ESSENTIAL SERVICES COMMISSION

MINIMUM ELECTRICITY FEED-IN TARIFFS

FOR APPLICATION FROM 1 JANUARY 2014 TO 31 DECEMBER 2014

DRAFT DECISION

JULY 2013

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EXECUTIVE SUMMARY

With the recent enactment of the *Energy Legislation Amendment (Feed-in Tariffs and Other Matters) Act 2013*, the Essential Services Commission (ESC) has been given the responsibility of determining minimum feed-in tariffs for small scale renewable energy embedded generation in Victoria. The ESC is required to determine the minimum feed-in tariff (FiT) by 31 August in the year before it will take effect. This Draft Decision represents the ESC's conclusion in regard to the minimum FiT that will apply from 1 January 2014 to 31 December 2014.

Licensed electricity retailers have an obligation to publish a renewable energy feed-in tariff offer that is generally available to any small embedded generator. This generally available FiT must be no lower than the Minimum FiT and every market offer made by a retailer must comply with the minimum FiT. At present the minimum FiT is 8.0 cents per kilowatt hour (c/kWh).

The ESC's role of deciding the minimum FiT for future years follows an inquiry into distributed generation by the Victorian Competition and Efficiency Commission in 2012. That inquiry recommended that a minimum FiT be imposed for a transitional period prior to moving to market-determined FiTs at a later date. The minimum FiT should ensure that distributed generators receive a price that reflects the value of the electricity they export to the grid and provide an efficient price signal to investors in small-scale distributed generators that will help achieve efficient use of distributed generation in a competitive electricity market (VCEC 2012, 147).

At the present time virtually all small scale distributed generation is from solar photovoltaic (PV) systems, and in this Draft Decision references to "embedded generation" and "solar PV exports" can be read as being essentially synonymous. However, new renewable technologies may come onto the market and be adopted by households and other small consumers, and the ESC intends to consider these in future reviews of the minimum FiT.

Most feed-in tariffs in Australian jurisdictions at the present time take the form of a single rate per kWh which applies to all periods of the day and year. Several policy development forums and bodies, such as COAG and the Productivity Commission, have recommended greater attention be paid to FiTs that are higher during periods of when electricity value is highest and are lower at other times. The purpose of price structures of that kind would be to improve incentives to maximise embedded generation exports at times when its system-wide value is highest. Since time-of-use retail electricity pricing will become available to small Victorian consumers in the second half of 2013, it will be practical to defer consideration of time-of-use feed-in tariff structures until the ESC's review of the minimum FiT for 2015.

In determining the fair and efficient value of small scale embedded generation exports, the ESC proposes to use the "wholesale price plus" approach recommended by VCEC and adopted by other jurisdictional regulators. The wholesale electricity spot market price corresponds to the marginal energy purchase cost that is avoided by an electricity retailer when one of its embedded generating customers exports an additional unit of electricity into the grid. For this reason, the wholesale spot price is the relevant avoided energy cost in relation to the marginal unit of embedded generation.

The "plus" element of the "wholesale price plus" formula refers to any other avoided costs associated with embedded generation. Because embedded generation reduces the average distance between generation and consumption, it is believed to reduce overall line losses. Thus, consistent with the approach adopted in other jurisdictions, the ESC considers there to be line losses that are avoided because of embedded generation. In the absence of better measures, the ESC has included the effect of these line losses using the distribution loss factors published by the Australian Energy Market Operator (AEMO). The weighted average distribution loss factor for the five distribution zones in Victoria is calculated as 1.06. The energy value of embedded generation is multiplied by this factor to obtain the overall value of embedded generation.

The energy value of embedded generation has been calculated as a weighted average of the forecast spot market prices for Victoria in 2014, which includes a forecast spot market price for each half hour period of 2014 (which means there are 17,520 periods in total). This set of forecast spot market prices was prepared by ACIL-Allen Consulting using its *PowerMark* model. Like all such forecasts, it is based on normal weather conditions, forecast electricity demand and the anticipated available generation capacity, for each period.

The weights used for averaging the spot market prices represent the relative amount of PV net exports which can be attributed to each half-hour period over the year. Ideally these weights should represent the time-profile of small embedded generator net exports over the year. However, this information was not available for the present review for Victoria, and instead the ESC has assessed two methods to approximate the export load / profile for Victoria for the purpose of weighting the spot price.

The time-profile of production from a standard north-facing PV unit in Melbourne has been chosen as the basis for constructing these weights. Specifically, historical data for the half-hourly production of a standard unit of this kind has been obtained by the ESC from AEMO and ROAM Consulting for Melbourne for the period 2004-05 to 2011-12. The ESC has used an eight-year average of the values in these profiles relating to each ordered half-hourly period to derive a 'weather normalised' profile covering 17,520 half-hourly periods over a year. This profile has been used as the weights for the purpose of constructing the FiT.

Using this approach, the energy value of embedded generation has been estimated for 2014 at 7.2 c/kWh, and when the uplift associated with the distribution loss factor is taken into account, the overall value of embedded generation is estimated to be 7.6 c/kWh. This estimate is broadly consistent with the prevailing FiT rate of 8.0 c/kWh. Given the scope for forecasting error, the ESC's view is that the difference does not warrant a change to the prevailing FiT rate of 8.0 c/kWh.

The ESC's draft decision is to adopt the minimum feed-in tariff rate of 8.0 c/kWh for 2014.

1 INTRODUCTION

1.1 Purpose

A feed-in tariff (FiT) is a price that distributed generators are paid per unit of electricity that they export into the grid (or in some cases, the amount they generate — see section 2.2).[1] Since January 2008, licensed electricity retailers in Victoria with over 5000 customers are required to publish a general renewable energy feed-in tariff offer for customers that have a small renewable generation facility (ie, one with a nameplate capacity of less than 100kW). In the great majority of cases, these facilities are rooftop solar photovoltaic (PV) systems, but other potential sources of renewable energy include wind energy, hydro-generation and biomass generation.

There is an implied obligation under Victorian legislation that the generally available FiT terms and conditions should be fair and reasonable.[2] Under recent legislation this obligation is extended to small retailers and supplemented by an explicit minimum FiT rate of 8 cents per kWh for the remainder of calendar year 2013.[3] From 1 January 2014, each retailer's generally available FiT must be no lower than the minimum FiT rate to be determined by the Essential Services Commission (ESC). The ESC must determine and publish the minimum FiT by 31 August of the year preceding the year in which the FiT will apply.

In making a determination of the minimum FiT the ESC must have regard to[4]:

- prices of electricity in the wholesale electricity market
- any distribution and transmission losses avoided in Victoria by the supply of small renewable energy generation electricity.

Retailers may have more than one FiT, but they must have at least one generally available FiT which is no lower than the minimum legislated.[5]

[1] Distributed generation refers to electricity produced by generators connected to the distribution network. In this paper the terms 'embedded generation' and 'distributed generation' are used interchangeably.

[2] Sections 40I & 40J of the *Electricity Industry Act 2000 (Vic)* (EIA).

[3] The *Energy Legislation Amendment (Feed-In Tariffs and Other Matters) Act 2013* amended the EIA. The minimum FiT is stipulated in s 40FBA(a) of the EIA as amended.

[4] EIA (as amended), s 40FBB(3).

[5] Refer sections 40G, 40GA, & 40FB of the amended EIA.

The purpose of the regulation of FiTs is to ensure that all customers that are small embedded renewable generators have access to an efficient and fair price for exported electricity (DTF 2012, 7). That is, prices that reflect the economic value of those electricity exports, without cross subsidies between those electricity customers that generate electricity and those that do not (VCEC 2012, xxx).

The ESC has determined a draft minimum FiT for the 1 January 2014 to 31 December 2014 period and invites comment on the methodology it has used.

1.2 Timetable and Consultation

As noted above the ESC must determine and publish its final FiT by 31 August 2013. The Commission will therefore conduct an abridged consultation for this draft decision to meet this requirement. The timetable for the FiT consultation process is as follows:

Submissions due on draft decision	25 July 2013
Final Determination	21 August 2013

Submissions on this draft decision paper should be emailed to: fitreview@esc.vic.gov.au by 5:00 pm on 25 July 2013.

Alternatively, they may be mailed or delivered within the same period to the ESC office at: Level 37, Casselden Place, 2 Lonsdale Street, Melbourne, VIC 3000. Enquiries on this draft decision may be directed to Jeff Cefai on (03) 9032 1320.

1.3 Structure of this Draft Decision

Chapter 2 discusses small embedded renewable generation in Victoria generally, and the nature and forms of feed-in tariffs. It also discusses policy principles relating to feed-in tariffs and the statutory framework in Victoria, how they have operated in practice, and the findings of recent inquiries into the policies and regulatory frameworks applying to feed-in tariffs. This information describes the context in which the ESC is conducting its role relating to feed-in tariffs.

Chapter 3 briefly discusses the possible forms that a feed-in tariff can take, and the reasons for the ESC's proposed adoption of a single-rate feed-in tariff for 2014.

Chapter 4 discusses the methodological issues relating to calculating the value of embedded generation exports and hence the minimum FiT. That chapter includes the ESC's reasons for its draft FiT rate.

2 BACKGROUND

This chapter provides summary background information pertinent to renewable energy feed-in tariffs (FiTs) in Victoria.

2.1 Solar PV Electricity Generation in Victoria

At present, the great majority of small, embedded renewables generation is from rooftop photovoltaic (PV) systems. The power generated from these units will offset some of the consumption of the households where they are installed, and at times there may be electricity exported into the network. For present purposes, only the facilities with a capacity no greater than 100 kW are of interest because the minimum FiT will not be applicable to larger units. Solar hot water systems generate heat from solar energy, rather than generating electricity that can be exported to the grid, and for this reason they are not relevant to this paper.

There has been a strong take-up of solar PV systems in the past four years, in part reflecting strong demand for electricity generated from renewable sources, and also the influence of upfront subsidies to households installing solar systems, such as under the Renewable Energy Target (RET) scheme, and FiT schemes. The Australian Energy Market Operator (AEMO) has estimated that the total installed rooftop PV capacity in Victoria was 288 MW in February 2012 (AEMO 2012a, 9). AEMO estimated the average capacity of a solar installation per household to be 3.5 kW,[6] which would suggest that around 4 per cent or more of Victoria's retail customers had solar PV installations by 2012.

AEMO's estimates suggest that in 2010-11, Victorian rooftop PV systems generated around 260 GWh, or approximately 0.6 per cent of total demand. The amount of Solar PV produced will generally be lower than rated capacity due to the alignment of the panels, shading from nearby trees or buildings, cloud cover etc. The amount of electricity exported will also be reduced by the amount of the household's consumption at the relevant time. AEMO estimated that at periods of maximum demand, solar generating units are on average producing at between one-third and one-half of their maximum rated capacity (AEMO 2012a, 28). The amount of electricity exported from small embedded solar generators in Victoria is not known, but in New South Wales

[6] The average installed PV capacity per household indicated by AEMO is at market saturation. At present, the average may be slightly lower.

IPART found that on average customers export from 32 to 50 per cent of the power they generate (IPART 2012, 2).

Under a moderate uptake scenario, AEMO forecast the amount of solar PV generated will increase to 1160 GWh in 2020 and 2840 GWh in 2030 (AEMO 2012a, 28). This suggests that rooftop solar PV production is anticipated to account for approximately 2.2 per cent of total energy consumption in Victoria by 2020,[7] and may account for around 5 per cent by 2030.

2.2 Feed-in tariffs & metering

There are two types of FiT schemes. The schemes used in Victoria, South Australia and Queensland all operate on a net basis, in which the FiT only applies to net power exports from the household. When the solar PV system is producing less power than is being consumed by the household, then the household benefits by reducing the power it draws from the grid—reducing the variable component of its electricity bills. When the household's power generation exceeds its consumption, it becomes a net power exporter,[8] and it receives the FiT rate applied to the electricity exports.

New South Wales and the Australian Capital Territory use gross feed-in tariff schemes. Households are compensated via the FiT for all of the power they generate from their solar PV system. On the other hand, they do not obtain the benefit of lower bills on account of drawing less power from the grid, as is the case with the net tariff.

The net and gross FiT approaches have different metering requirements. A gross FiT scheme requires the household to have both a Gross Meter[9] and an ordinary household electricity meter (which can be an accumulation meter or an interval meter). A net FiT scheme requires that the household either have an interval meter, or the combination of a Gross meter and an accumulation meter. Since the great majority of small customers in Victoria have a single interval meter, only the Net FiT approach is supported by current metering facilities.

Metering arrangements are a critical factor determining the design options available for feed-in tariffs. Accumulation meters only measure the amount of electricity consumed

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[7] Based on AEMO's medium forecast for Victorian energy consumption. (AEMO 2012b, 8–4)

[8] Exports are defined as the surplus of household electricity production over consumption in a period.

[9] Measures the output of a solar PV system separately from the meter used for household energy imports from the grid.

between two points in time, and provide no information about the time pattern of usage within that period, or even whether there were any periods during which electricity was exported by the household, and if so, when they occurred. Household power exports need to be calculated and system-wide averages are used to estimate the value of exported power. However, interval meters measure the electricity flows in half-hourly intervals, and can measure the amounts imported or exported by the household in each half-hourly period—which are the pricing periods in the NEM wholesale electricity market. Interval meters support a calculation of the value of electricity exports by each individual household based on their actual power exports in each half-hourly period and on the value of electricity in each of those periods.

The interval meters being rolled-out in Victoria provide two-way communications, remote meter reading and remote connection and disconnection. The regulatory timetable for the interval meter roll-out requires it to be substantially complete by the end of 2013.[10] Since the minimum FiT to be determined by the ESC will take effect from 1 January 2014, it can be assumed that the great majority of small customers in Victoria, and small embedded renewable generators, will have an interval meter installed at their premises.

2.3 Guiding Principles for FiT schemes

In 2008, the Council of Australian Governments (COAG) agreed that all new FiT schemes would conform to a set of national principles and these principles would also be used in reviewing existing schemes. Among these principles are the following:

- Residential and small business renewable energy generators should have the right to export energy to the electricity grid and market participants should be required to pay for that exported power at a price at least equal to the value of that energy in the relevant electricity market and the relevant electricity network it feeds into, taking into account the time of day during which energy is exported.
- The terms and conditions for small renewable generators should be incorporated into the overall regulation of the minimum terms and conditions for retail contracts so that charges for purchasing electricity and other terms and conditions are no less favourable than those for customers without small renewables. That is,

[10] Dept. Primary Industries <http://www.dpi.vic.gov.au/smart-meters/resources/reports-and-consultations/advanced-metering-infrastructure-cost-benefit-analysis/2.-background>, accessed 11/02/13.

retailers should not treat small renewables customers less favourably than customers without small renewables, but with a similar load on the network.

- Connection arrangements for small renewables should be standardised and simplified to recognise the market power imbalance between small renewable customers and networks (COAG 2008).
- The arrangements for small renewables generators should be subject to independent regulatory oversight according to clear principles, but should not interfere with the regulation of distribution tariffs.

Recently, the Standing Committee on Energy and Resources (SCER) decided that jurisdictions should develop guidelines for a consistent approach to fair and reasonable FiTs for micro-generators, and clear rights and obligations relating to interconnection. SCER will be seeking to move to a national framework in due course (SCER 2012, 4).

2.4 VCEC's inquiry

The Victorian Competition and Efficiency Commission (VCEC) re-examined the underlying policy rationale of the Victorian FiT schemes in light of Commonwealth policies such as:

(i) the $23/tonne carbon price introduced on 1 July 2012, and

(ii) Commonwealth subsidies for small-scale renewable generation directed to its target for 20 per cent of Australia's electricity supply to come from renewable energy by 2020 (VCEC 2012, xiv).

It concluded that, given the Commonwealth policies, further subsidising small scale embedded generation was likely to be a relatively expensive option for achieving reductions in greenhouse gas emissions, and would no longer be an appropriate policy instrument for the state government (VCEC 2012, 144). Further:

> *The distributed generation industry is now more viable, without the need for industry support measures and subsidies. Moreover, it is growing more rapidly than expected indicating that it is able to compete and secure a place in the electricity generation network into the future (VCEC 2012, xxv).*

VCEC recommended that the FiT should:

> *provide an efficient price signal to investors in small-scale distributed generators that will help achieve efficient use of distributed generation in a competitive electricity market. … distributed generators should receive a price that reflects the value of the electricity exported to the grid … (VCEC 2012, 147)*

In the long-term, VCEC considered that competition between retailers can be expected to ensure that market-determined FiTs will be the most efficient. However, transitional arrangements would be needed in the short-term.

VCEC reviewed a number options and its view was that "wholesale price plus" option is the most appropriate methodology to value the electricity exported into the network by distributed generators (VCEC 2012, 144). The "wholesale price plus" option is based on the wholesale electricity price with additions to reflect other avoided costs such as network losses.

2.5 AEMC & PC

Other reforms to feed-in tariff arrangements have also be proposed by the Australian Electricity Markets Commission (AEMC) and the Productivity Commission (PC).

In its recent review of demand-side participation in the National Electricity Market (NEM), the AEMC examined issues relating to feed-in tariffs. It recommended that "consideration be given to the ability of time varying tariffs to encourage owners of distributed generation assets to maximise export of power during peak demand periods" (AEMC 2012, recommendation 22). The value of energy from distributed generators to the electricity supply system varies according to market and network conditions, and is generally of higher value during peak demand periods. All things being equal, it could be expected that a time-varying FiT would better encourage small embedded generators to increase their export at peak times when compared to a fixed rate FiT.

VCEC expressed a similar view:

> *Adopting time-of-use pricing is desirable, because it provides a stronger economic signal to distributed generators of the value of production when overall electricity demand is high. (VCEC 2012, xxxi)*

In its recent review of Electricity Network Regulatory Frameworks, the PC makes similar recommendations relating to FiTs (PC 2013, 51 rec. 13.1).

> *State and territory governments should change the feed-in tariffs for any uncontracted small-scale distributed generators exporting power into the grid, so that their tariffs reflect the market wholesale prices at the time of energy production, and the (net) value to network businesses from reducing loads on their equipment at critical peak periods.* (PC 2013, 23)

2.6 Comments

The ESC notes that VCEC considers that the Standard FiT should be an efficient and fair rate that avoids cross-subsidies between consumers wherever possible. The Victorian Government has supported the use of VCEC's proposed "efficient and fair" criterion which is based on this principle (DTF 2012). Cross-subsidies between consumers may lead to wasteful over-investment in renewable generation installations and cause unnecessary hardship or expense for customers unable to invest in renewable generation—eg, due to lack of efficient investment opportunity, lack of income, tenancy restrictions etc. The minimum general FiT should be based on benefits (ie, cost savings) attributable to the export of power by small-scale distributed renewable generators.

The ESC also notes that the AEMC and the PC consider that a time varying FiT may be adopted. This would also be consistent with the COAG principle previously mentioned, that FiTs should take into account the time of day during which electricity is exported. That said the ESC considers that it may be too soon to contemplate the adoption of time-varying FiT rates for 2014.

The ESC does not intend to further consider approaches already reviewed and rejected by VCEC (2012, chapter 9). These include the payback period and "one-for-one" approaches. The remaining approaches able to be considered in this position paper belong to the "wholesale price plus" approach, which is the method the ESC proposes to use.

3 FORM OF THE FEED-IN TARIFF

The ESC considers there are three approaches that could be used to formulate a FiT:

- a single fixed-rate FiT in cents per kWh.
- a time-of-use FiT which has different rates applying to different periods of the day, such as peak, off-peak and shoulder periods, perhaps with seasonal variation.
- a time-varying FiT rate based on a formula linked to movements in the wholesale price of electricity and applied to each household based on their metered electricity exports during each half-hourly period.

The ESC considers that only the first two of these approaches would be within the scope of the ESC's discretion to implement under s 40FBA of the EIA, when it determines "the amount to be credited against the charges payable to a relevant licensee by a customer who is a relevant generator". The ESC therefore will not consider a time-varying FiT any further.[11]

A fixed-rate FiT, as the name suggests, does not change from period to period during the year. It is determined ex ante based on forecast aggregate quantities of embedded generation exports, and forecast wholesale electricity prices, in each half-hourly period of each day of the year.

A 'time-of-use' FiT refers to an ex ante tariff that potentially has different rates applying during peak, off-peak and shoulder periods of the day, weekdays and weekends, and seasons. Each of the elements of a time-of-use FiT is a fixed rate. The design of time-of-use tariffs can be complicated. The fixed rate for each period could be calculated analogously to the fixed-rate FiT, but based on the forecast aggregate quantities of embedded generation exports, and the forecast electricity prices, applying during the

[11] The ESC notes that COAG (2008) and the PC (2012) has emphasised that time-varying FiT s can provide households with the greatest incentive to export solar power during system peaks when its value is highest. This can be achieved by reducing household consumption during these periods to a level lower than the output of the solar PV system. It may also provide incentives to align solar panels to maximise output when the electricity value is highest. In the fixed-rate FiT models the household does not have this incentive.

periods for which the tariff element applies. However, an approach of this kind would not be adequate without taking the demand (and potentially supply) responses to such a tariff structure into account. An understanding of the capacity of households to switch load between periods would be needed to ensure that, after such adjustments have been made, the tariff would produce financial benefits to embedded generators equivalent to the value of their production.

A comprehensive analysis would be required to determine an appropriate form for a time-of-use FiT, which the time-frame of the present review does not permit. It would also be necessary for the ESC to understand whether there would be administrative complexities associated with introducing a time-of-use FiT. Since time-of-use electricity retail prices will become available to Victorian small consumers in the second half of 2013, it will be more practical to defer consideration of a time-of-use FiT until after their introduction.

Thus for reasons of practicality the ESC's draft decision is to determine a single fixed-rate minimum FiT for 2014. In subsequent years the ESC will give further consideration to using a time-of-use minimum FiT, taking into account insights from the introduction of time-of-use electricity retail pricing.

4 METHOD OF CALCULATING THE FIT RATE

This chapter outlines the ESCs approach to applying the “wholesale price plus” approach to determining the minimum FiT for 2014.

4.1 Retailer & system-wide perspectives

When a small customer exports solar electricity into the network, its retailer benefits because it is able to sell that power to other customers. Although there may be benefits to other parties in the electricity supply chain, there is a question whether such benefits should be recovered through the FiT. One approach to determining the value of electricity exports is to value the benefits flowing to the retailer supplying that customer. Another approach is to consider the system-wide benefits.

The most common approach in recent reviews of FiTs by bodies such as the Essential Services Commission of South Australia (ESCOSA), the Independent Pricing and Regulatory Tribunal (IPART) and the Queensland Competition Authority (QCA) is to interpret the fair and reasonable value of embedded electricity exports as:

> *… the direct financial benefit to the electricity retailer when it on-sells exported PV electricity. … [and] the value of the benefit to the retailer should be represented by the value of costs that retailers avoid when on-selling PV energy.* (QCA 2012, 9)

One limitation of this approach is that it is contingent on the structure of financial settlements in the wholesale electricity pool and of transactions between retailers and distributors or other input suppliers. In Victoria, the financial settlement process in the electricity pool is different from those in South Australia, New South Wales and Queensland because of the advanced stage of the smart meter roll-out. Further, the structure of transactions between retailers and distributors may not yet fully reflect principles established or proposed by relevant regulatory agencies. For example, the Australian Energy Markets Commission (AEMC) has stated that there remain shortcomings in the existing arrangements relating to passing-on avoided Transmission Use-of-System (TUoS) charges to embedded generators under the National Electricity Rules (AEMC 2012, 233). The PC has recommended changes to the arrangements by which embedded generators are reimbursed by network businesses for savings in network costs (PC 2013, 51). Changes of this kind may affect the retailer benefits arising from embedded generation, more closely aligning them with system-wide benefits.

Although it is important to have regard to the direct financial benefit to the retailer, the ESC proposes to also have regard to the system-wide benefits where it considers it is reasonable to do so — for example, where it is reasonable to expect some changes in the commercial arrangements relevant to the retailer.

4.2 Value of Embedded Electricity Exports

The value of electricity supplied by embedded generators broadly comprises the energy value of electricity produced and exported, associated reductions in line losses, and the ‘network value’ of distributed generation (ACIL Tasman 2012, 21). Table 4.1 shows a summary of the main retailer costs, showing those that other jurisdictions or previous reviews have considered to be avoided costs associated with embedded generation.

Table 4.1: Avoided Costs of FiTs

Avoided cost item	IPART	ESCOSA	QCA	VCEC
Wholesale electricity	✓	✓	✓	✓
Hedging	x	x	x	x
“Merit order effect”	x	x	x	x
System operation	✓	✓	✓	x
Transmission	x	x	x	x
Distribution*	x	x	x	x
Line losses	✓	✓	✓	✓
Metering	x	x	x	x
Retail services	x	x	x	x
Green scheme costs	x	x	x	x

* May be compensated directly by distributors.

Sources: (IPART 2012; ESCOSA 2012; QCA 2012; VCEC 2012)

Each of the components in Table 4.1 is discussed below.

Wholesale electricity

Energy value is the main element of the FiT rate in all jurisdictions. It is usually measured in terms of the forecast wholesale market cost of energy, but since this varies on a half-hourly basis there are various methods of estimating a representative value as a fixed rate. In Victoria, retailers mainly pay for the electricity used by their customers based on the amounts these customers actually use in each half-hourly interval (as recorded by their smart meter), whereas in other jurisdictions settlements are based on profiling using an aggregate average net consumption profile of all consumers over each half-hour of each day and season.[12] The retailer's avoided cost in these two situations will be quite different, so the method used to calculate the energy value of the FiT in Victoria will necessarily differ from the methods used by other regulators. The energy value of embedded generation is discussed in section 4.2.1.

Hedging

There is a question as to whether solar PV exports may reduce or increase retailer costs associated with risk mitigation through hedging contracts. For example, if the time-profile of embedded generation exports is correlated with demand it may provide a "natural hedge", and reduce hedging requirements, but if the effect of embedded generation is to make the overall patterns of net demand more peaked and volatile, then the opposite could be the case. Other jurisdictions have either rejected hedging costs as an avoided retailer cost (QCA 2013a, 20–21; ESCOSA 2012, 37–40) or did not address the question. Although some of the conclusions reached in other jurisdictions regarding hedging strategies may not apply in Victoria, due to different settlement arrangements, at this stage our view is that there is insufficient information to reach a conclusion that there are avoided hedging costs. In Victoria, solar PV does not appear to provide a "natural hedge" because embedded generation exports tend to be greatest during the 'shoulder' period in the middle of the day, and make a relatively small contribution during the summer evening peak.

[12] The ESC understands that once a meter is read as an interval meter and its data stream is setup in MSATS, it is settled in the NEM using the interval meter data (and therefore the NSLP is not applied). However, there remain a number of interval capable meters installed that are still being read as a basic meter and so their data streams are still setup in MSATS as a basic meter (they are awaiting for the logical conversion to interval process to be completed). Those meters will be settled in the NEM using basic meter data and NSLP is applied to determine half hour values.

ACIL Tasman has argued that the typical portfolio of swap and cap contracts held by a retailer is designed to hedge against price risk, but does not limit the retailer's volume risk. Consequently, for a fixed contract position, any variation in the electricity the retailer purchases incurs a cost (or cost saving) equal to the wholesale spot price. For this reason, the wholesale spot price is the relevant avoided cost in relation to the marginal unit of embedded generation (ACIL Tasman 2011, 22 & App. A). Accordingly, in this Draft Decision the avoided energy cost is measured by the spot market electricity value in the relevant periods.

Merit order

The 'merit order effect' referred to in Table 4.1 has been described by IPART as follows:

> *PV generation reduces the amount of electricity that retailers need to purchase from the wholesale market. This means that demand in the market can be settled at a lower bid in the merit order (ie, at a lower point on the supply cost curve) thereby lowering wholesale spot prices. This is referred to as the merit order effect. (IPART 2012, 81)*

Any source of reduced electricity demand by users, such as by reducing their use of electricity-using appliances, or installing more efficient appliances, or by generating electricity, among others, may affect the wholesale market price of electricity, at least in the short-term and if the reduction in demand is unanticipated. But in the medium-term, the available central generation capacity can be more closely matched to the residual demand not met by embedded generation, either by deferring investment in new capacity or by phasing out of operation older or more costly to operate generation plants sooner than would otherwise be the case. The same process may apply in a more timely way if the reduction in demand is anticipated. Given these market-related adjustment processes, there is no reason to expect there will be a merit order effect on the wholesale price of electricity in the medium-term.[13] Since the obligation to make Standard FiTs available to all relevant customers is an ongoing one, in the ESC's view the minimum FiT should not take account of possible short-run factors unlikely to be sustained. The ESC does not propose to include a "merit order effect" in the calculation of the minimum Standard FiT and notes that this approach is consistent with that taken by IPART, ESCoSA, QCA and VCEC (refer Table 4.1).

[13] See also VCEC (2012, 178).

System operation

System operation fees refer to fees levied by AEMO. Most other jurisdictions have considered these fees as an avoided cost to retailers because they are levied on the quantity of electricity traded on the wholesale market. We have some reservations about whether these fees can truly be considered an avoided cost, because AEMO's costs are independent of the amount of electricity traded through the wholesale market there will not be an avoided cost to retailers in aggregate. In any case, the ESC does not consider such benefits to be sufficiently material to take into account, since they amount to less than 0.1 c/kWh (SKM-MMA 2011, 3). Specifically, they have been estimated at between 0.035 and 0.050 c/kWh (SKM-MMA 2013, 11).

Distribution and Transmission Network Value

The network value of embedded generation refers to avoided costs of distribution or transmission network capacity augmentation caused by small-scale distributed renewable generation. In broad terms, the distributed generators are closer to the sources of electricity demand, and this may incrementally reduce the amount of infrastructure needed to conduct electricity over distances per unit of electricity consumed. Embedded generation can be a substitute for capacity augmentation that would otherwise be required to meet an increase in demand in a given locality from additional production by central generators (ACIL Tasman 2012, 23). When considering the question of network value, there is an important distinction between transmission capacity required to deliver energy from central generators to a distribution network, and distribution capacity needed to transfer energy from a transmission station to all of the customers within that distribution network. The following is a discussion on distribution network value.

Distributed generation exports must inevitably be carried on the distribution network. From the retailer's perspective there is no avoided DUoS charges associated with embedded generation exports, because these charges are partly fixed and partly depend on the amount of electricity the retailer sells to its customers (irrespective of the source) (IPART 2012, 52). But from a system-wide perspective, whether or not there is an avoided cost relating to distribution network infrastructure is a complicated matter. The benefits of embedded generation will vary between distribution networks and localities within them, and over time, depending on whether capacity is constrained in that locality and technological compatibility (see: ENA 2011). VCEC observed:

> *No reliable estimates of this value currently exist — at least in the public domain. The size of the network value is difficult to determine because it will be both time and location specific, but in constrained areas of the network it is likely to be large.* *(VCEC 2012, xxxvii)*

Recovering any distribution network value "is appropriately dealt with outside the FiT payment" (VCEC 2012, 179). Distribution network value should be compensated through an adjustment to the connection fee to take into account any reduction in the long run marginal cost of augmenting the distribution network as a result of the embedded generator being connected to the distribution. This would be consistent with the principles established in section 5 of the National Electricity Rules (NER). This may require a case-by-case assessment of network value (ACIL Tasman 2012, vii).[14] For these reasons, avoided distribution network costs should not be included in the minimum FiT.

The ESC does not propose to include avoided costs associated with transmission network capacity for reasons that are similar to above discussion on distribution network value. In addition the ESC is not aware of any specific pass-through arrangements for avoided transmission network costs via network use of system charges to retailers for customers who are small embedded generators. Again, the previous reviews summarised in Table 4.1 have all excluded network value as an avoided cost.

Line losses

Line losses occur when electricity is conducted along wires, and are generally related to the distance over which the electricity is conveyed and the voltages used. They are usually a substantial cost. Because embedded generation reduces the average distance between generation and consumption, usually quite dramatically, it is believed to reduce overall line losses. Most jurisdictions have included avoided transmission and distribution line losses as a benefit of embedded generation exports for this reason. Line losses are discussed in section 4.2.2.

[14] The Australian Energy Regulator (AER) is responsible for responsible for resolving disputes in relation to network connection charges and also issues connection charging guidelines, which address connection of small embedded generators (AEMC 2007).

Retail services

Retailer costs associated with metering and customer services are not avoided when a customer exports electricity into the distribution network because these services are needed to support the contracts which provide for feed-in arrangements. If there are any net effects of feed-in arrangements on retailer costs of this kind they are considered too small to be taken into account (ESCOSA 2012, 21).

Green scheme costs

Other regulators have considered whether any of the retailers' "green scheme" costs are avoided due to embedded generation, such as the Renewable Energy Target scheme (RET).[15] The overall consensus has been that such costs are not avoided costs. This is so for the RET, which is levied on the basis of the gross amount of electricity that the retailer supplies to its customers (whatever the sources), but the same conclusion has also been reached with regard to the various state-based schemes. The ESC does not propose to include any benefit associated with "green" schemes of this kind.

Avoided cost conclusions

The foregoing discussion has rejected most of the cost elements shown in Table 4.1.

The following sub-sections 4.2.1 and 4.2.2 discuss further the following avoided costs to be included in determining the FiT for 2014:

- the value of avoided electricity costs (including transmission line losses)
- avoided distribution line losses.

4.2.1 Wholesale electricity energy value

In the NEM, financial settlements relating to energy used by customers with interval meters are based on the metered half hourly consumption of each of those customers. Settlements for customers with accumulation meters are based on the overall average time-profile of consumption for all customers with such metering—the "net system load profile" (NSLP).[16] In jurisdictions where small customers usually have accumulation meters, such as South Australia, the avoided cost for the retailer of embedded

[15] For example, the Renewable Energy Target scheme (RET) and various state-based schemes.

[16] NSLP = Total electricity traded – estimated line losses – controlled load (eg, off-peak hot water) –interval metered load.

generation will be a weighted average of spot electricity prices, with the weights given by the NSLP. In Victoria, where most small customers have smart meters,[17] the avoided cost for the retailer of embedded generation (value of electricity exported) is:

- ***the wholesale spot price in each half-hour*** *multiplied by* ***the quantities of embedded generation exports of that retailer's customers in each corresponding half-hour period****.*[18]

In the Victorian context, the appropriate weights for averaging electricity spot market prices are given by the aggregate profile of small embedded generator electricity exports. The implications of the settlement process in Victoria is that each retailer pays for electricity consumed by its customers in each half-hour on the basis of the spot market price for that period, which represents the marginal cost of power generation in each half-hourly period. In the Victorian market, there is no distinction between the avoided energy cost to the retailer and the system-wide benefit, as is the case in other jurisdictions. For example, in South Australia, virtually all settlements for small customers are based on the NSLP, which is an average consumption profile, and each retailer pays the same price per kWh no matter when its customers consume electricity during the day.[19] In this situation there is a clear divergence between the avoided energy cost to the retailer and the system-wide benefit of a kWh embedded generation in a specific period.

Wholesale spot price

For the purposes of determining the 2014 FiT, the ESC proposes to use a projection of the half-hourly wholesale (spot) price of electricity in the Victorian region of the National Electricity Market (NEM), on each day of the year, prepared by ACIL-Allen. This forecast uses ACIL-Allen's *PowerMark* electricity price forecasting model (see: ACIL Tasman 2012).

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[17] The Victorian smart meter roll-out is expected to be substantially completed by 1 January 2014. Data presented in a recent study suggests that by mid-2012, either interval meters or smart meters had been installed for approximately one-quarter of customers in NSW, Queensland, Western Australia and the ACT and negligible percentages in SA, Tasmania and the Northern Territory (KEMA 2013 ss 2.4, 3.1 & 4.1).

[18] The relevant spot market electricity price is the Regional Reference Price (RRP) which applies in each half-hour period in the Victorian 'regional reference node' of the National Electricity Market (NEM). The RRP for each half-hour period and each node is published by AEMO. It includes an allowance for transmission line losses.

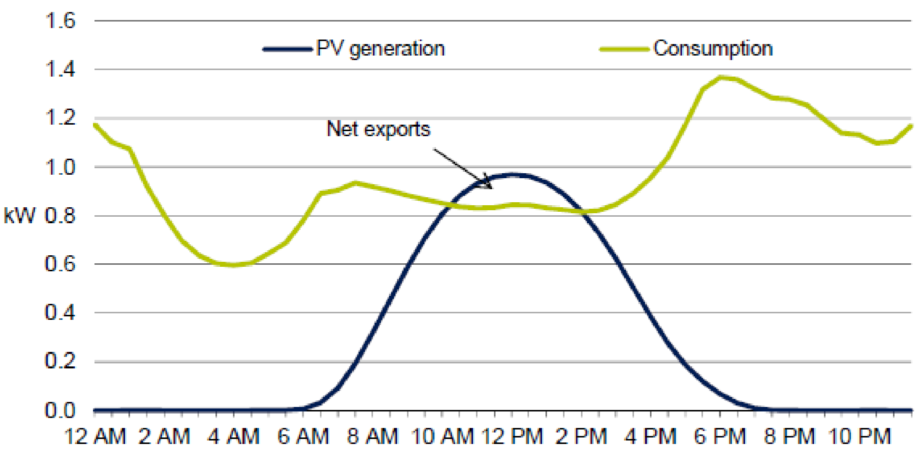
[19] Controlled load, such as off-peak hot water use, is settled on the basis of a separate profile. For details of the wholesale electricity settlement process in SA see: ACIL-Tasman (2011, 6).

Embedded generation exports

There are several different kinds of weights that can be used for calculating FiTs. These are summarised in Figure 4.1, which represents one example of the average consumption and solar PV generation patterns of a residential consumer in NSW. Two different profiles are shown for this small customer—and a third is discernible as the intersection of the two profiles shown. The three profiles are:

- *The average daily electricity consumption profile:* In jurisdictions where small customers have accumulation meters this is equal to the net system load profile (NSLP). This form of profile was used by ESCOSA (2012) and QCA (2013a).
- *The PV generation profile:* This is the total amount of electricity produced by the solar PV units in each period of the day.
- *The net export profile:* Net exports are the difference between this household's solar PV production and its consumption. IPART (2012) used an average net export profile in addition to the NSLP. The net export profile was developed using actual residential embedded generation export data supplied by distribution businesses. VCEC (2012) used a net export profile that was the different between the NSLP and a typical solar production profile.

Figure 4.1: Example Electricity Use Profiles*



Source: (IPART 2012, 35). * Average consumption and solar PV generation patterns of residential consumers in NSW with north-facing solar units of 2 kW capacity over a typical single day.

It is clear from Figure 4.1 that, for a given household, net solar PV exports will usually occur in a narrower band of the day than the overall output of the solar PV unit. In the example shown, exports only occur between approximately 10am and 3pm, whereas a solar PV unit typically produces electricity from 7am to 6pm. However, all households will be different. Households with greater generating capacity relative to consumption will produce power over a wider period of the day. Households with east-facing or west-facing panels would be likely to export electricity during an earlier or later period. There will be wide variation among individual household consumption profiles. Because of this heterogeneity, the aggregate solar PV export profile of all small embedded generators will not be the same as the difference between the average consumption profile and the average solar PV production profile. It will be a wider and flatter profile.

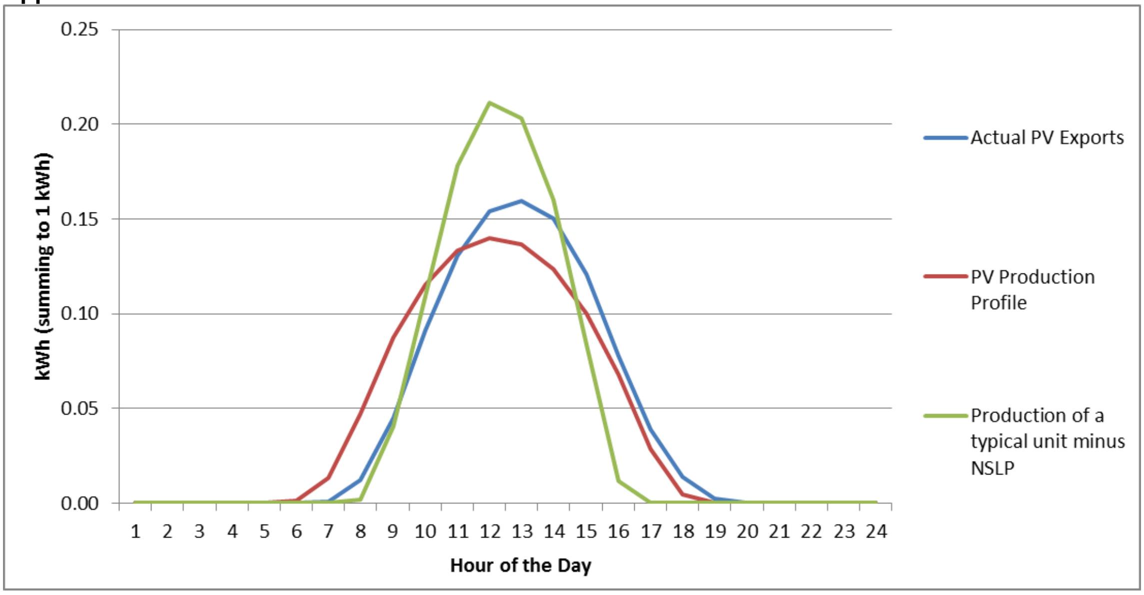
The ESC has considered several methods to estimate the aggregate profile of net exports. The use of the NSLP is not suitable for Victoria because it does not correspond to either the retailer avoided cost or the system-wide benefit (which are equivalent in this market). The aggregate profile of net exports is required, but this information is not available for Victoria, and therefore a profile needs to be adopted that provides the best approximation to that profile. Two methods of approximating the net export profile are:

(a) estimating the value of exported PV output based on the consumption and output generation characteristics of a typical residential solar customer.

(b) using the solar production profile to reflect the aggregate net export profile.

These two methods have been compared using data for Sydney, where 2011-12 data collected by IPART for actual household PV net export profiles is available on a half-hourly basis. The ESC has compared the actual aggregate solar net export profile for Sydney against method (a) and method (b) using Sydney data. This comparison is shown in Figure 4.2.

Figure 4.2: Actual Solar Net Export Profile Ausgrid Network NSW – Comparison with Approximate Profiles



Data Source: Ausgrid data provided to IPART & ESC analysis. Solar production profiles from AEMO & ROAM Consulting. Each profile is normalised to total 1 kWh over the day shown. Note, however, that the profiles for Victoria used by the ESC in its analysis sum to 1 kWh over a whole year.

The comparison shows that the actual solar PV net export profile is not confined to as narrow a period as the profile that is derived using method (a) — that is, the typical solar production profile for Sydney (assuming a 2.5 kW capacity unit) minus the average consumer consumption profile (the NSLP). That was essentially the method used by VCEC for Victoria. Figure 4.2 shows that method (b) — that is, the typical Sydney solar production profile — provides a closer approximation to the actual aggregate solar net export profile, particularly in the afternoon period when electricity prices tend to be higher. As mentioned, this result is due to the heterogeneity of both the solar production units and the household consumption patterns among embedded generators. The ESC therefore proposes to use method (b) — the solar production profile — to approximate the aggregate solar net export profile to determine the FiT for 2014.

Specifically the ESC has used a time series for the electricity production of a typical solar PV installation in Melbourne with a capacity of 1 kW in half-hourly periods from July 2003 to June 2012 provided by the AEMO and ROAM Consulting. The ESC has calculated, for each ordered half hour period of the year, the eight-year average of the solar production for that period. The resulting average solar production profile (the 'weather-normalised solar production profile') is used in the ESC's analysis to weight the spot prices for the purposes of calculating the FiT.

4.2.2 Line Losses

By reducing line losses, embedded generation can reduce the amount of electricity that a retailer has to buy at the transmission node because extra electricity is available within the network to be used by another customer (ESCOSA 2012, 35). Line losses are taken into account in pricing by applying loss factors to the wholesale price of electricity and applying this uplifted price to the quantity of electricity transmitted and distributed through the network (AEMO 2012c, 22–25). The cost of line losses is the amount of the uplift, and there will be avoided costs if embedded generation reduces the uplift. Transmission line losses are already factored into the Regional Reference Prices reported by AEMO, so it is not necessary to take these into account separately.

In consultations in other jurisdictions, some stakeholders have suggested that the effects of embedded generation in reducing distribution network line losses cannot be accurately quantified, and should not be included in the FiT (QCA 2012, 24). ESCOSA used the average distribution network loss factors to approximate the marginal benefits of embedded generation in terms of reducing network losses (ESCOSA 2012, 36). A similar approach has been adopted by IPART (2012, 58) and QCA (2013a, 26–27).

An alternative approach would be to rely on empirical information from trials that have quantified typical savings in distribution losses. Although there has been some analysis of this kind (see: ENA 2011), in the ESC's assessment, further analysis would be needed before it could be relied on for setting the FiT rate. The ESC proposes to use the AEMO average distribution losses factors (DLF), as have other regulators. The ESC has calculated an average DLF for Victoria using a representative DLF for each of the five distribution zones, and using customer numbers in each zone to calculate the weighted average.[20]

[20] The representative DLFs are those published by AEMO for the short sub-transmission systems in each zone, and specifically the DLF E, which is the distribution loss factor applied to a second tier customer or market customer connected to a low voltage line at 240/415 V.

4.3 Draft decision – value of embedded generation

In mathematical terms the methodology for calculating the FiT rate for the 1 January 2014 to 31 December 2014 can be summarised as follows:

$$FiT = DLF \sum_{h=1}^{17520} w_h p_h \qquad (4.1)$$

Where:

- DLF is the average distribution load factor
- *h* = 1 … 17520 is an indicator for the ordered half-hourly periods over a non-leap year
- w_h is the weather-normalised solar PV production profile expressed as weights with $\sum w_h = 1$, and
- p_h is the forecast spot electricity price in each half-hour period of 2014, expressed in c/kWh. The forecast spot price was produced by ACIL-Allen.

Table 4.2 shows the results of this method of calculating the value of embedded generation for 2014. The estimated value of small customer embedded generation is 7.6 cents per kWh. This can be decomposed into the wholesale energy value of 7.2 c/kWh, and the uplift that is due to the DLF, which is estimated to be 0.4c/kWh.

Table 4.2: Value of Embedded Generation

Avoided Cost	Contributions to FiT Rate (cents per kWh)
Wholesale energy value (incl. transmission line losses)	7.2
Distribution Line Losses	0.4
Total	**7.6**

The resulting estimate is broadly consistent with that reached by VCEC in 2012. Two counterbalancing factors have produced this result. Firstly, the forecast for Victorian electricity spot market prices prepared by ACIL-Allen is on average lower than the forecast it produced in 2012. This appears to be due to a combination of reduced electricity demand per household, and the sensitivity of spot prices to demand at certain times, particularly with regard to the number of days when prices are forecast to be above $300/MWh. The second factor is the different profiles used by the ESC for weighting spot market prices compared to the method used by VCEC. Under the method used by the ESC, more weight is given to afternoon periods when spot market prices tend to be higher, resulting in a higher average energy value overall.

The ESC's estimate is similar to the FiT recently recommended for Queensland by the QCA of 7.55 c/kWh (QCA 2013b), and lower than ESCOSA's draft determination for the South Australian FiT of 9.8 c/kWh. Although there are methodological differences which prevent direct comparison, the higher FiT in South Australia is consistent with higher electricity spot market prices compared to Victoria. Over the period from 2004-05 to 2011-12, the average spot electricity price in SA was $59/MWh, compared to $41/MWh in Victoria (AER 2012, 44).

The ESC's estimated value of small embedded generation exports of 7.6 c/kWh for 2014 is broadly consistent with the prevailing FiT rate of 8.0 c/kWh. Given the sensitivity of the estimated FiT to forecast electricity spot prices, which are in turn sensitive to demand forecasts, the ESC considers it appropriate to retain the prevailing FiT rate, rather than to make a minor change.

The ESC's draft decision is to adopt the minimum feed-in tariff rate of 8.0 c/kWh for 2014.

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