NABERS

The Interim Rules

Thermal Energy Systems

Version 1.0 – August 2021

NABERS is a national initiative managed by the New South Wales Government.

Cover photo: Chillers and boilers in a building's mechanical plant room.

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Contents

1 Introduction

1.1 Interim status

Version 1.0 of these **Rules** has been published with an interim status. The **National Administrator** will work closely with **Assessors** in the implementation of these **Rules** and will be gathering feedback before finalising the content of the **Rules**. The interim period is expected to last for six months.

These **Rules** (the present document) must be used during the interim period. However, the **National Administrator** may provide rating specific support to assist with the implementation of these **Rules** prior to their finalisation. This may include pre-approval of delayed implementation and approval of alternative evidence on a case-by-case basis.

The nature of these **Rules** is summarised in the following table:

Table 1.1: Guidance for the interim Rules

Application	The interim **Rules** will apply to all building sectors eligible for a NABERS Energy and Water rating. The interim **Rules** will apply to all ratings submitted from the 1st October 2021 onwards. Use of the interim **Rules** is mandatory during the interim period.
Interim period	The interim **Rules** will be subject to review and finalisation approximately six months from the date of publication.
Existing rating applications	If an existing rating application, close to submission, that has followed the previous thermal metering **rulings** experiences difficulty in meeting any requirements in these interim **Rules**, exemption from use may be granted by the **National Administrator**. **Note:** An exemption based on this reason will be less likely to be granted after two months has lapsed since publication.
Other exemptions	If an **Assessor** is unable to meet the requirements laid out in these interim **Rules**, the **Assessor** may apply for an exemption to these **Rules** by contacting the **National Administrator**. Exemptions may be granted conditionally, on a case-by-case basis and at the **National Administrator's** discretion.
Alternative methodology	**Assessors** must comply with the full interim **Rules** unless prior approval has been sought and approved by the **National Administrator**.

	Where appropriate, **Assessors** may contact the **National Administrator** for use of this **Rules'** methodology in alternative applications such as on-site recycled water and rainwater systems. Prior approval is required and may be granted conditionally, on a case-by-case basis and at the **National Administrator's** discretion.
Feedback and support	**Assessors** are encouraged to provide feedback, as well as any concerns or queries, to the NABERS mailbox at nabers@environment.nsw.gov.au

1.2 Summary

The National Australian Built Environment Rating System (NABERS) is a performance-based rating system managed by the **National Administrator**.

NABERS ratings are expressed as a number of stars, for example:

NABERS rating		Performance comparison
6 stars	★★★★★★	Market leading building performance
5 stars	★★★★★	Excellent building performance
3 stars	★★★	Market average building performance

An accredited NABERS Energy or Water rating is awarded when the **National Administrator** certifies a rating completed by an **Assessor**. The **National Administrator** may independently audit the rating and assist in resolving complex technical issues.

This document provides rules for NABERS **Assessors** when undertaking assessments for ratings with **shared thermal energy systems**. It supersedes the 2008 NABERS document *Validation Protocol for Thermal Energy Exclusions* v2.0.

Chilled water (CHW), condenser water (CCW), heating hot water (HHW) and/or domestic hot water (DHW) may be distributed by a system that is shared by both the **rated premises** and **other users**. The proportion of energy used by the **rated premises** must be included in the **minimum energy coverage** for the rating if it is within the minimum energy coverage of the rating.

This document also provides guidance on whether water usage of **shared thermal energy systems** (e.g. cooling towers) should be included or excluded when conducting a NABERS water rating.

In the following text, two methodologies for apportioning the energy consumption of **shared thermal energy systems** between the users of the thermal energy are defined:

a) Estimated Methodology (Chapter 3); and

b) Standard Methodology (Chapter 4).

The Standard Methodology applies to all buildings that can be rated using a NABERS Energy rating. The Standard Methodology can also be used to apportion water consumption of thermal energy systems for use in all NABERS Water ratings.

The Estimated Methodology applies only to NABERS Energy for Offices Base Building and Whole Building ratings and has no thermal or energy sub-metering requirements.

In addition, guidance on thermal metering validation requriments have been added to the end of this document (Appendix D – Thermal Energy Metering Validation Requirements).

1.3 Interpretations of the Rules

Assessments for an accredited rating must comply with the version of the **Rules**, and any relevant **rulings,** current on the day the rating application is lodged to NABERS, unless—

a) the **National Administrator** has specifically approved otherwise in writing, or

b) the assessment is conducted under the terms of a NABERS Commitment Agreement which specifies an earlier version of the **Rules**.

A **ruling** takes precedence if there is any conflict with the **Rules**. If there is a conflict between **rulings**, the most recent takes precedence.

In addition to the **Rules**, an **Assessor** is to make use of relevant **rulings** and the **NABERS rating input form**.[1] A list of the documentation required in relation to this document is given in Chapter 5.

1.4 Situations not covered by the Rules

These **Rules** are intended to cover most ratings. If an exceptional situation is encountered and the **Rules** are not easily applicable, the **Assessor** must contact the **National Administrator** for assistance.

Where an **Assessor** is unsure how to apply the **Rules**, the **National Administrator** may resolve the issue by making an interpretation of the **Rules** or by advising the use of a specific procedure that aligns with the intention of the **Rules**. Written correspondence from the **National Administrator** is required as evidence if this occurs.

Procedures not contained within these **Rules** may only be used for a particular rating with prior written approval from the **National Administrator**. Approval to use the same procedure must be sought from the **National Administrator** each time it is proposed to be used. Approval is entirely at the discretion of the **National Administrator**.

[1] **Rules** texts are amended as required by additional **rulings** which are published on the NABERS website: www.nabers.gov.au.

1.5 How to use this document

1.5.1 Coverage and related documents

The **Rules** allow apportioning of energy or water consumption of **shared thermal energy systems** to separate end uses that are required to be included in a NABERS rating from those that are not.

This document is to be applied in conjunction with the relevant **Rules** and does not replace the provisions of the relevant **Rules**. The following guidance regarding *end uses*, *shared facilities and services*, and *Co- or Tri-generation* applies:

a) **End uses:** This document does not define the end uses that are required to be included in the rating. The **Assessor** must always refer to the relevant **Rules** and subsequent **rulings** to determine the end uses to be included.

b) **Shared facilities and services:** There are a range of other shared facilities and services with specific **Rules** regarding their apportioning of energy and water inputs. The **Assessor** should refer to the *Shared Facilities and Shared Services Rulings*.

c) **Co- or Tri-generation:** When a rating includes a cogeneration or trigeneration system, the **Assessor** must refer to the principles outlined in the *Interim Methodology for the treatment of Cogeneration and Trigeneration Systems in NABERS ratings*.

1.5.2 Formatting conventions and referencing

The term '**Rules**' refers to a body of works produced by NABERS that specify what must be examined, tested and documented when an **Assessor** conducts a rating. Wherever the term is used in this document from Chapter 3 onwards, it refers to this particular document, *NABERS The Rules —[Title]*. Other **Rules** documents mentioned in the text are distinguished from the present document by the inclusion of their title.

Notes and **examples**: Text appearing with a grey tint in the background is explanatory text only. It is not to be read as part of the **Rules** and/or is not essential for the proper use of this document.

Text appearing **dark green and bold** is a defined term (see Chapter 2).

All main references to documentation requirements appear *italicised and in aqua font*.

Internal cross references appear as numbered sections (e.g. Section 4.2) or chapters (e.g. Chapter 3) and are hyperlinked. Cross references to an individual **Rules** text are numbered appropriately together with the title of the specific text.

1.6 Related documents

The following documents have been referenced within these Rules:

NABERS The Rules – Energy and Water for Offices, v4.1, 2020

NABERS The Rules – Energy and Water for Shopping Centres, v4.0, 2020

NABERS The Rules – Metering and Consumption, v1.2, 2020

Interim Methodology for the treatment of Cogeneration and Trigeneration Systems in NABERS ratings

Shared Facilities and Shared Services Rulings

CSA C900.1, *Heat Meters Part 1 – General Requirements*, 2013

EN 1434-1, *Thermal Energy Meters – Part 1: General Requirements*, 2015

EN 1434-2, *Heat Meters – Part 2: Constructional Requirements*, 2015

OIML R75-1, *Heat Meters Part 1: General Requirements*, 2002

Building Owners and Managers Association (BOMA), *Method of Measurement*, 1989 or 2017

Building Owners and Managers Association (BOMA), *Method of Measurement (Net Rentable Area)*, 1985 or 2017

The Property Council of Australia (PCA), *Method of Measurement: Commercial*, 2008 (1997 reprint)

2 Terms and definitions

This chapter lists the key terms and their definitions that are integral to the proper use of this document.

Term	Definition
acceptable data	Data which meets the applicable accuracy and validity requirements of these **Rules**.
acceptable estimate	The values derived from an estimation method permitted by these **Rules** in place of incomplete or uncertain data. Estimates that do not satisfy the above specifications are deemed unacceptable and cannot be used in the rating.
Assessor	An accredited person authorised by the **National Administrator** to conduct NABERS ratings.
billing period	The continuous 12-month period of data which is used for an individual meter in the rating.
calculator	A sub-assembly, which receives signals from the flow sensor and the temperature sensors, and calculates and indicates the quantity of the thermal energy exchanged.
circulation energy	The energy consumed by a circulation pump used in the process of transferring thermal energy. The energy used by this pump can be apportioned using these **Rules**. **Note:** If this pump is exclusively used to transfer energy from the **rated premises** to **other users** then it is considered to be **dedicated transfer energy** and NOT circulation energy.
computer server room	A room designed to accommodate computer and associated communications equipment that is separated from adjacent spaces by full-height walls and a door.

Term	Definition
dedicated transfer energy	The energy consumed by a dedicated transfer pump exclusively used in the process of transferring thermal energy from the **rated premises** to **other users** or vice versa. **Example:** The energy associated with a secondary chilled water pump circulating chilled water to the rated office as well as the adjacent hotel is **circulation energy** *not* **dedicated transfer energy**. However, if the same office rating had a separate heat exchanger connection to the adjacent hotel, then the tertiary chilled water pumps for the heat exchanger circulating chilled water to the adjacent hotel would be **dedicated transfer energy**.
energy input	The total energy consumption of all components of the **shared thermal energy system** being apportioned, including but not limited to: a) Electricity or gas inputs to chillers or boilers; b) Energy input to chilled water loop, heating hot water loop or condenser water loop circulation pumps (or, **circulation energy**); c) Energy inputs to cooling towers. **Note:** This definition does not include the energy use associated with building management systems or **dedicated transfer energy**.
exported flow rate	The volumetric flow rate (L/s) of chilled water (CHW), heating hot water (HHW), condenser water (CCW) or domestic hot water (DHW) exported from the **rated premises** that is not included in the **minimum energy coverage**.
excluded serviced area	The area of **other users** served by the **shared thermal energy system** measured to the **relevant area measurement standard(s)**. This includes the area of **other users** both inside and outside the boundaries of the building being rated.
flow sensor	A flow measuring sub-assembly which indicates the volume, mass or volumetric flow-rate of a liquid.
imported flow rate	The volumetric flow rate (L/s) of chilled water (CHW), domestic hot water (DHW), heating hot water (HHW) or condenser water (CCW) imported to the **rated premises** that must be included in the **minimum energy coverage**.

Term	Definition
measurement standard for rated area	The standard used for determining the Net Lettable Area (NLA), Gross Lettable Area Retail (GLAR) or Gross Lettable Area (GLA) of a **rated premises**, as set out in a) The Property Council of Australia (PCA), *Method of Measurement: Commercial*, 2008 (1997 reprint); or b) Building Owners and Managers Association (BOMA), *Method of Measurement*, 1989 or 2017; or c) Building Owners and Managers Association (BOMA), *Method of Measurement (Net Rentable Area)*, 1985 or 2017.
minimum energy coverage	The energy end uses required to be included in a rating assessment as defined in the relevant NABERS **Rules**.
minimum water coverage	The water end uses required to be included in a rating assessment as defined in the relevant NABERS **Rules**.
National Administrator	The body responsible for administering NABERS, in particular— a) establishing and maintaining the standards and procedures to be followed in all aspects of the operation of the system, and b) determining issues that arise during the operation of the system and the making of ratings, and c) accrediting **Assessors** and awarding accredited ratings in accordance with NABERS standards and procedures. The functions of the National Administrator are undertaken by the NSW Government.
NABERS rating input form	The rating input form provided by NABERS for use by **Assessors** in the calculation of accredited ratings. For NABERS ratings for Offices, this is in the NABERS Rate application. For NABERS **co-assess** ratings, this is the NABERS Co-Assess Office Rating Calculator. **Note:** A new online platform called NABERS Perform is being developed by the **National Administrator** that will consolidate the functions of NABERS Members and NABERS Rate. It is the **National Administrator's** intent that future rating applications will be submitted through this new online platform.
other users	A building or space whose services are not included in the **minimum energy coverage** and/or **minimum water coverage** of the rating being conducted.

Term	Definition
potential error	The total of all **acceptable estimates** (including assumptions, approximations and unverified data), included in the rating assessment. The **NABERS rating input form** automatically calculates the potential error based on the data provided.
rating period	The 12-month base period for the rating, requiring at least 12-months of **acceptable data** upon which the rating is based.
rated premises	The tenancy or building to be rated.
rating scope	The scope of the rating – either Base Building, Whole Building or Tenancy.
relevant area measurement standard	The measurement standard specified for measuring area in the relevant NABERS **Rules** for the specific space type. **Note 1:** The relevant area measurement standard is determined based on the space type, not the rating being conducted. **Note 2:** GLAR for retail tenancies, or NLA for office areas, both use a **measurement standard for rated area**. For space types where no NABERS provisions exist, **Assessors** may use area information defined in lease documentation or use a **measurement standard for rated area.**
Remote Metering Reading System (RMRS)	System whereby meter readings and other crucial meter data are sent to a data collection system. Such a system provides virtual meter access when physical access is not possible.
Rules	Authoritative document produced by the **National Administrator** that specifies what must be covered by an **Assessor** in order to produce a rating.
ruling	An authoritative decision by the **National Administrator** which acts as an addition or amendment to this document.
shared thermal energy	Chilled water (CHW), heating hot water (HHW), condenser water (CCW) and/or domestic hot water (DHW) that is shared between the **rated premises** and at least one **other user**.
shared thermal energy output	The output(s) of the **shared thermal energy system**: chilled water (CHW), heating hot water (HHW), condenser water (CCW) and domestic hot water (DHW) used to transfer thermal energy.

Term	Definition
shared thermal energy system	A system that supplies chilled water (CHW), heating hot water (HHW), condenser water (CCW) and/or domestic hot water (DHW) to the **rated premises** and at least one **other user**. **Example:** A chilled water plant providing chilled water to the rated building and the building next door.
temperature sensor pair	A sub-assembly (for mounting with or without pockets), which senses the temperatures of the heat-conveying liquid at the flow and return of a heat-exchange circuit.
total system flow rate	The total volumetric flow rate (in L/s) of the thermal system being considered within the **rated premise's** energy/water metering boundary. **Note:** This includes **exported flow rates** to **other users** in the same building or in a different building. **Example:** In an office rating, a chilled water plant within the office building boundary supplies chilled water to: a) The office spaces within the **rated premises**; b) A retail tenancy in the office building; and c) The hotel next door. The **total system flow rate** of chilled water is the sum of the flow rate to the office space, retail tenancy and hotel next door. The **exported flow rate** is the sum of the flow rate to the retail tenancy and hotel.
total serviced area	The sum of all areas served by the **shared thermal energy system** and measured to the relevant **measurement standard for rated area**. **Note:** This differs from the rated area used in the rating as it includes the area of **other users** in the building being rated.

3 Estimated Methodology

3.1 Summary

3.1.1 Application

The Estimated Methodology only applies to NABERS Energy for Offices Base Building and Whole Building ratings, and cannot be used for any other rating type. It can be used for either inclusions or exclusions.

The Estimated Methodology can be used concurrently for chilled water (CHW), domestic hot water (DHW), condenser water (CCW) and heating hot water (HHW), so long as the **potential error** of the rating does not exceed 5 %.

Note: The Estimated Methodology is based on a generic breakdown of commercial office Base Building and Whole Building emissions. The derivation is included in Appendix A – Derivation of Estimated Methodology Calculations. Energy figures to be used in the rating are wholly estimated based on approximations and electricity/ gas metering of the thermal system is not required.

3.1.2 Purpose

The Estimated Methodology allows **Assessors** to estimate a small inclusion or exclusion of energy from a **shared thermal energy system** to meet the **minimum energy coverage**.

There are no thermal or energy metering requirements for the shared system using this method and the estimate is included in the **potential error** calculation. The shared system can either be located within the boundaries of the **rated premises** or outside the boundaries. The location of meters for energy inputs to the shared system can be either within or external to the **rated premises**.

3.1.3 Using the Estimated Methodology

The rating assessment must be completed in accordance with the **Rules** before the Estimated Methodology can be applied.

There are two apportioning methods that can be used for the Estimated Methodology:

a) Flow rate based apportioning (Section 3.2), which is used to estimate an energy inclusion or exclusion;

b) Area-based apportioning (Section 3.3), which is used to estimate an energy exclusion.

Note: **Assessors** are only required to determine the inputs to the apportioning method used and enter the data into NABERS Rate. The energy to be included or excluded is automatically calculated within NABERS Rate.

If more than one thermal energy estimate is required, the **Assessor** must consider each type of thermal energy separately.

Example: An energy exclusion is required for chilled water and heating hot water. The **Assessor** must determine the apportioning inputs for the chilled water and heating hot water separately. The **Assessor** must enter the apportioning inputs for the chilled water and heating hot water into separate tabs in NABERS Rate.

3.1.4 Acceptable estimates

The Estimated Methodology is a method for calculating an **acceptable estimate** of excluded energy consumption, adding to the **potential error**. As the **potential error** cannot exceed 5 % in total for the rating, this method is only suitable for small adjustments.

If the **potential error** exceeds the allowable limit, it is acceptable to reduce the excluded flow rates so that the limits are not exceeded, and the building can be rated. This means some of the flow will effectively be included in the rating.

The Estimated Methodology cannot be used for small inclusions.

3.2 Flow rate based apportioning

3.2.1 General

The flow rate based apportioning method estimates the energy to be allocated to the rating. It does this by comparing the imported or **exported flow rate** to the **total system flow rate** of chilled water, heating hot water or condenser water.

For documentation requirements, see Section 5.2.1.

3.2.2 Process overview

The process for determining flow rate based apportioning is as per **Table 3.1**:

Table 3.1: Flow rate based apportioning

	Step	Reference
1	Determine the **total system flow rate**	Section 3.2.3
2	Determine the **imported** or **exported flow rate**	Section 3.2.4
3	Enter the data into NABERS Rate	Section 3.2.5

3.2.3 Measuring total system flow rate

3.2.3.1 General

The **total system flow rate** is determined using one of the methods below, in order of priority:

a) Volumetric flow meters measuring the instantaneous flow rate; or

b) Design parameters (the design flow rate at normal expected conditions rather than maximum capacity); or,

c) Accumulated flow meters measuring the total flow volume.

Note: As estimated usage profiles cannot be used to adjust the instantaneous or design flow rate calculations, **Assessors** are advised to use an accumulated flow measurement if they want to account for usage profiles in the Estimated Methodology.

3.2.3.2 Volumetric flow meters

Volumetric flow meters measuring the flow rate can only be used where the connected equipment can be manually set to the full design flow rate for the measurements, or if the flow rate can be proven not to vary significantly throughout the year. In other words, the use of this method assumes a constant flow system instead of a variable flow system.

The **total system flow rate** is the sum of instantaneous flow rates for all connected equipment and any bypass flow. If the coverage of instantaneous flow meters does not include all connected equipment in-use, then the instantaneous flow meters method cannot be used.

The unit of measurement for this method is litres per second (L/s).

3.2.3.3 Design flow parameters

When using design parameters for flow rates, use the design flow rates for all connected items of equipment in use on the demand side. Flow rate allowances for branches without connected equipment in-use (e.g. unused equipment, future equipment, or future expansion) must not be included. It is not acceptable for the design flow parameters to be estimated using a W/m^2 allowance.

The **total system flow rate** is the sum of all design flow for all connected equipment.

The unit of measurement for this method is litres per second (L/s).

3.2.3.4 Accumulated flow meters

Accumulated flow meters can be used where data is available for a full year, or over shorter periods as small as seven days, provided reasonable seasonal adjustments are made to annualise the data.

The **total system flow rate** is the sum of accumulated flow for all connected equipment and any bypass flow. If the coverage of accumulated flow meters does not include all connected equipment in-use, then the accumulated flow meters method cannot be used.

The unit of measurement for this method is litres or kilolitres.

3.2.4 Measuring imported or exported flow

The **Assessor** must determine the imported or **exported flow rate** using the same method used to determine the **total system flow rate**.

The **total system flow rate** and imported or **exported flow rate** readings must be taken at the same time when using instantaneous flow rate meters and accumulated flow meters.

3.2.5 Using the flow rate

The **total system flow rate** and the imported/**exported flow rate** values are entered into NABERS Rate. NABERS Rate will then calculate the excluded energy for the rating.

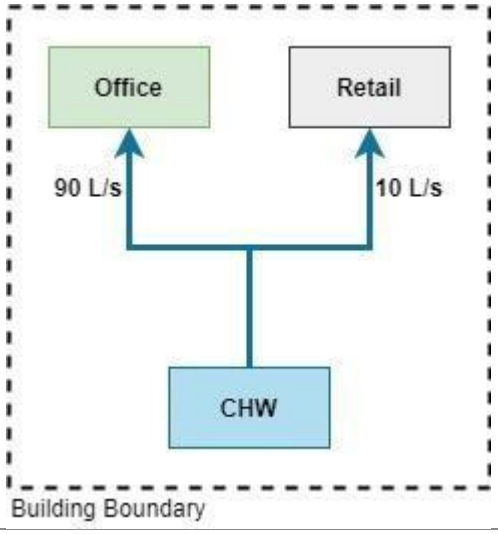
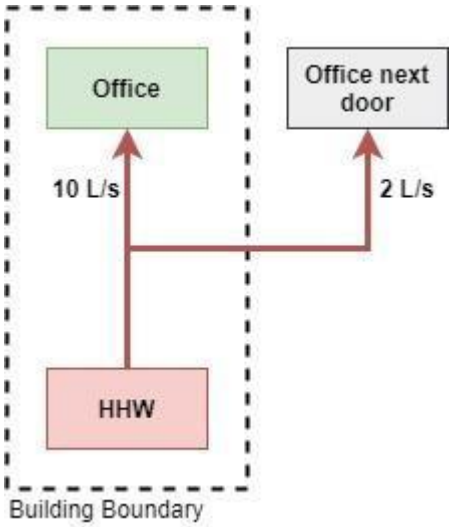
3.2.6 Examples

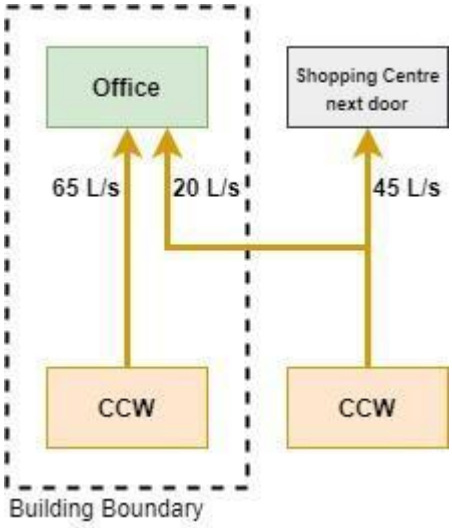
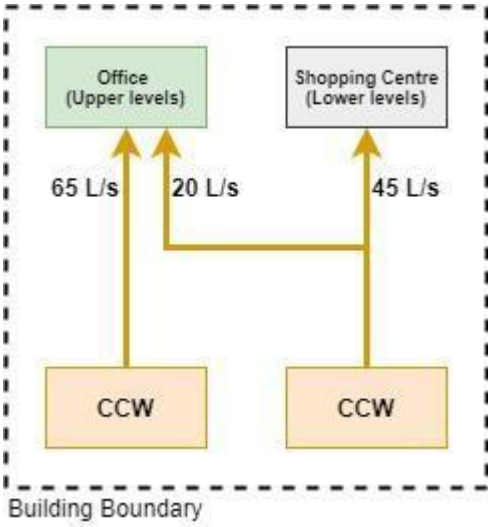
The following examples in **Table 3.2** assume that:

a) The **Assessor** has completed the rating assessment for the rated office premises;

b) The total energy consumption of **shared thermal energy systems** inside the building boundary has been included in the energy consumption for the rating.

Table 3.2: Examples of flow rate based apportioning

Example 1	Treatment
	A chilled water plant within the **rated premises** provides chilled water (CHW) to the office space and to a small retail tenancy on the ground floor. The **total system flow rate** is 100 L/s. (90 L/s office + 10 L/s retail) The **exported flow rate** is 10 L/s.
Example 2	**Treatment**
	A boiler within the **rated premises** provides heating hot water (HHW) to the office space to the office building next door. The **total system flow rate** is 12 L/s. (10 L/s office + 2 L/s other office) The **exported flow rate** is 2 L/s.

Example 3	Treatment
	A cooling tower within the **rated premises** provides condenser water (CCW) to the office space. A cooling tower in the shopping centre next door also provides condenser water to the office space. The **total system flow rate** is 65 L/s. (65 L/s) The **imported flow rate** is 20 L/s.
Example 4	**Treatment**
	A cooling tower within the **rated premises** provides condenser water to the office space. A second cooling tower provides condenser water to the office space and the shopping centre of the lower ground levels. The **total system flow rate** is 130 L/s. (65 L/s + 20 L/s + 45 L/s) The **exported flow rate** is 45 L/s.
	Note: If the second cooling tower is metered by the shopping centre rather than the office and the **Assessor** has not included its energy consumption in the rating, then the 20 L/s from the second cooling tower becomes the **imported flow rate**. In that case, the total system flow rate becomes 65 L/s.

3.3 Area-based apportioning

3.3.1 General

The area-based apportioning method estimates energy allocated to the office rating based on the area of the space served by the chilled water, domestic hot water, heating hot water or condenser water being excluded relative to the **total serviced area** within the building being rated.

Area-based apportioning is for exclusions only and may be used to exclude:

a) Chilled water; or

b) Condenser water; or

c) Heating hot water; or

d) Domestic hot water.

The area-based apportioning method cannot be used for inclusions.

For documentation requirements, see Section 5.2.2.

3.3.2 Process overview

The process for determining the area-based apportioning is as per **Table 3.3**.

Table 3.3: Area-based apportioning

	Step	Reference
1	Determine the **total serviced area** served	Section 3.3.3
2	Determine the **excluded serviced area**	Section 3.3.4
3	Enter the data into NABERS Rate	Section 3.3.5

3.3.3 Measuring total serviced area

The **total serviced area** served by that type of thermal energy must be determined. The **total serviced area** must be either NLA, GLAR or GLA measured using an acceptable **measurement standard for rated area** and may be a mix of these area types.

3.3.4 Measuring excluded serviced area

The **excluded serviced area** served by the **shared thermal energy system** for the exclusion must be determined. The **excluded serviced area** must be either NLA, GLAR or GLA measured using an acceptable **measurement standard for rated area** and may be a mix of these area types.

3.3.5 Using the area

The **total serviced area** and the **excluded serviced area** values are entered into NABERS Rate. NABERS Rate will then calculate the excluded energy for the rating.

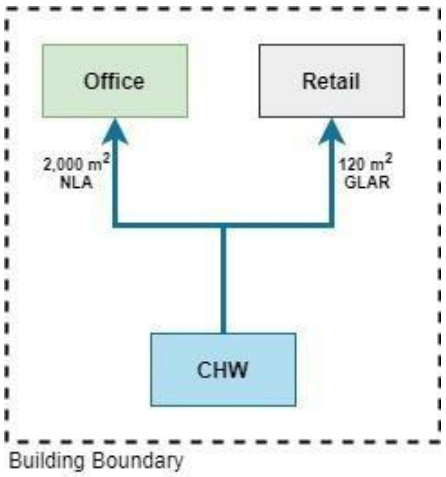
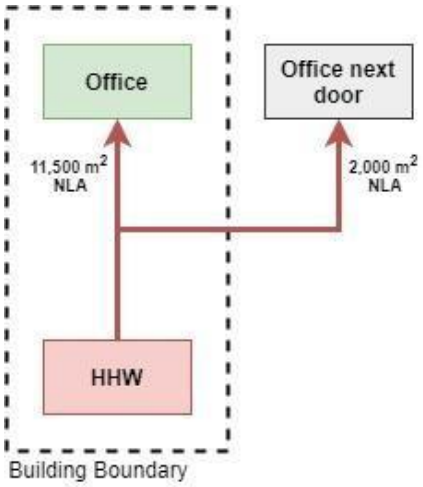
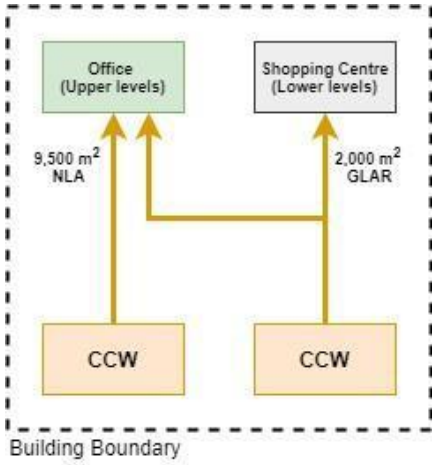
3.3.6 Examples

The following examples in **Table 3.4** assume that:

a) The **Assessor** has completed the rating assessment for the rated office premises;

b) The total energy consumption of **shared thermal energy systems** inside the building boundary has been included in the energy consumption for the rating.

Table 3.4: Examples of area-based apportioning

Example 1	Treatment
	A chiller within the **rated premises** provides chilled water (CHW) to the office space and a small retail tenancy on the ground floor. The NLA of the office area served by the chilled water system is 2,000 m^2. The GLAR of the retail area served by the chilled water system is 120 m^2. The **total serviced area** is 2,120 m^2. The **excluded serviced area** is 120 m^2.
Example 2	**Treatment**
	A boiler within the **rated premises** provides heating hot water (HHW) to the office rated area and the office building next door. The NLA of the office area served by the heating hot water system is 11,500 m^2. The NLA of the office area next door is 2,000 m^2. The **total serviced area** is 13,500 m^2. The **excluded serviced area** is 2,000 m^2.
Example 3	**Treatment**
	Two cooling towers within the **rated premises** provide condenser water (CCW) to the office rated area and to the shopping centre on the lower ground floors. The NLA of the office area served by the condenser water is 9,500 m^2. The GLAR of the shopping centre on the lower ground floors is 2,000 m^2. The **total serviced area** is 11,500 m^2. The **excluded serviced area** is 2,000 m^2.

4 Standard Methodology

4.1 Summary

This methodology applies to all NABERS Energy ratings. It also applies, where appropriate, to Climate Active Carbon Neutral ratings. For NABERS Water ratings, refer to Section 4.9.

The Standard Methodology enables **Assessors** to apportion the energy consumed by **shared thermal energy systems**. Unlike the Estimated Methodology, which does not require separate metering because it assumes a generic energy and emissions breakdown to calculate inclusion or exclusion energy, the Standard Methodology uses actual metered energy data in its calculations.

The Standard Methodology requires two types of measurements:

a) **Energy metering**: metering that measures electricity, gas or other **energy inputs** to the **shared thermal energy system**; and

b) **Thermal energy measurements**: Thermal energy metering that measures the thermal energy transferred by the **shared thermal energy system**.

Energy is apportioned between the users of thermal energy based on the quantity used by each end user. The energy consumption allocated to the rating using this methodology is considered **acceptable data** and is not added to the **potential error**.

Guidance is also provided below to allow water usage of **shared thermal energy systems** (e.g. cooling towers) to be included or excluded when conducting a NABERS water rating.

For further examples relating to the Standard Methodology, see Appendix B – Examples: Standard Methodology.

For additional guidance relating to thermal energy calculations, see Appendix C – Additional Guidance for Assessors.

4.2 Process overview

The process for the Standard Methodology is as per **Table 4.1**. For apportioning heating hot water, chilled water or condenser water for a NABERS energy rating, go to Step 1. For apportioning domestic hot water, go to Step 7. For NABERS water ratings, go to Step 8.

Table 4.1: Process overview

	Step	Reference
1	Determine the total energy inputs to the **shared thermal energy system** during the **rating period**	Section 4.3

	Step	Reference
2	Determine the **shared thermal energy output** to all end users and identify all end users of the **shared thermal energy system**	Section 4.4
3	Determine the thermal energy transferred to the **rated premises** from the **shared thermal energy system** and the **shared thermal energy output** transferred to **other users**	Section 4.4.1
4	Check that the ratio of **shared thermal energy outputs** to total **energy inputs** is reasonable for the type of system	Section 4.5
5	Conduct an energy balance between the **shared thermal energy output**, thermal energy transferred to the **rated premises** and thermal energy transferred to **other users**	Section 4.6
6	Apportion the energy inputs and calculate the allocation of energy to the **rated premises**	Section 4.7
7	Apportion the energy inputs for domestic hot water	Section 4.8
8	Apportion the water consumption from the **shared thermal energy system** for NABERS Water ratings	Section 4.9

4.3 Measuring energy inputs

4.3.1 General

The **Assessor** must determine all **energy inputs** to the **shared thermal energy system** using compliant metering. Energy inclusions require data for the entire **rating period** to be obtained. For examples of typical energy inputs, see **Table 4.2**.

Table 4.2: Examples of typical energy inputs

Thermal energy output	Examples of typical energy inputs
Chilled water	Chiller (electricity, gas) Chilled water circulation pumps (electricity) Heat rejection equipment (electricity)
Condenser water	Cooling tower fans (electricity) Condenser water circulation pumps (electricity)
Heating hot water	Boiler (gas, electricity) Heating hot water circulation pumps (electricity)

When apportioning chilled water, the **Assessor** must also consider the associated heat rejection. Energy inputs to heat rejection equipment may either be:

a) Included with the energy inputs to the chilled water system and apportioned with the chilled water; or

b) Apportioned separately.

See Section C.2 for further guidance for **Assessors**.

For document requirements, see Section 5.3.1.

4.3.2 Dedicated transfer energy

Any **dedicated transfer energy** applicable to the rating must be separately metered and 100 % allocated to the building receiving the thermal energy.

If the thermal energy system relies solely on system pressure from circulating pumps to transfer water from one space to another then the **dedicated transfer energy** is considered to be zero.

4.3.3 Energy inputs sub-metering requirements

Non-utility meters used to measure energy inputs must comply with the general requirements for non-utility meters set out in *NABERS The Rules – Metering and Consumption*.

4.3.4 Systems with insufficient or inadequate metering

If compliant metering is insufficient to determine some or all the **energy inputs** during the **rating period**, the following conditions apply:

a) Where **energy inputs** can be *excluded* from the rating, only the part of the energy input that is adequately sub-metered may be used.

b) Where the **energy input** is required to be *included* in the rating, the rating cannot proceed.

Example: A building provides chilled water to an office space and a small retail tenancy. The **Assessor** is conducting a NABERS Energy for Offices rating and can exclude the proportion of chilled water provided to the retail tenancy. The chiller is adequately sub-metered however there is no sub-metering for the chilled water pumps.

The **Assessor** may use the chiller energy input and exclude a proportion of this as determined in accordance with Section 4.7.

4.3.5 Measurement frequency

The annualised consumption of energy inputs must cover the full **rating period** when used for inclusions. The thermal energy measurements must be based on the same **billing period** as the energy input measurements.

It is preferable, but not a requirement, for the energy input measurements to be recorded *at the same time* as the thermal energy measurements.

Energy inputs must be measured *at least once* every 15 minutes during the same period as the thermal energy outputs. It is preferable for this to be logged every 15 minutes past the hour (e.g. 12:00pm, 12:15pm, 12:30pm, etc).

4.4 Measuring shared thermal energy outputs

4.4.1 Measuring shared thermal energy outputs

The **Assessor** must identify all end users of the **shared thermal energy system** and determine:

a) The **shared thermal energy output** transferred by the system during the **rating period**;

b) The thermal energy transferred to the **rated premises** during the **rating period**;

c) The thermal energy transferred to **other users** during the **rating period**.

See **Figure 4.1** for an example of a typical thermal energy metering configuration.

Note: Thermal energy measurements are typically taken using integrated thermal energy meters. Integrated thermal energy meters measure the flow rate and difference between the supply and return temperatures. The measurements are integrated over time to determine the thermal energy (in kWh).

The annual thermal energy is calculated by integrating all measurements recorded at the minimum frequency required in Section 4.4.2.2 across the whole **rating period**.

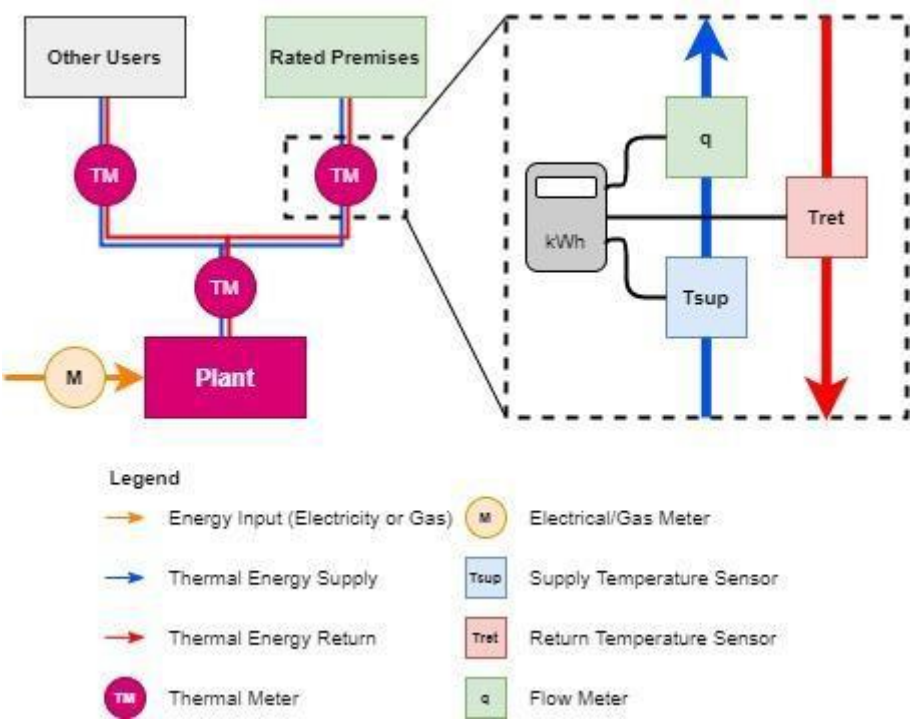


Figure 4.1: Typical thermal energy metering configuration

4.4.2 Thermal energy metering requirements

4.4.2.1 Validation requirements

All shared thermal energy outputs must be measured using equipment that meets the validation requirements in Appendix D – Thermal Energy Metering Validation Requirements.

Integrated thermal energy meters are preferred for reliability and should be installed and validated as per the manufacturer's specifications.

Alternatively, a combination of flow meter and two temperature sensors may be used to record readings to manually calculate the thermal energy transfer.

Note: The **Assessor** should verify that the thermal measuring equipment (temperature sensor pair and flow meter) has been installed correctly in accordance with manufacturer's instructions and is used for the correct working fluid type. Thermal energy measurement accuracy is extremely sensitive to correct temperature sensor pair installation, and immersion temperature sensors must be installed homogeneously between sensor pairs. Strap-on temperature sensors cannot be used. The **Assessor** may use a qualified and competent professional to verify this.

4.4.2.2 Measurement frequency

Thermal energy calculations for all measurement devices and sensors used in the rating must be—

a) recorded *at the same time*, and

b) at least once every 15 minutes during the **rating period**.

It is preferable for this to be logged every 15 minutes past the hour (e.g. 12:00pm, 12:15pm, 12:30pm, etc).

For integrated thermal energy meters, this refers to the $kW_{thermal}$ calculations. For non-integrated thermal energy calculations, this refers to the measured flow rate (L/s) and supply and return temperature (°C).

4.4.3 Systems with insufficient or inadequate thermal energy metering

All energy inputs to the thermal system must be allocated to the **rated premises** if:

a) The thermal energy sub-metering is insufficient to determine the percentage of total thermal energy used by the **rated premises**; or

b) The metering is insufficient to perform the energy balance in Section 4.6.

For inclusions, data collected must be available for the entire **rating period**. The rating cannot proceed if the inclusion data is not available for the entire **rating period**. All logs from each measurement device must be retained for audit purposes.

4.5 Verifying the Coefficient of Performance

The purpose of this verification is to check that the ratio of annualised **shared thermal energy outputs** to annualised **energy inputs** is reasonable for the type of system.

This is calculated using the following formula:

$$Coefficient\ of\ Performance\ (COP) = \frac{Shared\ thermal\ energy\ outputs\ (kWhthermal)}{Energy\ Inputs\ (kWh)}$$

While only annualised figures are checked, the underlying data used to calculate the annualised figures must meet the requirements of Section 4.4.2.2. See **Table 4.3** for examples of acceptable Coefficient of Performance (COP) checks for **shared thermal energy systems**.

Where the calculated COP does not fall within the range of acceptable COP in **Table 4.3**, the **Assessor** must retain evidence such as equipment technical data and calculations to prove that the COP is reasonable.

For documentation requirements, see Section 5.3.2.

Note: Where there are multiple equipment between the energy input measurement point and shared thermal energy measurement points, the range of acceptable system COP can be calculated by multiplying the individual equipment COPs. For example, where the energy input measurement is at the chiller, and the shared thermal energy metering points are on the secondary side of the heat exchanger. Assuming the COP of the chiller is 3.0 and the heat exchanger is 0.9, the expected COP across the system is approximately 2.7.

Table 4.3: Examples of COP checks on some common shared thermal energy systems

Shared thermal energy	Energy Inputs	Range of acceptable COP
Chilled water	Chiller electrical consumption	2.0 to 6.5 (Compression chiller)
Heating hot water	Boiler gas consumption	0.3 to 0.98
	Heat pump electrical consumption	1.0 to 4.5
Water-side Heat exchanger	None (this is the ratio of thermal energy on the secondary side of the heat exchanger to the thermal energy on the primary side of the heat exchanger)	0.6 to 0.9
Condenser water	Cooling tower fan electrical consumption	40 to 96

4.6 Conducting an energy balance

4.6.1 General

An energy balance of the **shared thermal energy system** must be conducted if the following situation is true:

a) The thermal energy measuring equipment was installed more than 10 years prior to the end of the **rating period**; or, factory calibration certificates proving that all sub-assemblies (**calculator**, **temperature sensor pair** and **flow sensor**) meeting the requirements in Section D.1.2 cannot be provided; AND,

b) The premises has had three or more subsequent ratings and 100 % of each type of meter has not been validated within the past 10 years in accordance with Appendix D – Thermal Energy Metering Validation Requirements.

The energy balance cannot be conducted using virtual meters. The Standard Methodology cannot be used where inadequate thermal energy measuring equipment is installed to separately measure thermal energy to the **rated premises** and to other users.

For documentation requirements, see Section 5.3.3.

Note: An energy balance is the only method to ensure thermal energy measurement equipment integrity. The current **Rules** includes a dispensation to only require energy balances for older equipment and non-availability of factory calibration certificates. This is in acknowledgement that it may be cost-prohibitive for existing NABERS rated buildings to install new submetering, due to inadequate thermal metering, for a compliant energy balance to be conducted.

This dispensation is subject to change pending industry consultation. As such, all new developments should endeavour to ensure that there is adequate metering for the **rated premises** and **other users**. Virtual meters must not be designed for use in an energy balance.

4.6.2 Process overview

The process for conducting an energy balance is as per **Table 4.4**.

Table 4.4: Process for conducting an energy balance

	Step	Reference
1	Ensure that there is sufficient thermal metering in place to determine the **shared thermal energy** to **rated premises** and to **other users**. Virtual meters cannot be used for energy balance.	Section 4.6.1
2	Balance the **shared thermal energy output**	Section 4.6.3

4.6.3 Balance shared thermal energy output

An energy balance must be conducted for the **shared thermal energy outputs** using the following formula:

$$STEout = STErated + STEother$$

Where:

STE_{out} = the **shared thermal energy outputs**,

STE_{rated} = **shared thermal energy** transferred to the **rated premises**,

STE_{other} = **shared thermal energy** transferred to **other users**.

The total **shared thermal energy outputs** must balance within 10 % of the sum of the transferred thermal energy.

Where the energy balance is not within 10 % of the sum of the transferred thermal energy, then the accuracy of each meter used for the energy balance must be validated using Section D.1.1(a) or Section D.1.1(c). The calculations must be forwarded to the **National Administrator** as part of the rating lodgement.

Note 1: The total shared thermal energy outputs encompass the whole measurement period. For example, if the shared thermal energy outputs comprise 12-months, then the total output is the annualised amount. If the shared thermal energy output comprise 6-month, then the total output is the total across 6 months.

Note 2: The energy balance only needs to be completed based on the annualised (or across the full measurement period) figure. There is no requirement to conduct the energy balance at each hourly interval.

4.7 Apportioning energy consumption

4.7.1 General

The annual energy inputs to the **shared thermal energy system** must be allocated to the users of the thermal energy based on the ratio of thermal energy use by the **rated premises**.

The calculated rating apportioned energy is conducted separately for different fuel sources.

Example: Each fuel type is apportioned separately if there is more than one type of fuel energy input to the **shared thermal energy system** (e.g. a heating hot water system that has a gas boiler input and electric pumps).

The Rating Apportioned Energy calculation is conducted automatically by NABERS Rate once the **Assessor** enters the annualised thermal energy and energy inputs, calculated in Sections 4.7.2 and 4.7.3.

For an example of allocating themal energy inputs to thermal energy outputs, see **Figure 4.3**.

For documentation requirements, see Section 5.3.4.

Note 1: Hourly apportioning, whilst permitted in these **Rules**, may not produce the most accurate result. The **Assessor** may rely on the apportioning calculation being done throughout the **rating period** on a much shorter timeframe, with aggregation to give the annual total.

Example: The **Assessor** may calculate the apportioning of thermal energy outputs and electricity energy inputs associated with the shared chiller water system every 15-minutes instead of the aggregated ratio on an hourly basis.

Dedicated transfer energy is not included in the apportioning calculation. All **dedicated transfer energy** must be allocated to the building receiving the thermal energy transfer in accordance with Section 4.3.2.

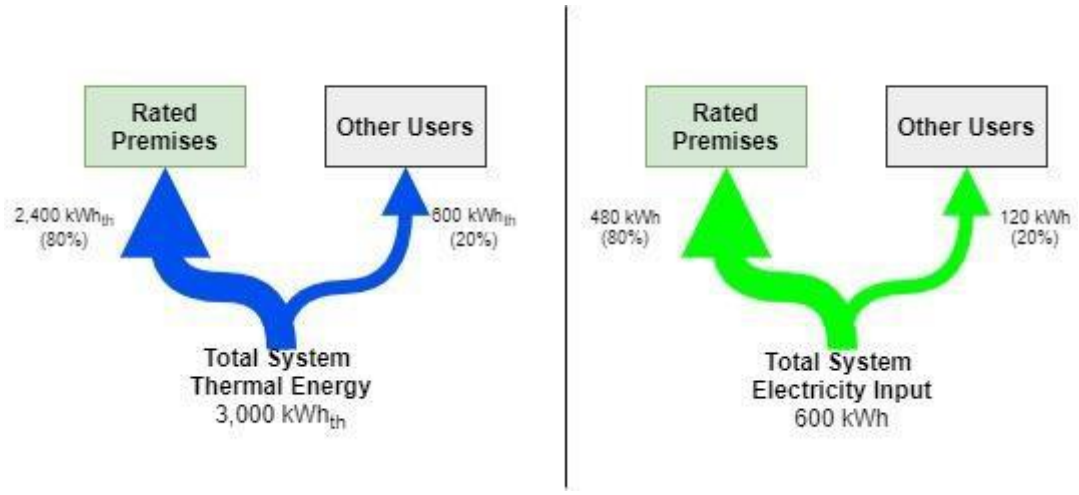


Figure 4.3: Example – allocating energy inputs to thermal energy outputs on an hourly basis.

4.7.2 Exclusions

If the total energy consumption of the **shared thermal energy system** has already been included in the rating assessment (e.g. the system is included in the utility bill for the **rated premises**), then the calculated rating apportioned energy will be excluded from the rating assessment.

For an exclusion, the rating apportioned energy is calculated by:

$$Annual\ Rating\ Apportioned\ Energy\ (exclusion) = Sum\ of\ \left(\frac{hourly\ thermal\ energy\ (other\ users)}{hourly\ shared\ thermal\ energy\ output} \times hourly\ energy\ input\right)$$

4.7.3 Inclusions

For an inclusion, the rating apportioned energy is calculated by:

$$Annual\ Rating\ Apportioned\ Energy\ (inclusion) = Sum\ of\ \left(\frac{hourly\ thermal\ energy\ (rated\ premises)}{hourly\ shared\ thermal\ energy\ output} \times hourly\ energy\ input\right)$$

4.8 Domestic hot water

4.8.1 General

Apportioning domestic hot water (DHW) uses a different methodology as it is an open loop system, making thermal metering a challenge. The energy is instead apportioned on the respective end uses for the DHW.

Thermal metering is not required for apportioning a shared DHW system, but water meters are required.

For documentation requirements, see Section 5.3.5.

4.8.2 Measuring total system energy consumption

Determine the total energy consumption of the shared DHW system for the **rating period** using compliant electrical or gas metering.

4.8.3 Measuring domestic hot water use

Several types of water meters are required to complete a water balance of the DHW system. This includes, at a minimum, the following types of meters:

a) Master water meter(s) to measure the total DHW use;

b) Water submeters for all end uses which, when added together, equal the total DHW use; and,

c) Sufficient water submeters to measure the DHW of the included/excluded DHW use.

Virtual water meters must not be used.

The **Assessor** must compare the total DHW production to the total system energy input using the thermal energy formula in Section C.1, and confirm that these values are reasonable for the type of DHW system. The basis for accepting these values should be documented and retained for any NABERS audit.

4.8.4 Apportioning energy consumption

The total energy consumption of the shared DHW system is apportioned based on the proportion of the DHW used by the **rated premises** compared to the total DHW use during the **rating period**.

4.8.5 Metering requirements

Non-utility meters used to measure the hot water consumption of a **shared thermal energy system** must comply with the validation, accuracy, frequency of readings and documentation requirements set out in *NABERS The Rules – Metering and Consumption*.

The hot water meters must also be appropriately rated for the temperatures of the DHW system. A standard water meter is designed for cold water and will not be accurately installed on a hot water system.

4.9 NABERS Water ratings

4.9.1 Summary

The Standard Methodology can also be applied to NABERS Water ratings to apportion the water consumption of **shared thermal energy systems** between users. The water consumption of the system is apportioned based on the thermal energy outputs.

This methodology only applies to water consumption associated with domestic hot water and water-based heat rejection (e.g. cooling towers). For application of this methodology to any other water systems, the **Assessor** must seek the approval of the **National Administrator** prior to rating submission.

See Section 0 for an example of allocating water consumption to shared thermal energy outputs.

For documentation requirements, see Section 5.3.6.

4.9.2 Measuring total shared thermal system water consumption

Determine the total water consumption of the **shared thermal energy system** for the **rating period** using compliant water metering.

4.9.3 Measuring thermal energy

Determine the total thermal energy transferred by the system during the **rating period** and the thermal energy transferred to the **rated premises** during the **rating period** using the process outlined in Section 4.4.1.

4.9.4 Apportioning water consumption

The total water consumption is apportioned based on the proportion of the thermal energy used by the **rated premises** during the **rating period**.

The apportionment is applied to the total water consumption of the **shared thermal energy system** rather than the total energy input.

When apportioning chilled water, the **Assessor** must consider what end users are downstream of the associated heat rejection. Section C.2 provides further guidance for **Assessors**.

Where the heat rejection system serves other end users in addition to the shared chilled water system, the **Assessor** must first determine the proportion of chilled water allocated to the **rated premises** and the corresponding proportion of shared chilled water system heat rejection thermal energy.

Example: Such a situation might occur when there is a tenant condenser water system that is within the minimum Base Building energy coverage.

An example process for allocating water consumption to shared thermal energy outputs is as follows:

Step 1: Use chilled water thermal meters to apportion shared chilled water thermal energy (See **Figure 4.4** below)

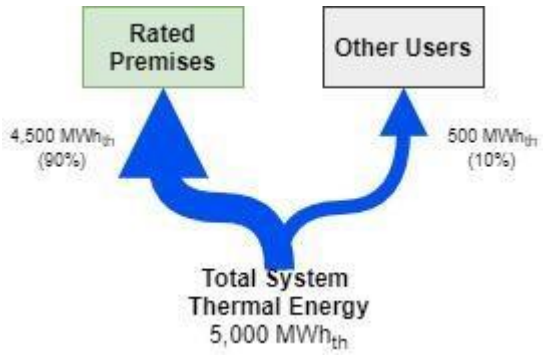


Figure 4.4: Determine percentage of total shared chilled water system thermal energy allocated to rated premises

Step 2: Determine the corresponding condenser water thermal energy associated with the shared chiller water system heat rejection (see **Figure 4.5** below).

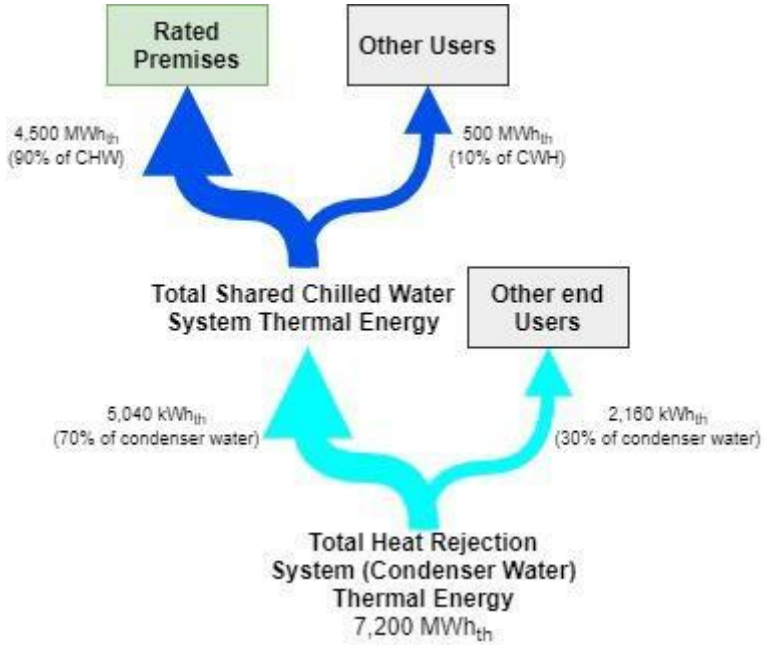


Figure 4.5: Determine percentage of total heat rejection system (condenser water) thermal energy allocated to chill water system

The proportion of shared chilled water system heat rejection used by the **rated premises** is:

$$90\ \% \times 5{,}040\ MWh_{th} = 4{,}536\ MWh_{th}$$

Step 3: Calculate the proportion of thermal energy for the **rated premises** as a portion of the total heat rejection system thermal system.

The proportion of total heat rejection system used by the **rated premises** is:

$$4{,}536\ MWh_{th} \div 7{,}200\ MWH_{th} = 63\ \%$$

Step 4: Apportion the heat rejection system water consumption. The total metered heat rejection system water consumption is 10,300 kL. The proportion of water consumption used by the **rated premises** is:

$$63\ \% \times 10{,}300\ mL = 6{,}532\ kL$$

4.9.5 Metering requirements

Non-utility meters used to measure the water consumption of a **shared thermal energy system** must comply with the validation, accuracy, frequency of readings and documentation requirements set out in *NABERS The Rules – Metering and Consumption*.

5 Documentation required for accredited ratings

5.1 Summary

5.1.1 Information and documentation requirements

The information in the tables below is required for a rating. Information may be contained in many different formats. The purpose of the documentation is to provide an acceptable, credible source of the required information. In some instances, specific document types may be unnecessary for an individual rating. Or, under different rating circumstances, the specific document types may carry multiple items of information required for the rating. The qualifying factor is not the type of document but that the documentation contains the required information in an acceptable format.

The tables in Section **Error! Reference source not found.** onwards are organised based on the divisions of previous chapters (Chapter 3 and Chapter 4). All the required information should be obtained from the premises' owner/manager before a site visit, and then confirmed during the site visit and subsequent assessment. A site inspection helps to verify that the information provided is accurate, current and complete.

Individual ratings may require additional information or documentation depending on the individual circumstances of the **rated premises**.

5.1.2 Documentation retention

Assessors must keep copies of the documentation that contains information on which an assessment is based. Data retained for audit must be in a form which facilitates reviews and makes anomalies easily apparent.

Access to original documents is highly desirable if they are available. Copies of original documents may be used as evidence as long as the **Assessor** is satisfied that they are, or can be verified to be, true and complete records of the original documents or files.

5.2 Documentation required for Chapter 3: Estimated Methodology

Topic	Requirements	Documentation
5.2.1 Flow rate based apportioning	Section 3.2	Information requirements: Details of the hydronic reticulation of the shared thermal system (chilled water, hot water and/or condenser water), including thermal energy transfer points to the **rated premises** and to **other user** must be retained. The **Assessor** must also retain evidence of flow rates or total flow volume to the **rated premises** and other users. Documentation: Documents that can be used as supporting evidence can include: a) Hydronic reticulation diagrams for the shared thermal system; b) Hand-drawn schematics of hydronic reticulation, that has been verified by the **Assessor**, showing inclusion/exclusion energy and whether they are already included in the rating utility bills; c) Photographic evidence of flow meters; d) Commissioning documentation showing design and commissioned flow rates, including any branches that do not have connected equipment in-use; e) Accumulated flow meter readings across a minimum of 7 days; f) Calculations for seasonable adjustments to accumulated flow measurements less than one year; g) Commissioning documentation showing design and commissioned flow rates, including any branches that do not have connected equipment in-use.

5.2.2 Area-based apportioning	Section 3.3	Information requirements: The **Assessor** must retain evidence showing the total serviced area served and the excluded serviced area. Details of the hydronic reticulation of shared thermal system (chilled water, hot water and/or condenser water), including thermal energy transfer points to the **rated premises** and to **other user** must also be retained. Documentation examples: Documents that can be used as supporting evidence can include: a) Hydronic reticulation diagrams for the shared thermal system; b) Hand-drawn schematics of hydronic reticulation, that has been verified by the **Assessor**, showing inclusion/exclusion energy and whether they are already included in the rating utility bills.; c) NLA, GLAR or GLA surveys, third party documentation or **Assessor** measurements using scaled drawings meeting the **measurement standard for rated area.**

5.3 Documentation required for Chapter 4: Standard Methodology

Topic	Requirements	Documentation
5.3.1 Measuring energy inputs and outputs	Section 4.3 Section 4.4	Required information: The **Assessor** must retain evidence of hydronic reticulation of the shared thermal system (chilled water, hot water and/or condenser water), including thermal energy transfer points to the **rated premises** and to **other users**. Documentation examples: Documents that can be used as supporting evidence can include: a) Hydronic reticulation diagrams for the shared thermal system; b) Hand-drawn schematics of hydronic reticulation, that has been verified by the **Assessor**, showing inclusion/exclusion energy and whether they are already included in the rating utility bills.
5.3.2 Verifying the Coefficient of Performance (COP)	Section 4.5	Required information: The **Assessor** must retain evidence including calculations and equipment documentation that demonstrates that the COP of the shared thermal energy system and energy inputs are reasonable. Documentation examples: Documents that can be used as supporting evidence can include: a) **Assessor** calculations; b) Equipment technical specifications and performance curves, showing gross efficiency; c) Shared thermal energy outputs metered data and annualised value; d) Energy input metered data and annualised value.

5.3.3 Conducting an energy balance	Section 4.6	Required information: If an energy balance has not been conducted, the **Assessor** must retain information proving that: a) The thermal metering energy system was installed less than 10 years ago; or, b) The thermal metering sub-assembly meets the factory calibration requirements in Section D.1.2 (a); or, c) The premises has had less than three ratings; or, d) The premises has had more than three ratings and 100% of each type of meter has been validated. If an energy balance has been conducted, evidence that the total shared thermal energy outputs balance within 10% of the sum of the transferred thermal energy must be retained. Documentation examples: Documents that can be used as supporting evidence can include: a) **Assessor** calculations; b) Total thermal energy metered data and summed value (the greater of the 12-month rating period or the measurement period) for the total shared thermal energy output, total thermal energy transferred to the **rated premises** and total thermal energy transferred other users; c) Commissioning results showing when meter installation date; d) Factory calibration certificates for the flow meter, calculator and temperature sensor pair; e) Meter validation certificates.

5.3.4 Apportioning energy consumption	Section 4.7	Required information: The **Assessor** must retain evidence that demonstrates apportioning calculations on an hourly basis. Documentation examples: Documents that can be used as supporting evidence can include: a) Records of the apportioning calculation used to determine the final thermal energy inclusion or exclusion. b) Records of metered energy inputs, metered total shared thermal energy, metered thermal energy to the rated premise and metered thermal energy other users recorded in 15-minute intervals. c) Energy readings from each meter, including calculations demonstrating that inconsistencies or disproportionate values are reviewed. d) Schematics showing all meters and end uses.
5.3.5 Domestic hot water (DHW)	Section 4.8	Required information: Records demonstrating of apportioning of total DHW energy consumption must be retained. The **Assessor** must retain evidence that the ratio of total DHW thermal energy production to total system energy input is reasonable for the type of DHW system. Documentation examples: Documents that can be used as supporting evidence can include: a) Technical specifications demonstrating temperature rating of water meters are appropriate; b) Hydronic reticulation of shared thermal system including location of meters and thermal energy transfer points to the **rated premises** and to **other users;** c) Documentation proving non-utility meters meet the requirements set out in *NABERS The Rules – Metering and Consumption*.

5.3.6 NABERS Water ratings	Section 4.9	Required information: The **Assessor** must retain details of the hydronic reticulation of shared thermal system, including thermal energy transfer points to the **rated premises** and to **other users**. Documentation examples: Documents that can be used as supporting evidence can include: a) **Assessor** calculations and metered data showing apportioning calculations; b) Records showing end users downstream for the associated heat rejection in accordance with Figure C.2.; c) Documentation proving non-utility meters meet the requirements set out in *NABERS The Rules – Metering and Consumption*.

5.3.7 Thermal energy metering validation	Section D.1	Information requirements: The **Assessor** must retain written evidence showing conformance to: a) Thermal Energy Meter Standards; and b) the Maximum Permissible Error for each sub-assembly. Documentation examples: Documents that can be used as supporting evidence can include: a) Calibration certificates for each sub-assembly (temperature sensor pair, flow meter, calculator); b) Technical specifications; c) Record of calculations; d) Manufacturers data; e) Commissioning records for on-site in-situ verification, showing readings taken using temporary measurement equipment and the sub-assembly (calculator, temperature sensor pair or flow sensor); f) Calibration certificates for any temporary measurement equipment, within 180 days of the measurement date.

5.3.8 RMRS validation	Section D.2	Information requirements: Documentation must be retained that confirms that 100% of the thermal meters have been validated within the past 10 years to read on the RMRS correctly. The **Assessor** must be able to confirm that the thermal meters have been installed correctly. Documentation examples: Documents that can be used as supporting evidence can include: a) RMRS validation records as per Appendix A of *NABERS The Rules – Metering and Consumption* v1.2; b) Signed statement by a competent person (name, company and qualification) confirming that meters have been installed correctly.

Appendix A – Derivation of Estimated Methodology Calculations

The following calculations are automated in NABERS Rate. The **Assessor** is only required to determine the relative flows or areas.

NABERS Rate estimates the excluded emissions using a standard emissions profile for an office building. This is to avoid the need for buildings to sub-meter the energy use of thermal systems, including any electrical or gas metering.

The calculations used in the Estimated Methodology are based on the tabulated percentage breakdown of commercial office greenhouse gas emissions, which was approximated using a generic breakdown of office energy use. The underlying data used to determine this approximation incorporated buildings with gas and electric gas heating technologies.

Table A.1: Greenhouse gas emissions for thermal energy types

Thermal Energy Type	Whole Building	Base Building
Domestic Hot Water	1	2
Heating Hot Water	4	12
Chilled Water	12	19
Condenser Water	6	10
Ventilation	14	24
Lighting, office equipment and other end uses	63	33
Total Greenhouse Emissions	**100**	**100**

The percentage of total greenhouse gas emissions (α) from **Table A.1** above, for the relevant thermal energy type, to be included or excluded from the rating is determined based on the relative flow rate or relative area as follows:

$$Exclusion\ \% = \alpha \times \left(\frac{Imported\ or\ Exported\ flow}{Total\ system\ flow\ rate}\right)$$

$$Exclusion\ \% = \alpha \times \left(\frac{Excluded\ \text{serviced}\ area}{Total\ serviced\ area}\right)$$

The resulting percentage inclusion or exclusion is applied to the total greenhouse gas emissions for the rating.

For example, for an exclusion of condenser water from a Base Building rating where the **total system flow rate** of condenser water in the rated building is 20 L/s and the exported flow rate is 2 L/s, the overall percentage of greenhouse gas emissions to be excluded from a Base Building rating is:

$$Exclusion\,\% = 10 \times (\frac{2}{20}) = 1\,\%$$

If the **Assessor** has determined that the **rated premises** consumes 100,000 kgCO_2-e during the **rating period**, then 1,000 kgCO_2-e can be excluded from the rating assessment.

Appendix B – Examples: Standard Methodology

B.1 Example 1: NABERS Energy for Offices Base Building rating (Shared Chilled Water and Condenser Water System)

Rating: NABERS Energy for Offices Base Building rating

A **shared thermal energy system** shown in **Figure B.1** provides chilled water to an office Base Building and a small retail tenancy located on the ground floor. The system also provides heat rejection to both the office and retail spaces through a cooling tower condenser water loop. The **rated premises** has a standalone tenant condenser water system that does not use the same cooling towers as the shared chilled water system. There are no other end users of the shared chilled water or condenser water.

The **Assessor** must determine the proportion of the energy input to be allocated to the **rated premises** from the chilled water and condenser water system.

Note: For further detail on treatment of chilled water systems, see Appendix C.

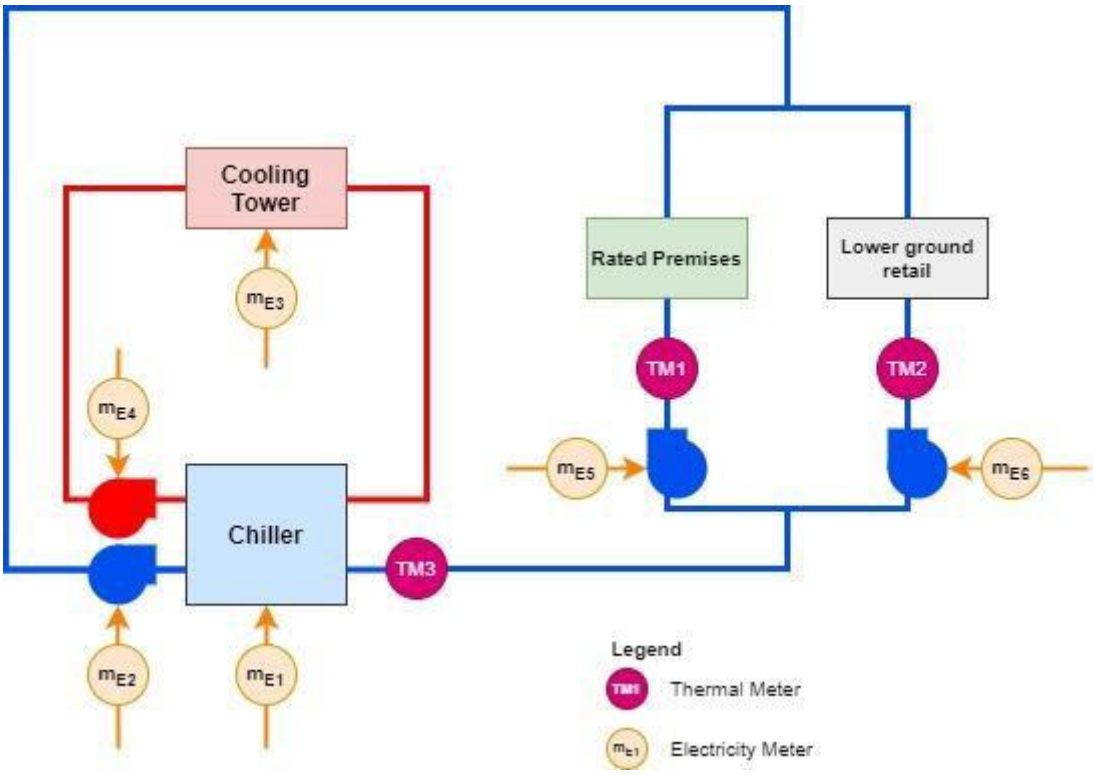


Figure B.1: Example 1 – Chilled water and condenser water schematic

Step 1: Determine the total energy inputs to the shared thermal energy system during the rating period

The energy consumption of all system components has been sub-metered for the duration of the **rating period**. These are recorded and exported to spreadsheet format in 15-minute intervals.

The **Assessor** obtains meter readings that meet the metering requirements outlined in *NABERS The Rules – Metering and Consumption*.

The annual consumption of energy inputs are as per **Table B.1**:

Table B.1: Annual consumption of energy inputs

Meter	Component	Annual consumption (MWh)
m_{E1}	Chillers	350
m_{E2}	Primary chilled water pumps	60
m_{E3}	Cooling tower fans	140
m_{E4}	Condenser water pumps	50
m_{E5}	Secondary chilled water pumps for the **rated premises** chilled water riser	100
m_{E6}	Secondary chilled water pumps for the lower ground retail chilled water riser	40

The total energy input to the system is:

$$m_{E1} + m_{E2} + m_{E3} + m_{E4} = 600\ MWh$$

m_{E5} – which measures the electricity consumption for secondary chilled water for the **rated premises** chilled water – is not part of the shared thermal energy system because it is dedicted transfer energy for the **rated premises**. As such, 100% of it is allocated to the **rated premises**.

M_{E6} – which measures the electricity consumption for secondary chilled water for the lower ground retail chilled water riser – is **dedicated transfer energy**. Therefore, 100 % of it is allocated to the lower ground retail. It is not apportioned.

An extract of the metered energy input data for each meter, processed on an hourly basis across 3 hours on the 5th of April, is shown in **Figure B.2** below.

Date	Reading Time	mE1 kW	mE2 kW	mE3 kW	mE4 kW	mE1 kWh	mE2 kWh	mE3 kWh	mE4 kWh
5/04/2021	13:00	60.00	3.20	5.00	5.00	15.00	0.80	1.25	1.25
5/04/2021	13:15	96.00	3.20	5.00	5.00	24.00	0.80	1.25	1.25
5/04/2021	13:30	105.00	4.80	5.00	5.00	26.25	1.20	1.25	1.25
5/04/2021	13:45	233.33	7.50	5.00	5.00	58.33	1.88	1.25	1.25
5/04/2021	14:00	200.00	7.50	5.00	5.00	50.00	1.88	1.25	1.25
5/04/2021	14:15	186.92	7.50	5.00	5.00	46.73	1.88	1.25	1.25
5/04/2021	14:30	185.08	7.50	5.00	5.00	46.27	1.88	1.25	1.25
5/04/2021	14:45	241.84	7.50	5.00	5.00	60.46	1.88	1.25	1.25
5/04/2021	15:00	214.29	7.50	5.00	5.00	53.57	1.88	1.25	1.25
5/04/2021	15:15	214.71	7.50	5.00	5.00	53.68	1.88	1.25	1.25
5/04/2021	15:30	172.00	7.50	5.00	5.00	43.00	1.88	1.25	1.25
5/04/2021	15:45	231.50	7.50	5.00	5.00	57.88	1.88	1.25	1.25
5/04/2021	16:00	250.00	7.50	5.00	5.00	62.50	1.88	1.25	1.25

Figure B.2: Extract of metered energy input data recorded in 15 minute intervals and processed hourly across 3 hours

Step 2: Determine the shared thermal energy output to all end users and identify the end users of the shared thermal energy system

The **Assessor** confirms that the only end users of the shared chilled water and condenser water are the office and the lower ground retail tenancy. All end users use the shared chilled water and condenser water: therefore, the total energy input can be apportioned based on the thermal energy transferred by the chilled water.

TM1 and TM2 are integrated thermal energy meters, and TM3 is a non-integrated thermal energy measurement using immersion temperature sensors and magnetic flow meters.

The **Assessor** obtains thermal energy metering records for the thermal energy transferred to each of the end users through the chilled water supply.

The **Assessor** confirms that the thermal meters meet the validation requirements in Appendix D – Thermal Energy Metering Validation Requirements and metering requirements in Section 4.4.2.

The **shared thermal energy output** for use in Step 4 is as per **Table B.2**:

Table B.2: Shared thermal energy output

Meter	End user	Annual thermal energy (MWhth)
TM1	Rated office premises	1,960
TM2	Lower ground retail	40

The **shared thermal energy output** transferred by the system is TM1 + TM2 = 2,000 MWh_{th}.

An extract of the metered shared thermal energy output for each meter, processed on an hourly basis across 4 hours on the 5th of April, is shown in **Figure B.3** below. The readings for the energy outputs are taken at the same time and interval as the energy inputs.

Date	Reading Time	TM1 kWth (office)	TM2 kWth (retail)	TM1 kWhth (office)	TM2 kWhth (retail)
5/04/2021	13:00	120.00	30.00	30.00	7.50
5/04/2021	13:15	205.00	35.00	51.25	8.75
5/04/2021	13:30	283.00	32.00	70.75	8.00
5/04/2021	13:45	1013.00	37.00	253.25	9.25
5/04/2021	14:00	1165.00	35.00	291.25	8.75
5/04/2021	14:15	1178.00	37.00	294.50	9.25
5/04/2021	14:30	1163.00	40.00	290.75	10.00
5/04/2021	14:45	1140.00	45.00	285.00	11.25
5/04/2021	15:00	1450.00	50.00	362.50	12.50
5/04/2021	15:15	1456.00	47.00	364.00	11.75
5/04/2021	15:30	987.00	45.00	246.75	11.25
5/04/2021	15:45	1342.00	47.00	335.50	11.75
5/04/2021	16:00	1453.00	47.00	363.25	11.75
5/04/2021	16:15	103.00	47.00	25.75	11.75
5/04/2021	16:30	103.00	47.00	25.75	11.75
5/04/2021	16:45	0.00	47.00	0.00	11.75
5/04/2021	17:00	0.00	47.00	0.00	11.75
5/04/2021	17:15	0.00	47.00	0.00	11.75

Figure B.3: Extract of metered shared energy output data recorded in 15 minute intervals and processed hourly across 4 hours

Step 3: Determine the thermal energy transferred to the rated premises from the shared thermal energy system and the shared thermal energy output transferred to other users

The proportion of annual thermal energy transferred is determined on an hourly basis.

An extract of the calculations completed on an hourly basis to determine the shared thermal energy to the **rated premises** and other users is shown in **Figure B.4** below. Here, the 15-minute interval data has been processed to be hourly, and the thermal energy to other users (retail) is in the blue column and the thermal energy to the **rated premises** (office) is shown in the beige column.

Date	Reading Time	mE1 kWh	mE2 kWh	mE3 kWh	mE4 kWh	TM1 kWhth (office)	TM2 kWhth (retail)	TM3 kWhth (total shared thermal energy)
5/04/2021	13:00	113.33	4.68	5.00	5.00	405.25	33.50	460.69
5/04/2021	14:00	203.46	7.50	5.00	5.00	1161.50	39.25	1230.77
5/04/2021	15:00	208.13	7.50	5.00	5.00	1308.75	47.25	1356.00
5/04/2021	16:00	68.42	7.50	5.00	5.00	177.25	47.00	441.77
5/04/2021	17:00	15.67	3.75	2.5	2.5	0.00	23.50	24.21

Figure B.4: Extract of calculations to determine shared thermal energy in hourly intervals across 5 hours

The annualised thermal energy for use in Step 4 is shown in **Table B.3**.

Table B.3: Calculating the proportion of annual thermal energy (example)

Meter	End user	Annual thermal energy (MWh)	Proportion
TM1	Rated office premises	1,960	98 %
TM2	Lower ground retail	40	2 %

Step 4: Check that the ratio of shared thermal energy outputs to total energy inputs is reasonable for the type of system

Using the formula in Section 4.5, the COP of the shared chilled water system is:

$$\text{COP} = \frac{TM1 + TM2}{m_{E1}} = \frac{2{,}000}{350} = 5.7$$

This is within the range of acceptable COP listed in Section 4.5.

Step 5: Conduct an energy balance between the shared thermal energy output, thermal energy transferred to the rated premises and thermal energy transferred to other users

The thermal measuring devices were installed more than 10 years ago. Therefore, the **Assessor** must conduct an energy balance in accordance with Section 4.6.

The annual thermal energy balance is calculated as per **Table B.4**:

Table B.4: Calculating the annual thermal energy

Meter	End user	Annual thermal energy (MWh)
TM1 + TM2	Rated office premises + Lower ground retail	2,000
TM3	Total **shared thermal energy output**	2,050

The annualised **shared thermal energy outputs** measured by TM3 is within 10 % of the sum of transferred thermal energy (TM1 + TM2):

$$\%\ \text{discrepancy} = \frac{TM3 - (TM1 + TM2)}{TM3} = \frac{50}{2050} = 2.4\%$$

Step 6: Apportion the energy inputs and calculate the allocation of energy to the rated premises

This example is an exclusion. For exclusions, the higher value of metered shared thermal energy output as calculated in Step 5 should be used. For example, the proportion of thermal energy used by the lower ground retail is calculated using TM3 instead of TM1 + TM2:

$$\%\ \text{thermal energy} = \frac{TM2}{TM3} = \frac{40}{2{,}050} = 2\ \%$$

As the apportioning is completed on an hourly basis, an extract of the calculations to determine the proportion of **rated premises** shared thermal energy to proportion of shared thermal energy transferred to other users is shown in **Figure B.5** below. Here, the 15-minute interval data has been processed to be hourly, and the proportion of retail TM2 to the shared thermal energy (TM3) is calculated and shown in the green column. It can be seen that the proportion allocation is different on an hourly basis, due to differences in the centralised plant efficiency at part load. The proportion of energy input allocated to retail is shown in column L.

Date	Reading Time	mE1 kWh	mE2 kWh	mE3 kWh	mE4 kWh	TM1 kWhth (office)	TM2 kWhth (retail)	TM3 kWhth (total shared thermal energy)	Proportion of retail TM2 to (TM3)	Total energy input (kWh) mE1 + mE2 + mE3 + mE4	Proportion of retail energy input (kWh)	Proportion of office energy input (kWh)
5/04/2021	13:00	113.33	4.68	5.00	5.00	405.25	33.50	460.69	7%	128.01	9.31	118.70
5/04/2021	14:00	203.46	7.50	5.00	5.00	1161.50	39.25	1230.77	3%	220.96	7.05	213.91
5/04/2021	15:00	208.13	7.50	5.00	5.00	1308.75	47.25	1356.00	3%	225.63	7.86	217.76
5/04/2021	16:00	68.42	7.50	5.00	5.00	177.25	47.00	441.77	11%	85.92	9.14	76.78
5/04/2021	17:00	15.67	3.75	2.5	2.5	0.00	23.50	24.21	97%	24.42	23.71	0.71

Figure B.5: Extract of calculation to determine the proportion of rated premises shared thermal energy to shared thermal energy transfer in hourly intervals across 5 hours

The proportion of retail energy input shown in column L in the **Figure B.5** is used in the rating. Assume that the proportion of retail energy input summed across the rating period is 12 MWh, and that the **Assessor** had already included the total shared thermal energy system electricity input (600 MWh) in the rating energy consumption. Therefore, the retail energy can be excluded from the rating.

The total exclusion is the apportioned amount of 12 MWh plus the dedicated transfer energy (secondary chilled water pumps, m_{E6}) of 40 MWh.

The **Assessor** can therefore exclude 12 MWh + 40 MWh = 52 MWh, allocated to the lower ground retail as it is not part of the **minimum energy coverage** for the office rating.

Note: A simplified illustration using annual data showing how energy inputs are apportioned and allocated is shown in **Figure B.6** Note that the illustration is only to demonstrate the concept – the **Rules** require this apportioning process to be completed on an hourly basis.

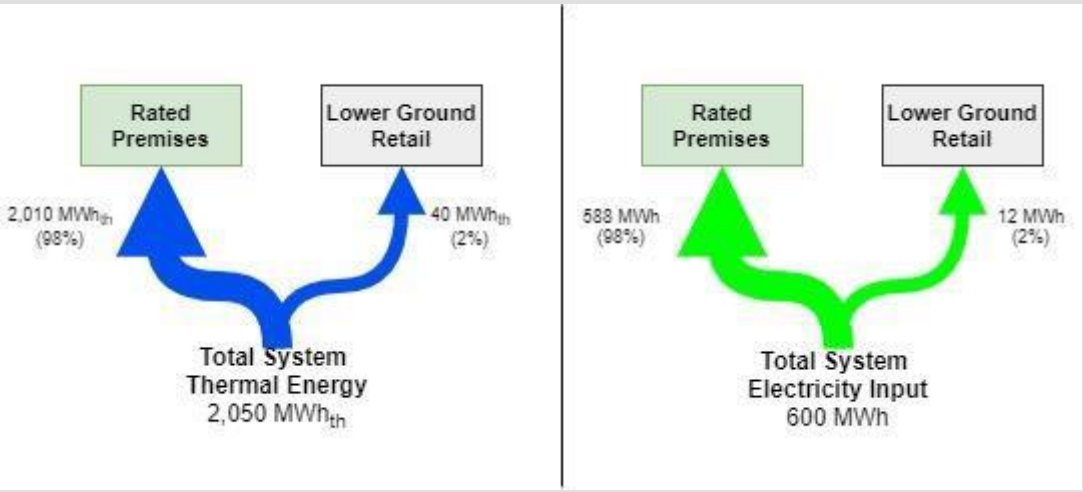


Figure B.6: Example 1 – Apportioning and allocation of energy inputs

B.2 Example 2: NABERS Energy for Offices Base Building rating (Shared Condenser Water System)

Rating: NABERS Energy for Offices Base Building rating

Heat rejection is provided to an office building (inclusive of the tenant condenser water system) and a small café located adjacent to the foyer of the building, as shown in **Figure B.7** Central chilled water is only provided to the office space and is not provided to the café. The condenser water loop does not serve any other end users beyond the tenant condenser water system and chilled water system.

The **Assessor** must determine the proportion of the energy input to be allocated to the **rated premises** from the shared condenser water system.

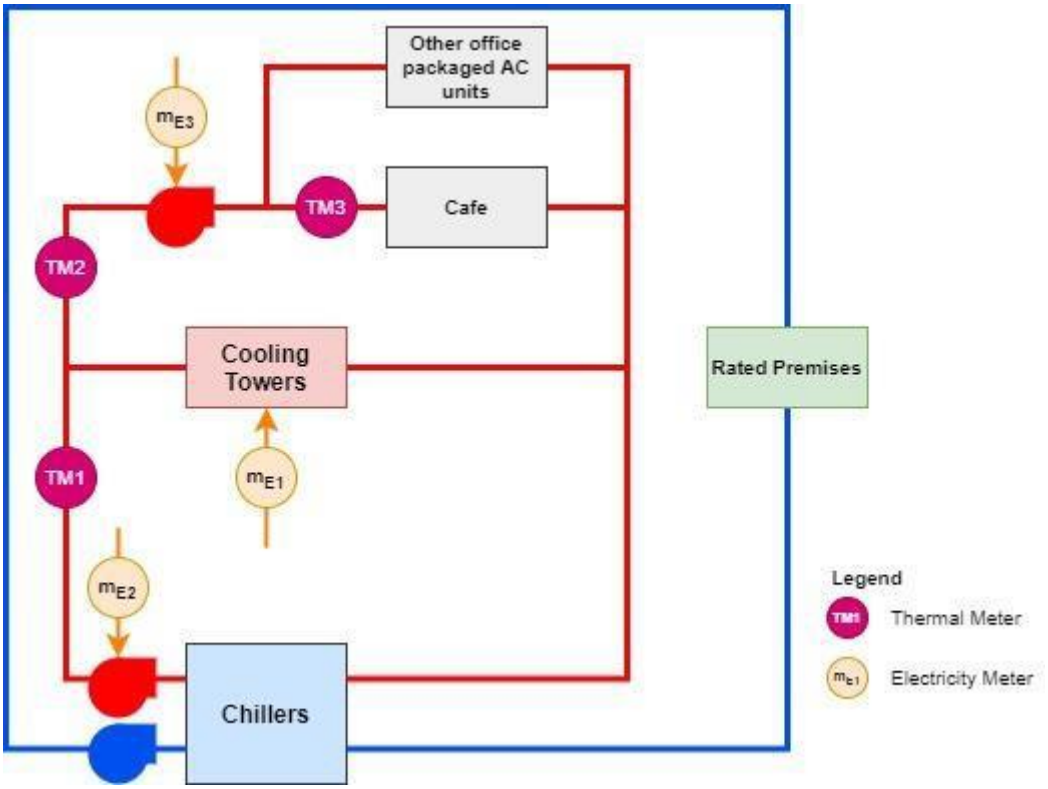


Figure B.7: Example 2 – Condenser water schematic

Step 1: Determine the total energy inputs to the shared thermal energy system during the rating period

The annual energy consumption of all system components has been sub-metered for the duration of the **rating period**. The **Assessor** obtains meter readings that meet the metering requirements outlined in *NABERS The Rules – Metering and Consumption*.

The annual consumption of energy inputs, for use in Step 4, are as per **Table B.5**:

Table B.5: Annual consumption of energy inputs

Meter	Component	Annual consumption (MWh)
m_{E1}	Cooling tower fans	50
m_{E2}	Condenser water pump to CHW system	200
m_{E3}	Tenant condenser water system pump	400

The condenser water pump to the shared tenant condenser water system, m_{E3}, is **circulation energy** not **dedicated transfer energy**. The **circulation energy** is apportioned. In this case, the **dedicated transfer energy** is zero.

The condenser water pump to the chilled water system is not part of the **shared thermal energy system**: it is considered **dedicated transfer energy** to the chilled water system. As such, 100 % of the energy consumption from m_{E2} is allocated to the Base Building chilled water system and will not be apportioned.

There are two **shared thermal energy systems** – the cooling tower fans and the shared tenant condenser water pumps. The total energy inputs are calculated for the two systems as follows:

a) The cooling tower fan total energy input is shared between the chilled water system, café and other office packaged AC units within the **rated premises**. The total energy input for the shared cooling tower fan system is m_{E1} = 50 MWh.

b) The tenant condenser water pumps are shared between the office packaged AC units and the café. The total energy input for the shared tenant condenser water system is m_{E3} = 400 MWh.

The total energy input for the systems that will be apportioned separately based on its end users is $m_{E1} + m_{E3}$ = 450 MWh.

An extract of the metered energy input data for each meter, processed on an hourly basis across 4 hours on the 10th of February, is shown in **Figure B.8** below.

Date	Reading Time	mE1 kW (cooling tower)	mE2 kW (CW pump)	mE3 kW (TCDW pump)
10/02/2020	14:00	4.51	28.00	46.00
10/02/2020	14:15	4.51	28.00	46.00
10/02/2020	14:30	4.51	28.00	46.00
10/02/2020	14:45	4.51	28.00	46.00
10/02/2020	15:00	4.51	28.00	46.00
10/02/2020	15:15	4.51	28.00	46.00
10/02/2020	15:30	4.51	28.00	46.00
10/02/2020	15:45	4.51	28.00	46.00
10/02/2020	16:00	4.51	28.00	46.00
10/02/2020	16:15	4.51	28.00	46.00
10/02/2020	16:30	4.05	26.60	46.00
10/02/2020	16:45	3.20	21.28	46.00
10/02/2020	17:00	2.45	0.00	46.00
10/02/2020	17:15	2.11	0.00	46.00
10/02/2020	17:30	1.80	0.00	46.00
10/02/2020	17:45	1.25	0.00	46.00
10/02/2020	18:00	1.25	0.00	46.00
10/02/2020	18:15	1.25	0.00	46.00

Figure B.8: Extract of metered energy input data processed hourly across 4 hours

Step 2: Determine the shared thermal energy output to all end users and identify the end users of the shared thermal energy system

The **Assessor** has confirmed that the only end users of the condenser water are the office and the café. The office users are within the **minimum energy coverage** for the **rated premises**. The café is downstream of these users so can be excluded using these **Rules**.

The **Assessor** has also confirmed that the end users of the chilled water and condenser water are different: the chilled water does not serve the café, therefore the chilled water energy inputs are allocated 100 % to the **rated premises**.

TM1, TM2 and TM3 are integrated thermal energy meters. The **Assessor** obtains thermal energy metering records for the thermal energy rejected by each of the end users through the condenser water. The **Assessor** confirms that the meter records meet the thermal energy metering requirements.

The annual thermal energy consumption for use in Step 4 is as per **Table B.6**:

Table B.6: Annual thermal energy of end users

Meter	End user	Annual thermal energy (MWh)
TM1	**Rated premises** condenser water for chillers	1,200
TM2	**Shared thermal energy outputs** for tenant condenser water system (TCDW)	1,800
TM1+TM2	**Shared thermal energy outputs** for condenser water system	3,000

An extract of the metered shared thermal energy output for each meter, processed on an hourly basis across 4 hours on the 10th of February, is shown in **Figure B.9** below. The readings for the energy outputs are taken at the same time and interval as the energy inputs.

Date	Reading Time	TM1 kWth (chiller CDW)	TM2 kWth (TCDW)	TM1 kWhth (chiller CDW)	TM2 kWhth (TCDW)
10/02/2020	14:00	111.33	30.00	27.83	7.50
10/02/2020	14:15	128.00	35.00	32.00	8.75
10/02/2020	14:30	136.11	32.00	34.03	8.00
10/02/2020	14:45	261.33	37.00	65.33	9.25
10/02/2020	15:00	228.00	35.00	57.00	8.75
10/02/2020	15:15	214.92	37.00	53.73	9.25
10/02/2020	15:30	213.08	40.00	53.27	10.00
10/02/2020	15:45	269.84	45.00	67.46	11.25
10/02/2020	16:00	207.10	50.00	51.78	12.50
10/02/2020	16:15	214.44	47.00	53.61	11.75
10/02/2020	16:30	228.73	45.00	57.18	11.25
10/02/2020	16:45	149.66	47.00	37.41	11.75
10/02/2020	17:00	0.00	35.00	0.00	8.75
10/02/2020	17:15	0.00	32.00	0.00	8.00
10/02/2020	17:30	0.00	30.00	0.00	7.50
10/02/2020	17:45	0.00	27.00	0.00	6.75
10/02/2020	18:00	0.00	27.00	0.00	6.75
10/02/2020	18:15	0.00	27.00	0.00	6.75

Figure B.9: Extract of metered shared thermal energy output processed hourly across 4 hours

Step 3: Determine the thermal energy transferred to the rated premises from the shared thermal energy system and the shared thermal energy output transferred to other users

The proportion of annual thermal energy transferred is determined on an hourly basis.

An extract of the calculations completed on an hourly basis to determine the shared thermal energy to the **rated premises** and other users is shown in **Figure B.10** below. Here, the 15-minute interval data has been processed to be hourly, and the thermal energy to other users (café) is in the blue column, the thermal energy to the **rated premises** (office) is shown in the beige column and the shared thermal energy system on the tenant condenser water system (TCDW) is shown in the yellow column.

Date	Reading Time	mE1 kWh (cooling tower)	mE2 kWh (CW pump)	mE3 kWh (TCDW pump)	TM1 kWhth (chiller CDW)	TM2 kWhth (TCDW)	TM3 kWhth (cafe)
10/02/2020	14:00	4.51	28.00	46.00	159.19	33.50	5.03
10/02/2020	15:00	4.51	28.00	46.00	231.46	39.25	5.89
10/02/2020	16:00	4.07	25.97	46.00	199.98	47.25	4.73
10/02/2020	17:00	1.90	0.00	46.00	0.00	31.00	2.79
10/02/2020	18:00	0.63	0	23	0.00	13.50	0.00

Figure B.10: Extract of calculation to determine the shared thermal energy to the rated premises and other users completed hourly across 4 hours

The annualised thermal energy transferred to the **rated premises** is as per **Table B.7**:

Table B.7: Annual thermal energy transferred (example)

Meter	End user	Annual thermal energy (MWh)
TM1	**Rated premises** chilled water system	1,200
TM2	Tenant condenser water system (TCDW)	1,800
TM3	Café	60
TM2-TM3	**Rated premises** TCDW	1,740

Step 4: Check that the ratio of shared thermal energy outputs to total energy inputs is reasonable for the type of system

Using the formula in Section 4.5, the COP of the shared condenser water system is:

$$\text{COP} = \frac{TM1 + TM2}{m_{E1}} = \frac{3{,}000}{50} = 60$$

This is within the range of acceptable COP listed in Section 4.5.

Step 5: Conduct an energy balance between the shared thermal energy output, thermal energy transferred to the rated premises and thermal energy transferred to other users

The **Assessor** confirms that the thermal energy measuring equipment was installed nine (9) years ago and has factory calibration certificates showing that the sub-assemblies were calibrated to EN 1434-2 Class 2, in accordance with the requirements in Section D.1.

As such, a separate energy balance does not need to be conducted.

As the thermal energy measuring equipment is close to 10 years old, the requirement for an energy balance to be conducted would be triggered in subsequent ratings. Therefore, the **Assessor** advises the client that an additional thermal meter needs to be installed to measure the thermal energy to the other office packaged AC units, allowing an energy balance to be conducted using TM2, TM3 and the new additional thermal meter.

The thermal metering system must be adequate to separate between **shared thermal energy outputs** to the **rated premises** and **other users** without the use of virtual meters.

Step 6: Apportion the energy inputs and calculate the allocation of energy to the rated premises

This is an exclusion, therefore the proportion of thermal energy used by the café is calculated and allocated to the various annual energy inputs.

Note: A simple illustration using annualised data is provided in **Figure B.11** below; however, note that this should be performed on an hourly basis as required in Section 4.7.

$$\text{Rating Apportioned Energy for shared cooling tower fans} = \frac{\text{TM3}}{\text{TM1} + \text{TM2}} \times (m_{E1}) = \frac{60}{3{,}000} \times 50 = 1 \text{ MWh}$$

$$\text{Rating Apportioned Energy for tenant condenser water system} = \frac{\text{TM3}}{\text{TM2}} \times (m_{E3}) = \frac{60}{1{,}800} \times 400 = 13.3 \text{ MWh}$$

The annual energy inputs are apportioned and allocated as shown in **Figure B.10**:

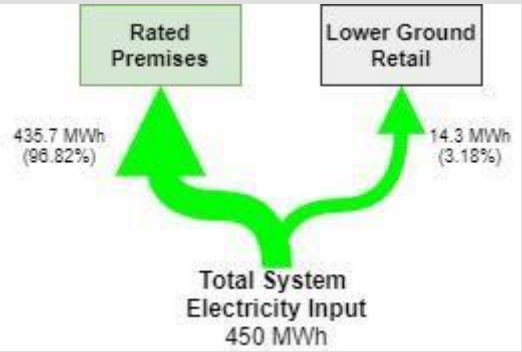


Figure B.11: Example 2 – Apportioning and allocation of energy inputs

As the apportioning is completed on an hourly basis, an extract of the calculations to determine the proportion of **rated premises** shared thermal energy to proportion of shared thermal energy transferred to other users is shown in **Figure B.12** below.

Here, the 15-minute interval data has been processed to be hourly. The proportion of café (TM3) to the shared thermal energy for the tenant condenser water system (TM2) is calculated and shown in the orange column. The proportion of café to the shared thermal energy for the cooling tower fans (TM1+TM2) is also calculated and shown in the blue column. When calculated against the total system electricity input (mE1 and mE3) in column M, the proportion of café energy input shown in column N (green column) is different on an hourly basis.

Reading Time	mE1 kWh (cooling tower)	mE2 kWh (CW pump)	mE3 kWh (TCDW pump)	TM1 kWhth (chiller CDW)	TM2 kWhth (TCDW)	TM3 kWhth (cafe)	Shared cooling tower fan energy (TM1+TM2)	Rating apportioned energy to café for shared cooling tower fans (TM3/[TM1+TM2] x (mE1)), kWh	Rating apportioned energy to café for tenant condenser water pumps (TM3/TM2 x (mE3)), kWh	Total café proportion of energy input (kWh) column J + K	Total energy input (kWh) mE1 + mE3	Proportion of café energy input (%)	Proportion of office energy input (%)
14:00	4.51	28.00	46.00	159.19	33.50	5.03	192.69	0.1177	6.9	7.0177	50.51	13.89%	50.37
15:00	4.51	28.00	46.00	231.46	39.25	5.89	270.71	0.0981	6.9	6.9981	50.51	13.85%	50.37
16:00	4.07	25.97	46.00	199.98	47.25	4.73	247.23	0.0778	4.6	4.6778	50.07	9.34%	49.98
17:00	1.90	0.00	46.00	0.00	31.00	2.79	31.00	0.1713	4.14	4.3113	47.90	9.00%	47.81
18:00	0.63	0	23	0.00	13.50	0.00	13.50	0.0000	0	0.0000	23.63	0.00%	23.63

Figure B.12: Extract of calculation to determine proportion of rated premises shared thermal energy to proportion to thermal energy transferred to other users completed hourly across 4 hours

The proportion of café energy input shown in column L in the figure above is used in the rating. Assume that the proportion of café energy input summed across the rating period is 14.3 MWh, and that the **Assessor** has already included the total shared thermal energy system electricity input (450 MWh) in the rating energy consumption. Therefore, the **Assessor** can exclude 14.3 MWh allocated to the café as it is not part of the **minimum energy coverage** for the office rating.

B.3 Example 3: NABERS Energy for Shopping Centres

Rating: NABERS Energy for Shopping Centres

A **shared thermal energy system** provides heating hot water to a shopping centre and an office building located next door to each other. The heating hot water is produced using a gas boiler and circulated using electric pumps. The heating hot water system is located in the office building and an additional pump is required to transfer the heating hot water from the office building to the shopping centre next door.

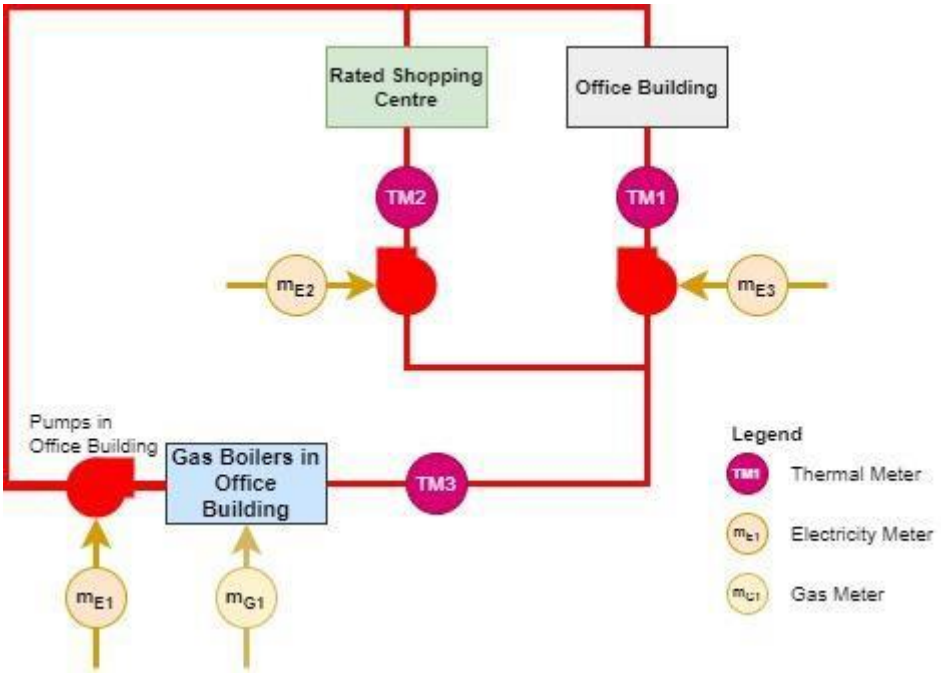


Figure B.13: Example 3 – Standard Methodology schematic

Note: All metered data in Example 3 is recorded at 15-minute intervals, and any annualised figures quotes are calculated using the interval data in a similar manner to Example 1 and Example 2 in Appendix B.

Step 1: Determine the total energy inputs to the shared thermal energy system during the rating period

The annual energy consumption of all system components has been sub-metered for the duration of the **rating period**. The **Assessor** obtains meter readings that meet the metering requirements outlined in *NABERS The Rules – Metering and Consumption*. The **Assessor** also obtains sub-metered data for the pump used to transfer the heating hot water to the shopping centre.

The total energy inputs to the **shared thermal energy system** is as per **Table B.8**:

Table B.8: Annual consumption of electricity and gas

Meter	Component	Annual electricity consumption (MWh)	Annual gas consumption (GJ)
GM1	Boilers	-	500
EM1	Primary heating hot water pumps and boiler burner fans	20	-
EM2	Secondary hot water pumps to shopping centre electrically fed from shopping centre	40	-
EM3	Secondary hot water pump to office building electrically fed from office building	100	

The fuels (electricity and gas) must be apportioned separately. The total energy input to the shared hot water system is:

$$GM = 500\ GJ\ (gas)$$

$$\mathrm{EM1}\ = 20\ MWh\ (electricity)$$

The primary heating hot water pumps energy of 20 MWh is **circulation energy** and apportioned as part of the total energy input.

The secondary hot water pumps metered using EM2 is only used for the shopping centre. Therefore, it is considered **dedicated transfer energy.** It will be 100 % allocated to the shopping centre and is not apportioned.

The secondary hot water pumps metered using EM3 is only used for the office building. Therefore, it is also considered **dedicated transfer energy.** It is 100 % allocated to the office and is not apportioned.

Step 2: Determine the shared thermal energy output to all end users and identify the end users of the shared thermal energy system

The **Assessor** has confirmed that the end users of the heating hot water are the shopping centre and the office.

The **Assessor** obtains thermal energy metering records for the thermal energy produced by the boiler and provided to each of the end users. The **Assessor** confirms that the meter records meet the thermal energy metering requirements.

The annual thermal energy consumption is as per **Table B.9**:

Table B.9: Annual thermal energy of end users

Meter	End user	Annual thermal energy (MWh_{th})
TM1	Office	40
TM2	Rated shopping centre	60

The total thermal energy transferred by the system is $\mathrm{TM1} + \mathrm{TM2} = 100\ MWhth$

Step 3: Determine the thermal energy transferred to the rated premises from the shared thermal energy system and the shared thermal energy output transferred to other users

The thermal energy transferred to the **rated premises** is as per **Table B.10**:

Table B.10: Determining annual thermal energy

Meter	End user	Annual thermal energy (MWh_{th})
TM1	Office	40
TM2	Rated shopping centre	60

Step 4: Check that the ratio of shared thermal energy outputs to total energy inputs is reasonable for the type of system

Using the formula in Section 4.5, the COP of the shared heating hot water system is:

$$\text{COP} = \frac{TM3}{GM1} = \frac{100}{500/3.6} = 0.72$$

This is within the range of acceptable COP listed in Section 4.5.

Step 5: Conduct an energy balance between the shared thermal energy output, thermal energy transferred to the rated premises and thermal energy transferred to other users

The thermal measuring devices were installed three years ago, but the **Assessor** is unable to obtain factory calibration certificates proving that all the thermal metering system sub-assemblies meet the requirements in Appendix D – Thermal Energy Metering Validation Requirements. Therefore, the **Assessor** must conduct an energy balance in accordance with Section 4.6.

The annualised thermal energy for the energy balance calculated using the 15-minute data is shown in **Table B.11**.

Table B.11: Determining annual thermal energy from an energy balance

Meter	End user	Annual thermal energy (MWh)
TM1 + TM2	Office + rated shopping centre	100
TM3	Total **shared thermal energy output**	96

The annualised **shared thermal energy outputs** measured by TM3 is within 10 % of the sum of transferred thermal energy (TM1 + TM2).

$$\%\ \text{discrepancy} = \frac{(TM1 + TM2) - TM3}{TM3} = \frac{4}{96} = 4.2\%$$

Step 6: Apportion the energy inputs and calculate the allocation of energy to the rated premises

As this is an inclusion, the lower value in Step 5 for shared thermal energy outputs is used.

Note: A simple illustration using annualised data is provided below; however, note that this should be performed on an hourly basis as required in Section 4.7.

The proportion of thermal energy used by the shopping centre is calculated and allocated to the various annual energy inputs as follows:

$$\text{Rating Apportioned Energy for gas} = \frac{\text{TM2}}{\text{TM1} + \text{TM2}} \times (GM1) = \frac{60}{96} \times 500 = 312.5 \text{ GJ}$$

$$\text{Rating Apportioned Energy for electricity} = \frac{\text{TM2}}{\text{TM1} + \text{TM2}} \times (EM1) = \frac{60}{96} \times 20 = 12.5 \text{ MWh}$$

The annual energy inputs are apportioned and allocated shown in **Figure B.14** and **Figure B.15**:

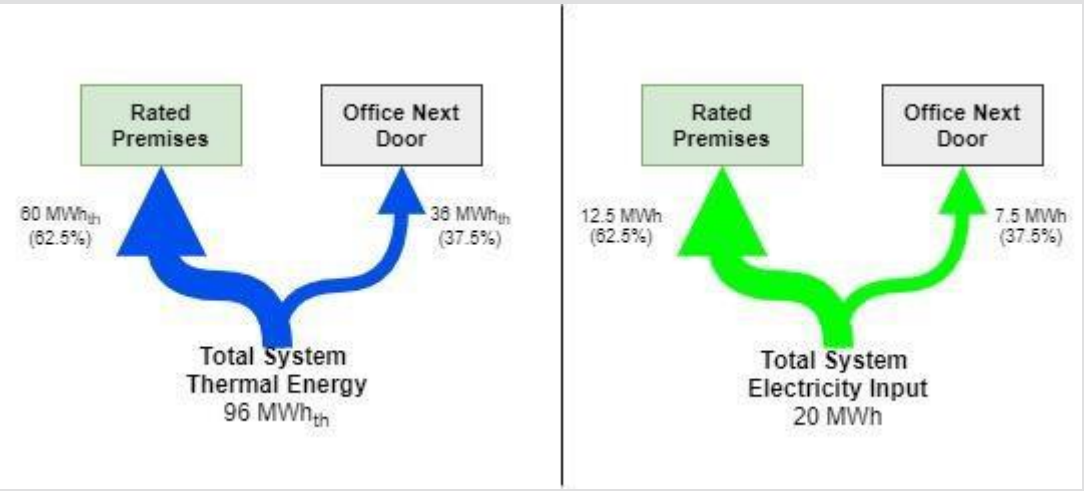


Figure B.14: Example 3 – Apportioning and allocation of electricity inputs

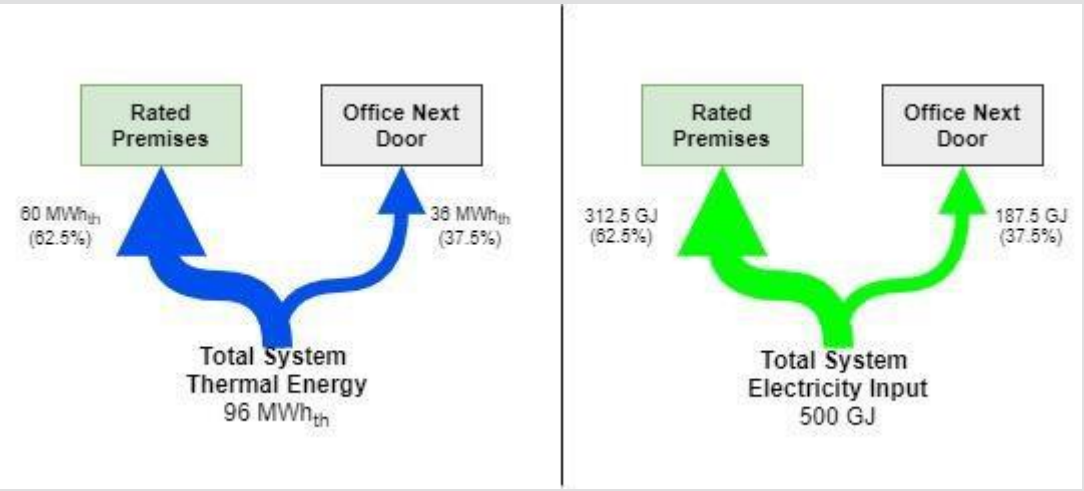


Figure B.15: Example 3 – Apportioning and allocation of gas inputs

The **Assessor** has not included the total energy inputs in the shopping centre rating energy consumption. As such, the **Assessor** must include the 312.5 GJ of gas and 12.5 MWh of electricity allocated to the shopping centre as it forms part of the **minimum energy coverage** for the shopping centre rating. The 40 MWh for the secondary hot water pumps to the shopping centre is already included as part of the shopping centre utility energy bills, and no further inclusions need to be made.

Appendix C – Additional Guidance for Assessors

C.1 Thermal energy calculations

In most cases, integrated energy meter readings are used to measure thermal energy. Integrated energy meters typically record instantaneous flow and temperature readings (one temperature sensor at least is remote) and use an on-board calculation device or BMS to convert to instantaneous energy demand (kW). The demand is integrated over time to obtain the total thermal energy transferred by the system during a certain period of time.

Integrated energy meters calculate the heat transfer rate (in kW) of a thermal energy system using the following formula:

$$Q = m\ C_p \Delta T$$

Where:

Q is the energy transferred in kW

m is the mass flow rate of the water in kg/s

C_p is the specific heat capacity of water (4.2 kJ/kg°C)

ΔT is the temperature difference between the supply and return temperature of the water

Where separate flow rate and temperature sensors are used in place of an energy meter, the **Assessor** may use the flow rate and temperature readings and calculate the instantaneous energy demand using the formula above. When using the above formula, the following requirements apply:

a) If the flows are measured in L/s, they must be converted to kg/s.

b) The flow rate and temperature readings must be taken at the same time and must meet the requirements outlined in Section 4.4.2.

c) The instantaneous demand readings (kW) at no more than 15 minute intervals must be integrated over time to produce a total annual thermal energy consumption figure (kWh). Calculations may be automated by a meter reading system or performed by the **Assessor**.

C.2 Apportioning shared chilled water systems

This section provides guidance to **Assessors** when apportioning the energy consumption of shared chilled water systems.

The appropriate treatment will depend on—

a) the type of chiller (air-cooled or water-cooled),

b) the thermal metering configuration, and

c) the end users of the heat rejection.

Figure C.1 illustrates the process for determining the energy inputs and thermal metering requirements for shared chilled water systems.

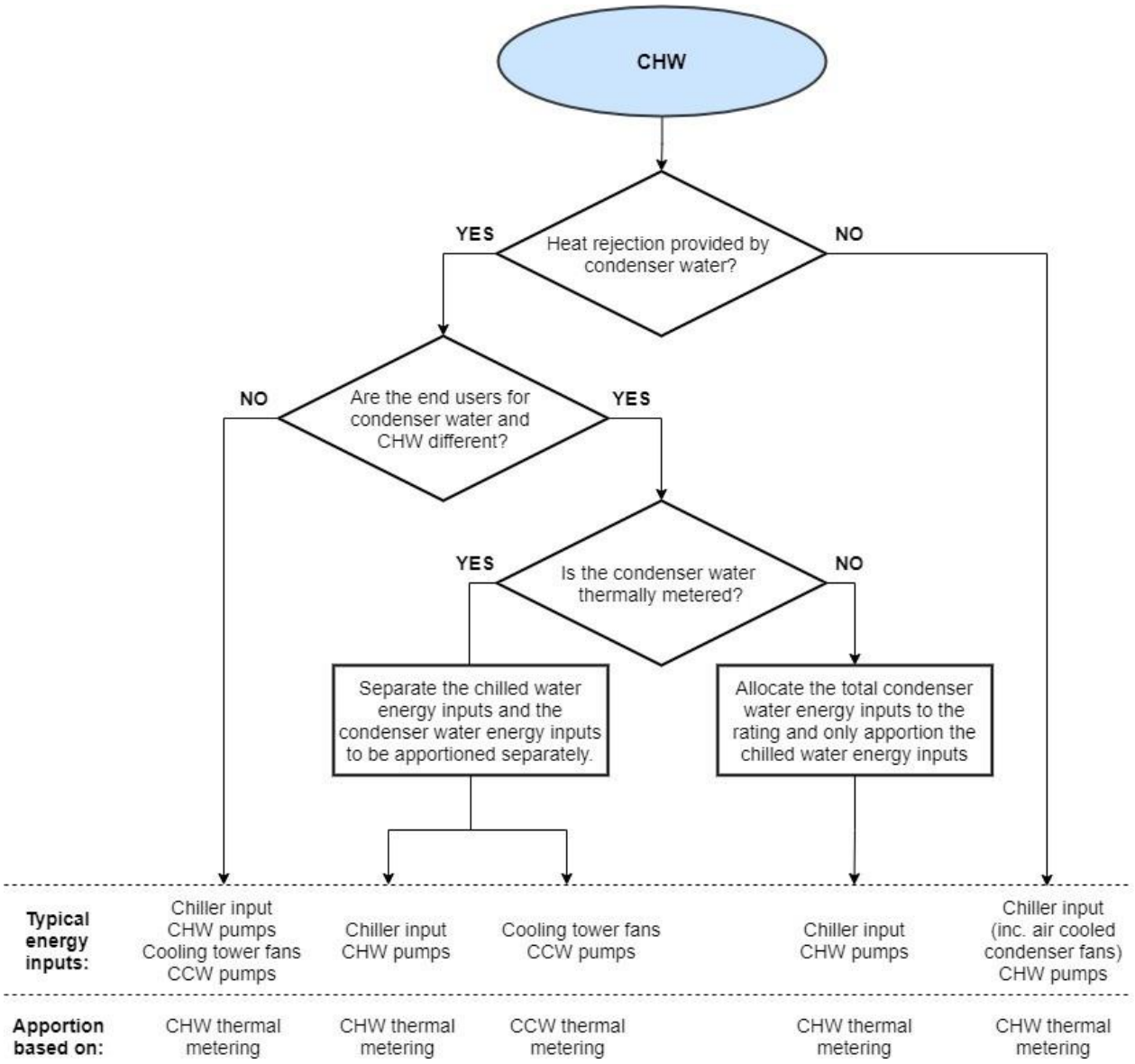


Figure C.1: Apportioning shared chilled water systems for NABERS Energy ratings

Figure C.2 illustrates the process for determining the water inputs and thermal metering requirements for shared chilled water systems.

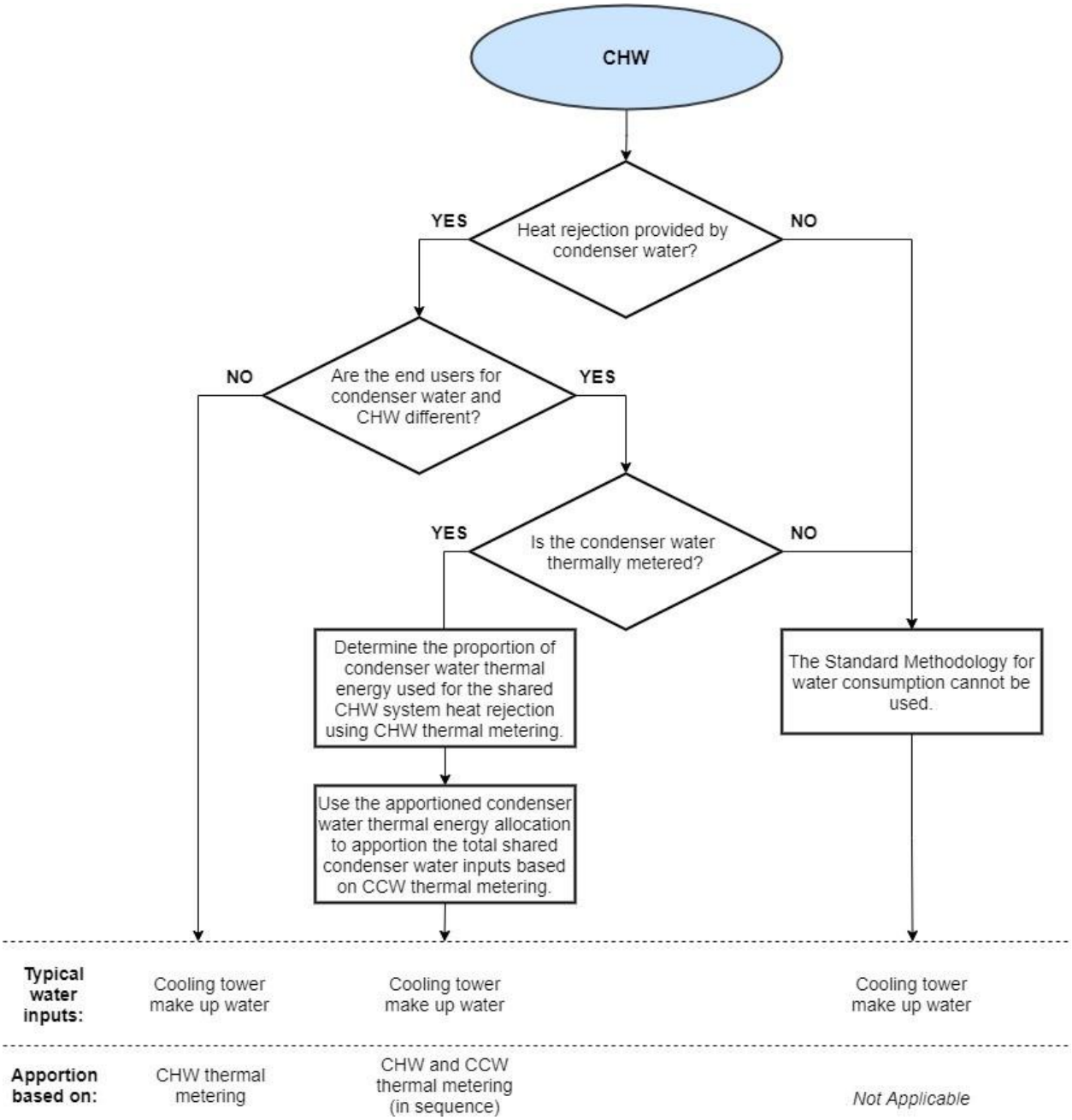


Figure C.2: Apportioning shared chilled water systems for NABERS Water ratings

Appendix D – Thermal Energy Metering Validation Requirements

D.1 Validation of thermal energy meter accuracy

D.1.1 General

The thermal energy meter accuracy requirements may be demonstrated using the following methods in order of priority:

a) Confirmation via calibration certificates for the **calculator**, **temperature sensor pair** and **flow sensor** of conformance to the Thermal Energy Meter Standards in Section D.1.2;

b) Equipment technical specifications showing that the maximum permissible error for each sub-assembly listed in Section D.1.3 is not exceeded;

c) Confirmation via on-site verification using secondary in-situ calibrated immersion **temperature sensors pairs** and calibrated **flow sensors**. The following rules also apply:

1) Any secondary equipment used for on-site verification must be factory calibrated less than 180 days prior to the verification date.

2) The difference in permanently metered thermal energy consumption relative to the secondary metered thermal energy consumption must be within the maximum permissible error for the thermal metering system in Section D.1.3;

d) A thermal energy balance of the **shared thermal energy system** meeting the requirements of Section 4.6.

It is unacceptable for the **Assessor** to use a lower priority method due to convenience; and the **Assessor** must retain evidence documenting why a method of higher priority could not be used for the rating. This requirement applies to all the thermal energy meters used in the rating.

For documentation requirements, see 5.3.7.

D.1.2 Thermal energy meter standards

The thermal energy meters shall conform to one of the following standards:

a) EN 1434-1 (Class 2) *Heat Meters – Part 1: General Requirements*; or,

b) CSA C900.1 (Class 2) *Heat Meters Part 1 – General Requirements*; or,

c) OIML R75-1 (Class 2) *Heat Meters Part 1: General Requirements*.

Where the thermal energy meter standards used to calibrate all sub-assemblies within the thermal metering system cannot be verified through third party documentation, the **Assessor** must verify that the accuracy requirements in Section D.1.3 are met for each thermal metering system sub-assembly.

Example: Third party documentation could be a calibration certificate.

D.1.3 Thermal energy meter maximum permissible error

Note: The requirements in Section D.1.3 have been adapted from the thermal energy meter standards in Section D.1.2.

The maximum permissible error for each thermal metering system is the arithmetic sum of the maximum permissible errors of all sub-assemblies, as shown below:

$$E = E_{temperature} + E_{flow}$$

Where all values are expressed in percentages (%).

Where the thermal energy meter standards used to calibrate all sub-assemblies within the thermal metering system are not specified on the meter calibration certificate, the **Assessor** must—

a) verify the accuracies of the metering equipment through associated technical specifications/functional descriptions, and

b) include any calculations to demonstrate that the maximum permissible error requirements are met.

Maximum permissible errors for the sub-assemblies are given in **Table D.1**:

Table D.1: Permissible errors of thermal metering system sub-assemblies

Sub-assembly	Maximum permissible error of the reading
Temperature sensor pair	$E_{temperature} = \pm (0.5 + \frac{\Delta\theta min}{\Delta\theta})$ % but no more than 2°C Where $\Delta\theta_{min}$ is the lowest allowable temperature difference of the sensor pair $\Delta\theta$ is the design temperature difference between and the supply and return circuits. If the temperature differential ratio cannot be determined, then $E_{temperature}$ is ± 0.5 %. The use of strap-on and surface mounted temperature sensors is unacceptable.
Flow sensor	E_{flow} = ± (2 + 0.02 x ($\frac{q_p}{q_i}$)) % but no more than ± 5 % Where q_p is highest flow rate at which the meter rated to function continuously; q_i is the lower limit of the flow rate meter. If the flow rate ratio cannot be determined, then E_{flow} is ± 2 %.

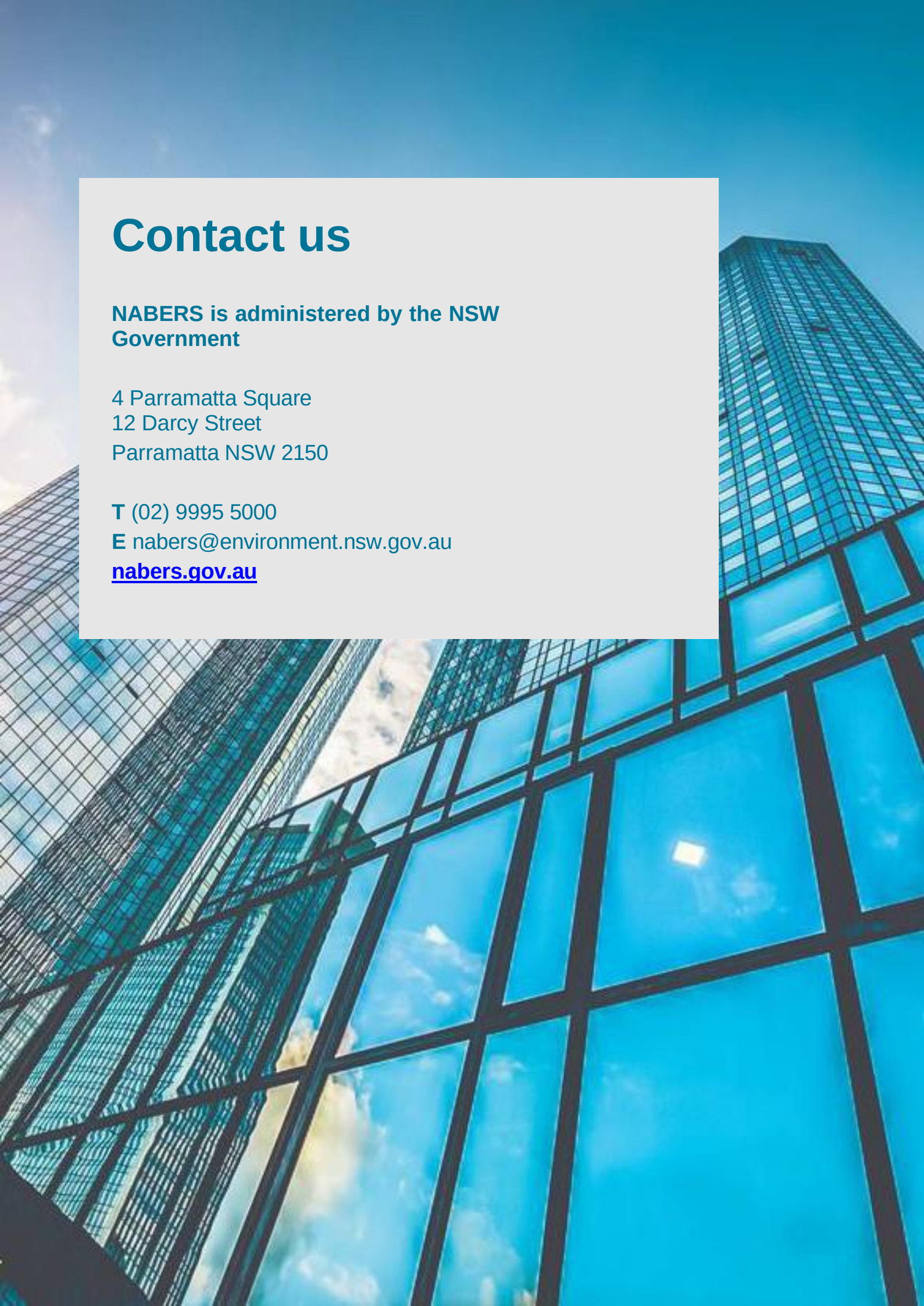
D.2 Remote Metering Reading System validation

If the thermal energy metering system includes a **Remote Metering Reading System (RMRS**), including an interface to a Building Management System (BMS) used to transmit meter data, then the **Assessor** must check that all necessary validation requirements in accordance with Section 6.3.3 of *NABERS The Rules – Metering and Consumption* have been met.

It cannot be assumed that newly installed non-utility metering systems have been validated. All of the thermal meters connected to the **RMRS** must be validated, and evidence of their validation obtained by the **Assessor**.

The **RMRS** validation must be repeated at least once every 10 years, or whenever a change in **RMRS** occurs, whichever happens first.

For documentation requirements, see Section 5.3.8.



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