IPART
New South Wales

Independent Pricing and Regulatory Tribunal

Method Guide
Power Factor Correction Energy Savings Formula

Deemed Energy Savings Method

Energy Savings Scheme
August 2016

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V2.0	Application Form: Part B removed from the Method Guide to be a separate document.	15 January 2015
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Contents

1 About this document

The NSW Energy Savings Scheme (**ESS**) seeks to reduce energy consumption in NSW by creating financial incentives for organisations to invest in energy saving projects.

The other objects of the ESS are to:

- assist households and businesses to reduce energy consumption and energy costs
- make the reduction of greenhouse gas emissions achievable at a lower cost, and
- reduce the cost of, and need for, additional energy generation, transmission and distribution infrastructure.[1]

Electricity retailers and other mandatory participants (**Scheme Participants**) are obliged to meet energy saving targets. Energy savings can be achieved by installing, improving or replacing energy saving equipment. Persons that become Accredited Certificate Providers (**ACPs**) can create energy savings certificates (**ESCs**) from these activities and then sell those ESCs to Scheme Participants. The Independent Pricing and Regulatory Tribunal of NSW (**IPART**) is both the Scheme Administrator and Scheme Regulator of the ESS.[2]

This document provides guidance about how the Power Factor Correction Energy Savings Formula (**PFC**) method of the ESS operates, some of the key requirements that must be met when using the method, and how to calculate energy savings for a Recognised Energy Saving Activity (**RESA**) and create ESCs. This document should be used by:

- applicants seeking accreditation as a certificate provider, to assist them in completing their application,[3] and
- those persons who are already ACPs, to assist them in accurately calculating energy savings using this method.

1.1 Legislative requirements

This document is a guide only and is not legal advice. The legal requirements for ACPs participating in the ESS are set out in:

- Part 9 of the *Electricity Supply Act 1995* (**Act**)

1 *Electricity Supply Act 1995*, section 98(2)
2 *Electricity Supply Act 1995*, sections 153(2) and 151(2)
3 A full explanation of the application process is provided in the Application Guide www.ess.nsw.gov.au/How_to_apply_for_accreditation/Apply_now_-_guides_and_application_forms. Please ensure you read this document and the Application Guide in full before applying for accreditation.

- Part 6 of the *Electricity Supply (General) Regulation 2014* (**Regulation**), and
- the *Energy Savings Scheme Rule of 2009* (**ESS Rule**).

ACPs are also required to meet any additional conditions of accreditation as set out in their Accreditation Notice.

The **ESS Rule was amended** on 15 April 2016. The information in this document reflects the requirements of the ESS Rule as amended and should be referred to for all implementations. Where changes have been made to a section of this document as a result of amendments to the ESS Rule, the section is highlighted and marked with the following symbol:

Note that the previous version of the ESS Rule could have been used to calculate energy savings arising from an implementation with an implementation date before 15 April 2016, provided that:

- no previous applications to register ESCs in respect of that implementation were made prior to 15 April 2016, and
- the application to register ESCs in respect of those energy savings was made on or before 30 June 2016.[4]

Further guidance on calculating energy savings under the previous version of the ESS Rule, in accordance with cl 11.1 of the ESS Rule, can be found in version 2.0 of this document.[5]

2 Method overview

The PFC method provides a way to calculate and create ESCs from the energy savings achieved by installing power factor correction capacitors at sites connected to the NSW electricity network.

3 Requirements that must be met

The information below is guidance about the requirements of the method. This is not an exhaustive list of requirements, and you should ensure that you are familiar with your obligations under the Act, Regulation, ESS Rule and any conditions of your accreditation.

4 *ESS Rule*, cl 11.1

5 Available here: www.ess.nsw.gov.au/Methods_for_calculating_energy_savings/Document_archive

3.1 Energy saver

An ACP can only calculate energy savings and create ESCs from an implementation if the ACP is the 'energy saver' under the ESS Rule. The ACP must be the energy saver as at the implementation date. An energy saver can be either:

- **the original energy saver** – which, under this method, is the purchaser, or
- **the nominated energy saver** – which is someone the original energy saver has nominated as the energy saver by completing a Nomination Form using the method-specific template.[6]

An ACP that is the original energy saver must be accredited as an ACP prior to the implementation date in order to create ESCs from an implementation.

If you are the nominated energy saver, you must have a documented procedure identifying how you will obtain the nomination from the original energy saver. The nomination is taken to occur on the date that it is signed by both the **original energy saver** and **nominated energy saver.** To create ESCs from an implementation you must be:

- **accredited** as an ACP **prior to** the implementation date and before the nomination is made,[7] and
- **nominated** by the original energy saver **on or before** the implementation date.

3.2 Purchaser

In general, the purchaser is the person who purchases or leases the goods or services that enable the relevant energy savings to be made. However, the following persons cannot be a 'purchaser' and therefore cannot be an original energy saver under the PFC method:

- **an ACP who is not the owner, occupier or operator of the relevant site,[8]**
- **a person who purchases or leases the goods or services for the purpose of reselling the end-user equipment, unless the resale will be an inclusion in a contract for the sale of land or a strata scheme lot.[9]**

6 Available here: www.ess.nsw.gov.au/Methods_for_calculating_energy_savings/Power_Factor_Correction

7 The ESS website provides information on applying to become an ACP at: www.ess.nsw.gov.au/How_to_apply_for_accreditation.

8 ACPs that are nominated Energy Savers will typically fall under this category.

9 Wholesalers will typically fall under this category.

3.2.1 Network service provider power factor correction

A network service provider who installs power factor correction capacitors on their network may qualify as the purchaser. However, the installation of power factor correction capacitors by a network service provider is ineligible if:

- the capacitors are installed to meet a mandatory legal requirement, such as a 'reliability corrective action' undertaken to meet a service standard set under the National Electricity Rules (**NER**), or
- the installation of the capacitors satisfies a regulatory investment test under the NER when revenue from the ESS is not included.

3.3 Implementation and Implementation Date

An implementation is the delivery of a recognised energy saving activity (**RESA**)[10] at a site. For ACPs that use the PFC method, the implementation date is the date the power factor correction capacitors are installed.

To create ESCs, an ACP must be accredited for the relevant RESA **prior to** the implementation date.[11] ACPs that create ESCs must be the energy saver as at the implementation date. ACPs that are nominated as the energy saver must be nominated by the original energy saver **on or before** the implementation date.

3.4 Site requirements

The site where the power factor correction capacitors are installed must meet several requirements to be eligible under this method.

3.4.1 Supply voltage

The site where the power factor correction capacitors are installed must be connected to the NSW electricity network at a voltage less than 50 kilovolts (**kV**). This voltage is the voltage at the point of supply as defined by the Service and Installation Rules of New South Wales.[12]

3.4.2 Main switchboard

The power factor correction capacitors must be installed at the main switchboard, which is the switchboard where the main switches that control the whole

10 A RESA must meet all of the criteria set out in clause 5.3 and 5.4 of the ESS Rule.

11 The ESS website provides information on applying to become an ACP at: www.ess.nsw.gov.au/How_to_apply_for_accreditation.

12 Available here: www.resourcesandenergy.nsw.gov.au/energy-supply-industry/pipelines-electricity-gas-networks/network-connections/rules

electrical installation are located. The main switchboard is typically identified with a label (eg, main switchboard). The Australian/New Zealand Wiring Rules[13] provide further clarification on whether a switchboard is considered a main switchboard.

3.5 Equipment requirements

3.5.1 Power factor correction

The power factor correction provided at the site must be supplied through capacitors. Eligible power factor correction systems include:

- switched capacitor banks
- static var[14] compensators (**SVCs**), as they use capacitors to provide their reactive power, and
- static synchronous compensators (**STATCOMs**), as they also employ capacitors.

Synchronous condensers and 'overly excited' generators are not eligible as they do not use capacitors to provide the power factor correction.

3.5.2 Power factor after installation

The power factor correction capacitors must improve the power factor of the site to a minimum of 0.9 lagging.

The installation of power factor correction capacitors must not result in a leading power factor or interfere with the operation of frequency injection load control systems.[15]

3.5.3 New capacitors

The power factor correction capacitors installed at the site must be new.

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13 The Australian/New Zealand Wiring Rules is also known as: AS/NZS 3000:2007 Electrical installations.

14 "var" is reactive power (volt amperes reactive).

15 These are requirements of the Service and Installation Rules of New South Wales. www.resourcesandenergy.nsw.gov.au/energy-supply-industry/pipelines-electricity-gas-networks/network-connections/rules

3.6 Legal requirement to install

For power factor correction capacitors to be eligible under this method, they must not be installed as part of a mandatory program of installation, eg, to meet a legal requirement to provide power factor correction.

3.7 Electrical work

The power factor correction equipment must be installed in accordance with the requirements of the relevant electrical and safety standards, including the Service and Installation Rules of New South Wales and the Australian/New Zealand Wiring Rules.[16]

4 Calculating energy savings

The relevant equations and tables used to calculate energy savings using the method are provided in Appendices A and B of this guide. Under the ESS Rule, energy savings comprise both 'electricity savings' and 'gas savings'.

4.1 Electricity savings

The electricity savings from an implementation of the method can be calculated using Equations 13 and 14 of the ESS Rule (refer to Appendix A of this Guide). The electricity savings are calculated as the power savings over the expected lifetime of the power factor correction capacitors. For the purposes of this method, this lifetime is taken to be 10 years.

4.1.1 Regional Network Factor

The equation to calculate electricity savings includes a regional network factor. The applicable regional network factor is based on the postcode of the site and can be found in Table A24 of the ESS Rule (refer to Appendix B of this Guide).

4.1.2 Power savings

The power savings calculated in Equation 14 of the ESS Rule are equal to the line loss power savings less capacitor losses. Equation 14 requires the following inputs:

- the real power component of the average site load during operating hours

[16] The Australian/New Zealand Wiring Rules are also known as AS/NZS 3000:2007 Electrical installations.

- the distribution loss factor
- the initial power factor for the site load before the capacitors were installed
- the final power factor for the site load after the capacitors were installed, and
- the rating of the installed capacitors.

Real power component of the average site load

This is the average real power consumption of the site (measured in kilowatts) during operating hours.

This average must be measured over a period that reflects normal operating conditions and must exclude periods not representative of normal operating conditions, such as maintenance and shutdown periods.

Distribution loss factor

The distribution loss factor (**DLF**) reflects the electrical distribution losses that occur in supplying electricity to the site. The installation of power factor correction capacitors at a site with a higher DLF will produce a greater amount of energy savings.

Table A19 of the ESS Rule (refer to Appendix B of this Guide) specifies a DLF for each Distribution Network Service Provider (**DNSP**) in NSW. There are three DNSPs in NSW and each is responsible for electrical distribution in separate geographic regions of NSW, known as distribution districts.

There are three easy ways to determine which DNSP is responsible for the supply of electricity to a site:

- referring to the electricity bill or connection agreement for the site,
- checking the local government area the site is in, or
- using the Australian Energy Regulator's (**AER**) 'Energy Made Easy' service.

These are outlined further below.

Determining the DSNP from the electricity bill

Most electricity bills identify the DNSP under the 'Faults and Emergencies' section, as the DNSP is responsible for maintaining and repairing the network.

Determining the DSNP from the local government area

The DNSP can also be determined using the local government area (council) where the site is located, as each distribution district is aligned with local government area boundaries. Schedule 3 of the Act specifies the DNSP for each distribution district.

Determining the DNSP from the AER tool

The AER maintains an online electricity comparison tool[17] which can identify the DNSP responsible for the supply of electricity to the site, from the site's postcode. The DNSP for the postal area is listed on the summary page under 'Distributor'.[18]

Initial power factor

The initial power factor is the power factor of the load before the power factor correction capacitors are installed. This power factor should be measured at the main switchboard, or the point of supply. The initial power factor must be representative of the power factor under normal site operating conditions.

If the measured initial power factor is below 0.9, the initial power factor is taken to be 0.9 when calculating the power savings.

Final power factor

The final power factor for the load is the power factor of the site load after the power factor correction capacitors are installed. This power factor should be measured at the main switchboard, or point of supply. The final power factor must be recorded under conditions similar to those when the initial power factor was recorded.

If the measured final power factor is above 0.98, the final power factor is taken to be 0.98 when calculating the power savings.

Rating of installed capacitors

The electricity consumed by the power factor correction capacitors must be subtracted from the overall power savings. This is determined from the rated reactive power (measured in kvar[19]) of the installed capacitors.

4.2 Checking energy savings measurements

The formula provided below will assist you to calculate the theoretical capacitor rating needed to achieve the change in power factor for a given load. You can use this formula to check that your measurements of the power factor and real power are accurate.

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17 Available here: www.energymadeeasy.gov.au

18 The AER service is unable to identify the DNSP where a postcode is serviced by multiple DNSPs.

19 "kilovolt-amperes reactive", which is reactive power.

$$Required\ kvar\ =\ Real\ Power(kW)\ \times\left(\frac{\sqrt{1-(initial\ pf)^2}}{initial\ pf}-\frac{\sqrt{1-(final\ pf)^2}}{final\ pf}\right)$$

Where:

- *initial pf* is the power factor of the load before the capacitors are installed, or 0.9, whichever is greater, and
- *final pf* is the power factor of the load after the capacitors are installed, or 0.98, whichever is lesser.

4.3 Gas Savings

The gas savings from this method will always be equal to zero (as, under the ESS Rule, gas savings are not calculated for this method and are therefore not applicable).

5 Calculating and creating ESCs

Equation 1 of the ESS Rule is used to calculate the number of ESCs that may be created from the energy savings calculated in relation to an implementation.

Equation 1

Number of Certificates = $\Sigma_{Implementations}$ Electricity Savings x Electricity Certificate Conversion Factor + Gas Savings x Gas Certificate Conversion Factor

5.1 Applying to register ESCs

Certain information must be submitted to us **before an ACP applies to register** ESCs created from energy savings arising from an implementation or implementations.[20] ACPs are to provide the required information by completing an Implementation Data Sheet[21] and submitting it through the ESS Portal.[22] The Implementation Data Sheet will include a calculation of the number of ESCs to be created in accordance with Equation 1 in the ESS Rule. This calculation involves multiplying the electricity savings arising from the implementation or implementations by the certificate conversion factor for electricity (1.06).[23]

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20 *ESS Rule,* cl 6.8

21 The implementation data sheet is available from the ESS Website at: www.ess.nsw.gov.au/Registry/Registering_certificates

22 Information and access to the portal can be found here: www.ess.nsw.gov.au/ESS_Portal

23 *The Act,* s 130(1)(a). This may be amended by regulations: see *the Act*, s 130(3).

The result is the total number of ESCs that ACPs can apply to register from the implementation or implementations. If the result is not a whole number, it is rounded down to the nearest whole number.

There are no restrictions on how many implementations can be bundled together in the same Implementation Data Sheet. However:

- ACPs must apply to register all ESCs included in an Implementation Data Sheet in a single application
- ACPs cannot split energy savings calculated from a single implementation across two or more Implementation Data Sheets, and
- each Implementation Data Sheet must only include the calculation of energy savings that are taken to have occurred in the same calendar year (commonly referred to as 'vintage').

When determining how many Implementations to bundle in the same Implementation Data Sheet, ACPs should consider:

- the ESC creation limit specified in their Accreditation Notice, as they must be able to register all the ESCs in the bundle at the same time, and
- the cost of registering the ESCs.[24]

More information on applying to register the creation of ESCs can be found on the ESS website.

6 Minimum required records

ACPs are required to keep records of the energy savings activity, including:

- the location in which the energy savings activity occurred
- the energy savings arising from that activity
- the methodology, data and assumptions used to calculate those energy savings, and
- any other records specified by the Scheme Administrator.[25]

ACPs must retain records for at least six years, in a form and manner approved by the Scheme Administrator. Each ACP's Accreditation Notice may include a

24 The ESC registration fee must be paid in a single payment for all ESCs registered in a single bundle. Payment for a single bundle cannot be split into two payments. Refer: www.ess.nsw.gov.au/Registry/Registering_certificates

25 *The Regulation*, cl 46

condition requiring that the ACP's record keeping arrangements are consistent with the ESS Record Keeping Guide.[26]

Tables 1 and 2 below describe the minimum documents you must keep as a record of the energy savings from your project. You must collect the required documents for each implementation of your activity.

[26] Available at: www.ess.nsw.gov.au/Accredited_Certificate_Providers/Record_keeping_arrangements

Table 1 Minimum required records for all implementations - general requirements

Requirement	Document	Description
Implementation date	Completion/commissioning report **or** Certificate of Compliance – Electrical Work (CCEW) **or** Tax invoice	The document must clearly show the date the power factor correction equipment was installed.
Implementation address	Completion/commissioning report **or** Certificate of Compliance – Electrical Work (CCEW) **or** Tax invoice	The document must clearly show the location of the site where the power factor correction equipment was installed.
Energy Saver	Sales ledger **or** Tax invoice	The document must clearly show that the purchaser paid for the power factor correction equipment.
Nomination	Nomination form (not required if you are the original energy saver, ie, the purchaser)	The nomination form must: ▾ be in the required form (ie, using the relevant template available from the ESS website), and ▾ be signed by both the purchaser and the ACP on or before the implementation date.
Energy saving calculations	The spreadsheet or calculation tool used to calculate energy savings from each implementation.	The document must clearly show your calculation of energy savings in accordance with equations 13 and 14 of the ESS Rule.

Table 2 Minimum required records for all implementations - activity requirements

Requirement	Document	Description
Capacitors installed at the main switchboard	Provide **two** of the following **three** documents: ▾ single line diagram ▾ schematics ▾ photographs (geo-tagged)	The document must: ▾ identify the main switchboard, ▾ identify the connection of the power factor correction installation, and ▾ show the power factor correction capacitors are installed at the main switchboard. The photograph must: ▾ be clear and in focus, and ▾ identify the power factor correction capacitors and the connection to the main switchboard.[a]
Supply voltage	Single line diagram **or** Schematics **or** Connection or Supply Agreement	The single line diagram must: ▾ identify the site, ▾ show the point where the site connects to the NSW electricity network, and ▾ show the voltage at the connection point. The agreement must: ▾ identify the site, and ▾ identify the supply voltage.
Real power	Site interval data[b] **or** Electricity retailer report	The document must: ▾ show the average real power during normal operating hours, and ▾ identify the time period over which the measurements were taken.
Initial power factor	Site interval data[b] **or** Electricity retailer report	The document must: ▾ show the average power factor during normal operating hours before the power factor correction equipment was installed, and identify the time period over which the measurements were taken.

Requirement	Document	Description
Final power factor	Site interval data[b] **or** Electricity retailer report	The document must: ▾ show the average power factor during normal operating hours after the power factor correction equipment was installed, and ▾ identify the time period over which the measurements were taken.
Distribution network service provider (DNSP)	Electricity bill **or** Connection agreement **or** Single line diagram **or** Council rates notice (or other similar council document) **or** Australian Energy Regulator “Energy Made Easy” extract	The document must identify: ▾ the location of the site where the power factor correction equipment was installed, and ▾ the DNSP responsible for the supply of electricity to the site.[c]
Rating of installed capacitors	Single line diagram **or** Manufacturer specification **or** Photographs (geo-tagged) **or** Completion or commissioning report **or** Tax invoice	The document must: ▾ identify the site where the power factor correction capacitors were installed, and ▾ show the rating of the installed capacitors.

a A photograph showing the main switchboard together with a photo of the switchboard panel containing the switchgear for the power factor correction installation is sufficient.

b Site interval data must be measured at the main switchboard or connection point.

c The council rates notice may evidence this by showing the local government area the site is located in.

7 Glossary

Table 7.1 Power Factor Correction Energy Savings Formula definitions

Term	Definition
ACP	Accredited Certificate Provider
DLF	Distribution Loss Factor
DNSP	Distribution Network Service Provider
Energy saver	Refer to section 3.1 of this guide
ESC	Energy Savings Certificate
ESS	Energy Savings Scheme
ESS Rule	*Energy Savings Scheme Rule of 2009*
Implementation	Refer to section 3.3 of this guide
Implementation Date	Refer to section 3.3 of this guide
kV	Kilovolt
kvar	Kilovolt-amperes reactive
kW	Kilowatt
kWh	Kilowatt-hour
PF	Power Factor
PFC	Power Factor Correction
Purchaser	Refer to section 3.2 of this guide
RESA	Recognised Energy Saving Activity
MWh	Megawatt-hour

Appendices

A Equations to calculate energy savings

A.1 Clause 9.6 of the ESS Rule

Equation 13

For each Implementation:

$$\textit{Electricity Savings} = \textit{(Power Savings) / 1000 x (Annual operating hours) x (Site Life) x Regional Network Factor}$$

Where:

- *Power Savings*, in kW, is the line loss power savings, less capacitor losses, during operating hours, and is calculated according to **Equation 14;**
- *Annual operating hours*, in hours/year, is the number of hours per year that the Site is operating and equals 1750; and
- *Site Life*, in years, is the expected remaining lifetime of the Site and the capacitors and equals 10.
- *Regional Network Factor*, is the value from Table A24 corresponding to the postcode of the Address of the Site or Sites the where the Implementation(s) took place.

Equation 14

$$\textit{Power Savings (kW)} = \textit{Real Power x 0.7 x (DLF - 1) x (1 – (Initial power factor)}^2 \textit{ / (Final power factor)}^2 \textit{) – 0.0039 x (Rating of installed capacitors)}$$

Where:

- *Real Power*, in kW, is the real power component of the average Site load during operating hours;
- *DLF* is the distribution loss factor for the Distribution District that the Site is connected to, as detailed in Table A19 of Schedule A;
- *Initial power factor* is the power factor of the load before the capacitors are installed, or 0.9, whichever is greater;
- *Final power factor* is the power factor of the load after the capacitors have been installed, or 0.98, whichever is lesser; and
- *Rating of installed capacitors*, in kvar, is the rated reactive power of the installed capacitors.

B Tables from the ESS Rule

Table A19: Distribution Loss Factors (DLF) for losses between the Subtransmission network and Low Voltage connection points

Distributor	Distribution District	DLF
Endeavour Energy	Endeavour Energy	1.054
Essential Energy	Essential Energy	1.074
AusGrid	AusGrid	1.043

Table A24: Regional Network Factors

Postcode of Site where Implementation occurred	Regional Network Factor
2311-2312	1.03
2321	1.03
2324	1.03
2329	1.03
2338-2490	1.03
2536-2537	1.03
2545-2551	1.03
2579-2599	1.03
2619-2739	1.03
2787	1.03
2791-2844	1.03
2850-2880	1.03
3585	1.03
3644	1.03
4383	1.03
All other postcodes	1