32**	
Scenario 1 - Premises vacant during the day - only fridge running.						
Export (kWh/year)	90%	6,129	5,048	3,965	2,524	
Import Avoided (kWh/year)	10%	681	561	441	280	
Import Avoided Value		$167	$137	$108	$69	
Net FiT		**$0.16840**	**$0.16897**	**$0.17300**	**$0.23171**	
Scenario 2 - Premises occupied during the day - two people, no aircon, gas stove, efficient.						
Export (kWh/year)	75%	5,107	4,207	3,304	2,103	
Import Avoided (kWh/year)	25%	1,702	1,402	1,101	701	
Import Avoided Value		$416	$343	$269	$171	
Net FiT		**$0.15318**	**$0.15385**	**$0.15869**	**$0.22915**	
Scenario 3 - Premises occupied during the day - more than two people, aircon, electric stove, pool, bar fridge.						
Export (kWh/year)	60%	4,086	3,366	2,643	1,683	
Import Avoided (kWh/year)	40%	2,724	2,244	1,762	1,122	
Import Avoided Value		$666	$549	$431	$274	
Net FiT		**$0.13034**	**$0.13118**	**$0.13723**	**$0.22530**	

Observations

Just considering the 2 kW system (column 6):

- For scenario 1 (10% import avoided) a Net FiT of $0.232 per kWh is needed to breakeven.
- For scenario 2 (25% import avoided) a Net FiT of $0.229 per kWh is needed to breakeven.
- For scenario 3 (40% import avoided) a Net FiT of $0.225 per kWh is needed to breakeven.

The 2 kW system has by far the highest Net FiT needed to breakeven in 10 years. This is due to the price per watt being skewed i.e. inverter, meter, installation, and maintenance costs are a much greater percentage of the total cost of a 2 kW system.

Just considering scenario 2 (25% import avoided):

- For a 5 kW system a Net FiT of $0.153 per kWh is needed to breakeven.
- For a 4 kW system a Net FiT of $0.154 per kWh is needed to breakeven.
- For a 3 kW system a Net FiT of $0.159 per kWh is needed to breakeven.
- For a 2 kW system a Net FiT of $0.229 per kWh is needed to breakeven.

Currently electricity retailers offer a Net FiT of between $0.06 and $0.08 per kWh. This is insufficient to breakeven in 10 years.

Overall the Net FiT needed to breakeven in 10 years varies between $0.13 per kWh and $0.23 per kWh. The wide range of Net FiTs demonstrates the lack of transparency and complexity as well as the inherent bias of a Net FiT. A consumer is faced with the difficulty of guessing their electricity usage, electricity prices, and grid related charges for 10 years ahead in order to determine if it is feasible to breakeven.