ENERGY SAVINGS SCHEME

PIAM&V METHOD APPLICATION REQUIREMENTS FOR NON-ROUTINE EVENTS AND ADJUSTMENTS

NO. 2 OF 2022

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Why we made this document

This document, *the Project Impact Assessment with Measurement and Verification (PIAM&V) Method Application Requirements for Non-Routine Events and Adjustments* ("NRE-A Requirements"), is published by NSW Government to support clauses 7A.5B and 7A.5B1 of the *Energy Savings Scheme Rule of 2009* ("ESS Rule").

Clause 7A.5B of the ESS Rule defines the NRE-A Requirements, while Clause 7A.5B1 provides how to manage Non-Routine Events (NREs) and Non-Routine Adjustments (NRAs).

Once changes are made in the ESS Rule to include clauses 7A.5B and 7A.5B1, Accredited Certificate Providers (ACP)s must comply with the Requirements listed in the NRE-A Requirements when using clause 7A.5B1 of the ESS Rule.

Interaction with the PIAM&V method provisions in the ESS Rule

The NRE-A Requirements must be read in conjunction with the PIAM&V Method provisions listed under clause 7A of the current ESS Rule. A contravention of any of the Requirements contained in the NRE-A Requirements by an ACP is a contravention of the ESS Rule.

In this document, unless the contrary intention appears, terms used have the same meaning as they have for the purposes of Schedule 4A of the Electricity Supply Act 1995 and the ESS Rule.

When managing NREs in accordance with clause 7A.5B1, if any potential inconsistencies exist between this document and the PIAM&V Method Requirements, provisions in this document will prevail.

If any potential incompatibilities exist between this document and the ESS Rule, the ESS Rule must take precedence.

Summary of Requirements

If NREs occur within the Measurement Boundary, an ACP may choose to wait until the changes to energy consumption caused by the NREs have concluded before establishing the Measurement Periods for the Energy Models.

To manage NREs using clause 7A.5B1 of the ESS Rule, an ACP must follow the steps outlined in this section and summarised by the flowchart in **Figure 1**:

Step 1 Can the Observations impacted by the NREs be avoided in the Energy Models' Measurement Periods by waiting until the changes in energy consumption caused by the NREs are concluded?
    (a) If "yes", then an ACP may establish the Energy Models' Measurement Periods by avoiding the NRE-impacted periods.
    (b) If "no", then go to step 2.

Step 2 Identify any changes in energy consumption that amount to NREs in accordance with **Requirement 2**.
Any of the following will constitute NREs:
    (a) Temporary or permanent events affecting energy consumption that are not modelled by any of the Independent Variables or the Site Constants.
    (b) Energy Savings from Other Implementations (OIMPs).

Step 3 Can the root causes and specific causes of the NREs be identified?

    (a) If "yes", then record the root causes and specific causes of the identified NREs in accordance with **Requirement 3**, then go to step 4.
    (b) If "no", then NRAs cannot be made.

Step 4 Are any of the identified NREs caused by Energy Savings from OIMPs within the Measurement Boundary as per **Requirement 2.1(b)**?
    (a) If "yes" and the NRE is sub-metered, then use the Sub-metering Method in accordance with **Requirement 7** to make the NRAs, then go to step 5.
    (b) If "yes" and the NRE is not sub-metered, then use the Other Implementations (OIMPs) Estimate Method in accordance with **Requirement 4** to make the NRAs, then go to step 5.
    (c) If "no", and the NRE meets **Requirement 2.1(a)**, then go to step 6.

Step 5 Is there another NRE that meets **Requirement 2.1(a)**?

    (a) If "yes", then go to step 6.
    (b) If "no", then go to step 9.

Step 6 Is the NRE sub-metered?

    (a) If "yes", use the Sub-metering Method in accordance with **Requirement 7** to make an NRA, then go to step 5.
    (b) If "no", then go to step 7.

Step 7 Is the NRE

(i) A Temporary NRE amounting to less than or equal to 25% of the Measurement Period of choice?

Or

(ii) A Permanent NRE commencing within the first 25% of the Baseline Energy Model Measurement Period or within the last 25% of the Operating Energy Model Measurement Period?

    (a) If "yes" to either scenario, then use the Data Exclusion Method in accordance with **Requirement 5** to make an NRA, then go to step 5.

    (b) If "no" to either scenario, then go to step 8.

Step 8 Use the Short Energy Models Method in accordance with **Requirement 6** to make NRAs, then go to step 5.

Step 9 Finally, are the resulting Energy Models Acceptable Energy Models in accordance with 7A.5B1(c) of the ESS Rule?

    (a) If "yes", then go to step 10.

    (b) If "no", then Energy Savings Certificates (ESCs) cannot be created.

Step 10 Record and maintain documentary evidence of all adjustments to the NREs in accordance with **Requirement 3**.
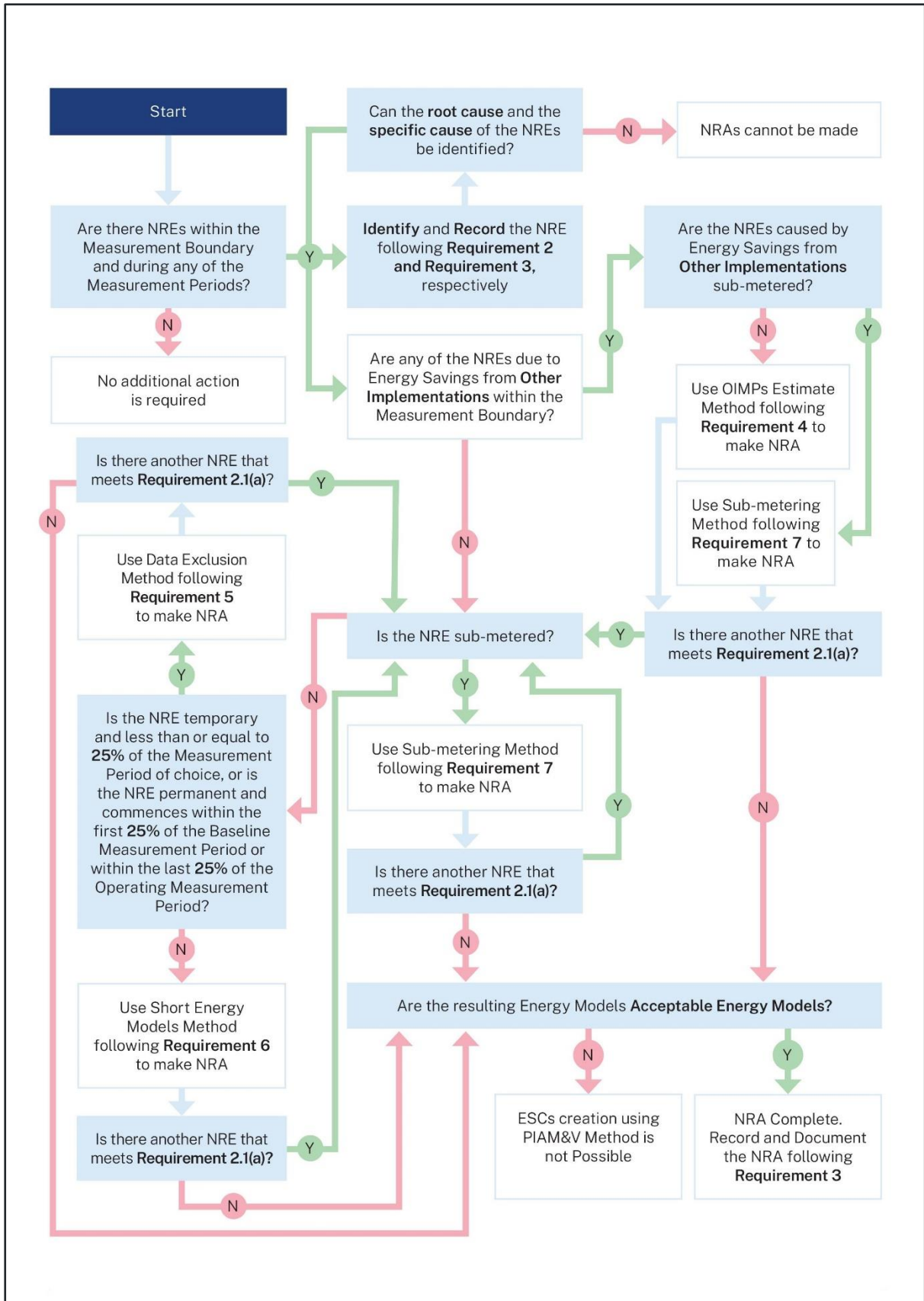
Figure 1: Flowchart showing steps to follow to manage NREs and NRAs.

Requirement 1   When to use this document

Requirement 1

1.1   The Requirements are those parts of the NRE-A Requirements that ACPs must comply with under clauses 7A.5B and 7A.5B1 of the ESS Rule. For the avoidance of doubt, Requirements are contained within boxes with bolded outlines.

1.2   The explanatory text within the NRE-A Requirements provides guidance, examples, and additional information on the scope and operation of the Requirements but is not legally binding. To the extent an ACP deviates from the approach outlined in the explanatory text, they must provide further explanation to demonstrate how their approach complies with the Act, the ESS Rule, the PIAM&V Method Requirements, and the NRE-A Requirements. For the avoidance of doubt, everything that is not a Requirement in this document is explanatory text.

1.3   To apply any of the NRA methods of this document, the Independent Variables used in both the Baseline and Operating Energy Models must be identical.

1.4   An ACP can use the NRA methods outlined in this document to adjust for Multiple NREs within the Measurement Boundary.

1.5   The application of the NRE-A Requirements is restricted to:

   (a) making NRAs for Energy Models that use Regression Analysis using any of the NRA methods provided in Requirements 4, 5, 6, and 7; and
   (b) making NRAs for Energy Models that use Estimate of the Mean only using the NRA methods provided in Requirements 4, 5, and 7.

1.6   The NRA methods listed in this document are not applicable to Energy Models that use Computer Simulation in accordance with clause 7A.2(a)(iii) of the ESS Rule.

1.7   The NRA methods listed in this document are not applicable with projects that use the Sampling Method.

1.8   An ACP may opt to wait until the impacts of NREs on energy consumption end, to establish the Measurement Periods for the Energy Models.

Explanatory text:

Requirement 1.3 necessitates the use of identical Independent Variables in both the Baseline Energy Model and the Operating Energy Model to appropriately enable a like-for-like comparison.

Table 1 below provides a summary of Requirement 1.4.

Table 1: NRA Methods that can be applied for different types of NREs based on the type of modelling.

NRA method	Regression Analysis	Estimate of the Mean	Computer Simulation
OIMPs Estimate	✓	✓	✕
Sub-metering	✓	✓	✕
Data Exclusion	✓	✓	✕
Short Energy Models	✓	✕	✕

Requirement 2   Identify NREs

Requirement 2

2.1   In accordance with clause 7A.5B1, an ACP must identify any NREs that are due to any of the following causes:

(a) Any temporary or permanent events that affect energy consumption and are not modelled by any of the Independent Variables or the Site Constants.
(b) Energy Savings from OIMPs that exist within the Measurement Boundary.

2.2   For NREs that are not caused by Energy Savings from OIMPs within the Measurement Boundary, an ACP must identify whether the NREs are Temporary NREs or Permanent NREs.

2.3   To undertake an NRA, an ACP must confirm the occurrence of any NREs by identifying their root causes and the specific causes. If the root cause and the specific cause of an NRE cannot be identified, then an NRA cannot be made.

2.4   If any Measurement Period occurs during COVID, an ACP must provide evidence of whether COVID has caused any NREs and define the COVID-Impacted Period.

Explanatory text:

In accordance with requirement 2.3, a root cause of a NRE may include multiple specific causes. Documentary evidence in accordance with Requirement 3 must be provided to prove the presence of the specific causes for all the periods over which NREs occur.

In accordance with requirement 2.2, a Permanent NRE is considered to be continuous and persists into the future after the Operating Energy Model Measurement Period has elapsed. Examples of permanent NREs are:

- Site expansion or contraction.
- The addition of new equipment.
- The removal of existing equipment.

The establishment of a new normal (e.g., following a COVID-Impacted Period) can also be considered as a Permanent NRE provided it is evidenced with the appropriate documentation as per Requirement 3.

As a result of Requirement 2.1, an ACP cannot use OIMP Estimate Method to make NRAs for Energy Savings from energy saving activities that were not used to create ESCs as they do not qualify as OIMPs. This includes energy saving activities that created Australian Carbon Credit Units (ACCUs).

As shown in Figure 2, NREs can arise from one of the three root causes:

- Energy Savings from OIMPs.
- COVID or a similar state of emergency.
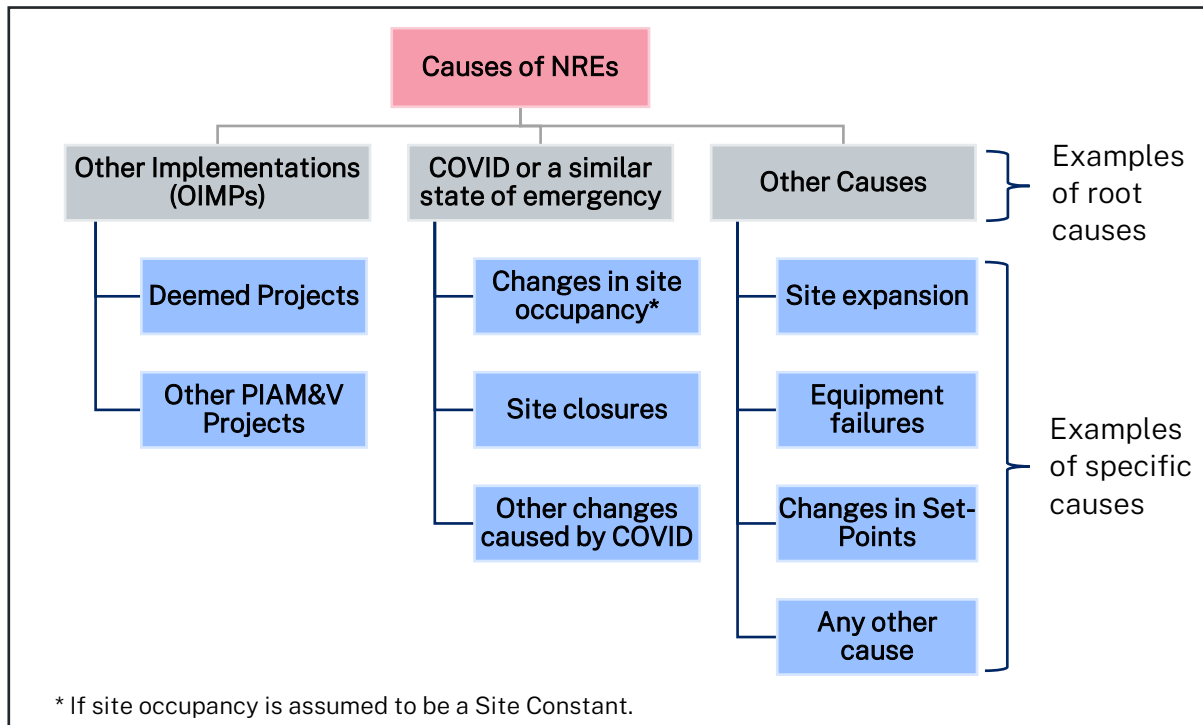- Other causes.

Figure 2: Examples of NRE root causes and specific causes.

Illustrating Requirement 2.1 (a)

Observations where changes in the energy consumption are not modelled by any of the Site Constants constitute NREs. In practice, this can occur due to changes to Sites Constants. Therefore, Site Constants must be identified and monitored for any changes by site staff. Site inspections or surveys may also be required to identify or confirm changes to Site Constants.

Impacts of COVID on Site Constants must be determined.

As per Requirement 2.4, an ACP is required to provide evidence that COVID has impacted a site and define the impacted period. A site may be subject to multiple COVID-Impacted Periods, and therefore multiple NREs.

Readily available public information similar to what is provided in **Table 2** can guide the selection of periods where COVID impacts must be queried.

Table 2: Chronological overview of COVID-19 significant impacts in NSW.

Date	Restrictions
From 16 to 29 March 2020	• Limit on public events, social distancing • Pubs, cafes and restaurants, entertainment facilities, amusement centres, casinos, micro-breweries, indoor recreation facilities, places of public workshop closed • Takeaway allowed • Food courts, markets, hair and beauty, swimming pools, libraries and museums, community facilities closed • Schools closed • Access to residential age care restricted
30 March 2020	Stay at home orders – public gatherings limited to 2 people
June 2020	Easing of public health restrictions, businesses allowed to open if they have a COVID-19 safety plan
July 2020	• Limits on public gatherings increased to 20 people • Further easing of business restrictions • Border to Victoria shut
June 2021	Lockdowns of Local Government Areas in Greater Sydney commence
August 2021	Further tightening of restrictions, regional NSW went into lockdown
September 2021	Regional lockdown partially lifted
October 2021	Lockdown eased on 11 October – 80% of adults now fully vaccinated

A change in circumstances out of the site control, such as COVID, is not in itself a sufficient reason for an NRA without further evidence accounting for its impact on the site energy consumption. The impact of these circumstances, represented by the root cause and the specific cause, must be identified as exemplified in **Table 3**.

For example, if occupancy in an office building decreased due to the impact of COVID, evidence of this specific cause may be:

- employee attendance records, or
- average number of devices connected to the office's local computer network, or
- evidence from people counters, etc.

Table 3: Examples of NREs root causes and specific causes.

Example	Root cause	Specific cause
Office occupancy decreased during COVID	COVID	Change in occupancy
A Lighting Upgrade is undertaken	OIMP	Deemed lighting upgrade
An additional production line is added	Other causes	Additional production line

Example: In an office building environment, occupancy was the designated Site Constant during the Baseline Energy Model Measurement Period. However, due to the impacts of COVID, occupancy is no longer constant during the Operating Energy Model Measurement Period.

Illustrating Requirement 2.1 (b)

Energy Savings from OIMPs occurring between the start of the Baseline Energy Model Measurement Period and the end of the Operating Energy Model Measurement Period are considered NREs and must be adjusted.

Example: A Lighting Upgrade Implementation used the Deemed Energy Savings Method under the ESS Rule to create ESCs. If the Lighting Upgrade Implementation occurred within the Measurement Boundary of a PIAM&V Energy Model that uses a whole of site approach, then the Energy Savings from the Lighting Upgrade Implementation is considered as an NRE.

Illustrating Requirement 2.2

In the examples listed in **Table 3** above, the addition of a production line may constitute a Permanent NRE in a manufacturing facility where the number of production lines was considered as a Site Constant.

Temporary NRE examples may include short periods of equipment failure or maintenance.

Moreover, COVID may introduce NREs that can be temporary or permanent. In the example in **Table 3**, the decrease in office occupancy due to COVID could be considered a Temporary NRE if it were limited to periods of lockdown declared by state or federal governments. Alternatively, this NRE may also be a Permanent NRE where COVID gave rise to new normal circumstances of lowered office occupancy.

Requirement 3   Record NREs and NRAs

Requirement 3

3.1   In accordance with clause 7A.5B1, an ACP must record NREs that were identified according to Requirement 2.

3.2   An ACP must keep records of the following when determining the Baseline and Operating Energy Model:

(a) All Independent Variables and all Site Constants.
(b) Whether or not any NREs occurred during any of the Measurement Periods and the Implementation Period.
(c) A list of Site Constants that changed, and the reason for these changes.
(d) For each NRE occurring during any of the Measurement Periods and the Implementation Period:
(i)   The root cause of the NRE.
(ii) The nature of the NRE as being temporary or permanent.
(iii) Dates when an NRE impacted the relevant Measurement Period.
(iv) Calculations supporting the NRA methods performed during the Baseline and the Operating Energy Model Measurement Period.
(e) For each NRE occurring during any of Measurement Periods and the Implementation Period, records of eligible documentary evidence of the NRE's specific causes. These include:
(i)   payment invoices or operational records;
(ii)   internal memos or data from the company website;
(iii) public health orders relevant to the facility type;
(iv) photograph evidence; or
(v)   data from SCADA or BMS logs.

3.3   When using the OIMPs Estimate Method, an ACP must keep the following records:

(a) The Implementation Date(s) of OIMP(s).
(b) The number of ESCs created for the OIMPs.
(c) The date of ESCs registration.

3.4   If the Sub-metering Method is used, an ACP must keep the following records:

(a) A diagram showing the PIAM&V Measurement Boundary and the sub-meter boundary.
(b) Specification of the sub-meter(s) used.
(c) Sub-meter raw data.
(d) Independent Variable raw data, where equipment is added or removed with a consequent change in an Independent Variable which is a direct or an indirect output of the equipment.
(e) A list of Observations excluded from any Measurement Period due to missing sub-meter data.
(f) For installing on-site generation, the certificate showing the connection date of the onsite generation.

Explanatory text

The NRE-A Requirements mandates maintaining records and documentation of evidence pertinent to managing NREs.

For Requirement 3.2(e), eligible documentary evidence for an NRE specific cause may include any of the following:

- Payment invoices.
    - Example: Invoices provided by an HVAC contractor for reprogramming run hours and changing ventilation rates.
- Operational records.
    - Example: Service or production records/reports.
- Data from the company website.
    - Example: In the case of COVID-caused NREs, a notice announcing site closure or changes in operating hours.
- Internal memos.
    - Example: Email evidence from management to staff advising them to stay at home during lockdown periods.
- Public health orders relevant to the facility type.
- Photograph evidence.
    - Example: Dated and geo-located photos.
- SCADA or BMS data logs.

Requirement 4   Other Implementations (OIMPs) Estimate Method

Requirement 4

4.1   An ACP must adjust for Energy Savings from OIMPs that are not sub-metered within the Measurement Boundary as NREs.

4.2   In accordance with clause 7A.5B1(b)(i), an ACP must use the OIMPs Estimate Method to adjust for Energy Savings resulting from OIMPs with no existing sub-metering within the Measurement Boundary.

4.3   ESCs for Energy Savings from OIMPs must have been created and registered before an ACP can use the OIMPs Estimate Method to make the NRAs.

4.4   For top-up ESC creation under clause 7A.14 of the ESS Rule, if new OIMPs are implemented after the end of the Operating Energy Model Measurement Period of the Current Implementation, their energy consumption must be sub-metered and adjusted for in accordance with Requirement 7.

4.5   Where multiple OIMPs occur within the Measurement Boundary, ACPs must adjust for each of these OIMPs individually in accordance with the steps described in Requirement 4.6.

4.6   If an OIMP is not sub-metered, and occurs between the start of the Baseline Energy Model Measurement Period and the end of the Operating Energy Model Measurement Period, then Energy Savings from the OIMP must be adjusted for using the OIMPs Estimate Method in accordance with the following steps:

Step.1 Determine the average annual Energy Savings from the OIMP:

The annual Energy Savings from the OIMP must be used in the adjustment process. If the annual Energy Savings of the OIMP are not available, then the ACP must use the number of ESCs registered for the OIMP to calculate their average annual Energy Savings using formula **NRA.F.1** below.

$$Average\ annual\ Energy\ Savings\ from\ the\ OIMP\ (MWh) = \frac{Number\ of\ ESCs\ created\ from\ the\ OIMP}{Lifetime\ of\ OIMP\ (years) \times * Certificate\ Conversion\ Factor \times * Regional\ Network\ Factor}$$

(NRA.F.1)

Where:
Certificate Conversion Factor is at the time of the OIMP ESC Registration.
Regional Network Factor is as defined in the ESS Rule.

Step.2 Determine the adjusted average annual Energy Savings from the OIMP:

The OIMP-adjusted average annual Energy Savings, in MWh, must be calculated in accordance with formula **NRA.F.2** below.

$$Adjusted\ average\ annual\ Energy\ Savings\ from\ the\ OIMP\ (MWh) = Average\ annual\ Energy\ Savings\ from\ OIMP (MWh \times) * OAF$$ (NRA.F.2)

Where: OAF is the OIMP Adjustment Factor.

OAF = **1.0** for an OIMP that uses clause 7A or 8 of the ESS Rule to create ESCs.

OAF = **1.1** for an OIMP that uses clause 7 or 9 of the ESS Rule to create ESCs.

Step.3 Determine the adjusted average Energy Savings from the OIMP for each Observation:

OIMP's Energy Savings for each Observation must then be determined by dividing the OIMP's adjusted annual Energy Savings, calculated in Step 2, by the number of Observations in a year using formula **NRA.F.3** below.

$Energy\ Savings\ from\ the\ OIMP\ per\ Observation\ (MWh)\ =$
$$\frac{Adjusted\ average\ annual\ Energy\ Savings\ arising\ from\ the\ OIMP\ (MWh)}{Number\ of\ Observations\ per\ year}$$ (NRA.F.3)

Step.4 Make the NRA:

For each observation where the OIMP exists within the Baseline Energy Model Measurement Period and Operating Energy Model Measurement Period, adjust the metered energy consumption data to account for the Energy Savings from the OIMP.

The NRA must be performed by adding the OIMP Energy Savings to the metered energy consumption data for each Observation using formula **NRA.F.4** below. The starting date for this addition process must be the Implementation Date of each OIMP.

$Adjusted\ metered\ energy\ per\ Observation\ for\ the\ OIMP = metered\ energy +$
$\sum_i Energy\ Savings\ from\ the\ OIMP_i$ (NRA.F.4)

Where: $OIMP_i$ is the ith OIMP

Step.5 Establish the Baseline and Operating Energy Models and calculate the estimated Energy Savings for the Current Implementation.

Step.6 Adjust the overall Relative Precision of the Estimated Energy Savings:

Adjusting for Energy Savings from the OIMP is expected to increase the overall modelling error. This is represented as an increase in the overall Relative Precision of the estimated Energy Savings.

The overall Relative Precision must be determined using formula **NRA.F.5** below.

$Overall\ Relative\ Precision =$
$Relative\ Precision\ of\ the\ Estimated\ Energy\ Savings\ from\ the\ Current\ Implementation +$
$\sum_i Xi^2$ (NRA.F.5)

Where:

X_i: Is the ratio of Energy Savings from the ith OIMP to the overall Normal Year Energy Savings. The overall Normal Year Energy Savings in this context represents the overall Energy Savings from the Current Implementation and Energy Savings from the ith OIMP.

Requirement 5   Data Exclusion Method

Requirement 5

5.1   In accordance with clause 7A.5B1(b)(ii), an ACP must use the Data Exclusion Method to adjust for an NRE by excluding up to 25% of a Measurement Period's data points only if:

(a)   a Permanent NRE commences within the first 25% of the Baseline Energy Model Measurement Period, in which case up to 25% from the start of the Baseline Energy Model Measurement Period must be excluded;

(b)   a Permanent NRE commences within the last 25% of the Operating Energy Model Measurement Period, in which case the data points corresponding to the NRE must be excluded, and top-up ESC creation under clause 7A.14 of the ESS Rule is not permitted; or

(c)   a Temporary NRE is less than or equal to 25% of the Measurement Period of choice, in which case the data points corresponding to the NRE must be excluded.

5.2   An ACP cannot use the Data Exclusion Method if a Permanent NRE commences in the first 75% of the Operating Energy Model Measurement Period.

5.3   An ACP cannot use Data Exclusion Method if a Permanent NRE commences in the last 75% of the Baseline Energy Model Measurement Period.

5.4   An ACP can use the Data Exclusion Method to adjust for multiple NREs that are discretely scattered within a Measurement Period. The total allowable exclusion, encompassing all NREs, is 25%.

5.5   For avoidance of doubt, an ACP cannot use the Data Exclusion Method to adjust for Energy Savings from OIMPs occurring within the Measurement Boundary.

5.6   In accordance with clause 7A.5(f1) of the ESS Rule, time periods during which the Independent Variables may reasonably be expected to lead to the Current Implementation increasing energy consumption must not be excluded.

Explanatory text:

If multiple NREs exist within the Measurement Boundary, the maximum allowable data exclusion for all NRAs is 25%. ACPs cannot exclude 25% to adjust for one NRE, and another 25% to adjust for another NRE. **Figure 3** illustrates different scenarios when the Data Exclusion Method can be used.

In accordance with Requirement 5.1 (a), the Data Exclusion Method can be used to exclude data points from the Baseline Energy Model Measurement Period that do not correspond to the NRE. This is appropriate to facilitate a like-for-like comparison between the two Measurement Periods.

If a Permanent NRE commences within the first 20% of the Baseline Energy Model Measurement Period, the non-NRE period in the Baseline Measurement Period can be excluded. Moreover, if a second Temporary NRE was later identified amounting to 4% of the original Baseline Energy Model Measurement Period that included the non-NRE period, then Data Exclusion Method can still be used to exclude the second NRE period.
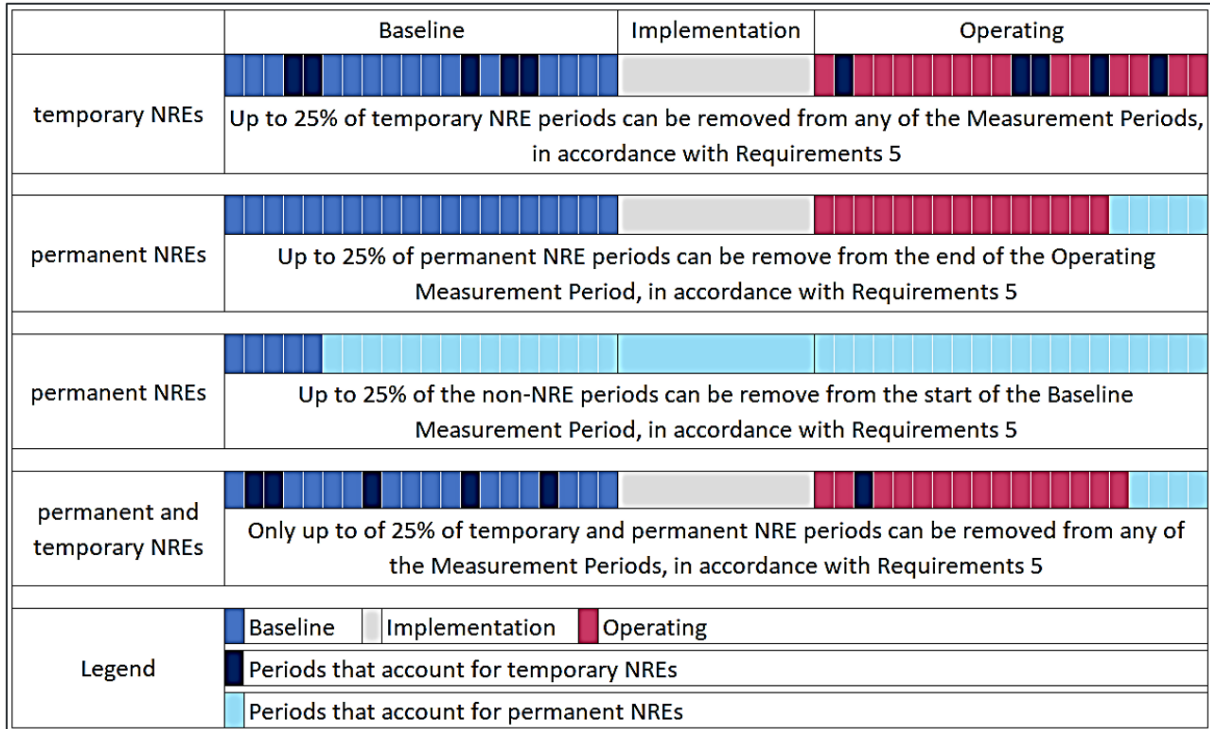

Figure 3: Illustration of the Data Exclusion Method. Each cell of the Baseline and Operating Energy Models' Measurement Periods represents 5%.

As the flowchart in **Figure 4** illustrates, the Data Exclusion Method can only be used under the three circumstances outlined in Requirement 5.1. Otherwise, the Short Energy Models Method must be used.
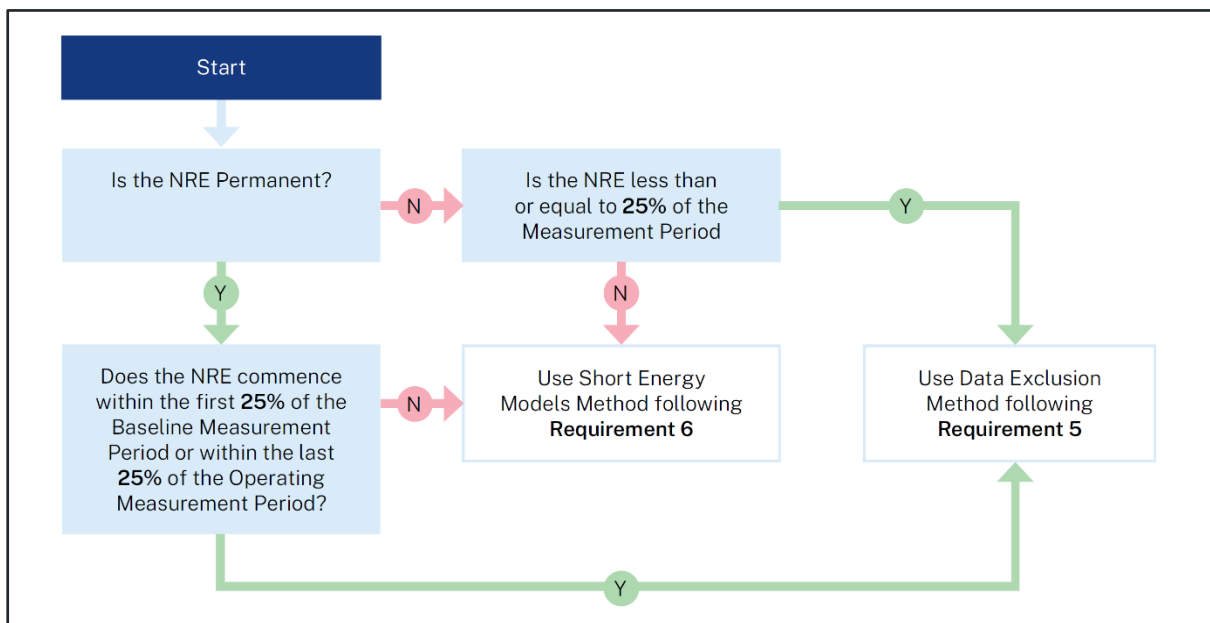

Figure 4: Flow chart illustrating the use of the Data Exclusion and Short Energy Models Methods.

Requirement 5.6 mandates that periods where the Independent Variables will cause energy consumption to increase cannot be excluded using the Data Exclusion Method. An example is peak summer or winter periods where large temperature changes can lead to large increases in energy consumption.

Example 1 A new packaging line is added to a factory where an M&V effort is underway. The new line is commissioned on the 85th day of the Baseline Measurement Period that uses a daily Baseline Energy Model over a full year. This addition represents a Permanent NRE. To make an NRA, the Data Exclusion Method can be used to exclude the first 84 days of the Baseline Energy Model Measurement Period. This is because 84 days amount to 23.0% of the Baseline Energy Model Measurement Period, which is less than 25%.

Example 2 A new packaging line is added to a factory where an M&V effort is underway. The new packaging line is commissioned on the 5th month of the Baseline Energy Model Measurement Period that uses a monthly Energy Model over a full year. This addition represents a Permanent NRE. In this example, however, the Data Exclusion Method cannot be used. This is because when excluding the first 25% of the Baseline Energy Model Measurement Period (3 months), the remainder of the Baseline Energy Model Measurement Period will still include data points from periods before the new packaging line is added. This means it is not possible to make a like-for-like comparison, and therefore the Data Exclusion Method is not applicable.

Requirement 6   Short Energy Models Method

Requirement 6

6.1   In accordance with clause 7A.5B1(b)(iii), an ACP can only use the Short Energy Models Method if:

(a) a Temporary NRE amounts to more than 25% of the Measurement Period of choice; or

(b) a Permanent NRE commences after the first 25% of the Baseline Energy Model Measurement Period but before the last 25% of the Operating Energy Model Measurement Period.

6.2   An ACP cannot use the Short Energy Models method to adjust for NREs that are caused by Energy Savings from OIMPs.

6.3   If a Temporary NRE amounts to more than 25% of the Measurement Period of choice, an ACP can use the Short Energy Models Method to create Short Energy Models' Measurement Periods that exclude the NRE impacted periods.

6.4   If a Permanent NRE commences after the first 25% of the Baseline Energy Model Measurement Period but before the last 25% of the Operating Energy Model Measurement Period, then both Short Energy Models must:

(a) only include time periods at the Modelling Frequency that are completely outside the NRE impacted period, in which case top-up ESC creation under clause 7A.14 of the ESS Rule is not permitted; or

(b) only include time periods at the Modelling Frequency that are completely inside the NRE impacted period.

6.5   If the NREs satisfy Requirement 6.1 of this document, then the number of independent observations at the Modelling Frequency in any of the Short Energy Models' Measurement Periods created using Short Energy Models Method must be at least 4 times the number of the Independent Variables.

6.6   For the avoidance of doubt, Requirement 6.5 of this document is supplementary to, and is not inconsistent with, the requirements in clause 7A.2(a)(ii) of the ESS Rule.

6.7   For an ACP to use the Short Energy Models Method, the Measurement Periods created for both Short Energy Models must cover less than 75% of a Full Operating Cycle.

6.8   For the avoidance of doubt, the maximum length of any Short Energy Model's Measurement Period is the length that corresponds to 75% of a Full Operating Cycle.

6.9   When creating Short Energy Models, an ACP must ensure that the ranges of the Independent Variables values for the Baseline Energy Model and the Operating Energy Model are similar.

6.10 When creating Short Energy Models, 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.

6.11　When using the Short Energy Models Method, both the Baseline Energy Model and the Operating energy Model must meet the Requirements of Short Energy Models.

6.12　The Effective Range Adjustment Factor (ERAF) may only be applied for forward creation of ESCs when using the Short Energy Models Method, in which case **NRA.F.6** must be used to calculate the Normal Year Energy Savings as follows:

$$Normal\ Year\ Energy\ Savings = \sum_t \left(\left(E_{Baseline(\tilde{x}_1(t),\ \tilde{x}_2(t),...\tilde{x}_p(t)\ t)} - E_{Operating(\tilde{x}_1(t),\ \tilde{x}_2(t),...\tilde{x}_p(t)\ t)} \right) . ERAF_t \right) + Interactive\ Energy\ Effects \qquad (NRA.F.6)$$

Where:

$ERAF_t$: is the Effective Range Adjustment Factor of a time period at the Modelling Frequency: $0 < ERAF < 1$

If the $ERAF$ is calculated to be less than 0, then an ERAF of 0 is to be applied.

All other variables are as defined in the ESS Rule.

The $ERAF$ is used with Short Energy Models to adjust for Normal Year Energy Savings during time periods at the Modelling Frequency that correspond to Independent Variables that fall outside the Short Energy Model's Effective Range, and is determined as follows:

For values of Independent Variables within the Effective Range of the Short Energy Model, an $ERAF$ of 1.0 is applied. Otherwise $ERAF$ is calculated as follows:

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

Where:

$POER$: Percentage Outside Effective Range.

$POER$: is a percentage that describes how far a value of an Independent Variable is, outside the Effective Range of a Short Energy Model, from the minimum value or the maximum value of the Effective Range. POER is determined as follows:

$$POER = \frac{Min - a}{R}; \qquad Or \qquad POER = \frac{b - Max}{R}$$

Where:

Min: is the lower limit of the Short Energy Model's Effective Range.

Max: is the upper limit of the Short Energy Model's Effective Range.

a: is the value of the Independent Variable of a time period at the Modelling Frequency where the Independent Variable is less than the lower limit of the Short Energy Model's Effective Range.

b: is the value of the Independent Variable of a time period at the Modelling Frequency where the Independent Variable is greater than the upper limit of the Short Energy Model's Effective Range.

R: is the range of the Short Energy Model's Effective Range determined as follows:

$$R = Max - Min$$

For Short Energy Models with multiple Independent Variables outside the Effective Range, the highest $POER$ of those Independent Variables is used to calculate the $ERAF$. Moreover, the highest $POER$ of the two POERs calculated for each of the two Short Energy Models (Baseline and Operating Energy Models) is used to calculate the $ERAF$.

Explanatory text:

In accordance with Requirement 6.10, the Measurement Periods of the 2 Short Energy Models must not differ in length by more than 30% from one another.

In accordance with Requirement 6.7, the Short Energy Models Method uses Energy Models with Measurement Periods that include less than a Full Operating Cycle of data. For sites where energy consumption is affected by seasonal variation, a Full Operating Cycle is one that encompasses energy consumption during summer and winter periods.

The Short Energy Models Method allows for energy data points that correspond to Independent Variables outside of the Short Energy Models' Effective Range, which otherwise would be excluded, to be included in the Energy Savings calculations. The weight of such data points however diminishes depending on how far the data points are outside the Effective Range.

Figure 5 below draws a comparison between two scenarios to illustrate the impact of using the ERAF on the calculated Energy Savings. The first scenario is without the use of ERAF which is represented by the blue coloured area. In this scenario, data points that correspond to Normal Year's Independent Variable values outside the Effective Range are excluded and do not contribute to the overall Energy Savings.

On the other hand, the second scenario uses the ERAF which results in including the grey coloured area into the overall Energy Savings calculations. The grey coloured area covers the Energy Savings from time periods at the Modelling Frequency that correspond to Independent Variables' values outside the Effective Range, and decay by a factor that depends on how far the Independent Variables' values are outside the Effective Range.

The example in **Figure 5** uses the Independent Variable of heating degree days (HDDs) as a proxy measure for ambient temperature. HDDs are a measure of how cold the average temperature is on a given day or during a period of days.
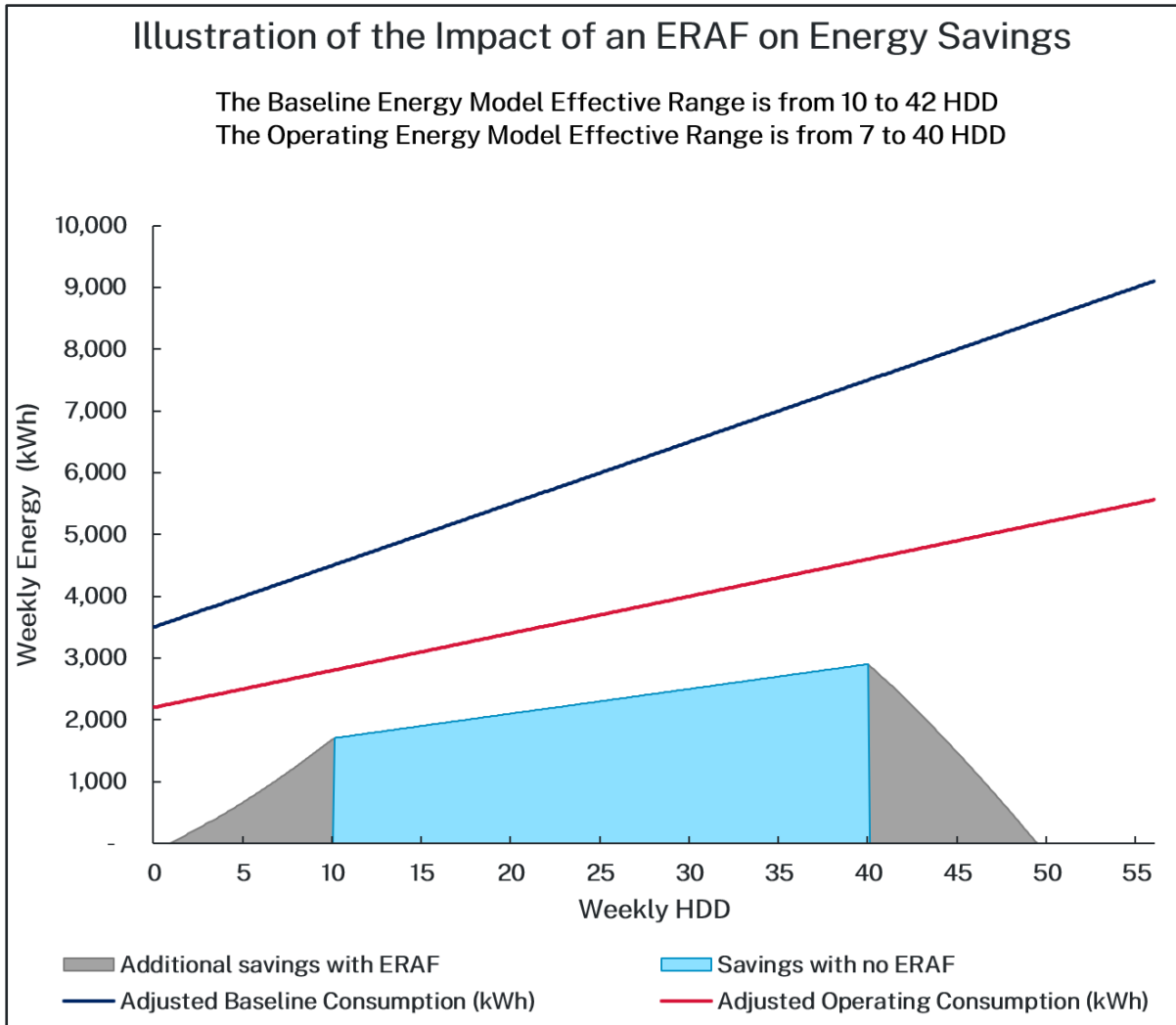
Illustration of the Impact of an ERAF on Energy Savings

The Baseline Energy Model Effective Range is from 10 to 42 HDD
The Operating Energy Model Effective Range is from 7 to 40 HDD

Y-axis: Weekly Energy (kWh) — scale from – to 10,000 in increments of 1,000
X-axis: Weekly HDD — scale from 0 to 55

Legend:
- Additional savings with ERAF (grey)
- Savings with no ERAF (light blue)
- Adjusted Baseline Consumption (kWh) (dark blue line)
- Adjusted Operating Consumption (kWh) (red line)

Figure 5: Illustration of the ERAF impact on the Normal Year Energy Savings calculation.

Requirement 6.9 mandates that, when using the Short Energy Models Method, the choice of the short Measurement Periods must be such that the Independent Variables of choice in the 2 Short Energy Models must have similar range of variation.

For example, if the cooling degree days (CDDs) is the Independent Variable as a proxy measure for ambient temperature, and the Baseline Energy Model Measurement Period was chosen to be 4 months of summer, then the Operating Energy Model Measurement Period must seek to include similar summer months. CDDs are a measure of how hot the average temperature is on a given day or during a period of days.

Example on Energy Savings calculation using ERAF:

In reference to **Figure 5**, two weekly Short Energy Models were established with their respective Effective Ranges as described. The following is the calculation process of the Energy Savings for a week that corresponds to an Independent Variable of 6 HDDs. This value is clearly outside the Baseline and Operating Energy Model's Effective Range.

Calculating the ERAF:

First, calculate the POER for this HDD value in the Baseline Energy Model:

- The Baseline Energy Model has an Effective Range from 10 to 42 HDDs, with an overall range of $R = Max – Min$ so that *R = 42 – 10 = 32 HDDs.*
- In the week with 6 HDDs, the POER is calculated according to the formula: $POER = \frac{Min-a}{R}$ so that *POER = (10-6)/32 = 0.125*.

Second, calculate the POER for this HDD value in the Operating Energy Model:

- The Operating Energy Model has an Effective Range from 7 to 40 HDDs, with an overall range of $R = Max – Min$ so that *R = 40 – 7 = 33 HDDs*.
- In the week with 6 HDDs, the POER is calculated according to the formula: $POER = \frac{Min-a}{R}$ so that *POER = (7-6)/33 = 0.0303*.

The POER of choice is that of the Energy Model with the highest POER value. In this case the Baseline Energy Model has the highest POER, therefore the POER is 0.125.

<u>Calculating the ERAF:</u>

In reference to the example POER calculation, the ERAF is

$1 − |3.0 * POER| = 1 − |3.0 * 0.125| = 0.625$.

<u>Calculating Energy Savings using ERAF:</u>

In reference to **Figure 5**, assuming no Interactive Energy Savings, the HDD value corresponds to Energy Savings of 1,500 kWh. Applying the ERAF the savings are *1,500 x 0.625 = 937.5 kWh.*

Examples of Short Energy Models' Measurement Periods:

I.   If CDD is used as the Independent Variable during summer, for a 45-day Operating Energy Model just before COVID, the Baseline Energy Model must also be from a summer period. It is permitted to use adjacent periods if the range of Independent Variables is similar (still during the same summer).

II. The Implementation Date was 20 January 2020. Using a daily Energy Model, the Short Operating Energy Model Measurement Period is from 21 January 2020 to 15 March 2020, a period of 55 days. The Independent Variable is CDD. A Baseline Energy Model Measurement Period can be chosen as:
    a. the same period of the previous year (January to March 2019); or
    b. the period just before the Implementation Date where the range of CDDs is similar (10 November 2019 to 19 January 2020 – a period of 70 days).

III. The Implementation Date was on 16 November 2019. A weekly Short Energy Model is used, with 17 weeks in the Short Operating Energy Model Measurement Period up until the start of COVID. The Independent Variables are the CDD and production. To capture a similar range of the Independent Variables, the Short Baseline Energy Model Measurement Period must be chosen to start around 52 weeks earlier and run for 17 weeks.

IV. The Implementation Date was on 30 June 2019. Monthly Short Energy Models are used with 2 Independent Variables and 8 months in the Measurement Period corresponding to the Operating Energy Model (July 2019 to February 2020). The Baseline Energy Model Measurement Period must be the same 8 months, a year earlier (July 2018 to February 2019).

Requirement 7   Sub-metering Method

Requirement

7.1   In accordance with clause 7A.B1(a) of the ESS Rule, the Sub-metering Method can only be used to adjust for NREs that are due to:

   (a) the addition or removal of equipment other than the Current Implementation's End User Equipment (EUE);
   (b) the expansion or contraction of the Measurement Boundary;
   (c) the addition of on-site generation; or
   (d) Energy Savings from OIMPs with existing sub-metering.

7.2   The NRA using the Sub-metering Method must be made directly to the energy consumption data of the corresponding Observations in which the NRE applies.

7.3   The NRA using Sub-metering Method must be undertaken for each Observation.

7.4   The time clocks of any sub-metering equipment used in the Sub-metering Method must be in synchronization with the time clock of the meter used to establish the PIAM&V Energy Models. The maximum acceptable error in time clock synchronization is 1.2 hours, or 5% of an Observation, whichever is smallest.

7.5   If sub-metered data is missing for more than 2% of one sub-metered Observation, the entire Observation must be discarded. The maximum amount of sub-metered Observations that can be excluded from the relevant Energy Models' Measurement Period is 25%.

7.6   Where equipment is added or removed within the Measurement Boundary with a consequent impact on an Independent Variable that is a direct or indirect output of the equipment, both the energy consumption and the Independent Variable of the added or removed equipment must be sub-metered if an adjustment is to be made using the Sub-metering Method.

7.7   For the purpose of satisfying Requirement 7.6, the NRA using the Sub-metering Method must be applied to both the energy consumption and the Independent Variables' data.

7.8   If an NRE which meets one or more of the criteria in Requirement 7.1 causes the energy consumption to increase, the Sub-metering Method must be followed in accordance with Formula **NRA.F.7a** below:

$$Adjusted\ metered\ energy\ =\ metered\ energy\ -\ NRA\ per\ Observation \qquad \text{(NRA.F.7a)}$$

7.9   If an NRE which meets one or more of the criteria in Requirement 7.1 causes the energy consumption to decrease, the Sub-metering Method must be followed in accordance with Formula **NRA.F.7b** below:

$$Adjusted\ metered\ energy\ =\ metered\ energy\ +\ NRA\ per\ Observation \qquad \text{(NRA.F.7b)}$$

Explanatory text:

The Sub-metering Method may be used to adjust for NREs that would cause the energy consumption within the Measurement Boundary to increase or decrease, with **Table 4** showing examples of each.

Table 4: Examples of NREs that cause energy consumption to either increase or decrease.

NREs that cause energy consumption to increase	NREs that cause energy consumption to decrease
- Cogeneration system causes metered site gas usage to increase. - Building extension causes metered site electricity consumption to **increase.** **A new steam boiler is added to cope with increased demand for steam due to increased production.**	- Grid-connect solar PV system installed on rooftop causes metered site electricity usage to decrease. - Cogeneration system causes metered site electricity usage to decrease. - Use of a production line is discontinued. - A Lighting Upgrade is implemented as an OIMP.

Requirement 8   Definitions

8.1   In this document:

"Acceptable Energy Model" is an Energy Model which meets the minimum statistical requirements in accordance with Table A22 of Schedule A in the ESS Rule. An Energy Model is not acceptable if it does not meet the minimum statistical requirements.

"COVID-19" is the disease caused by the virus SARS-CoV-2.

"COVID" is any period in which NSW, or part of NSW, is subject to a Public Health Order issued due to the novel coronavirus (COVID-19) pandemic.

"COVID-Impacted Period" refers to any period commencing at or after the start of COVID during which a site energy consumption, provided such changes are attributed to COVID.

"Current Implementation" is the Implementation for which the PIAM&V Energy Model is being established and is impacted by NREs.

"Effective Range Adjustment Factor (ERAF)" is an adjustment factor applied to the Normal Year Energy Savings during time periods at the Modelling Frequency that correspond to values of the Independent Variables that fall outside the Short Energy Model's Effective Range.

"Energy Model" means the Baseline Energy Model or the Operating Energy Model.

"Full Operating Cycle" is the period that spans the full range of the equipment energy consumption, from maximum energy consumption and demand to minimum.

"Observation" is the time period at the Measurement Frequency, during which the measured data of energy consumption, Independent Variables, and Site Constants is used to build an Energy Model.

"Other Implementation (OIMP)" is defined as the delivery of a Recognised Energy Saving Activity other than the Current Implementation. "Other Implementation (OIMP)" refers to an Implementation that used clause 7, 7A, 8, or 9 of the ESS Rule to create ESCs within the Current Implementation's Measurement Boundary.

"Permanent NRE" is a continuous event that permanently affects energy consumption and is not modelled by any of the Independent Variables or the Site Constants.

"Relative Precision of the Estimated Energy Savings" is the amount by which the estimated Energy Savings is expected to deviate from the true value, expressed as a percentage of the estimated Energy Savings and determined at a 90% confidence level.

"Short Energy Model" refers to an Energy Model created using the Short Energy Models Method in accordance with Requirement 6 for the purpose of making an NRA.

"Temporary NRE" is an intermittent event that affects energy consumption for a short period and is not modelled by any of the Independent Variables or the Site Constants.

Requirement 9   Formulas

NRA.F.1

$$Average\ annual\ Energy\ Savings\ from\ OIMP\ (MWh)\ = $$
$$\frac{Number\ of\ certificates\ created\ from\ OIMP}{Lifetime\ of\ OIMP\ (years)*Certificate\ Conversion\ Factor*Regional\ Network\ Factor}$$

NRA.F.2

$$Adjusted\ average\ annual\ Energy\ Savings\ from\ OIMP\ (MWh)$$
$$= Average\ annual\ Eligible\ Fuels\ Savings\ from\ OIMP(MWh)*OAF$$

NRA.F.3

$$Energy\ Savings\ from\ the\ OIMP\ per\ Observation\ (MWh)$$
$$= \frac{Adjusted\ average\ annual\ \ Energy\ Savings\ from\ OIMP\ (MWh)}{Number\ of\ Observations\ per\ year}$$

NRA.F.4

Adjusted metered energy per Observation for the OIMP

$$= metered\ energy + \sum_i Energy\ Savings\ from\ OIMP_i$$

NRA.F.5

$$Overall\ Relative\ Precision =$$
$$Relative\ Precision\ of\ the\ Estimated\ Energy\ Savings\ from\ the\ Current\ Implementation +$$
$$\sum_i Xi^2$$

NRA.F.6

$$Normal\ Year\ Energy\ Savings$$
$$= \sum_t \left(\left(E_{Baseline(\tilde{x}_1(t),\ \tilde{x}_2(t),\dots\tilde{x}_p(t)\ t)} - E_{Operating(\tilde{x}_1(t),\ \tilde{x}_2(t),\dots\tilde{x}_p(t)\ t)} \right). ERAF_t \right)$$
$$+ Interactive\ Energy\ Savings$$

NRA.F.7a

NRA-Adjusted metered energy = (metered energy) – (NRA per Observation)

NRA.F.7b

NRA-Adjusted metered energy = (metered energy) + (NRA per Observation)

APPENDIX A

Examples on Other Implementations (OIMP) Estimate Method

Example 1

Consider a Lighting Upgrade under the Commercial Lighting Energy Savings Formula sub-method (CLF) within the Measurement Boundary for a heating, ventilation, and air conditioning (HVAC) upgrade under the PIAM&V Method. Daily Baseline and Operating Energy Models are established using Regression Analysis on a site that is located in metropolitan Sydney.

The HVAC upgrade's Implementation Date was 21 February 2020, with a Baseline Energy Model Measurement Period extending from 1 January 2019 to 31 December 2020. The Operating Energy Model Measurement Period was chosen to be from 1 March 2020 to 28 February 2021.

The Lighting Upgrade occurred on 15 May 2020, during the Operating Energy Model Measurement Period of the HVAC upgrade where the lighting circuit was not sub-metered. As an OIMP, the occurrence of Energy Savings from the Lighting Upgrade is considered as an NRE.

The OIMPs Estimate Method will be used to make the NRA.

Assume an overall of 387 ESCs were created from the Lighting Upgrade. As per the ESS Rule method used to calculate ESCs for the Lighting Upgrade, the lifetime is 10 years. The Electricity Certificate Conversion Factor is 1.06 and the Regional Network Factor is 1.0. Therefore:

Using Formula **NRA.F.1**, annual Energy Savings $= \frac{387}{10 * 1.06 * 1.0} = 36.5\ MWh = 36,500\ kWh$

Using Formula **NRA.F.2**, and using OAF = 1.1, the adjusted annual Energy Savings = $36,500 * 1.1 = 40,150\ kWh$

Using Formula **NRA.F.3**, the daily Energy Savings from the Lighting Upgrade $= \frac{40,150\ kWh}{365} = 110\ kWh$

The day immediately after the commissioning of the Lighting Upgrade (on 16 May 2020), whole site electricity usage was measured to be 655 kWh.

Applying formula **NRA.F.4**, the metered energy for that day is $655 + 110 = 765\ kWh$.

In all subsequent days (Observations) of the Operating Energy Model Measurement Period after the lighting upgrade's Implementation Date, 110 kWh must be added to the metered energy data.

Over the HVAC Upgrade Operating Energy Model Measurement Period (from 1 March 2020 to 28 February 2021), the lighting upgrade occurred from 16 May 2020, or for 288 days. Therefore, the overall Energy Savings from the Lighting Upgrade over the Operating Energy Model Measurement Period were (288 days) * (110 kWh/day) = 31,680 kWh

After adjusting for the Lighting Upgrade using formula **NRA.F.4**, the savings from the Current Implementation (the HVAC upgrade) were 182,500 kWh. Then the ratio of the Energy Savings from the lighting upgrade to the overall Energy Savings (X) is:

$$X = \frac{31,680}{31,680 + 182,500} = 0.148$$

With the Current Implementation's Relative Precision being 0.11, then using formula **NRA.F.5**, the overall Relative Precision $= 0.11 + (0.148)^2 = 0.132$

According to Table A23 of the ESS Rule, this corresponds to an Accuracy Factor of 1.0.

Example 2

Following the Lighting Upgrade in Example 1, the same site undertakes a refrigeration upgrade on 2 July 2020, with annual Energy Savings of 120 MWh calculated using PIAM&V. Therefore:

Using Formula **NRA.F.2**, and using OAF = 1.0, the adjusted annual Energy Savings of the refrigeration upgrade $= 120,000 * 1.0 = 120,000 \, kWh$

Using Formula **NRA.F.3**, the daily Energy Savings from the refrigeration upgrade $= \frac{120,000 \, kWh}{365} = 328.8 \, kWh$

Over the HVAC Upgrade Operating Energy Model Measurement Period (from 1 March 2020 to 28 February 2021), the refrigeration upgrade was present from 3 July 2020, or for 240 days. Therefore, the overall refrigeration Energy Savings over the Operating Energy Model Measurement Period were (240 days) * (328.8 kWh/day) = 78,904 kWh.

In this example, the Energy Savings from the Lighting Upgrade and from the refrigeration upgrade must be used to make an adjustment to the metered energy consumption using the OIMPs Estimate Method:

1. From 16 May 2020, 110 kWh must be added to the metered energy consumption data to adjust for the Lighting Upgrade – as per example 1.
2. From 2 July 2020, 328.8 kWh must be added to the metered energy consumption data to adjust for the refrigeration upgrade.

After adjusting for the Lighting Upgrade using formula **NRA.F.4**, the savings from the Current Implementation (the HVAC upgrade) were 182,500 kWh. Then the ratio of the Energy Savings from the Lighting Upgrade to the overall savings (X_1) is:

$$X1 = \frac{31,680}{31,680 + 182,500} = 0.148$$

And the ratio of the Energy Savings from the refrigeration upgrade to overall savings (X_2) is:

$$X2 = \frac{78,904}{78,904 + 182,500} = 0.302$$

With the Current Implementation Relative Precision being 0.11, then using formula **NRA.F.5**, the overall Relative Precision $= 0.11 + (0.148)^2 + (0.302)^2 = 0.223$

According to Table A23 of the ESS Rule, this corresponds to an Accuracy Factor of 1.0.

APPENDIX B

Examples on Sub-Metering Method

Illustrating Requirement 7.4:

Example 1

A Regression Analysis is used to build a PIAM&V Energy Model using daily electricity data from a utility meter. Within the Measurement Boundary, a sub-meter time clock is exactly one hour behind the utility meter, as shown in **Figure 6**. As an error of 1 hour is less than the smallest of (5% of 1 day = 1.2 hours) and (1.2 hours), the error is acceptable.

Measurement interval																									
Time shown on PIAM&V meter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0
Time shown on Submeter	23	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

> The submeter time clock is one hour different to the PIAM&V meter. Over an Observation of 24 hours (1 day), the error in the submeter time clock is 1/24 = 4.2%. This is acceptable, as it is less than the smallest of 5% of an Observation and 1.2 hours.

Figure 6: Illustration of sub-meter time clock error.

Example 2

A Regression Analysis is used to build PIAM&V Energy Models using hourly electricity data from a utility meter. Within the Measurement Boundary, a sub-meter time clock is 10 minutes behind the utility meter. The lesser of 5% of one hour or 1.2 hours is 0.05 hours (3 minutes). The submeter time clock must be accurate to within 3 minutes of the corresponding time clock of the utility Observation meter. Therefore, the Sub-metering Method cannot be used with the sub-meter in this example.

Illustrating Requirement 7.5:

Example

A sub-meter is set to log data hourly. Data is missing from 5pm, Monday 23 August to 10am, Saturday 4 September 2021:

    i. If a daily regression model is used, the days from 23 August to 4 September must be removed from the model.

    ii. If a weekly regression model is used, the weeks that encompass the period 23 August to 4 September must be removed, including any partial weeks.

    iii. If a monthly regression model was used, August and September must be removed from the model, as more than 2% of the data is missing from both months.

Illustrating Requirements 7.6 and 7.7:

Example 1

A site uses gas in a steam boiler, with the Independent Variable being the kilograms of steam produced (direct output). The Current Implementation has been to fit an economizer to the boiler. To cope with increased production, an additional steam boiler is added. Both the gas supply to the new boiler and its steam production must be metered to undertake the NRA using the Sub-metering Method, as shown in
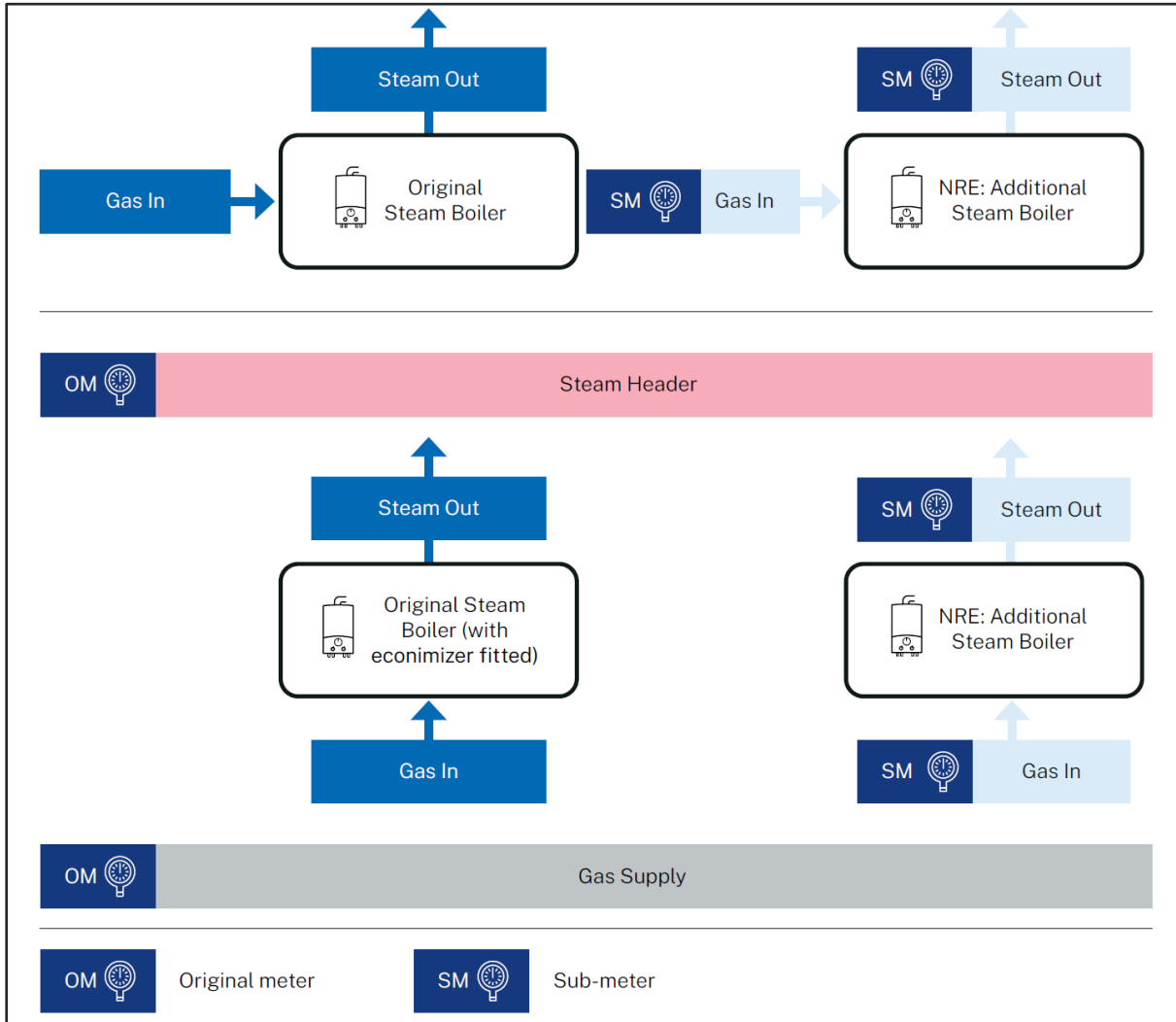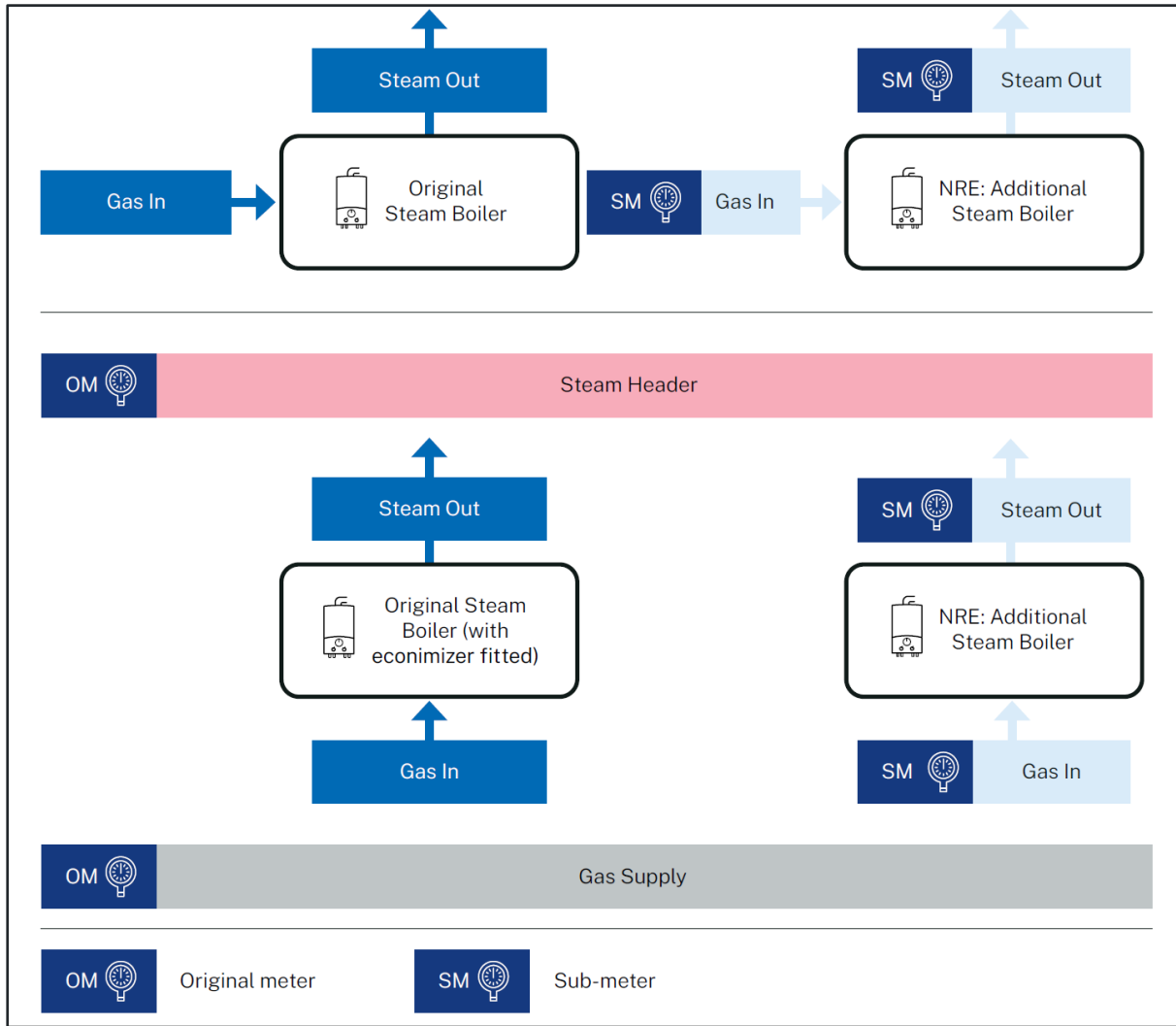

Figure 7.

Figure 7: An illustration to show the need for sub-metering (marked as "SM") to undertake the NRA.

Example 2

A site uses compressed air in production lines, with the Independent Variable being the number of widgets produced across all production lines. This system is shown in **Figure 8**. The Current Implementation is to install a ring main to optimize air pressures. An additional production line is added causing the demand for compressed air to increase and resulting in installing an additional air compressor dedicated solely to the supply of air to the new production line.
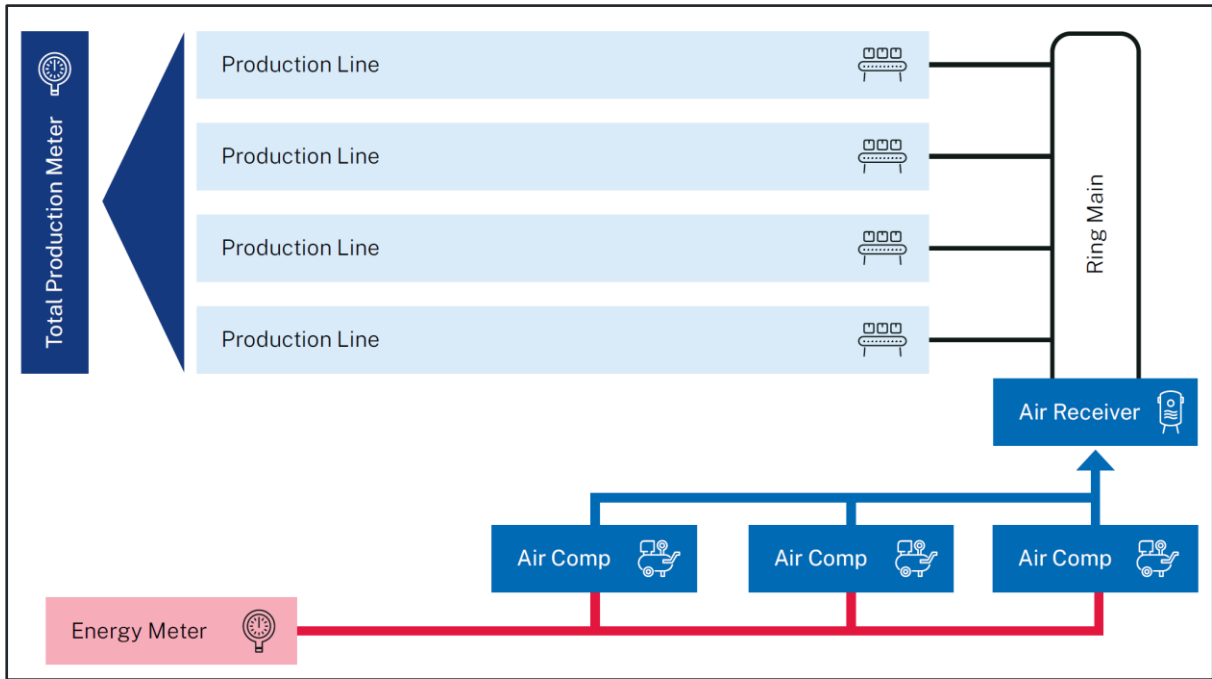
Figure 8: An illustration of the Compressed Air System (CAS) before the NRE.

As shown in **Figure 9**, to undertake the NRA using the Sub-metering Method, both the production of the new line (an Independent Variable that is an indirect output of the equipment) and the electricity consumption of the new compressor must be sub-metered.
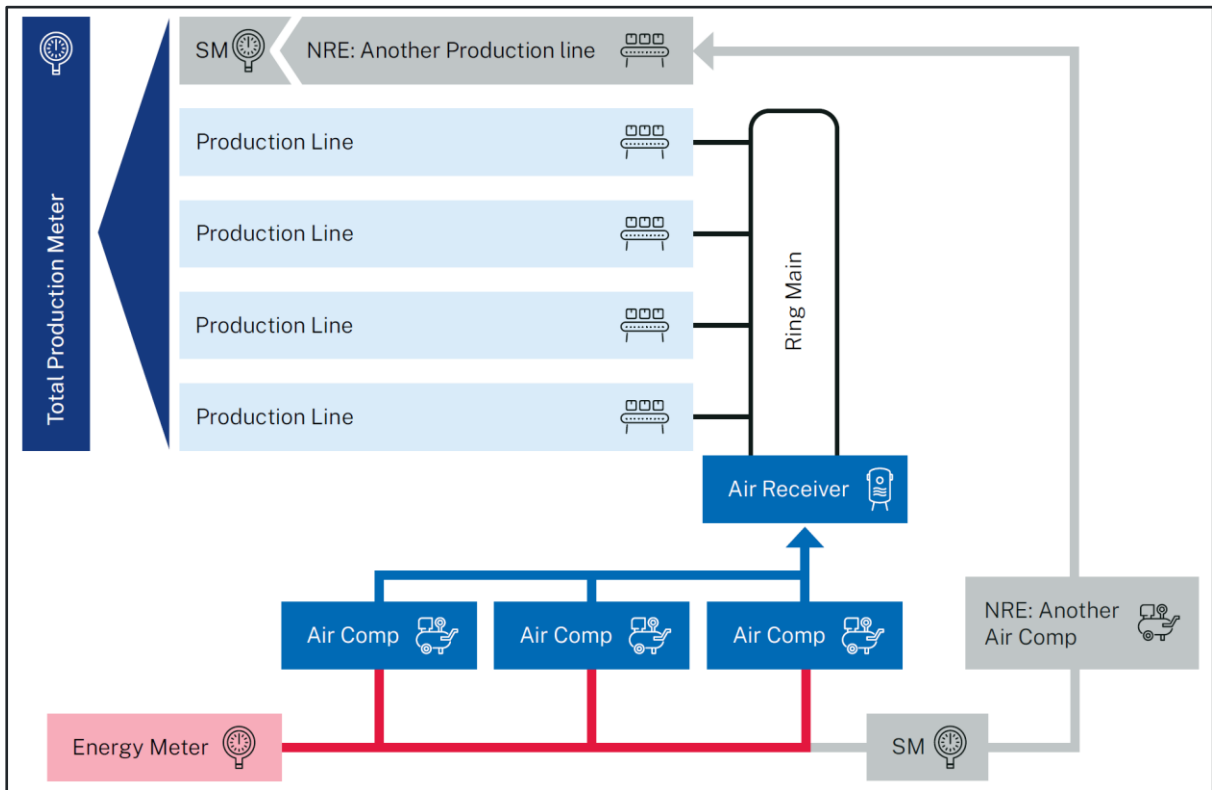

Figure 9: An illustration of the CAS after the addition of new equipment (NRE), with sub-metering installed to undertake the NRA using the Sub-metering Method.

Example 3

A site uses compressed air in production lines, with the Independent Variable being the number of widgets produced across all production lines. The Current Implementation has been to install a ring main and optimize air pressures. This system is shown in **Figure 8**. An additional production line is added and connected to the ring main, increasing the demand for compressed air, and resulting in the installation of an additional air compressor supplying the ring main system, with submeters installed as shown in **Figure 10**. In this case it is not possible to directly relate the energy consumed by the new compressor to the change in the Independent Variable (Production). For example, the new compressor may be more efficient, and consequently one of the old compressors may be mostly turned off. Therefore, an NRA using the Sub-metering Method is not applicable.
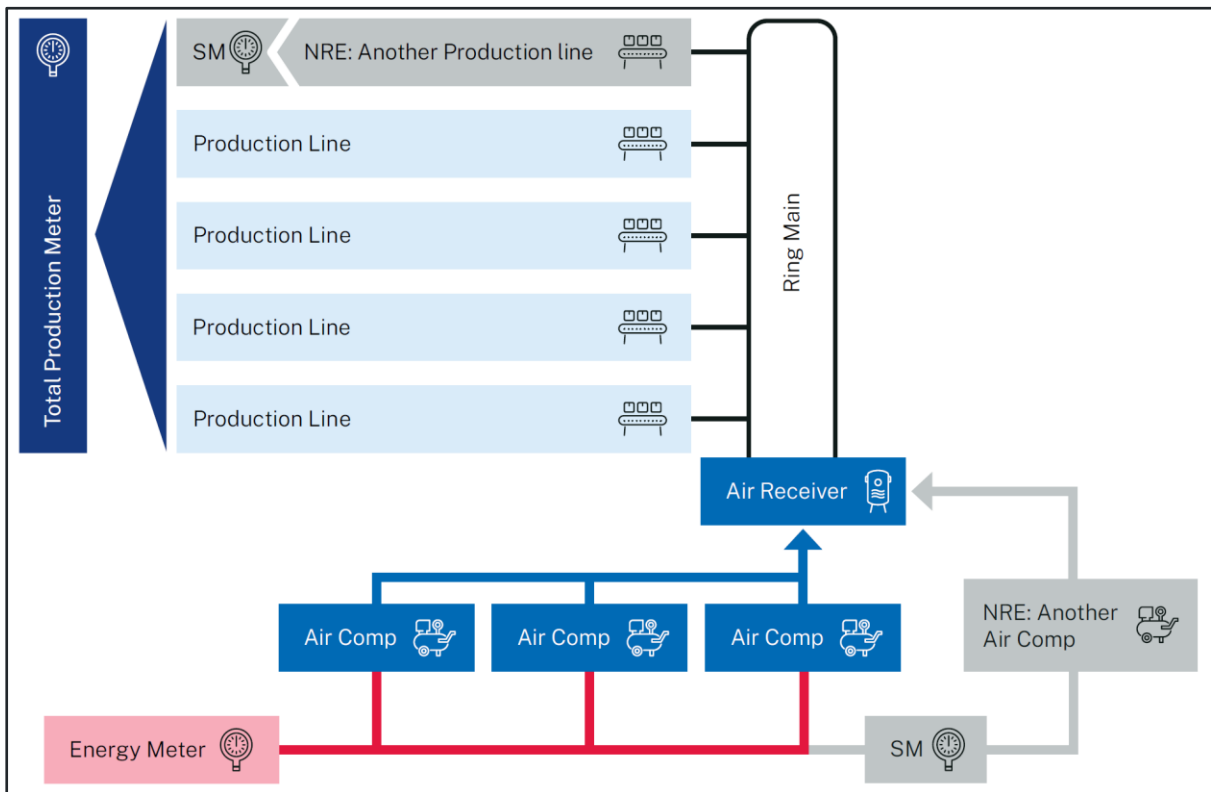

Figure 10: An illustration of the CAS after the addition of new equipment (NRE) and showing sub-metering (SM) installed. An NRA using Sub-metering Method cannot be made because the additional production from the new line cannot be directly attributed to the additional air compressor.

Example 4

A site uses compressed air in production lines, with the Independent Variable being the number of widgets produced. The Current Implementation has been to install a ring main and optimize air pressures, as shown in **Figure 8**. The throughput of the existing production lines is dramatically increased, greatly increasing the demand for compressed air and resulting in the installation of an additional air compressor. The new air compressor is connected to the original air distribution systems as shown in **Figure 11**. In this case it is not possible to determine how much of the increased demand for compressed air is being met by the new compressor. This means that the Sub-metering Method cannot be used in this example, and therefore savings from the Current Implementation cannot be determined when production is above the Effective Range.

Furthermore, if the new compressor was significantly efficient and was staged to be the leading compressor, then Energy Savings would increase. But the added Energy Savings would not be due to the Current Implementation.
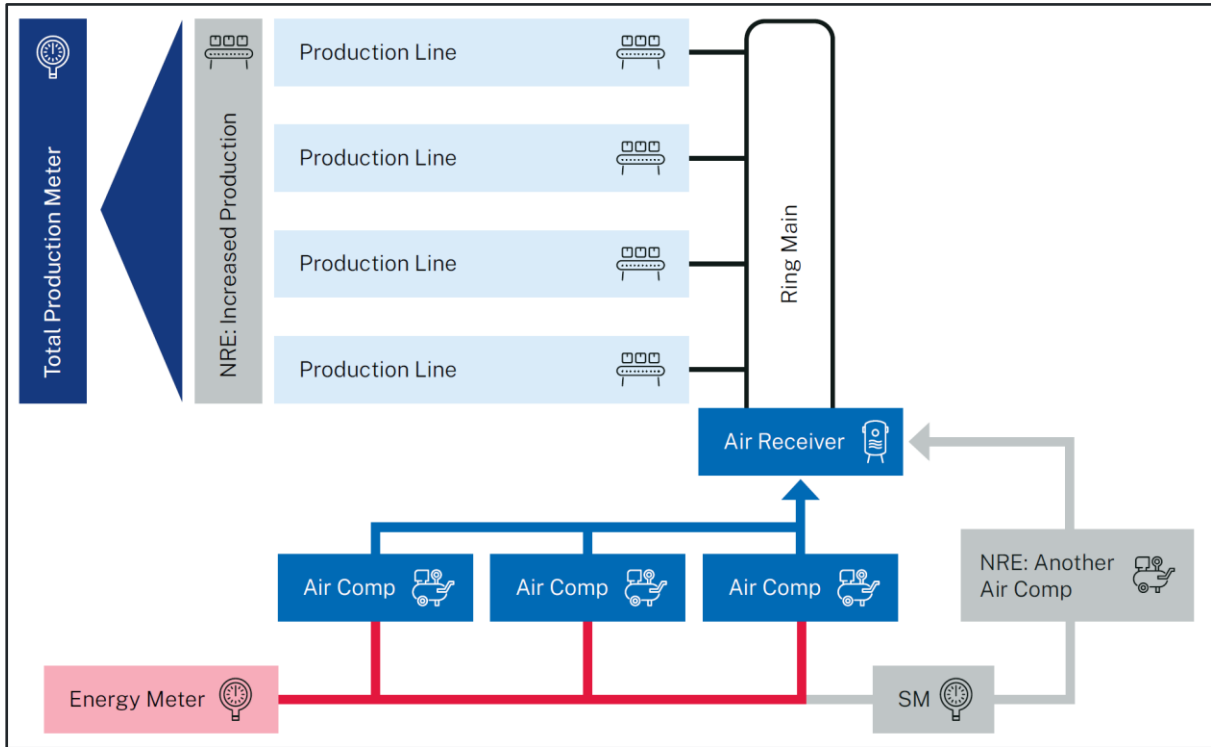

Figure 11: An illustration of the CAS after the addition of new equipment (NRE) and showing submetering (SM) installed. An NRA cannot be made because the additional production cannot be directly attributed to the additional air compressor