

Ruling

# Treatment of Cogeneration and Trigeneration Systems

Version 1.2 — May 2022



Cover photo: Steam turbine condenser of a cogeneration plant. Image sourced from IStock.

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# Contents

<b>1</b>	<b>Introduction</b>	<b>2</b>
1.1	Summary	2
1.2	Interpretation of the Rules and Rulings	2
1.3	Situations not covered by the Rules	2
1.4	How to use this document	2
1.5	What's new in this version	3
1.6	Related documents	3
<b>2</b>	<b>Terms and definitions</b>	<b>4</b>
<b>3</b>	<b>Methodology</b>	<b>6</b>
3.1	General	6
3.2	Process overview	6
3.3	Step 1: Determining the system location	7
3.4	Step 2: Measure energy inputs, system outputs and end-user allocations	8
3.5	Step 3: Calculate proportion of input energy to rated premises and entry into the NABERS rating input form	11
	<b>Appendix A: Calculations</b>	<b>12</b>

# 1 Introduction

## 1.1 Summary

This document is a **Ruling** for the treatment of either a **cogeneration system** or a **trigeneration system** (“a **system**”). It provides guidance for **Assessors** where such **systems** are present either **onsite** or **offsite** relative to the **rated premise** and the metering and measurements of all scenarios.

The methodology presented in this document outlines how to use the **calculator** to determine the energy inputs to be entered in the **NABERS rating input form**, based on the apportioning of energy and the allocation of greenhouse gas emissions as determined by the **calculator**.

This **Ruling** will supersede the *Interim Methodology for the treatment of Cogeneration and Trigeneration Systems in NABERS ratings (version 1.1)*.

## 1.2 Interpretation of the Rules and Rulings

This **Ruling** applies to the treatment of a **system** as part of a premise’s application for a NABERS energy rating.

This **Ruling** is to be read in conjunction with the respective NABERS **Rules** as they apply to the building type.

Where a conflict between this **Ruling** and existing **Rules** is present, the requirements of this **Ruling** take precedence over the **Rules**.

This **Ruling** applies to any building type eligible for a NABERS rating using the NABERS energy rating tool.

## 1.3 Situations not covered by the Rules

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

Procedures not contained within this **Ruling** 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**.

## 1.4 How to use this document

The term “**Ruling**” 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 document, *NABERS Ruling*

— *Cogeneration and Trigeneration Systems*. Other **Rules** documents mentioned in the text are distinguished from the present document by the inclusion of their title.

Text appearing **dark green** and **bold** is a defined term. Defined terms can be found in in Chapter 2 of this **Ruling**. Additional terms and definitions can be found in Chapter 2 of the *NABERS Metering and Consumption Rules*.

The following formatting conventions may appear in this text:

 Important requirements and/or instructions are highlighted by an information callout box.

**Note:** Text appearing with a grey background is explanatory text only and is not to be read as part of the **Ruling**.

**Example:** Text appearing with a green background is intended to demonstrate a worked example of the respective **Rules** section or **Ruling** section.

## 1.5 What's new in this version

The following changes have been included in this current version:

- a) General rewriting for clarity and simplicity.
- b) Methodology summary drawing updated, see Chapter 3.
- c) Drawings showing **onsite** and **offsite** examples added, see Section 3.3.1.

## 1.6 Related documents

The following documents have been referenced within this **Ruling**:

*NABERS The Rules — Metering and Consumption*, v1.3, 2021

*NABERS The Interim Rules — Thermal Energy Systems*, v1.0, 2021

## 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
<b>auxiliary energy</b>	<p>Energy required for controlling equipment and other devices directly attached to <b>system</b> components. Energy inputs include, but are not limited to the following:</p> <ul style="list-style-type: none"><li>a) Jacket heating to the generator.</li><li>b) Pumping used to reject heat from the generator and absorption chiller.</li><li>c) Primary pumping required to transport heat to the absorption chiller and to transport heating hot water and chilled cold water output from the cogeneration or trigeneration plant to the primary or third party clients.</li><li>d) Electrical inputs to the absorption chiller.</li><li>e) On-board controls and variable speed drives (VSDs) for cogeneration or trigeneration plant items.</li></ul> <p><b>Note:</b> This <b>auxiliary energy</b> excludes energy associated with the operation of building management <b>systems</b>, or with supplementary fuels used to boost the heat or chilled cold water outputs.</p>
<b>Assessor(s)</b>	An accredited person authorised by the <b>National Administrator</b> to conduct NABERS ratings.
<b>calculator</b>	The NABERS Cogeneration Calculator v2.0.
<b>cogeneration system</b>	<p>An energy <b>system</b> that uses fuel, usually gas, to generate electricity and heating hot water.</p> <p>A <b>cogeneration system</b> includes the generator and pumps for the transport of heat from the <b>system</b> to the building <b>systems</b>.</p> <p>Supplementary boilers used to boost the heating hot water outputs from the <b>system</b> and secondary pumping to distribute the water around the premise are excluded from a <b>cogeneration system</b>.</p>
<b>NABERS rating input form</b>	The rating input form provided by NABERS for use by <b>Assessors</b> in the calculation of accredited ratings.

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**National Administrator** The body responsible for administering the NABERS scheme, and in particular for the following functions:

- a) establishing and maintaining the standards and procedures to be followed in all aspects of the operation of the scheme;
- b) determining issues that arise during the operation of the scheme and the making of ratings;
- c) accrediting **Assessors** and awarding accredited rating in accordance with NABERS standards and procedures.

The functions of the National Administrator are undertaken by the NSW Government.

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**offsite** Located outside of the legal boundary of the building or precinct.

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**offsite cogeneration electricity** Electricity supplied to the **rated premises** from an **offsite cogeneration** or **trigeneration system**.

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**onsite** Located within the legal boundary of the building or precinct.

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**rated premise(s)** The building or building section to be rated.

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**rating period** The 12-month base period for the rating, requiring at least 12 continuous months of acceptable data upon which the rating is based.

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**Rules** Authoritative document produced by the **National Administrator** that specifies what must be covered by an **Assessor** in order to produce a rating.

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**Ruling(s)** An authoritative decision by the **National Administrator** which acts as an addition or amendment to the **Rules**.

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**system(s)** Either a **cogeneration system** or **trigeneration system**.

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**trigeneration system** A **cogeneration system** that uses part of the heating hot water to operate an absorption chiller that produces chilled cold water for use at the premise.

A **trigeneration system** includes the following:

- a) The generator and primary pumps for the transport of heat from the **system** to the building **systems**.
- b) The absorption chiller and associated primary pumps for the transport of chilled cold water to the building **system**.

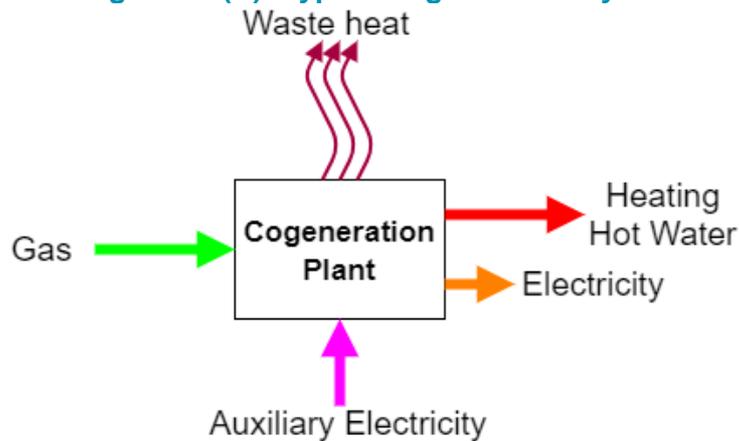
Supplementary boilers and chillers used to boost the heat or chilled cold water outputs from the **system** and secondary pumping to distribute the water around the premise are excluded from a **trigeneration system**.

# 3 Methodology

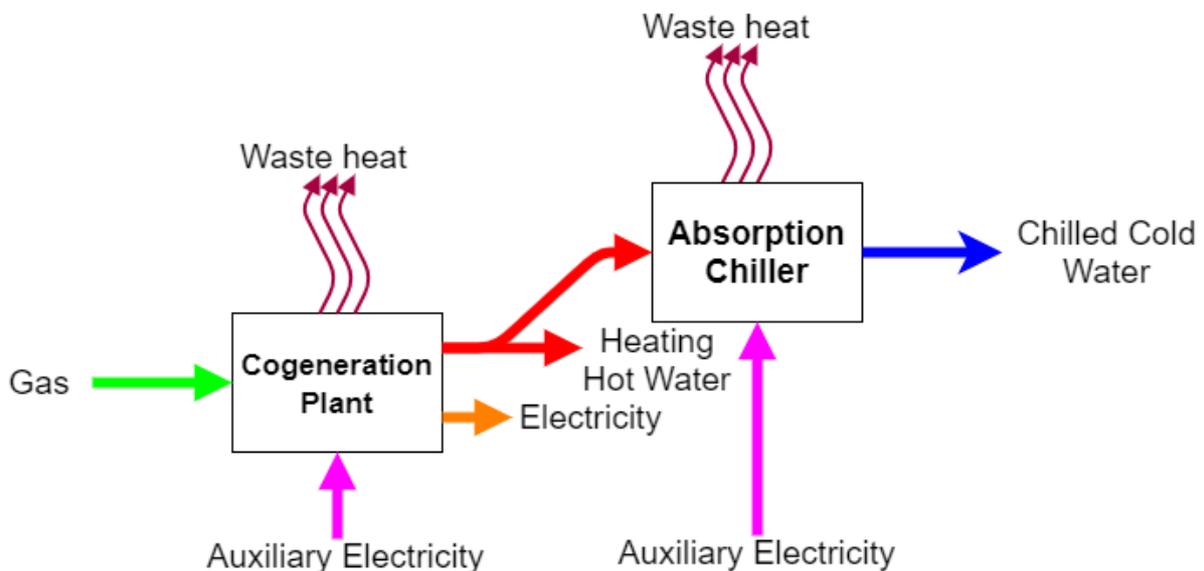
## 3.1 General

The methodology described in this chapter must be used by the **Assessor** when they are conducting an energy rating and a **system** is present. Figures 3.1(A) and 3.1(B) show the basic differences in the outputs of these two **systems**.

**Figure 3.1(A): Typical cogeneration system**



**Figure 3.2(B): Typical trigeneration system**



## 3.2 Process overview

The process for determining the energy rating for the **system** must be in accordance with Table 3.2.

**Table 3.2: Determining the system energy rating**

Step	Task	Reference
1	Determine whether the <b>system</b> is located <b>onsite</b> or <b>offsite</b> .	Section 3.3
2	Determine the <b>system's</b> energy inputs and the energy outputs to the end-users.	Section 3.4
3	Use the <b>calculator</b> to determine the allocation of energy inputs to the <b>rated premises</b> .	Section 3.5

### 3.3 Step 1: Determining the system location

#### 3.3.1 General

The location of the **system** determines how apportioning of the input and output of these **systems** are treated.

For ratings other than office tenancy or data centre IT equipment ratings, the **system** is assessed as being “**onsite**” if it is one of the following:

- a) Located within the same legal/lot boundary of the premises being rated, see Figure 3.3.2(A).
- b) Located in a building that shares a common space that connects two or more buildings, such as a common basement or podium, see Figure 3.3.2(C).

**Note:** If the location of the **system** is not clearly defined, **Assessors** should seek the advice of the **National Administrator**.

#### Example: Ratings other than office tenancy and data centre IT equipment

**Figure 3.3.2(A)**

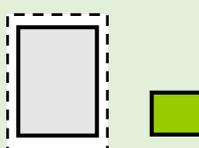


**Assessment**

The **system** is located within the boundaries of the building and its grounds.

The **system** is considered **onsite**.

**Figure 3.3.2(B)**



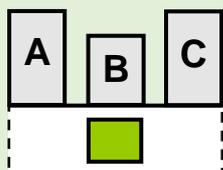
**Assessment**

The **system** is not located within the boundaries of the building.

The **system** is considered **offsite**.

Figure 3.3.2(C)

**Assessment**

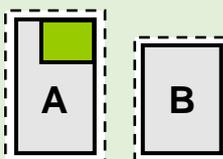


Three buildings are supplied with services from a **cogeneration system**, which is located in a shared basement.

The **system** is considered **onsite** for all three buildings.

Figure 3.3.2(D)

**Assessment**

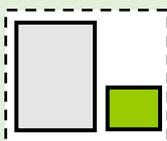


Two buildings are supplied with services from a **cogeneration system**, which is physically located in Building A.

The **system** is considered **onsite** for Building A, and **offsite** for Building B.

Figure 3.3.2(E)

**Assessment**



The **cogeneration system** or **trigenation system** is located within the legal grounds of the building.

The **system** is considered **onsite**.

### 3.3.2 Rating exceptions

For office tenancy or data centre IT equipment ratings and all other instances that do not meet either Item a) or Item b), the **system** is considered “**offsite**”.

## 3.4 Step 2: Measure energy inputs, system outputs and end-user allocations

### 3.4.1 General

When assessing a **system**, the **Assessor** must determine the following:

- The total energy inputs of the **system** for the entire duration of the **rating period**.
- The total outputs of the **system** for the entire duration of the **rating period**.
- The end-users of the energy outputs and their allocation.

All total energy inputs to and outputs from the **system** must be metered and data recorded in compliance with the requirements in *NABERS The Rules — Metering and Consumption* and *NABERS The Rules — Thermal Energy Systems*.

### 3.4.2 Step 2(A): Determine energy inputs to the system

**Assessors** must determine all energy inputs to the **system** for the entire **rating period**.

The energy inputs include the following:

- The total gas inputs to the generator.

- b) The total **auxiliary energy** inputs.

Supplementary boilers and chillers used to boost the heating hot water or chilled cold water outputs and secondary pumps used to distribute water around the buildings are not considered part of the **system** and are directly attributable to the specific end-user they serve. As such their energy inputs must not be included in the energy inputs of the **system**.

For an **onsite system**, any part of the **auxiliary energy** that is not metered must be included in the rating separately and is not to be apportioned. For an **offsite system**, only metered **auxiliary energy** is included, based on the **calculator** output.

### 3.4.3 Step 2(B): Determine energy outputs of the system

**Assessors** must determine the total energy outputs from the **system** for the entire **rating period**.

The types of energy outputs for the **system** that must be recorded include the following:

- Electricity generation ( $\text{kWh}_e$ ).
- Heating hot water ( $\text{kWh}_{th}$ ).
- Chilled cold water ( $\text{kWh}_{th}$ ).

If the electricity outputs are not properly metered then all energy inputs to the **system** are allocated to the **rated premises**.

**Note:** For the purposes of fuel allocation, where compliant thermal metering is insufficient to determine the actual production of heating hot water and chilled cold water by the **system**, the **calculator** will assume the heating hot water is zero and all thermal energy to be chilled cold water, see Example.

#### Example: Chilled cold water determination

In this scenario, the calculation of allocated chilled cold water is determined as follows:

- Assume the **system** converts 75 % of the energy input into outputs.
- Subtract the electricity from the total outputs to determine the chilled cold water output, in accordance with the following equation:

$$CHW = G \times 0.75 - E$$

where:

- $CHW$  = Annual production of chilled cold water ( $\text{kWh}_{th}$ )  
 $G$  = **System's** annual fuel input ( $\text{kWh}$ )  
 $E$  = Electricity generation ( $\text{kWh}_e$ )

### 3.4.4 Step 2(C): Determine the use of system outputs by the rated premises

**Assessors** must determine how much of the energy outputs from the **system**, determined in Step 2(B), was used by the **rated premises** during the **rating period** as follows:

- Identify all end-users of the following **systems**, including the **rated premises**:

- 1) For **onsite systems**, any energy output that is exported to other users outside the **rated premises** is treated as being to a single end user for calculation purposes.
  - 2) For **offsite systems**, it is only necessary to determine the end-users within the same legal/lot boundary of the **rated premises**, provided the total energy output that is imported has been accurately measured.
- b) Determine the allocation of outputs to the **rated premises** over the **rating period** based on one of the following:
- 1) Written evidence demonstrating contractual arrangements or evidence of payment which clearly specific the allocation of **system** output to each end-user.
  - 2) The measured amount of output to each end-user using compliant metering.

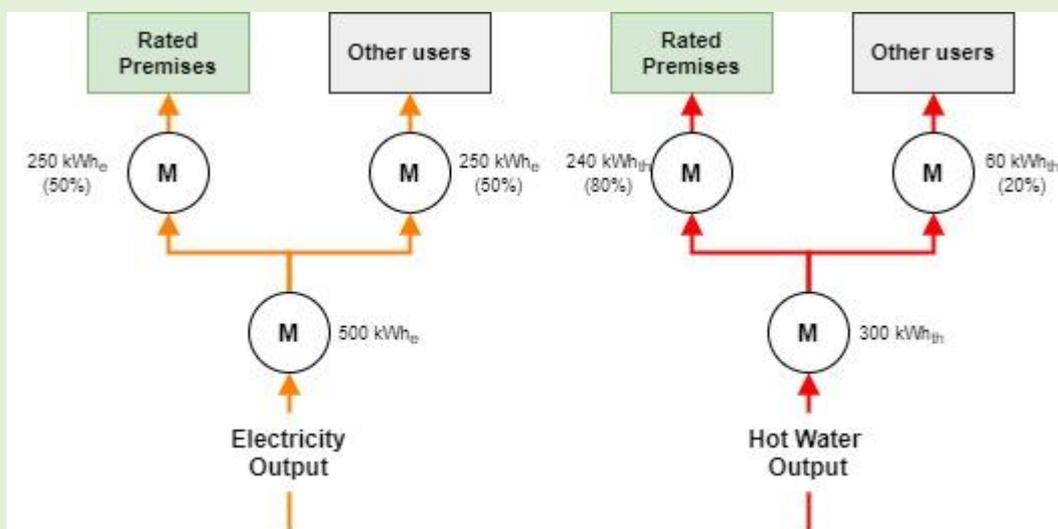
The following examples show how this can be achieved for a **cogeneration system**, (Example 1) and a **trigeration system** (Example 2).

### Example 1: Cogeneration system output

Figure 3.4.4(A) shows a **system's** outputs being proportioned between the **rated premises** and other users through metering. In this example, the following proportions apply to the **rated premises**:

- a) 50 % of electricity output.
- b) 80 % of heating **hot** water output.

**Figure 3.4.4(A): Determining proportion of cogeneration plant's total outputs during rating period must go to each end-user**



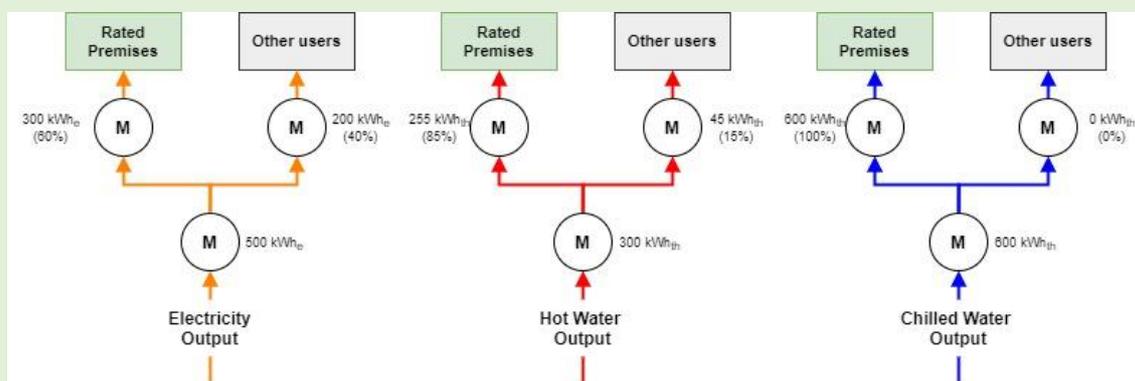
### Example 2: Trigeration system output

Figure 3.4.4(B) shows a **system's** outputs being proportioned between the **rated premises** and other users through metering. In this example, the following proportions apply to the **rated premises**:

- a) 60 % of electricity output.
- b) 85 % of heating hot water output.

c) 100 % of chilled cold water output.

**Figure 3.4.4(B): Determining proportion of trigeneration plant's total outputs during rating period must go to each end-user**



Some **systems** may have insufficient metering to determine the allocation of outputs that were used by the **rated premises** over the **rating period**. In such cases, 100 % of the energy output from the **system**, including exported energy, will be allocated to the **rated premises**.

**Note:** Where the allocation of one type of energy output (e.g. heating hot water) cannot be accurately determine, **Assessors** are only required to allocate 100 % of that energy output to the **rated premises**, by entering 0 kWh<sub>th</sub> in the relevant **calculator** field.

### 3.5 Step 3: Calculate proportion of input energy to rated premises and entry into the NABERS rating input form

The proportion of energy inputs determined in Section 3.4.2 are allocated to each end-user based on the energy outputs of the **system** as determined in Section 3.4.4. This calculation is performed automatically by the **calculator**, which will provide the following values **Assessors** must input into the **NABERS rating input form**:

- A “fuel input” value (MJ) that must be entered as a gas inclusion.
- A “auxiliaries” value (kWh) that must be entered as an electricity inclusion.
- A “**offsite** cogeneration electricity” value (kWh) that must be entered as an electricity inclusion, with provided GreenPower™ value.

**Note:** For further details of the equations used by the **calculator**, see Appendix A.

# Appendix A: Calculations

The percentage of emissions from the energy inputs identified in Section 3.4.2 are allocated to the end-users of **cogeneration systems** or **trigeneration systems** as determined in Section 3.4.4. The percentage of emissions from the energy inputs that are allocated to the energy outputs are calculated with the following Formulas A(1) to A(3).

## Formula A(1)

Emissions associated with the electricity ( $P_E$ ) output are calculated as follows:

$$P_E = \frac{E \times EF_e}{(E \times EF_e) + \left(\frac{HHW \times 3.6}{0.75} \times EF_{gas}\right) + \left(\frac{CHW}{4} \times EF_e\right)}$$

## Formula A(2)

Emissions associated with the heating hot water ( $P_{HHW}$ ) output are calculated as follows:

$$P_{HHW} = \frac{\left(\frac{HHW \times 3.6}{0.75} \times EF_{gas}\right)}{(E \times EF_e) + \left(\frac{HHW \times 3.6}{0.75} \times EF_{gas}\right) + \left(\frac{CHW}{4} \times EF_e\right)}$$

## Formula A(3)

Emissions associated with the chilled cold water ( $P_{CHW}$ ) output are calculated as follows:

$$P_{CHW} = \frac{\left(\frac{CHW}{4} \times EF_e\right)}{(E \times EF_e) + \left(\frac{HHW \times 3.6}{0.75} \times EF_{gas}\right) + \left(\frac{CHW}{4} \times EF_e\right)}$$

where:

- $P$  = Percentage of CO<sub>2</sub>-e emissions in %
- $E$  = Electricity output in kWh<sub>e</sub>
- $HHW$  = Heating hot water output in kWh<sub>th</sub>
- $CHW$  = Chilled cold water output in kWh<sub>th</sub>
- $EF_e$  = NGA emission factors for electricity input in kgCO<sub>2</sub>/kWh<sub>e</sub>
- $EF_{gas}$  = NGA emission factors for natural gas input (kgCO<sub>2</sub>/MJ<sub>th</sub>)

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