



Quality Assurance for Combined Heat and Power

The CHPQA Standard

Issue 5

November 2013

Prepared by the Department of Energy and Climate Change, in consultation with other Government Departments, as well as the Scottish Executive, the National Assembly for Wales and the Northern Ireland Department of Enterprise, Trade and Investment.

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This document can be downloaded from
<http://chpqa.decc.gov.uk/>

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Citation and Applicability

This Document may be cited as 'The CHPQA Standard'. It has been prepared for the Department of Energy and Climate Change (DECC), who are the custodians of the document.

Assessment, Registration and Certification under CHPQA shall be available to Schemes in the whole of the United Kingdom (UK) of Great Britain and Northern Ireland or owned by Companies registered here. In addition, overseas CHP Schemes that wish to export electricity from Good Quality CHP into the UK may also apply.

This Document will be applied by the CHPQA programme from 1st January 2014.

Transitional Arrangements

The CHPQA Standard specifies different Quality Index formulae for the purposes of determining eligibility for benefits other than ROCs. These formulae are more stringent than those currently used in CHPQA Guidance Note 44 for determining eligibility for ROCs.

DECC consulted from December 2012 to March 2013 on amendments to Guidance Note 44, and consequential amendments to other CHPQA documents, proposing tightening the Guidance Note 44 requirements to reflect improvements in the efficiency of renewable CHP schemes since Guidance Note 44 was first developed. The Government's response, setting out the changes which would be implemented, was published on 12th July 2013.

In some cases the revised formulae are now more stringent than those in Issue 3 of the CHPQA Standard (this is the case for <25MW schemes only) and have been used here (in Table 1), to replace those currently in Issue 3 of the Standard.

However, with CHPQA certification based on scheme performance over the previous calendar year, Issue 3 of the Standard formulae will be used for the 2014 certification of existing schemes. This will allow these schemes to reconcile their 2013 performance using the old formulae. Issue 5 of the Standard formulae will apply from 1st January 2014 and will be used for the 2015 certification of existing schemes. This will allow these schemes to reconcile their 2014 performance using the new formulae.

For schemes not previously certified, there is no reconciliation over the previous calendar year and Issue 5 of the CHPQA Standard formulae will both apply and be used for the 2014 certification of new schemes from 1st January 2014.

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1 SCOPE

CHPQA is an initiative by the Government to encourage the wider practical application of Good Quality Combined Heat and Power, Community Heating and Alternative Fuel technologies. CHPQA aims to monitor, assess and improve the quality of UK Combined Heat and Power.

This Standard sets out definitions, criteria and methodologies for the operation of CHPQA. It should be read in conjunction with the supporting CHPQA Guidance Notes, which provide detailed information on how this Standard will be interpreted by Government Departments and agencies as well as guidance on compliance with this Standard.

It is the intention that this Standard should be subject to minimum change; developments in the application of the Standard will, whenever possible, be reflected in changes in the CHPQA Guidance Notes.

This Standard does not address issues relating to the use of CHPQA for determining eligibility for fiscal benefits. For these matters, reference should be made to the CHPQA Guidance Notes and, where necessary, the appropriate Government Department.

2 PURPOSE AND AIMS

CHP makes significant fuel, cost and emissions savings over conventional, separate forms of power generation and heat-only boilers. The generation and supply of electricity from power stations is generally at an efficiency in the range 25-50%, based on the Gross Calorific Value (GCV) of the fuel and including transmission and distribution losses. This means that 50-75% of the energy content of the fuel is not usefully employed. This unutilised energy content is rejected as heat directly to the atmosphere or into seas or rivers. The generation of electricity and the recovery of heat in CHP Schemes typically achieve overall efficiencies of 60-80% and sometimes more.

Unlike conventional methods of electricity generation, some of the heat cogenerated in a CHP Scheme is used typically in industrial processes or for heating and hot water in buildings. The heat used in this way displaces heat that would otherwise have to be supplied by burning additional fuel and so leads directly to a reduction in emissions. The development of CHP provides a particularly cost-effective approach for reducing CO₂ emissions and therefore plays a crucial role in the UK Climate Change programme.

The aims of CHPQA are to:

- Define, assess and monitor the quality of CHP Schemes on the basis of energy efficiency and environmental performance.

- Ensure fiscal and other benefits are in line with environmental performance.
- Provide clear signals to users and potential users to minimise the cost of energy demands through CHP.
- Achieve the above at minimum cost to CHP users and to Government.

3 USES FOR CHPQA

CHPQA provides the following:

- A methodology for assessing the quality of CHP Schemes, and their qualification as Good Quality CHP for all or part of their inputs, outputs and capacity.
- A programme whereby Responsible Persons can apply for the Registration and Certification of their Schemes in accordance with the criteria for Good Quality CHP and hence qualify for benefits. Application to the CHPQA programme is voluntary.
- A programme that provides a robust methodology for calculating primary energy savings from CHP, and is used to determine the eligibility of schemes for fiscal and other benefits.

Certification issued under the CHPQA programme may be used for determining the eligibility of Schemes for fiscal or other benefits and for determining compliance of Schemes with regulatory requirements where quality is relevant to entitlement.

GQCHP Schemes with total installed capacity of

- <1MWe - provide > 0% primary energy savings compared with the Cogeneration and Energy Efficiency Directives' harmonized reference values for separate production of heat and electricity;
- ≥1MWe - provide ≥10% primary energy savings compared with the Directives' harmonized reference values for separate production of heat and electricity;
- >25MWe - have an overall efficiency of above 70% (based on Net Calorific Value).

The criteria above have been accommodated within the CHPQA framework through the development of a specific set of CHPQA QI formula, detailed in Table 1.

4 INTERPRETATION

Administrator is that body contracted by the Government to have responsibility for the management of the CHPQA programme.

Alternative Fuels are fuels other than Conventional Fuels and they fall into broad categories for the purposes of CHPQA (see Table 1).

Annual Operation (AO) is a period commencing on 1st January and finishing on 31st December and is normally 8760 hours except for leap years.

Audit is any activity carried out by the Administrator to confirm compliance with this Standard. It typically includes a site-based evaluation of the operation of a CHP Scheme to confirm that the Self-Assessment is founded on a correct interpretation of the CHPQA Standard and that the data and calculations submitted are corroborated by site data records.

Certification is the issuing by the Administrator of a certificate that a Scheme meets the criteria for Good Quality for all or part of its energy inputs, outputs and capacity, based on Validation of Self-Assessment submitted by a Responsible Person.

CHP (Combined Heat and Power) is defined as the simultaneous generation of heat and power in a single process. The power output is usually electricity, but may include mechanical power. Heat outputs can include steam, hot water or hot air for process heating, space heating or absorption chilling.

CHPQA programme is a management and administrative process under which Registration and Certification is being taken forward. It proceeds through the application for Registration and Self-Assessment of CHP Schemes by a Responsible Person to Certification in accordance with the criteria for Good Quality CHP. The Administrator will carry out Registration, Validation, Certification and Audit on behalf of the Secretary of State for Energy and Climate Change.

CHP Scheme means the equipment and operating system for the whole Scheme, including monitoring systems, at any stage of development from design to actual operation. It will include one or more prime movers (e.g. gas turbine or reciprocating engine) driving electrical generator(s) or mechanical loads and some means of recovering waste heat, which would otherwise be released to the environment, for a useful purpose.

A Scheme can consist of a number of prime movers connected in series or in parallel. A gas turbine or a reciprocating engine operated in combined cycle mode, where the heat generated is used to produce steam that feeds into a steam turbine, would be an example of connection in series. An example of parallel connection is a number of gas turbines with suitable heat recovery steam generators connected to a common steam system.

Where prime movers are connected in series, they shall be treated as part of a single Scheme. Where prime movers are connected in parallel, they may be treated as part of a single Scheme or as separate, individual Schemes. The decision on how to treat multiple prime movers in parallel rests with the Responsible Person making the application for Registration.

A Scheme boundary may be defined to include associated auxiliary or back-up boilers or generators.

CHP Qualifying Fuel Input (CHP_{QFI}) is the registered annual fuel input to a CHP Scheme qualifying as input to Good Quality CHP (MWh), based on GCV. Most Schemes will meet the Threshold Power Efficiency Criterion for Good Quality CHP in Annual Operation and therefore CHP_{QFI} is the total annual fuel input (CHP_{TFI}). For a Scheme that does not achieve the Threshold Power Efficiency Criterion for Good Quality CHP, CHP_{QFI} is that portion of the annual fuel input to a Scheme that would have achieved the Power Efficiency Criterion, based on the actual annual power generation (CHP_{TPO}).

CHP Qualifying Heat Capacity (CHP_{QHC}) is the registered maximum heat supply capacity of a CHP Scheme (MW_{th}). It is the maximum rate of heat supply demonstrably utilised to displace heat that would otherwise be supplied from other energy sources.

CHP Qualifying Heat Output (CHP_{QHO}) is the registered amount of useful heat supplied annually from a CHP Scheme (MWh_{th}). It is heat output that is demonstrably utilised to displace heat that would otherwise be supplied from other sources.

Note: CHP_{QHO} excludes any heat rejected to the environment without any beneficial use. Examples include, *inter alia*, heat lost from chimneys or exhausts and heat rejected in equipment such as condensers and radiators.

CHP Qualifying Power Capacity (CHP_{QPC}) is the registered power generation capacity of a CHP Scheme (MW_e) that qualifies as Good Quality CHP. It is used for monitoring the installed capacity of Good Quality CHP in the UK.

Most Schemes will meet the relevant Threshold QI Criterion for Good Quality CHP Capacity and therefore CHP_{QPC} is the same value as the total power capacity (CHP_{TPC}). For a Scheme that does not achieve the Threshold QI Criterion for Good Quality CHP, CHP_{QPC} is that portion of the total generation capacity that would achieve the Threshold QI Criterion, under the conditions of Maximum Heat Output under Normal Operating Conditions.

CHP Qualifying Power Output (CHP_{QPO}) is the registered annual power generation from a CHP Scheme (MWh_e) that qualifies as Good Quality CHP. Most Schemes will meet the relevant Threshold QI Criterion for Good Quality CHP in Annual Operation and therefore CHP_{QPO} is the total power output (CHP_{TPO}). For a Scheme that does not achieve the Threshold QI Criterion for Good Quality CHP, CHP_{QPO} is that portion of the annual power output from a Scheme that would have achieved the Threshold QI Criterion, based on the actual annual heat supplied (CHP_{QHO}).

CHP Total Fuel Input (CHP_{TFI}) is the total registered annual fuel input to a CHP Scheme (MWh), based on GCV.

CHP Total Power Capacity (CHP_{TPC}) is the registered maximum power generation capacity of the CHP Scheme (MW_e), at the reference conditions defined in the CHPQA Guidance Notes. It defines the size of the Scheme for the purpose of selecting the appropriate Quality Index definition in Table 1 or Table 2, if applicable. Where there is more than one electrical generator in a Scheme, CHP_{TPC} shall include the total electrical capacity of all generators that can run together, i.e. the actual maximum generation capacity. Where a Scheme includes mechanical power output, this shall be converted to an equivalent electrical power output and included in CHP_{TPC}.

CHP Total Power Output (CHP_{TPO}) is the total annual power generation from a CHP Scheme (MW_h), as measured at the generator terminals, plus the electrical equivalent of any qualifying mechanical power supplied by the Scheme.

The CHPQA Unit List is held on <http://chpga.decc.gov.uk/> and details the performance of a number of CHP units, based on manufacturers' specifications, that meet the following criteria:

- CHP Total Power Capacity (CHP_{TPC}) less than 500kWe,
- No in-built facility to dump heat,
- Only includes a single prime mover,
- One main heat output system e.g. a single system recovering heat from the engine cooling systems, or/as well as exhaust gases in the case of a reciprocating engine.

This allows the gas consumption and/or heat output of CHP Schemes based on these units to be estimated.

For each unit, the list displays: Manufacturer; Model; Engine Type; Total Power Capacity (equivalent to instantaneous power output) and Qualifying Heat Capacity (equivalent to instantaneous heat output).

Community Heating (CH) is the centralised provision of heat to a number of residential, institutional, commercial, industrial or other sector buildings, premises, sites and users typically for the purpose of providing hot water, space heating or cooling and can include the provision of process steam. CH Schemes may also provide heat users with associated electricity.

Conventional Fuels are those described as taxable commodities under the Finance Act, 2000, Schedule 6, or oil as defined in the Hydrocarbon Oil Duties Act, 1979. See also Alternative Fuels.

Directive is the European Union Directive 2004/008/EC - Promotion of Cogeneration based on a useful heat demand in the Internal Energy Market or, from 5th June 2014 onwards, European Union Directive 2012/27/EU on energy efficiency.

Gross Calorific Value (GCV) of a fuel is the total energy available from that fuel (solid, liquid or gas) when it is completely burnt. It is expressed as heat per unit weight or volume of fuel. ‘Gross’ signifies that the water formed or liberated during combustion is condensed to the liquid phase. The GCV of a solid or liquid fuel is determined at constant volume and the GCV of a gaseous fuel is determined at constant pressure.

Heat Efficiency (η_{heat}) is the qualifying heat output divided by the total fuel input over the period in question. Normally, η_{heat} is calculated over Annual Operation and is therefore CHP_{QHO} divided by CHP_{TFI} .

Heating Season (HS) for a Residential Community Heating Scheme is defined by 7 months during Annual Operation selected at the discretion of the Responsible Person.

Initial Operation (IO). During this period a reduced Threshold QI Criterion may apply.

Initial Operation starts when the Responsible Person notifies the Administrator that the Scheme has begun operating. For a Scheme serving an individual user or site, IO ends after the first complete AO. For a Scheme serving Community Heating Initial Operation ends after the first two complete AOs.

Maximum Heat Output under Normal Operating Conditions (MaxHeat).

Maximum Heat Output under Normal Operating Conditions varies with application as some Schemes have very distinct patterns of heat demand that can cycle over varying periods. It is expected that Responsible Persons will take this into account when deciding the specific periods of output to count towards their aggregate Maximum Heat Output.

To qualify as Normal Operating Conditions, the Maximum Heat Output shall be maintained for an absolute minimum of not less than the following cumulative periods during Annual Operation:

| | |
|--|------------|
| Industrial, commercial or institutional ($<10\%$ CHP_{QHO} to Residential Users) | 1000 hours |
| Mixed residential, institutional, commercial or industrial ($\geq 10\%$ residential) | 750 hours |
| Residential Community Heating | 500 hours |

For Schemes under AO, MaxHeat shall be based on actual performance. For proposed, new Schemes, evidence shall be required to support predictions of future loads, for example, projected build-up of a Community Heating Scheme.

Monitoring is the measurement of those energy inputs and outputs for a Scheme relevant to the Self-Assessment, together with the provision of maintenance of records and calibration of metering equipment. A Scheme includes the Monitoring systems required for compliance with this CHPQA Standard.

Power Efficiency (η_{power}) is one of two key parameters for assessing a CHP Scheme (the other being the Quality Index) and it is the total annual power output (CHP_{TPO}) divided by the total annual fuel input (CHP_{TFI}). Where a Scheme includes mechanical power output, this shall be converted to an equivalent electrical power output as described in Section 5.10 and included in the calculation of Power Efficiency.

Quality Index (QI) is one of two key parameters for assessing a Scheme (the other being Power Efficiency). QI is an indicator of the energy efficiency and environmental performance of a Scheme, relative to the generation of the same amounts of heat and power by separate, alternative means.

Registration is the process of recording initial details about the Responsible Person and the CHP Scheme outline by the Administrator. Further details shall be recorded on the appropriate proformas issued to the Responsible Person by the Administrator.

Residential Community Heating (RCH) is the centralised supply of heat, predominantly for Residential Users for space heating and domestic hot water. Residential Use is defined by the Finance Act 2000 and the term Residential User is defined in the CHPQA Guidance Notes. For a Community Heating Scheme to qualify as RCH, the Responsible Person must demonstrate that it meets at least one of the following criteria:

- The proportion of CHP Qualifying Heat Output (CHP_{QHO}) in Annual Operation provided for Residential Use is $>60\%$.
- The proportion of CHP Qualifying Heat Output (CHP_{QHO}) during the Heating Season provided for Residential Use is $>70\%$.
- The proportion of CHP Qualifying Heat Output (CHP_{QHO}) at MaxHeat provided for Residential Use is $>60\%$.
- Residential Users out-number institutional, commercial and industrial customers by at least 50:1 and the proportion of CHP_{QHO} in Annual Operation supplied for Residential Use is $\geq 10\%$.
- In the case of proposed, new Schemes, Schemes in Initial Operation and Schemes that are developing as defined in the CHPQA Guidance Notes, the proportion of CHP_{QHC} for Residential Use is $>60\%$.

Responsible Person means that person or corporate body registered with the Administrator as responsible for the operation of a Scheme.

Self-Assessment is the evaluation by the Responsible Person of the quality of a CHP Scheme, including calculation of key parameters, using the appropriate documentation for Self-Assessment as issued by the Administrator. The forms that come with the documentation for Self-Assessment shall be used to define the CHP Scheme and to record the Self-Assessment data.

Small-Scale Scheme is one of CHP_{TPC} less than $2MW_e$.

Threshold Criteria for Good Quality CHP

- **For Fuel Inputs under Annual and Initial Operation:**
A Scheme that qualifies as Good Quality CHP for its entire annual energy inputs is one where the Power Efficiency equals or exceeds 20%.
- **For Power Outputs under Annual Operation:**
A Scheme that qualifies as Good Quality CHP for its entire annual energy outputs is one where the Quality Index equals or exceeds 100. Normally, the **Threshold QI Criterion** is based on Annual Operation, but it can be based on other periods, for example on the Heating Season in the case of RCH Schemes.
- **For Power Outputs under Initial Operation:**
A Scheme that qualifies as Good Quality CHP for its entire annual energy outputs is one where the Quality Index equals or exceeds 95. Normally, the Threshold QI Criterion is based on Annual Operation, but it can be based on other periods, for example on the Heating Season in the case of RCH Schemes.
- **For Power Generation Capacity under Annual Operation:**
The Threshold Criterion for existing Good Quality CHP Capacity is that the CHP Scheme achieves a QI of at least 100 at its Maximum Heat Output under Normal Operating Conditions.
- **For Proposed New Power Generation Capacity:**
Threshold Criteria for proposed new Good Quality CHP Scheme Capacity, at design, specification, tendering and approvals stages, are
 - $QI \geq 105$ (at Maxheat) and Power Efficiency $\geq 20\%$, both under Annual Operation

Validation is the confirmation by the Administrator of the assessment method, assumptions made and consistency of the information provided in a Self-Assessment. Validation, unlike Audit, is the routine confirmation that a Self-Assessment has been carried out properly. It includes verification that the Scheme definition and calculations are correctly applied.

5 DETAILED REQUIREMENTS

Responsible Persons operating CHP Schemes must demonstrate compliance with this CHPQA Standard in order to gain and maintain Good Quality CHP Certification. Certification may be used to determine eligibility for fiscal or other benefits associated with the operation of such Schemes.

For each Scheme, the Responsible Person shall:

- Apply for Registration (Section 5.2).

- Install appropriate monitoring systems and maintain appropriate records (Section 5.3).
- Conduct a Self-Assessment and apply for Certification under CHPQA (Section 5.4).
- Comply with Validation and Audit obligations (Section 6).
- Notify the Administrator of any changes to the Scheme relevant to the Registration and Self-Assessment.

The Administrator of the CHPQA programme shall:

- Produce and maintain Guidance Notes for the operation of CHPQA (Section 5.1).
- Define and maintain a timetable for the operation of CHPQA.
- Process applications for Registration and Certification (Section 5.2).
- Issue appropriate documentation for Self-Assessment.
- Respond to enquiries from Responsible Persons submitting Self-Assessments.
- Establish and maintain a database of Registered Schemes (Section 5.2).
- Receive and Validate reports of Self-Assessments carried out by Responsible Persons (Section 5.4).
- Carry out Validation and Audit activities as appropriate (Sections 5.4 & 6).
- Issue Certificates of Good Quality CHP as appropriate (Section 5.4).

5.1 CHPQA Guidance Notes

The Administrator shall produce and maintain CHPQA Guidance Notes for use by Responsible Persons applying for Registration and Certification.

The CHPQA Guidance Notes provide explanation of how the requirements of this Standard will be interpreted by the Administrator on behalf of DECC and other Government departments.

The CHPQA Guidance Notes explain the operation of the programme and include technical details and worked examples. They also contain standard proformas to apply for Registration and Certification.

The Administrator will regularly review, evaluate and update the CHPQA Guidance Notes. As experience with the CHPQA programme develops, updates may be made to reflect technology and market developments in order to ensure that the objectives of CHPQA continue to be met. Such updates shall be approved by DECC and made available as quickly as possible.

5.2 Registration

Persons wishing to register a Scheme shall submit to the Administrator an application for Registration proforma, providing information on the Responsible Person, site and overall Scheme parameters.

Responsible Persons shall provide any additional information required by the Administrator for the purpose of assessing an application for Registration. All information supplied shall be treated in confidence by the Administrator but may be shared with DECC and Ofgem for the purposes of assessing the operation of the scheme; to fulfil legislative requirements, for the administration of measures supporting Good Quality CHP, and for statistical and research purposes.

Should an application be unsuccessful, the Administrator shall notify the Responsible Person and DECC in writing, stating the reasons for rejection.

5.3 Monitoring

Monitoring is the determination of those energy inputs and outputs for the Scheme relevant to the Self-Assessment, together with the provision for the maintenance of records and the calibration of metering equipment. In some cases, monitoring may include the use of indirect methods as an alternative to direct metering.

The Responsible Person shall ensure that there are appropriate systems in use to monitor all energy inputs and outputs for the Scheme which are relevant to the calculation of QI, Power Efficiency and, if appropriate, CHP_{QPO} , CHP_{QPC} and CHP_{QFI} . Monitoring systems shall apply to both main and auxiliary fuel inputs.

All monitoring systems shall be designed, installed and verified to provide the appropriate standards of accuracy as defined in the CHPQA Guidance Notes.

The Responsible Person shall maintain records of annual energy inputs and outputs and shall retain the records for a minimum of six years.

5.4 Self Assessment

Self-Assessment requires that the Responsible Person shall specify, determine or calculate the following:

- (i) Scheme boundary and selected QI definition
- (ii) Monitoring and recording provisions
- (iii) Power Efficiency
- (iv) Heat Efficiency
- (v) Quality Index (QI)
- (vi) Qualifying Power Capacity (CHP_{QPC})
- (vii) Qualifying Heat Capacity (CHP_{QHC})
- (viii) Qualifying Fuel Input (CHP_{QFI})
- (ix) Qualifying Power Output (CHP_{QPO})
- (x) Qualifying Heat Output (CHP_{QHO})

The Self-Assessment shall be reported to the Administrator using proformas to define the CHP Scheme, to record fuel inputs and energy outputs and to calculate the required parameters.

Responsible Persons may define Scheme boundaries to include items such as auxiliary or back-up boilers and generators but should be aware of the implication for quality assessment and thereby eligibility for benefits (see CHPQA Guidance Notes).

In order to maintain the Certification for a Scheme, the Responsible Person shall submit a Self-Assessment for each Annual Operation.

The Administrator shall validate the Self-Assessment. Validation activities shall be appropriate to the size of the Scheme. The Administrator shall determine whether the Scheme meets the Good Quality CHP Threshold Criteria, for all or part of its inputs, outputs and capacity, and issue Certification to this effect.

Responsible Persons shall provide any additional information required by the Administrator for Validation of a Self-Assessment. Responsible Persons shall provide access to the Scheme site if required. All information provided for the purposes of Validation shall be treated in confidence by the Administrator.

Responsible Persons shall notify the Administrator of any changes made to the Scheme relevant to the Self-Assessment.

5.4.1 Small-Scale Schemes with No Heat Rejection Facility

For Small-Scale Schemes with no heat rejection facility (that is where all available heat output is utilised beneficially, see definition of CHP_{QHO}), the requirement for Self-Assessment is normally limited to determination of the Power Efficiency and QI. If the Power Efficiency is less than the Threshold Criterion, CHP_{QFI} shall be calculated. Where suitable heat metering does not exist, the annual heat supplied (CHP_{QHO}) may be determined on the basis of the estimated heat supply profile and design information for the Scheme. If the CHP unit upon which the Scheme is based is on the CHPQA Unit List, the annual heat supplied (CHP_{QHO}) may be estimated by multiplying the Total Power Output (CHP_{TPO}) by the List's Heat to Power ratio for that unit.

5.4.2 Small-Scale Schemes with Heat Rejection Facility

Small-Scale Schemes with a heat rejection facility must comply with the heat monitoring requirement as applied to Schemes of $CHP_{TPC} \geq 2MW_e$ and over.

5.5 The Quality Index, QI

The Quality Index is one of two key parameters for assessing a CHP Scheme. QI is an indicator of the energy efficiency and environmental performance of a Scheme.

The general form of the QI definition is:

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

X is a coefficient related to alternative power supply options. Similarly Y is a coefficient for heat generation, related to alternative heat supply options. The values of X and Y vary for different sizes and types of Scheme as shown in Table 1.

Where a Scheme utilises both Conventional and Alternative Fuels, weighted mean values for X and Y shall be used for the definition and calculation of QI.

QI is normally calculated on an annual basis where:

$$\eta_{power} = \text{CHP}_{\text{TPO}}/\text{CHP}_{\text{TFI}}$$

$$\eta_{heat} = \text{CHP}_{\text{QHO}}/\text{CHP}_{\text{TFI}}$$

QI may also be calculated for other specific periods, most commonly under conditions of Maximum Heat Output under Normal Operating Conditions (MaxHeat) or over the Heating Season in the case of Residential Community Heating.

Efficiency values shall be based on the Gross Calorific Value (GCV) of the input fuel.

CHP Schemes may be Registered, Self-Assessed and Certified at various stages from design through operation to improvement and up-grading. For this reason, the values of power supplied, heat supplied and fuel used may be derived from design data or determined by monitoring actual annual performance.

The annual power supplied (CHP_{TPO}) is the total electricity generated, as measured at the generator terminals, plus the electrical equivalent of any mechanical power supplied by the Scheme (see Section 5.10).

The annual heat supplied (CHP_{QHO}) is the total heat supplied across the CHP Scheme boundary that is utilised in a manner that demonstrably displaces heat that would otherwise be supplied from other energy sources.

The QI definitions shall be subject to periodic review to ensure that the following criteria are met:

- (i) The values of X and Y remain applicable and appropriate for each size and type of CHP Scheme.
- (ii) Certified Good Quality CHP will continue to provide significant environmental and other benefits compared to conventional energy supply alternatives.
- (iii) The QI definitions provide a challenging threshold for all CHP Schemes and promote continuous improvement of CHP plant.
- (iv) The QI definitions remain compatible with specified EU reference efficiency values used for calculating primary energy savings.

5.6 Power Efficiency, η_{power}

Power Efficiency is one of two key parameters for assessing a CHP Scheme (the other being Quality Index) and it is the total annual power output (CHP_{TPO}) divided by the total annual fuel energy input (CHP_{TFI}).

$$\eta_{power} = \text{CHP}_{\text{TPO}}/\text{CHP}_{\text{TFI}}$$

The Threshold Power Efficiency Criterion is 20%.

5.7 CHP Qualifying Fuel Input, CHP_{QFI}

Where the Power Efficiency meets or exceeds the Threshold Criterion, all of the fuel input to the Scheme qualifies, i.e. $CHP_{QFI} = CHP_{TFI}$. Where the Power Efficiency for a Scheme is less than the Threshold Criterion, the fuel use that qualifies as input to Good Quality CHP (CHP_{QFI}) shall be calculated. CHP_{QFI} is that portion of the fuel input that would have provided a Power Efficiency equal to the Threshold Criterion, based on the annual power output (CHP_{TPO}).

$$CHP_{QFI} = CHP_{TFI} \times (\eta_{power} / \eta_{power(threshold)}) \text{ MWh}$$

Where

$\eta_{power(threshold)}$ = The Threshold Power Efficiency Criterion

5.8 CHP Qualifying Power Output, CHP_{QPO}

For Schemes that meet the Threshold QI Criterion, the qualifying power output is the same as the total power output, i.e. $CHP_{QPO} = CHP_{TPO}$. For Schemes that do not qualify as Good Quality CHP for the whole of their output, the power output is considered in two portions:

- (i) The portion represented by the CHP Qualifying Power Output, CHP_{QPO} . This is the portion of the actual annual electrical (or mechanical) energy supplied which would result in achieving a QI equal to 100 (or other transitional value), given the actual annual heat supplied (CHP_{QHO}). This portion may be eligible for benefits.

$$CHP_{QPO} = CHP_{QHO} / (\text{Heat-to-power ratio at } QI=100) \text{ MWh}_e$$

Where (Heat-to-power ratio at $QI=100$) = $\eta_{heat(QI=100)} / \eta_{power}$ and

$$\eta_{heat(QI=100)} = [100 - (X \times \eta_{power})] / Y$$

- (ii) Annual electrical energy supplied in excess of the CHP_{QPO} . This portion does not qualify as an output from Good Quality CHP.

The treatment of these two separate portions in Government policies shall depend on the purpose and scope of the individual policy instruments.

Note: for fully or partially qualified condensing steam turbines, including those in combined cycle CHP Schemes, a Z factor must be used. The Z factor provides a means of accounting for the interdependency between heat and power outputs in this type of Scheme; see CHPQA Guidance Notes 26 & 28.

5.9 CHP Qualifying Power Capacity, CHP_{QPC}

For Schemes that meet the Threshold QI Criterion, the qualifying power capacity is the same as the total power capacity, i.e. $CHP_{QPC} = CHP_{TPC}$. For Schemes that do not qualify as Good Quality CHP for the whole of their output, the CHP Qualifying Power Capacity (CHP_{QPC}) shall be calculated. CHP_{QPC} is that portion of the power generating capacity that would provide a QI value of 100 for existing Schemes and

105 for new Schemes, under the conditions of Maximum Heat Output under Normal Operating Conditions. Normally, for an existing CHP Scheme based on gas turbines or reciprocating engines

$$\text{CHP}_{\text{QPC}} = \text{MaxHeat}/(\text{Heat-to-power ratio at } Q_{\text{IMaxHeat}}=100) \text{ MW}_e$$

Where MaxHeat = Maximum Heat Output under Normal Operating Conditions,

$$(\text{Heat-to-power ratio at } Q_{\text{IMaxHeat}}=100) = \eta_{\text{heat}(Q_{\text{IMaxHeat}}=100)} / \eta_{\text{power}} \quad \text{and}$$

$$\eta_{\text{heat}(Q_{\text{IMaxHeat}}=100)} = [100 - (X \times \eta_{\text{power}})]/Y$$

Note: for fully or partially qualified condensing steam turbines including those in combined cycle Schemes, a Z factor must be used. The Z factor provides a means of accounting for the interdependency between heat and power outputs in this type of Scheme, see CHPQA Guidance Notes.

5.10 Mechanical Power

Where mechanical power is provided by a Scheme, this shall be included in the Self-Assessment of CHP_{TPO} as an equivalent electrical output, by multiplying the mechanical energy by a factor of 1.05.

6 AUDIT

The Administrator shall carry out periodic, selective Audits of CHP Schemes, the scope of which shall be appropriate to the size of the Scheme. Audits will typically involve a site-based evaluation of a CHP Scheme but can include any activity carried out by the Administrator to confirm compliance with this Standard.

In addition to confirming that this Standard has been correctly interpreted and that any data submitted at the time of the Self-Assessment can be corroborated, the Audit may extend to the overall operation of the total Scheme, including management systems and documentation.

The Responsible Person shall provide access to the Scheme and all associated documentation as required and shall retain records for six years from the time that they were created.

7 PENALTIES

Any Responsible Person who submits misleading information provided under the CHPQA programme, in order to gain eligibility for benefits, shall be subject to penalty arrangements enforced by the appropriate Government Department.

8 APPEALS

Appeals concerning Registration, Validation or Certification can be made using the appeals process described in the Guidance Notes. All such appeals shall be directed in the first instance to the Administrator, with ultimate referral, if necessary, to DECC.

9 QUALITY INDEX (QI) DEFINITIONS

9.1 QI Definitions

The definitions for the different broad categories of CHP Scheme are given in Table 1.

9.2 Initial Operation

During Initial Operation of a Scheme, the Self-Assessment shall be based on a Threshold QI Criterion of 95. Initial Operation starts when the Responsible Person notifies the Administrator that the Scheme has begun operating.

For a Scheme serving an individual user or site, Initial Operation ends after the first complete AO. For a Community Heating Scheme, Initial Operation ends after the first two complete AOs.

Table 1 lists the QI definitions for various sizes and types of existing CHP Scheme. Use the CHP_{TPC} to select the appropriate definition for the size of the Scheme unless the Scheme falls into one of the Special Cases shown in the bottom part of the table.

The general definition for QI is

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

Where Power Efficiency (η_{power}) = CHP_{TPO}/CHP_{TFI} and

Heat Efficiency (η_{heat}) = CHP_{QHO}/CHP_{TFI}

Table 1 QI Definitions for Various Sizes and Types of CHP Scheme

| Size Of Scheme (CHP_{TPC}) | QI Definition |
|---|---|
| CONVENTIONAL FOSSIL FUELS SCHEMES | |
| Natural gas (inc. Reciprocating Engines) | |
| $\leq 1MW_e$ | $QI = 249 \times \eta_{power} + 115 \times \eta_{heat}$ |
| >1 to $\leq 10MW_e$ | $QI = 195 \times \eta_{power} + 115 \times \eta_{heat}$ |
| >10 to $\leq 25MW_e$ | $QI = 191 \times \eta_{power} + 115 \times \eta_{heat}$ |
| >25 to $\leq 50MW_e$ | $QI = 186 \times \eta_{power} + 115 \times \eta_{heat}$ |
| >50 to $\leq 100MW_e$ | $QI = 179 \times \eta_{power} + 115 \times \eta_{heat}$ |
| >100 to $\leq 200MW_e$ | $QI = 176 \times \eta_{power} + 115 \times \eta_{heat}$ |
| >200 to $\leq 500MW_e$ | $QI = 173 \times \eta_{power} + 115 \times \eta_{heat}$ |
| $>500MW_e$ | $QI = 172 \times \eta_{power} + 115 \times \eta_{heat}$ |
| Oil | |
| $\leq 1MW_e$ | $QI = 249 \times \eta_{power} + 115 \times \eta_{heat}$ |
| >1 to $\leq 25MW_e$ | $QI = 191 \times \eta_{power} + 115 \times \eta_{heat}$ |
| $>25MW_e$ | $QI = 176 \times \eta_{power} + 115 \times \eta_{heat}$ |
| Coal | |
| $\leq 1MW_e$ | $QI = 249 \times \eta_{power} + 115 \times \eta_{heat}$ |
| >1 to $\leq 25MW_e$ | $QI = 191 \times \eta_{power} + 115 \times \eta_{heat}$ |
| $>25MW_e$ | $QI = 176 \times \eta_{power} + 115 \times \eta_{heat}$ |

| SPECIAL CASES | | | |
|--|--------------|---|----------------------------|
| FUEL CELL SCHEMES | | $QI = 180 \times \eta_{power} + 120 \times \eta_{heat}$ | |
| ALTERNATIVE FUEL SCHEMES¹ | | | |
| Category A (e.g. AD gas, sewage gas, landfill gas) | | | |
| $\leq 1MWe$ | $QI = 238x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 25MWe$ | $QI = 225 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 193 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category B (e.g. synthesis gas) | | | |
| $\leq 1MWe$ | $QI = 275x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 25MWe$ | $QI = 251 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 193 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category C e.g. Fatty Acid Methyl Ester, Pyrolysis oil etc.) | | | |
| $\leq 1MWe$ | $QI = 245 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 25MWe$ | $QI = 191 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 176 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category D (e.g. Tallow, Used Cooking Oil) | | | |
| $\leq 1MWe$ | $QI = 245 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 25MWe$ | $QI = 226 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 176 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category E (e.g. Municipal waste, sewage sludge, paper sludge etc.) | | | |
| $\leq 1MWe$ | $QI = 370 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 10MWe$ | $QI = 370 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >10 to $\leq 25MWe$ | $QI = 370x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 220 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category F (e.g. Logs, Energy crops, Agricultural residues etc.) | | | |
| $\leq 1MWe$ | $QI = 348x$ | η_{power} | $+ 130 \times \eta_{heat}$ |
| >1 to $\leq 10MWe$ | $QI = 348x$ | η_{power} | $+ 130 \times \eta_{heat}$ |
| >10 to $\leq 25MWe$ | $QI = 348 x$ | η_{power} | $+ 130 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 220 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category G (e.g. Contaminated waste wood) | | | |
| $\leq 1MWe$ | $QI = 352x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 10MWe$ | $QI = 338 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >10 to $\leq 25MWe$ | $QI = 338x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 220 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category H (e.g. Wood pellets, straw, clean waste wood etc.) | | | |
| $\leq 1MWe$ | $QI = 329 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 10MWe$ | $QI = 293x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >10 to $\leq 25MWe$ | $QI = 286 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 220 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category I (e.g. by-product gases produced in industrial processes) | | | |
| $\leq 1MWe$ | $QI = 294 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 25MWe$ | $QI = 221 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 193 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category J (e.g. waste gases such as carbon monoxide, or waste heat such as the exhaust gas from high temperature processes, or as a product of exothermic chemical reactions). | | | |
| $\leq 1MWe$ | $QI = 329 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 25MWe$ | $QI = 299 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 193 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| Category K (e.g. liquid waste-non renewable) | | | |
| $\leq 1MWe$ | $QI = 275 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| >1 to $\leq 25MWe$ | $QI = 260 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |
| $>25MWe$ | $QI = 176 x$ | η_{power} | $+ 120 \times \eta_{heat}$ |

¹ In accordance with the EU Cogeneration Directive's harmonised efficiency reference values and defined in the CHPQA Guidance Notes.