IPART
New South Wales

Independent Pricing and Regulatory Tribunal

Method Guide
Project Impact Assessment with Measurement and Verification Method

Energy Savings Scheme
May 2016

Enquiries regarding this document should be directed to:

ESS Enquiries (02) 9290 8452 or ess@ipart.nsw.gov.au

Independent Pricing and Regulatory Tribunal of New South Wales
PO Box K35, Haymarket Post Shop, NSW 1240
Level 15, 2-24 Rawson Place, Sydney NSW 2000

T (02) 9290 8400 F (02) 9290 2061

www.ipart.nsw.gov.au

Document control

Version number	Change description	Date published
V1.0	Initial release – following gazettal of ESS Rule Amendment no. 2	8 January 2015
V2.0	Application Form: Part B and Evidence Package removed from the Method Guide to be separate documents.	10 February 2015
V2.1	Revised statement regarding additional application documentation.	6 May 2015
V3.0	Updates following amendments to the ESS Rule commencing on 15 April 2016	May 2016

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 Project Impact Assessment with Measurement and Verification (**PIAM&V**) 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.

Specifically, this guide provides information on the calculation of energy savings and creation of ESCs using clause 7A of the ESS Rule[4] for:

- forward creation of ESCs from a single site model calculated from a Baseline Energy Model and Operating Energy Model (modelling energy performance before and after project implementation)[5] (section 4.1 of this guide)

---

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 http://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.

4 *Energy Savings Scheme Rule of 2009*, as amended from time to time.

- annual creation or top-up of ESCs based on actual performance of a project following implementation, and compared to an Baseline Energy Model (sections 4.2 and 4.3 of this guide), and
- multiple site ESC creation based on a multiple site model, and using a sampling method (section 5 of this guide).[6]

In addition to this guide, the following references are recommended reading when using this method:

- the Measurement and Verification Operational Guide published by the NSW Office of Environment and Heritage,[7] and
- the International Performance Measurement and Verification Protocol, Concepts and Options for Determining Energy and Water Savings, Volume I, 2012 (IPMVP), published by the Efficiency Valuation Organization.[8]

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**)
- 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 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 from that date. Where changes have been made to a section of this document as a result of amendments to the ESS Rule, the section will be highlighted and marked with the following symbol:

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

---

5 A RESA may involve multiple sites, where each site has its own energy model.

6 After 15 April 2016, ACPs are not able to be accredited to use a sampling method until 1 October 2016.

7 Available at www.environment.nsw.gov.au Refer to Appendix D for further information.

8 Available at www.evo-world.org

- no previous applications to register ESCs in respect of that implementation have been made prior to 15 April 2016, and
- the application to register ESCs in respect of those energy savings is made on or before 30 June 2016.[9]

ACPs who intend to calculate energy savings under the previous version of the ESS Rule, in accordance with clause 11.1 of the ESS Rule, should refer to version 2.1 of this document.[10]

2 Method overview

The PIAM&V method requires applicants to measure and verify the energy savings from implementing equipment that is more energy-efficient than the original equipment being replaced, or from modifying the existing equipment to improve its energy efficiency. It also allows New End-User Equipment to be installed where the specific conditions of the ESS Rule are met.[11]

By using measurement and verification techniques to predict and then verify energy savings, the method can assist decision-makers to evaluate funding proposals and make investment decisions. The method accounts for changes in operating conditions, which means that energy savings from different activities can be reasonably compared.

A key feature of this method is that it allows energy savings to be calculated (deemed)[12] for a maximum period of 10 years after the implementation date. Discounting is applied to the calculated energy savings based on the quality of the measured data and how well it fits with predicted energy models. The discounted energy savings are then used to forward create ESCs for up to 10 years.

ESCs that are forward created can also be topped up[13] yearly if additional energy savings beyond those calculated from forward creation can be demonstrated. For more information on topping-up, see section 4.2 of this guide.

9 *ESS Rule*, cl 11.1

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

11 *ESS Rule*, cl 5.3B

12 'Deeming' refers to the fact that the energy savings for the entire period (e.g. 10 years) are deemed to occur under the ESS Rule at the time of implementation, and therefore ESCs can be created from those energy savings as from that time.

13 'Topping up' refers to ACPs being able to create ESCs in addition to the ESCs created from the original calculation for the deemed energy savings. These 'top up' ESCs are created from the difference between the actual energy savings that are verified at the end of each year through ongoing measurement, and those used to create the ESCs from the original calculation.

There are four acceptable types of energy models that may be used to model the energy use and calculate energy savings:[14]

- ***Estimate of the Mean*: to be based on measurements of energy consumption, independent variables and site constants and, where relevant, specifies a measurement period. The coefficient of variation of the energy consumption over the measurement period must be less than 15%.**
- *Regression Analysis*: to be based on measurements of energy consumption, independent variables and site constants and specifies a measurement period. **The number of independent observations for the independent variables must be at least six times the number of model parameters in the energy model**.
- *Computer Simulation*: must use a commercially available software package approved by the Scheme Administrator for use in modelling the relevant type of end-user equipment, and that is calibrated against measurements taken from the actual end-user equipment being simulated to meet any requirements as published by the Scheme Administrator.
- *Sampling Method*: based on measurement and estimate of the mean, regression analysis or computer simulation of similar end-user equipment at similar sites, and meets any requirements published by the Scheme Administrator.

  Note that clause 7A.1(c) of the ESS Rule stipulates that the sampling method may only be used by ACPs that were accredited either on or before 15 April 2016 or on or after 1 October 2016.

2.1 Calculating gas savings

For implementations on or after 15 April 2016 the PIAM&V method may be used to calculate either electricity savings or gas savings or both. Where both gas and electricity savings are being calculated, different energy models must be created for each energy type. The term 'energy savings' is used throughout this document and means electricity savings or gas savings or both.

ACPs interested in using the PIAM&V method to calculate gas savings will first need to submit an application for amendment of their conditions of accreditation to IPART.[15]

14 *ESS Rule*, cl 7A.2

15 Refer: www.ess.nsw.gov.au/Accredited_Certificate_Providers/Accreditation_Notice_and_Amendments

Under clauses 5.3 and 5.4(j) of the ESS Rule, **fuel switching from electricity to gas, or gas to electricity may be an eligible activity if** (as well as all other requirements being met) it:

- increases the efficiency of the overall energy consumption at the site, and
- does not increase greenhouse gas emissions.

Where a project involves a fuel switching activity, greenhouse gas emissions must be calculated using electricity savings, gas savings and full fuel cycle emissions factors and equations from the current version of the National Greenhouse Accounts Factors. More information on fuel switching can be found in Appendix C of this guide.

Measurements of gas must be made in accordance with the requirements set out in either:

- the *National Greenhouse and Energy Reporting (Measurement) Determination 2008*,[16] or
- the National Measurement Institute standard for gas meters *NMI R 137 Gas Meters*.[17]

Gaseous fuels that are eligible in the ESS are set out in the definition of 'Gas' in clause 10 of the ESS Rule.

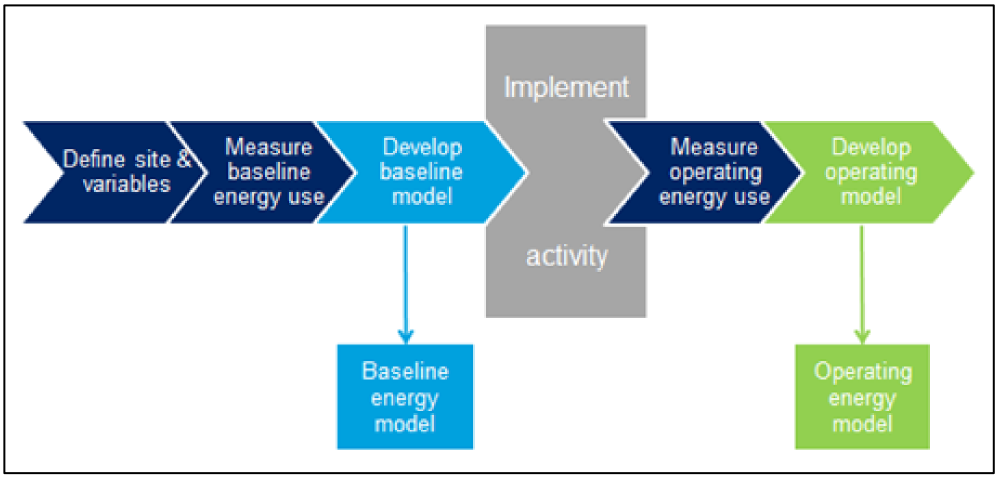
2.2 Measurement and verification method

The calculation of energy savings under this method is based on comparing the results of a baseline energy model with those from an operating energy model, as shown in Figure 2.1 below. This requires:

- baseline and operating energy use to be measured and modelled before and after an implementation, and
- independent variables and site constants to be determined and included in the energy models.

16 Available at: www.legislation.gov.au/Details/F2013C00661
17 Available at: www.measurement.gov.au/Pages/Gas-Meters-Comment-Sought-on-NMI-R-137.aspx

Figure 2.1 Development of baseline and operating energy models from measurements



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.

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 the PIAM&V method, is the purchaser (discussed below), or
- **the nominated energy saver** – which is someone the original energy saver has nominated to be the energy saver by completing a Nomination Form using the method-specific template.[18]

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.

18 The nomination must be made in a form and manner approved by the Scheme Administrator. The relevant method-specific template for nomination forms is available at: http://www.ess.nsw.gov.au/Methods_for_calculating_energy_savings/Project_Impact_Assessment_with_MV

A nominated energy saver must have a documented procedure for obtaining the nomination from the original energy saver. The nomination is taken to occur on the date that the nomination form is signed by both the **original energy saver** and **nominated energy saver.** To create ESCs from an implementation, a nominated energy saver must be:

- **accredited** as an ACP **prior to** the implementation date and before the nomination is made,[19] 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 PIAM&V method:

- **an ACP who is not the owner, occupier or operator of the relevant site,**[20]
- **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.**[21]

Box 3.1 Evidence for the energy saver

The original energy saver (purchaser) can be evidenced by a document in relation to the purchase or lease of the goods that enable the energy savings to be made, such as a tax invoice or sales ledger extract, that:

- shows the completion date and address
- identifies the recipient
- identifies the supplier (including their ABN), and
- provides a brief description of the equipment or service provided (itemised if possible).

If the ACP is a nominated energy saver they must also have a signed nomination form.

3.3 Implementation and implementation date

An implementation is the delivery of an energy saving activity (called a 'RESA' in the ESS Rule)[22] at a site. For ACPs that use the PIAM&V method, the

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

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

21 Wholesalers will typically fall under this category.

implementation date is the date that the implementation commenced 'normal operations'.[23] Normal operations are considered to commence when the installation of the end-user equipment is complete, or when a new service commences. They may commence after a commissioning period or after fine-tuning the performance of the equipment or process. If normal operations are to commence after a commissioning period, details of the commissioning process should be included in the nomination form or other formal project documentation.

To create ESCs, an ACP must be accredited for the relevant RESA **prior to** the implementation date.[24] ACPs who create ESCs must be the energy saver as at the implementation date. ACPs who are nominated as the energy saver must be nominated by the original energy saver **on or before** the implementation date.

Box 3.2 Evidence of the implementation date

The implementation date can be evidenced by a completion/commissioning report that:

- is produced by the party responsible for the design and commissioning of the equipment
- clearly identifies the location where the implementation occurred, and
- shows the implementation date and is signed by an appropriately qualified and responsible person.

The report can be an internal document that demonstrates the completion of process improvements by internal staff.

3.4 Production and service levels

Energy savings cannot be calculated from a reduction in production or service levels. For example, closing down a manufacturing plant is not an eligible activity. However, turning off redundant machinery, whilst maintaining production or service levels, is an eligible activity.

To address this issue, production or service levels must be included as independent variables or site constants and accounted for in the energy models. Their inclusion must be done in a way that allows direct comparison of performance before and after an implementation.

---

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

23 *ESS Rule*, cl 7A.17

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

Box 3.3 Evidence of maintenance of production and service levels

This can be evidenced by a document showing the calculation of a production or service metric for each site, before and after an implementation.

3.5 Efficiency requirement for installing new end-user equipment

If new end-user equipment[25] is being installed, it must be more efficient than the average energy efficiency of end-user equipment that provides the same type, function, output or service. The average energy efficiency may be estimated by reference to:

- product-weighted averages of products registered as complying with an Australian / New Zealand Standard (AS/NZS) that defines how energy efficiency is to be measured for that class of end-user equipment
- sales-weighted market data for that class of end-user equipment collected from installers, retailers, distributors or manufacturers, or
- baseline efficiency for that class of end-user equipment which may, from time to time, be published by the Scheme Administrator.

3.6 Developing an M&V Plan

To calculate energy savings using the PIAM&V method, you must develop a Measurement and Verification Plan (M&V Plan). Development of a detailed M&V Plan is central to the successful use of M&V for estimating energy savings.

The M&V Plan is typically used to: set out the measurement approach; explain the parameters used (and not used) in the energy models; and, to record the energy savings resulting from an activity. The OEH Measurement and Verification Operational Guide, and the IPMVP (both referenced above) provide detailed guidance on the development and use of M&V Plans.

For PIAM&V, the M&V Plan can be used to record how energy models meet the requirements of the ESS Rule, by including sub-headings to check off that each of the ESS Rule requirements have been addressed.

The M&V Plan should describe how each of the parameters used in energy models was derived, so that all assumptions and inputs to the calculation

25 "New end-user equipment" is defined as end-user equipment where no end-user equipment of the same type, function, output or service was previously in its place (but does not include additional components installed in the course of modifying existing end-user equipment).

spreadsheets[26] can be referenced and verified by the M&V Professional or at audit if required.

3.7 Developing an energy model

The ESS Rule requires that the following parameters are considered and established to support the development of the baseline and operating energy models:

- measurement boundary
- interactive energy savings
- choice of independent variables and site constants
- normal year, and
- effective range.

More details on how each of these parameters is considered and established for an implementation are provided in Appendix A of this guide.

The development of energy models is represented in Figure 3.2 below.[27] These are represented by the dashed lines across the tops of the graphs for energy consumption, which emulate the energy consumption changes in the baseline and operating periods.

The energy models must also account for *non-routine events* to ensure that a reasonable comparison can be made between the energy consumption measurements before and after an implementation. Non-routine adjustments are made to the measured data to account for unexpected changes in energy use that occur due to non-routine events, such as unscheduled maintenance. Time periods corresponding to non-routine events may be removed, however, the percentage of time removed must be less than twenty percent of the measurement period.

When establishing energy models, the *measurement boundary* needs to be established (see Figure 3.1). This determines what equipment and parameters will be included and excluded from the energy savings calculations. It effectively sets a boundary for the energy models.

Setting the correct measurement boundary is important as the energy models also need to account for interactive energy savings. These are changes to a site's

---

26 Including the M&V Tool developed by the Office of Environment and Heritage (OEH M&V Tool) to assist in the calculation of energy savings with forward creation for a single site model http://www.environment.nsw.gov.au/business/piamv-tool.htm

27 An operating energy model is not required when calculating energy savings and creating ESCs annually.

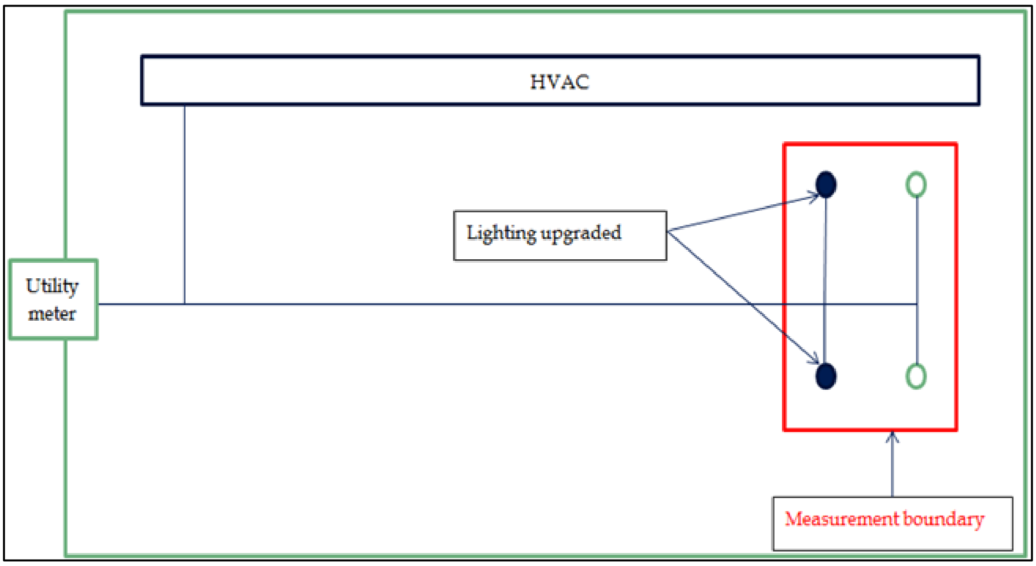
energy consumption that are due to the implementation, but that occur outside of the measurement boundary.

In a simple example provided in Figure 3.1, a lighting upgrade with more efficient lamps reduces the heat load for a building. This may reduce demand for cooling[28] from the heating, ventilation and air-conditioning (HVAC) system and therefore reduce the overall energy consumption for the measurement period, as measured by the utility meter. Any energy savings arising from the changes to HVAC demand need to be estimated and taken into account when determining the normal year energy savings (see Figure 3.2).

Box 3.4 Evidence of the RESA boundary

Documents must be collected to demonstrate that you have adequate metering in place to define the RESA boundary. This must be evidenced by an electrical line diagram or piping and instrumentation diagram (P&ID) showing the location of the meter(s) used in measuring the energy consumption.

Figure 3.1 Example of the measurement boundary showing equipment outside the measurement boundary that may result in interactive energy savings



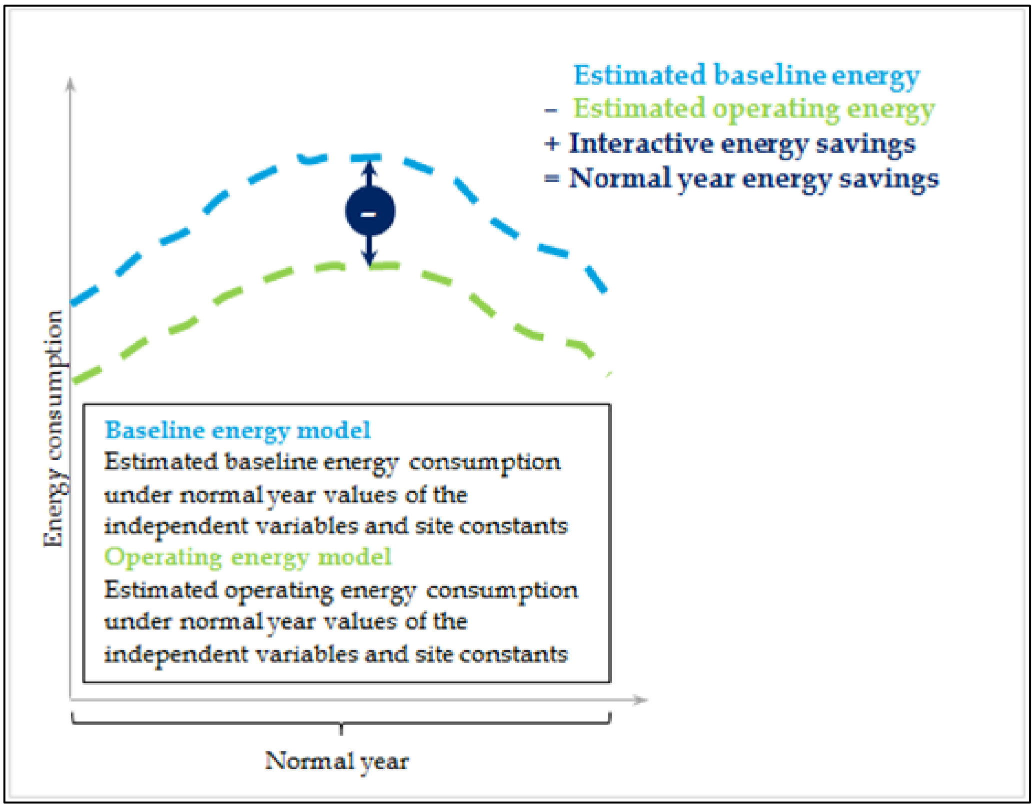
To establish a working energy model, the time period over which measurements are taken must also be established, including the start date and end date of the measurement periods. The values for *energy consumption*, *independent variables* and *site constants* must be within these measurement periods.

28 There may be a corresponding increase in heating requirements during colder periods.

The energy savings from an implementation are calculated for savings over a *normal year* (normal year energy savings), as shown in Figure 3.2 below. This figure shows the difference in energy consumption of the baseline and operating energy models for a normal year. A normal year is defined as a typical year of operation of the end-user equipment at a site, after the implementation date.[29]

The *interactive energy savings* must be estimated and added when determining the normal year energy savings. While the interactive savings are not shown on the below figure, the formula in the diagram explains how they are accounted for to determine energy savings.

Figure 3.2 Baseline energy model and operating energy model with normal year input conditions (plus any interactive energy savings) defines the normal year energy savings



The calculation of energy savings also requires the use of a *decay factor*, which accounts for the degradation in equipment operation over time.[30]

The decay factor and the interactive energy savings may be influenced by the measurement boundary, the type of end-user equipment that is the subject of the

29 Clause 7A.12 of the ESS Rule defines the maximum time period for forward creation.

30 The decay factor may be applied using a default value from Table A16 of the ESS Rule, or estimated from a persistence model in accordance with clause 7A.13 of the ESS Rule.

implementation, as well as the site conditions where the implementation occurs. These additional parameters are also explained in further detail in Appendix A of this guide.

3.8 Recycling requirements

ACPs are responsible for ensuring that lighting equipment removed or replaced during a lighting upgrade is disposed of appropriately. If the post-code of the implementation is in a Metropolitan Levy Area with a postcode listed in Table A25 of the ESS Rule, any lighting equipment containing mercury must be recycled in accordance with the recycling requirements of a product stewardship scheme such as Fluorocycle or equivalent.

3.9 Requirement to use a Measurement & Verification Professional

The ESS Rule requires that an M&V Professional deems as appropriate, the following aspects of the M&V approach for each implementation:

- the parameters used when measuring energy consumption, independent variables, site constants and any other relevant parameters
- the method for selecting independent variables and site constants
- **the measurement procedures**
- the normal year (not required for annual creation)
- the effective range
- the interactive energy savings
- the accuracy factor
- **use of a persistence model**
- the baseline energy model, and
- the operating energy model (except for annual creation).

The ESS Rule requires the M&V Professional to provide written explanatory reasoning for each of the above.

What is an M&V Professional

An M&V Professional is a person who meets the requirements of clause 7A.15 of the ESS Rule including that they must be approved by the Scheme Administrator.

The Guide for M&V Professionals outlines these requirements and how interested parties can apply to be approved as an M&V Professional.[31]

How to find an M&V Professional

Once published, the list of approved M&V Professionals will be available from the ESS website.[32]

A person may not meet all of the M&V Professional requirements for all types of energy saving activities. For such cases, this is noted on the M&V Professional list. In choosing an M&V Professional to assess your M&V approach, you will need to ensure that they:

- have relevant skills and experience relating to the particular energy saving activity, and
- are able to conduct an independent assessment of your M&V approach. This means that you will need to use an M&V Professional that has not been involved in developing or implementing the project (including the development of the energy models).

When to use an M&V Professional

You should consider whether to engage an M&V Professional in the design process for each implementation. This will allow the M&V Professional to assess relevant aspects of the M&V approach prior to the commencement of measurement and modelling. Involving an M&V Professional at this stage may reduce the risk of the M&V approach for the implementation not meeting the requirements of the ESS Rule, and also may reduce the risk of invalid ESC creation.

4 Calculating energy savings

The energy savings that can be claimed using this method are limited to:

- a maximum period of 10 years after the implementation date, and
- when using forward creation, a maximum of 50,000 ESCs, for each implementation.

31 Available at: http://www.ess.nsw.gov.au/Methods_for_calculating_energy_savings/Project_Impact_Assessment_with_MV

32 Refer to: http://www.ess.nsw.gov.au/Methods_for_calculating_energy_savings/Project_Impact_Assessment_with_MV

Energy savings can be calculated, and ESCs created, using the following equations from clause 7A of the ESS Rule:

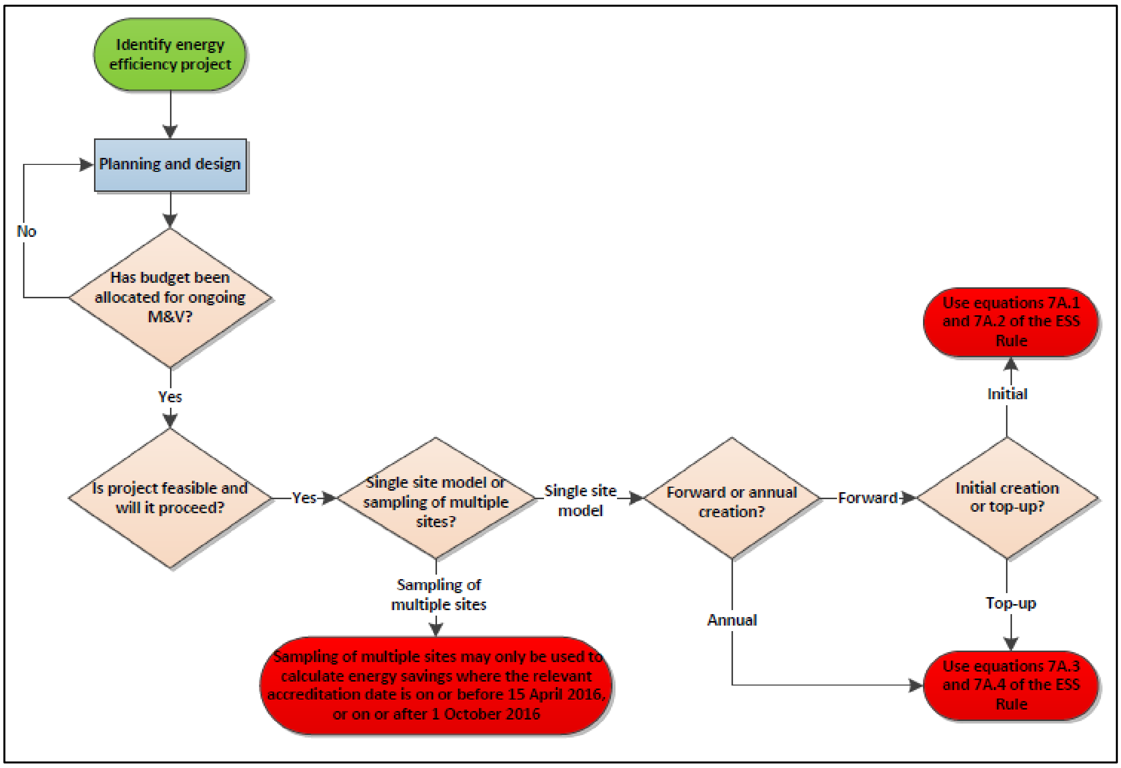
- forward creation for a single site model using equations 7A.1 and 7A.2
- top up of energy savings using equations 7A.3 and 7A.4, and
- creation based on measured annual energy savings using equations 7A.3 and 7A.4.

Where both gas and electricity savings are being calculated they must be calculated separately for each implementation. Where fuel switching occurs, ESCs can be created where the total energy savings (gas plus electricity) is a positive number.

The equation to calculate electricity savings includes a regional network factor. The applicable regional network factor is based on the post code of the implementation and can be found in Table A24 of the ESS Rule.

See Figure 4.1 below for a flowchart to assist you in determining which equations from the ESS Rule to use for the calculation of energy savings. The three options outlined above are detailed in the following sections.

Figure 4.1 Determining which equation to use for calculating energy savings using the PIAM&V method



4.1 Forward creation of ESCs

Appendix A of this guide describes the steps required to develop the energy models under forward creation.

Energy savings are calculated using equations 7A.1 and 7A.2 from the ESS Rule. Equation 7A.2 is used to calculate the normal year energy savings, which is then used as an input into equation 7A.1 to calculate the overall energy savings from an implementation.

The process for forward creation of ESCs is outlined in Figure 4.2 below.

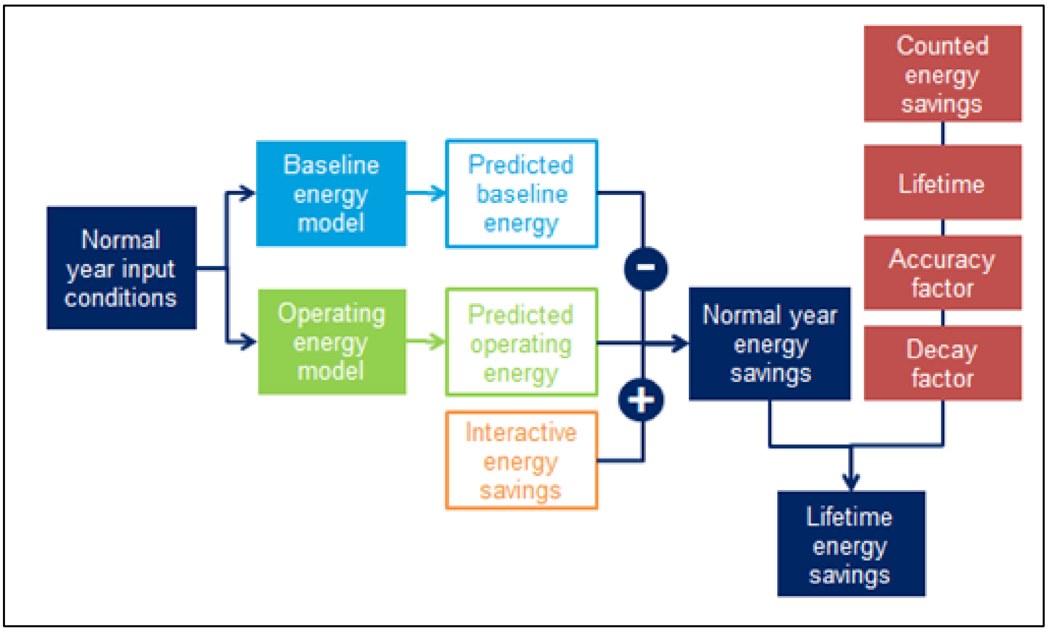
Once the normal year energy savings are determined, the 'lifetime' energy savings need to be calculated, for example, over 10 years. The lifetime energy savings are based on the expected life of the end-user equipment (to a maximum of 10 years) and the following additional factors:

- an *accuracy factor*, with a value between 0 and 1, is used to discount the energy savings according to the relative precision of the calculation of the energy savings[33]

[33] This is estimated from the predicted energy consumption derived from an energy model.

- a *decay factor*, either from a persistence model[34] or from default values, is used to discount the normal year energy savings to calculate the lifetime energy savings, and
- any *counted energy savings* from previous ESC creation for the RESA or at the same site from another RESA (or corresponding scheme[35]), which must also be deducted.

Figure 4.2 Process for determining lifetime energy savings for forward creation



4.2 Top-up after forward creation of ESCs

'Top-up' refers to creating ESCs from the difference between the predicted (deemed) baseline energy consumption and the actual measured operating energy consumption for a year. Top-up is allowed where energy savings can be demonstrated beyond those calculated for the lifetime energy savings, discounted by an accuracy factor and reduced by any counted energy savings, as shown in Figure 4.3 below. This option is only available where ESCs have already been created for the site through forward creation.

Appendix A of this guide describes the steps required to top up energy savings after you have forward created.

34 A persistence model is essentially a model that forecasts the continuation of energy savings from a RESA (ie installed energy-efficient equipment) over its useful lifetime.

35 Clause 53(2) of the Regulation gives the Scheme Administrator the power to require the surrender of ESCs for which a benefit was obtained under a corresponding scheme, such as the Commonwealth Government's Emission Reduction Fund (ERF).

The site, activity and boundary must be the same as already defined in step 1 for the forward creation sub-method, which is described in Table A.1 of this guide.

You must check if there have been any changes to end-user equipment within the defined measurement boundary following the implementation of the RESA. If changes have occurred, for example the addition of new end-user equipment as part of a brownfield expansion,[36] a non-routine adjustment is required to adjust the energy consumption for the effect of the change in end-user equipment.

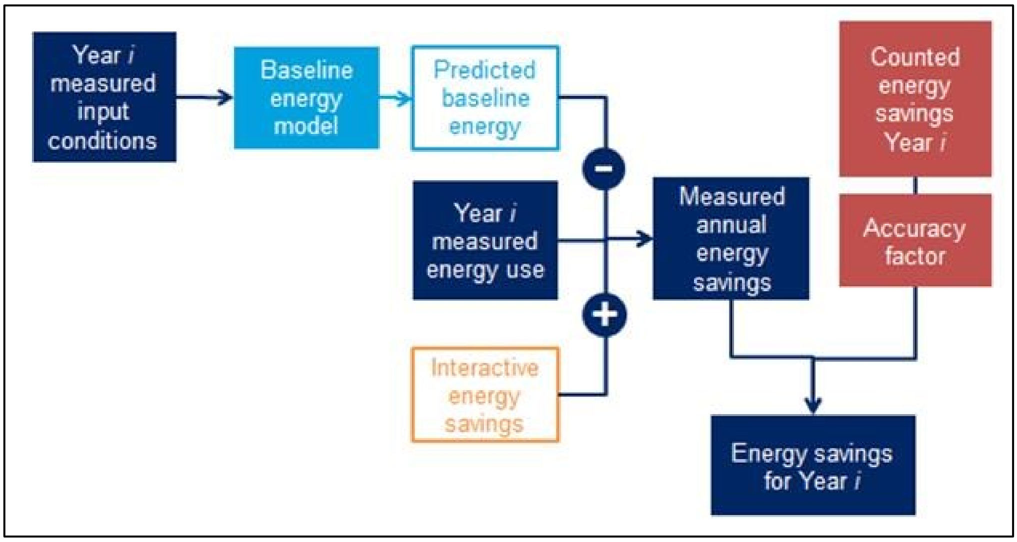
Energy savings are calculated using equations 7A.3 and 7A.4 from the ESS Rule. Equation 7A.4 is used to calculate the measured annual energy savings, which is then used as an input into equation 7A.3 to calculate the uncredited energy savings from the implementation.

The calculation of top-up energy savings includes:

- actual values used as inputs to the baseline operating model, including the actual non-routine adjustments and interactive energy savings
- updating the accuracy factor, which may increase if the relative precision of energy savings increases, and
- determining energy savings from any previous ESC creation for the RESA, either under forward creation or from other RESAs at the same site.

The baseline energy model must be based on a measurement period that has an end date no more than ten years prior to the end date of the measurement period for which energy savings are being claimed.

Figure 4.3 Process for top-up of ESCs



[36] A brownfield expansion refers to the expansion of a facility at a site, as opposed to a new build on a site with no previous facility, which is referred to as a greenfield site.

4.3 Annual creation of ESCs

Table A.3 of this guide describes the steps required to develop the energy models under annual creation.

In order to create ESCs using this approach, you must first check if there have been any changes to end-user equipment within the defined measurement boundary following the implementation of the RESA. If changes have occurred, for example the addition of new end-user equipment as part of a brownfield expansion, a non-routine adjustment is required to adjust the energy consumption for the effect of the change in end-user equipment.

Energy savings are calculated using equations 7A.3 and 7A.4 from the ESS Rule. Equation 7A.3 is used to calculate the energy savings from the implementation. Equation 7A.4 is used to calculate the measured annual energy savings.

ESCs can be calculated annually for an implementation, by measuring the actual operating energy consumption for a full year after an implementation, against energy consumption that is estimated using a baseline energy model. Unlike forward creation, no operating energy model is used. The calculation of energy savings are based on:

- an accuracy factor, with a value between 0 and 1, which is used to discount the energy savings according to the relative precision of the calculation of the energy savings determined, and
- any counted energy savings from previous ESC creation for the RESA or at the same site from another RESA, (or corresponding scheme), which must also be deducted.

The equations used are the same as for calculating energy savings from top-up (see section 4.2 of this guide).

The baseline energy model must be based on a measurement period that has an end date no more than ten years prior to the end date of the measurement period for which energy savings are being claimed.

5 Calculating and creating ESCs

Once energy savings have been calculated for an implementation, Equation 1 of the ESS Rule can be used to calculate the number of ESCs that may be created. Note that ESCs can only be created where Equation 1 has a result that is greater than zero.

Equation 1

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

5.1 Creation of ESCs based on a multiple-site model

This method can be used to calculate energy savings for implementations across multiple sites using sampling, one baseline energy model and one operating energy model. **The amendments to the ESS Rule that commenced on 15 April 2016 have put this sub-method on hold. Clause 7A.1(c) of the ESS Rule establishes that ACPs can only use this sub-method if they were accredited on or before 15 April 2016, or on or after 1 October 2016.**

5.2 Applying to register ESCs

Certain information must be submitted to the Scheme Administrator **before an ACP applies to register** ESCs created from energy savings arising from an implementation or implementations.[37] ACPs are to provide the required information by completing an Implementation Data Sheet[38] and submitting it through the ESS Portal.[39]

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 from the implementation or implementations by the electricity certificate conversion factor (1.06)[40]
- multiplying the gas savings from the implementation or implementations by the gas certificate conversion factor (0.39),[41] and
- adding the two figures together. If this number is a fraction it is rounded down to the nearest whole number.

The result is the total number of ESCs that ACPs can apply to the Scheme Administrator 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:

37 *ESS Rule*, cl 6.8

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

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

40 Specified in section 130(1) of the Act

41 Specified in section 130(1) of the Act

- 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.[42]

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

The maximum number of ESCs that you can bring forward for any one implementation is 50,000 (or 50,000 notional MWh of energy savings).[43]

6 Applying for accreditation

A completed application for this method is required for a person or organisation to become an Accredited Certificate Provider and create ESCs. An application has multiple parts, which are explained in the Application Guide.

6.1 Application options

Developing an application to use the PIAM&V method can be costly and time-consuming. As such, three application options are provided for applicants.

- *Option 1* is the minimum information that can be provided to be considered for accreditation and will focus on the eligibility of the applicant for accreditation and general record keeping processes.
- *Option 2* can be used to demonstrate a more thorough understanding of the method, by the provision of a proposed M&V Plan and baseline energy model and all supporting information.

42 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

43 As required by clause 7A.11(c) of the ESS Rule.

- *Option 3* requires a fully worked example, demonstrating baseline and operating energy models, and calculations for ESC creation for an implementation. If the activity is implemented prior to accreditation, it can only be used for demonstration purposes.[44]

For example, if you wish to implement a RESA at multiple sites, you can apply to become accredited using information from an implementation that has already occurred – to demonstrate your ability to calculate energy savings in accordance with the requirements of the PIAM&V method. ESCs would not be able to be created for this implementation, as ESCs can only be created for implementations that occur after the date of accreditation.

Depending on which application pathway is used, the Scheme Administrator may apply different types of conditions to the accreditation, such as:

- Option 1 accreditation may result in a zero ESC creation limit (ie, no ESCs allowed to be created); a spot audit regime (ie, an audit at any time); and a requirement that the ACP submit certain information to the Scheme Administrator.
- Option 2 accreditation may result in a pre-registration audit regime, with audits conducted by an auditor approved to conduct PIAM&V audits.
- Option 3 accreditation may result in the standard conditions as applied to ACPs by reference to the Compliance and Performance Monitoring Strategy.

ACPs accredited under either Option 1 or Option 2 will have certain conditions placed on their accreditation that may limit their ability to create ESCs until they provide further information to the Scheme Administrator, or successfully complete an audit. Once these conditions are met, ACPs can then submit an application for amendment of their conditions to the Scheme Administrator.

More information on applying to amend the conditions of accreditation can be found here: www.ess.nsw.gov.au/Accredited_Certificate_Providers/Accreditation_Notice_and_Amendments

6.2 Scope of RESA

Those wanting to implement multiple activities that cover different technologies or industries, should group the activities by industry or technology type. The scope of each accreditation needs to be specific enough so that the methodology can be applied to all implementations under the accreditation.

For example, the energy models developed to account for compressed air energy savings (dependent on production) are likely to be significantly different from

44 To meet the requirements of clause 6.2(a) of the ESS Rule.

energy models dealing with HVAC (dependent on weather). Keeping these different scenarios separate makes it easier to develop discrete M&V plans and energy models. The more complexity that is built-in, by trying to combine different technologies and industry types, the greater the risk of invalid ESCs being found at audit.

6.3 Existing Project Impact Assessment Method accreditations

Those accredited to use the Project Impact Assessment Method (PIAM)[45] can apply to have the PIAM&V method added to their existing accreditation if they are interested in using the PIAM&V method to calculate additional energy savings for past implementations. They may also want to add the PIAM&V method to an existing PIAM accreditation for future implementations of an activity for which they are already accredited. In both cases, ACPs will need to complete an application for amendment of their conditions of accreditation and include a completed PIAM&V Application Form Part B to demonstrate their ability to calculate energy savings using the PIAM&V method.

Once an application for amendment is received, the Scheme Administrator will consider the information provided and will determine if the PIAM&V method can be added to the existing PIAM accreditation. Depending on the application, additional information may be requested, and audits may be required before ESCs can be registered.

7 Required records

ACPs are required to keep records of the energy saving 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.[46]

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 condition requiring that the ACP's record keeping arrangements are consistent with the ESS Record Keeping Guide.[47]

45 *ESS Rule*, cl 7
46 *Electricity Supply (General) Regulation 2014*, cl 46
47 Available at: http://www.ess.nsw.gov.au/Accredited_Certificate_Providers/Record_keeping_arrangements

The boxes throughout this document and the tables in the appendices provide some guidance as to the information that should be kept as a record of the energy savings from each implementation. Those applying for accreditation, however, will need to provide detailed information in their application as to the records they intend to keep to support ESC creation.

8 Glossary

Term	Definitions
ACP	Accredited Certificate Provider
Accredited Certificate Provider	A person accredited under the ESS to create ESCs for Recognised Energy Saving Activities.
Accuracy factor	A number between 0 and 1, used to discount energy savings according to the relative precision of normal year energy savings at 90% confidence level.
Coefficient of variation	The sample standard deviation expressed as a percentage of the sample mean.
Computer simulation	A method to establish an energy model that uses software to simulate energy consumption by End-User Equipment and can be tested against statistical requirements Published by the Scheme Administrator.
Decay factor	A number between 0 and 1 which quantifies the decay of the energy savings due to equipment degradation over time.
Effective range	The range over which values of independent variables and / or site constants for which a baseline energy model or operating energy model (as the case may be) is valid.
Electricity savings	The reduction of the amount or equivalent amount of electricity consumption (in MWh) arising from the implementation, may be negative for fuel switching activities
Energy model	A mathematical model describing the energy use profile before an implementation (baseline) and after an implementation (operating) occurs.
Energy saver	Refer to section 3.1 of this guide.
Energy savings	Electricity savings or gas savings or both
ESC	Energy Savings Certificate
ESS	Energy Savings Scheme
ESS Rule	Energy Savings Scheme Rule of 2009
Estimate of the mean	A method in PIAM&V that can be used to establish an energy model.
Gas	Any fuel listed in National *Greenhouse and Energy Reporting (Measurement) Determination 2008* (Cth) Schedule 1 Part 2—Fuel combustion—gaseous fuels or liquefied petroleum gas
Gas savings	The reduction of the amount of gas combusted for stationary energy (in MWh) arising from the implementation, may be negative for fuel switching activities
Implementation	The delivery of a Recognised Energy Saving Activity at a site.
Implementation date	Refer to section 3.3 of this guide.

Term	Definitions
Independent variable	A parameter that varies over time, that can be measured and affects the end-user equipment's energy consumption at a site.
Interactive energy savings	A change in a site's energy consumption due to interactions with end-user equipment for which energy consumption is not measured.
Measurement and verification professional	Refer to section 3.9 of this document.
Measurement boundary	The area of a site that is subject to the implementation, where the energy consumption by any end-user equipment located within it is directly affected by the implementation.
Measurement period	The duration of time over which measurement of energy consumption will be taken for the purposes of calculating the energy savings.
Non-routine events	Events which affect energy use, within the chosen measurement period, that are not modelled by any independent variables or site constants. They are required to be removed from the measurement period to enable like-for-like comparison of before and after energy savings scenarios. They are typically due to static factors that may include fixed, environmental, operational and maintenance characteristics.
Normal operations	Typical operating conditions of end-user equipment, excluding commissioning.
Normal year	A typical year for the operation of the end-user equipment at the site after the implementation date.
Number of model parameters	In relation to an energy model, means the number of parameters required to unambiguously define the functional form of the energy model. In a linear energy model, it is the number of coefficients or the number of independent variables and site constants that are used to explain energy consumption variation.
Persistence model	A model used to forecast the continuation of energy savings from an implementation over its useful lifetime.
Pre-implementation period	The measurement period prior to the implementation period.
Purchaser	Refer to section 3.2 of this guide.
Regression analysis	A method in PIAM&V used to establish an energy model that determines a mathematical function for approximating the relationship between energy consumption and independent variables and / or site constants and includes, but is not limited to, linear regression, and mixed models.
Relative precision	A measure of the relative range within which a true value is expected to occur with some specified confidence level.
RESA	Recognised Energy Saving Activity
Sampling method	The statistical method for conducting measurements on a subset of a population to estimate the characteristics of the entire population.
Site constant	A parameter for a site, which does not vary over time under normal operating conditions, and affects the end-user equipment's energy consumption.

Appendices

A Guidance for creation of ESCs

This section of the guide provides more detail on applying the ESS Rule to the creation of ESCs. The tables step out key requirements of the ESS Rule, but are guidance only, so care must be taken to ensure all ESS Rule requirements are met.

The tables reference the OEH M&V Tool[48] that steps through the requirements of the ESS Rule for forward creation with a single site model utilising regression analysis. Use of the tool is recommended, but is not required.

The M&V Plan (or other supporting documents) developed for each implementation is expected to address each section of the tables below relevant to the energy model being developed.

A.1 Forward creation at an individual site

Table A.1 provides a step-by-step approach to developing energy models for use with forward creation at a single site; to meet the requirements of clause 7A.1(a) of the ESS Rule. Each of the steps in Table A.1 matches the sections of the OEH M&V Tool.

A.2 'Top-up' after forward creation at an individual site

Table A.2 provides a step-by-step approach to 'top-up' after forward creation at a single site; to meet the requirements of clause 7A.1(b) of the ESS Rule. The calculation of ESCs using this approach is not included in the OEH M&V Tool.

A.3 Annual creation at an individual site

Table A.3 provides a step-by-step approach to annual creation at a single site; to meet the requirements of clause 7A.1(b) of the ESS Rule. The calculation of ESCs using this approach is not included in the OEH M&V Tool.

[48] http://www.environment.nsw.gov.au/business/piamv-tool.htm

Table A.1 Detailed calculation steps when using forward creation at an individual site

Step	Description and M&V Tool reference	Details
1	Define implementation, site and measurement boundary ▼ Step 1 in the *Boundaries and variables* sheet	▼ Describe the equipment or process that will comprise the RESA, including: – performance characteristics of the end-user equipment, including that used to modify the system, and – consideration of Australian certification, performance and safety standards applicable to the equipment. ▼ The measurement boundary must include all end-user equipment whose energy consumption will be effected by the RESA, where feasible: – consider setting the measurement boundary to minimise the proportion of measured energy consumption that is unrelated to the project. ▼ Define the measurement boundary with reference to: – the business / operating cycle – independent variables impacting energy use within the boundary, and – site constants impacting energy use at the boundary.

<table>
<tr><th>Step</th><th>Description and M&V Tool reference</th><th>Details</th></tr>
<tr><td>2</td><td>Define energy model data frequency and variables
Steps 2a and 2b in the Boundaries and variables sheet</td><td>For each energy model, define the data frequency for measurements of:
energy consumption
independent variables
site constants, and
any other relevant parameters.
The frequency of these measurements must be consistent to allow them to be used in the energy models.
For each variable, site constant and energy consumption, include:
name, description and units
measurement procedure, including responsibility for recording and reporting measurement equipment
how any measurements were converted to a different frequency for use in the energy model
any calculations performed on measurements to derive each input
the value of a site constant or independent variable during normal operating conditions, and
measurement accuracy (relative error or absolute error).
To further support the energy model development process, identify and define variables that are neither independent variables nor site constants (i.e. will not be used in an energy model), including details of:
assigned name, description and units
measurement procedure
typical value or range of values, and
reason they have been excluded from the model.
This may include any number of variables that were considered as inputs to the energy model, but were not included in the final energy model, for example due to finding that the variable had very little influence in describing variations in energy use.</td></tr>
</table>

Step	Description and M&V Tool reference	Details
3	Establish normal year of operating conditions ▾ Step 3a on the *Data - Normal year* sheet to enter normal year values for each independent variable and site constant ▾ Step 3b on the *Normal year* sheet for all other information	▾ Define values for independent variables and site constants over a normal year of operation, representing a typical year of operation for the end-user equipment over the maximum time period for forward creation. ▾ When defining a normal year, ACPs must: – consider future 'typical' operating conditions of the site, which may differ from the baseline period. Operating conditions may include typical weather conditions, operating days per year, maintenance periods, changes in site activities (ie production levels), etc, – use actual data rather than estimates, where practical (typically, data should not be older than 3 years to be indicative of current/predicted performance), – describe how the normal year is constructed, noting any adjustments, calculations or manipulations, and – where the operating cycle of the system is less than one year, the normal year may be constructed by combining values from multiple operating cycles to make up one year.
4	Establish baseline energy model ▾ Step 4a on the *Data - baseline* sheet to enter normal year values for each independent variable and site constant ▾ Step 4b on the *Baseline Energy Model* sheet to define the model	▾ Establish the baseline energy model to estimate the energy consumption in the absence of the implementation, as a function of independent variables and site constants measured under normal operating conditions and based on a Normal Year. ▾ The baseline energy model may be established by: – **estimate of the mean that is based on measurements of energy consumption, independent variables and site constants, where relevant, specifies a measurement period, and where the coefficient of variation of the energy consumption over the measurement period is less than 15%** – regression analysis that is based on measurements of energy consumption, independent variables and site constants, specifies a measurement period, and where the number of independent observations for the independent variables when calculated in accordance with clause 7A.6 of the ESS Rule **is at least six times the number of model parameters** in the energy model, or – computer simulation using a commercially available software package determined to be acceptable by the Scheme Administrator (refer Table B.2 of this guide). ▾ For new-end user equipment, the baseline energy model may be established by one of the above methods, by using average energy performance of the same type of end-user equipment, to transform the measurements of energy consumption, independent variables and site constants into inputs, used to establish the operating energy model.

Step	Description and M&V Tool reference	Details
5	Implement and commission activity ▾ Step 5 on the *Implementation* sheet	▾ Define and record the implementation date. ▾ Determine the length of each measurement period, with the first measurement period starting after the implementation date.
6	Establish operating energy model ▾ Step 6a on the *Data-operating* sheet ▾ Step 6b on the *Operating model* sheet	▾ Establish operating energy model to estimate the energy consumption following implementation, as a function of independent variables and site constants measured under normal operating conditions and based on a Normal Year. ▾ The operating energy model may be established by: – **estimate of the mean that is based on measurements of energy consumption, independent variables and site constants, where relevant, specifies a measurement period, and where the coefficient of variation of the energy consumption over the measurement period is less than 15%** – regression analysis that is based on measurements of energy consumption, independent variables and site constants, specifies a measurement period, and where the number of independent observations for the independent variables when calculated in accordance with clause 7A.6 of the ESS Rule **is at least six times the number of model parameters** in the energy model (refer Table B.1 of this guide), or – computer simulation using a commercially available software package determined to be acceptable by the Scheme Administrator (refer Table B.2 of this guide).
7	Calculate interactive energy savings ▾ Step 7 on the *Interactive Energy Savings* sheet	▾ Identify and define interactive effects, which lead to interactive energy savings, by including all end-user equipment outside of the measurement boundary that will have its energy consumption affected by the RESA. ▾ Include written explanation as to why the measurement boundary has not been modified to include this equipment. ▾ An example of an interactive effect is a decrease in the energy requirements for a cooling system, located outside of the measurement boundary, which occurs as a result of a project that installs high efficiency lights that emit less heat. ▾ When estimating interactive energy savings, they cannot represent more than 10% of total energy savings respectively, unless they are estimated in accordance with a guidance document published by the Scheme Administrator.

Step	Description and M&V Tool reference	Details
8	Calculate normal year energy savings ▼ Step 8 on the *Normal Year Energy Savings* sheet, based on previously entered values	▼ Calculate normal year energy savings, in MWh, using Equation 7A.2 by substituting the value of independent variables from the normal year into the baseline energy model and operating energy model, and using the interactive energy savings calculated in step 7. ▼ Any time periods for which any of the normal year values for the independent variables **are less than 95% of the minimum or greater than 105% of the maximum** of the effective range for either the baseline energy model or operating energy model must be excluded from the energy savings calculation. ▼ Additionally, any time periods where the site constants are not their standard value must be excluded from the savings calculation.
9	Apply accuracy factor ▼ Step 9 on the *Accuracy Factor* sheet, based on previously entered values	▼ You must apply an accuracy factor (as specified in Table A23 of the ESS Rule or as otherwise determined by another process published by the Scheme Administrator) that corresponds to the relative precision[a] of the energy savings estimate at a 90% confidence level. ▼ The relative precision of the energy savings estimate must take into account model uncertainty, input and output measurement uncertainty[b], and where relevant, sampling uncertainty. ▼ Depending on the measurement frequency, the relative precision may also need to be adjusted for autocorrelation effects.

<table>
<tr><th>Step</th><th>Description and M&V Tool reference</th><th>Details</th></tr>
<tr><td>10</td><td>Determine lifetime and decay factors
▾ Step 10 on the Decay Factor sheet, to either use decay factors or the built-in persistence model</td><td>▾ The expected lifetime of the end-user equipment determines the maximum time period for forward creation, to a maximum of ten years after the implementation date (or five years for RESAs previously created under PIAM).
▾ In addition, a decay factor is used to estimate the decay of the energy savings due to equipment degradation over its lifetime.
Decay factors
▾ A decay factor can be estimated by either using a persistence model or specified default values from Table A16 of the ESS Rule.
Persistence model
▾ If a persistence model is being applied, it must take into account:
– the business classification of the site (from Table A18 of the ESS Rule), if known and relevant
– the end-user equipment type,
– the operating hours (as determined by measurements) for the end-user equipment, and
– typical ambient conditions for that site, including temperature, humidity and salinity.
▾ It also needs to:
– estimate the expected lifetime of the end-user equipment in whole years
– estimate the decay factor for each future year within the maximum time period for forward creation, and
– be publicly accessible and accepted for use by the Scheme Administrator.
▾ If using the built-in persistence model with the M&V tool, some inputs are fixed. To use other inputs, you will need to submit evidence that is acceptable to the Scheme Administrator.</td></tr>
<tr><td>11</td><td>Determine counted energy savings
Step 11 of the Counted Energy Savings sheet</td><td>▾ It is possible that energy savings may have already been claimed in relation to the end-user equipment within the measurement boundary, in which case they must be identified and accounted for.
▾ As this calculation is for the initial forward creation of certificates, ESCs must not have previously been created for the implementation under this RESA (or a corresponding scheme).
▾ For counted energy savings that are from energy savings under a different RESA, determine the counted energy savings for the implementation in each year.</td></tr>
</table>

Step	Description and M&V Tool reference	Details
12	Calculate energy savings Step 12 on the *Energy Savings Summary* sheet	▼ The energy savings to be forward created over the maximum time period for forward creation are then calculated according to Equation 7A.1.

a The equation for calculating relative precision at 90% confidence level is (t-statistic x sample standard error)/estimate, where the estimate is any empirically derived value of a parameter of interest (p. 91 – IPMVP vol.1 2012).

b Input measurement uncertainty arises from independent variables (eg, weather conditions), while output measurement uncertainty is estimated from the accuracy of an instrument used to measure energy use.

Table A.2 Detailed calculation steps for 'topping-up' after forward creation at an individual site

Step	Description	Details
1	Measure operating energy consumption	▾ Measure the operating period energy consumption, along with all independent variables and site constants that were defined for the RESA for the forward creation sub-method. ▾ Measurement period must be for a full year that commences on the anniversary of the implementation date as previously determined for the RESA for the forward creation sub-method, and must end within the maximum time period for forward creation.
2	Calculate interactive energy savings	▾ Calculate the interactive energy savings as defined for the RESA for the forward creation sub-method as per step 7 of Table A.1 of this guide. ▾ The interactive energy savings must be adjusted to be representative of operating period conditions.
3	Calculate measured annual energy savings	▾ Calculate measured annual energy savings, in MWh, using Equation 7A.4 of the ESS Rule. – The predicted baseline energy consumption is determined by substituting values of independent variables from a measurement period into the baseline energy model. – The operating energy consumption is as measured during a measurement period. – The interactive energy savings are calculated as per step 2. ▾ Exclude any time periods for which any values for the independent variables fall outside the effective range of the baseline energy model, for the purpose of calculating energy savings. ▾ Additionally, any time periods where the site constants are not their standard value must be excluded from the savings calculation.
4	Apply accuracy factor	▾ The accuracy factor is either the value in Table A23 of the ESS Rule that corresponds to the relative precision of the energy savings estimate at **a 90% confidence level**, or the value determined by another process published by the Scheme Administrator. ▾ The energy savings estimate is the measured annual energy savings as defined in Equation 7A.3 of the ESS Rule. ▾ The relative precision of the energy savings estimate must account for model and measurement uncertainty.[a] ▾ For the measured operating period energy consumption, only output measurement uncertainty is considered. ▾ Depending on the measurement frequency, the relative precision may also need to be adjusted for autocorrelation effects.

Step	Description	Details
5	Determine counted energy savings	▾ It is possible that energy savings may have already been claimed in relation to the end-user equipment within the measurement boundary, in which case they must be identified and accounted for. ▾ Account for energy savings for the RESA determined using the forward creation sub-method for each measurement period. ▾ Counted energy savings that are from energy savings under a different RESA (or a corresponding scheme), not included in the counted energy savings during the forward creation sub-method, must also be included for each measurement period.
6	Calculate energy savings	▾ The energy savings for a measurement period are then calculated according to Equation 7A.3 of the ESS Rule.

a Input measurement uncertainty arises from independent variables (eg, weather conditions), while output measurement uncertainty is estimated from the accuracy of an instrument used to measure energy use.

Table A.3 Calculation steps for annual creation at an individual site

<table>
<tr><th>Step</th><th>Description</th><th>Details</th></tr>
<tr><td>1</td><td>Define implementation, site and measurement boundary</td><td>Describe the equipment or process that will comprise the RESA, including:
▾ performance characteristics of the end-user equipment, including that used to modify the system, and
▾ consideration of Australian certification, performance and safety standards applicable to the equipment.
The measurement boundary must include all end-user equipment whose energy consumption will be affected by the RESA, where feasible:
▾ consider setting the measurement boundary to minimise the proportion of measured energy consumption that is unrelated to the project.
Define the measurement boundary with reference to:
▾ the business / operating cycle
▾ independent variables impacting energy use within the boundary, and
▾ site constants impacting energy use at the boundary.</td></tr>
<tr><td>2</td><td>Define energy model data frequency and variables</td><td>For the baseline energy model, define the data frequency for measurements of:
▾ energy consumption
▾ independent variables, and
▾ site constants.
The frequency of these measurements must be consistent to allow them to be used in the baseline energy model.
For each variable, site constant and energy consumption, include:
▾ name, description and units
▾ measurement procedure, including responsibility for recording and reporting measurement equipment
▾ how any measurements were converted to a different frequency for use in the baseline energy model
▾ any calculations performed on measurements to derive each input, and
▾ the value of a site constant or independent variable during normal operating conditions, and
▾ measurement accuracy (relative error or absolute error).
To further support the baseline energy model development process, identify and define variables that are neither independent variables nor site constants (i.e. will not be used in the baseline energy model), including details of:
▾ assigned name, description and units, and
▾ measurement procedure.</td></tr>
</table>

Step	Description	Details
		This may include any number of variables that were considered as inputs to the energy model, but were not included in the final energy model, for example due to finding that the variable had very little influence in describing variations in energy use.
3	Establish baseline energy model	Establish the baseline energy model to estimate the energy consumption in the absence of the implementation, as a function of independent variables and site constants. The baseline energy model may be established by: ▾ an estimate of the mean that is based on measurements of energy consumption, Independent Variables and Site Constants, where relevant, specifies a Measurement Period, and where the Coefficient of Variation of the energy consumption over the Measurement Period is less than 15%, or ▾ regression analysis that is based on measurements of energy consumption, Independent Variables and Site Constants, specifies a measurement period, and where the number of independent observations for the independent variables when calculated in accordance with clause 7A.6 of the ESS Rule is at least ten times the degrees of freedom in the energy model (refer Table A.3 of this guide), or ▾ computer simulation using a commercially available software package determined to be acceptable by the Scheme Administrator. For new-end user equipment, the baseline energy model may be established by one of the above methods, by using average energy performance of the same type of end-user equipment, to transform the measurements of energy consumption, independent variables and site constants into inputs, used to measure the annual energy savings.
4	Implement and commission activity	Define and record the implementation date.
5	Measure operating energy consumption	Measure the operating period energy consumption, along with all independent variables and site constants that were defined for the RESA. ▾ The measurement period must be for a full year, and commences after the implementation date.
6	Calculate interactive energy savings	Identify and define interactive effects, which lead to interactive energy savings, by including all end-user equipment outside of the measurement boundary that will have its energy consumption affected by the RESA. ▾ Include written explanation as to why the measurement boundary has not been modified to include this equipment. ▾ An example of an interactive effect is a decrease in the energy requirements for a cooling system, located outside of the measurement boundary, which occurs as a result of a project that installs high efficiency lights that emit less heat. ▾ When estimating interactive energy savings, they cannot represent more than 10% of total energy savings respectively, unless they are estimated in accordance with a guidance document published by the Scheme Administrator.

Step	Description	Details
7	Calculate measured annual energy savings	Calculate measured annual energy savings, in MWh, using Equation 7A.4 of the ESS Rule. ▾ The predicted baseline energy consumption is determined by substituting values of independent variables from a measurement period into the baseline energy model. ▾ The operating energy consumption is as measured during a measurement period. ▾ The interactive energy savings are calculated as per step 6. ▾ Exclude any time periods for which any values for the independent variables fall outside the effective range of the baseline energy model, for the purpose of calculating energy savings. ▾ Additionally, any time periods where the site constants are not their standard value must be excluded from the savings calculation.
8	Apply accuracy factor	The accuracy factor is the value in Table A23 of the ESS Rule, or as otherwise determined by another process published by the Scheme Administrator, that corresponds to the relative precision of the energy savings estimate at a 90% confidence level. ▾ The energy savings estimate is the measured annual energy savings as defined in Equation 7A.3 of the ESS Rule. ▾ The relative precision of the energy savings estimate must account for model and measurement uncertainty. ▾ For the measured operating period energy consumption, only output measurement uncertainty is considered. ▾ Depending on the measurement frequency, the relative precision may also need to be adjusted for autocorrelation effects.
9	Determine counted energy savings	It is possible that energy savings may have already been claimed in relation to the end-user equipment within the measurement boundary, in which case they must be identified and accounted for. ▾ Energy savings for the RESA determined using the forward creation sub-method for each measurement period. ▾ Counted energy savings that are from energy savings under a different RESA (or corresponding scheme), not included in the counted energy savings during the forward creation sub-method, must also be included for each measurement period.
10	Calculate energy savings	The energy savings for a measurement period are then calculated according to Equation 7A.3 of the ESS Rule.

B Guidance for development of energy models

B.1 Establishing energy models by regression analysis

An ACP using this method can use regression analysis to establish an energy model for a system that estimates the energy consumption of the system subject to a number of independent variables and site constants that vary over time.

The energy model will be established for:

- baseline conditions, before implementation (forward creation and top-up sub-methods), and
- operating conditions, after implementation (for forward creation sub-method).

The energy model expresses the energy consumption as a mathematical function of the independent variables and is used to perform “routine adjustments” as defined under the IPMVP.

The form of the model is defined based on the independent variables and site constants, and a regression analysis is performed to optimise the values of the coefficients of each of the variables in the energy model.

Table B.1 provides a suggested approach to regression analysis when it is being used in an energy model (like that being developed in Table A.1). Regression analysis can be used to establish the baseline and Operating Energy Model for an Implementation, to meet the requirements of the ESS Rule.

B.2 Establishing energy models by computer simulation

Computer simulation can be used to establish an energy model for an implementation that estimates the energy consumption using a number of independent variables and site constants that vary over time.

The energy model will be established for:

- baseline conditions, before implementation (forward creation and top up sub-methods), and
- operating conditions, after implementation (for forward creation sub-method).

The energy model expresses the energy consumption as a mathematical function of the independent variables and is used to perform “routine adjustments” as defined under the IPMVP.

Requirements

To use computer simulation, the ESS Rule requires the use of software that:

- is commercially available
- is approved by the Scheme Administrator for use in modelling the relevant type of end-user equipment
- is calibrated against measurements taken from the actual end-user equipment being simulated to meet requirements as published by the Scheme Administrator, and
- can be tested against requirements published by the Scheme Administrator.

If you propose to use computer simulation to calculate energy savings, please contact IPART prior to submitting an application for accreditation. You can propose the software package to be used to develop your energy models, however the Scheme Administrator will need to consider the validity of its use on a case-by-case basis.

When assessing the use of your chosen software package, the Scheme Administrator may assess it using the guidelines described in Table B.2.

Table B.1 Suggested approach for establishing energy models by regression analysis

Step	Description	Details
1	Measure energy consumption and site variables over the measurement period	Define the start date and end date of the measurement period. ▾ Measurement periods are required before implementation (baseline conditions) and after implementation (operating conditions). ▾ Ideally the measurement period should define a full operating cycle of the end-user equipment. ▾ If a measurement period is shorter than a full operating cycle, there is a risk that the data collected over the measurement period will not be representative of the full operating range of the equipment and the Independent Variables and Site Constants – this has implications in determining the Effective Range. ▾ Measure energy consumption and all Independent Variables and Site Constants for the set measurement period.
2	Remove measurements taken under non-normal site conditions	Non-routine adjustments account for those characteristics of a facility which affect energy use, within the chosen measurement period, that are not used as the basis for any Independent Variables or Site Constants. ▾ Record any non-routine adjustments of measured data, where time periods that cover non-routine events (eg, unscheduled maintenance) are excluded from all measurements. ▾ Calculate the non-routine adjustment ratio as the percentage of measurements removed from total number of measurements taken within the measurement period.
3	Test for correlation between Independent Variables	It is important that the variables used in the energy model are independent of one another, since co-dependence will result in poor regression parameters and introduce unnecessary complexity to the energy model. ▾ Test for correlation between the measured values for the variables, for example by calculating the Pearson's correlation coefficient. ▾ Review any variables that are strongly correlated and consider refining your regression model. ▾ If using the OEH M&V tool, this function is performed in the tool using the CORREL function. ▾ The Effective Range is to include any Normal Year values for Independent Variables or Site Constants under which the Implementation could reasonably be expected to increase energy consumption.

Step	Description	Details
4	Determine Effective Range	The Effective Range is the range of values over which the energy models are valid. ▾ Each Independent Variable and Site Constant used in an energy model must have an accompanying Effective Range. ▾ The Effective Range needs to be consistent with the range of measured values for Independent Variables and Site Constants. ▾ Techniques for determining the Effective Range are provided below in Steps 4a, 4b. ▾ Other methods for determining the Effective Range may be considered.
4a	Method to determine Effective Range – Bounding Box	The OEH M&V tool uses a bounding box of all of the measured values of each Independent Variable to determine its maximum and minimum values, the values being: ▾ $x_{j.max}$ = max($x_j(t)$), and ▾ $x_{j.min}$ = min(xj(t)), ▾ where xj(t) is the value of the Independent Variable x_j measured during the relevant time period.
4b	Method to determine Effective Range – Convex Hull	A convex hull method can be used to incorporate all of the measured values of an Independent Variable to define the Effective Range. ▾ The convex hull method determines an equation, or range, that describes a single or multi variable region within which all the measured values exist.
5	Using regression analysis to estimate energy model	Regression analysis may include linear and non-linear multivariate regression techniques. You can use the OEH M&V tool to record the data and calculate energy savings, however: ▾ the regression analysis must be calculated outside of the tool ▾ it can only accept linear regression equations, and ▾ non-linear regression analysis must be conducted outside of the tool using appropriate software or tools. You can also use your own calculation spreadsheets to calculate the energy savings. When you submit your energy model and evidence to support the calculation of ESCs, you should provide at least the following, describing their use and any assumptions in the M&V Plan (or similar): ▾ the software/tool used to conduct the regression analysis ▾ the value of the regression coefficient for each variable and associated t-statistic ▾ the coefficient of determination (R^2) and adjusted R^2, and ▾ the standard error (SE) of the regression equation.

Table B.2 Guidelines for the use of computer simulation (using a commercially available software package determined to be acceptable by the Scheme Administrator)

Requirement	Information provided by applicant	Guidelines that may be used by Scheme Administrator to assess requirement
Commercially available & models relevant type of end-user equipment	Name and version of model	▾ List of programmes on US Dept. of Energy at: http://apps1.eere.energy.gov/buildings/tools_directory/ ▾ Validated using IEA-BESTest protocol.
Calibrated against measurements taken from the actual end-user equipment being simulated	▾ Calibration data ▾ M&V Professional ability to calibrate outputs from computer simulation	▾ Calibration using ASHRAE 14 Guideline – 2002. ▾ Other applicable standards. ▾ Relevant skills, experience or qualifications of M&V Professional.

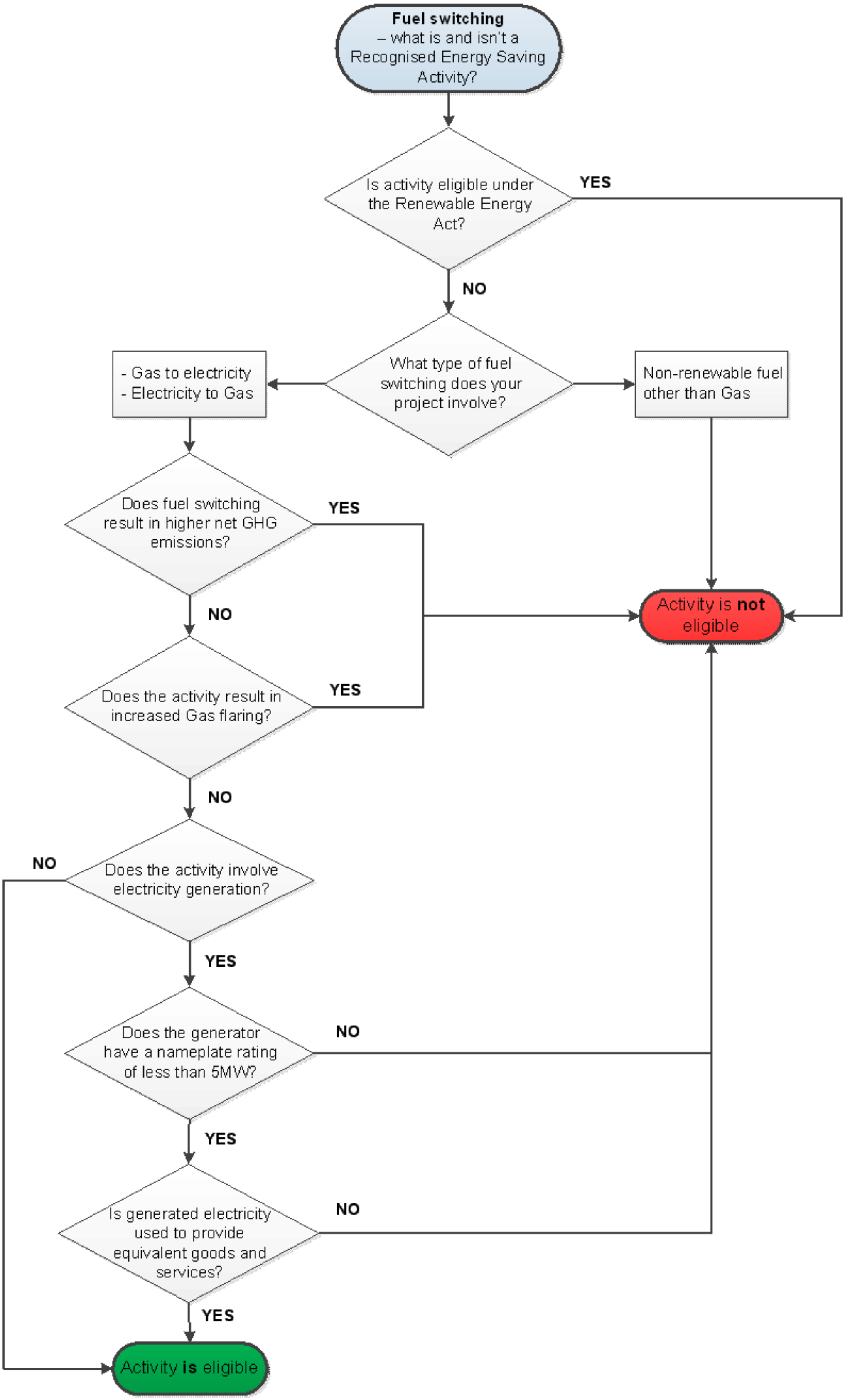
C Fuel switching activities

Under clause 5.3 of the ESS Rule, fuel switching (from electricity to gas or from gas to electricity) that increases the efficiency of energy consumption may constitute a RESA, provided the activity meets certain criteria.

Figure C.1 may assist potential applicants for accreditation to determine if a proposed fuel switching project is eligible to be treated as a RESA under the ESS.

Some project examples are included in Boxes C.1 and C.2 for further reference.

Figure C.1 Flowchart of eligible fuel-switching activities



C.1 Examples of fuel switching activities eligible under the ESS

Eligible Activity	Example
Gas to Electricity	▼ Installing a gas engine, cogeneration or trigeneration unit with a power generation capacity of less than 5MW, where all generated electricity is used onsite for the production of goods and/or services (ie, no power exports). ▼ Replacing gas-fired heating equipment with electric heating equipment.[49]
Electricity to Gas	▼ Replacing electric heating equipment with gas-fired equipment.[50] ▼ Replacing an electrical drive or electrically driven equipment[51] with gas-powered equipment.

C.2 Examples of fuel switching activities not eligible under the ESS

Ineligible Activity	Examples
Gas or electricity to other fuels (renewable and non-renewable)	▼ Replacing a gas-fired boiler with a: ▪ coal-fired boiler ▪ biogas-fired boiler ▪ biomass boiler ▼ Retrofitting a dual gas burner on an existing boiler to replace natural gas with biogas.
Fuel switching that results in an increase in flaring	▼ Replacing a biogas-fired heater with an electric heater resulting in increased biogas flaring as less biogas is used (where biogas is generated onsite).
Fuel switching that results in an increase in net Greenhouse Gas (GHG) emissions	▼ Removing a gas cogeneration system to reduce gas consumption resulting in higher purchased electricity use and increased net GHG emissions. ▼ Retrofit a dual gas burner on an existing cogeneration system to co-fire coal seam gas and reduce natural gas consumption. The switch to coal seam gas will result in higher GHG emissions due to the higher emission factor of coal seam gas compared to natural gas.
Fuel switching activity that is eligible to create tradeable certificates under the *Renewable Energy (Electricity) Act 2000*	▼ A 1MW biogas electric generator, which is eligible to create Large-scale Generation Certificates (LGCs) under the Renewable Energy Target (RET) scheme. Biogas is an eligible renewable energy source under the RET scheme to create renewable energy certificates.
Electricity generation where any generated power is not used to provide equivalent goods or services	▼ A 4MW cogeneration system that supplies more than 100% of a site's electrical consumption with the excess power exported to the grid.
Electricity generation from a generating system that has a nameplate rating greater than 5MW	▼ A 6MW cogeneration system running at 80% capacity. Though the power output is less than 5MW the nameplate rating is greater than 5MW.

[49] Such as a furnace, water heater or steam producer using eg, a resistance, induction or microwave heater.

[50] Heating equipment such as a furnace, kiln, dryer, water heater or steam generator.

[51] Such as air-conditioning systems, refrigeration compressors or pumps.