Centre for Energy and Environmental Markets

The Australian PV Power Systems Consortium

Submission to the Government of South Australia

Discussion Paper on South Australia's Feed-in Mechanism for Residential Small-Scale Solar Photovoltaic Installations February 2007

Australian PVPS Consortium
and
CEEM UNSW

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Australian participation in the International Energy Agency Photovoltaic Power Systems (IEA PVPS) Program is funded and expedited through the Australian PVPS Consortium. The work of the IEA PVPS is arranged by Tasks, each with its own commitments of time and resources. At present Australia participates in:

- Task I – PV Information Exchange and Dissemination
- Task 8 – Very Large PV systems;
- Task 9 – PV Services for Developing Countries;
- Task 10 – Urban Scale PV Applications
- Task 11 – PV Hybrid Systems within Minigrids.

Current Consortium members: ANU, BCSE, BP Solar, Conergy, Dyesol, Greg Watt, GSES, IT Power, Novolta, Origin Energy, RES, RISE, SV, SA Government, UNSW.

The Consortium receives $35,000 per year from the Australian Greenhouse Office to assist with the costs of IEA PVPS membership and Task activities.

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The Centre for Energy and Environmental Markets

CEEM is an internal UNSW research centre which undertakes interdisciplinary research in the design, analysis and performance monitoring of energy and environmental markets and their associated policy frameworks. It brings together UNSW researchers from the Faculties of Engineering, Business, Science and Arts and Social Sciences, as well as the Institute for Environmental Studies and the Australian Graduate School of Management.

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Introduction

Before examining the SA Feed in Tariff (FiT) proposal, we briefly explore the nature of the FiT and market support in some of the IEA PVPS countries in which it has been applied.[1]

What is a FiT?

In the world of grid-connected photovoltaics (PV), the term FiT simply refers to an explicit monetary reward for producing PV electricity, at a rate per kWh somewhat higher than the retail electricity rates being paid by the customer – which is why the measure is often more correctly termed an enhanced FiT. In principle the measure encourages efficient production of PV electricity with the output from the PV system being monitored and recorded, and has consequently been promoted as the performance-based market support measure. As discussions about PV policy support mature, other performance-based measures are now also attracting some interest, such as expected performance-based buydowns and incentive hold-backs.

The FiT does not directly help with the problem of the large up-front costs associated with installing a PV system, unless the future cash flow projections help the customer to more easily secure some sort of financing. For some classes of potential PV users this remains a significant barrier.

Variations in implementation

There are two main variations of the FiT approach: in the first case, all the electricity produced by the PV system, irrespective of how much is used by the customer or fed into the grid, qualifies for the feed-in tariff. In the other situation, only the PV electricity that is surplus to the customer's requirements is paid under the feed-in tariff. The remainder has the same value to the customer as their retail electricity rate. The attractiveness to the customer of the FiT is further downplayed if net-billing is used and the grid import / PV export balance is calculated over an extended period of time.

The FiT becomes most attractive for all parties when time-of-use metering and pricing are employed, reflecting the real benefits to the electricity network of reducing customer demand or adding power to the system when it is most needed. From the electricity utility's perspective this may be either when bulk power is most expensive to purchase or in locations where supply is constrained, or both.

Typically, funds for the FiT are raised through a levy on electricity bills across the board, which has two main attractions: the scheme is not subjected to the usual budgetary whims associated with government funds, and, potentially, all electricity customers are contributing to improvements in their electricity supply system.

Setting an appropriate FiT level

There are a number of ways that the level of the FiT can be set. Simple financial calculations can indicate the cash flow required to provide a certain return on investment for a given PV customer in a particular location. Estimates of the value of externalities,

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[1] From the IEA-PVPS publication "PV Power", Issue 26. Available from www.iea-pvps.org.

such as the unfunded costs of pollution associated with traditional energy supply, can form the basis of the tariff. The specific electricity network benefits that may be relevant, such as peak demand reduction or line support, can be monetized. Or it may simply be decided that twice (or three times or so on) the retail electricity price sounds about right!

The target market

In isolation, the FiT is best targeted at entities with a business cash flow requirement such as housing developers, investors, commercial entities. If the FiT is combined with a direct capital subsidy, it also becomes appealing for customers with a limited access to capital such as households, small businesses and public organizations.

Countries using a FiT

FiT schemes are becoming more widespread and are showing a variety of outcomes. Amongst the IEA PVPS countries notable examples can be found in Austria, France, Germany, Italy, Korea, the Netherlands, Portugal and Spain. Detailed data on growth rates in various national markets can be found in the annually published report “Trends in photovoltaic applications”, available from www.iea-pvps.org. While a high tariff level has been shown to be capable of driving substantial market growth, some of the controlling conditions that have been placed on different countries’ schemes have resulted in difficulties in achieving such a result or sustaining high levels of investment. These controlling conditions have included caps on PV capacity allowed under the scheme, exclusion of certain types of projects such as BiPV or large-scale plants (or lack of appropriate differentiation of tariffs), inadequate period guaranteed for the FiT and overly complex administrative requirements. Even in Germany, where these problems have largely been avoided, the combination of a generous FiT and a year-by-year decrease in the tariff level has driven a huge demand very quickly, which has created its own challenges – sustaining the required level of investor interest may be difficult when system prices do not also fall steadily, and there would be some local political interest in seeing local industry meeting a greater proportion of the German demand for PV.

Alternative market support approaches

Notable amongst countries that have not yet pursued the FiT approach but which, in many cases, have still seen significant development of their grid-connected PV markets are Japan, the USA, Switzerland and Australia. In these countries the PV support mechanisms of choice have been direct capital subsidies, renewable portfolio standards, green electricity schemes or tax exemptions, or some combination of these. Generally, in these countries growth of the PV market is typically slower but steadier than in the countries using the FiT. Japan’s residential sector in particular is worth noting for the emergence of what may well be the world’s first unsupported grid-connected PV market.

Problems and solutions

A particular focus of policies that support deployment of technologies is to achieve a certain level of uptake. This is certainly not easy to predict – as demonstrated by the rush of investment in the early stages of MRET. Where a FiT is used, if the pool of potential investors is not adequately understood – their motivations, financial positions and so on – overheated markets can result initially if the tariffs are set too high. Set the tariffs too low and the investments could be negligible, consequently wasting the time and effort that has been invested in development of the scheme.

The most obvious solution is to set the initial tariff at the 'right' level – but this is easier said than done if the FiT is being used as a broad support mechanism. An advantage of a FiT over a scheme such as MRET is that it can be adjusted each year in response to changing circumstances and to help target a certain level of deployment. Within each year it is possible to use a system of price 'tiers' that reduce as certain levels of deployment are reached. This can also apply to individual systems using a tariff that decreases at higher levels of generation. This avoids the need for setting a potentially problematic cap on the size of the scheme, a source of considerable angst in some international cases.

It is also possible to clearly target the approach on specific, limited market segments, which can then be expanded over time.

Policy considerations

As with any proposed tool of public policy, a mechanism should be evaluated broadly against a number of criteria. In the case of a proposed FiT, the outcomes that have been achieved elsewhere are becoming easier to document. But are the local barriers to be addressed the same as those tackled elsewhere? Is the local electricity industry structure compatible with the approach? Will the scheme be flexible enough to survive political change? Can the scheme alone transform the market? How costly is the administrative burden compared to that of other approaches? Is the free-rider effect minimized? And what are the overall socio-economic-environmental impacts of the measure?

In summary, the simple answer to a complex problem can often raise many more questions – but they are always worth tackling in the long run.

The following box summarises the key design principles we consider necessary for a successful FiT for PV. These principles are derived from the international experiences cited above, and on experiences in Australia with renewable energy support mechanisms. With these principles in mind, we then discuss three issues raised in the Discussion Paper: the value of PV, whether the FiT should be on total PV generation or net export, and different Scheme proposals.

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Key Design Principles of a Photovoltaic Feed-in-Tariff

Timeframe:
In order to create market certainty, attract investment and deliver meaningful economic and environmental dividends:

- A FiT should guarantee payment to the system owner for a minimum of 15 years.
- The programme should run for minimum of 15 years, meaning the FiT is paid out over 30 years (systems installed in year 15 will still earn a FiT for the following 15 years).

Reducing tariffs:
The FiT should be fixed only for the systems installed in any one year and can be changed for the systems installed in successive years. A predetermined system of reducing FiT price “tiers” over the scheme timeframe can provide predictability for investors and a known expense for government. The FiT for installations in successive years could decrease by say 5% to capture and encourage cost reduction potential as the industry moves down the cost learning curve.

Payment on generation:
The FiT should be paid on all electricity generated by the system and should be independent of the standard electricity tariff. This simplifies calculation of future revenue streams and so provides investment certainty.

Source of subsidy money:
The revenue to pay for the FiT should be raised through an across-the-board levy on network providers so as to remove any issues of competition at the retail level. Retailers would subtract all or a proportion of the cost of exported generation from the customer’s bill and the network provider would make up the difference.

New installations only:
To maximise new deployment, and to facilitate the introduction of standard metering arrangements, the FiT should be provided to new and extended installations only, where the latter receive the FiT only for the extension. An interval meter with at least 2 channels should be used so as to enable metering of total generation.

Guaranteed connection and purchase:
Electricity retailers and network providers should guarantee that solar PV systems which comply with technical connection requirements imposed by Australian Standards and State or Territory regulators will be connected and all their generation purchased.

Grid-connection agreements:
The application and approval processes for connection of PV systems to the grid should be streamlined. Ideally the FiT arrangements should be incorporated directly into this process.

Monitoring:
Some form of monitoring/assessment program should be incorporated into any FiT program to:

- assess PV’s contribution to total generation and during times of peak demand,
- collect demographic energy information, and
- assess take-up rates, drivers, significant price points, customer preferences and any issues arising.

Discussion Points

Key aspects of the SA FiT proposal are discussed below, with reference to the principles outlined above and, where appropriate, using real PV data. It is noted that several of the proposed features of the SA FiT are inconsistent with the principles we have established, while others have not yet been sufficiently defined.

Notwithstanding the general principles of a good FiT, government support programmes are typically established to meet a specific set of aims. For renewable energy these might include development of a local industry with associated local employment, reduced greenhouse gas emissions, providing power in locations where other sources are difficult to deploy, assistance to disadvantaged communities, amelioration of network constraints or taking advantage of a good local resource base.

The SA Discussion Paper cites a number of reasons for the Government to introduce a Feed in Tariff in SA:

- Build on current grid market leadership.
- Contribute to the State's climate change strategy of 60% emissions reductions by 2050 and 20% renewables by 2014.
- Fill the gap in funding potentially created by the decline in REC value and the end of PVRP.
- Support home owners to take control of their energy needs and provide them with investment certainty.
- Support the local PV industry.
- Enhance security and diversity of the SA energy supply.

Hence SA expects an enhanced PV market to contribute very broadly, across a range of policy objectives. Some of these will be addressed in the discussion below.

Network Value of PV

One of the key issues raised in the Discussion Paper is the value which PV contributes to the electricity network and to system owners. In addressing this issue, we refer to analyses performed by CEEM using half hourly residential load and PV output data over the period July 2004 to June 2005 from 30 passive solar houses in Newington Village. These houses are fitted with 1 kWp PV systems, represent a broad range of load patterns and household composition and could be considered to represent a typical residential customer base. We would consider the current South Australian data set reported in the Discussion Paper to potentially be biased by larger than average PV systems and lower than average daytime household occupation. Proposed installations under the Adelaide Solar Cities programme target a wide demographic and will use standard 1 kWp systems.

In the Newington Solar Village, as in South Australia, we found little correlation between high NEM spot prices and high demand, nor between high NEM spot prices and PV output. Thus, in terms of generation, PV output can be valued at the average NEM spot price. PV output on the distribution network avoids both DUOS and TUOS charges, not just transmission charges as stated in the Discussion Paper. Thus, according to the values in the Discussion Paper's Appendix A, PV avoids approximately 86% of the retail cost (50% network charges and 36% generation costs).

Eligible Customers

PV's contribution to delaying augmentation of transmission/distribution infrastructure is proportional to the total installed. It is also dependent on the nature of the load profile. PV is better suited to offsetting commercial or similar load profiles that peak in the middle of the day. Thus, to maximise the network values of PV, it may be better to target specific areas of the network where commercial or other daytime loads dominate. FiTs are an ideal mechanism for a targeted rollout, as higher buy back rates can be used to encourage PV uptake by particular customer groups or in areas likely to be in need of grid augmentation within say 5 years.

Consideration should therefore be given to the offer of an appropriate PV FiT to commercial / agricultural electricity customers. These customers are more likely to install larger PV systems, which would thus contribute more towards reducing network peaks and to establishing a PV industry hub in SA. One of the key features of the success of the FiT in countries like Germany has been the ability to leverage large private sector finance through the commercial sector, with economies of scale also leading to PV price reductions. For instance, important agricultural sectors, such as the grape and wine industry in SA which is concerned about the impacts of climate change and has done a lot of work on its energy use, may find PV tariff incentives attractive. They have the roof space for larger systems and are already used to making longer term financial planning decisions.

The Western Australian government is currently funding a project that aims to analyse empirically the benefits of PV on particular substations and feeders, then develop policy accordingly. If network support is an important aim of the FiT, the South Australian FiT policy development process would be well served by equivalent analysis. Such analysis could be performed even after the FiT has been introduced – as long as the latter retains sufficient flexibility and so can be fine-tuned in light of study findings.

Tariff on total generation or net export

In our discussion below, net export is taken to mean net over a half hour period, not net over a billing period. It is not entirely clear which of these definitions the Discussion Paper uses. It should be noted that very few customers would benefit if it were the latter, providing no incentive other than for very large systems or very low loads.

There are both benefits and problems associated with a FiT based on net export, as proposed by SA. In the Discussion Paper, a SA FiT based on net export is considered to have the following advantages:

- technically simpler and easier to implement
- less expensive connection costs,
- faster to implement
- encourages the installation of larger systems
- encourages demand reduction by system owners during times of PV output.

However, if the FiT applies only to net export, the cost to the government, the financial benefit to system owners, and hence the amount of PV uptake are strongly influenced by both system size and the owner's load profile, making these estimations very difficult. It also discourages people who have high daytime loads from installing PV, making the use of PV to reduce the need for peak load infrastructure reliant on having low load sites on the same feeder/substation. It also disadvantages people on lower incomes because people who can afford larger systems benefit disproportionately – see Figures 1 & 2 below.

Although international experiences indicate that PV ownership can increase energy awareness and reduce demand, the Newington study indicated that residential midday loads are essentially baseload (such as refrigerators, security systems and appliance standby electricity use) and provide little opportunity for reduction.

If a net export FiT is chosen, very careful analysis of expected system sizes, loads and resultant export is required. The Discussion Paper cites a paper by Watt et al which indicates that 25% of total system output is returned to the grid[2]. The Discussion Paper also cites industry data indicating that about 50% of total generation in SA is exported, and subsequent calculations are based on the 50% export figure. For the Newington case study, just over 4% of the PV output was exported.

Using the Newington half-hourly data, it is possible to change the effective system size and residential load and calculate net export for each half hour period. The Sydney insolation profile is not dissimilar to that of Adelaide, and given that the Newington houses were passive solar designed, they should, if anything, have a lower daytime load than the average Adelaide house, thus increasing the net PV export.

Increasing the system size to 1.6kW (the current SA average) and reducing the annual load to 5000kWh/yr,[3] results in total generation of approximately 1,850 kWh and net export of 504 kWh (27%). Table 1 shows the financial outcome for the current arrangement in SA (net metering), payment on total generation and payment on net export assuming a 22c/kWh retail price and a 44c/kWh FiT, as proposed in the SA Discussion Paper.

Table 1: Financial returns: net metering, total generation & net export

	Net Metering	**Total Generation**	**Net Export**
22c/kWh	$405.51		$294.60
44c/kWh		$811.12	$221.81
Total			$516.41
Difference to current	**0**	**$405.61**	**$110.90**

Thus the Newington houses, with increased system size and decreased load, would earn an additional $110 per year on a net export FiT basis. If installed in the first year of the current 5 year proposal in the Discussion Paper, such systems would earn a total of about $550, about 14% of the current PVRP. A FiT based on total generation would provide an additional $2,025 over the life of a 5 year scheme, about 50% of PVRP. Systems installed in subsequent years would earn less, if our understanding of the 5 year scheme limit is correct.

Figure 1 shows how the percentage export is affected by both the system size and the household load (using the Newington house data). Even on low daily loads, 50% export is only achieved with comparatively large systems. Figure 2 shows how the financial outcome for different sized systems is affected by net metering, payment on total generation or payment on net export (assuming a 5000kWh/yr load, a 22c/kWh retail price

[2] Note that this number is from a paper by Pop, Watt, Rivier and Birch, presented at Solar 2005, Dunedin.

[3] The Newington systems were 1 kW and the average annual load was about 5,850 kWh.

and a 44c/kWh FiT). It can be seen that for a 1kW system the proposed FiT is little better than the current net metering arrangement. As expected, payment on gross generation doubles the financial return.

These issues are especially important as Adelaide sets up its Solar City program. Not only will the demographic of household types be wider than current uptake (this is the aim of the program), but houses in the Solar City will be offered only 1 kW standard PV systems and so most will not earn anything extra from the proposed net export FiT.

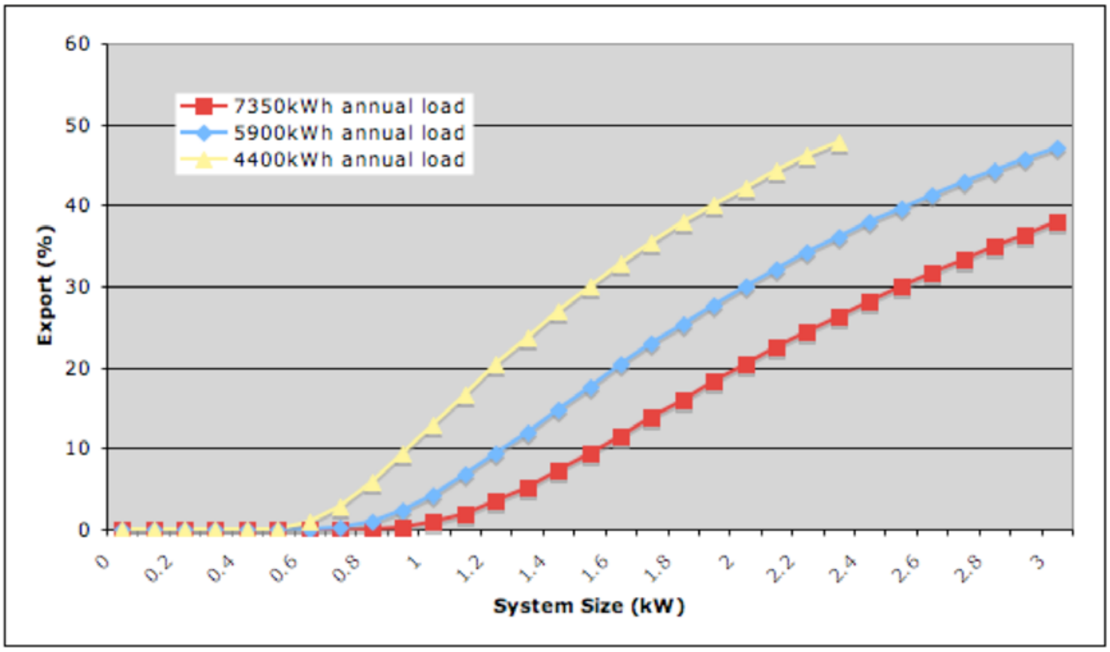

Figure 1 Percentage export vs system size and load

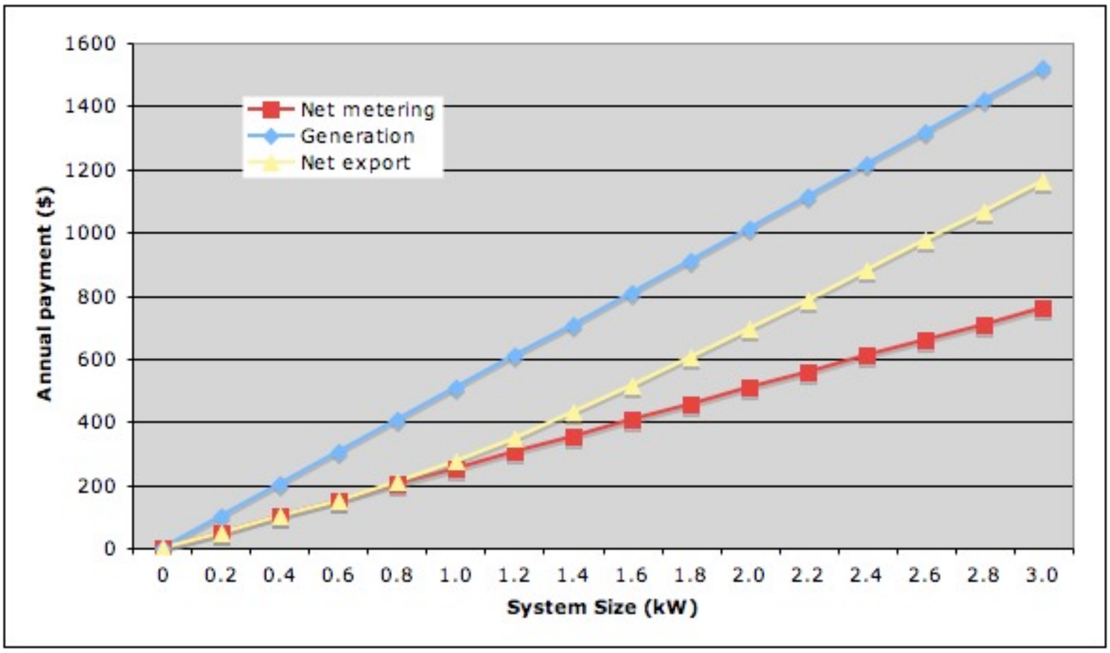

Figure 2 Financial outcome vs system size for different types of FiTs

Managing the Scheme

One of the main criticisms of Government support schemes is the problem created in industry by their 'stop-start' nature. This needs to be handled carefully if long term industry development is desired. Short term support programs destabilise and distort the market, creating problems for the industry at the start and at the end of the program. They impact on availability of trained personnel and product costs, as well as on timely installations and quality. Little impact could be expected on system price or on innovation, because of the rush to install.

Flexible reducing tariffs

Ideally, to ensure government control over both the cost of the scheme and the amount of deployment, the FiT should be fixed only for the systems installed in any one year and can be changed for the systems installed in successive years – preferably with a pre-determined declining tariff, but otherwise with, say, a year's notice of any change. This means the program would not need to be capped, but instead can respond to changes in the market.

All other things being equal, the FiT rate for installations in successive years should decrease by say 5% per annum to capture and encourage cost reduction potential as the industry moves down the cost learning curve. For example, systems installed in year 1 could receive 44c/kWh for the next 15 years (5 years in the current SA proposal) and systems installed in year two could receive 41.8c/kWh and so on. This provides certainty in the industry as well as a better managed scheme end. It is important that the rate does not drop too rapidly, otherwise market growth would be curtailed.

Program Caps

Care must be taken with the introduction of any system cap as a low cap can result in a rush to install, with the program cap reached within a few months, as has occurred in several other countries. If a cap is absolutely necessary, a system of "tiers" based on installed capacity could provide predictability for investors and a known expense for government. For example, the first 10 MW installed would earn $0.44/kWh, the next 10 MW $0.40/kWh etc. A similar tiered system could also be applied to individual systems, if the cost of the scheme needs to be capped – where annual export above a certain amount earns a lower tariff. As previously discussed, this would only need to be considered if a total generation scheme is introduced, or for very large systems installed under a net export scheme.

Timeframe

A 5 year FIT mechanism is too short a timeframe to provide the certainty that both industry and the market needs to confidently invest.

It is not clear from the Discussion Paper whether the proposal is based on a rolling 5 year scheme (consistent with other FiTs) or if it is only a 5 year scheme in total.

If it is the later, then it will create distortions and significantly reduce the incentive to invest in a solar PV system in the later years of the scheme (Years 3-5). A Year 5 investor would only receive FIT on net exported amounts for one year. A 5 year scheme would not provide any additional certainty on system payback for early entrants either, as the design proposed is on net generation. A 15 year period would provide an increased degree of comfort but only at the margin if a net generation proposal is adopted.

It is recommended that new PV system owners be offered a FiT for 15 years. If the scheme itself only operates for 5 years, this would mean FiTs would be available for a total period of 20 years. However, installation rates would only remain high for the initial 5 year period – too short a time frame for significant industry investment or development. With a 5% per annum declining tariff, as previously proposed, a scheme timeframe of 10 years would allow for a better managed phase-out.

Metering Issues

The paper appears to assume that all existing PV systems in SA have the same type of net import/export metering. In other States, metering types vary and digital meters have often been installed. One of the key arguments used against the introduction of a FiT on total generation in SA is that new metering would be required for existing systems. There are a number of aspects to consider:

- If the aims of the program are as stated above, there is no justification to apply a FiT to existing PV systems. Hence the meter replacement argument would be invalid.
- For new PV system installers, the Discussion Paper assumes that a new 2nd meter will be required in any case, because current accumulation meters are not adequate to record exports. Under this situation, the additional cost of installing a 2 channel digital (or ‘smart’) meter which can record import and export separately will be marginal.
- COAG has already agreed to the roll-out of smart meters, even though SA considers the benefits do not currently outweigh the costs (despite the Discussion Paper noting that SA has one of the world’s most peaky load patterns). In the longer term, digital meters will therefore be required anyway and, if PV system owners already have appropriate meters, no replacements will be necessary, costs will be saved, time of day price signals will be able to be introduced more rapidly and PV system owners will be able to benefit immediately.

Scheme implementation proposals

The Discussion Paper canvasses different proposals for implementing a FiT in SA. The following discusses these options, assuming the FiT is applied to net export only, as currently proposed.

The retailer-based proposal is the least desirable of those proposed. It discourages retailers to take up the scheme because their contestable customers bear the costs, seems to ignore the benefits to network providers, requires calculation of the reduced wholesale costs and line losses, and the various proposed 'equalising measures' would increase administration costs.

Although the distributor-based proposal ignores PV's benefits to retailers, as discussed above, these are likely to be minimal anyway. However, reduction of the Distribution Loss Factor (DLF) for retailers effectively means the retailer is getting the electricity for free.

The following variation on the combined Retailer/Distributor proposal is, in our opinion, the best option. The Distributor could recover the cost of the scheme from consumers through modified regulated distribution tariffs. Initially this could occur through a 'Regulated Pass Through' then through the 2010 Electricity Distribution Price Review. As for the retailer-based scheme, retailers would be required to net meter all electricity including net export as part of their licence conditions. Using the import/export meter arrangement described in the Discussion Paper, this would be achieved by the retailer subtracting the net export meter reading from the import meter, and so in effect paying net metering for all generation. The Distributor would then pay the additional 22c FiT only on the export meter reading, bringing the total payment to 44c for net export. There should be little administrative burden once this is automated. There is no need to reduce the retailers' DLFs because they are getting the net exported electricity. Alternatively the retailer could pay 86% of the retail price on net exports (as per p41 of the Discussion Paper to cover wholesale and network costs) and the DNSP could make up the difference to 44c.

If the FiT is applied to all generation, then cost recovery by the Distributor would be the same. Similarly, the retailer would then subtract the generation meter reading from the import meter, and so in effect pay net metering for all generation.

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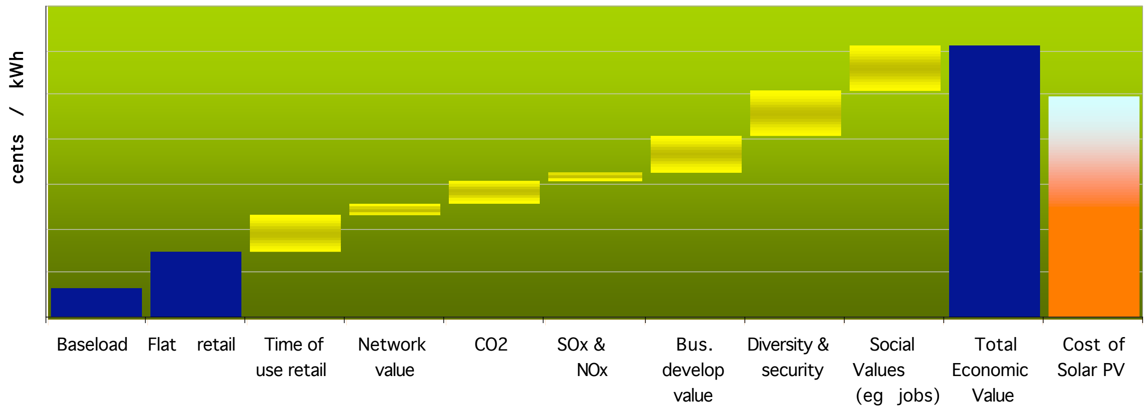
Additional Comments on Some Questions Posed

Question 3

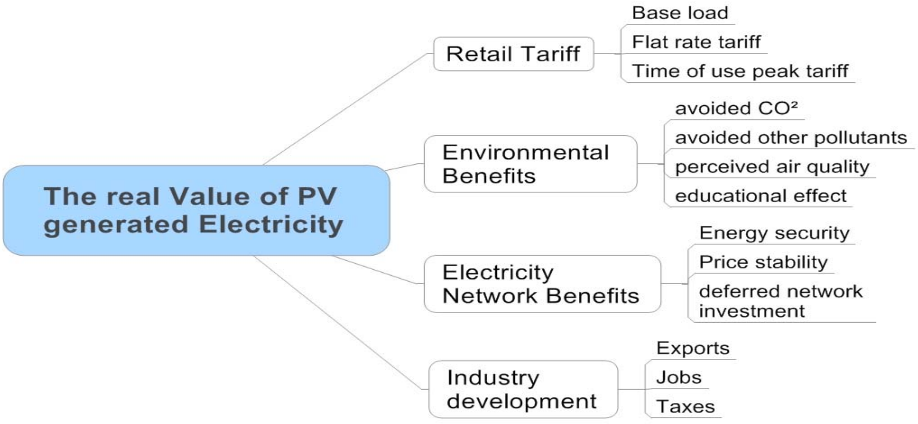
- Agree that there is little value in offsetting expensive generation
- Avoids transmissions <u>and</u> distribution costs
- In terms of delaying augmentation of transmission/distribution infrastructure, PV's contribution is proportional to total installation and also dependent on load, so it is better to target specific areas of the network.

Question 4

It is certainly possible to estimate it, although this would need the approach taken by SEDO WA, or similar. However, in general, PV certainly creates a net economic benefit. To adequately compare solar electricity with other generation technologies, several additional value components have to be taken into account. Solar PV eliminates the complex supply chain and geographic distance between electricity generation and consumption. It spreads economic benefits such as technology investment, jobs and environmental effects into communities. These and other additional values as shown in the graphs below can be captured in a Feed-in tariff.



A well designed FiT in South Australia could deliver clean peak generation capacity, economic expansion, job creation in high-tech industry, low-cost energy diversification, and the potential to access the rapidly expanding $14 billion solar PV export market.



Question 5

- Current uptake levels may be maintained, assuming PVRP continues, and may increase with higher awareness of climate change and its impacts.

Question 6

- Very difficult to estimate with a net export scheme, since individuals will not know how much they are likely to benefit. With a total generation scheme, a 1.6 kW system may benefit from $4000 through the PVRP, plus ~$2000 from the FiT, making PV significantly more attractive to Adelaide householders.
- Advantage of FiT is that it can be adjusted each year. Therefore it is important not to lock in a tariff level.
- There is a “tipping point tariff level” for each renewable energy technology - a feed-in policy can either be very effective or ineffective. This is illustrated below, based on the German experience:

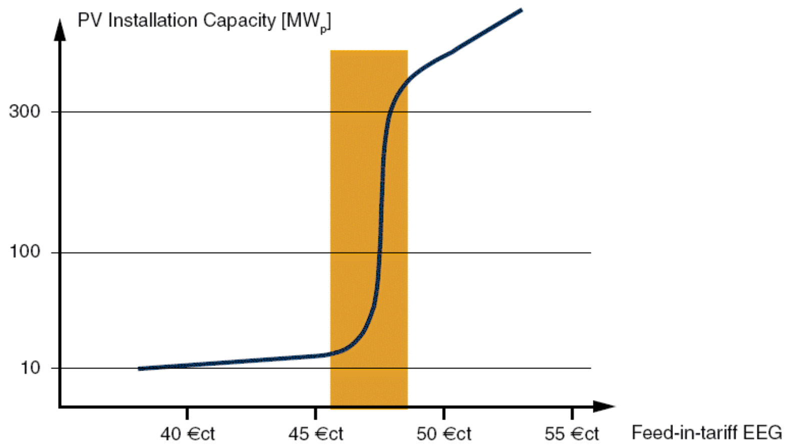


Figure D2-1: PV market mechanism in Germany