Impediments to Grid Connection of Solar Photovoltaic: the consumer experience.

Research into the challenges facing Victorians negotiating grid connection and recommendations for how these may be overcome.

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1. Executive Summary

Small renewable embedded generation systems provide consumers with a means of producing their own electricity and contributing to reductions in greenhouse gas emissions. Since 2001, the number of grid connected solar PV systems has risen in Victorian and throughout Australia. System owners have invested some $120 million in solar PV with support from government.

Sustained reductions in technology costs allows optimistic forecasts for rapid increases in penetration of solar PV and other small renewable embedded generation systems (such as Fuel Cells).

However, there currently exist a number of impediments that owners of small renewable embedded generation systems face when they try to negotiate connection of their system to the electricity grid. Significant disincentives remain for Victorian consumers investing in solar PV, despite the efforts of many solar PV system installers, who often attempt to negotiate - often above and beyond their contracted role - grid connection on behalf of the system owner.

In Victoria, these impediments include:

- A return on investment – of up to $30,000 by some Victorians – in solar PV systems that remains meagre despite the many benefits these systems produce. Some system owners can face the indignity of *bigger* electricity bills from their retailer (due to higher tariffs for the minimal electricity purchased) following their investment.

- A lack of information that can assist system owners negotiate and undertake what is often an unnecessarily technically and administratively complex process.

- Unnecessarily complex technical regulation which discriminates against system owners.

- An economic regulatory framework which provides:

    - little incentive for retail or distribution businesses to actively encourage small renewable embedded generation. This is evident from the amount and type of information provided by energy utilities, the generally unsatisfactory level of customer service and inconsistency with which system owners are dealt with.

    - minimal protection for system owners. This includes allowing retailers to remove standing tariff offers and compulsory reassignment of tariffs to grid connected system owners.

  - Market failure which discriminates against solar PV and fails to recognise the true value of electricity that solar PV systems produce during hot summer periods. While electricity costs can reach as high as $10,000 per MWh on the wholesale market, solar PV system owners are not rewarded accordingly for electricity they export during these periods.

- Minimal consistency in the treatment of system owners negotiating grid connection.

- Unnecessarily high charges for interval metering which currently provides little financial return – due to a lack of corresponding interval tariffs – to system owners.

- Some distribution businesses demanding gross metering (despite poorly drafted and ambiguous codes which attempt to stipulate otherwise).

ATA recommends that these issues be addressed by the Essential Services Commission (ESC) and Government as a matter of urgency to ensure that the uptake of small renewable embedded generation increases. Initiatives required to improve the current arrangements include:

- A regulatory framework that recognises investment in small renewable embedded generation as being equivalent to other demand management initiatives.

- Recognition of, and regulatory support for, the vulnerable *negotiating* position of system owners forced onto new network and retail tariffs for import and export of electricity.

- Clarification and more effective enforcement of the existing regulatory framework to ensure system owners are not *required* to implement gross metering.

- Development of ‘How-to-guides’ that provide system owners with information and guidance to inform and simplify the grid connection process.

- The adoption of standard grid connection agreements aimed at developing the simplest, easiest and lowest cost process possible for connection of small embedded generators. It would be far better to recognise that solar PV system owners must meet electrical safety regulations and remove unnecessary regulations that constrain choices that allow greater expression of economic sovereignty in the energy market.

2. Introduction

Australia currently has among the highest level of emissions of greenhouse gas (GHG) per capita, requiring immediate and deep cuts to minimise the impacts of global warming. Australia must commence an immediate transition to cleaner and renewable fuel sources for energy generation. Within Australia, Victoria stands out with, by far, the highest GHG emissions per capita, which is due, primarily, to reliance on highly polluting brown coal.

Energy efficiency can provide one solution to these problems, minimising greenhouse gas emissions while reducing dependence on traditional fossil fuel based energy sources.

Solar PV, in particular, is a technology that can provide the environmental benefits of renewable energy (avoiding emission intensive fossil based generation) as well as reliable energy supply.

Additional benefits of solar PV include:

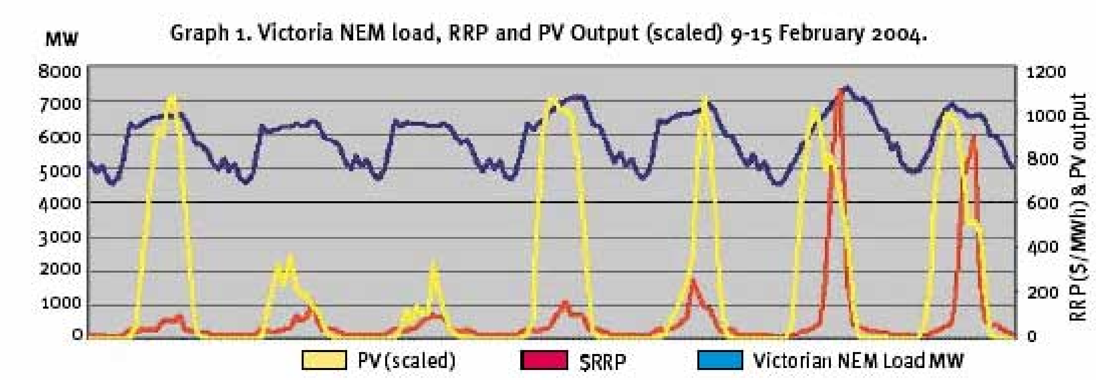
- avoided network augmentation costs and more efficient network tariffs
- improved supply reliability
- individual and community control over energy sources resulting in reduced dependence on a small number of large remotely located generators
- power generation closer to customers improving power quality and reducing power losses
- improved employment opportunities, with small-scale renewable projects demonstrated to provide more jobs per MWh of electricity produced than conventional energy sources.

The development of the renewable energy industry will provide a clear net social benefit to Australia. Strong commitment to policy and program implementation would stimulate the development of much needed (and currently absent) skills and expertise necessary to deliver renewable energy. This would translate into jobs within the trade and services sector of the economy as well as research, development and distribution of new and innovative energy efficiency technology. These outcomes would result in a strong and positive contribution to the economic well being of Australia.

Solar PV systems generally cost between $15,000 and $30,000 for a typical residential installation, depending on the system specification. Solar PV can be installed as a stand alone system or a grid interactive system if a household is already connected to the electricity grid. Installation of a grid-connected solar PV system can offer two additional benefits (over stand alone systems):

- During periods of low sunlight, when the solar PV system is not producing enough electricity, households can draw additional electricity from the electricity grid. This can ensure a reliable electricity supply to the solar PV household.

- Surplus electricity produced during periods of high solar radiation (hot summer afternoons that are likely to coincide with peak summer demand) can be sold back to the electricity grid.
- In some instances, maximum output from a solar PV system will coincide with extreme wholesale market electricity price (as shown in Graph 1 below).



Source: Muriel Watt, Scott Partlin, Monica Oliphant, Hugh Outhred, Iain MacGill & Ted Spooner, 'Analyses of Photovoltaic System Output, Temperature, Electricity Loads and National Electricity Market Prices – Summer 2003-04', Proceedings of Solar 2004, Perth 1-3 Dec 2004.

But there currently exists many barriers to consumers contributing to this effort and deriving the benefits that should accrue from grid connecting their solar PV systems.

The ATA's submission to the Essential Services Commission (ESC) consultation on the Draft Embedded Generation Guideline was made on 22 August 2003. In the covering letter to this submission, the ATA noted:

> *Over the past few years, many of ATA's members have become small embedded generators, and we expect that more of our members are planning to install grid-connected renewable energy systems in the near future in Victoria and other states of Australia.*
>
> *The varying experiences of ATA's members have shown that small embedded generators do not receive consistent treatment in their dealings with monopoly distribution companies, and often find themselves involved in frustrating negotiations with them.*
>
> *ATA supports the right of individuals to invest their own private funds into lower greenhouse gas emission generation, and would like to see improvement in the treatment of small embedded generators in the NEM to make this a less risky investment for embedded generators.*

Despite active participation by the ATA in the ESC's review of its Embedded Generation Guideline, the ESC paid little attention to issues raised by the

ATA[1] and endorsed yet another regulatory instrument largely influenced by supply-side entities.

ATA has conducted a project researching the experiences of its members when negotiating grid connection of small renewable embedded electricity generators. This report focuses on the regulatory, economic and information barriers that prevent or complicate the negotiation of a fair and reasonable agreement for solar PV system owners in Victoria.

While this report focuses on Victoria, ATA believes many similar impediments exist in other Australian states and territories.[2] Likewise, while this report focuses on solar PV, these impediments equally apply to other small renewable embedded generation systems.

2.1. Structure of this report

The introduction above outlines the benefits of small renewable embedded generation. Section 3 below details the impact of Australian (and State) Government policies that have the objective and effect of promoting significantly increased penetration of small renewable embedded generation (particularly solar PV systems).

Section 4 details the research conducted by ATA and presents the results derived from a questionnaire circulated to ATA members. This includes details of a number of specific and relevant case studies and summarises the issues discovered.

Section 5 assesses the cause of these impediments and argues that recent developments in solar PV technologies have the potential to increase the rate at which solar PV costs fall which, in turn, is likely to increase penetration of solar PV.

Section 6 outlines the regulatory framework that applies to small renewable embedded generation and contrasts this ‘excess of belts and braces – and supply-side interference’ to the virtual lack of constraint on other forms of energy efficiency and energy conservation choices available to residential consumers. Section 7 also refers to specific examples of the consequences arising from the complex regulatory framework that have come to light through the ATA survey of solar PV users.

Section 8 concludes the report and argues that many of these issues warrant a very close inspection by the ESC and Government.

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1 The only issue raised by the ATA that the ESC explicitly accepted was the suggestion that the Guideline include criteria specified in the AS 4777 (*Grid connection of energy systems via inverters*) for inverter capacity as that applying to ‘small’ embedded generators. But even so, this aspect of the ESC’s decision only aligned the *Embedded Generation Guideline* with the electricity industries own *Service and Installation Rules*.

2 The ATA has also recently made a submission to the Essential Services Commission of South Australia’s review of Standard Connection Agreements for small embedded generators. This review highlighted identical problems for small generator owners, and the same disappointing response by ESCoSA (who allowed ETSA Utilities to propose terms and conditions in a standard connection agreement that were notably biased in favour of the utilitiy),

3. Growth of Small Embedded Generation

This section of the report discussed the emerging possibilities for small renewable embedded generation.

The first 'commercial' installation of a grid-connected solar PV system for a residential electricity consumer in Victoria occurred in July 1998,[3] some three years after the current regulatory regime commenced;[4] and some 18 months before commencement of the Photovoltaic Rebate Program (which, as noted below, led to a substantial increase in interest and connection of solar PV systems).

Prior to commencement of the current regulatory regime, there were relatively few embedded generators connected to the Victorian distribution networks. All of these were 'large' installations, of very substantially greater capacity than any residential solar PV system. The arrangements and processes used to design, connect and operate these 'large' embedded generators, and the terms and conditions of connection agreements, were developed in the context of the organisational, technical and economic culture that existed in the electricity supply industry prior to June 1995. This culture took account of the effects that these 'large' embedded generators had on distribution networks.

A key issue for this report is that the current regulatory regime has developed without any reasonable consideration of the advent of small renewable embedded generation capability. Indeed, the regulatory regime ignores the potential impact of a range of developing energy technologies that could fundamentally alter the characteristics and economics of the 'consumer-side' of the electricity supply system. In June 1995, the prospect of significant numbers of small renewable embedded generation existing by June 2005 was no more than 'a gleam in the eye' of the most ardent enthusiast. But that 'gleam in the eye' is becoming a reality that the electricity supply industry and the ESC must deal with effectively and fairly.

Data published on the Australian Greenhouse Office website[5] shows that at the end of November 2004, 1,363 qualifying solar PV systems had been installed in Victoria, with total capacity of 1.50 MW (an average of 1.08 kW). Five hundred and thirty six (536) of these systems were grid-connected with a total installed capacity of 730.5 kW (an average of 1.36 kW, which has remained reasonably constant over the period from 2000).

A time series presentation of the data for Victoria is presented in Graph 2 below. This shows the rapid deployment of solar PV systems in the first year

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3 Advice from Dr Richard Potter of Solar Charge Pty Ltd. Dr Potter also advised that prior to July 1998, there had been one or two 'experimental' systems installed.

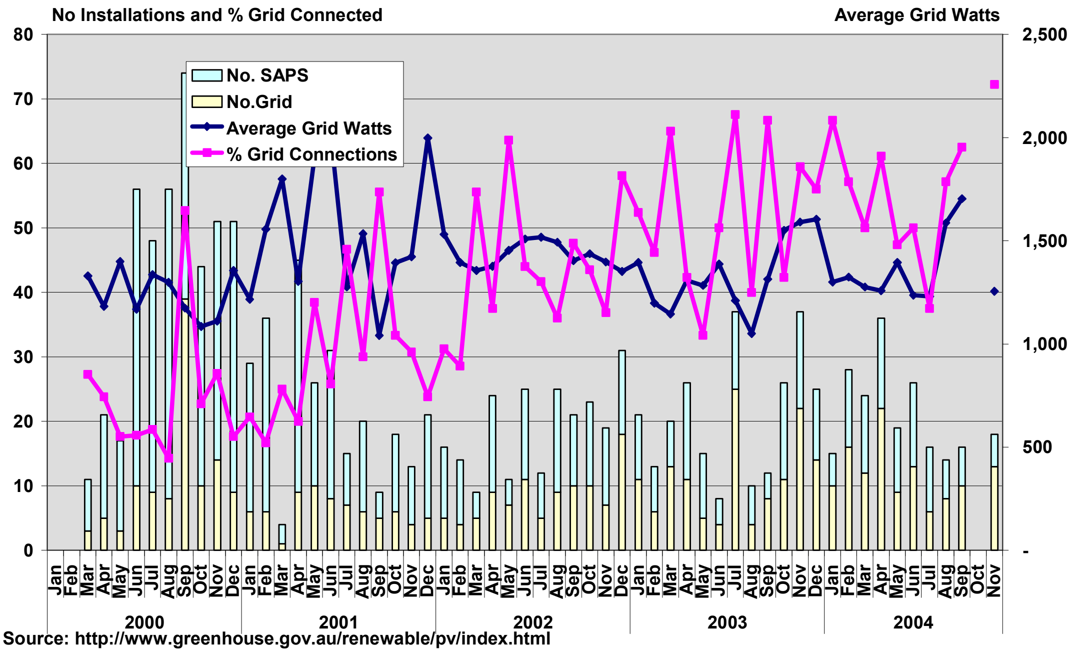
4 The *Electricity Supply Industry Tariff Order* was promulgated on 30 June 1995.

5 http://www.greenhouse.gov.au/renewable/pv/index.html

of the PVRP program, with the rate of installation reducing somewhat in Victoria after June 2001, then increasing slightly. The data shows the proportion of grid connections increasing steadily.[6]

This data suggests that the minimum total value of investment in solar PV in Victoria (excluding any non-Rebate complying installations) is around $18 million and is growing at a rate of around $4.3 million per year.[7]

GRAPH 2: REBATE COMPLYING SOLAR PV INSTALLATIONS - VICTORIA



Source: http://www.greenhouse.gov.au/renewable/pv/index.html

To put this in context:

- Prior to January 2000, there were virtually no requests for grid connection of solar PV systems.
- Since January 2000, there have been between 73 (in 2001) and 134 (in 2003) new grid connected solar PV installations per year in Victoria (at least).[8]
- The rate of grid connection in Victoria has increased somewhat since 2001 to around 130 installations per year.[9]

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[6] The AGO data does not indicate whether any of initial Stand Alone Power Systems (SAPS) were subsequently connected to the grid.

[7] Based on cost for a grid-connected installation of average capacity from Origin Energy (See: http://www.origin.com.au/home/home_subnav.php?pageid=174). The Origin data shows total costs ranging from $17,000/kW for the minimum Rebate complying installation (450 Watts) to $11,500/kW for a 2.0kW installation.

[8] The PVRP covers only residential and Community Use Solar PV installations meeting defined criteria. Solar PV industry survey data published by the University of NSW shows substantially greater growth in installed Solar PV system capacity than indicated in the PVRP data.

[9] The zero installation figure in October 2004 was the result of a suspension of rebates pending a decision on the future of the PVRP (and other) rebate programs.

3.1. Further Change Ahead

It is possible that the relatively small scale of solar PV activity has obscured consideration of the possible longer-term impacts, benefits and opportunities (for both consumers and the energy sectors) that will eventuate as costs of various small renewable embedded generation technologies continue to fall.[10] That is, a progressive increase in the number of small-scale solar PV installations is, potentially, only the start of possible proliferation of small renewable embedded generation technologies. For example:

- Origin Energy has established a manufacturing plant for the 'Sliver' Solar PV technology at Regency Park in Adelaide and expects to commence sales of solar PV panels incorporating this new technology in 2005.[11] The projected cost benefits for this form of solar PV technology are claimed to be very promising.[12] Even though Origin is seeking to capture the full market value of this technology initially, consumers may not have to wait very long before solar PV prices start falling much faster than the 2-3%/year[13] of the last five years (if the cost advantages claimed by Origin for the 'Sliver' cell technology are achievable).

  There is already clear evidence that the cost of solar PV installations is falling in real terms. For example:

  - In April 2004, Origin Energy provided data on its Website that showed total costs (for systems installed by Origin for its customers) ranging from $17,000/kW for the minimum PVRP complying installation (450 Watts) to $11,500/kW for a 2.0kW installation (before the PVRP rebate).
  - By March 2005, Origin's reported costs had fallen by 13.5% to $14,700/kW for a 510 Watt system and 27% to $8,400/kW for a 2.38kW system (again before the PVRP rebate).[14]
  - Independent review of solar technology market trends by the University of NSW (undertaken for the International Energy Agency) confirms the reduction in system costs is occurring in all major components of solar PV systems, with the fastest price falls occurring for inverters.[15]

- Ballard Systems of Vancouver has confirmed[16] that shipping of 1 kW natural gas powered Fuel Cells (FC) to the Japanese residential CHP

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10 United Energy's submission to the ESC's review of its Embedded Generation Guidleine refers explicitly to the potential, over the longer term, for the increasing presence of embedded generation (particularly small-scale generation connected to the low voltage network) to cause significant changes to the way distribution networks operate.

11 See: http://www.originenergy.com.au/environment/subnav_section.php?pageid=1159.

12 Origin's initial Media launch suggested 'savings' of up to $20,000/installation - although Executive General Manager, Generation Andrew Stock was reported in *The Age* on 18 April 2004 as saying consumers would have to wait for cheaper Solar PV cells until Origin gets back its $26 million investment in establishing the technology (See: http://www.theage.com.au/articles/2004/04/18/1082140125998.html).

13 See http://www.solarbuzz.com/ for information on the 'commodity market' pricing of Solar PV modules.

14 See: *Origin Energy Solar system pricing guide* at http://www.originenergy.com.au/environment/environment_subnav.php?pageid=252

15 *National Survey Report of PV Power Applications in Australia, 2002*, Report for the International Energy Agency Co-operative Programme on Photovoltaic Power Systems, Author – Muriel Watt, UNSW, June 2004).

16 Email advice from Ballard Systems dated 16 April 2004. See also Ballard Systems News Release for 16th February, 2005 (http://www.ballard.com/).

(combined heat & power) market commenced in November 2004. These units will be installed and commissioned by Ebara Ballard Corporation in support of the Tokyo Gas limited commercial launch.[17] In addition, Ebara Ballard continued to provide natural gas-fuelled systems to Osaka Gas and Toho Gas as well as kerosene-fuelled systems to Nippon Oil Corporation for field trial testing in support of their commercialization plans.

- Ceramic Fuel Cells (CFC) in Melbourne advised the expected completion of development for a 1kW to 2kW FC stack that will be trialled in late 2004 and 2005; and that CFC is actively seeking manufacturing partners in Europe who will utilise the technology.[18]
- Plug Power in California is already shipping small hydrogen powered FCs and expects to begin shipping small natural gas powered FCs in the 2005.

These are just a few examples of rapidly developing new small renewable embedded generation technologies. Increasing numbers of reports are appearing in the US media suggesting contracts are being struck for supply of small FCs (under 5kW) at less than US$5,000/kW, with prices forecast to fall to the US Department of Energy target of US$1,000/kW by 2010 – and acceptance by FC developers that prices will have to fall below US$200/kW to achieve widespread penetration in the residential sector.

Despite these rapid developments, the Victorian regulatory framework appears ill-prepared for the possible larger scale deployment of such technologies.

3.2. Government Support

Prior to 2000, there were relatively few small-scale embedded generators that were owned by residential energy consumers and connected to electricity networks.[19] This has changed significantly over the last five years primarily in response to the increased government support for renewable energy through the Australian Government's Photovoltaic Rebate Program (PVRP), Mandatory Renewable Energy Target scheme (MRET) and Remote Renewable Power Generation Program (RRPGP).

3.2.1. Photovoltaic Rebate Program

The PVRP is quite straight forward. The rebate offered by Government provides funding up to a maximum of 25% (limit of $4,000) towards the cost of

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17 The Tokyo Gas launch will include the installation of systems at the Prime Minister's official residence in 2005.

18 Email from David Peck, Business Development Manager, Ceramic Fuel Cells Ltd dated 15 April 2004.

19 Total installed Solar photovoltaic capacity in Australia was reported as 25.32 MW at December 1999, of which just 1.49 MW was distributed small-scale grid-connected and another 6.82 MW was small-scale off-grid domestic. At the end of 2003, the installed capacity had increased to 45.63 MW, of which 4.63 MW was distributed small-scale grid-connected and another 13.59 MW was small-scale off-grid domestic (See: Table 1, p7, *National Survey Report of PV Power Applications in Australia, 2002*, Report for the International Energy Agency Co-operative Programme on Photovoltaic Power Systems, Author – Muriel Watt, UNSW, June 2004).

a registered designer/installer installing a new solar PV system between 450 W and 1 kW capacity at the applicant's principal residence.[20] In Victoria, the PVRP scheme is administered by the Sustainable Energy Authority of Victoria (SEAV).[21]

3.2.2. Mandatory Renewable Energy Targets

The MRET program is more complex, although it does allow residential consumers to be partially compensated on an ongoing basis for installing small-scale renewable energy generators (where these systems qualify under the *Renewable Energy (Electricity) Act 2000*).

The MRET scheme imposes an obligation on energy retailers (and other buyers of wholesale market electricity) to achieve minimum targets each year for purchase of (1MWh) Renewable Energy Certificates (RECs) from renewable energy generators. MRET provides a 'market mechanism' through the buying and selling of RECs, with the price determined by the supply (determined by renewable energy generation output) and demand (set as a mandatory target) for RECs. A retailer (or wholesale electricity buyer) that does not meet the assigned target for purchase of RECs is required to pay a $40 penalty for each REC shortfall to the Office of the Renewable Energy Regulator (ORER).

To simplify the inclusion of small generation units in MRET, the number of Deemed RECs claimed for eligible systems can be calculated using a methodology specified by the ORER. Deemed RECs may be either created and traded by the owner of the system, or assigned to a registered Agent in return for some benefit to the system owner, such as a rebate or price reduction. Where assigned, the Agent will own the Deemed RECs for the period of assignment.

A major deficiency in the MRET scheme (as far as small-scale solar PV system owners are concerned) is that no information is published on the actual prices paid for RECs. This is hardly conducive to development of a 'free market' for RECs and leaves solar PV systems owners at a disadvantage when they come to sell their RECs because either:

- have to put a lot of effort into seeking 'quotes' for the RECs they have; or
- rely on their energy retailer or system supplier to give them a 'fair deal'.[22]

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[20] The PVRP scheme also provides rebates for "community" installations (of up to $8,000 on 2kW capacity systems), but these represent a relatively small number of installations are not the focus of this report.

[21] See: http://www.sea.vic.gov.au/renewable_energy/pv_rebate/index.asp. Note that the terms and conditions of the scheme were changed towards the end of 2003. These changes included a reduction in the maximum rebate rate from $8,000 to $4,000. But these changes have not impacted substantially on the rate of installation of solar PV systems.

[22] It is noteworthy that virtually no energy retailers now disclose the price they pay for RECs on their Websites. In the early days of the MRET scheme some did, and quoted the price of RECs substantially below the estimates of REC price shown reports published on the ORER Website. It is difficult to tell if the retailers were seeking to take advantage of REC sellers, or the ORER estimates were unrepresentative of the 'market price'. In either case, it indicates a less than satisfactory market condition.

The ORER has, however, commissioned several modelling studies of REC price trends that suggest RECs will increase in value from $25 to $35 (per 1MWh REC) in 2005-2010 to a high estimate in excess of $50 by 2020 (the current end date for MRET). Information on the ORER Website shows that a typical grid-connected residential solar PV system in Victoria (around 1.0 kW capacity) would qualify for 1 Deemed REC per year.[23] That is, a Victorian residential consumer with an average capacity, grid-connected solar PV system should receive between (at least) $25 and $35/year through RECs traded in the MRET scheme.[24]

An important characteristic of the MRET scheme, so far as grid-connected residential consumers are concerned (and so far as this report is concerned), is that the value of RECs can be determined by an administrative process. Metering of output from the solar PV system is not mandatory and is not a pre-requisite for receipt of this ongoing (*albeit* small) commercial benefit. This is particularly relevant to this report as the commercial value of RECs attributed to small solar PV systems and the value of energy the systems might export to the grid are both of the same order of magnitude in value. A solar PV system owner is able to capture the value of RECs through a simple administrative process - without any metering. Yet, the ESC has established an administrative procedure that allows energy retailers and distributors to insist on complex and (relatively) expensive metering for all solar PV installations as a pre-requisite for obtaining the commercial benefit of solar PV generation.[25] The costs associated with installing and reading the meters that the ESC's regulations require, quite frequently, are of the same order of magnitude as the value of energy exports. This inhibits the solar PV system owner capturing the full value of their investment, without generating any off-setting of financial benefit for energy utilities.

3.2.3. Remote Renewable Power Generation Program

The RRPGP is also straight-forward, but has little application to matters considered in this report. RRPGP relates to those areas of Australia not serviced by a main electricity grid and provides financial support to increase the use of renewable energy generation that presently rely on diesel for electricity generation. There is no funding for RRPGP in Victoria.

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23 The formula used by the Renewable Energy Regulator for calculating Deemed RECs is explained at http://www.orer.gov.au/publications/photovoltaic.html. Note also that "stand alone" Solar PV systems qualify for RECs – but are not the subject of this paper.

24 The number of Deemed RECs depends on both the capacity of the Solar PV system and its geographic location. The ORER assigns a Zone Rating based on Postcode. The Zone rating for Postcodes in southern Victoria is 1.185; the Zone Rating in northern Victoria is 1.382. A Deemed REC is calculated by multiplying the Zone Rating by the system capacity (and the time period of assignment if this is relevant) and then rounding down the resulting figure to the nearest whole number.

25 Discussions with the ESC confirmed that the Retail Energy Metering Code was intended to allow Solar PV system owners to gain advantages through 'net metering' of their consumption. But the Code explicitly requires measurement of gross System output and gross energy consumed, which requires separate metering registers and a more complex metering installation that is necessary to measure 'net energy' consumed.

3.3. *Impact of Government Support*

The PVRP and MRET programs have stimulated growth of small renewable embedded generation. As shown in Table 1 below, more than 5,600 solar PV systems [26] of average size 1.16 kW had been installed in the first 5 years of the PVRP, which commenced in January 2000. A total of 2,060 systems had been connected to distribution networks.

Victoria had a total of 1,388 solar PV systems installed over the five year period, with an average capacity of 1.08 kW; of which 536 systems, with an average capacity of 1.36 kW had been grid-connected.[27] The rate of grid connection in Victoria has varied between 5 and 25 systems per month, with an increasing trend in the proportion of installed systems being grid-connected.

While the number of consumers with small-scale grid-connected solar PV systems is low compared to the total number of electricity consumers,[28] it is noteworthy that solar PV users have made a substantial investment in their systems.[29] For example, the PVRP offers a total commitment of $40.4 million over 5 years to 2010. In the same period, residential recipients of PVRP rebates will have invested more than $120 million across Australia in solar PV systems. If the share of rebates remains constant through to 2010, residential consumers in Victoria will have invested around $45 million in solar PV systems by 2010 - with at least half that amount for grid-connected systems.

TABLE 1: INSTALLED PHOTOVOLTAIC SOLAR SYSTEMS BY STATE

STATE	INSTALLED SYSTEMS (Number)					INSTALLED CAPACITY (kW)		
	Total	Residntl	Communty	Grid Connected	Stand Alone	Total	Grid Connected	Stand Alone
NSW	1,849	1,814	35	388	1,461	1,945.4	533.2	1,412.2
VIC	1,388	1,363	25	536	852	1,496.0	730.5	765.5
QLD	1,031	963	68	170	861	1,207.7	263.0	944.7
SA	967	909	58	844	123	1,435.3	1,306.8	128.6
TAS	221	221	0	24	197	189.5	31.8	157.8
WA	136	121	15	74	62	197.1	117.0	80.2
ACT	23	22	1	21	2	35.0	32.3	2.7
NT	11	11	0	3	8	13.1	6.1	7.1
Total	**5,626**	**5,424**	**202**	**2,060**	**3,566**	**6,519.3**	**3,020.6**	**3,498.7**

Source: http://www.greenhouse.gov.au/renewable/pv/index.html (Data to November 2004)

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26 There is a range of technologies suitable for small-scale embedded generation. However, this report focuses on solar photovoltaic (Solar PV) systems because increased government support for renewable energy has resulted in substantial growth in the number of small-scale Solar PV systems installed by residential consumers.

27 Only 25 of the Solar PV systems qualifying for a PVRP rebate in Victoria were designated 'Community' systems. The remainder are residential systems. It is assumed that all 25 Community systems would be grid-connected, and all 25 would be higher capacity than residential systems.

28 There were 2,304,278 consumers connected to Victorian electricity distribution networks at the end of 2003. Of these, 2,009,033 were residential consumers. The rate of increase in consumer numbers was reported as 2.3% overall (2003 compared to 2002), and 2.5% for residential consumers (See: p 75, *Electricity Distribution Businesses – Comparative Performance Report for the Calendar Year 2003*, ESC, September 2004).

29 Currently available Solar PV systems are only one of the potential technologies for small-scale embedded generation. Substantial resources are being committed to large-scale research and development of new, more efficient, and lower-cost PV and Fuel Cell technologies both in Australia and overseas. The difficulties and challenges faced by small-scale PV-users discussed in this report are identical to those that will face users (and investors in) other technologies unless fundamental changes occur in the NEM.

3.4. *Significant Investment from Solar PV System Owners*

The numbers in Table 1 above may suggest that in physical and material terms the impact of solar PV installations is negligible. By comparison, the Victorian Region of the National Electricity Market has maximum peak demand in excess of 8,000MW and a retail energy market turnover in the order of $5 billion per year. The level of investment by residential consumers in solar PV systems may also appear inconsequential by comparison with the value of supply side investment of the order of $1 billion per year.[30] For the affected consumers, however, the investment is substantial in dollar terms and the financial 'rewards' minimal or, in some cases, non-existent as will be highlighted and discussed in subsequent sections of this report.

A decision to undertake investment in solar PV is not whimsical. It requires very careful consideration of a whole range of energy use choices. Solar PV owners deliberately implement a full range of energy conservation and demand management strategies to maximise the impact of their investment. This is reflected in the advice provided by ATA to potential solar PV users.[31] In effect, the investment in solar PV is the last - and most costly - form of demand management/energy conservation implemented by a solar PV household. Put simply, it makes sense to link a comprehensive demand management and energy efficiency strategy to an investment worth thousands of dollars in a solar PV system that produces (on average) around 1,500 kWh/year (less than half the average household consumption).

[30] Capital investment in distribution networks reported to the ESC has been between $300 million and $430 million ($June 2004) since 1996. Capital investment in transmission (reported in ACCC transmission revenue Determinations) has been between $80-110 million per year. There is no consolidated public domain data reporting investment in generation capacity but substantial investment in gas turbine plant has been reported by Loy Yang Power, Edison Mission.

[31] *Solar Electricity – Plan your own solar electricity system*, Booklet 2 ATA info series, Alternative Technology Association, Undated.

4. Research Findings

4.1. Methodology

A number of research methods were adopted to gain an understanding of the barriers being faced by solar PV system owners seeking grid connection. These are discussed below.

The questionnaire was distributed nationally, following responses to advertisement in the ATA quarterly publication *ReNew* and member newsletter. As detailed below, the survey generated a total of 15 responses from ATA members who had experienced grid connection. This is a small sample size given the 1300 plus systems now installed in Victoria alone.

The results from the user survey were corroborated through detailed discussions with accredited system installers. The ATA also confirmed feedback from survey respondents through contact with energy retailers and electricity distributors, with the ATA taking a role as a consumer interested in installing a grid-connected solar PV system. The responses by energy retailers and distributors were also tested by Dr Washusen in the same manner – and with the same totally unsatisfactory results indicated in the survey responses.

While the small number of survey responses limits the certainty of judgement concerning the issues highlighted, it did allow collection of specific case studies (as per below) and summary of the issues that may be encountered when negotiating grid connection within the current under the current regulatory framework. However, both the ATA and MJA are satisfied that the survey responses identify real issues and concerns that are, almost certainly, typical of issues and concerns faced by many potential and actual solar PV system owners.

Anyone doubting the validity of the observations and conclusions in this part of the report may only need to spend a few hours attempting to get a sensible and supportive response from energy utilities through their call centres.

4.2. Questionnaire Summary

ATA designed and distributed a questionnaire to its members with the objective of capturing the experiences of householders in negotiating grid connection. This questionnaire is attached as Appendix A.

The questionnaire focused on the lifecycle of Motivation - System Design – Research & Information – Installation – Grid Connection – Maintenance of a solar PV system. This allowed ATA to capture the experiences of householders in negotiating grid connection while also elaborating on the overall expectations and outcomes of solar PV generally.

The questionnaire was distributed nationally, with a total of 15 responses from ATA members who had experienced grid connection. The following summarises their experiences, on average, out of 10, where 1 is Low/Unsatisfactory and 10 is High/Excellent:

Motivation for installing a renewable energy system: Reduction of Greenhouse Gas Emissions Saving Money Showcase and educate	 8 8 7
Satisfaction with information available	4.5
Satisfaction with system installer	7
Was your electricity retailer helpful	3
Was your electricity distributor helpful	2.5
Information to assist householders negotiate grid connection: Easy to obtain Useful	 2.5 2.75
How easy was negotiating grid connection	3.25
How satisfied are you with the investment that you have made	6.5

ATA has drawn two key conclusions from these findings which will be addressed throughout the remainder of this report:

Difficult process

The first domestic grid interactive solar PV system was installed in late 1990. To date there have been several thousand grid interactive solar PV systems installed across Australia. However, the process for grid connection remains complex and frustrating for system owners and installers (who often act as the interface between the system owner and the energy retailer and/or distributor). This is due to:

- A lack of familiarity by electricity distribution and retail business customer service operatives with the technical and procedural requirements for grid connection. See section 3 of this document for examples.
- System owners lack of familiarity with the technical specifications, concepts and terminology involved in grid connection – and the technical and economic regulatory

arrangements that dictate the way their systems must be installed.
- Lack of clarity and poor communication between retail and distribution businesses concerning their respective responsibilities.

The outcomes from this aspect of the survey are entirely consistent with findings from the *Who Buys Solar Power Systems?* research conducted by the NSW Sustainable Energy Development Authority in 2004.

Insufficient information

The above difficulties were largely a result of either a lack of any, or poor quality information regarding grid connection. Both retail and distribution businesses, as well as governments, provide very little written material to assist system owners negotiate installation.

4.3. Case Study

The questionnaire revealed a number of ATA members who had overcome challenges when grid connecting their systems. This section discusses a sample of these experiences from four questionnaire respondents.

Note that names have been withheld to ensure privacy.

Respondent A:

Respondent A invested $27,640 in a 2.1 kW solar PV system for his Newport home. The high cost of connecting reticulated gas and a desire to contribute to reductions in GHG emissions made solar PV an attractive option.

While respondent A's system was installed by December 2003, grid connection took several more months of frustration and liaison with the retailer and distributor. Negotiation of this final grid connection was difficult with poor service from the retailer and distributor and confusion regarding responsibilities. It was three months before technical issues relating to surge protection, locks on the circuit breaker and signage from the supply line were communicated by the distributor as well as new metering completed.

This issue resulted after Respondent A's system was installed and after a Certificate of Electrical Safety had been provided by the installer. However the electricity distributor inspecting this system had requirements beyond those specified in AS4777 and the *Service and Installation Rules*.[32] Respondent A was subsequently required to pay for the installation of an additional circuit breaker even though the initial installation complied with generally accepted industry and technical safety standards.

[32] AS4777-2002, *Grid connection of energy systems via inverters*. This is the Australian Standard called up in the Victorian Electricity Supply Industry *Service and Installation Rules*. AS4777 specifies the performance standards, protection and installation requirements for grid-connected inverters.

Respondent A highlighted the technical complexity related to grid connectivity with terms such as 'short term rating of invertor' and 'switchboard bus bar rating' that he was expected to comprehend in his contract with the distributor.

Respondent A stated the experience with grid connection 'has not been good' due to the technical complexity he was exposed to as a result of poor customer service, poor communication and little cooperation and help from the distributor.

This is a story shared by other questionnaire respondents such as Respondent F, from Skeynes Creek Victoria, who lost months of generation (in early 2004) during the peak generation period of the year due to his distributor being 'hopelessly slow at getting a meter changed'.

<u>Respondent B</u>

Respondent B installed his system in Feb 2001 in Langwarrin Victoria after investing some $8000 of his own money and receiving $7200 rebate under the AGO Photovoltaic Rebate Programme. Respondent B was motivated by the need for reductions in GHG emissions and an interest in showcasing new technology.

When Respondent B was sizing and selecting his system he conducted a cost benefit analysis based on tariffs of $0.17 kWh for peak periods and $0.045 kWh for off-peak. This was based on his existing tariff as his retailer confirmed that he was able to remain on this tariff after his PV system was installed. His analysis, using these tariffs approximated a 4% annual return on his $8000 investment.

However, upon installation of his system he was advised by the same retailer that he would have to change to an alternative tariff, which due to his different pattern of use of electricity resulted in an overall increased cost. That is, despite the reduction in total consumption, due to the solar contribution, Respondent B actually pays more to his electricity retailer. He described this outcome in terms of:

> *'The irony of this is excruciating'*.

Since installing the system, Respondent B has experienced recurring problems with the billing of his electricity usage. His retailer has often added the readings for his solar contribution to his total usage instead of subtracting it. On each occasion, considerable time and effort has been spent in getting the account corrected.

While Respondent B does not regret his investment, the economic return is significantly different - because of this changed tariff – from his original projections.

Respondent C

A similar concern was raised by Respondent C who installed a system in Echuca in late 2003. After waiting several months for the system to be connected due to delays from the distributor, Respondent C has experienced a number of problems and concerns with billing. When the house was vacant for 3 months over summer bills were still received for power and as a result she is 'dubious about the benefits' of the system.

She found negotiation of grid connection difficult and the charges unreasonable and is not satisfied with the investment that was made.
Working in the construction industry, Respondent C consequently no longer recommends solar PV to clients.

Respondent D

Communication and cooperation with and between distributor and retailer was the greatest challenge faced by Respondent D when she negotiated grid connection of her 1.8 kW system in Altona in December 2003.

Respondent D invested $20,700 in the system, and obtained a $7500 rebate from the AGO PVRP. Respondent D considered reduction of GHG emissions, saving money from reduced electricity consumption and an interest in new technology as the key motivators for this investment. Respondent D was extremely satisfied with the system installer who 'did a wonderful job' including attending meetings with the distributor and retailer on behalf of Respondent D to resolve grid connection issues.

Despite this, the panels sat idle for a couple months after the system had been installed, because the distributor 'lost the paperwork' for the new metering required before the system could become operational. Once operational, it took over some six months for an accurate bill to verify the cost effectiveness of her investment.

Overall Respondent D admitted 'it was a frustrating experience'.

The tariff for electricity exported to the grid (in both peak and off peak times) offered by her retailer is equal to that for any electricity imported from the grid. While Respondent D did not compare electricity retailers or subsequently change retailers, these tariffs clearly do not reflect the premium that retailers are able to claim when retailing her green electricity.

Respondent E

Respondent E also found that 'the retailer's staff were unhelpful and knew little about solar energy. Spent days trying to talk to someone with this knowledge'.

Her system lay idle for months after installation in 2004, eventually requiring her to contact the Victorian Electricity Ombudsman to assist and resolve grid connection. At the time she completed the survey, over 6 months after her system was installed, she still had not received an accurate bill and has again contacted the Ombudsman to assist.

While Respondent E has not yet changed retailers (while her bill remains incorrect and outstanding) she plans to do so in the future. However the complexity of comparing tariff offers as well as renegotiating this agreement is a daunting process which she believes may not be worth her efforts.

4.4. Electricity Utilities

ATA research involved requests for information assisting the grid connection of solar PV systems. This research revealed not only the difficulty in obtaining information but also the lack of information available.

Over a two week period ATA contacted each (major) Retail and Distribution company in Victoria and requested general information concerning the grid connection of a solar PV system. A log of contact made is recorded and attached as Appendix B. The five retailers and distributors were contacted either via email, online website or telephone in mid-late June 2004. ATA made this contact to gauge the level and quality of information obtainable from the utilities normal customer service representatives, although where directed by respective utility staff, ATA pursued this information to specialist departments or representatives.

ATA found that the information provided varied significantly between specific customer service staff. This highlights the difficulty in determining and documenting the utilities policy and/or procedures in regards to grid connection.

Generally, however, the results of this research correlated closely to the feedback from the case studies.

The case study revealed that information to assist in the process of grid connection was not easy to obtain (average of 2.5 out of 10 from questionnaire responses) or useful (2.75 out of 10)

Distributors

Of the five distribution businesses contacted just two provided any information (as of October 1 2004). Surprisingly, one distributor stated they

'Do not have any published information regarding the connection of solar systems to our grid'

Few of the customer consultants that ATA spoke to were familiar with any specific details concerning grid connection. This included metering arrangements, technical specifications of connectivity (such as inverter models supported) or of the process to connect the system to the distributor's grid.

Retailers

Five retailers were contacted with the majority offering to provide a quote on a new contract.[33] There was however a lot of confusion regarding solar PV, best highlighted with the following comments from a customer service representative:

'We do not purchase electricity from PV owners. You would need to speak to your distributor'.

In each instance, the actual tariff rate for any electricity sold back to the grid was not clear. Not only was it difficult to determine exactly what the rate was from each retailer, it was almost impossible to make any competitive comparison of these rates.

'The rate is the same as the buy rate – which varies and is subject to change'

The impact of this on householders evaluating the cost effectiveness of investing in solar is significant. The case study revealed that a number of the Respondents' tariffs had been changed following grid connection which subsequently reduced the return on investment and led them to regret their investment.

4.5. Summary of Barriers

The questionnaires highlighted a wide range of barriers that exist when householders negotiate grid connection. The following summarises each of these barriers.

4.5.1. Economic

Renewable energy systems produce electricity free of the pollution associated with traditional fossil fuel electricity generators. However, this benefit is not reflected in the price paid for such electricity. This puts distributed generation

[33] This outcome highlights the substantially different outcomes consumers might encounter. Dr Washusen made repeated attempts (as a 'normal' consumer) to obtain information from TXU Retail about the terms and conditions applying to solar PV systems connected to TXU's distribution network. TXU is the only distributor in Victoria that has published a network tariff applying specifically to solar PV systems. Despite repeated, return calls, e-mails and contact from a person who described herself as TXU's 'retail manager', TXU failed to provide any information at all on the rems and conditions of a retail offer.

such as solar PV at a clear economic disadvantage, despite the fact it does not produce the same pollution.

Renewable technologies and particularly solar PV have another distinct advantage over traditional energy generators. Electricity costs are impacted by the increasing peak summer demand. This demand, places a premium on electricity generated during the hottest periods of summer days (correlating with high ambient air temperature and AC use). The generation capacity of solar PV is also at a maximum at this time.

However the real economic benefits of solar PV to meet this summer peak demand is not recognised, due to the tariff structures which smear these peak costs across all energy consumers and times.

Project Fees:

Most distributors charge a fee for the connection of solar PV to their electricity grid. This cost covers preparation of connection agreements, approvals and labelling of network connection points (to reflect and warn of connection of an embedded generator connection within the customer's premises as required by Electrical Safety Regulations).

The distributor's fee is one of the regulated charges subject to approval by the ESC from time to time.[34] Powercor, for example, has a standard project fee of $299.20

However, these fees vary by distributor. Several of the installers interviewed by the ATA for this report stated that there is 'no standard fee whatsoever'.

Comparing retail tariffs:

Full Retail Competition (FRC), which commenced in January 2001, has allowed electricity retailers to offer a range of electricity tariffs and compete for customers. So far, a minority of customers have switched electricity retailers for supply. This is due partially to the complexity involved in comparing tariff offers between retailers. This was acknowledged recently by the Victorian ESC, launching the *Energy Comparator.*[35]

However, comparison of retail tariffs is even more complex when comparing tariffs for electricity exported back to the grid from PV systems, which the Energy Comparator does not cater for. System owners must analyse the different tariffs for export and import of electricity (which are often different)

[34] It is understood that the ESC only requires these fees, which are known as Excluded Service Charges, to be reviewed when they are changed by a distributor. There is nothing on the ESC Website to indicate that the ESC undertakes detailed scrutiny of the basis on which Excluded Service Charges have been established. However, the ESC is reviewing metering charges as part of the current electricity distribution price review. Substantial differences between the level of the fees between distributors, for essentially the same 'service', suggests the ESC should closely scrutinise the basis of the fees.

[35] Available at http://www.esc.vic.gov.au/electricity878.html.

from each retailer as well as consider the variance in conditions (such as contract length and conditions and method of payment for net export).

This increased difficulty is reflected by the fact that not one respondent changed electricity retailers. While the questionnaire does not determine if comparisons between retailers were undertaken during renegotiation of tariffs, it can be assumed that few system owners did so.

It is worth noting however that 80% of respondents did not initially understand the difference between their energy retailer and distributor. System owners also wanted to avoid any further complexity in negotiating grid connection, which would be involved if they were changing retailers.

Variable rates:

While Full Retail Competition allows electricity consumers to choose retailers, local retailers are obliged to make an offer to supply electricity to small consumers located in their initial 'franchise' areas, under a basic contract called a Standing Offer. This requirement is prescribed under section 14 of the *Electricity Industry Act 2000*.[36]

However, when a solar PV system is installed, this Standing Offer is no longer being applied by retailers, who may only offer a new tariff – for electricity imported and exported to the grid. In all cases that ATA is aware of this occurring, the new tariff was less advantageous to the solar PV system owner than the previous Standing Offer tariff.

The case study of Respondent B above revealed one such example, where the electricity retailer changed the tariff rate once the system was installed, changing considerably the economic viability of the system. The return on investment period changed significantly as a result and Respondent B now regrets his investment decision.

Fixed connection charges:

While installation of a renewable energy system will reduce the amount of electricity consumed and purchased from the electricity retailer, the fixed service to property charges remain. This provides a disincentive for reduced consumption or purchase of renewable energy systems.

While it must be acknowledged that the electricity distributor will incur costs maintaining the connection, and retailers incur costs in dealing with and billing customers, the application of fixed charges is inconsistent with the actual charges incurred by system owners. This provides a disincentive for either energy efficiency or the installation of a renewable energy system, as the monthly charges can remain significant even if little electricity is consumed

[36] http://www.austlii.edu.au/au/legis/vic/consol_act/eia2000261/s14.html

from the grid. This contributes to the very poor return on investment that many system owners experience, and the excessively high ongoing charges from electricity retailers (despite minimal consumption of electricity from the grid).

GST:

The Goods and Services Tax introduced in July 2001 applies to electricity supplied if the:

Solar owner is registered for GST and the supply is made in the course or furtherance of their enterprise.

However, this supposes that the system owner and energy retailer can determine the amount of electricity that is generated – that is the gross export – by the system.

Many solar PV systems are installed with net metering, which simply shows the total amount of electricity imported or exported to/from the electricity utility. What this does not account for is the actual amount of electricity that is generated by the system and consumed by the householder.

While the electricity supplied to the system owner from the utility is taxable, this metering configuration limits the ability to calculate the amount of electricity generated by the system and hence how much tax maybe payable.

The Australian Tax Office (ATO)[37] agrees that this limits the capacity of system owners to calculate GST and electricity and conclude that:

Some metering equipment currently installed may not be capable of separately determining the exact quantity of both the electricity supplied to the solar owner and from the solar owner. The cost of replacing such meters may not be economically viable.

In these circumstances, the electricity retailer can only determine the value of electricity supplied to the solar owner.

The ATO therefore does not mandate gross metering for the vast majority of domestic solar PV systems. There is no requirement for system owners to install interval meters and record gross metering of electricity (based on this interpretation).

DUoS, TUoS charges:

Restructuring of the Victorian electricity sector has resulted in the privatisation and disaggregation of electricity retail, distribution, transmission and generation businesses. Under this industry structure, the costs for the

[37] http://www.ato.gov.au/businesses/content.asp?doc=/content/41341.htm

Distribution use of Service (DUoS) and Transmission use of Service (TUoS) for electricity are passed on to the consumer by the electricity retailer.

Electricity retailers are charged DUoS based on the amount of electricity consumed by all of the retailers' customers. When a solar system exports surplus electricity back to the grid, the DUoS charges incurred by the retailer (from the appropriate distributor) are reduced accordingly.

These savings are achieved by the retailer and the benefits may not be reflected in the tariffs offered to system owners.[38]

Renewable Energy Certificates:

Most solar PV systems are also eligible to earn Renewable Energy Certificates (REC) for electricity generated. There are a number of options available for claiming the value of these. System owners can do nothing, claim the RECs themselves or sell them to an Agent.

Few system owners are aware of these options and may often unknowingly transfer the right to these to their electricity retailer or PV system retailer. A number of system owners faced contractual issues, when they had unknowingly agreed to provide their RECs to their retailer (when signing their contract for retail electricity). The system owners had however already committed the RECs to the PV system retailer at the time of purchase.

This highlighted the level of complexity and detail within the retail contracts and the lack of awareness (or clarity provided) concerning RECs.

4.5.2. Service Levels

The questionnaire respondents largely agreed that service provided by both the distributors and retailers was of a poor standard (2.5 and 3 out of 10 respectively).

ATA acknowledges that the questionnaire may have attracted responses from members whose experience was the most unsatisfactory (those riled enough to respond). However ATA's own experience from contacting utilities and attempting to obtain information (refer to section 4.4 above) confirmed that there is much room for improvement in service.

The following issues were highlighted throughout the course of this research.

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[38] It appears that some retailers are indifferent to changes in cost of serving individual customers either because of oversight, indifference or administrative expediency.

There is an incentive for retailers to structure their retail prices in a way that mirrors network costs. This action reduces the business risk associated with losing the customer to another retailer. However, retailers do not always structure their prices to reflect network costs. For example, United Energy's ToU interval meter network tariffs impose very different costs on retailers, based on the consumption choices of individual customers. But not one retailer offers a retail product that reflects this difference in network costs.

Customer Service technical skills:

The front line customer service staff of retail and distribution businesses had very limited understanding of solar PV or the procedures and protocols that their companies adopted regarding grid connection.

Many of the questionnaire respondents highlighted that there was little ‘enthusiasm' or sympathy for the challenges faced by solar PV system owners from customer service staff. This creates significant difficulty for system owners particularly when proactively planning and understanding grid connection. This was translated into frustration when attempting to (reactively) resolve issues with grid connection – either technical issues or when the process itself had stalled.

This was best summarised by one respondent’s comments that:

‘The retailer’s staff were unhelpful and knew little about solar energy. Spent days trying to talk to someone with this knowledge.’

This was a significant contributor to many systems remaining unutilised and disconnected for months after installation.

Billing:

Many system owners revealed that it had taken many months for the retailer to correctly calculate and provide accurate billing information.

‘The retailer now regularly adds the readings (and energy supplied to grid) rather than subtract’.

A number of respondents had, therefore, contacted the Victorian Electricity and Water Ombudsman to assist in the satisfactory resolution of billing issues.

IT systems of electricity retailers were originally designed to record billing information for electricity *sold* to customers, not *purchased* from owners of renewable energy systems. This is likely the key cause of this issue and appears to be resolved amongst most retailers.

A second cause surrounds the actual reading of the more complex electronic meters installed at small embedded generators.

Coordination and responsibilities:

The process for obtaining grid connection varies significantly between distributors throughout Australia. Both the process and guidelines vary, with distributors developing connection agreements independent of each other or regulators.

Distributors are required to negotiate 'in good faith' a 'fair and reasonable' agreement and charge for connecting solar PV systems to the network. In reality costs vary significantly – depending on location and distributors and retailers - and there is little scope for negotiating or appealing against these charges. These issues are discussed in detail in Section 6 of this report.

These ill-defined procedures have also resulted in poor coordination and communication of responsibilities between retailer, distributor and the system owner. This was often the course of systems remaining idle for several months are installation, as responsibility for metering of the final connection remained ambiguous and unresolved.

'My experience trying to grid connect my system has not been good' was a common complaint from the survey respondents.

Maximum Export Cap:

A number of survey respondents stated that their connection agreement included a limit on the total energy exported to the grid on a monthly basis. Further, there were also limitations on the amount, timing, and form of payment for any net exports of electricity.

It is not clear what drives retailers to impose conditions such as this. It could be that they see it as 'unfair' that a solar PV system own 'gets away with receiving services at a discount' relative to other customers. Or it could be that the retailers have a single pricing policy that relates to all embedded generators irrespective of size. Such a policy would 'bundle' residential solar PV system owners in the same consumer cohort as a hospital with a 1MW (or 5MW) cogeneration unit – even though the network and retail costs involved in serving these different customers would be fundamentally different.

Whatever the reason, these constraints seem unconnected with other aspects of retailers' (and distributors') policies. A common feature of network and retail pricing policies is the 'smearing' of costs across consumers with similar consumption patterns and similar costs.

It is clear that solar PV system owners' total consumption will be less than households without solar PV. However, the overall consumption, or even the consumption pattern, would not necessarily be substantially different to a significant number of other low-consumption residential customers[39] – apart from the possibility that the system will be able to export (relatively small amounts of) energy during daylight hours.

Nor would the incremental change in overall consumption following solar PV installation necessarily be different to other forms of energy choice initiated by a consumer. For example, a 'normal' customer could achieve significant overall reduction in GHG emissions, and substantially reduce electricity

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39 For example, a small city apartment used on the weekend by someone who lived in the country, or an occasionally interstate visitor.

demand (and their total energy cost), by switching from electric heating to gas heating. In that case, the reduction in electricity demand and consumption would be much greater than would occur with installation of a solar PV system. However, that 'normal' consumer would face no constraint whatsoever to their energy consumption choice.

By comparison, conditions such as export caps, appears to be based primarily on unfair policies that deliberately, and unfairly, discriminate against small solar PV system owners.

4.5.3. Technical

The technical guidelines and specifications imposed by distributors for grid connection vary considerably, often in excess of relevant Australian Standards (AS4777 relating to Grid Connection of energy systems via inverters) and those specified by State or Territory regulators. Electricity utilities are responsible for approving inverters used in their supply territory. System installers are aware of these technical specifications for the specific electricity distributor.

Technical standards:

While few system owners are aware of the relevant technical standards and requirements, they must engage nationally accredited system installers to qualify for any Government rebate. These installers are familiar with the relevant standards and technical guidelines.

Primary amongst these are Australian Standards AS 4777[40] and the *Service and Installation Rules* developed by the electricity distributors and overseen by the Office of Chief Electrical Inspector.

Despite these standards, the most technically knowledgeable system owners and installers expressed concern about the ways these standards are interpreted and applied by distributors. The areas of concern include wiring or metering (see below) and surge protection.

For example, Respondent A was required to have a second circuit breaker installed before the distributor would replace his electricity meter and connect his system to the grid.

40 This includes:

- AS 4777.1 Grid connection of energy systems via inverters - Part 1: Installation requirements
- AS 4777.2 Grid connection of energy systems via inverters - Part 2: Inverter requirements
- AS 4777.3 Grid connection of energy systems via inverters - Part 3: Grid protection requirements

Meter Wiring:

The Victorian ESC *Electricity Customer Metering Code*[41] states that:

*(5) **Metering equipment** for **non-market generators** must be able to measure positive and negative flows separately and for the avoidance of doubt the metering requirement in this sub-paragraph 5 allows the customer load and the non-market generator to be connected together on the customer's side of the meter so that any exports are "net metered";*

This clause is difficult to interpret and is confusingly ambiguous. On the one hand it says that the meter '*must be able to measure positive and negative flows separately*', which can only be done if the generator output is brought back to the meter. On the other hand, it says '*load and the non-market generator* (can) *be connected together on the customer's side of the meter*', which is the way "net metering" has been implemented previously – and which does not require the generator output to be brought back to the meter.

The ESC seems to have got itself confused about the technical capabilities and limitations of low-cost metering technologies.

The ATA's understanding is that (the conventional interpretation of) "net metering" is easily implemented at low cost by connecting the output of a solar PV system to a switchboard in the owner's premises and recording energy inflow and export on a "net" basis using a rotating Ferraris Disk meter. The Ferraris Disk meter is a (very) low cost device that has been used for measuring electricity consumption since the late 1800s. It records electricity consumption electromechanically and has the attribute that the disk rotates in one direction if energy is imported and the other if energy is exported. Therefore, "net metering" can be implemented automatically without any change in meter.[42]

The ATA also understands that measurement of '*positive and negative flows separately*', and then implementing "net metering" by addition of the separate positive and negative amounts, can only be achieved by taking the output of the solar PV system back to a single metering point and installing metering technology that is capable of reading both positive and negative flows separate. This can be achieved by installing two separate Ferraris Disk meters or a single, advanced electronic meter.[43] Irrespective of the metering technology, this requirement imposes additional costs for the wiring to bring the solar PV system output back to the metering point; and for the additional, or new, metering required to measure positive and negative flows.

Apart from the psychological issues this creates for many solar PV system owners (see below), the additional costs involved in meeting this Code

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[41] http://www.esc.vic.gov.au/apps/page/user/pdf/ECMC_FinalVer_1_1_16March04.pdf

[42] The ESC has advised that its understanding is that a Ferraris Disk meter cannot meet the accuracy requirements of the Code (or the National Electricity Market Metrology Procedures) in both directions. These meters are required to achieve an accuracy of +/- 2% for energy consumed.

[43] The ATA understands that all commonly available electronic electricity meters have capability to measure positive and negative flows separately, but cannot automatically detect exports of energy.

requirement are more than likely to wipe most of the (relatively) small benefit that solar PV system owners can gain under existing energy buy-back tariffs offered by retailers.

Interpretation and/or compliance by distributors of this Code requirement impacts system owners negatively.

Connection of the solar PV system to the customer side of the meter allows the customer to directly consume the electricity generated from their own system. This is a very important point for most solar PV system owners. Many purchase solar PV systems so they can actively contribute toward improved environmental outcomes. It is of great pride that they produce clean renewable energy and can use this to power their own homes.

However, several electricity distributors interpret this Code requirement as requiring the solar PV system to be connected directly to the meter. Refer to Appendix C which illustrates this requirement. At the time of writing both Alinta (United Energy) and CitiPower insisted on this type of wiring in apparent contradiction to the ESC's interpretation of its own Code.[44]

This has a significant impact on system owners; they do not get to directly consumer the electricity their system produces.

There is also an additional cost associated with this configuration, particularly if the meter is located considerable distance from the switch board where the solar PV system would otherwise be connected.

Metering:

As discussed above, grid connection often requires an upgrade to the existing electricity meter to allow recording of bi-directional electricity flow - when the system sends surplus electricity back into the grid. The cost of this meter upgrade can be significant (relative to the value paid by retailers for energy exports), and may be at the discretion of the electricity distributor. Responsibility for planning and performing this upgrade is often the point of most confusion.

Utilities specify the type of meter to be installed and this cost is borne by system owners. There is little incentive therefore for utilities to select the least cost metering option, and metering costs may be higher than otherwise necessary.

The Victorian ESC recent decision on Electricity Customer Metering endorses this approach. This decision mandated the rollout of manually-read interval meters, but does not commence for newly installed and replacement residential consumers until 2006. Even then, the roll-out focuses on new

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[44] Concerns with this issue were discussed with the ESC, which has undertaken to review the wording of the Code and discuss the issue with distributors. The ATA's position is that the Code should be rewritten to allow "net metering" with a single Ferraris Disk meter, with the choice of any alternative metering being solely at the discretion of the solar PV system owner.

connection, high consumption households and Off-Peak electricity users. The slow rollout of this manually-read metering technology will ensure that few households have access to convenient, easy-to-use automated, remote load control technology that is suitable for ‘sensitive management’ of ‘high impact’ loads such as air conditioning (AC).

There are numerous international examples of power system technologies that are capable of offering a range of convenient, automated, remotely-activated services that would assist consumers manage their use of electricity. In particular, these technologies could assist consumers lower their overall energy consumption and improve the efficiency of operation of electricity systems - as well as improved environmental outcomes. Utah Power, for example, uses technology that allows remote load control of AC units.

Related communications technology may well offer considerable benefits to network operators and small embedded generator owners, but there are currently no plans by any Australian electricity distributor to roll-out such technology with the mandated meter changeover.

As discussed elsewhere in this report, the actual benefits realised by system owners as a result of being required to install interval metering is miniscule. While system owners are forced to pay for interval meters, these are of no financial value while corresponding time of use tariffs remain absent.

The current regulatory framework allows nonsensical charges of hundreds of dollars (because the ESC has yet to insist that the DBs Excluded Service Charges are set at “fair” levels) when the total annual value of net exports are likely to be much less than $100.

When solar PV system exports electricity a Ferraris Disk meter will rotate backwards. ATA is aware of some limitations of accuracy of “reverse” Ferraris disk meters and compliance with the National Measurement Act and NEM Metrology Procedures.

These analogue meters have a level of inaccuracy when cycling forward, which no doubt exists (and possibly to a greater extent) when working in reverse. However, as discussed above, given the high costs of alternate metering and nominal amount of electricity exported per annum, ATA believes that Ferraris Disk meters can provide an adequate metering solution at present and until such time as time of use tariffs are introduced.

5. Assessing the Causes

Small embedded generator owners are in a vulnerable negotiating position, as they are generally individuals who have invested their own private funds in a renewable energy system who do not have a high level of technical understanding of issues affecting electricity distributors or retailers.

The critical issue is that solar PV owners generally consider solar PV systems as one of a suite of demand management and energy conservation choices that they have *a right* to choose. For example:

- they will have reduced demand and consumption by installing low-energy compact fluorescent or LED[45] lighting and energy-efficient appliances, which they are free to do without any reference to their distributor or retailer (or, in most case, without reference to a qualified electrical contractor); and
- they may even arrange for a solar PV system to be installed and connected to supply part of their electricity needs without reference to their distributor and retailer – provided the system is not connected to the grid supply.

In both these cases, the consumer would be able to stay on a standard residential tariff and capture the full value of their energy conservation choices.

However, as soon as they make the choice to grid-connect their solar PV system, the rules change totally and they are compelled by the regulatory framework to:

- deal with their energy retailer and distributor;
- seek the approval of their retailer and distributor to grid-connect their solar PV system;
- accept a new, and more costly metering arrangement – if *their distributor* decides this is 'necessary';[46] and
- lose the 'protection' provided by ESC oversight and approval of default tariffs (and/or Standing Offer energy contracts).

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[45] A light-emitting diode (LED) is a solid-state semiconductor device that converts electrical energy directly into light. Recent advances in the design and manufacture of these miniature semiconductor devices may result in the obsolescence of the common light bulb, perhaps the most ubiquitous device utilised by modern society – because LEDs have far longer life (up to 100 times) than incandescent lights, and use much less energy (as low as 20%). (See: http://www.micro.magnet.fsu.edu/primer/lightandcolor/ledsintro.html). Low-cost LEDs also have the potential to displace compact fluorescent lighting. Widespread deployment of LED lighting would introduce another innovative technology with potential to fundamentally change the demand profile of residential and Commercial energy use.

[46] There are circumstances where a solar PV system owner could gain a benefit from a more sophisticated metering arrangement. But this would only occur where retailers offer well-designed, time-of-use tariffs that reflect the full value of the energy characteristics of a solar PV household. Unfortunately, not one single retailer in Australia offers such tariffs at this point in time. Therefore, sophisticated metering will not offer any benefit to a residential solar PV system owner.

The contrast between the right to choose and compulsion to dictate is stark in the extreme, and is the cause of the misunderstanding and dissatisfaction expressed by solar PV system owners as detailed in Section 4 above. The regulatory origins of this stark contrast are explored in later sections of this report.

5.1. Impact of 'Open Access' Principles

A major factor that has assisted development of renewable technologies is the 'open access' principles of the National Electricity Code (Code) and/or Jurisdictional laws and regulations.[47] In Victoria, these relationships are determined by the Victorian Electricity Supply Industry Tariff Order, (through the *Electricity Industry Act 2000*), the Distribution Code and regulatory Guidelines which enable the ESC to set tariffs and conditions for access etc.[48] However, as noted below, the objectives, obligations, responsibilities, protections and processes specified in documents controlled and overseen directly by the ESC are all very general. The details of the physical connection of solar PV systems to distribution networks, pricing of network and retail services and the details of 'contract' arrangements between residential solar PV system owners and energy retailers are all developed by supply-side entities through processes that have *no effective* solar PV system owner input and are subject to *little effective* scrutiny or oversight by the ESC.

The reality for residential solar PV system owners is that, despite the in-principle support for small renewable embedded generation, the regulatory and market framework is structured so that the 'odds favour the supply-side'. This 'light-handed' approach has developed because the ESC specifies only minimum terms and conditions (generally using qualitative descriptive language) and assumes that end-users have the knowledge, experience and power to 'negotiate' as equal partners in the 'access transaction'. This reliance on 'negotiated' outcomes may be sound in theory, but many small embedded generator owners are unaware of their rights and obligations – which frustrates their ability to 'negotiate' with distribution and retail companies.

In addition, the real-life experiences of residential solar PV system owners discussed in this report demonstrates that small-scale embedded generators do not receive consistent treatment in their dealings with monopoly distribution companies, or with energy retailers. Instead, they often find themselves involved in frustrating, lengthy and expensive negotiations that sometimes result in confiscation of whatever economic and environmental benefits they are creating.

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47 The Code requires the jurisdictional regulators to create an environment in which generation, energy storage, demand side options and network augmentation options are given due and reasonable consideration (Clause 6.10.3(e)(2)). Chapter 5 of the Code details the requirements for the connection of embedded generation to distribution networks. The Code requires that distributors negotiate in 'good faith' with embedded generators in respect to access to the network and avoided Transmission Use of System payments (TUOS). Chapter 6 of the Code outlines the requirements of distributors to the treatment of avoided distribution costs, cost allocation and prices. While the Code is <u>not</u> the controlling document for regulation of the distribution and retail sectors in Victoria, the objectives, obligations, responsibilities, protections and processes specified in the Code are (largely) replicated in the jurisdictional arrangements administered by the ESC.

48 NSW, SA and Queensland have parallel, but significantly different requirements.

5.2. *Discriminatory Treatment*

Despite these principles of open access, discrimination remains. An essential difficulty with the existing regulatory framework affecting small renewable embedded generation is that the ESC has not explained why regulatory policy legitimises discrimination between small embedded generation and other forms of demand management that have a similar quantum of impact on residential consumer load. For example, a residential (or Small Business) consumer:

- can replace an Off-Peak electric hot water service with a gas or solar unit without having to do anything other than comply with applicable technical and safety regulations (the consumer may benefit from advising her retailer that the change has been made, if lower-cost electricity metering/tariffs applied, but could make the changeover without anyone being the wiser);[49]
- can replace standard incandescent light fittings with low-energy compact fluorescents or LED lighting without having to do anything other than purchase the new light fittings from their nearest supermarket and install them;
- could add a Sauna heater or refrigerative AC unit (or any other major load appliance) without having to do anything other than comply with applicable technical and safety regulations - provided the total load is less than the Supply Fuse capacity; or
- could install a Stand Alone solar PV system without having to do anything other than comply with applicable technical and safety regulations.

Each of these actions would change the consumers' load characteristics significantly; or in the case of the first three even substantially more than a grid-connected solar PV installation. In particular, the widespread proliferation of high-capacity refrigerative AC very clearly has a much greater impact on network costs than would solar PV installations. However, current regulations administered by the ESC require that a customer installing a grid-connected solar PV system must notify their distributor and comply with complex connection procedures that are not required for any of the above.

Fundamental issues not addressed in the current regulatory framework are whether:

- technical or safety regulations 'justify' discriminatory treatment of 'small' grid-connected embedded generators; or

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[49] This is not a hypothetical case. Interval meter data for an Off-Peak hot water heating consumers provided to Pareto Associates by a major Victorian retailer and used to analyse the impact of United Energy's ToU network tariffs showed no signs of Off-Peak load. It could only be assumed that the retailer selected the data set based on standard accumulation meter tariffs, and the consumer had changed from Off-Peak electric water heating to gas heating without advising the retailer.
(This was reported in *Smart Meters for Smart Competition? Will Current Proposals Hand Back Power to Consumers? Update 2003 - A consumer-focussed comment on the Victorian Essential Services Commission Position Paper Installing Interval Meters for Electricity Customers - Costs and Benefits*, Report for the Energy Action Group, March 2003).

- discrimination is related to 'cultural' issues affected by challenges in dealing with 'large' embedded generators; or
- discrimination is a form of monopoly exploitation in the commercial and/or financial relationships between the customer, the distributor and the retailer.

5.3. Legitimacy of discrimination

The ATA, and its members, recognise that technical and safety issues are extremely important. Accordingly, MJA discussed with the Office of the Chief Electrical Inspector (OCEI) whether legislated technical or safety obligations on distributors or customers justify treating 'small' embedded generators differently to other forms of demand management.

In summary, discussion with the OCEI confirmed that there are no specific obligations on distributors, consumers or electrical contractors arising from technical or safety legislation/regulations administered by the OCEI that justify discriminatory treatment of solar PV system owners by the ESC. Provided total loading of the consumer's electrical installation remains below supply capacity, the only action required by an electrical contractor under technical/safety regulation is to ensure the installation complies with the *Service and Installation Rules* and other technical standards; and clearly label the connection point to show an embedded generator is connected at the consumer's premises.

This suggests that the discriminatory treatment of solar PV owners has 'cultural' origins that derive from electricity industry practices, policies and procedures that focus on the commercial/economic relationship between the consumer and distributor that are subject to oversight by the ESC.

MJA also discussed with the OCEI how electrical contractors might respond to clause 9.2(d) of the *Distribution Code*,[50] given that it is more likely that a consumer's contractor would be the party that contacted a distributor about matters change in a consumer's load characteristics. This matter was raised with the OCEI because the ESC indicated in its Draft Decision on the Embedded Generation Guideline that the obligations imposed by clause 9.2(d) would be sufficient to ensure "*customers … notify a distributor when an embedded generator is to be connected, whether via a new connection or through an existing connection*".[51]

It is of particular interest that the ESC indicated support for this position in response to recommendations/suggestions by distributors that:

- *embedded generators be required to register with the network operator, to ensure safety, operations, planning, technical and commercial*

[50] Clause 9.2(d) requires consumers to notify distributors and retailers of any changes to the consumer's electrical installation, or use of electricity, that is likely to affect the distributor, other consumers or the relationship with their retailer.
[51] p25, *Guideline for Embedded Generation - Draft Decision*, Essential Services Commission, April 2004.

considerations are made, supported by appropriate regulation that makes 'do it yourself' connection illegal.

- *a robust process (be implemented) for capturing and maintaining information on distributed generators. The process would be triggered by a mandatory application to connect a generator to a distribution network.*[52]

The distributors' proposals clearly intend to ensure the solar PV system owners are treated differently to other consumers.

It is not immediately clear the ESC's response is justified by comparison to the absence of intrusion into the affairs and choices of AC users, for example. There is no doubt that increasing penetration and use of AC is creating significant challenges for distributors, but neither the ESC nor the distributors has taken any action that treats these consumers differently.

Given the degree of intrusion into the affairs of solar PV system owners, it is reasonable that the ESC clearly explain the basis of this position.

This is particularly the case given that the nub of the response given by the OCIE in regard to clause 9.2(d) is that electrical contractors have a clear legal obligation to ensure that a consumer's electrical installation and all work they undertake complies with technical and safety regulations. A contractor would only raise issues with a distributor if the capacity of the service connection required changing. Given that virtually no small consumer would be aware of the obligation under Clause 9.2(d), and no electrical contractor would be obliged to notify a distributor unless supply capacity needed to be increased, it is not at all clear that it is practicable to rely on that clause to fulfil the purpose intended by the ESC.

In the absence of any explicit legal origin for the discriminatory treatment of 'small' embedded generation as a form of demand management, the ESC has an obligation to protect consumer interests. The ESC can discharge this responsibility by ensuring that such discrimination, if it is to be permitted by the ESC, should only be permitted on the basis that it can be demonstrated to be 'fair and reasonable'.

It is difficult to discern what arguments have been mounted to support the assertion that it is:

- 'fair and reasonable' to allow a consumer to change from Off-Peak electric to gas-boosted solar water heating, or change from incandescent to fluorescent lighting (or even to add a 10kW AC load) without involving a distributor, or subjecting the consumer to a complex administrative process or a change in tariff; and
- 'fair and reasonable' to require solar PV system owners to follow an intrusive and complex process when investment in a grid-connected solar

[52] *Ibid.*

PV embedded generator has the same or less impact on the distribution system .

In addition, it is not clear that it is ‘fair and reasonable’ to set an arbitrary constraints on solar PV system owners when the functionality specified for grid-connected Inverters under AS 4777, which is the requirement specified in the industry’s own *Service and Installation Rules*, provides electrical safety protection that is considered adequate by the OCEI.

5.4. Consumer resistance and workable guidelines

Whatever the origins of discriminatory treatment of ‘small’ embedded generation, a primary reason for raising this issue is that one of the respondents to the ESC's consultation on the Embedded Generation Guideline referred to solar PV users ‘by-passing’ existing procedures - which are generally considered by users to be onerous, excessively complex and frustrating. The ESC’s Decision on the Embedded Generation Guideline also refers to the possibility of ‘do it yourself’ illegal connections, which was raised by TXU. Apart from this one quote from TXU, the ESC makes no reference to ‘illegal connections’ in its Decision.[53]

The ATA has no information to suggest how serious an issue this might be at present. However, the rate of ‘illegal connection’ is almost certainly low. The vast majority of solar PV installations must comply with ‘formal’ connection procedures to qualify for the Federal Government Photovoltaic Rebates. However, it does raise a question about why the procedures ‘need’ to be so complex that they may lead a consumer to do something ‘illegal’,[54] particularly when small renewable embedded generation is almost certainly not going to have the same impact on a distribution network as ‘Large’ embedded generators.

[53] It is also noted that TXU refers to ‘safety and operations’ of embedded generators. The OCEI indicated that ‘safety and operational’ issues would be addressed by electrical contractors ensuing the installation complied with appropriate technical Codes and Standards. Of particular relevance is a requirement in AS 4777 for complying Inverters to have an automatic disconnection capability if external supply exceeds minimum and maximum criteria. An AS 4777 complying Inverter would create no more ‘safety or operational’ challenges for distributors than any other form of appliance connected to a distribution network. Indeed, an AS 4777 complying Inverter would, most likely, improve supply quality at the connection point. Given this situation, and given that Inverters sold in Australia that are intended for grid-connected systems would comply with AS 4777, it is difficult to understand why United Energy raises unspecified objections to adopting AS 4777.

[54] The ESC should note that the ‘illegal’ action in this instance would be no more than flicking a switch on an Inverter panel to initiate ‘export’ mode. The “illegal” action would require no additional wiring or any change to the consumer’s electrical installation. The ESC should also note that the ‘legality’ or otherwise of this action is determined by conditions specified in instruments administered by the ESC, not by any legislated technical or safety obligation placed on the consumer.

6. The Regulatory Framework

This section of the report provides a brief overview of the regulatory framework by reference to how key documents defined the role of, and relationship between, embedded generator owners and the electricity supply industry. This is intended to allow the cause and/or origins of problems faced by small-scale solar PV system owners to be identified and placed in context.

6.1. The Electricity Market

The regulatory framework for the electricity supply industry is based on the assumption that individual energy consumers will (eventually and/or preferably) be capable of exerting sufficient economic pressure through the exercise of choice in a competitive market to determine the quality and price of services provided. Wherever practicable, the framework is designed to allow competition to prevail. Regulatory constraint on ‘the market’ is only applied where there is clearly no possibility of competitive pressures being developed.

The theoretical basis supporting the preference for outcomes from a competitive market is that competitive businesses generally act in a manner that promotes economic efficiency and delivers services that meet consumers expectations and needs. That is, competitive businesses generally seek to reduce costs and increase the quality of their output to gain a competitive advantage over other firms. If firms make positive profits, then other firms will be encouraged to enter the industry. The entry of new firms will increase output, and will place downward pressure on prices. Firms will compete for customers on all three dimensions of a service - price, quality and reliability. Competition therefore encourages firms to be responsive to the requirements of customers and leads to output being produced at least cost.

In markets that are not competitive, such as the supply of network services (where the cost of providing competing service infrastructure will always exceed the economic efficiency benefits delivered by competition), it is not possible to rely on competition to discipline an incumbent supplier to ensure that costs are minimised and service levels improved. Instead of relying on market forces policy makers seek to replicate businesses’ incentives for efficient behaviour through regulation.

The assumption that competition can be made to be effective in all aspects of electricity supply - including provision of services to small-scale embedded generators - is both the cause of many of the problems identified by residential solar PV system owners at the ‘retail end’ of the market, and the cause of difficulties experienced in creating the regulatory regime that applies to the non-market segments of the industry.

6.2. A Consumer Led Revolution?

The objectives intended for reform and restructuring of the Victorian electricity industry were clearly articulated by the Kennet Government:

> *As competition has been introduced into the electricity industry the Government has ensured consumers enjoy the benefits of reform by implementing the key objectives listed below, providing consumers with greater benefits and protection than before. The key objectives of reform are to:*
>
> - *provide the lowest sustainable electricity prices to consumers;*
> - *create the most efficient electricity industry in Australia - aim to achieve world's best practice;*
> - *maximise customer choice and encourage efficient investment;*
> - *ensure an appropriate regulatory environment exists to protect customer service and safety standards;*
> - *ensure long-term security of supply; and*
> - *provide a framework for an effective and sustainable competitive energy market.*
>
> *… The growing National Electricity Market (NEM) increasingly offers a better deal for consumers and places the Victorian industry on a competitive footing.*[55]

The 'greater benefits and protection' were to be achieved by "*privatisation … producing further gains in terms of reduced costs and improved service in the coming years … and from increased pressure on businesses within the NEM to retain customers*."[56] Specific examples of early gains for consumers were trumpeted as:

- *real reductions in the cost of electricity* – without any acknowledgement that the 'base year' for comparison of the price reductions was after the Kennet Government increased prices to virtually all residential consumers through a tariff re-structure implemented in 1992/93;
- *improvements in reliability of supply* – although the Energy Networks Forum (the national representative and lobby group for energy network owners) is now stating publicly that reliability has never been worse; and
- *improvements in service* (indicated by declining disconnection rates, good performance in meeting Guaranteed Service Levels, distribution of Customer Charters and establishment of the Electricity Industry Ombudsman (now EWOV) and reduction in number of complaints).[57]

The benefits conferred on embedded generator owners were the 'right' of open access to the distribution network (implemented by an obligation specified in the Distribution Licence held by all distributors) and freedom to

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55 Section 1.3, *Victoria's Electricity Supply Industry - Towards 2000*, Department of Treasury & Finance Energy Projects Division, June 1997.

56 *Op Cit,* Section 2.1.

57 *Op Cit*, Figure 4, Section 2.2

(eventually) choose the retailer who would sell (and/or buy) electricity required (and/or generated). However, the presumption appears to have been that embedded generators would be owned and operated by holders of Generation or Distribution/Retail Licences (i.e. 'large' embedded generators). For example, the Kennett Government said

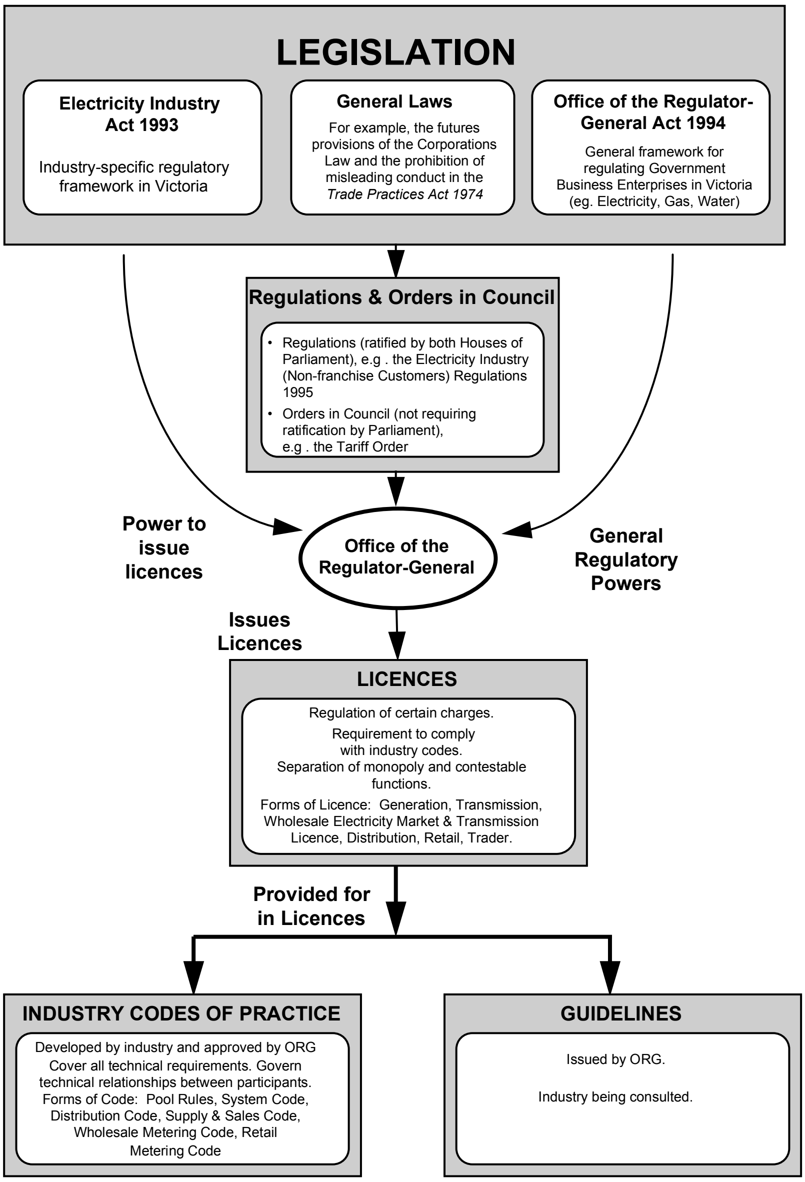
> *"Licensed generators will be able to sell electricity into the NEM generated from wind farms, solar energy, small hydros, ceramic fuel cells, wave power and other sources. One distribution business already offers Victorians the chance to obtain their power from solar electricity panels."*[58]

The regulatory framework applying to the newly re-structured electricity industry (as it was established by 1994) is outlined in Chart 1 below.

This regulatory framework is still the basis on which the industry operates and is regulated, with the only significant changes being the change in name of the Office of the Regulator-General to the Essential Services Commission and progressive development of numbers of 'industry codes of practice' and 'guidelines' that are intended to facilitate interpretation of Licences and Codes' issued by the ESC.

58 *Op Cit*, Section 10.7.

CHART 1: VICTORIAN ELECTRICITY INDUSTRY REGULATORY FRAMEWORK



A large number of documents exist to 'define' this regulatory framework. These include at least:

- six separate pieces of legislation (*Essential Services Commission Act 2001, Electricity Industry Act 2000, Electricity Safety Act 1998, National Electricity (Victoria) Act 1997, Trade Practices Act 1974 and Fair Trading Act 1999– as well as related Regulations (where appropriate – such as the Electricity Safety (Installations) Regulations 1999)*)
- the *National Electricity Code* and the *Electricity Supply Industry Tariff Order* (which has the effect of overriding some areas of the *National Electricity Code* in Victoria);

- five different kinds of Licences (*Distribution, Generation, Retail, Trader and Transmission*) issued to more than 40 entities;
- seven separate 'industry codes of practice' (*System Code, Electricity Distribution Code, Energy Retail Code, Electricity Customer Metering Code, Public Lighting Code, Electricity Customer Transfer Code and Code of Conduct for Marketing Retail Energy in Victoria*); and
- thirteen 'industry guidelines' (covering *Regulatory Accounting Information Requirements* (#3), *Credit Assessment* (#4), *Connection and Use of System Agreements* (#5), *Regulatory Information Requirements* (#8), *Regulatory Audits of Retail Businesses* (#9), *Confidentiality and Explicit Informed Consent* (#10), Voltage Variation Compensation (#11), *Metering Reversion and Contract Termination* (#12), *Greenhouse Gas Disclosure on Electricity Customers' Bills* (#13), *Provision of Services by Electricity Distributors* (#14), *Connection of Embedded Generation* (#15), *Regulatory Audits of Distribution Businesses* (#16), and *Electricity Ring-Fencing* (#17).[59]

Fortunately, not all of these are relevant to all consumers, and only a few are of primary relevance to small-scale embedded generators – although all documents that assist in defining the 'customer-supplier' relationship in general terms are also relevant to residential solar PV system owners.

Equally unfortunately, there is a host of other documents developed and maintained by the electricity supply industry that also impact specifically on residential solar PV system owners. These include the *Victorian Service and Installation Rules* and individual company *policy and procedures manuals* that are not readily accessible to solar PV system owners. None of these latter documents is directly subject to effective oversight or supervision of the ESC. There are also other documents subsidiary to legislation and regulations. Such documents include *Australian Standards AS 4777 Grid connection of energy systems via Inverters and AS/NZS 3000:2000 Wiring Rules*, and the technical and safety 'codes' and 'guidelines' listed by the Office of the Chief Electrical Inspector.[60]

The key documents of direct relevance to solar PV system owners are the:

- *Electricity Distribution Code;*
- *Energy Retail Code;*
- *Electricity Customer Metering Code;*
- *Provision of Services by Electricity Distributors* (Guideline #14) ;
- *Connection of Embedded Generation* (Guideline #15);
- *Australian Standards AS 4777 Grid connection of energy systems via Inverters;*

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[59] Elsewhere in this report, reference is mode to the possible large-scale (future) deployment of natural gas Fuel Cells. If one was to overlay the 'gas market framework' on the 'electricity market framework', the number of documents would increase substantially.

[60] See: http://www.ocei.vic.gov.au/industry/ARCGlist.htm.

- *AS/NZS 3000:2000 Wiring Rules*;
- *Victorian Service and Installation Rules;* and (ultimately)
- distributor specific and retailer specific *policy and procedures manuals* that dictate how company staff (and company contractors) discharge the delivery of services to consumers in accordance with the objectives, obligations, responsibilities, protections and processes specified for the regulatory framework.

6.3. The Governments' Roles

The roles for respective Governments in the (national) electricity market are, in principal, straight forward. Primary jurisdictional responsibility for energy rests with the Victorian Government. However, it is the Australian Government that has (so far) taken a lead role in developing energy/environmental policy and programs – and provided funding to implement and resource these programs.

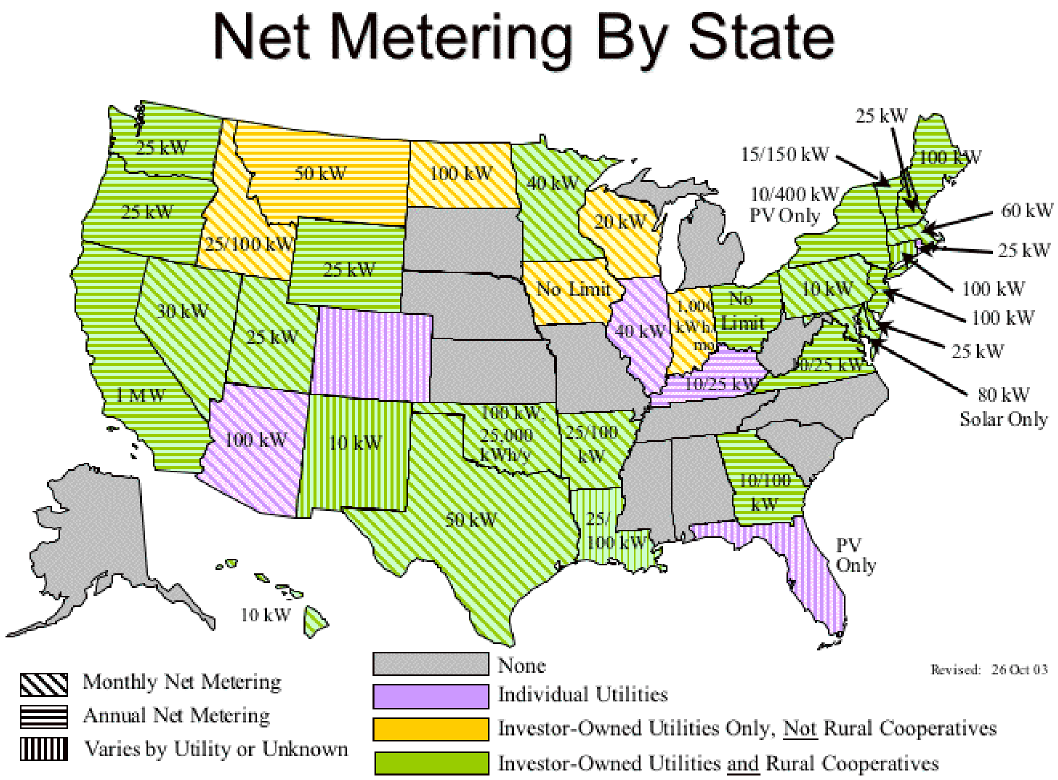
The primary role for Governments is to define the policy framework for the electricity market through legislation and statutory rules. If, for example, the Australian and/or Victorian Governments wanted a different outcome from the PVPR program (such as ensuring solar PV system owners gained access to the full economic benefit of their personal investment), they would have to legislate changes in law or regulation that altered to roles, responsibilities and obligations of market institutions, the ESC and energy market entities.

It is clear that both the Australian and Victorian governments have active policies supporting investment in energy technologies that improve environmental outcomes. The joint role in funding and administering the PVRP is just one example. Accordingly, it may well be appropriate to enact legislation that requires the ESC to adopt policies that ensure the environmental and economic benefits of 'small-scale' embedded generators are taken into account in the relationship between distributors and consumers. Put simply, it is not logical to have a policy that subsidises investment in environmentally beneficial energy use, but no policy on how the subsequent economic benefits are distributed.

6.3.1. Net Metering example

A specific example could be to legislate changes to the *Electricity Industry Act 2000*, or the *Essential Services Commission Act 2000* requiring mandatory adoption of 'net metering', and payment of prescribed benefits to residential (and other) solar PV system owners. This approach has been adopted widely across the US (for example) to assist in promoting and supporting development of solar PV technology and improve environmental outcomes (see below). A further specific example could be to legislate changes to the *Electricity Industry Act 2000*, or the *Essential Services Commission Act 2000* requiring the ESC to explicitly take into account a policy that promotes environmental outcomes.

Such inconsistencies appear to be absent from the large number of US jurisdictions with similar policies. The ATA is not aware of any jurisdictions in the US that provide subsidies for solar PV installations (or other forms of environmentally efficient embedded generation) and do not also have policies that allow the investors in these technologies to gain access to the benefit of their investment on an ongoing basis. Almost all have simple administrative procedures such as compulsory Net Metering or direct ongoing 'compensation' that reflects avoided network benefits.



Source: http://www.eere.energy.gov/greenpower/netmetering/nm_map.html[61]

The basis of this example is not mere sophistry. From the perspective of residential solar PV system owners, it is not at all clear why one form of demand management (small renewable embedded generation) should be treated in a discriminatory fashion. Nor is it clear why there should be complex and expensive administrative and metering solutions imposed on 'small-scale' embedded generator owners that have the effect of diluting or eliminating the (admittedly) small economic benefit of "net metering". Given

[61] An abbreviated summary of the terms and conditions applying to Net Metering arrangements on a State basis is posted at http://www.eere.energy.gov/greenpower/docs/metering_0603.doc. More detailed explanations are available at http://www.eere.energy.gov/greenpower/markets/netmetering.shtml#state .

that solar PV installations are required to meet mandatory technical and safety standards, it is not clear why this discrimination should be permitted.

As a minimum, there is a practical, common sense issue of materiality to consider. Even when the PVRP funding is fully expended, there will be no more than 30MW of subsidised solar PV in Australia. If current trends continue maybe 75% of that will be grid-connected - and it will be dispersed across thousands of connection points. Under those conditions, solar PV will not have a material impact on distribution systems, or on retailers' activities. The costs associated with a discriminatory policy fails a simple ‘common sense’ test and almost certainly delivers no overall economic benefit to distributors, retailers or consumers.

It would be much more sensible to formalise proposals made by the Australian Greenhouse Office (for the sake of ‘national consistency’) which include application of Net Metering (amongst other things) to all solar PV connections. It would also be sensible to require implementation of the simplest, easiest and lowest cost process possible for connection of ‘small-scale’ embedded generators. Such a process should require no more than an obligation for ‘small-scale’ embedded generator owner to:

- adhere to mandatory technical and safety standards, including a requirement than grid-connected Invertors comply with AS 4777;
- formally notify distributors and retailers that the connection has been made and that it complies with the relevant technical and safety standards; and
- clearly specify Net Metering and ‘Deemed tariffs’ as the default, with the option for consumers to choose any other tariff/metering arrangement offered by distributors and/or retailers - if this better reflects the true economic value of the connection.

Such a solution has potential to remain workable until the impact of small renewable embedded generation gains the potential to become material.

A parallel and sensible longer-term policy would be to follow approaches adopted in the UK and require the ESC to develop a ‘full-blown’ program aimed at providing balanced incentives for expanded investment in wide-scale distributed embedded generation. Apart from the brief statement included in United Energy’s submission to the ESC review of the Embedded Generation Guideline, there is little evidence that any of the distributors is considering the future implication of widespread small renewable embedded generation. However, it is possible that falling FC costs (and even Origin's ‘Sliver’ Solar PV technology) will lead to accelerating, wide-scale proliferation of small renewable embedded generation over the coming decade. If that does eventuate there is a real possibility that current policies would result in significant asset stranding, which would not be a useful outcome for anyone.

6.4. The Role of the Retailer, Distributor and ESC

The current regulatory arrangements compel prospective (or existing) solar PV system owners (via Clause 9.2 of a *Distribution Licence*) to advise their retailer (and/or distributor) that they intend to connect their system to the grid.

If they choose not to seek grid connection, the system owner is not required to advise either their retailer or their distributor that the system has even been installed. Clause 9.2(d) does say that "*A customer must inform its distributor or its retailer as soon as practicable if there is any … major change to the amount of electricity likely to be used by the customer at the customer's supply address.*" However, the term 'major change' is not defined by the ESC and advice provided by the OCEI confirms that the system owner's electrical contractor (or accredited system installer) would not normally advise the distributor that a non-grid connected solar PV systems had been installed except in the unlikely event that some physical modification to the distributor's existing connection was required.[62]

Advice to the system owner's retailer that grid connection is required triggers two important processes. The first is that the retailer is required (by conditions specified in Clauses 7 and 14 of an *Electricity Retail Licence*) to make an offer to supply the customer and notify the relevant distributor (in accordance with procedures specified in the *Codes* and *Guidelines* issued by the ESC) that a change in connection is required. The second is that these procedures allow both the distributor and retailer to change the terms and conditions of supply:

- in the case of the distributor, the changed conditions of supply must be consistent with tariffs (and/or tariff processes) approved by the ESC;[63] but
- the details of the actual physical connection, and the metering arrangements, may vary between distributors (which affects to cost of the grid connection; and the ongoing cost of tariffs) because –
  - the arrangements specified by the ESC are very general (intending to be 'technology neutral') and 'process focussed';
  - the ESC takes no role is oversighting specification of the detailed physical connection arrangements; and
  - the OCEI – which does oversight the technical and safety aspects of the connection standards, process and procedures – takes no role in oversighting the economic or financial aspects of the connection; and

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62 It is noted, however, that the ESC has indicated some sympathy for the view that installation of an interval meter could be used as a condition for compulsory reassignment of affected consumers to new tariffs (see: p186, *Electricity Distribution Price Review 2006-10 - Position Paper*, ESC, March 2005)

63 TXU is the only distributor that (currently) publishes a network tariff (NEE23 Photovoltaic) for Solar PV systems. TXU has changed the NEE23 Tariff somewhat since its introduction in 2003; but it is noteworthy that it has:

- a substantially higher (175%) Standing Charge than the Residential Single Rate tariff (NEE11);
- a slightly higher (8%) rate for Peak energy consumed; and
- a substantially (28%) discounted "Buy Back" rate during the summer peak period only.

Like all other retailers, TXU does not disclose the price of its retail 'market tariffs'.

United Energy (Alinta) does not publish network tariffs specifically for Solar PV systems. But is does publish a suite of Time-of-Use tariffs for half-hourly interval meters that have potential to deliver significant value to non-air conditioning Solar PV system owners. Unfortunately, not one retailer offers a product that transfers the benefits of the United network tariffs to consumers.

- in the case of retailers, the changed conditions - as they affect the price offered for the changed supply conditions - may be set by the retailer's judgement of the market.

  That is, the request for grid connection is intended to result in delivery of the grid connection but there is no obligation on the retailer or distributor to offer terms and conditions that are the same as those applying prior to the grid connection.

Prospective grid-connecting Solar PV system owners should also note that, completion of the grid connection may result in:

- a requirement that two AC isolation switches be fitted to the solar PV installation (one at the rooftop solar panels, and the second where the invertor connects to 'normal wiring installation) – but only if the system is installed in CitiPower's distribution area;

  (This is permitted as a company specific modification of the *Victorian Service and Installation Rules*).

- a change in metering configuration from a 'conventional Ferraris (rotating disk) accumulation' meter to an electronic, 'half-hourly, interval' meter – but (currently) only in CitiPower's and United Energy's (Alinta's) distribution networks;

  (This is permitted under clause 8.4(c)(5) of the *Electricity Customer Metering Code*.)

Issues related to the impact of regulations governing metering are expanded in section 4 of this report.

6.5. Scalability of the guidelines

A major issue relates to the wide-scale proliferation of small renewable embedded generation would have a fundamental impact on distribution networks. The ESC's Guideline for Embedded Generation might be workable for (say) 150-300 connections/year. But if gas-powered combined heat and power fuel cells (CHP FC) become affordable, distributors may have to cope with hundreds or even thousands of connections per week.[64]

If the costs of solar PV systems and FCs fall as anticipated, it is entirely possible that within the next decade Victorian consumers will be able to buy solar PV systems and/or CHP FC units (instead of hot water heaters or central heaters) by the thousand - and produce electricity as a buy-product.

Given the levels of frustration reported by solar PV system owners in Section 4 above, the regulatory framework is not likely to be either convenient or workable if there is proliferation of 'small'-scale embedded generators based

[64] An approximate estimate based on an assumption that around 50% of hot water users might switch to low-cost CHP hot water units as conventional gas heaters were replaced at the end of their useful life.

on emerging low-cost technologies. Retention of (relatively) complex and onerous obligation for solar PV system owners to notify the distributor/retailer and follow a complex, user-unfriendly process to achieve grid-connection will almost certainly lead to widespread, adverse consumer reaction.

6.6. Regulatory step-change

The wide scale proliferation of low-cost, small-scale embedded generation would require a major re-think about how distributors design, build and operate their networks, how they can be 'incentivised' to provide services that consumers will seek anyway, and what form of pricing policies would best provide incentives for embedded generator investors and distributors. This is not just a matter of focussing on "positive" incentive for distributors. It is very easy to visualise the possibility of several neighbouring consumers establishing an active 'mini-grid' and by-passing the distribution network. In those circumstances, distributors (and other consumers) would be interested in ensuring there were 'positive' incentives for consumers to stay connected.

As noted above, it is of concern that it has taken nearly a decade for the ESC to get a first embedded generation Guideline in place. Accordingly, the ATA endorses the general thrust of United Energy's comments[65] that the ESC should consider a 'paradigm shift' in policy and focus that policy on issues impacting "small" embedded generation. As United suggests, it would be far better for the ESC to develop an "enduring" approach to treatment of small renewable embedded generation". The ATA believes that a suitable policy would minimise intrusion into decisions made by consumers, and provide balanced incentives for distributors and small renewable embedded generation investors.

A further related issue that is already being considered by some regulators in overseas jurisdictions is the potential for inappropriate investment in distribution (and transmission) networks that does not take account of the impact of proliferating distributed embedded generation. OFGEM, for example, commenced a formal work program in 2001 that includes examination of changes needed in the UK regulatory regime to:

- facilitate investment in CHP and other distributed embedded generation technologies;
- provide clear incentives for distributors (in particular) to support this investment; and
- avoid the risk of asset stranding in the event that small renewable embedded generation technologies proliferate to the extent that distribution networks are transformed from their current 'passive' role to that of an interactive 'mini-grid'.

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[65] See United Energy's submission to the ESC consultation on the Embedded Generation Guideline.

OFGEM said in 2001 that:

> *Today's distribution networks operate passively delivering power from the transmission network, through the distribution network to the end customer.*
>
> *They have been built, and are operated and regulated, to work in this way.*
>
> *Substantial embedded generation would require more active distribution networks which allow electricity to flow in two directions – to the electricity user for consumption in the home or business, and on to the network when the user is exporting excess generation capacity.*
>
> *Ofgem is currently looking at the issues facing embedded generation to ensure that its development is not hindered by the way in which networks are currently operated and regulated.*
>
> *In looking at these issues, Ofgem's overriding consideration is to ensure that any changes for the future do not put at risk electricity customers' access to a secure, good quality electricity supply at a fair price.*[66]

The regulatory framework in Victoria embodied in the Distribution Licences, Distribution and Customer Metering Codes and Metrology Procedures still presupposes that all energy users are 'passive' consumers who impose costs on distributors - and that distribution networks would only ever serve a 'passive' role. This assumption does not allow for the possibility that some energy users have a role that parallels, at least in part, the role of energy service providers.

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[66] *Ofgem factsheet 5* | *27.09.01* (See: Ofgem's Response to the Embedded Generation Working Group Report on Network Access Issues. http://www.ofgem.gov.uk/ofgem/work/index.jsp?section=/areasofwork/distributedgeneration#)

7. Recommendations - The way forward

7.1. Regulatory

7.1.1. How Many “Belts & Braces” are too many?

As noted above, a large number of documents exist that define the relationship between electricity consumers and the industry that is (supposed to be) *producing further gains in terms of reduced costs and improved service in the coming years … and from increased pressure on businesses within the NEM to retain customers*.

In the case of solar PV system owners, the fundamental issues that control the different way that solar PV is treated compared to all other forms of demand management and energy conservation have not been explicitly identified or defined by the ESC. It appears that discriminatory practices applying to small-scale solar PV systems (and, potentially, all other forms of small-scale embedded generators) are:

- an historical and cultural hangover from the time (pre-1995) where all embedded generators were sufficiently large (relatively) to impact on distribution networks;
- an (almost obsessive) ‘need’ to develop regulatory and business-specific policies and procedures that treat all forms of embedded generation in the same way – even when it is clear that multiple small-scale, and widely dispersed embedded generators will have a substantially different impact on distribution networks; and
- unclearly stated concern about the ‘electrical safety’ impact of small renewable embedded generation.

The first two issues are reflected in language and style of the ESC’s *Codes* and *Guidelines*. This is almost certainly because of the overt (cultural) influence of the demonstrably ‘conservative’ electricity supply industry. The last issue is reflected in the increasingly detailed, and repeatedly made, references to connection details included in various *Codes*, *Guidelines, Rules and Standards* – and the requirement specific to CitiPower that requires two separate AC isolator switches to be fitted to (some) solar PV system installations.

The ‘safety’ issue was raised by electricity industry submitters to the ESC’s consultation on the *Electricity Industry Guideline No. 15 - Connection of Embedded Generation*. The ESC noted that:

> *TXU Networks recommended that embedded generators be required to register with the network operator, to ensure safety, operations, planning, technical and commercial considerations are made, supported by appropriate regulation that makes ‘do it yourself’ connection illegal. The National Electricity Distributors*

> *Forum also recommended the registration of embedded generators with the distributor. United Energy advocated a robust process for capturing and maintaining information on distributed generators - a process that would be triggered by a mandatory application to connect a generator to a distribution network.*
>
> *The Commission supports the proposal that customers should notify a distributor when an embedded generator is to be connected, whether via a new or existing connection. In the latter case, the Commission's decision to require embedded generators to measure positive and negative flows separately will require a distributor (or retailer) to review the metering requirements. The customer will thus need to inform the distributor about the connection of an embedded generator.*[67]

However, the ESC has not clearly articulated why it supports this proposal.

ATA takes no issue with the need to ensure that electrical safety standards are met. Victoria's record on electrical safety has been outstanding and nothing should be done that would increase the risks to electricity users or electricity industry workers. But it is problematic from a consumer perspective that:

- effective electrical safety standards are achieved by precisely specifying the technical performance characteristics of the inverters that allow solar PV systems to be grid-connected;
- such specification is a key component of *Australian Standards AS 4777 Grid connection of energy systems via Inverters;*
- an AS 4777 compliant inverter is specified as an essential pre-requisite for grid connection for any solar PV system (or other small-scale embedded generator) in –
  - the definition of a 'small embedded generator' in the ESC *Guideline No 15;*
  - Clause 6.8.4 of the 2005 *Victorian Service and Installation Rules*; and
  - the SEAV requirements for applications for the SEAV fact sheet *Commonwealth Residential Photovoltaic Rebate Program.*[68]

The facts appear incontrovertible. There is a clear and unequivocal requirement for all grid-connected solar PV systems to meet minimum, mandated safety standards. Accordingly, it seems unnecessary to impose further constraints on solar PV system owners through the economic regulatory regime.

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67 p 19, *Final Decision: Embedded Generation Guideline*, Essential Services Commission, 27 July 2004

68 The SEAV Factsheet also refers to "grid-connected system … inverter(s) must be type-tested against and meet the Electricity Supply Association of Victoria (ESAA) "Australian Guidelines for Grid Connection of Energy Systems via Inverters", or have equivalent external safety protection installed. However, it appears the ESAA 'guidelines', which are dated 28 April, 1998, have been superseded by AS 4777.

It would be far better to recognise that solar PV system owners must meet electrical safety regulations and remove unnecessary regulations that constrain choices that allow greater expression of economic sovereignty in the energy market.

7.1.2. The Current Regulatory Framework is Inappropriate

The relatively small scale of solar PV activity to date may lead distributors, energy retailers and the ESC to pay too little attention to the difficulties and frustrations faced by small renewable embedded generation owners. There may also be too little attention paid to the potential economic, environmental and social benefits that would come from extending the 'demand management culture' exhibited by solar PV system owners to the broader community. For example:

- There is no evidence that the ESC or distributors recognise that solar PV system owners see their installations as one of a range of demand management and energy efficiency choices they can use to improve environmental outcomes.
- Despite occasional references to 'small' embedded generation, relevant documents that define the regulatory framework for embedded generators in Victoria more clearly focus on issues, problems and challenges related to 'large' embedded generators.
- There is no acknowledgement that widely dispersed, 'small' embedded generators raise different technical and cost issues for distributors (and retailers) than do 'large' embedded generators. For example:
  - a large number of dispersed solar PV systems with total installed capacity of (say) 1MW is extremely unlikely to create the need for any network augmentation (and would probably reduce the need for augmentation), whereas a single 1MW installation would invariably initiate network augmentation;
  - transaction and metering costs associated with an individual solar PV installation can be relatively large compared to the potential ongoing benefits available to the solar PV system owner.
- There is limited recognition of the potential benefits that solar PV could deliver to distribution networks particularly in regard to maximising contributions to network support during periods of extreme peak summer demand. But there is no attempt to ensure incentives are provided for solar PV users to 'offer' such a service.

  This is reflected in the assertion in United Energy's submission to the ESC review of its Embedded Generation Guideline that "*in United Energy's service areas, network peaks usually occur in late afternoon, at 5pm or later, by which time generation from photovoltaic for example is far from its peak output capacity*."[69]

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[69] p12, *Submission to the Essential Services Commission on Issues Paper: Guidelines for Embedded Generators*, United Energy Limited, July 2003.

As far as it goes, this assertion is correct. The output from a fixed panel solar PV installation oriented due North would reach peak output around midday, with output reducing to zero before sunset. However, a fixed panel array oriented North West (at an inclination of 30 degrees) could still be operating near peak output at 6:00PM (at a 'cost' of 5% less system output during the day), and a tracking array even later still (while increasing system output by nearly 40%).[70]

As with all energy use choices there are costs and benefits to be considered. A solar PV user would either have to invest significantly more to provide a tracking capability, or lose (on average) about 20% of total annual output from the solar PV installation if it were oriented to the North West. Incremental economic considerations will dictate whether the solar PV user considers it worthwhile 'offering' this capability. But the solar PV user would be very unlikely to even consider 'offering' the service unless distributors, retailers and regulators offer appropriate incentives.

The ATA believes that the ESC should not only include explicit consideration of the differences between 'large' and 'small' embedded generation technologies. The ESC should consider what incentives might reasonably be constructed for owners of differing 'small' technologies to offer services of value.

- There is no acknowledgement that the regulatory arrangements and energy market are supposed to deliver benefits to solar PV users; and make it easier to do the things than was possible in 'the good old days of the SECV'.

The regulatory framework that determines the relationship between small-scale solar PV system owners and the electricity industry is defined in Licences, Code and Guidelines developed and overseen by the ESC. This framework has been developed in an environment dominated by the electricity supply industry, and by consideration of issues that existed at the time the electricity industry restructuring was undertaken (in the early to mid 1990s). The fact that the arrangements and processes developed in this environment proved to be unsatisfactory in the new regulatory regime is clearly justification for the ESC to establish minimum mandatory arrangements. The fact that this step proved necessary because even large consumers experienced difficulty in achieving 'fair and reasonable' outcomes in 'negotiation' with distributors and retailers is additional justification for the ESC to pay particular attention to the issues affecting small consumers.

[70] See: *Using PV to meet Peak Electricity Loads*, M.E. Watt, M. Oliphant, H. Outhred and R, Collins, Centre for Photovoltaics Engineering, University of NSW, November 2003.

7.2. Standard Grid Connection Agreements.

The ATA believes that several of the issues identified above can be resolved through the development and implementation of standard grid connection agreements. These agreements have the potential – if designed to equally reflect the interest of system owners and industry – to alleviate the burden of grid connection and ensure consistent treatment of grid connected systems.

For example, these issues have been more broadly addressed in the Standard Grid Connection Agreement developed by the Australian Greenhouse Office and University of NSW.[71] ATA sees this connection agreement as a vehicle for alleviating the burden on system owners.

7.3. ATA How-to-Guide.

The results detailed in section 4 reveal a lack of information available to assist system owners negotiate grid connectivity, particularly when that process does not proceed as planned or hoped.

The ATA sees the *'How-To-Guide'* (included in Appendix E) as an efficient way to deal with the increasing numbers of enquiries for advice from ATA Members and other persons interested in installing solar PV systems. The *'How-To-Guide'* is intended to ease the frustration that ATA Members and others find in dealing with energy retailers, distributors and the ESC.

The *'How-To-Guide'* provides advice and assistance to solar PV users; outlines their obligations, rights and responsibilities; and assists them navigate (what they see as) the 'minefield' of contradictory and confusing rules, regulations and procedures associated with installation and connection of small renewable embedded generation.

This information will be made available to ATA members, the general public and electricity retailers and distributors. ATA will publish the '*How-to-Guide*' in the solar Electricity Booklet, *ReNew* magazine and on the ATA website.

The *'How-To-Guide'* focuses on the following key issues:

- Renewable Energy Certificates
- The Grid Connect Process
- Understanding and Maximising economic benefits

[71] See http://www.pv.unsw.edu.au/Research/academicpublications-2004.asp

Appendix A. ATA Solar PV User Questionnaire

Alternative Technology Association

Barriers to Grid Connection of Small Renewable Energy Systems

ATA is conducting a project researching the experiences of our members when negotiating grid connection of small renewable embedded electricity generators. The project aims to remove the barriers to grid connection and produce reference material that will assist members with future grid connections. This will focus on identifying the regulatory, economic and information barriers that prevent or complicate the negotiation of a fair and reasonable agreement.

Anyone who has recently undertaken this task and wishes to contribute to easing the burden for future grid connections is encouraged to complete the following questionnaire.

Please return this questionnaire to Kane Thornton, Energy Policy Officer at kane@ata.org.au or PO Box 2919 Fitzroy, VIC 3065. Please call Kane on (03) 9415 2105 if you have any questions.

First Name		
Surname		
Year of birth		
Address		
Town		
Postcode		
Home Phone		
Work Phone		
Mobile Phone		
Email Address		
Household Occupants	**Number**	**Ages**
ATA Member	**YES / NO**	

System design

A 1. What type of system have you installed:
☐ Solar PV ☐ Wind Turbine ☐ Micro Hydro

Other: ___________________________________

A 2. Make and model (BP, Sanyo, etc): _______________

A 3. Capacity of System: _______________ watts

A 4. Inverter model: _______________

A 5. Does your Inverter comply with Australian Standard AS 4777:
☐ Yes ☐ No ☐ Don't know

A 6. Do you have battery storage: ☐ Yes ☐ No

A 7. Battery type and capacity: ___________________________________

A 8. Backup Generator : ☐ Yes ☐ No

If Yes, please explain: ____

A 9. What was the total cost of installing your system: _______________

A 10. When did you install your system: _______________

A 11. Did you claim the Australian Greenhouse Office Solar PV Rebate:
☐ Yes ☐ No ☐ Don't know

A 12. Value of rebate: _______________

A 13. Would you have purchased your system without this rebate:
☐ Yes ☐ No

Motivation

B 1. How reliable was the existing grid power supply (if applicable):
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

B 2. Do you consider the price of electricity purchased from the grid expensive:
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

B 3. Rate how this price motivated you to invest in your own system:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

B 4. Based on current electricity prices, how long will it take to recover the costs of your system: _______________ years

B 5. Rate the significance of the following in your decision to choose to install your system:

Reduction of Greenhouse Gas Emissions:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

Saving money from reduced electricity consumption:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

Increasing the reliability of your electricity supply:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

Interest in new technology:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

Showcase and educate new technology:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

Research & Information

C 1. When researching the type and costs of systems (panels, inverters, etc) available, what resources did you utilise:

☐ Online ☐ Books ☐ System retailers ☐ System installers

☐ Friends/Family ☐ Electricity retailer

☐ Organisations (ATA, Govt bodies etc)

C 2. Which information was most useful to you: _______________

C 3. How satisfied were you with the level of information available to assist your decision:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

C 4. How did ATA assist you in this decision:

☐ Phone/email advice ☐ Website ☐ Renew Magazine

C 5. Did you utilise the ATA's *Solar Electricity* Booklet: ☐ Yes ☐ No

C 6. Was this booklet useful:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

C 7. Did you estimate the Greenhouse Gas reductions that would result from your system: ☐ Yes ☐ No

If Yes, what value: ______________________________

Installation

D 1. How did you find the system installer:

☐ SEAV ☐ ATA/Renew magazine ☐ BCSE

☐ Retailer ☐ Yellow Pages ☐ Other: ________

D 2. Did the installer assist with negotiation of grid connection: : ☐ Yes ☐ No

D 3. Overall satisfaction with system installer:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

D 4. What is the orientation of your solar PV cells:

☐ North ☐ West ☐ Tracking array ☐ Other: Specify

D 5. Were you required by your electricity distributor or retailer to take additional Public Liability Insurance: ☐ Yes ☐ No

Grid connection

E 1. Is your system Grid Connected: ☐ Yes ☐ No

E 2. When did you connect your system to the grid: _______________

E 3. Was grid connection expensive:
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
No Mildly Very Extremely

E 4. Did grid connection require an upgrade of your electricity meter:
Yes ☐ No ☐ Don't know

E 5. Cost of upgrade: __________

E 6. When you started, did you know there is a difference between the role played by your electricity retailer and your distributor: ☐ Yes ☐ No

E 7. Did you seek assistance from your electricity retailer: ☐ Yes ☐ No

E 8. Your Electricity Retailer is:
☐ AGL ☐ Country Energy ☐ EnergyAustralia ☐ Integral

☐ Origin Energy ☐ TXU ☐ Ergon Energy ☐ Energex

☐ Other: Specify _______________

E 9. Was your electricity retailer helpful:
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
No Mildly Very Extremely

E 10. Did you seek assistance from your electricity distributor:
☐ Yes ☐ No

E 11. Your Electricity Distributor is:
VIC: ☐ CitiPower ☐ Powercor ☐ TXU
☐ United Energy ☐ AGL

NSW: ☐ EnergyAustralia ☐ Integral
☐ Country Energy ☐ ACTEWAGL

SA: ☐ ETSA Utilities

QLD: ☐ Energex ☐ Ergon Energy

E 12. Was your electricity distributor helpful:
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
No Mildly
Very Extremely

E 13. How did you obtain information about how to connect to the grid:
☐ Retailer ☐ Distributor ☐ System installer ☐ Other

E 14. In what form did you obtain this information:

☐ Website ☐ Telephone ☐ booklet

☐ Other: Please specify:________________________________

E 15. Information to assist you in the process of grid connection was:

Easy to obtain:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

Useful:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

Accurate:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

E 16. Do you have a contract agreement covering your connection to the grid: ☐ Yes ☐ No

E 17. Who is the agreement with:
☐ Retailer ☐ Distributor ☐ Both
☐ Other : Specify ____________________________

E 18. What is the length (years) of the contract agreement for grid connection: _______________

E 19. Do you sell electricity back to your retailer: ☐ Yes ☐ No

E 20. Retail tariff rates of electricity sold back to the grid: __________

E 21. Is your system Green Power accredited:
☐ Yes ☐ No ☐ Don't know

E 22. Is there a cap on total electricity sold to the grid:
☐ Yes ☐ No ☐ Don't know

E 23. How many Renewable Energy Certificates (REC) will/does your system produce: _______________

E 24. How are you receiving the value (approx $35 per MWh) of these RECs: __________

E 25. Would you consider donating your RECs to ATA to further renewable energy policy: ☐ Yes ☐ No

E 26. Did you change electricity retailers as a result of grid connection negotiation: ☐ Yes ☐ No

E 27. Would you change retailers if they offered you:
Better purchase/sell price of electricity ☐ Yes ☐ No
Higher service level: ☐ Yes ☐ No

E 28. How easy was negotiating grid connection:
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
No Mildly Very Extremely

E 29. Do you believe the costs charged were reasonable:
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
No Mildly Very Extremely

E 30. What information would have aided you in negotiating grid connection with your distributor/retailer:

Maintenance

F 1. Do you maintain the system yourself: ☐ Yes ☐ No

F 2. How would you rate the level of maintenance to be acceptable:
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
No Mildly Very Extremely

F 3. Are you satisfied with the investment that you have made
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
No Mildly Very Extremely

F 4. How would you rate the cost effectiveness of the investment:
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
No Mildly Very Extremely

F 5. How has your behaviour toward energy efficiency changed

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

No Mildly Very Extremely

F 6. Other comments:

Appendix B. Obtaining Grid Connect Guidelines

Distributors

CitiPower

June 22 2004, 10:30AM Phoned Connection Enquires 1300 301 101

Customer service representative unsure of any guidelines. Advised to call CitiPower Electrical Inspector on <number withheld> between 8AM and 9:30AM weekdays.

June 29 2004, 9:30AM. Spoke to <name withheld>, very unhelpful and impatient. Referred me to my retailer. Eventually convinced him to fax me a copy of their technical guidelines. However fax did not arrive

(Information later provided by non-CitiPower installer).

United Energy
June 22, 2004, 10:30AM Phoned General Enquiry 1300 131 689
Advised that guidelines available, but not on Internet. I must provide an address within their distribution region before they could post the guidelines.

June 22, 2004, 10:30AM Phoned General Enquiry 1300 131 689
Again asked for guidelines (armed with an address). They would be sent immediately (no address requested).

Received 24 June 2004.

PowerCor

Customer Guidelines for Grid Connection of Inverter Power Sources up to 20kW available from http://www.powercor.com.au/docs/20kw_generator.pdf

TXU

Enquiry placed on 22 June 2004 via website at http://www.txu.com.au/home/enquiries.asp

Response:

TXU does not have any published information regarding the connection of solar systems to our grid. The best source for initial information is the Sustainable Energy Authority Victoria (SEAV).

You can contact them on 1300 363 744 and talk to them regarding Photovoltaic systems and the Rebate Program.

It is very difficult to respond to your enquiry in detail without knowing more details of your proposal as TXU is involved in these installations both as a Retailer and as a Network owner.

Could you please contact me on the number below or ask for me via our Call Centre on telephone 133466 so that I can provide any information you require.

AGL

Enquiry placed on 22June 2004 via website:
http://www.agl.com.au/AGLNew/At+your+service/Enquiry+form.htm

Booklet received July 10 2004.

Alinta
Called Alinta service desk (1300 131 685) 12 July 2004. Booklet will be sent immediately. Has not arrived.

Retailers.

AGL

Online query requests tariff rates 11AM 16th August 2004.

http://www.agl.com.au/AGLNew/At+your+service/Contact+us.htm#sales

No feedback received.

Country Energy

Online query requests tariff rates 2PM 17th August 2004.

http://www.countryenergy.com.au/internet/cewebpub.nsf/Content/cus_trn_energyquote#

Received message from <name withheld> to return call. 18th August 2004.

Spoke to <name withheld> on 13 23 56 (Option 4) at 2PM 19th August 2004. She advised that Country Energy pay for any electricity at Peak rate (given most PV power is produced during peak times). The rate is the same as the buy rate – which varies and is subject to change. She advised me to speak to a tariff advisor named <name withheld> on 02 6214 9842. He was unavailable. .

Energy Australia

Called 13 88 08 11am August 16th 2004. Spoke to <name withheld> who advised that they "do not purchase electricity from PV owners. I would need to speak to my distributor".

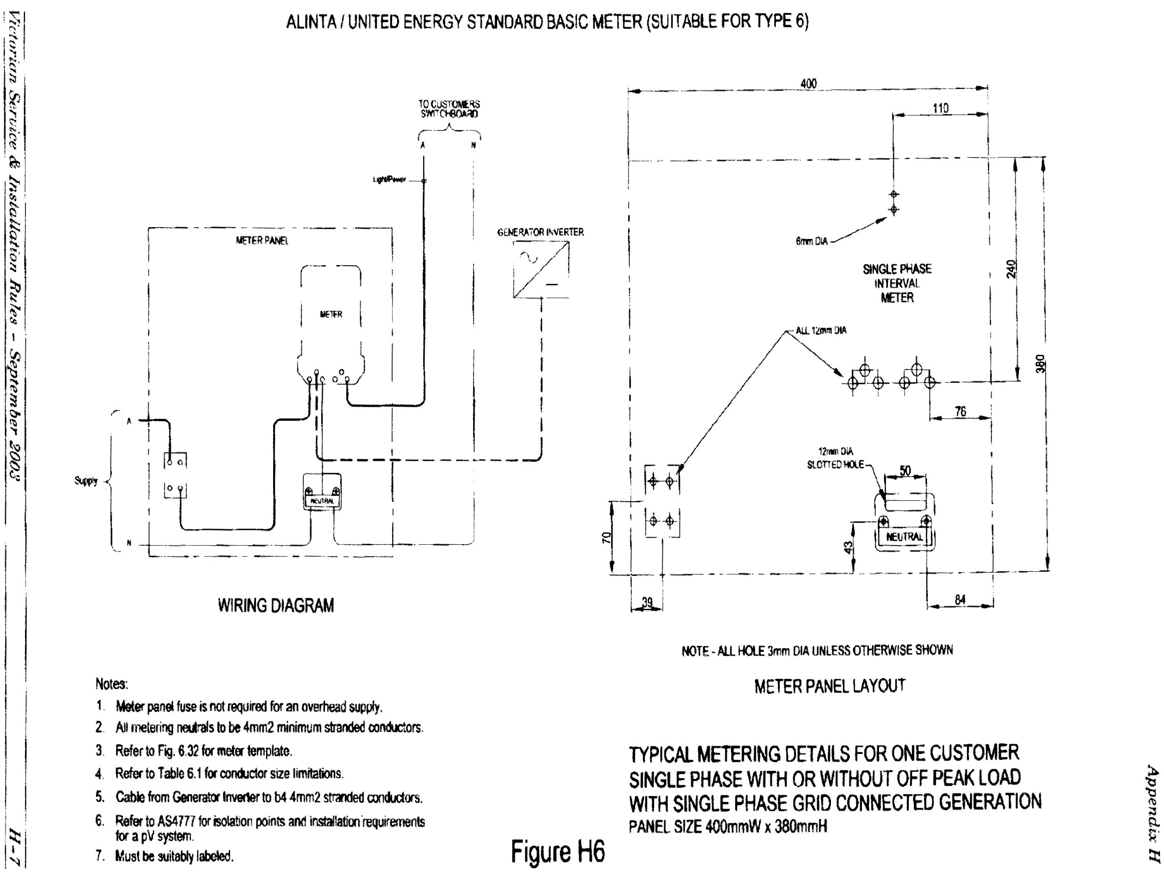
Origin Energy

Phoned 28 June 2004. Information received via post 2 July 2004.

TXU

Called 133 466 3PM August 17 2004. Advised that they purchase electricity only from those who produce in their distribution area. Net usage metered only – and hence no payment if net surplus of electricity.

Appendix C. United Energy/Alinta Meter Connection Diagram



Appendix D. Extracts from documents that define the regulatory framework for embedded generators

D.1 Victorian Electricity Supply Industry Tariff Order

5.7 **Excluded services**
5.7.1 A Distributor may levy additional charges for certain services and other matters related to its Distribution business excluded from the price controls specified in this clause 5.

5.7.3 Subject to clauses 5.7.2 and 5.7.4, the following services or charges are the only excluded services and charges for the purposes of clause 5.7.1:

(b) connection to the Distributor's Distribution System;

(i) network services for connection points where customers operate parallel generation requiring a stand-by supply;

(m) charges for distribution services and system augmentation required to receive energy from an embedded generator, as defined in a licence issued under Part 12 of the EIA to distribute electricity or another Distributor;

D.2 Electricity Distribution Licence

6. OBLIGATION TO OFFER CONNECTION SERVICES TO EMBEDDED GENERATORS

If an *embedded generator* (or a person who has made application or intends to make application for a *generation licence* or for an exemption granted under the *Act*) requests the *Licensee* to offer to provide *connection services* so as to allow the *supply* of electricity from an *embedded generating unit* of the *embedded generator* which is in the *distribution area* to the *Licensee's distribution system*, the *Licensee* must make such an offer within 65 *business days* in accordance with clause 10.

SCHEDULE 1
DEFINITIONS AND INTERPRETATION
1. DEFINITIONS

embedded generating unit means a *generating unit* which is *connected* (or to be *connected*) to a *distribution system*.

Embedded generator means a *generator* whose *generating units* are *connected* to a *distribution system*.

D.3 Electricity Retail Licence

Contains no reference to embedded generators.

7. OBLIGATION TO OFFER TO SELL

7.1 The ***Licensee*** must offer to supply and sell electricity to any ***domestic or small business customer*** in relation to the ***Licensee***:

(a) at tariffs determined by the ***Licensee*** and published by the ***Licensee*** in the Government Gazette at least 2 months before they take effect; and

(b) on terms and conditions determined by the ***Licensee*** and approved by the ***Office*** and published by the ***Licensee*** in the Government Gazette at least 2 months before they take effect.

7.2 The obligation of the ***Licensee*** under clause 7.1 does not apply to the extent nominated by the ***Office*** in any ***communication*** given to the ***Licensee***.

7.3 An offer in accordance with clause 7.1 must be made to a ***domestic or small business customer*** by the ***Licensee*** within ten ***business days*** after a request from the ***customer.***

7.4 If a ***domestic or small business customer*** accepts an offer made by the ***Licensee*** in accordance with clause 7.1, the ***Licensee*** must comply with the resulting contract.

Note that Gazetting of Tariffs applies only to 'Deemed' small residential and Business customers who have not voluntarily transferred to a "market contract" tariff. Retailers and distributors consider connection of a solar PV system to be a change in connection or load characteristic. This allows a retailer to compulsorily and unilaterally move the consumer off a Standing Offer tariff (and allows a distributor to compulsorily and unilaterally re-assign the consumer off a standard residential tariff).[72]

D.4 Energy Retail Code

Contains no reference to embedded generators.

2. RETAILER'S OBLIGATION TO CONNECT

[72] See clause 2.1.20 (p6) and clause 3.1.13 (p23), *Electricity Distribution Price Determination 2001-05 - Volume Ii Price Controls*, Office of the Regulator-General, September 2000.

A ***retailer*** must ***connect*** a ***customer*** at the ***customer's supply address*** as soon as practicable after the ***customer*** applies for ***connection*** in accordance with clause 1.

Without limiting clause 36.1, by no later than the next ***business day*** after the application is made or their ***energy contract*** commences to be effective (whichever occurs last), the ***retailer*** must make a request to the relevant ***distributor*** to ***connect*** the ***customer's supply address*** to the ***distributor's*** distribution system.

4.1 Form of bill

A ***retailer*** must prepare a bill so that a ***customer*** can easily verify that the bill conforms to their ***energy contract***.

4.2 Information

A ***retailer*** must include at least the following information in a ***customer's*** bill:

(a) the ***customer's*** name and account number, each relevant ***supply address*** and any relevant mailing address;

(b) each relevant ***assigned meter identifier*** and ***checksum*** or, if any case there is no ***assigned meter identifier***, the ***customer's meter*** number or another unique identifying mark assigned to the ***customer's*** metering installation;

I the period covered by the bill;

(d) the relevant ***tariff*** or ***tariffs*** applicable to the ***customer***;

(e) whether the bill is based on a ***meter*** reading or is an estimated bill;

(f) the total amount of electricity (in kWh) or of gas (in MJ) or of both consumed in each period or class of period in respect of which a relevant ***tariff*** applies to the ***customer*** and, if any ***meter*** of the ***customer*** measures and records consumption data on an accumulation basis rather than an interval basis, the dates and total amounts of the immediately previous and current ***meter*** readings or estimates;

(g) if the ***retailer*** directly passes through a network charge to the ***customer***, the separate amount of the network charge;

(h) for an ***electricity contract*** the amount payable for electricity and for a ***gas contract*** the amount payable for gas;

(i) the pay by date;

(j) the amount of arrears or credit and the amount of any ***refundable advance*** provided by the ***customer***;

(k) a summary of payment methods and payment arrangement options;

(l) if the ***customer*** is a ***domestic customer***, details of the availability of ***concessions***;

(m) a telephone number for billing and payment enquiries and a 24 hour contact telephone number for faults and emergencies;

(n) if the ***customer*** is a ***domestic customer***, in relevant languages, details of interpreter services; and

(o) if the bill is a reminder notice, contact details for the ***retailer's*** complaint handling processes.

4.3 Bundled charges

On request, a ***retailer*** must provide a ***customer*** with reasonable information on network charges, retail charges and any other charges relating to the sale or supply of ***energy*** comprised in the amount payable under the ***customer's*** bill.

D.5 Distribution Code

1.3.4 Each ***customer*** must comply with this Code to the extent that an obligation to do so is included as a term or condition in a contract for the ***supply*** of electricity by a ***distributor*** or the sale of electricity by a ***retailer***, to the ***customer*** or in a ***deemed distribution contract***.

1.3.6 An agreement for the ***distribution*** of electricity between an ***embedded generator*** and a ***distributor*** or an agreement for the sale of electricity between an ***embedded generator*** and a ***retailer*** must include a term obliging the ***embedded generator*** to comply with this Code.

1.8.1 This Code does not set out comprehensively all rights and obligations of ***distributors, retailers, customers*** and ***embedded generators*** relating to the ***supply*** of electricity to a ***customer's supply address*** or to or from an ***embedded generator's supply address***.

A list of other relevant applicable laws and codes as at 1 January 2002 is shown in Appendix 1. Other documents (in addition to those listed above) directly relevant to embedded generators include:

- *Electricity Safety Act* 1998.
- *Electricity Safety (Network Asset) Regulations* 1999.
- *Electricity Safety (Installation) Regulations* 1999.

Statements and guidelines (available from the ***Office***) published by the Office under the ***Act*** or under section 12 of the *Office of the Regulator-General Act* 1994.

The list does not include any documents generated and/or maintained by the electricity supply industry.

7 EMBEDDED GENERATORS

7.1 Agreement to connect

7.1.1 A ***distributor*** must ensure that its ***distribution system*** is able to receive a ***supply*** of electricity from an ***embedded generating unit connected*** to its ***distribution system***, in accordance with an agreement with the ***embedded generator*** on the terms and conditions of dispatch, ***connection*** and ***disconnection***.

7.1.2 If such an agreement is sought by an ***embedded generator***, the ***distributor*** and ***embedded generator*** must negotiate in good faith.

7.1.3 Despite clause 7.1.1, if two or more ***embedded generating units*** are ***connected*** in parallel, their obligations under clauses 7.5, 7.6, 7.7 and 7.8 of this Code apply to the ***point of common coupling*** and the maximum permissible contribution of each ***embedded generating unit*** is to be determined in proportion to their capacity, unless otherwise agreed.

7.2 Supply frequency

7.3 Co-ordination and compliance of embedded generating units

7.4 Minimum requirements for embedded generating units(synchronous type) (applies only to embedded generators over 1MW)

7.5 Negative sequence voltage

7.6 Harmonics

7.7 Inductive interference

7.8 Fault levels

D.6 Electricity Safety (Network Assets) Regulations 1999

Contains no reference to embedded generators.

D.7 Electricity Safety (Installations) Regulations 1999

406. Prescribed electrical installation work

e) wiring systems, switchgear, controlgear and accessories installed to provide control and protection of standby generation or cogeneration electricity supply systems;

SCHEDULE 4
PART A—PRESCRIBED CLASSES OF ELECTRICAL INSPECTION WORK

S Wiring systems, switchgear, controlgear and accessories installed to provide control and protection of standby generation or co-generation electricity supply systems.

D.8 Victorian Service and Installation Rules 2005 (Draft for Consultation)

6.8.4 Grid Connection of Energy Systems via Inverters

These Rules specify the electrical installation requirements for inverter energy systems with ratings up to 10 kVA for single-phase units, or up to 30 kVA for three-phase units.

6.8.4.1 Inverter Requirements

Only approved models that satisfy AS 4777 Part 2 "Grid Connection of Energy Systems via Inverters -, Inverter Requirements and Part 3, Grid Protection Requirements" may be connected to the grid.

Type Test certification of compliance with this standard must be provided to the Distributor prior to the grid connection of the inverter.

6.8.4.2 Installation and Connection to Grid

The installation of the inverter shall be in accordance with the requirements of AS 4777.1 and AS 4777.3. and these Rules:

- The customer's inverter must be connected to a dedicated circuit on the customer's main switchboard or distribution switchboard closest to the inverter via a lockable isolating switch,
- The switchboard must be clearly and permanently labelled as having an inverter energy system connected to it. The circuit breaker, fuse or switch must also be clearly labelled.
- The installation of an Inverter Controlled Energy System is "prescribed work" and a copy of the Certificate of Electrical Safety and Electrical Work Request shall be provided to the Distributor.
- A test shall be carried out by the relevant Distributor's representative at the time the system is commissioned to ensure that "islanding" does not occur.

A label indicating that an alternative power supply system is connected to the installation shall be fitted at the FOLCB for an overhead electricity supply or at the consumer terminals and service fuse for underground supply.

6.8.4.3 Metering

The meter shall be an electronic meter with import and export registers to accept periods of reverse power flow when power is flowing into the grid from the customer’s premises. Refer to Sections 8 and 9 for details. (*Note: There is nothing in Sections 8 and 9 of the Draft 2005 SIRs that refers to metering for embedded generator installations).*

Appendix E. How to Guides.

Grid Interactive Solar Photovoltaics

How-to-Guide: Economics

Costs

Capital cost of solar PV system

Cost of solar PV panels, grid interactive inverter and other components.

Get at least two quotes from accredited suppliers and installers.

Installation Costs

Installation of the solar PV system by a Business Council for Sustainable Energy (BCSE) accredited installer.

Get at least two quotes from accredited installers.

Project costs

Charged by the electricity distributor to cover their management and approvals of installation and labelling at network connection points.

These costs are approved by the State Regulator, but can be challenged if you think they are too high. Complaints are/or appeals should be referred to the State Regulator.

Metering

Installation of a new meter by the electricity distributor (for and billed through the retailer) to handle import and export measurements.

The costs for meters are approved by the State Regulator for small consumers. Ask both your selected retailer and your local distributor to explain in detail (and provide proof) if they require your meter to be changed. Most state regulators allow you to decide what type of meter you want, although the meter types you are able to choose from will depend on the retail tariff you select.

The ATA's survey of solar PV owners shows this can be amongst the most frustrating and confusing issues to decide and resolve.

The lowest cost meter is a rotating disk, electro-mechanical meter. These have been used to measure electricity consumption since the late 1800s, but can only be used for simple two part tariffs. They are inherently simple and reliable devices. They rotate backwards when you export electricity to the grid, which automatically adjusts your energy consumption – although the meters may not be as accurate when they rotate backwards. This is called 'net metering', and means your retailer can only bill you for 'net' electricity used.

New, computerised, electronic interval meters are available that can measure energy produced and consumed each half-hour. However, electronic meters cannot automatically measure export electricity. Wiring must be run from your Inverter back to the electronic meter to measure total generator output and total energy consumed in your home. An equivalent 'net metering' outcome can be calculated by your retailer by adding the energy produced and energy used, as recorded by the meter.

Benefits:

Government rebates:

Various government programs provide incentives and rebates toward solar PV. These include the Photovoltaic Rebate Program (PVRP) which currently offers up to $4000 toward the upfront cost of new systems installed by accredited installers on your principal residence.

The PVRP is funded by the Commonwealth Government and administered by State agencies. More information is available from http://www.greenhouse.gov.au/renewable/government.html; or

Australian Greenhouse Office
Department of the Environment and Heritage
GPO Box 787
CANBERRA ACT 2601
Phone: (02) 6274 1888

MRET and REC's:

Most solar PV systems are eligible to earn Renewable Energy Certificates (REC) for electricity generated. RECs are created to measure the amount of new renewable energy being generated in Australia. The number of RECs created by your solar PV system depends on its size, where you live and how your system is installed.

You do not have to install a new meter or measure the output of your solar PV system to determine the number of RECs. Metering is just one of the approved methods. Other methods are explained on the Website of the Office of the Renewable Energy Regulator (http://www.orer.gov.au/). Further details are also available in the ATA How-To-Guide on RECs.

It is now mandatory under the Mandatory Renewable Energy Target (MRET) for energy retailers and large buyers of electricity (including government departments) to purchase RECs in proportion to their total wholesale electricity purchases. The MRET program continues to 2020.

The price of RECs is set through a market mechanism overseen by the Office of the Renewable Energy Regulator but the current price is not published by the ORER. Accordingly, you should seek offers from both your system supplier and energy retailers before you decide which system to buy and which retail offer to choose.

There are a number of options available for claiming the value of RECs. System owners are able to sell their RECs to an Agent for an agreed period and value. The most convenient Agent is likely to be your solar PV system supplier or your chosen electricity retailer.

Always remember that your solar PV system will continue to create RECs as long as the MRET scheme continues. Most Agents will only offer to buy your RECs for a limited period of one year to five years. You are free to find another buyer when that period expires. Make sure you don't forget to follow this up when the time comes.

Tariffs

The ATA's survey of solar PV owners shows this is also amongst the most frustrating and confusing issues to decide and resolve. There is no doubt you will have to work hard to get the best deal available.

Installation of a solar PV system may require renegotiation of your electricity tariff with your retailer. In states with Full Retail Competition you may be entitled to stay on a Default or Deemed tariff of your 'Host' retailer. Your will also be able to choose a 'market offer' from any retailer. If you decide to change from a Default or Deemed tariff, it is highly advisable to shop around to secure the most competitive tariff for the electricity that you import from the grid (consume) and export to the grid. This is the best way to get value from your investment in a solar PV system.

You may be able to find a retailer with a 'time-of-use' tariff product that suits interval meters. Time-of-use tariffs that reflect the value of excess solar PV output at periods of high electricity demand may give you a better deal than 'net metering' applied to a conventional flat tariff.

While comparing retail tariffs can be difficult, you should remember that there can be a premium price available for green renewable energy produced by your system. Also, solar PV regularly produces maximum output during most periods of peak demand (when the wholesale cost of electricity is likely to be higher). For this reason it can be financially beneficial to negotiate two-part Peak/Off-Peak or Time-of-Use tariffs.

GreenPower

All energy retailers offer some form of 'green' energy tariff. These products reflect the cost to the retailer of buying or creating their own green energy. You can supplement the green energy from your own solar PV system by buying green energy from your retailer.

Remember to negotiate hard. You will probably find retailers wanting to charge you more to buy green energy than they are prepared to pay for the RECs produced by your solar PV system.

Also remember that if you have sold your RECs to your system supplier, or some other party, retailers will not be able to take the value of your RECs into account when they make you an offer.

Grid Interactive Solar Photovoltaics

How-to-Guide: Renewable Energy Certificates (RECs)

Introduction

Most solar PV systems are eligible to earn Renewable Energy Certificates (REC) for the total electricity generated. RECs are the tender created to measure the amount of new renewable energy being generated in Australia. It is now mandatory under the Mandatory Renewable Energy Target (MRET) in Australia that energy retailers and large buyers of electricity (including government departments) purchase RECs in proportion to their total energy purchases. The proportions are based on achieving generation of an additional 9500 gigawatt-hours of renewable energy per year by 2010.

Calculating your REC's

The number of REC's that your system creates depends on the size of your system, where you live and how you have installed the system. The solar potential – the amount of energy actually generated – varies around the nation.

A 1kW solar PV system will generate approximately 1 REC per annum in Victoria, which can be deemed for a five year period. The exact number of REC's your system is eligible for must be calculated using a formula as described on the ORER website (http://www.orer.gov.au/forms/pubs/attachment-pv-jan04.pdf).

Options

If your system satisfies the ORER guidelines and is eligible for creation of REC's, there are a number of options available. You can do nothing, claim the REC's yousefl or sell them to an Agent.

Do nothing: The obligation for purchasing REC's lies with electricity retailers and selected large consumers. Each year they must purchase a given number of REC's and surrender these to the ORER.

While your system may create renewable energy and you are eligible to claim REC's, you may actually encourage further renewable energy by not claiming these certificates. If you do not sell your RECs, the energy industry will need to stimulate demand for additional green energy to produce the necessary REC's as mandated by MRET.

For this reason, your greatest contribution to the renewable energy industry and curbing global warming may in fact be to do nothing.

Claim the REC's: If you wish to recover some of the investment in your renewable energy system, the most cost effective option is to claim the REC's yourself. This requires you to complete the following process:

- Check your eligibility (run through the steps above);
- Complete the registration form
- Send the completed registration form and a copy of your installation report to ORER with $20.00;
- When the form has been processed, the ORER will advise you of your installation code;
- Log onto the REC-registry. You must have applied for a username and password to use the rec-registry. This can be done over the internet at www.rec-registry.com;
- Follow the prompts to create certificates (the process is outlined in the guide available at www.orer.gov.au/registries)
- Find a buyer and negotiate a selling price;
- Transfer the RECs to the buyer through the registry (follow the process outlined in the guide available at http://www.orer.gov.au/registries/index.html)

REC Agents: There are currently just 13 registered agents, who will pay cash for your REC's. This is often below the market rate for REC's, but may still represent value for money given the relative complexity of claiming the REC's yourself.

Often the supplier of your Solar PV system will have offered you a discount in return for the transfer of REC's (for the first five year deeming period).
To do this, the system owner must complete and sign a single form permitting the agent to claim these REC's for the five year deeming period.

The ORER maintains a list of REC agents at the following website:

http://www.orer.gov.au/publications/pubs/agents-may04.pdf

How-to-Guide: The Process

For Victorian Solar PV system owners.

1. Determine your position on REC

Decide what you want to do with the RECs your system will create.

- Claim them from ORER.
- Sell to Agent

2. Apply for Rebate

Contact SEAV and complete an application form for the Photovoltaic Rebate Program (PVRP). Applications must be approved prior to installation to qualify for the rebate.

3. Select preferred Retailer and negotiate retail tariff

Contact each electricity retailer and attain the best possible offer for electricity exported and purchased.

4. Apply to Distributor

Contact your electricity distributor and complete application form for grid connection. Ensure that the Distributor permits net metering as per the intent of ESC Metering Code.
Select the meter type that matches your retail tariff.

INSIST THE METER YOU SELECT IS INSTALLED BY THE DISTRIBUTOR.

5. Complete Connection Agreement

Receive connection agreement from your electricity Distributor, complete and return. Pay Project Fee to distributor.

CONTACT THE ESC IF YOU BELIEVE THE PROJECT FEE IS EXCESSIVE.

6. New Meter Application

Contact your electricity retailer and request a new electricity meter. This request will then be passed to the distributor for them to install.

INSIST THE METER YOU SELECT IS INSTALLED BY THE DISTRIBUTOR.

7. PVRP approval

Ensure you have received a letter from the SEAV confirming your application for PVRP has been approved.

8. System Install

Have your solar PV system installed by a BCSE approved installer.

INSIST ON WATCHING TESTING OF THE SYSTEM AND INVERTER AS THIS IS YOUR RESPONSIBILITY.

9. Certificate of Electrical Safety

Arrange for (S Class) licensed electrical inspector to issue Certificate of Electrical Safety (CES).

KEEP THE CERTIFICATE FOR FUTURE REFERENCE.

10. Request New Meter

Advise distributor that CES has been granted and request installation of new meter.

INSIST THE METER YOU SELECT IS INSTALLED BY THE DISTRIBUTOR.

11. System On

Distributor will install new meter and complete grid connection.

IF THE DISTRIBUTOR IS NOT SATISFIED, SHOW THEM THE CERTIFICATE OF ELECTRICAL SAFETY. COMPLAIN TO THE ESC AND EWOV.

12. Claim PVRP

After the installation of your system complete the Victorian Installation Report Form with your installer and return to SEAV to claim payment of the PVRP.

13. Notify Retailer

Contact your selected retailer and advise that the system is operational.

***IF NOT OPERATIONAL, ASK THE RETAILER TO RESOLVE WITH THE DISTRIBUTOR.
MAKE SURE THE RETAILER ALWAYS GIVES YOU ACCURATE AND TIMELY BILLS AND GOOD SERVICE.***