IPART Energy Sustainability Schemes

Project Impact Assessment with Measurement and Verification

Method Guide

April 2023

ESS »

The Independent Pricing and Regulatory Tribunal (IPART)

IPART's independence is underpinned by an Act of Parliament. Further information on IPART can be obtained from IPART's website.

IPART is the Scheme Administrator of the Energy Savings Scheme under clause 54 of Schedule 4A to the *Electricity Supply Act 1995*. In this Method Guide, a reference to the Scheme Administrator is a reference to IPART.

Acknowledgment of Country

IPART acknowledges the Traditional Custodians of the lands where we work and live. We pay respect to Elders both past and present.

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

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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 and Evidence Package removed from the Method Guide to be separate documents.	February 2015
V2.1	Revised statement regarding additional application documentation.	May 2015
V3.0	Updates following amendments to the ESS Rule commencing on 15 April 2016.	May 2016
V3.1	Updates to include additional technical guidance (Appendices D and E) and a number of minor amendments.	November 2016
V4.0	Updated to reflect amendments to the ESS Rule and changes to the PIAM&V application process.	September 2017
V4.1	Updated to clarify amendments to the additional requirements for M&V Professionals, reflect amendments to the ESS Rule commencing 31 July 2018 and introduce end-user equipment categories.	July 2018
V4.2	Updated to reflect amendments to the ESS Rule.	March 2020
V4.3	Updated to clarify requirements in respect of Counted Energy Savings.	June 2021
V4.4	Updated to reflect minor changes to processes following the introduction of The Energy Security Safeguard Application (TESSA).	September 2022
V5.0	Updated to reflect amendments to the ESS Rule commencing 14 April 2023	April 2023

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1 About this document

This chapter sets out information about:

- the Energy Savings Scheme (**ESS**) and Project Impact Assessment with Measurement and Verification (**PIAM&V**) method
- the purpose of this method guide
- how to use this guide
- other resources we recommend you read when using this method.

1.1 About the ESS and PIAM&V method

The ESS provides financial incentives to install, modify, replace or remove energy savings equipment and appliances in NSW households and businesses. The ESS relies on calculating energy savings using different calculation methods set out in the *Energy Savings Scheme Rule of 2009* (**ESS Rule**). These energy savings are then converted into Energy Savings Certificates (**ESCs**).

The PIAM&V method is one of the calculation methods. It uses internationally recognised measurement and verification principles to calculate energy savings from energy efficiency projects.

This document provides guidance about the PIAM&V method. Please refer to our website for more information on the ESS and how it works.

1.2 Purpose

Use this document if you are:

- an applicant seeking accreditation as an Accredited Certificate Provider (**ACP**) to create certificates using the PIAM&V method. It will help you understand the requirements of the method[a]
- an ACP already accredited for the PIAM&V method to help you accurately calculate energy savings.

The requirements for the PIAM&V method are set out in clause 7A of the ESS Rule.

This document offers guidance on how to:

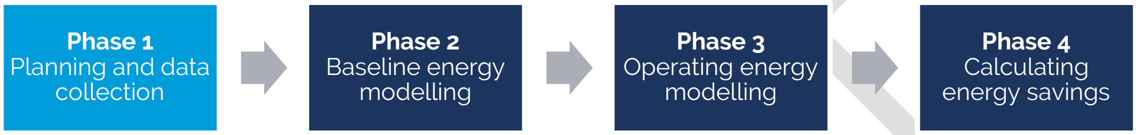
- meet key requirements under the ESS Rule

[a] A full explanation of the application process is provided in the ESS Application for Accreditation Guide – ACPs. Applicants should read this method guide and the Application for Accreditation Guide – ACPs in full before applying for accreditation.

- understand key PIAM&V concepts
- calculate energy savings using the method.

1.3 How to use this guide

This guide provides an overview of the PIAM&V method (chapter 2). It then goes on to explain how to document your PIAM&V project (chapter 3) and the 4 phases of a PIAM&V project (chapters 4–7).



This figure appears in each of chapters 4–7. We use colour coding to help you understand which phase is described in the chapter.

Finally, the guide provides more detail on how to collect data and model energy consumption using the Sampling method (chapter 8).

Key information covered in each chapter is summarised at the start of each chapter.

Throughout the Method Guide, you will also find references to PIAM&V Method Requirements (see section 2.3.2 for more details), and evidence requirements. Because you must comply with these requirements to properly create certificates under the ESS, we have used the following to help you quickly identify these.

We have included references to the PIAM&V Method Requirements in relevant sections of this guide, indicated by this icon. This guide should be read in conjunction with the PIAM&V Method Requirements and the PIAM&V Method Application Requirements for Non-Routine Events and Adjustments (refer to section 2.3.3).

Evidence requirements

- Evidence requirements you must meet to support certificate creation under the PIAM&V method are presented in these boxes.

Abbreviations and key terms used in this document are defined in Appendix C.

1.4 Other resources

The following references are also recommended reading when using this method:

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- Measurement and Verification guidance published by the Office of Energy and Climate Change from time to time
- the *International Performance Measurement and Verification Protocol, Core Concepts*, March 2022 published by the Efficiency Valuation Organization
- PIAM&V Method Application Requirements for Non-Routine Events and Adjustments, published by the NSW Government.

You should also make sure you understand the legal obligations for ACPs participating in the ESS (see section 2.2).

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2 What you need to know before getting started

This chapter sets out:

- what you should understand about the PIAM&V method before planning your project
- legislative requirements you need to meet
- PIAM&V specific requirements set out in clause 7A of the ESS Rule.

2.1 How the PIAM&V method works

The PIAM&V method uses measurement and verification principles to calculate energy savings by comparing modelled energy consumption before an implementation with either modelled or measured energy consumption after the implementation has been commissioned. It is designed to be completed progressively as the project moves through 4 key stages of the Measurement and Verification (**M&V**) process (Figure 2.1).

Figure 2.1 Key stages of the Measurement and Verification process

The savings calculated in phase 4 are converted to ESCs.

2.2 Legislative requirements

Legal requirements for ACPs participating in the ESS are set out in:

- Part 1 of Schedule 4A to the *Electricity Supply Act 1995* (**Act**)
- Part 6 of the *Electricity Supply (General) Regulation 2014* (**Regulation**)
- the *Energy Savings Scheme Rule of 2009*.
- your Accreditation Notice.

You should familiarise yourself with the requirements set out in these documents. The General Requirements Guide (**General Requirements**) has been developed to help you by summarising the key requirements that apply to all ACPs irrespective of calculation method. You will need to refer to the General Requirements and the legislation to fully understand your obligations as an ACP.

One of the key requirements relates to eligibility. To be eligible to create ESCs from an implementation, you and the activity must meet eligibility requirements set out in the legislation.

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2.2.1 You must be eligible

To be eligible to create ESCs from an implementation you must meet certain conditions on or before the implementation date. To meet these conditions, you must be:

- accredited under the ESS for the PIAM&V method
- accredited for the specific end-user equipment (**EUE**) category
- nominated as the energy saver.

If you aren't accredited for the PIAM&V method, you must apply for accreditation for the method and the EUE. See our website for more information on applying for accreditation.

If you are not already the energy saver for the project, then you must be nominated by the original energy saver. More information on nomination is available on our website.

Evidence requirements – eligibility

Evidence you must collect and retain:

- evidence that you are accredited for the EUE (e.g. accreditation notice including relevant EUE)
- signed and completed nomination form
- evidence that the person signing the nomination form is the energy saver (e.g. a document setting out who purchased or leased the equipment)

2.2.2 Eligible projects

Only certain energy savings projects are eligible to create ESCs. The PIAM&V method can be used to calculate savings from a wide range of activities provided they are eligible. Eligible activities include:

- modifying EUE to make it more efficient
- replacing EUE with more efficient EUE
- installing new EUE that is more efficient than the average energy consumption of EUE, and consumes less non-renewable fuel than EUE that is the same type, function, output or service
- removing EUE that is no longer required.

In addition to the above, the activity must be used for stationary energy purposes and reduce consumption of an Eligible Fuel by

- increasing the efficiency of consuming an Eligible Fuel
- switching to another eligible fuel where the switch results in reduced eligible fuel consumption and lower greenhouse gas emissions

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- generating energy with the result that there is an overall reduction in the consumption of an eligible fuel than would otherwise have been consumed
- reducing consumption of an Eligible Fuel per unit of output
- must result in the outcome of Equation 1 being a positive number using the savings from each Eligible Fuel even if negative.

Where EUE is replaced or removed it must:

- not be refurbished, re-used or resold
- meet recycling requirements for mercury and refrigerants (see the General Requirements Guide for details).

New EUE may be installed without replacing existing EUE provided it is more efficient than the average energy efficiency of EUE that provides the same type, function, output or service. The average energy efficiency may be estimated using:

- 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 EUE
- sales-weighted market data for that class of EUE collected from installers, retailers, distributors or manufacturers, or
- baseline efficiency for that class of EUE which may, from time to time, be published by the Scheme Administrator.

2.2.3 Ineligible projects

Ineligible projects include activities that reduce consumption of an Eligible Fuel by:

- reducing production, service or safety levels
- increasing consumption of non-renewable fuels (other than electricity) to provide equivalent goods or services
- generating electricity from a system with a nameplate rating of 30 megawatts or higher
- installing certain lighting EUE[1] (see the Product Applications Guide for lighting equipment requirements under the PIAM&V Method)
- reducing gas or biogas consumption by flaring
- generating energy using native forest bio-materials.

An activity is ineligible if it is:

- undertaken to meet mandatory legal requirements in any jurisdiction
- a standard control service or prescribed transmission service undertaken by a network service provider
- involved in supplying or purchasing electricity from the electricity network on the basis that greenhouse gas emissions are reduced through generating electricity from a particular energy source, including purchases of GreenPower

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- implemented in the Australian Capital Territory where energy consumption must be reported or development approval is required under certain government legislation and policies.

ESCs cannot be created by:

- exporting electricity, gas or biogas to the electricity network or gas network
- installing a solar photovoltaic system, except for solar irrigation pumping
- installing a solar or heat pump water heater, except where replacing an electric or gas hot water heater or installing in a non-residential building.

Refer to clauses 5.3 and 5.4 of the ESS Rule for more details on eligibility criteria.

Evidence requirements – activity eligibility

You must collect and retain evidence that:

- describes the equipment or service to be implemented (example evidence includes an itemised list of equipment and photographs of the EUE including nameplate)
- the activity meets the eligibility criteria in clauses 5.3 and 5.4 of the ESS Rule (summarised above)
- if installing new equipment, the efficiency of the new EUE is greater than average energy efficiency of EUE that provides the same type, function, output or service
- production, service and safety levels have been maintained for the site
- the old equipment has been disposed of appropriately and recycled where required.

2.3 PIAM&V specific legislative requirements

PIAM&V-specific requirements are set out in:

- clause 7A of the ESS Rule
- the PIAM&V Method Requirements (refer to section 2.3.2 below)
- PIAM&V Method Application Requirements for Non-Routine Events and Adjustments (**NRE-A Requirements**) (refer to section 2.3.3 below)
- Item 2 of the Schedule to your Accreditation Notice.

2.3.1 Clause 7A of the ESS Rule

Clause 7A sets out requirements when using the PIAM&V method to calculate energy savings. It includes:

- acceptable energy model types, independent variables and site constants

- measurement procedures including measurement frequency and measurement boundaries
- adjusting for non-routine events
- determining a normal year and effective range
- estimating interactive energy savings
- using decay factors or a persistence model to account for the reduction in energy savings due to equipment degradation over time
- certificate creation
- sampling method requirements.

2.3.2 PIAM&V Method Requirements

The Scheme Administrator publishes the PIAM&V Method Requirements under the ESS Rule. These requirements may complement and/or supplement the requirements set out in clause 7A of the ESS Rule but must be consistent with the ESS Rule.

You must comply with the PIAM&V Method Requirements when using the PIAM&V method.[2]

Remember that this symbol indicates a reference to the Method Requirements.

2.3.3 PIAM&V Method Application Requirements for Non-Routine Events and Adjustments

The PIAM&V Method Application Requirements for Non-Routine Events and Adjustments set out how to manage non-routine events and make non-routine adjustments to your data to remove their impact from your models. You must comply with these NRE-A Requirements, which are discussed in more detail in section 5.3).

2.3.4 Accreditation Notice

Once you are accredited you will receive an Accreditation Notice that sets out what you're accredited for and the conditions of that accreditation. You must also comply with the conditions of accreditation. The *ESS Notice 01/2013 (V3.0) Minimum requirements of conduct* and Record Keeping Guide are referenced in the Accreditation Notice and must also be complied with.

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3 How to document your PIAM&V project

As M&V projects are complex, we require you to keep specific PIAM&V records and have your approach to measurement and verification deemed[b] appropriate by an independent Measurement and Verification Professional (**M&V Professional**) approved by the Scheme Administrator.

This chapter sets out:

- what an approved M&V Professional needs to do for a PIAM&V project
- how to find an M&V Professional
- the types of report that the M&V Professional must produce and where to find relevant templates for the reports (Preliminary M&V Professional Report and final M&V Professional Report)
- what to include in an M&V Plan, when to include a sampling plan where to find template M&V Plan
- what to include in an M&V Report
- the use of calculation tools and spreadsheets.

3.1 Measurement and Verification Professionals

The ESS Rule requires that various parameters in your M&V approach be deemed appropriate by an M&V Professional. As M&V is a progressive process, the M&V Professional must provide a Preliminary M&V Professional Report that confirms the measurement procedures relating to the baseline energy model are appropriate and provides their reasoning.[3] [c] This report must be signed and dated by the M&V Professional and ACP *before* the Implementation Date.

The M&V Professional must also prepare an M&V Professional Report at the end of the project in which they confirm the following parameters are appropriate and provide their written reasoning:

- parameters used when measuring energy consumption, independent variables, site constants and any other relevant parameters
- method for selecting independent variables and site constants
- measurement procedures for baseline and operating energy models
- measurement procedures to adjust for non-routine events
- normal year for single site models (not required for annual creation or top-up)
- the procedure for determining the normal year for multiple site models
- effective range

[b] Throughout this guide, 'confirm' is used in place of 'deem'
[c] This requirement does not apply to ESCs of an Implementation with an Implementation Date on or before 14 August 2020 (ESS Rule, cl 11.12)

- interactive energy effects
- accuracy factor
- use of a persistence model
- baseline energy model
- operating energy model (except for annual creation or top-up)
- sampling method (if applicable).

The Preliminary M&V Professional Report and M&V Professional Report do not need to be completed by the same M&V Professional.

Additional information and a template for the Preliminary M&V Professional Report and the M&V Professional Report can be found on our website.

You are responsible for the quality of the M&V Professional Report prepared for each of your implementations. As such, you are expected to conduct your own quality assurance of the work of the M&V Professionals you work with.

The written explanatory reasoning required under clause 7A.5A of the ESS Rule must be provided in the form of a Preliminary M&V Professional Report which is consistent with any current template Preliminary M&V Professional Report published by the Scheme Administrator. The Preliminary M&V Professional Report must be prepared by an M&V Professional.

The Preliminary M&V Professional Report must:

a. be signed and dated by an M&V Professional and the ACP prior to the Implementation Date
b. be based on a review of the M&V Plan and include written explanatory reasoning of the appropriateness of the items listed in clause 7A.5(a)–(g) of the ESS Rule and, regarding the Baseline Energy Model only, the Measurement Procedures for:
   i the Independent Variables and Site Constants
   ii the baseline Measurement Period, ensuring that the selected Measurement Period represents a complete operating cycle and includes periods for which Independent Variables may reasonably be expected to lead to the Implementation increasing consumption of Eligible Fuels.

The M&V Professional Report must be signed by an M&V Professional and refer to and consider both the Preliminary M&V Professional Report and the M&V Report

If the Measurement Procedures change, these changes must be assessed by an M&V Professional who must confirm the amended Measurement Procedures are appropriate and provide their written reasoning in the M&V Professional Report.

3.2 How to find an M&V Professional

A list of approved M&V Professionals is available on the Energy Sustainability Schemes website.

An M&V Professional may not be approved for all EUE categories or energy model types. The list of approved M&V Professionals includes the relevant EUE categories and energy model types. You should ensure you select someone who:

- has relevant skills and experience relating to the particular energy saving activity
- can provide an independent opinion over the validity of your M&V approach.

When a person is an M&V Professional for a PIAM&V project they:

- can provide their professional opinion and expert advice relating to the project and the M&V approach (i.e. they can provide feedback to assist you in developing the M&V approach for the project)
- cannot be responsible for validating their own work (i.e. if they develop the energy models for the project they cannot independently validate that they meet the requirements of the ESS Rule)
- must cease their role as the M&V Professional where their ability to provide an independent opinion becomes compromised because of their involvement in a project.

For example, if the M&V Professional is responsible for developing the M&V Plan and energy models for a project, they cannot act as the M&V Professional. Their level of involvement in the project means they are not able to provide an independent opinion on the validity of the energy models and the M&V approach for that implementation.

3.3 M&V Plan

Developing a detailed M&V Plan is central to successfully using M&V for estimating energy savings. The M&V Plan is typically used to:

- set out the measurement approach, measurement boundaries and limits to the modelling
- explain the parameters used (and not used) in the energy models
- explain the approach that will be used to calculate energy savings resulting from an activity.

The *International Performance Measurement and Verification Protocol, Core Concepts* (referenced in section 1.4) provides guidance on developing and using M&V Plans.

If using the sampling method, you must also develop a sampling plan (refer to section 8.2).

3.4 M&V Report

You must also develop an M&V Report summarising the outcomes of the implementation. It should describe project implementation details, energy models used (and their development process) and calculation of energy savings, including all M&V parameters and assumptions used in the calculations.

The M&V Report 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 has been addressed.

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The M&V Report should describe how each parameter used in the energy models was derived, so all assumptions and inputs to the calculation spreadsheets can be referenced and verified by the M&V Professional or at audit if required.

The M&V Report should also include information about implementation of the sampling plan (if applicable), including any changes to the original plan (e.g. addition of extra sites to the population).

3.5 Calculation tools

Spreadsheets and tools used in calculating energy savings and developing energy models (e.g. regression analysis) must be developed and maintained as supporting information for the M&V Report.

Energy savings must be calculated in accordance with the relevant PIAM&V equations outlined in the ESS Rule. Refer to chapter 7 for more details on how to calculate energy savings.

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4 Phase 1 – Planning your PIAM&V project

This chapter sets out what you need to know about:

- planning your PIAM&V project
- your EUE type
- EUE categories
- the measurement boundary
- independent variables and site constants
- the measurement period and operating cycle
- measurement procedures
- engaging an M&V Professional.

4.1 Why planning your PIAM&V project is important

Planning your PIAM&V project (**Phase 1**) is the most important step in calculating energy savings using the PIAM&V method. It ensures you have set the most appropriate measurement boundary, identified relevant independent variables and site constants, data sources and measurement approaches before you proceed to **Phases 2 and 3** (modelling).

4.2 Understanding end-user equipment

The PIAM&V method allows ACPs to use a wide range of activities involving different types of EUE to create energy savings. These activities must meet eligibility requirements set out in clause 5.3 of the ESS Rule.

The existing EUE at the site and replacement EUE influences the type of modelling approach that can be used as different equipment has different independent variables, site constants and operating cycles. These factors influence the type of data to be collected and the model that can be generated. A thorough understanding of how EUE converts eligible fuel to end-use services and how this conversion is impacted by external factors is the first step in calculating energy savings because it influences the type of data to be collected and for how long.

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4.2.1 You must be accredited/approved for the EUE

You must be accredited for the specific EUE category before the implementation date of the project. This is because you must demonstrate your ability to model the energy consumption from this type of equipment. If you aren't accredited for the relevant EUE category you cannot create certificates from the implementation.

Approved M&V Professionals are also approved for specific EUE categories and cannot provide M&V services under the ESS Rule for categories outside their approval.

ACPs and M&V Professionals can get accredited/approved for multiple EUE categories listed in section 4.2.2. See our website for information on how to apply.

4.2.2 End user equipment categories

To create consistency of EUE for ACP accreditations and M&V Professional approvals, the following EUE categories have been developed:

- building envelope
- commercial heating/cooling
- fluid transport and materials handling
- industrial heating/cooling
- information and communication technology
- lighting
- power generation systems
- power supply/distribution systems
- industrial processes (other).

Each category comprises a range of different equipment, processes and systems. Refer to Appendix A for further information and examples of equipment under each category.

4.2.3 Lighting equipment requirements

Lighting EUE have specific requirements including that the lighting upgrade must be either:

- a 'standard equipment class' as listed in Table A9.1 of Schedule A to the ESS Rule, or
- an 'other equipment class' as listed in Table A9.3 of Schedule A to the ESS Rule.[4]

If you plan to install equipment in a lighting upgrade that is in an 'other equipment class', equipment requirements relating to safety apply.[5] Equipment in an 'other equipment class' must be accepted by the Scheme Administrator as meeting these requirements before you can create ESCs from the use of that equipment. Further information about the equipment requirements and how to have particular equipment accepted by the Scheme Administrator is set out in the *Product Applications Guide*.

The Scheme Administrator also publishes a list of EUE that has been accepted as meeting the lighting equipment requirements.[6] Refer to our website for more information about product acceptance.

Evidence requirements – end-user equipment

You must collect and retain evidence that:

- you are accredited for the EUE
- your M&V Professional is approved for the EUE
- describes the EUE that is modified, replaced, installed or removed as part of the implementation
- the lighting equipment requirements have been met for each lighting activity you implement
- any additional eligibility evidence requirements set out in sections 2.2.1 and 2.2.3.

4.3 Measurement boundary

The measurement boundary sets the boundary for which data is collected to generate the energy models and must set out the items of EUE for which energy consumption must be measured. Under the ESS Rule, the Measurement Boundary is defined as:

- all EUE which is modified, replaced, installed, or removed because of the implementation
- all EUE within that boundary whose energy consumption is impacted by the implementation.[7]

The selection of the measurement boundary is an important step in developing a PIAM&V project because it could:

- impact how well the measured energy consumption reflects the energy consumption of the EUE
- include equipment that is not eligible for ESC creation
- impact the independent variables and site constants that are selected to model energy consumption
- result in interactive energy effects outside the measurement boundary.

You should carefully consider setting the measurement boundary to ensure the measured energy consumption is representative of the energy consumption of the EUE that is the subject of the implementation. For example, it may be appropriate to use utility meter data (that is, a whole of site approach) where you can demonstrate the energy savings are greater than 10% of the baseline energy consumption. If the energy savings are less than 10% of the baseline energy consumption, then you should adjust the measurement boundary and install sub-metering to directly measure the energy consumption of the EUE for the baseline and operating measurement periods.

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4.3.1 Measurement boundary and ineligible equipment

Where the utility meter data includes equipment that is not eligible for ESC creation (section 2.2.3), you should consider sub-metering the energy consumption or supply of eligible fuel to this equipment so the energy consumption data from the utility meter can be adjusted accordingly.

4.3.2 Measurement boundary and interactive energy effects

Setting the correct measurement boundary is important when accounting for interactive energy effects. Interactive energy effects occur because the implementation affects the energy consumption of EUE outside the measurement boundary. An example of this is where a lighting upgrade that emits less heat reduces the energy consumption of the air conditioning system. If the measurement boundary is set around the lighting upgrade, the change to the energy consumption of the air conditioning system is not measured. The measurement boundary may be adjusted to include the affected equipment or the impact on energy consumption on the affected equipment may be estimated. See section 7.2.4 for an example of an interactive energy effect and how to manage them.

In defining the Measurement Boundary for an Implementation, an ACP must document and retain evidence of all items of EUE within the Measurement Boundary as defined in the ESS Rule.

An ACP must ensure that Energy Savings calculated using measurements from a utility meter have occurred as a result of the Implementation.

Evidence requirements – measurement boundary

You must define the measurement boundary in your M&V Plan by:

- listing all affected EUE
- demonstrating that you have adequate metering in place. For example, this can be evidenced by an electrical line diagram or piping and instrumentation diagram showing the location of the meter(s) used in measuring the energy consumption.

4.4 Independent variables and site constants

Independent variables and site constants are parameters that affect energy consumption and must be considered when modelling eligible fuel savings.

An independent variable as defined in the ESS Rule is a parameter that routinely varies over time (such as average daily temperature), can be measured and affects the energy consumption of the EUE.

Site constants are parameters that affect the energy consumption of the EUE, but they do not vary over time under normal operating conditions. If a site constant does change, then a non-routine adjustment must be made in accordance with clause 7A.5B1. Site constants are not independent variables and are not used to derive dependent variables.

Unlike the International Performance Measurement and Verification Protocol (**IPMVP**), the ESS Rule requires that the independent variables and site constants relate to the energy consumption of the EUE. While the definition is different from the IPMVP, it is consistent with the IPMVP guidelines which set out that the measurement boundary should be drawn around the equipment being upgraded where savings are being calculated. This ensures that the independent variables and site constants relate to the energy consumption of the EUE that is upgraded. For example, temperature would not be an appropriate independent variable for a lighting upgrade as the electricity consumption of the light is not temperature dependent. Care should therefore be taken to ensure selected independent variables and site constants meet the ESS Rule definitions as stated above.

An ACP must have regard to and document all relevant Independent Variables and Site Constants in the M&V Plan and M&V Report.

An ACP must ensure that the selected Independent Variables and Site Constants affect the energy consumption of the EUE.

Measurements of the Independent Variables and Site Constants must:

a. consider the context of the EUE within the Site; and
b. be made under Normal Operating Conditions.

An ACP must define and document the Normal Operating Conditions of the EUE for the measurements taken.

Evidence requirements – independent variables and site constants

- You must document the independent variables and site constants used to model energy consumption in your M&V Plan. Note, it is good practice to include independent variables and site constants that you considered but later discarded.
- Your independent variables and site constants must be deemed appropriate by an approved M&V Professional with their explanatory reasoning provided in a Preliminary M&V Professional Report and M&V Professional Report.

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4.5 Measurement period and operating cycle

To establish an energy model, you must specify the measurement period to measure energy consumption, independent variables and site constants. Each measurement period must have a start date and end date for each energy model that meets the requirements of the ESS Rule.[8]

The values for energy consumption, independent variables and site constants must be within these measurement periods, which must represent a complete operating cycle for the EUE. A complete operating cycle covers the range from maximum to minimum energy consumption and the measurement period should include time periods in which independent variables may reasonably be expected to lead to the implementation increasing consumption of the relevant eligible fuel. Where there is seasonal variation in the energy consumption profile, the operating cycle is likely to be one year. You must collect data for both the baseline and operating measurement periods.

The ESS Rule specifies that:

- the end date of the **baseline measurement period** must be before the implementation date and
- the start of the **operating measurement period** must be on or after the implementation date.

The start of the baseline measurement period and the end of the operating measurement period are determined based on the operating cycle of the existing and replacement EUE respectively. As a result, the measurement periods for the baseline and operating energy models may differ as the operating cycle of the existing and replaced EUE may differ. This concept is illustrated in the example in Box 4.1.

The measurement periods for energy savings that rely on measured operational energy consumption data (annual creation and top-up creation) are set by the ESS Rule. Information on how to set these measurement periods is provided in section 5.3.2.

Box 4.1 Operating cycle example

A fan that operates 24 hours a day, 365 days a year is replaced by a fan with a variable speed drive that operates only when temperatures exceed a set point.

- The operating cycle for the original fan could be as short as one day because energy consumption does not change day to day
- The operating cycle of the replacement fan could be 12 months as seasonal variations in temperature must be taken into consideration.

An ACP must include evidence in the M&V Report that the Measurement Periods for the

a. Baseline Energy Model, and

b. Operating Energy Model

include one or more complete operating cycles of the EUE.

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Evidence that is provided by an ACP in support of the above requirement must

a. demonstrate Eligible Fuel usage patterns over one or more complete operating cycles of the EUE and

b. demonstrate how the relevant variables are captured in the Measurement Period.

When developing the Measurement Periods for the Baseline Energy Model and the Operating Energy Model, ACPs must take all reasonable steps to reduce statistical bias.

Evidence requirements – measurement period

- You must document the operating cycle of the EUE and demonstrate that it includes energy consumption and demand from maximum to minimum.
- You must document the proposed measurement periods for your baseline and operating models in your M&V Plan.
- You must include any assumptions you've made in setting the measurement periods.
- Your measurement period must be deemed appropriate by an approved M&V Professional with their explanatory reasoning provided in a Preliminary M&V Professional Report and M&V Professional Report.

4.6 Measurement procedures

Before you begin collecting your data, you must first define your measurement procedures including:

- **data sources** – the sources or methods for collecting and storing data relevant to the eligible fuel and its consumption. This also includes sourcing data for independent variables and site constants, depending on your energy savings activity. Data sources may include:
  - for energy consumption: on-site utility meters or other sources of measurement approved by the Scheme Administrator
  - for independent variables such as air temperature or equipment status: publicly available data sets from weather stations (such as BOM station no. 66124), business records or purchased datasets
- **measurement frequency**[9] – how often you measure energy consumption, independent variables, or any other relevant parameters. You should align your measurement frequency so data from all variables have the same time interval
- **calibration procedures** – accuracy and precision of your measurement methods for meters other than meters approved by the National Measurement Institute used for trade as defined by the *National Measurement Act 1960*
- **reasonable periods** – procedures to ensure the Measurement Period includes time periods during which independent variables may reasonably be expected to lead to the Implementation increasing consumption of the relevant eligible fuel.

Evidence requirements – measurement procedures

- You must document your measurement procedures in your M&V Plan.
- You must have your measurement procedures deemed appropriate by an approved M&V Professional in the Preliminary M&V Professional Report.

4.7 Engaging an M&V Professional

To satisfy the requirements of clause 7A of the ESS Rule, you must engage an M&V Professional before the implementation date so that the measurement procedures for the baseline energy model can be confirmed as appropriate by an approved M&V Professional. If the M&V Professional does not agree with the measurement procedures used, they should be adjusted until they can be confirmed as appropriate. The M&V Professional must provide their explanatory reasoning for confirming the procedures are appropriate in their Preliminary M&V Professional report, which must be signed and dated by the M&V Professional and ACP prior to the Implementation Date. The M&V Professional reports must be retained so they can be provided to an auditor.

4.8 End of Phase 1

By the end of Phase 1 of your M&V project you should have:

- identified and documented your existing EUE
- set your measurement boundary
- identified relevant independent variables and site constants
- set up your measurement procedures
- determined your measurement period and operating cycle of the EUE
- collected energy consumption data, independent variable and site constant data for your baseline
- documented your measurement procedures in your M&V Plan
- engaged an M&V Professional to complete a Preliminary M&V Professional report that confirms the measurement procedures for the baseline energy model are appropriate and provide their written reasoning.

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5 Phase 2 – Baseline energy model

This chapter sets out the approach to generating energy models. Because the same approach is used to create the baseline and operating energy models, to avoid repetition the information in this chapter is relevant to both models. Information that is important to developing operating energy models is provided in the next chapter. This chapter sets out information about:

- acceptable model types
- modelling considerations
- how to make non-routine adjustments for non-routine events
- the baseline energy model.

5.1 Establishing your baseline energy model

Once you have developed your M&V Plan and measured your baseline energy consumption, independent variable and site constant data (**end of Phase 1**), you can establish the baseline energy consumption model (**Phase 2**).

5.2 Modelling the data

Under the PIAM&V method, the relationship between measured consumption of each eligible fuel and relevant independent variables and site constants can be modelled using one of 3 types of energy model:

- estimate of the mean
- regression analysis
- computer simulation.

5.2.1 Estimate of the mean

The estimate of the mean model can be used when energy consumption over the measurement period does not change significantly over time. It determines the mean of the energy consumption and can be used provided the coefficient of variation (the ratio of the standard deviation to the mean) of the energy consumption over the measurement period is less than 15%.

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This approach models energy consumption by taking the mean energy consumption. It does not use independent variables to model energy consumption and does not have an effective range. To meet the requirements of clause 7A an estimate of the mean model must:

- be based on measurements of energy consumption, independent variables and site constants (where relevant)
- specify a measurement period and modelling frequency
- have a coefficient of variation of the energy consumption over the measurement period less than 15%.

When using an estimate of the mean model:

1) An ACP must assign a value for each time period in each Measurement Period for relevant:
   a. Independent Variable(s) and Site Constant(s) for Regression Analysis
   b. Site Constant(s) for an Estimate of the Mean.
2) An ACP must demonstrate that the use of an Estimate of the Mean model is appropriate. This includes:
   a. assessing if there are Independent Variables that significantly affect energy consumption
   b. measuring likely Independent Variables to ensure that they do not have a significant effect on the energy consumption as described in the M&V Guide.
3) The ACP must document:
   a. the process used to determine that an Estimate of the Mean energy model is appropriate
   b. all potential Independent Variables that were tested and why the variables were excluded from the model
   c. that the selected Measurement Periods include one or more complete operating cycles.

An estimate of the mean model does not use independent variables or site constants to model energy consumption. However, there may be independent variables that influence energy consumption, but that influence is minor. In these cases, it is recommended that any relevant independent variables and site constants that could influence energy consumption be recorded in your M&V Plan and report as potential independent variables even if they haven't been used in the model.

5.2.2 Regression analysis

Regression analysis expresses the energy consumption as a mathematical function of the independent variables and site constants. It must:

- be based on measurements of energy consumption, independent variables and site constants

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- specify a measurement period and modelling frequency and meet statistical requirements set out in Table A22 of Schedule A to the ESS Rule
- be based on independent observations at the modelling frequency:
  - the number of independent observations must be at least 6 times the number of model parameters in the energy model, except when the Short Energy Models Method is used to make a Non-Routine Adjustment in accordance with clause 7A.5B1(b)(iii) of the ESS Rule.

A suggested approach for establishing energy models by regression analysis is set out in Appendix B.

5.2.3 Computer simulation

Computer simulation uses simulation software to model energy consumption for the baseline and operating measurement periods against relevant independent variables and site constants. 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. Energy models may be developed using a:[10]

- **single site** – based on measurements taken from that site, or
- **sampling method (multiple sites)** – based on measurements taken from sample sites using a sampling approach.

It must:

- use a commercially available software package approved by the Scheme Administrator (this is done on a case-by-case basis) for use in modelling the relevant type of EUE
- be calibrated against measurements taken from the actual EUE being simulated to meet any requirements published by the Scheme Administrator.[11]

You will also have to meet the following additional Scheme Administrator requirements:

- the computer simulation software must calculate energy consumption for specified time intervals and be based on engineering equations and user-defined parameters relevant to the EUE that is modelled (e.g. a tool that performs regression analysis or similar type of statistical simulations is not considered computer simulation software), and
- you must determine and justify the accuracy requirements of the calibrated computer simulation model in accordance with industry standards.

Applicants proposing to use computer simulation to calculate energy savings should contact us prior to submitting an application for accreditation. Applicants can propose the software package to be used to develop the energy models, however the Scheme Administrator will need to consider the validity of its use on a case-by-case basis. The process for assessing and approving computer simulation software is conducted as part of an application for accreditation assessment process.

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Guidelines for using computer simulation with a commercially available software package are set out in Appendix B. The Scheme Administrator may assess use of a chosen software package using these guidelines.

5.3 Modelling considerations

Different model types may be used to model energy consumption for the baseline and operating measurement periods depending on the type of EUE that is replaced and its replacement. The models may have different measurement periods depending on the operating cycle of the EUE. For example, a fan that operates 24 hours a day, 7 days a week may be modelled using an Estimate of the Mean model. If it is replaced by a fan with a variable speed drive that is activated by a set temperature, a regression analysis which uses temperature as the independent variable may be used. Where regression analysis is used for both models, the baseline and operating energy models should have the same independent variables and site constants.

5.3.1 Modelling frequency

You must define and record the modelling frequency (i.e. hourly, daily, weekly, monthly) for energy consumption, independent variables or site constants used in the energy model. The modelling frequency is how often independent observations of energy consumption, independent variables or any other relevant parameter are used in the baseline or operating energy models.

The frequency must be the same for each energy model as you must assign values for each parameter for each time period at the modelling frequency in each measurement period. The measurement frequency and modelling frequency may differ where measurements are aggregated into independent observations. For example, energy consumption may be measured every hour (measurement frequency), but the independent variable data (temperature) is measured daily. The modelling frequency for all data must be the same so the energy consumption data must be aggregated to create daily data.

5.3.2 Measurement period

The measurement period must include at least one complete operating cycle of the EUE from minimum to maximum energy consumption. Care should be taken when defining the measurement period to ensure it captures:

- periods where independent variables may reasonably be expected to cause energy consumption of the implementation to increase
- the full range of independent variables as this can affect the effective range of the model.

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5.3.3 Meeting statistical requirements

The baseline and operating energy models that use regression analysis must meet the minimum statistical requirements set out in Table A22 of Schedule A to the ESS Rule (Table 5.1).

Table 5.1 Minimum statistical requirements

Modelling criteria	Minimum requirement
t-statistic of independent variables	Absolute value > 2
Adjusted coefficient of determination (Adjusted R^2) and Coefficient of Variation of the Root Mean Square Error (CV_{RMSE})	$CV_{RMSE} < 0.25$ for (Adjusted R^2) ≥ 0.5 $CV_{RMSE} < 0.1$ for (Adjusted R^2) < 0.5

5.4 Accounting for non-routine events

Non-routine events (**NREs**) are defined in the ESS Rule as temporary or permanent events that affect energy consumption within the measurement boundary and during any measurement period. These events are not modelled by any independent variables or site constants. For example, unexpected maintenance could impact energy use.

The baseline and operating energy models must account for NREs to ensure a reasonable comparison can be made between energy consumption measurements before and after an implementation. NREs are only considered for impacts inside the measurement boundary and are accounted for by making a non-routine adjustment (**NRA**) to the measured data.

You must use the PIAM&V Method Application Requirements for Non-Routine Events and Adjustments to identify and record any NREs occurring within the measurement boundary and during any of the measurement periods or the implementation period. These NRE-A Requirements set out the steps you must follow and requirements you must meet to manage NREs.

Four methods can be used to make an NRA:

1. Sub-Metering Method, for NRAs that are sub-metered
2. Other Implementations Estimate Method
3. Data Exclusion Method, or
4. Short Energy Models Method.[12]

Note the NRE-A Requirements stipulate that to apply any of the NRA methods, the selected independent variables must be used in both the baseline and operating energy models.[13]

After applying the NRA, you must ensure the baseline and operating energy models meet the minimum statistical requirements set out in Table A22 of the ESS Rule. An M&V Professional must also confirm the measurement procedures are appropriate.[14]

Non-Routine Events must be recorded in the M&V Report.

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5.5 Calculating non-routine adjustments

If you can identify the root cause of the NRE, and you cannot avoid the NRE-impacted periods, an adjustment for the NRE can be made using one of the 4 methods listed above.

You are also required to record and maintain evidence of all NRAs made to the model or measured data. The documentary evidence required for each NRA method is listed in Requirement 3 of the NRE-A Requirements.

5.5.1 Sub-Metering Method

The Sub-Metering Method is used to adjust for sub-metered NREs that increase or decrease energy consumption within the measurement boundary. In this method, you apply an NRA directly to the energy consumption data for each observation impacted by an NRE.

NREs that are eligible for the Sub-Metering Method include:

- the addition or removal of equipment other than the current implementation's EUE
- the expansion or contraction of the measurement boundary
- the addition of on-site generation
- energy savings from other implementations (**OIMPs**) that have existing sub-metering.

Under the Sub-Metering Method, if the NRE causes energy consumption for an observation to:

- increase, you need to subtract the NRA for that observation from the total metered energy
- decrease, you need to add the NRA for that observation to the total metered energy.

Note that under this method, you will need to adjust the metered energy for each observation affected by the NRE. To use this method, you will also need to ensure your sub-metering equipment and sub-metered data comply with Requirements 7 of the NRE-A Requirements.

5.5.2 Other Implementations Estimate Method

The Other Implementations (OIMPs) Estimate Method is used to adjust for OIMPs that affect energy consumption within the measurement boundary of the current implementation). An OIMP is another implementation within the measurement boundary that has already been used to create energy savings certificates using clauses 7, 7A, 8 or 9 of the ESS Rule. It does not need to be adjusted for if it occurs before the baseline measurement period of the current recognised energy saving activity.

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An example of when the OIMP Estimate Method should be used is where a whole of site approach is used to model a commercial refrigeration upgrade at a site where a lighting upgrade was implemented during the operating measurement period and used to create certificates under the Commercial Lighting Formula (clause 9.4 of the ESS Rule). As the lighting EUE is within the refrigeration upgrade measurement boundary, the energy savings from the lighting upgrade must be accounted for using the OIMP Estimate Method set out in the NRE-A Requirements. Similarly, the OIMP Estimate Method must also be used if the lighting upgrade was implemented during the baseline measurement period or the implementation period of the commercial refrigeration upgrade.

In this method, you calculate the average energy savings from the OIMP, divide it by observations per year, and adjust the energy consumption data for each observation where the OIMP exists in the measurement period. The calculation steps are available in Requirement 4 of the NRE-A Requirements.

After you have applied the NRAs and established your baseline and operating energy models, you must update the relative precision of the model. This step reflects the impact the OIMP has on the overall modelling error and is expected to increase the relative precision of the model.

Note that under this method you will need to separately adjust for each OIMP that occurs in the measurement boundary.

5.5.3 Data Exclusion Method

The Data Exclusion Method is used to adjust for NREs by excluding data where any of these occur:

- a permanent NRE commences in the first 25% of the baseline measurement period
- a permanent NRE commences in the last 25% of the operating measurement period
- a temporary NRE is less than or equal to 25% of the measurement period.

In this method you exclude up to 25% of data from a measurement period using the criteria set out in Requirement 5 of the NRE-A Requirements. This method cannot be used to exclude data for periods where independent variables are expected to increase energy consumption, nor can it be used to adjust for OIMPs.

Note that under this method, if you exclude data at the end of the operating measurement period due to a permanent NRE commencing, you are not permitted to use top-up certificate creation.

5.5.4 Short Energy Models Method

The Short Energy Models Method is used to adjust for NREs that lasts longer than 25% of the measurement period or permanent NREs not eligible for the data exclusion method.

In this method, you shorten the measurement period of an energy model according to the rules outlined in Requirement 6 of the NRE-A Requirements. You then shorten the other energy model's measurement period so that both your baseline and operating energy model's measurement periods are similar in length and have similar ranges of independent variables.

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For example, if an ACP uses the Short Energy Models Method so their operating measurement period is 50 days at the end of Summer 2020, and the independent variable is CDD, then the baseline measurement period must also be in Summer. As long as the range of independent variables is similar, the ACP may select the adjacent period (in the same Summer) or select a previous Summer as the baseline.

To apply this method, both the shortened baseline energy model and shortened operating energy model must meet the criteria outlined by Requirement 6 in the NRE-A Requirements, including:

- having similar ranges of independent variables
- having a measurement period that covers less than 75% of the full operating cycle
- the length of the shorter Measurement Period of one Energy Model must be at least 70% of the Measurement Period's length of the other Energy Model
- having at least 4 times the number of independent observations (at the modelling frequency) than the number of independent variables.

In NRAs, the Effective Range Adjustment Factor (**ERAF**) may only be applied for forward creation of ESCs when using the Short Energy Models Method. In this case, a slightly modified version of Equation 7A.2 from the ESS Rule must be used to calculate the normal year energy savings. Note that NREs caused by energy savings from OIMPs cannot be adjusted using this NRA method.

5.6 Baseline energy model

A baseline energy model is developed for all types of certificate creation under the PIAM&V method. It determines the consumption of an eligible fuel in the absence of the implementation using one of the 3 model types included in the ESS Rule.

Clause 7A.3 of the ESS Rule requires that the baseline energy model estimate consumption of one eligible fuel in the absence of the implementation as well as:

- depend on independent variables and site constants, where relevant, established by measurements taken under normal operating conditions (refer to section 4.3)
- if the model is for new EUE, it must be based on the average energy performance of the same type of equipment in accordance with clause 5.3B of the ESS Rule
- be confirmed as appropriate by an M&V Professional, with their written explanatory reasoning provided, **before** the implementation date (refer to section 3.1).

If there is more than one eligible fuel involved in the implementation than a baseline energy model must be produced for each eligible fuel.

Modelling can be an iterative process, and there may be more than one model type or approach that can be used to model energy consumption. You may need to develop multiple models to determine the combination of independent variables and site constants that meet the minimum statistical requirements. If a non-routine event is identified in the baseline or operating measurement period or the implementation period, a non-routine adjustment may need to be made to the baseline energy model as described above.

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Evidence requirements – baseline energy model

You must collect and retain evidence of:

- baseline energy consumption, independent variable and site constant data used in the model at the measurement and modelling frequency
- the calculation tool used for modelling
- non-routine events and adjustments made to the model
- the model expressed in mathematical terms
- sources of error
- for regression analysis – standard error of the model including t-statistic, adjusted coefficient of determination (adjusted R^2) coefficient of variation of the root mean square error (CV_{RMSE})
- for estimate of the mean – coefficient of variation.

5.7 End of Phase 2

By the end of Phase 2, you should have:

- aggregated measured baseline energy consumption, independent variable and site constant data to meet the modelling frequency of choice for the baseline energy the model
- selected an appropriate model that relates your baseline energy consumption to relevant independent variables and site constants
- identified any non-routine events and adjustments to be made to the baseline energy model
- determined a mathematical relationship between baseline energy consumption and independent variables (if appropriate) that meet the minimum statistical requirements of the ESS Rule
- had your baseline energy model and procedures used for non-routine events confirmed as appropriate by an M&V Professional.

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6 Phase 3 – Operating energy model

A similar process is used to develop the baseline and operating energy models as described in the previous chapter. This chapter does not repeat the steps to generate the model, but it does highlight important differences and concepts. This chapter sets out information about:

- the implementation date
- the implementation period
- data collection and the measurement period
- the operating energy model.

6.1 Establishing your operating energy model

Developing the operating energy model occurs in Phase 3 of an M&V project. The energy model must be developed using data collected after the implementation has commenced normal operations.

6.2 Implementation date

The implementation date is an important concept in the ESS and can be different for different methods. For the PIAM&V method, the implementation date is the date the implementation commenced normal operations.[15] Normal operations commence when the installation of the EUE is complete or when a new service commences.

Normal operations may commence after a commissioning period or after fine tuning the performance of the equipment or process. If normal operations commence after a commissioning period, details of the commissioning process should be provided in project documentation.

Evidence requirements – implementation date

- The implementation date must be evidenced. The evidence must be signed by an appropriately qualified person that is responsible for undertaking the implementation. This person should not be the ACP.
- The evidence must include:

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Evidence requirements – implementation date

- the date when the implementation commenced normal operations
- the location of the implementation.

6.3 Implementation period

The implementation period is the period between the end date of the Baseline Energy Model Measurement Period and the start date of the Operating Energy Model Measurement Period. The Implementation Date occurs within this period.

Any non-routine events occurring within the implementation period must be identified and recorded (refer to section 5.3).

6.4 Data collection and the operating measurement period

Before you start collecting data for your operating energy model you should ensure the new implementation is working under normal operating conditions and all post implementation issues have been resolved.

The same measurement procedures should be used to collect the operating energy consumption, independent variable and site constant data as was used for the baseline measurement period.

As with the baseline measurement period, the measurement period for the operating energy model must include at least one operating cycle of the EUE and capture periods when the independent variables may cause the EUE to increase energy consumption. See section 5.2 (modelling considerations) for more details about measurement periods and section 5.3 for details about non-routine events and adjustments.

6.5 Operating energy model

Like the baseline model, you may need to develop multiple energy models to determine the combination of independent variables that achieve the best fit for the model. The model may only estimate consumption of one eligible fuel. A different type of model may be used to model operating energy consumption than was used to model baseline energy consumption. This means that if an Estimate of the Mean model was used to model the baseline energy consumption that a Regression Analysis may be used to model the operating energy consumption.

Clause 7A.4 of the ESS Rule requires that the operating energy model estimate consumption of one eligible fuel after an implementation as well as:

- depend on independent variables and site constants established by measurements taken under normal operating conditions (refer to section 4.3)

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- have an effective range
- be confirmed as appropriate by an M&V Professional, with their written reasoning provided (refer to section 3.1).

If there is more than one eligible fuel involved in the implementation then an operating energy model must be produced for each eligible fuel.

Evidence requirements – operating energy model

You must collect and retain evidence of:

- operating energy consumption, independent variable and site constant data used in the model at the modelling frequency
- the calculation tool used for modelling
- non-routine events and adjustments made to the model
- the model expressed in mathematical terms
- sources of error
- for regression analysis – standard error of the model including t-statistic, adjusted coefficient of determination (adjusted R^2) and coefficient of variation of the root mean square error (CV_{RMSE})
- for estimate of the mean – coefficient of variation.

6.6 End of Phase 3

By the end of Phase 3, you should have:

- aggregated measured operating energy consumption, independent variables and site constant data so that it meets the selected modelling frequency of the model (if necessary)
- selected an appropriate model that relates your operating energy consumption to relevant independent variables and site constants
- identified any non-routine events and adjustments to be made to the operating energy model
- determined a mathematical relationship between operating energy consumption and independent variables (if appropriate) that meet the minimum statistical requirements of the ESS Rule
- had the operating energy model confirmed as appropriate by an M&V Professional.

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7 Phase 4 – Calculating energy savings

This chapter sets out information about:

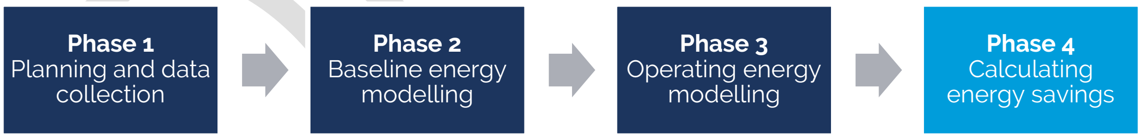
- the 2-stage approach to calculating certificates
- forward creation
- annual creation
- top-up creation
- calculating and creating ESCs
- fuel switching activities.

7.1 Approaches to calculating energy savings

Energy savings are calculated in phase 4 of a PIAM&V project after energy consumption in the baseline and operating measurement periods has been modelled and/or measured. Energy savings for an implementation can be calculated annually or for up to 10 years (forward creation) using one of 3 approaches:

- forward creation for a single site
- forward creation for multi-site model
- annual creation/top-up.

Each uses a 2-stage approach to calculate savings. This chapter sets out the 3 approaches and when to apply the corrections that must be made in each stage.



7.2 Two-stage approach to calculating certificates

The PIAM&V method allows energy savings to be calculated annually or for up to 10 years (forward creation) using a 2-stage approach. Throughout this section of the guide, we use eligible fuel savings to refer to energy savings. This approach has been adopted to be consistent with the ESS Rule which allows multiple fuels to be included in an implementation, for example, fuel switching projects. Where this occurs savings for each fuel type in an implementation must be calculated separately.

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7.2.1 Stage 1

Stage 1 uses Equations 7A.2 (forward creation – single site), 7A.4 (annual creation and top/up) or 7A.5 (forward creation – multi-site) to calculate eligible fuel savings from predicted baseline energy consumption and predicted or measured operating energy consumption. Table 7.1 summarises the type of energy consumption data used for each approach.

Table 7.1 Baseline and operating energy consumption data for each approach

Approach	Equations	Baseline energy consumption	Operating energy consumption
Forward creation	7A.2 – single site 7A.5 – multi-site	Modelled using normal year independent variable data	Modelled using normal year independent variable data
Annual creation/top-up	7A.4	Modelled using independent variable data for the year savings are calculated (measurement year)	Measured energy consumption for the year savings are calculated (measurement year)

The calculated eligible fuel savings also consider measurement boundary and data related corrections including:

- effective range (range of independent variables used to model energy consumption)
- interactive energy effects (effects from the implementation on EUE outside the measurement boundary).

7.2.2 Stage 2

The eligible fuel savings are then fed into the Stage 2 equations to calculate either eligible fuel savings for one year (Equation 7A.3) or eligible fuel savings calculated for each year in the forward creation period and then summed (Equations 7A.1).

Both Equation 7A.1 and 7A.3 calculate eligible fuel savings that account for the uncertainty in the savings calculation and any counted energy savings that have already been realised from the implementation in each year. Equation 7A.1 also uses a decay factor for each year in the forward creation period to account for equipment degradation over the forward creation period.

Table 7.2 summarises the 2 stages for each approach.

Table 7.2 Stages for each approach

Approach	Equation 1	Equation 2
Forward creation – single site	Equation 7A.2 – Normal year eligible fuel savings	Equation 7A.1 – Eligible fuel savings over forward creation period
Forward creation – multi-site	Equation 7A.5 – Normal year eligible fuel savings	Equation 7A.1 – Eligible fuel savings over forward creation period
Annual creation/top-up	Equation 7A.4 – Measured annual eligible fuel savings	Equation 7A.3 – Eligible fuel savings for one year

The following sections explain how to apply the approaches in detail.

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7.3 Stage 1 – calculating annual savings

7.3.1 Calculating energy consumption using models

Calculating energy consumption is the first step of calculating eligible fuel savings. Energy consumption may be calculated using an energy model or may be measured. Energy consumption is predicted by substituting values for independent variables and site constants into an energy model.

Baseline and operating energy models are based on measurements of independent variables and site constants. These measurements are taken over different time periods, that is a baseline measurement period may cover the 12 months of 2019, while the operating measurement period may be the 12 months in 2020. Each year may have different temperature ranges. For example, the temperature may be cooler in 2019 and warmer in 2020 resulting in different temperature conditions for each measurement period.

To calculate eligible fuel savings, it is important to use the same set of values for independent variables and site constants to predict energy consumption from the baseline and operating energy models. This is because eligible fuel savings should be calculated based on baseline and operating energy consumption that has been predicted using the same set of conditions.

The set of independent variables and site constants used to predict energy consumption from the models is different depending on the approach used to calculate eligible fuel savings.

Forward creation uses a 'normal year' of independent variables and site constants to predict energy consumption using the baseline and operating energy models.

Annual creation uses independent variables and site constants from the year in which energy consumption is measured (measurement year). This data is used to predict energy consumption from the baseline energy model only.

The following sections provide more details on developing a normal year of independent variables and site constants.

7.3.2 Normal year

A normal year is defined as a typical year of operation of the EUE at the site after the implementation date. The normal year must be applicable for the full forward creation period. That is, up to 10 years. When defining a normal year you must:

- consider future 'typical' operating conditions of the site. Operating conditions may include typical weather conditions, operating days per year, maintenance periods, changes in site activities (e.g. production levels) etc.
- include values for all independent variables and site constants used to model eligible fuel savings
- use measured data. Typically, data should not be older than 3 years to be indicative of current/predicted performance

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- describe how the normal year is constructed, noting any adjustments, calculations or manipulations
- have the normal year confirmed as appropriate by an M&V Professional with their written reasoning provided.

Where the operating cycle of the system is less than one year, the normal year may be made up by combining values from multiple operating cycles to make up one year.

Evidence requirements – normal year

- Data for the normal year must be provided at the modelling frequency of the model for both independent variables and site constants. Even though the site constant does not change, a value for the site constant must be assigned to each time period within the normal year.
- A description of how the normal year has been developed must be included in the M&V Report and include any adjustments, calculations or manipulations undertaken.

7.3.3 Effective range and effective range adjustment factor (ERAF)

The effective range represents the range of independent variable values over which the model is valid. Effective range is calculated by determining the lower and upper limits of the independent variable data used in both the baseline and operating energy models.

The **lower limit** is calculated by subtracting 5% of the difference between minimum and maximum measured value from the minimum measured value of the independent variable.

The **upper limit** is calculated by adding 5% of the difference between minimum and maximum measured value from the maximum measured value of the independent variable.

Table 7.3 provides an example of the effective range calculation for baseline and operating energy models produced using temperature as an independent variable.

Table 7.3 Effective range calculation

Model	Minimum temp (°C)	Maximum temp (°C)	Effective range (min)	Effective range (max)
Baseline	5	35	3.5	36.5
Operating	4	39	2.25	40.75

The PIAM&V method uses the effective range of the baseline and operating energy models to calculate an ERAF which is applied to the calculation of eligible fuel savings. The ERAF adjusts the eligible fuel savings during time periods that the independent variable values fall outside the energy model's effective range.

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Effective range adjustment factor (ERAF)

The ERAF is calculated for each independent variable in the normal year or the measurement year that falls outside the effective range of the model for forward creation or annual certificate creation respectively). It is a value between 0 and 1 and is used to reduce the eligible fuel savings for each time period in which an independent variable is outside the effective range.

The ERAF is based on the calculation of the percentage outside effective range (**POER**) according to the following equation.

$$ERAF = 1 - |3.0 * POER|$$

If the result of this ERAF calculation is negative, then ERAF is set to 0.

The POER is the difference between the independent variable and the limit (minimum or maximum) of the effective range, divided by the range of the effective range.

$$POER = (Min - a) \ / \ R \quad \text{or} \quad POER = (b - Max) \ / \ \mathrm{R}$$

$$\text{Where R} = \text{Max} - \text{Min}$$

This means POER will be higher when a value is further away from the effective range, and closer to zero when a value is closer to the effective range.

You need to calculate POER for each independent variable outside the effective range in your baseline and operating energy models and use the highest POER across all independent variables and models to calculate the ERAF. Note, if you ha

Table 7.4 presents an example where POER is calculated for an energy model that uses temperature as an independent variable. Table 7.5 then shows an example where ERAF is calculated using the higher POER value and its effect to discount normal year eligible fuel savings from 360 megawatt hours (**MWh**) to 305 MWh.

Table 7.4 Calculating the percentage outside effective range (POER)

Model	Effective range minimum (°C)	Effective range maximum (°C)	Temp outside effective range (°C)	POER formula	POER
Baseline	3	42	43	POER = (43 – 42) / (42 – 3)	2.56%
Operating	2	41	43	POER = (43 – 41) / (41 – 2)	5.13%

Table 7.5 Calculating the effective range adjustment factor (ERAF)

Selected POER	ERAF formula	ERAF	Eligible fuel savings before ERAF	Eligible fuel savings after ERAF
5.13%	1 – (3.0 x POER)	0.85	360 MWh	305 MWh

If an independent variable for a time period is even further outside the effective range, the ERAF would be smaller and so would the eligible fuel savings contribution for that time period.

Evidence requirements – effective range and ERAF

When documenting effective range and ERAF, you must:

- clearly define the effective range of the baseline and operating energy models for each independent variable in your M&V report
- an M&V Professional must deem the effective range appropriate for the baseline and operating energy models, with their explanatory reasoning provided in writing in their M&V Professional report
- include calculations of POER and ERAF for all independent variables outside the effective range for that variable for both the baseline and operating energy models in your calculation tool or spreadsheet
- include calculation of ERAF for the highest POER calculated for the time period. (Note: the highest POER should be determined by reviewing POERs for the time period for all independent variables used in the baseline and operating models).

Estimate of the mean models do not have an effective range

It is important to note energy models developed using the estimate of the mean method do not have an effective range applied, as they do not have any independent variables. This means that effective range does not apply to models that use estimate of the mean.

7.3.4 Interactive energy effects

Interactive energy effects occur where consumption of an eligible fuel outside the measurement boundary is affected by the implementation. For example, a lighting upgrade that emits less heat may decrease energy consumption of the cooling system. If the cooling system is outside the measurement boundary this effect would not be measured (Figure 7.1).

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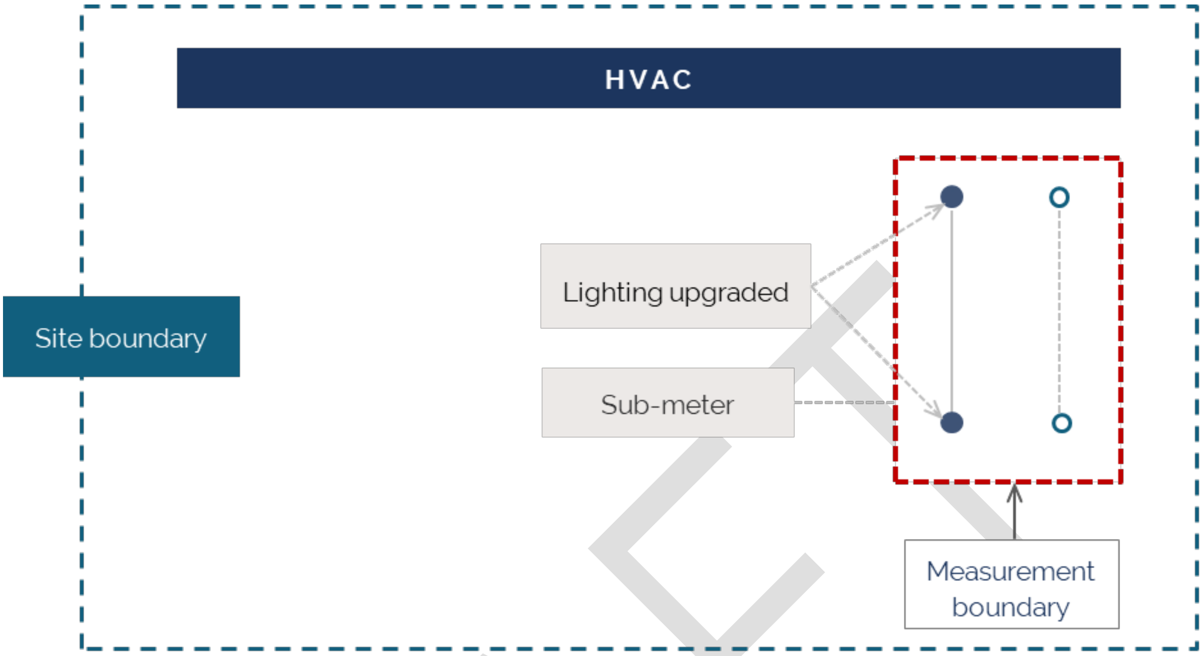
Figure 7.1 Example of equipment outside the measurement boundary resulting in interactive energy effects



Eligible fuel savings must include any positive or negative interactive energy effects, As the interactive energy effects are not measured, they must be estimated.

You must estimate the sum of the change in consumption of each affected eligible fuel (interactive energy effect) and ensure the sum of the absolute value of the interactive energy effects is not more than 10% of total eligible fuel savings for the relevant eligible fuel.

This approach ensures that the magnitude of both positive and negative interactive energy effects is considered when determining if the measurement boundary used is appropriate. If absolute interactive energy effects are greater than 10% of eligible fuel savings, you should consider adjusting the measurement boundary to account for them.

Evidence requirements – interactive energy effects

- When documenting interactive energy effects, you must:
  - identify all EUE outside of the measurement boundary that will have its energy consumption affected by the implementation
  - include a written explanation as to why the measurement boundary has not been changed to include this EUE in your M&V report
  - set out in your M&V report how you have estimated the change in energy consumption to account for the effect.
- An M&V Professional must deem the interactive energy effects appropriate for the implementation, with their explanatory reasoning provided in writing.

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7.3.5 Completing Stage 1

To complete stage 1 of eligible fuel savings calculation, you should have:

- predicted baseline energy consumption using independent variables and site constants from a normal year or the measurement year for each time period using the baseline energy model (all approaches)
- predicted operating energy consumption for each time period using normal year independent variables and site constants (forward creation) **or** measured operating energy consumption for each time period (annual creation)
- defined the effective range of your models and calculated ERAF for all independent variables outside the effective range
- identified and quantified any interactive energy effects.

7.3.6 Calculating normal year eligible fuel savings (forward creation – single site)

Predicted baseline and operating energy consumption for each time period in a year is calculated by applying normal year independent variable and site constant values to the baseline and operating energy models. Eligible fuel savings are calculated by taking the difference between predicted operating and baseline energy consumption for each time period and multiplying the difference by the ERAF where the independent variable falls outside the effective range of the models (Equation 7A.2).

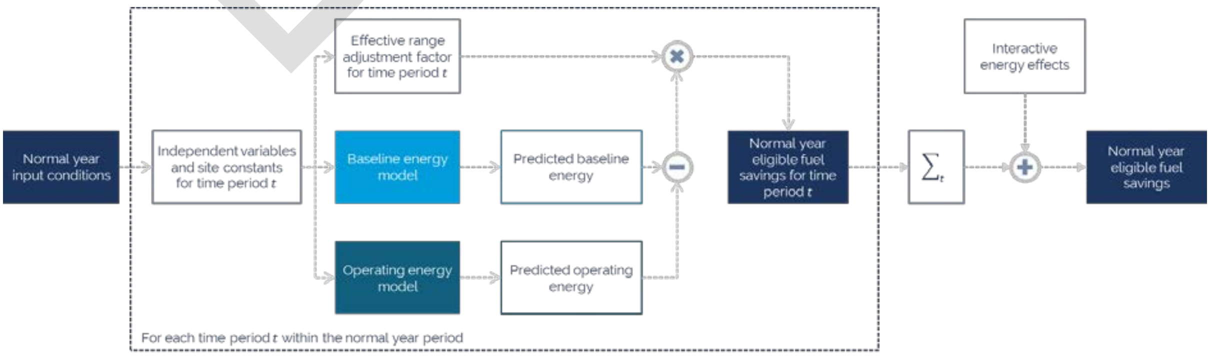
Normal year eligible fuel savings are calculated by summing the eligible fuel savings for each time period in a year and adding interactive energy effects (if relevant). Interactive energy effects may be positive or negative.

$$Normal\ Year\ Eligible\ Fuel_f Savings\ =$$

$$\sum_t \left(\left(E_{Baseline,f}\left(\tilde{x}_1(t), \tilde{x}_2(t), \ldots \tilde{x}_p(t)\right) - E_{Operating,f}\left(\tilde{x}_1(t), \tilde{x}_2(t), \ldots \tilde{x}_q(t)\right)\right). ERAF_{ft} \right)$$
$$+ Interactive\ Energy\ Effects_f$$

This calculation is illustrated in Figure 7.2.

Figure 7.2 Defining normal year eligible fuel savings



7.3.7 Calculating normal year eligible fuel savings (forward creation – multi-site)

Normal year eligible fuel savings for multiple sites (sampling method) is calculated using a similar approach to that used for single sites. Predicted baseline and operating energy consumption for each time period in a year is calculated by applying normal year independent variable and site constant values to the baseline and operating energy models. Eligible fuel savings are calculated by taking the difference between predicted operating and baseline energy consumption for each time period (Equation 7A.5).

Normal year fuels savings are calculated by summing the eligible fuel savings for each time period in a year and adding interactive energy effects (if relevant). Interactive energy effects may be positive or negative.

$$Normal\ Year\ Eligible\ Fuel_f Savings\ =$$

$$\sum_t \left(E_{Baseline,f}\left(\tilde{x}_1(t), \tilde{x}_2(t), \ldots \tilde{x}_p(t), y_1, y_2, \ldots\ y_r\right) - E_{Operating,f}\left(\tilde{x}_1(t), \tilde{x}_2(t), \ldots \tilde{x}_q(t), y_1, y_2, \ldots\ y_r\right)\right)$$
$$+ Interactive\ Energy\ Effects_f$$

7.3.8 Calculating measured annual eligible fuel savings

Predicted baseline energy consumption for each time period in a year is calculated by applying independent variable and site constant values from the measurement year to the baseline energy model. The measurement year is the year for which the eligible fuel savings are to be calculated.

The end date of the **baseline measurement period** must be before the implementation date and cannot be more than 10 years earlier than the end date of the measurement period used to claim eligible fuel savings. This requirement is illustrated in the example in Box 7.1.

The **operating measurement period** must be a full year commencing on or after the implementation date and have an end date that is the day before the anniversary of the start date such that the measurement period is a full year.

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Box 7.1 Eligible baseline measurement period for annual creation example

An ACP wants to create certificates from an implementation that occurred on 1 January 2013 for the operating measurement period between 1 January 2022 and 31 December 2022.

Baseline data is available for the period 1 January 2010–31 December 2012, but only data from 1 January 2012–31 December 2012 is eligible to use as baseline data because it is not more than 10 years before the end date of the measurement period used to claim eligible fuel savings.

Eligible fuel savings for each time period are calculated by taking the difference between measured operating energy consumption and predicted baseline energy consumption and multiplying the difference by the ERAF where the independent variable falls outside the effective range of the baseline model (Equation 7A.4).

Measured annual eligible fuel savings are calculated by summing the eligible fuel savings for each time period in a year and adding interactive energy effects (if relevant). Interactive energy effects may be positive or negative.

$$Measured\ Annual\ Eligible\ Fuel_f\ Savings\ =$$

$$\sum_t \left(\left(E_{Baseline,f}\left(\, x_1(t), x_2(t), \ldots\, x_p\,(t)\right) - E_{Measured,f}(t\,)\right).ERAF_{ft}\right) +\ Interactive\ Energy\ Effects_f$$

7.4 Stage 2 – calculating eligible fuel savings

Eligible fuel savings are calculated from the outputs of Stage 1 either annually or for up to 10 years using forward creation. The following sections describe how to determine the accuracy factor and counted energy savings that should be applied when calculating eligible fuel savings. It also sets out when to use a decay factor and how to determine it.

7.4.1 Accuracy Factor

An accuracy factor must be applied to eligible fuel savings to account for the uncertainty in the calculation of eligible fuel savings. Relative precision is used as a proxy measure for this uncertainty, and it accounts for all sources of error in the eligible fuel savings calculation. The accuracy factor has a value between 1 and 0 and is determined by using the value corresponding to the energy model type and relative precision of the eligible fuel savings estimated at 90% confidence level as listed in Table A23 of Schedule A to the ESS Rule. No other process for determining the accuracy factor has been published, but the Scheme Administrator may publish one from time to time.

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When calculating the relative precision of the model An ACP must consider all material sources of error associated with the development of the model. This should include, but not be limited to, the following sources of error:

a. data uncertainty, being the uncertainty generated from insufficient data either in terms of quantity or time period
b. measurement uncertainty
c. modelling uncertainty, including uncertainty generated using estimates and assumptions.

Potential sources of error you should consider include:

- estimating energy consumption of EUE using a whole of site approach rather than direct measurement of the energy consumption of the EUE
- using out-of-range data that may represent a non-routine event
- omitting relevant independent variables or including independent variables that do not affect the energy consumption of the EUE
- incorrect mathematical functional form of the energy model
- insufficient data quantity or duration.

Evidence requirements – accuracy factor

You must collect and retain evidence of:

- material errors considered
- relative precision of the models
- accuracy factor used in the calculation
- an M&V Professional has deemed the accuracy factor to be appropriate and provided their written explanatory reasoning in the M&V Professional report.

7.4.2 Counted energy savings

Counted energy savings are the total eligible fuel savings for which ESCs have previously been created for the implementation. Eligible fuel savings must account for any counted energy savings. Counted energy savings can only be used to account for ESCs created for the same implementation, not for ESCs created under another recognised energy saving activity.

Evidence requirements – counted energy savings

You must collect and retain evidence of the creation of certificates from the implementation including forward creation period and number of certificates.

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7.4.3 Decay factor and persistence model (forward creation only)

The decay factor accounts for the reduction in eligible savings over the life of the EUE due to equipment degradation. It is only used when future energy savings are estimated (forward creation) and may be based on factors in Table A16 of Schedule A to the ESS Rule or from factors from a persistence model.

If using a persistence model, it must:

- be accepted for use by the Scheme Administrator
- estimate the expected lifetime of the EUE in whole years
- estimate the decay factor for each future year for the life of the EUE within the maximum time period for forward creation
- be publicly accessible
- satisfy any requirements published by the Scheme Administrator (note the Scheme Administrator has not published any requirements at this time)
- be confirmed as appropriate by an M&V Professional.

The model must consider:

- the business classification from Table A18 of Schedule A to the ESS Rule for the site, if known
- the EUE type
- the operating hours for the EUE
- typical ambient conditions for the site including, where relevant, temperature, humidity and salinity.

Where multiple types of EUE are included in an implementation, the most conservative decay factors should be used to calculate energy savings.

The persistence model used should be documented in the M&V Report and confirmed as appropriate by an M&V Professional.

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Evidence requirements – persistence model

You must collect and retain evidence of:

- acceptance of the persistence model by the Scheme Administrator
- EUE type
- operating hours of the EUE
- typical ambient conditions of the site e.g. humidity, temperature, salinity
- an M&V Professional has deemed the persistence model used to be appropriate and provided their written explanatory reasoning in the M&V Professional report.

7.4.4 Lifetime

The ESS Rule allows ESCs to be created for the useful lifetime of the energy savings up to a maximum of 10 years. The lifetime in whole years of the EUE can be based on the specifications of the EUE and the persistence model used.

Evidence requirements – lifetime

You must collect and retain evidence of:

- specifications of the EUE setting out useful lifetime in whole years or
- lifetime as set by the persistence model.

7.4.5 Completing Stage 2

To complete stage 2 you should have:

- calculated your annual normal year eligible fuel savings (forward creation) **or** calculated your measured annual eligible fuel savings (annual creation)
- determined your accuracy factor
- identified counted energy savings from your implementation (if any)
- determined the appropriate decay factor (forward creation only).

7.5 Forward creation

To calculate the Eligible Fuel Saving using forward creation you multiply your normal year eligible fuel savings for each year in the forward creation period by the accuracy factor and decay factor for the relevant year and then subtract any counted energy savings for that year. The savings for each year are then summed to determine the eligible fuel savings (Equation 7A.1) (Figure 7.3).

$$Eligible\ Fuel_f\ Savings =$$

$$\sum_i \left(Normal\ Year\ Eligible\ Fuel_f\ Savings \times Accuracy\ Factor_f \times Decay\ Factor_{fi} - Counted\ Energy\ Savings_{fi} \right)$$

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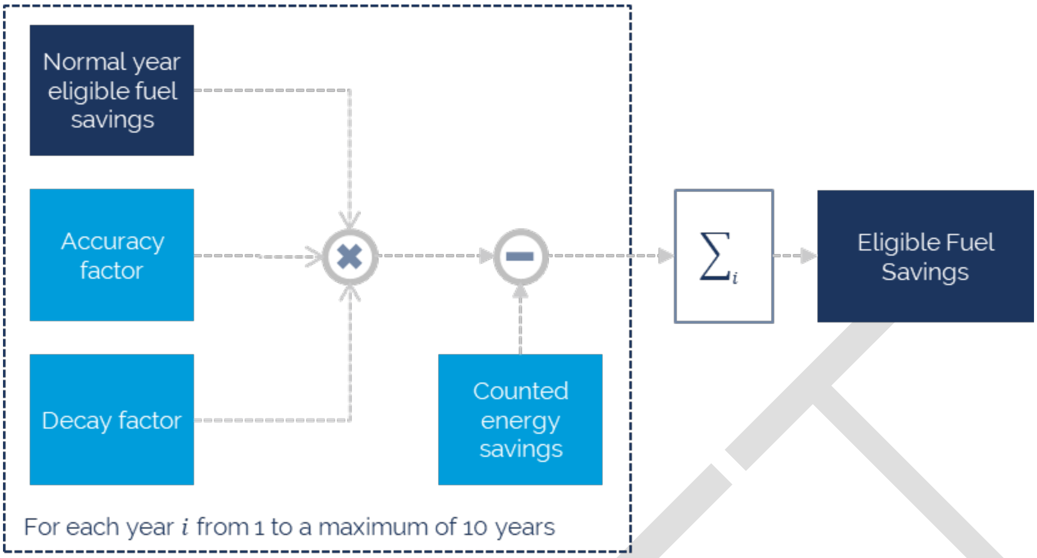
Figure 7.3 Determining eligible fuel savings using forward creation



Note, the forward creation period covers the life of the energy savings up to a maximum of 10 years.

Maximum forward creation and acceptable approaches to creating additional savings

A maximum of 50,000 ESCs may be forward created but you can create more ESCs from the implementation if you can demonstrate additional energy savings have occurred. The Scheme Administrator has published an acceptable approach to top-up certificate creation. This approach is set out below. If you are considering adopting an alternative approach, we strongly recommend you discuss this approach with us before creating any new ESCs using that approach.

Additional energy savings (top-up certificate creation) are calculated using the annual creation process described below.

The Scheme Administrator's acceptable approach to top-up energy savings requires that an ACP wait until after the total measured annual energy savings for the implementation are greater than the total energy savings for which ESCs have previously been forward created.

Where an implementation is forecast to generate more than 50,000 ESCs, those 50,000 ESCs should be apportioned to the first few years of the forward creation period. For example, an implementation is forecast to produce 9,000 ESCs per year over a period of 10 years. Additional ESCs should not be created for the implementation until the measured energy savings demonstrates that more than 50,000 ESCs of savings have been realised by the implementation. This is likely to occur in year 6 of the life of the implementation.

Once 50,000 ESCs of energy savings have been realised, provided additional energy savings can be demonstrated through measurements, an ACP may use the annual creation process to:

- top-up certificate creation annually or

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- top up one or more years of certificate creation. If using this approach, the additional energy savings for each year must be calculated separately. The top-up certificate creation process is illustrated in Figure 7.4.

Note, top-up can only occur for savings realised within the forward creation period.

7.6 Annual creation

To calculate eligible fuel savings annually you multiply the measured annual eligible fuel savings by the accuracy factor and account for any counted energy savings generated by the implementation in that year.

$$Eligible\ Fuel_f\ Savings =$$

$$Measured\ Annual\ Eligible\ Fuel_f\ Savings\ \times\ Accuracy\ Factor_f\ - Counted\ Energy\ Savings_{fi}$$

7.7 Top-up creation

Top-up creation is a form of annual creation. It allows an ACP to create certificates from additional energy savings that have been verified through energy consumption measurements. In line with the Scheme Administrator's acceptable approach to top up, it occurs once all energy savings from the forward creation period have been realised. This may occur before the end of the forward creation period.

To calculate additional energy savings, you must first check that there has not been any changes to the EUE within the defined boundary following the implementation. If changes have occurred, a non-routine adjustment may be required to the baseline energy model to account for the change.

7.7.1 Measurement periods

You must also determine the baseline and operating measurement periods. As with annual creation, the end date of the baseline measurement period must be before the implementation date and cannot be more than 10 years earlier than the end date of the operating measurement period used to claim additional energy savings. See example in Box 7.1 above.

The operating measurement period must be one or more full years commencing on either the implementation date or the anniversary of the implementation date. The number of years in the operating measurement period cannot exceed the maximum time period for forward creation, which is defined by:

- the lifetime of the energy savings as determined by the persistence model, where it is used. For example, the persistence model for a type of EUE limits its life to 7 years, this would be the maximum number of full years for which top-up savings could be calculated.
- whether certificates have previously been created for the implementation using the Project Impact Assessment method, in which case the period cannot exceed 5 years

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- the start date of the period is the implementation date, and the end date of the period is not later than 10 years after the implementation date.

7.7.2 Calculating baseline energy consumption

To calculate energy consumption using the baseline energy model you must use independent variables and site constants from the measurement year. You must use the same baseline energy model that was used for forward creation. You may also need to make a non-routine adjustment if changes have occurred at the site.

7.7.3 Calculating measured annual eligible fuel savings for top-up

Energy savings for each time period are calculated by taking the difference between measured operating energy consumption and predicted baseline energy consumption and multiplying the difference by the ERAF where the independent variable falls outside the effective range of the baseline model (Equation 7A.4).

Measured annual eligible fuel savings are calculated by summing the energy savings for each time period in a year and adding interactive energy effects (if relevant). Interactive energy effects may be positive or negative.

7.7.4 Eligible fuel savings

Finally, the eligible fuel savings are calculated by multiplying the measured annual eligible fuel savings by the accuracy factor and subtracting any counted energy savings. The energy savings are taken to occur on the end date of the relevant measurement period for the purposes of section 34 of Schedule 4A to the *Electricity Supply Act 1995* (NSW).

This process may be completed for one or more measurement periods where additional eligible fuel savings from the implementation have been verified in the forward creation period.

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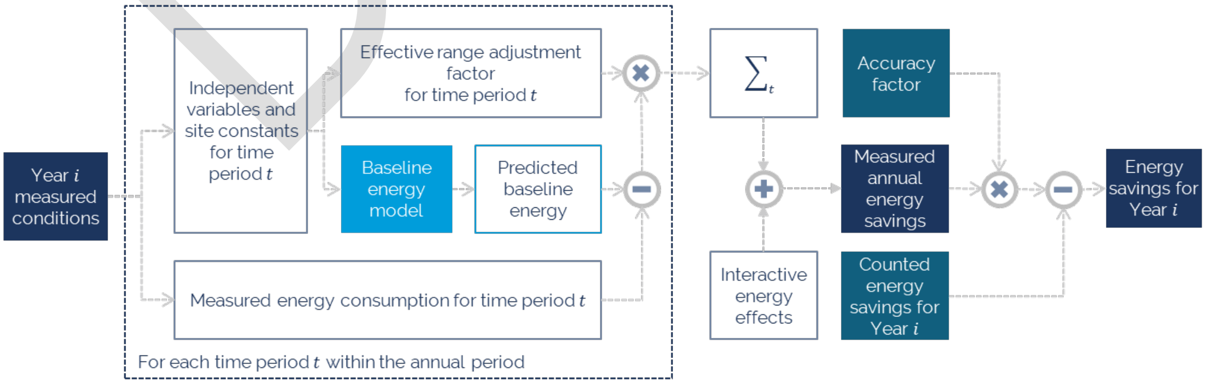
Figure 7.4 Top-up certificate creation process



7.8 Calculating and creating ESCs

Once eligible fuel savings have been calculated for an implementation using the PIAM&V method, Equation 1 of the ESS Rule is used to calculate the number of ESCs that may be created from an implementation or implementations.[16]

$$Number\ of\ Certificates = \sum_{implementations} \begin{bmatrix} Electricity\ Savings \times Regional\ Network\ Factor \times Electricity\ Certificate\ Conversion\ Factor \\ + Gas\ Savings \times Gas\ Certificate\ Conversion\ Factor \\ + Diesel\ Savings \times Diesel\ Certificate\ Conversion\ Factor \\ + Biofuel\ Savings \times Biofuel\ Certificate\ Conversion\ Factor \\ + Biogas\ Savings \times Biogas\ Certificate\ Conversion\ Factor \\ + Biomass\ Savings \times Biomass\ Certificate\ Conversion\ Factor \\ + Onsite\ Renewables\ Savings \times Onsite\ Renewable\ Energy\ Certificate\ Conversion\ Factor \end{bmatrix}$$

7.9 Fuel switching activities

PIAM&V can be used to calculate energy savings from fuel switching activities. These are activities where energy is saved by switching from one type of fuel to another.

Eligible fuels in the ESS include:

- electricity
- biofuel
- biogas
- biomass
- diesel
- liquefied petroleum gas
- natural gas
- onsite renewable energy.[17]

Separate energy measurements, models and calculation of energy savings must be developed for each eligible fuel type. Energy savings from all relevant fuels are added together in Equation 1. Note, the fuel being switched from will have positive energy savings and the fuel being switched to will have negative energy savings. Only projects that result in positive energy savings when calculated using Equation 1 will be able to create certificates.

In addition to the eligibility requirements for recognised energy savings projects, only fuel switching projects that do not result in increased greenhouse gas emissions based on factors provided in Table A28 of Schedule A to the ESS Rule (Figure 7.5) are eligible to create certificates.

Box 7.2 sets out an example of calculating energy savings from a fuel switching activity.

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Box 7.2 Fuel switching example

A boiler is switched from using natural gas to biogas. To assess the energy savings, 2 sets of baseline and operating energy models need to be created: one set for natural gas and a second set for biogas.

A baseline energy model of the natural gas consumption is developed and compared to the operating energy consumption for natural gas after implementation. As there is no natural gas used after the implementation, operating natural gas consumption is zero and the natural gas savings are the equivalent of the normal year baseline gas consumption corrected for effective range and interactive energy effects.

An operating energy model of the biogas consumption is then developed and compared to the baseline energy consumption of zero as biogas was not previously consumed. The biogas energy savings is equivalent to the normal year operating energy consumption corrected for effective range and interactive energy effects.

Assuming forward creation is used, the eligible fuel savings for natural gas and biogas are calculated separately by taking into account the lifetime savings, accuracy factor, decay factor and any counted energy savings.

Energy savings from the project are calculated using Equation 1 where natural gas savings would be positive and biogas savings would be negative

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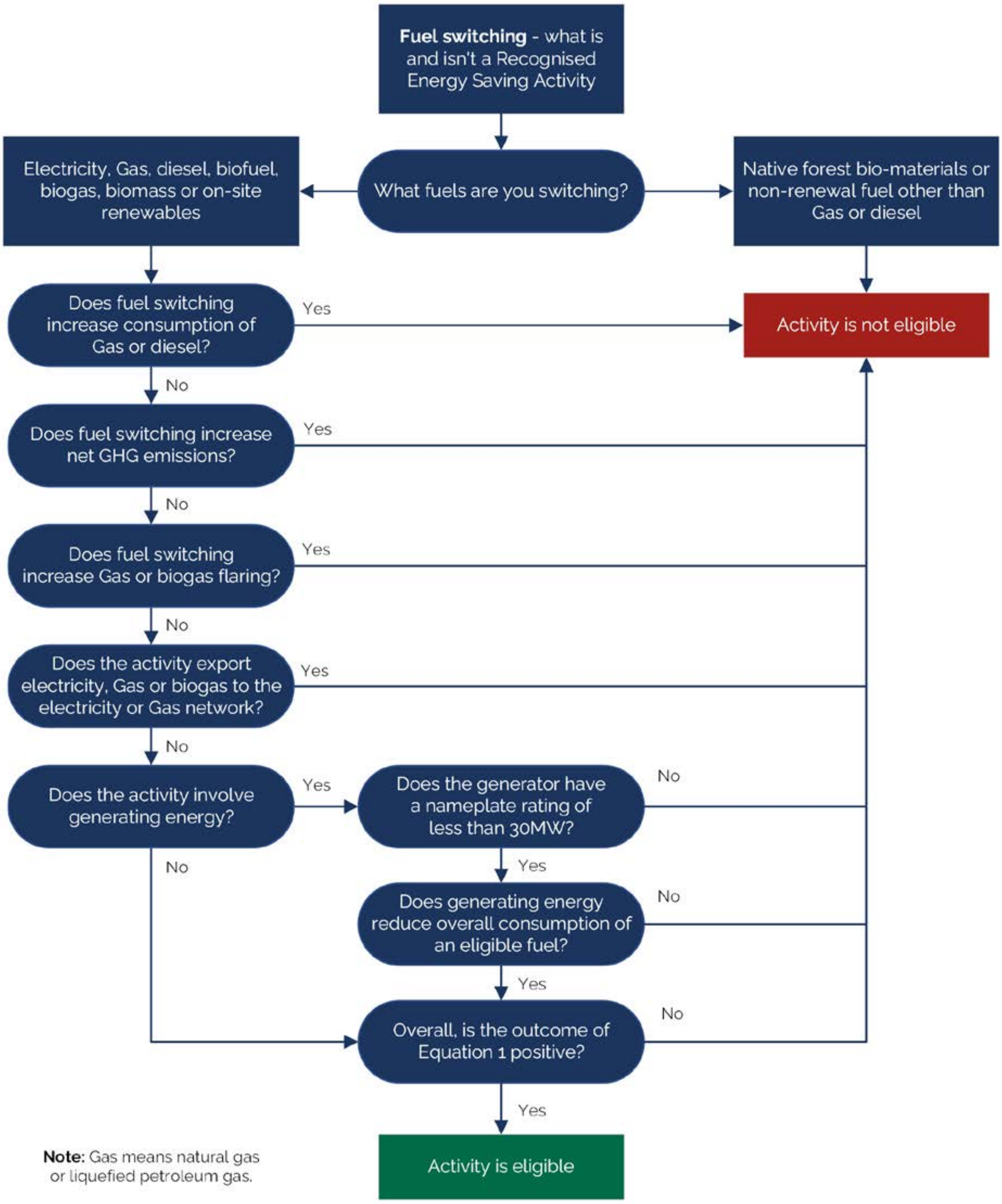
Figure 7.5 Flowchart of eligible fuel switching activities



7.9.1 Applying to register ESCs

You must submit certain information to the Scheme Administrator when applying to register ESCs for one or more implementations.[18] This implementation data is uploaded in a csv format file through our online system, TESSA.

Implementation data

The implementation data upload must include the energy savings by energy type and if fuel switching has occurred the percentage of savings attributable to fuel switching and the fuels involved. For example, 15% electricity to gas.

The information in the implementation data upload is used by TESSA to calculate the number of certificates in accordance with Equation 1 of the ESS Rule. This calculation involves:

- calculating the number of ESCs that can be created for each eligible fuel from the implementation(s) by multiplying the eligible fuel savings for each fuel by the certificate conversion factor for each fuel[d]
- adding together the number of ESCs that can be created for each eligible fuel from the implementation(s) (rounded down to the nearest whole number).

More information about the implementation data that must be provided for the PIAM&V method is set out on our website and in the *CSV Specification Guide*.

7.10 End of Phase 4

By the end of phase 4 you should have:

- developed a normal year
- calculated energy consumption using normal year data or measured year data in the baseline and operating energy models
- identified the effective range of the models and used the effective range adjustment factor appropriately
- identified and quantified interactive energy effects
- calculated normal year eligible fuel savings (forward creation – single and multi-site)
- calculated measured annual eligible fuel savings (annual creation)
- applied accuracy factor, decay factors and counted energy savings to the calculation of eligible fuel savings (forward creation and annual creation)
- understood how to do top-up certificate creation.

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[d] Certificate conversion factors are specified in clauses 33(1) and 33A of Schedule 4A of the Act and clause 37A of the *Electricity Supply (General) Regulation 2014*, and reproduced in Table 1 of the ESS Rule.

8 Using the sampling method for forward creation – multi-sites

This chapter sets out information about:

- the sampling method used to estimate energy savings at multiple sites with similar attributes
- developing a sampling plan
- eligibility requirements
- implementations and the implementation date
- adding sites to the population.

8.1 Overview of the sampling method

The sampling method reduces measurement costs while maintaining the accuracy of energy savings estimates. It can be used to estimate energy savings for multiple sites that have the same or similar attributes. It works by establishing baseline and operating energy consumption models for a sample of eligible representative sites. The energy models from these sites can be applied to all sites in the population to calculate energy savings.

ESS Rule requirements you must meet when using the sampling method include:

- developing a sampling plan
  - defining and documenting population eligibility requirements
  - describing the expected distribution of site constants
  - minimising bias when selecting sample sites
  - applying a representativeness test to the distribution of site constants
  - meeting a minimum sample size
  - determining the normal year
  - determining interactive energy savings, persistence models and any other relevant M&V parameters for each site
- evidencing the implementation date for implementations
- adding sites to the population.

The sections below offer guidance on how to apply the ESS Rule and associated requirements in each of these areas.

8.2 Sampling plan

If using the sampling method you must develop a sampling plan. The plan should describe the planned sampling approach including:

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- population eligibility requirements
- the process to ensure only sites that meet the population requirements are included in the population
- the expected distribution of site constants
- the representativeness test
- conditions under which additional sites are included in the sample
- how the minimum number of sample sites meets the requirement that it be at least 6 times the number of site constants
- how bias is minimised in sample selection
- the procedure to determine the normal year
- the process to determine interactive energy savings, persistence model and any other relevant M&V parameters for each site in the population.

The sampling plan must be confirmed as appropriate by an M&V Professional, who must provide their explanatory reasoning.

8.2.1 Population eligibility requirements

The population is a set of sites that have similar characteristics, where similar implementations are taking place. There is no limit on the maximum number of sites included in the population, provided they meet the population eligibility requirements.[19]

The population eligibility requirements must be defined and documented in the sampling plan. These requirements ensure only sites with similar characteristics are included in the population. The sampling plan should be developed for the whole population rather than for each individual site.

The sampling plan must clearly explain the process for determining whether each site in the population meets the population eligibility requirements, which must be defined based on:[20]

- the existing EUE at the site
- end-use services being provided by the EUE
- the recognised energy saving activity to be undertaken
- site constants
- any additional requirements published by the Scheme Administrator.

8.2.2 Distribution of site constants

The expected distribution of site constants across the population must be described in the sampling plan. For example, if the site constant is Building Code of Australia (**BCA**) Climate Zone, and the values of BCA Climate Zone are 2, 4 or 5 (as defined in the population eligibility requirements), you must estimate the distribution of these values among the population. The estimation can be in the form of either percentage or number of sites.

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8.2.3 Sample sites, representativeness test and bias

Sample sites are sites where energy measurements are taken to develop an energy model to represent energy consumption for the population. The process of selecting samples sites should minimise bias.[21]

A representativeness test must be defined and used to ensure the distribution of the site constant among the sample sites is representative of the distribution of the site constant across the whole population. For example, if it is estimated that 50% of the population is located in BCA Climate Zone 3, then approximately 50% of the sample sites should be located in this zone.

Where possible, the same sample sites should be selected to conduct baseline and operating measurements. If this approach is not feasible, you must document the reasons for selecting different sites for baseline and operating samples.

8.2.4 Minimum number of sample sites

The minimum number of sample sites per population must be at least 6 times the number of site constants.[22] The site constant(s) is a parameter that affects energy consumption and varies between sites but does not vary over time under normal operating conditions.

Additional statistical requirements (such as confidence levels, precision and coefficient of variation) should be applied to determine the minimum number of sample sites for large, unknown populations.

8.2.5 Determining the normal year

A procedure to determine the normal year must be developed and described in the sampling plan. The procedure must be applied to each site of the population, as the normal year values may differ from site to site.

For example, if the independent variable used in the energy models is Cooling Degree Days (**CDDs**) for sample sites in the population located in a particular area, the procedure to calculate normal year CDD values for each site may consider use of typical meteorological year data from the closest weather station to that area.

8.2.6 Interactive energy savings and persistence models

Similar to the normal year procedure, the sampling plan should describe the process to determine interactive energy savings, persistence models and any other relevant M&V parameters for each site of the population when calculating the energy savings for that site.

8.3 Implementation and implementation date

Certificates must be calculated for each individual implementation. Under the sampling method, each site is an implementation, and the population consists of multiple implementations.

The implementation date for each implementation must be evidenced, including implementations on sample sites and non-sample sites. Each implementation can have a different implementation date. Each sample site can also have a different start and end date for measurement periods.

Energy savings cannot be calculated until the operating energy model is established, which is determined by the latest end date of all the measurement periods for the sample sites. The example provided in Table 8.1 shows how the earliest ESC creation date, for sites in the sample and other sites in the population, is influenced by the operating energy model measurement period.

Table 8.1 Implementation date and ESC creation under sampling

Implementation number	Type of site	Implementation date	Operating model measurement period end date	Earliest ESC creation date
1	Sample	1 January 2017	1 June 2017	11 July 2017
2	Population	1 December 2016	N/A	11 July 2017
3	Sample	1 February 2017	1 July 2017	11 July 2017
4	Sample	11 February 2017	11 July 2017 (latest)	11 July 2017
5	Population	1 August 2017	N/A	1 August 2017
6	Population	1 May 2017	N/A	11 July 2017

Note: this list is not the complete list of implementations for this population. Implementation 4 has the latest measurement end date among all sample sites.

N/A not applicable

8.4 Adding new sites to the population

Additional sites can be added to the population after the sampling plan has been implemented and the energy model developed, as long as they meet the population eligibility requirements. You must keep records of the procedures you undertake to ensure all additional sites meet the population eligibility requirements.

As sites are added to the population, the representativeness test must be applied to check if existing sample sites are still representative of the population. Where the existing sample sites fail the representativeness test, new sample sites must be selected and measured data from the new sample sites used to update the energy models.

For example, the sites in the original sample (based on the estimated distribution of the site constant in the population) may have the distribution in Table 8.2.

Table 8.2 Example of a sample distribution

Climate Zone	Percentage of total sample sites
3	50%
5	50%

If it was later determined that 90% of the sites in the actual population were from Climate Zone 5, then additional sample sites would need to be selected from Climate Zone 5 to ensure sample sites are representative of the population.

You must use the updated energy models to calculate energy savings for all new sites added to the population. For sites in the original population, the original energy models may be used until the updated energy models are developed. Only one set of energy models can be valid for a population at any time.

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Appendices

Appendix A End-user equipment categories

Table B.1 Examples of equipment under each end-user equipment category

EUE category	Examples
Building envelope	• Building design • Insulation • Window glazing • Reflective painting • Lifts • BMS (e.g. security, access control, fire systems)
Commercial heating/cooling	• Heating ventilation and air conditioning (HVAC) systems (e.g. boilers, air handling units, chillers, humidifiers). Includes Computer Room Air Conditioning (CRAC) • Commercial freezers • Cold rooms • Hot water systems • Commercial ovens • Commercial heaters
Fluid transport and materials handling	• Pumping systems • Fans (e.g. ventilation systems) • Compressed air systems • Blowers (e.g. aeration systems) • Mixers • Conveyors • Packaging systems • Storage • Electrical drives / motors
Industrial heating/cooling	• Refrigeration plants (compressors, condensers, evaporators, expansion valves) • Steam systems • Industrial hot water systems • Boilers • Industrial freezers • Heat exchangers / heat recovery • Industrial ovens / kilns • Furnaces / smelters
Information and communication technology	• Telecommunications equipment and applications • Data centres • Computer Room Air Conditioning (CRAC) • Broadcast transmitters, receivers • PABX and phone system equipment • Multiplexers
Lighting	• Commercial and industrial lighting • Lighting control systems (e.g. BMS)
Power generation systems	• Gensets • Cogeneration • Trigeneration • Turbines
Power supply / distribution systems	• Voltage optimisation • Power factor correction • Uninterruptible power supply (UPS) • BMS (electric power control)
Industrial processes (other)	• Separation processes (e.g. filtering, screening, refining) • Chemical processes (e.g. reactors) • Mining and mineral processing (e.g. crushing, grinding, refining) • Food processing (not covered under industrial heating and cooling)

Appendix B Guidance for establishing energy models

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). • The measurement period must define a full operating cycle of the EUE. • Measure energy consumption and all independent variables and site constants for the set measurement period.
2	Account for non-routine events	• Non-routine adjustments must be made to energy models using the PIAM&V Method Application Requirements for Non-Routine Events and Adjustments to account for non-routine events affecting energy consumption within the measurement boundary during any measurement period or the implementation period that are not modelled by any independent variables or site constants. • Record and maintain evidence of all non-routine adjustments.
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, e.g. by calculating the Pearson's correlation coefficient. • Review any variables that are strongly correlated and consider refining your regression model.
4	Determine effective range	• The effective range is the range of values over which the energy models are valid. • Each Independent Variable in an energy model must have an accompanying effective range. • The effect range needs to be consistent with the range of measured values for Independent Variables.
5	Using regression analysis to estimate energy model	• Regression analysis may include linear and non-linear multivariate regression techniques. • ACPs can use their own calculation spreadsheets to calculate the energy savings. • When submitting the energy model and evidence to support the calculation of ESCs, ACPs 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 – the coefficient of variation of the root mean square error (CV_{RMSE})), and – the standard error (SE) of the regression equation.

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Table B.2 Guidelines for using 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 the Scheme Administrator to assess requirement
Commercially available and models relevant type of EUE	Name and version of the software Description of the model, including process or equipment diagram, key inputs/outputs and other simulation parameters	List of programmes on US Department of Energy at: https://www.energy.gov/eere/buildings/listings/software-tools Validated using IEA-BESTest protocol.
Calibrated against measurements taken from the actual EUE being simulated	Calibration data Inputs, outputs, parameters and assumptions 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.

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Appendix C Acronyms and key concepts

C.1 Acronyms

Acronym / Abbreviation	Full name
Act	*Electricity Supply Act 1995*
ACP	Accredited Certificate Provider
BCA	Building Code of Australia
CDD	Cooling Degree Days
ERAF	Effective Range Adjustment Factor
ESC	Energy Savings Certificate
ESS	Energy Savings Scheme
ESS Rule	*Energy Savings Scheme Rule of 2009*
EUE	End-User Equipment
General Requirements	General Requirements Guide published by the Scheme Administrator
IPART	Independent Pricing and Regulatory Tribunal
IPMVP	International Performance Measurement and Verification Protocol, Core Concepts, March 2022, published by the Efficiency Valuation Organization
M&V	Measurement and verification
M&V Plan	Measurement and Verification Plan
M&V Professional	Measurement and Verification Professional
M&V Professional Report	Measurement and Verification Professional Report
M&V Report	Measurement and Verification Report
MWh	Megawatt hours
NRA	Non-Routine Adjustments
NRE	Non-Routine Event
NRE-A Requirements	PIAM&V Method Application Requirements for Non-Routine Events and Adjustments
OIMP	Other implementations
PIAM&V	Project Impact Assessment with Measurement and Verification
PIAM&V Method Requirements	PIAM&V Method Requirements published by the Scheme Administrator under clause 7A.16(a) of the ESS Rule
POER	Percentage outside effective range
Preliminary M&V Professional Report	Preliminary Measurement and Verification Professional Report
Record Keeping Guide	Record Keeping Guide, published by the Scheme Administrator
Regulation	*Electricity Supply (General) Regulation 2014*
TESSA	The Energy Security Safeguard Application

C.2 Key terms and concepts

Terms that are defined in the ESS Rule and used in this document have the same meaning in this document as in the ESS Rule, unless the context requires otherwise.

Term	Description
Accreditation conditions	Conditions imposed by the Scheme Administrator on the accreditation of an ACP under clause 41(1)(b) of Part 1 of Schedule 4A of the Act and specified in their Accreditation Notice.
Accreditation Notice	A written notice issued by the Scheme Administrator under clause 48 of the Regulation specifying any accreditation conditions.
Accredited Certificate Provider (ACP)	A person accredited as an energy savings certificate provider under Part 1 of Schedule 4A to the Act and whose accreditation is in force. ACPs are voluntary participants in the Energy Savings Scheme (ESS) and are parties that are accredited to create Energy Savings Certificates (ESCs) from Recognised Energy Saving Activities (RESAs) that save energy.
Accuracy Factor	Has the meaning given in clause 7A.10 of the ESS Rule.
Additional Energy Savings	Energy Savings for which no Energy Savings Certificates have been created, but which arise from an Implementation in relation to which Energy Savings Certificates have been created.
Address	A street address within an ESS Jurisdiction, in a format approved by the Scheme Administrator.
Adjusted Coefficient of Determination	For the purpose of clause 7A, a statistical measure of the extent to which variations in the energy consumption are explained by an energy model that is established using Regression Analysis, adjusted to the number of Independent Variables used in the energy model.
AS/NZS	An Australian/New Zealand Standard as published by SAI Global.
Audit	An assessment of whether the ACP has complied, in all material respects, with the requirements of the ESS. Audits can occur either before certificate registration (pre-registration) or after certificate registration (post-registration).
Baseline Energy Model	The model described in clause 7A.3 of the ESS Rule.
BCA	The Building Code of Australia, forming part of the National Construction Code as updated from time to time.
BCA Climate Zone	The BCA Climate Zone number listed by postcode, as detailed in Table A26 of the ESS Rule.
Biodiesel	Has the same meaning as it has in the *Biofuels Act 2007* (NSW).
Biofuel	Has the same meaning as it has in the *Electricity Supply (General) Regulation 2014*.
Biogas	Has the same meaning as it has in the *Electricity Supply (General) Regulation 2014*.
Biomass	Has the same meaning as it has in the *Electricity Supply (General) Regulation 2014*. Note: Energy Crops and the biomass-based waste fuels listed in the NSW Environment Protection Authority's *Eligible Waste Fuels Guidelines* a are eligible types of Biomass under the ESS Rule.
Certificate Conversion Factor	Are as specified in clauses 33(1) and 33A of Schedule 4A of the Act and clause 37A of the Regulation.
Coefficient of Variation	The sample standard deviation expressed as a percentage of the sample mean.
Coefficient of Variation of the Root Mean Squared Error	The standard error of an energy model that is established using Regression Analysis expressed as a percentage of the average energy consumption.
Compliance period	The period commencing on 1 January and ending on 31 December.
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.
Counted Energy Savings	The total Eligible Fuel Savings for which Energy Savings Certificates have previously been created for the Implementation. Counted Energy Savings can only be used to account for Energy Savings Certificates created for the same Implementation, not for Energy Savings Certificates created under another Recognised Energy Saving Activity.

Term	Description
Data Exclusion Method	The Non-Routine Adjustment method described in the PIAM&V Method Application Requirements for Non-Routine Events and Adjustments that is used to adjust for a temporary Non-Routine Event that is less than or equal to 25% of the Measurement Period of choice, or to adjust for a permanent Non- Routine Events commencing within the first 25% of the Baseline Energy Model Measurement Period or within the last 25% of the Operating Energy Model Measurement Period.
Decay Factor	A number between 0 and 1 which quantifies the decay of the relevant Energy Savings due to equipment degradation over time.
Effective Range	The range over which values of Independent Variables for which a Baseline Energy Model or Operating Energy model (as the case may be) is valid.
Effective Range Adjustment Factor	An adjustment factor applied to Normal Year Eligible Fuel Savings and measured Eligible Fuels Savings during time periods at the Modelling Frequency corresponding to values of the Independent Variables that are outside the Effective Range of either the Baseline Energy Model or Operating Energy Model.
Electricity Network	All electricity Transmission Systems and Distribution Systems located in an ESS Jurisdiction.
Electricity Retailer	Has the same meaning as "retailer" in the National Energy Retail Law (NSW).
Electricity Savings	The reduction of the amount or equivalent amount of electricity consumption (in MWh) arising from the Implementation as calculated by the approved calculation method in clause 7A.
Eligibility Requirements	The set of defined requirements that a Site must meet to be included in the Population.
Eligible Fuel	The recognised forms of energy prescribed in clause 29A of the *Electricity Supply (General) Regulation 2014*. Note: For the purpose of the ESS Rule, electricity is referred to as a type of fuel.
End-Use Service	The primary service provided by End-User Equipment, such services being as detailed in Table A17 of Schedule A to the ESS Rule.
End-User Equipment	Eligible Fuel consuming equipment, processes, or systems, including the equipment directly consuming one or more Eligible Fuels, and other equipment or products that cause, control or influence the consumption of one or more Eligible Fuels.
Energy model	A mathematical model describing the energy use profile before an implementation (baseline) and after an implementation (operating) occurs.
Energy Saver	The person who has the right to create Energy Savings Certificates for particular Energy Savings arising from an Implementation of a Recognised Energy Saving Activity at a Site, as defined in the relevant calculation method of the ESS Rule.
Energy Savings	The Electricity Savings, Gas Savings, Diesel Savings, Biofuel Savings, Biogas Savings, Biomass Savings, Onsite Renewables Savings or a combination or two or more of these.
Energy Savings Certificate (ESC)	means an energy savings certificate created under Part 1 of the Act. One ESC represents one notional megawatt hour (MWh) of energy.
Energy Security Safeguard	The Safeguard is part of the NSW Government's Electricity Strategy and aims to improve the affordability, reliability and sustainability of energy through the creation of financial incentives encouraging "energy activities".
Equipment Requirements	The equipment requirements as specified in a Schedule in the ESS Rule or as Published from time to time by the Scheme Administrator in accordance with clause 7A.21A.
ESS Jurisdiction	The state of New South Wales, or a jurisdiction in which an Approved Corresponding Scheme is in operation in accordance with clause 30 of Schedule 4A of the Act.
Estimate of the Mean	A method to establish an energy model as described in clause 7A.2 (a)(i).
Evidence requirements	Evidence you must keep to support certificate creation.
Gas	Natural gas or liquefied petroleum gas.
GreenPower	Renewable energy purchased in accordance with the National GreenPower Accreditation Program Rules.
Implementation	The delivery of a Recognised Energy Saving Activity at a Site, or for the purposes of clause 8.9, the delivery of a Recognised Energy Saving Activity across a Population.

Term	Description
Implementation Date	Is defined in each calculation method of the ESS Rule and is the date from which energy savings can be calculated.
Implementation Period	The period extending from the end date of the Baseline Energy Model Measurement Period to the start date of the Operating Energy Model Measurement Period, and within which the Implementation Date occurs.
Improperly created ESCs	ESCs that are not created in a way that meets the requirements of the Act, Regulation, ESS Rule and/or any accreditation conditions imposed on the ACP. In general, improperly created ESCs must be surrendered by the ACP.
Independent Variable	A parameter that varies over time, can be measured, and affects the End-User Equipment's energy consumption for the purposes of clause 7A of this Rule.
Interactive Energy Effects$_f$	A change in a Site's consumption of Eligible Fuel, f, outside of the Measurement Boundary, due to interactions with End-User Equipment for which energy consumption is not measured for the purposes of clause 7A.
IPMVP	The International Performance Measurement and Verification Protocol, published by the Efficiency Valuation Organization.
Lifetime	The time period over which Energy Savings will be delivered and for the purposes of Schedules B, C, D, E, and G are for reference only, as the relevant time period is already taken into account in the savings factors in those Schedules.
Lighting Upgrade	The replacement of existing lighting End-User Equipment with new lighting End-User Equipment that consumes less electricity, or the modification of existing lighting End-User Equipment resulting in a reduction in the consumption of electricity compared to what would have otherwise been consumed.
liquefied petroleum gas	Has the same meaning as it has in the *Gas and Electricity (Consumer Safety) Act 2017.*
Maximum Time Period for Forward Creation	Is determined in accordance with clauses 7A.12 and 8.8.10 (a), accordingly.
Measurement and Verification Professional	Is defined in clause 7A.15 of the ESS Rule.
Measurement Boundary	All End-User Equipment which is modified, replaced, installed, or removed as a result of the Implementation, as well as all End-User Equipment within that boundary whose energy consumption is impacted by the Implementation.
Measurement Frequency	Is how often measurements of Eligible Fuel consumption, Independent Variables, Site Constants, or any other relevant parameter are taken.
Measurement Period	The duration of time over which measurement of energy consumption will be taken for the purposes of calculating the Energy Savings under clause 7, 7A or 8, and defined therein.
Modelling Frequency	Is how often independent observations of Eligible Fuel consumption, Independent Variables, or any other relevant parameter are used in the Baseline Energy Model or Operating Energy Model. Measurement Frequency and Modelling Frequency may differ where measurements are aggregated into independent observations.
National Greenhouse Accounts Factors	The factors published by the Australian Government's Department of the Environment designed for use by companies and individuals to estimate greenhouse gas emissions.
Normal operations	Typical operating conditions of EUE, excluding commissioning.
Native Forest Bio-materials	Has the meaning given to that term under the *Protection of the Environment Operations (General) Regulation 2009* (NSW).
natural gas	Has the same meaning as it has in the *National Gas (NSW) Law.*
New End-User Equipment	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).
Non-renewable Fuels	Fuels which are existing in limited quantities that cannot be replaced after they have all been used. This includes coal, oil, gas, and nuclear fuels.

Term	Description
Non-Routine Adjustments	Amendments made to energy data to account for a Non-Routine Events in accordance with clause 7A.5B1 to enable like-for-like comparison of before and after Energy Savings scenarios.
Non-Routine Events	Temporary or permanent events which affect energy consumption, within the Measurement Boundary and during any Measurement Period. The events are not modelled by any Independent Variables or Site Constants.
Normal Operating Conditions	The normal operating conditions of the End-User Equipment over one complete operating cycle, from maximum energy consumption and demand to minimum.
Normal Year	Is a typical year for the operation of the End-User Equipment at the Site after the Implementation Date for the purposes of clause 7A of this Rule.
Number of Certificates	The number of Energy Savings Certificates permitted to be created by an Accredited Certificate Provider for Energy Savings calculated in accordance with clause 6.5 and the methods set out in clause 7, 7A, 8 or 9.
Number of Model Parameters	If the energy model is developed for a single Site, the number of Independent Variables; or if the energy model is developed for multiple Sites, the sum of the number of Independent Variables and Site Constants.
Onsite Renewable Energy	Has the same meaning as it has in the Regulation.
Onsite Renewables Savings	The reduction of the amount of Onsite Renewable Energy consumption for stationary energy (in MWh) arising from the Implementation as calculated by the approved calculation method in clauses 7, 7A, 8 or 9. Onsite Renewables Savings may be negative.
Operating Energy Model	The model established in accordance with the criteria in clause 7A.2 and described in clause 7A.4.
Other Implementations (OIMPs) Estimate Method	The Non-Routine Adjustment method described in the PIAM&V Method Application Requirements for Non-Routine Events and Adjustments that accounts for Energy Savings from Implementations other than the Implementation for which the PIAM&V energy model is being established.
Persistence Model	A model that is able to forecast the continuation of Energy Savings from an Implementation over its useful lifetime.
PIAM&V Method Application Requirements for Non-Routine Events and Adjustments	The Project Impact Assessment with Measurement and Verification Method Application Requirements for Non-Routine Events and Adjustments and is a document Published by the NSW Government to support clause 7A.5B1 under clause 7A.5B.
Population	The set of all Sites identified as meeting the Eligibility Requirements.
Product	A class of End-User Equipment identified uniquely by its manufacturer identifier and manufacturer's model identifier and, in some cases, model year or year of manufacture.
Product Stewardship Scheme	A recycling program such as 'Fluorocycle' or equivalent.
Project Impact Assessment Method	The method in clause 7 of the ESS Rule.
Project Impact Assessment with Measurement and Verification Method	The method in clause 7A of the ESS Rule.
Public Lighting Inventory	The inventory required to be maintained by the Distributor, in accordance with the NSW Public Lighting Code.
Publish	To document and make publicly available, on the Energy Savings Scheme website,
Recognised Energy Savings Activity (RESA)	An activity in respect of which an energy savings certificate may be created under Part 1 of the Act.
Regional Site	A Site that has a regional network factor more than 1 according to Table A24 in the ESS Rule.

Term	Description
Regression Analysis	A method 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.
Representativeness Test	A test that can be applied to the set of Site Constants across the Sample Sites to test whether they are distributed in a way that represents the expected distribution of those Site Constants across the Population.
Residential Building	A building or part of a building classified as a BCA Class 1, 2 or 4 building, and may include any Non-Habitable Building on the same site.
Sample Site	A Site in the Population where measurements are taken for inclusion in a multiple Site model.
Sampling Method	The statistical method for conducting measurements at Sample Sites in a Population to estimate the Energy Savings of the entire Population for the purposes of clause 7A of this Rule.
Scheme Administrator	IPART is the Scheme Administrator of the ESS.
Short Energy Models Method	The Non-Routine Adjustment method described in the PIAM&V Method Application Requirements for Non-Routine Events and Adjustments that is used to adjust for a temporary Non-Routine Event that is greater than 25% of the Measurement Period of choice, or to adjust for a permanent Non-Routine Event commencing after the first 25% of the Baseline Energy Model Measurement Period and before the last 25% of the Operating Energy Model Measurement Period.
Site	The location of the End-User Equipment included in a Recognised Energy Saving Activity, as defined by: (a) an Address; or (b) a unique identifier, as specified for the relevant Implementation that identifies the affected End-User Equipment; or (c) a method accepted by the Scheme Administrator.
Site Constant	A parameter of a Site that does not vary over time under Normal Operating Conditions. A Site Constant affects energy consumption of End-User Equipment but is not an Independent Variable and is not used to derive a dependent variable.
Sub-metering Method	The Non-Routine Adjustment method described in the PIAM&V Method Application Requirements for Non-Routine Events and Adjustments that is used to adjust for Non-Routine Events with existing sub-metering.
t-statistic of Independent Variable	A statistical test to verify the accuracy and significance of the estimated relationship between an Independent Variable and energy consumption for an energy model that is established using Regression Analysis.
You/your	An ACP accredited for the PIAM&V method or applicant seeking accreditation for the PIAM&V method.

1 ESS Rule, cl 5.4(a).
2 ESS Rule, cl 7A.16.
3 ESS Rule, cl 7A.5A.
4 ESS Rule, cl 7A.21.
5 ESS Rule, cl 7A.21.A.1.
6 ESS Rule, cl 7A.21.A.2.
7 ESS Rule, cl 10.1.
8 ESS Rule, cl 7A.5.
9 ESS Rule, cl 7A.5(c).
10 ESS Rule, cl 7A.2(b).
11 ESS Rule, cl 7A.2(a)(iii).
12 ESS Rule, cl 7A.5B1.
13 NRE-A Requirements, cl 1.3.
14 ESS Rule, cl 7A.5B1(c)-(d).
15 ESS Rule, cl 7A.17.

[16] ESS Rule, cl 6.5.
[17] Act, cl 2; Regulation, cl 29A.
[18] ESS Rule, cl 6.8
[19] ESS Rule, cl 7A.20.
[20] ESS Rule, cl 7A.20(a)(i)–(v).
[21] ESS Rule, cl 7A.20(g).
[22] ESS Rule, cl 7A.20(f).

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