

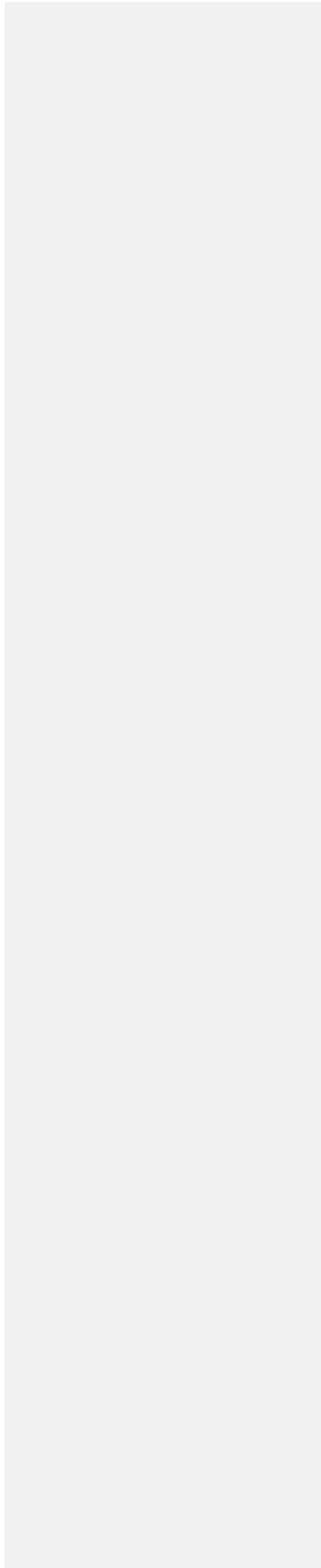


Power Factor Correction Energy
Savings Formula

Method Guide

V3.4, April 2023

ESS >>



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We recognise the unique cultural and spiritual relationship and celebrate the contributions of First Nations peoples.

The Independent Pricing and Regulatory Tribunal

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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
- 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.

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
- those persons who are already ACPs, to assist them in accurately calculating energy savings using this method.

1.1 Legislative requirements

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

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

1.2 Document control

Version number	Change description	Date published
V1.0	Initial release – following gazettal of ESS Rule Amendment No.2	January 2015
V2.0	Application Form: Part B removed from the Method Guide to be a separate document.	January 2015
V3.0	Updated to reflect changes to the ESS Rule	August 2016
V3.1	Updated to reflect amendments to the ESS Rule	May 2017
V3.2	Updated to reflect changes to the ESS Rule	March 2020
V3.3	Updated to reflect minor changes to processes following the introduction of The Energy Security Safeguard Application (TESSA)	September 2022
V3.4	Updated to reflect amendments to the ESS Rule	April 2023

2 Requirements that must be met

We have provided guidance below about the requirements of the method. This is not an exhaustive list of requirements, and ACPs should ensure that they are familiar with their obligations under the Act, Regulation, ESS Rule and any conditions of their accreditation.

2.1 Energy Saver

An ACP can only calculate energy savings and create ESCs 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 the PFC method, is the purchaser (discussed below)
- **the nominated energy saver** – which is someone the original energy saver has nominated as the energy saver by completing a [nomination form](#).

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

An ACP that is a nominated energy saver must:

- be [accredited as an ACP](#) **before** the implementation date and before the nomination is made
- have a documented procedure for obtaining the nomination from the original energy saver
- be **nominated** by the original energy saver **on or before** the implementation date. The nomination is taken to occur on the date that the nomination form is signed by the original energy saver.

2.1.1 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,^a
- 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.^b

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

^b Wholesalers will typically fall under this category.

2.1.2 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.

2.2 Implementation and Implementation Date

The ESS Rule defines 'implementations', 'implementation dates' and 'site' (explained below). These concepts are used to determine the number of ESCs, and from when they can be created.

2.2.1 Implementation

An implementation is the delivery of an energy saving activity (called a 'RESA' in the ESS Rule) at a site. RESA must meet all of the criteria set out in clause 5.3 and 5.4 of the ESS Rule.

2.2.2 Implementation date

For ACPs that use the PFC method, the implementation date is the date the power factor correction capacitors are installed.

2.2.3 Site requirements

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

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](#).

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 electrical installation are located. The main switchboard is typically identified with a label (e.g. main switchboard). The Australian/New Zealand Wiring Rules^c provide further clarification on whether a switchboard is considered a main switchboard.

2.3 Equipment requirements

2.3.1 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^d compensators (**SVCs**), as they use capacitors to provide their reactive power
- 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.

2.3.2 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. These are requirements of the [Service and Installation Rules of New South Wales](#).

2.3.3 New capacitors

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

2.4 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, e.g. to meet a legal or mandatory requirement to provide power factor correction.

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

^d "var" is reactive power (volt amperes reactive).

2.5 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.^e

2.6 Minimum requirements of conduct

The Scheme Administrator has established minimum requirements for the conduct of ACPs and their representatives. This includes ACP responsibilities for:

- training representatives
- maintaining a register of representatives
- ensuring there is a formal, documented, signed and enforceable (legally binding) contract or agreement in place for each representative
- providing appropriate customer service.

ACPs are accountable for all ESS activities conducted by employees, third parties and other representatives. This includes all aspects of an activity for which they create ESCs, from the initial engagement with customers, through to the final quality assurance of documents. ACPs will be held responsible for all actions, omissions and information provided by representatives acting on their behalf under the ESS – regardless of any contract or agreement with other parties. For more information, refer to *ESS Notice 01/2013 (V3.0) Minimum requirements of conduct*.

^e The Australian/New Zealand Wiring Rules are also known as AS/NZS 3000:2007 Electrical installations.

3 Calculating energy savings

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.

This method is only designed to calculate electricity savings. It does not consider savings from other fuel types such as gas, diesel, biofuel, biomass, biogas and onsite renewables. Therefore, savings from these fuel types will always be equal to zero when calculated using this method.

3.1 Electricity savings

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

3.1.1 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
- 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
- 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 due to a low power factor will produce a greater amount of energy savings.

Table A19 of the ESS Rule 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 2 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.

These are outlined further below.

Determining the DNSP 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 DNSP 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.

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^f) of the installed capacitors.

3.2 Checking energy savings measurements

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

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

Where:

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

^f "kilovolt-amperes reactive", which is reactive power.

4 Minimum required records

ACPs are required to keep records in respect of a RESA, including records of:

- the location in which the RESA occurred
- the energy savings arising from that RESA
- the methodology, data and assumptions used to calculate those energy savings
- any other records specified in writing by the Scheme Administrator.²

ACPs must retain records for at least six years, in a form and manner approved by the Scheme Administrator.³ Each ACP's Accreditation Notice may include a condition requiring that the ACP's record keeping arrangements are consistent with the *Record Keeping Guide*.

Table 6.1 and Table 6.2 below describe the minimum documents ACPs must keep as a record of the energy savings from their project. ACPs must collect the required documents for each implementation of their activity.

Table 6.1 Minimum records for all implementations – general requirements

Requirement	Document	Description
Implementation Date	<ul style="list-style-type: none"> Completion/commissioning report 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	<ul style="list-style-type: none"> Completion/commissioning report 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	<ul style="list-style-type: none"> Sales ledger, or Tax invoice 	<ul style="list-style-type: none"> The document must clearly show that the purchaser paid for the power factor correction equipment.
Nomination	Nomination form (not required if the ACP is the original energy saver i.e. the purchaser)	<p>The nomination form must:</p> <ul style="list-style-type: none"> be in the required form (i.e. using the relevant template available from the ESS website) be signed by the original energy saver on or before the implementation date.
Energy Saving Calculations	The spreadsheet or calculation tool ACPs use to calculate energy savings from each implementation.	The document must clearly show ACPs' calculation of energy savings in accordance with equations 13 and 14 of the ESS Rule.

Table 6.2 Minimum records for all implementations – activity requirements

Requirement	Document	Description
Capacitors installed at the main switchboard	Provide two of the following three documents: <ul style="list-style-type: none"> • Single line diagram • Schematics • Photographs (geo-tagged) 	<p>The document must:</p> <ul style="list-style-type: none"> • identify the main switchboard, • identify the connection of the power factor correction installation • show that the power factor correction capacitors are installed at the main switchboard. <p>The photograph must:</p> <ul style="list-style-type: none"> • be clear and in focus • identify the power factor correction capacitors and the connection to the main switchboard.⁹
Implementation Address	<ul style="list-style-type: none"> • Single line diagram • Schematics, or • Connection or Supply Agreement 	<p>The single line diagram must:</p> <ul style="list-style-type: none"> • identify the site • show the point where the site connects to the NSW electricity network • show the voltage at the connection point. <p>The agreement must:</p> <ul style="list-style-type: none"> • identify the site • identify the supply voltage.
Real power	<ul style="list-style-type: none"> • Site interval data,^h or • Electricity retailer report 	<p>The document must:</p> <ul style="list-style-type: none"> • show the average real power during normal operating hours • identify the time period over which the measurements were taken.
Initial power factor	<ul style="list-style-type: none"> • Site interval data, or • Electricity retailer report 	<p>The document must:</p> <ul style="list-style-type: none"> • show the average power factor during normal operating hours before the power factor correction equipment was installed • identify the time period over which the measurements were taken.
Final power factor	<ul style="list-style-type: none"> • Site interval data, or • Electricity retailer report 	<p>The document must:</p> <ul style="list-style-type: none"> • show the average power factor during normal operating hours after the power factor correction equipment was installed • identify the time period over which the measurements were taken.

⁹ 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.

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

Requirement	Document	Description
Distribution network service provider (DNSP)	<ul style="list-style-type: none"> Electricity bill Connection agreement Single line diagram, or Council rates notice (or other similar council document) 	<p>The document identify:</p> <ul style="list-style-type: none"> the location of the site where the power factor correction equipment was installed the DNSP responsible for the supply of electricity to the site.ⁱ
Rating of installed capacitors	<ul style="list-style-type: none"> Single line diagram Manufacturer specification Photographs (geo-tagged) Completion or commissioning report, or Tax invoice 	<p>The document must:</p> <ul style="list-style-type: none"> identify the site where the power factor correction equipment was installed show the rating of the installed capacitors.

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

5 Glossary

Words which are defined in the ESS Rule and used in this Method Guide have the same meaning in this Method Guide as in the ESS Rule, unless the context requires otherwise.

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 3.2 of this guide
Implementation Date	Refer to section 3.2 of this guide
kV	Kilovolt
kvar	Kilovolt-amperes reactive
kW	Kilowatt
kWh	Kilowatt-hour
MWh	Megawatt-hour
PF	Power Factor
PFC	Power Factor Correction
Purchaser	Refer to section 3.1 of this guide
RESA	Recognised Energy Saving Activity
var	Volt-amperes reactive

¹ Cl 98(2) of Schedule 4A, *Electricity Supply Act 1995*.

² Cl 46 of the *Electricity Supply (General) Regulation 2014*

³ Cls 46(3)-(4) of the *Electricity Supply (General) Regulation 2014*

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