SIMPLE GUIDE TO GOOD QUALITY CHP AND THE QUALITY INDEX VALUE

Abstract

This is a simple guide to 'Good Quality' CHP (GQCHP) and the Quality Index (QI) value scoring system.

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1. Introduction

The ‘Simple Guide To’ series is designed to assist Responsible Persons (RPs) in understanding various aspects of the CHPQA process. The content here is a simplified and condensed form of that found in the detailed Guidance Notes 10 and 24 - 27 which are outlined below and can be accessed online with the following hyperlinks. References are made to these and other guidance notes in the form “**GNXX.X**” which refer to paragraphs within the detailed guidance notes. In any cases of doubt, please refer to the detailed guidance notes as they are comprehensive and shall always take precedence.

Detailed Guidance Notes:

GN10 – Defining Good Quality CHP
GN24 – Determination of Scheme Quality
GN25 – Determination of CHP Qualifying Fuel Input
GN26 – Determination of CHP Qualifying Power Output
GN27 – Determination of Qualifying Power Capacity

CHPQA Guidance Notes

https://www.gov.uk/guidance/chpqa-guidance-notes

Good Quality (GQ) is the term coined to describe CHP Schemes that are considered energy efficient under the CHPQA assessment criteria. The Quality Index (QI) is the scoring system developed for CHPQA that provides a means of assessing the quality of CHP Schemes.

For Schemes to meet the definition of Good Quality they must meet a power efficiency threshold (20%) and meet or exceed a pre-determined QI threshold value (usually 100). Schemes that do not meet these criteria are described as ‘partially qualified’ and any fiscal benefits that they may be eligible for are scaled back. It is therefore in the best interests of an RP to achieve the Good Quality CHP criteria to maximise the subsidies/exemptions available, whilst also reducing the Scheme’s environmental impact.

2. What is considered ‘Good Quality’ CHP?

There are two parameters CHPQA use for assessment of Good Quality CHP (GQCHP): **QI** and **Power Efficiency**. If these **threshold criteria** are met,

the fuel inputs and/or power outputs can be considered GQCHP and the Scheme is **fully qualified**.

Subsidies and exemptions gained from certification under the CHPQA scheme are based on three metrics:

Qualifying Fuel Input (QFI)	Qualifying Power Output (QPO)	Qualifying Power Capacity (QPC)

If the relevant thresholds are met and the Scheme is considered Good Quality CHP, the Qualifying Fuel Input and the Qualifying Power Output are equal to their Total counterparts (see boxes below). When the thresholds are not met, some of the fuel input or power outputs are not considered as Good Quality CHP inputs or outputs, and qualifying metrics are scaled back from their Total counterparts (see Section 3). It is therefore in the best interests of an RP to achieve the Thresholds to maximise the qualifying values and hence maximise any subsidies and exemptions.

'Good Quality' Fuel Inputs

If a CHP Scheme achieves the relevant **Power Efficiency Threshold** (20%), all fuel used is considered to be Good Quality CHP fuel input.

Qualifying Fuel Input (QFI) = Total Fuel Input (TFI)

'Good Quality' Power Outputs

If a CHP Scheme achieves the relevant **QI Threshold** (usually 100), all power generated is considered to be Good Quality CHP power output.

Qualifying Power Output (QPO) = Total Power Output (TPO)

‘Good Quality’ Power Capacity

If an **Existing** CHP Scheme meets a **QI Threshold** of 100 at its **Maximum Heat Output** under Normal Operating Conditions, its entire power capacity is considered to be Good Quality CHP power capacity.

If a **New** CHP Scheme meets a **QI Threshold** of 105 based on design **Maximum Heat Output** conditions and **Power Efficiency** of 20%, its entire power capacity is considered to be Good Quality CHP power capacity.

Qualifying Power Capacity (QPC) = Total Power Capacity (TPC)

Existing *and* ***New*** *Schemes are explained in the section below.* ***Maximum Heat Output*** *is based on operation at the heat output that is expected to be exceeded for the hours specified in the CHPQA Standard and further explained in GN27 depending on the use of the CHP heat output.*

2.1. How is the Power Efficiency determined?

Power efficiency is the Total Power Output (TPO) generated in MWh during the reporting period expressed as a percentage of the Total Fuel input (TFI) in MWh during the same period.

$$\eta_{power} = CHP_{TPO} / CHP_{TFI}$$

Note: CHP_{TFI} must be based on the Gross Calorific Value (GCV) or Higher Heating Value (HHV) of the fuel.

2.2. How is the Quality Index (QI) value determined?

The QI methodology ensures validity across a broad spectrum of CHP plant and applications, considering all sizes, fuel and types of CHP technology. The QI formulae have been developed and tested based around a simple general form:

$$QI = (X \times \eta_{power}) + (Y \times \eta_{heat})$$

Where heat efficiency is the Qualifying Heat Output (QHO) generated in MWh during the reporting period expressed as a percentage of the Total Fuel input (TFI) in MWh during the same period.

$$\eta_{heat} = CHP_{QHO} / CHP_{TFI}$$

The QI value enables a simplified comparison of the overall power and heat efficiency of the CHP scheme compared to individual power generating and heat generating plants respectively.

X is a coefficient related to alternative power supply options. Similarly, Y is a coefficient for heat generation, related to alternative heat supply options (boilers). The values of X and Y vary for different sizes and fuel types of Scheme and the date of certification. Refer to the relevant CHPQA Standard for full details and identification of the appropriate QI definition for a given Scheme.

2.1. Threshold Values

The below table details the threshold values for Power Efficiency and QI that need to be met for the fuel inputs and/or power outputs to be considered Good Quality CHP input and/or output.

> **New** Schemes are those that are still in the final design or development stages; and do not have sufficient operational data for at least one month.
>
> **Existing** Schemes are those that are commissioned and running; and have sufficient operational data for at least one month.

The **Initial Operation (IO)** of a Scheme begins when the RP notifies CHPQA that the CHP Scheme has begun operating as a CHP. IO finishes and subsequently **Annual Operation (AO)** commences, once the Scheme has **operated for a full calendar year**. For example, if a Scheme were to begin operating in February 2019, its IO would finish on 31 December 2020, after it had operated for the full calendar year of 2020. Its AO would subsequently commence on 1 January 2021.

Scheme Status	Power Efficiency Threshold (η_{Power})	QI Threshold (QI_{th})
Initial operation	20%	95
Existing	20%	100
New	20%	105

A lower QI threshold is set for schemes in IO, to provide leniency on Schemes

that have just started operating, as they may encounter operational issues, or may have yet to connect all of their heat loads. Conversely, a stricter, higher QI threshold is set for New Schemes, as their performance is based on design conditions and so could be considered a best-case performance scenario.

3. What happens if the Power Efficiency and/or QI thresholds are not met?

Schemes that do not meet the power efficiency and/or the QI threshold are still eligible for fiscal benefits, but the extent of that eligibility is reduced. Schemes that do not meet the Good Quality CHP thresholds are deemed to be partially qualified. Partially qualified Schemes are still certified under CHPQA, but only a portion of the fuel input and/or power outputs classify as being 'Good Quality'.

Power efficiency threshold not achieved

For Schemes that do not achieve the power efficiency threshold, the fuel input that is considered to be GQCHP is scaled back from the Total Fuel Input (TFI) to **Qualifying Fuel Input (QFI).** If a New Scheme, the Total Power Capacity (TPC) would be scaled back to **Qualifying Power Capacity (QPC),** when assessed under Maximum Heat Output conditions.

Qualifying Fuel Input (QFI) < Total Fuel Input (TFI)

Qualifying Power Capacity (QPC) < Total Power Capacity (TPC)

For most CHP schemes, the power efficiency achieved is consistent each year. This means that the amount of useful heat used is the biggest factor towards increasing the QI value. In simple terms, the heat-to-power ratio must be improved to meet the QI Threshold (QI_{th}).

QI threshold not achieved

For Schemes that do not achieve the QI threshold, the power output that is considered to be GQCHP is scaled back from the Total Power Output (TPO) to **Qualifying Power Output (QPO)** and the Total Power Capacity (TPC) is scaled back to **Qualifying Power Capacity (QPC).**

Qualifying Power Output (QPO) < Total Power Output (TPO)

Qualifying Power Capacity (QPC) < Total Power Capacity (TPC)

3.1. How do I determine Qualifying Fuel Input (QFI)?

The QFI is equal to the Total Fuel Input (TFI) for fully certified GQCHP schemes. However, for partially qualified schemes the QFI is the proportion of TFI that is qualified as GQCHP. The method to calculate the QFI for partially certified schemes is shown below:

$$CHP_{QFI} = \frac{\eta_{Power} \times CHP_{TFI}}{\eta_{Threshold\ Power}}$$

For example, if a Scheme achieves a power efficiency (η_{power}) of 15%, which is lower than the threshold power efficiency of 20% ($\eta_{threshold}$), and given the TFI is 100 MWh, the Qualifying Fuel Input (QFI) is determined as follows:

$$CHP_{QFI} = \frac{0.15 \times 100}{0.20} = 75MWh$$

3.2. How do I determine Qualifying Power Output (QPO)?

The QPO is equal to the **Total Power Output** (TPO) for fully certified GQCHP schemes. However, for partially qualified schemes, the QPO is the proportion of TPO that is qualified as GQCHP power output. The method to calculate the QPO for partially qualified schemes is shown below. Condensing/pass-out steam turbine based CHP schemes should refer to the method in **GN26.6-26.7**.

1. **Determine the new heat efficiency required to meet the QI threshold:**

$$\eta_{New\ heat} = \frac{QI_{th} - (X \times \eta_{power})}{Y}$$

2. **Calculate the equivalent heat-to-power ratio:**

$$H{:}\,P_{equivalent} = \frac{\eta_{New\ heat}}{\eta_{power}}$$

3. **The QPO is then determined by:**

$$CHP_{QPO} = \frac{CHP_{QHO}}{H{:}\,P_{equivalent}}$$

Where QHO is the Qualifying Heat Output, see GN50 for more information.

For example, a CHP Scheme with the performance characteristics in the below table would calculate their QI and QPO based on the following steps:

Metric	Value
X	195
Y	113
Total Fuel Input (TFI)	500MWh
Total Power Output (TPO)	175MWh
Qualifying Heat Output (QHO)	100MWh
Power efficiency (η_{power})	175 / 500 = 35%
Heat efficiency (η_{heat})	100 / 500 = 20%

The Quality Index (QI) must first be calculated in order to determine whether the QPO needs to be scaled back from the TPO.

$$QI = (195 \times 0.35) + (113 \times 0.2) = 90.85$$

The CHP Scheme has not met the QI threshold of 100 (assuming that this is an Existing Scheme - see section 2.1 for definition). Its QPO must therefore be scaled back from its TPO.

Firstly, the heat efficiency that would be required to meet the QI threshold should be determined:

$$\eta_{New\ heat} = \frac{100 - (195 \times 0.35)}{113} = 28.1\%$$

Then calculate the heat-to-power ratio between the new heat efficiency and the power efficiency:

$$H{:}\,P_{equivalent} = \frac{0.281}{0.35} = 0.80$$

The QPO is determined as follows, given a QHO of 100MWh:

$$CHP_{QPO} = \frac{100}{0.80} = 120MWh$$

4. Further information

4.1. Further guidance

See the accompanying series of ‘Simple Guide to’ guides and the detailed guidance notes here: https://www.gov.uk/guidance/chpqa-guidance-notes

4.2. Contact Us

In the first instance, all queries on CHPQA should be directed to the CHPQA helpline, or emailed to the Administration team using the details below:

CHPQA Helpline:

- Tel: 01235 753004
- E-mail: chpqainfo@chpqa.com
- Website: https://www.gov.uk/combined-heat-power-quality-assurance-programme