

CHP

QA

A Quality Assurance Programme
for
Combined Heat and Power



Quality Assurance for
Combined Heat and Power
The Government's decisions
following consultation



Prepared by the Department of the Environment, Transport and the Regions, 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

July 2000

Department of the Environment, Transport and the Regions: London

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Published by the Department of the Environment, Transport and the Regions. Printed in the UK, July 2000 on paper comprising 75% post-consumer waste and 25% ECF pulp.

Product code 00 EP 0318.

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EXECUTIVE SUMMARY

SECTION 1 OUTLINES THE CONSULTATION PAPER AND RESPONSES RECEIVED

'Good Quality' CHP schemes are energy efficient in operation, providing very significant fuel savings and thus cost and emissions savings, over conventional forms of electricity generation and heat supply. The UK currently has around 4,300 MWe of CHP in operation, estimated to save around £800 million and 4 million tonnes of carbon (MtC) per annum. CHP provides one of the most cost-effective approaches for reducing CO₂ emissions and with further savings of as much as 6 MtC per annum by 2010, will play a crucial role in the UK Climate Change programme. In formulating the future UK strategy for CHP, Government is working to achieve a target of at least 10,000 MWe by 2010.

The Chancellor announced in November 1999 that 'Good Quality' CHP would be exempt from Climate Change Levy. From April 2001, Assessment and Certification under CHPQA will determine the eligibility of CHP schemes for Climate Change Levy exemption, Enhanced Capital Allowances (both subject to EU State Aids clearance) and, it is proposed, exemption of plant and machinery from rating.

Proposals for determining 'Good Quality' were outlined in a consultation paper on a Quality Assurance programme for Combined Heat and Power (CHPQA) in January 2000 and comments on the proposals were invited.

The Government received over 130 responses to the CHPQA consultation. Many provided detailed analysis and examples and the Government is grateful for the valuable contribution from CHP users and suppliers and other interested parties in developing these arrangements. After careful consideration of these responses, there are a number of important amendments to the proposals. In developing its proposals, the Government has tried to ensure that the CHPQA programme gives very clear signals to incentivise good environmental performance without undue interference in commercial decisions or burden on business.

The Government's decisions following the consultation were announced by the Minister for the Environment Michael Meacher in a statement to the House on 17 May. This document sets out the decisions in full.

A CHPQA Standard and full Guidance Notes will be published in August (paras 3.4 and 3.5).

SECTION 2 INCLUDES DETAILS OF KEY CHANGES AND DECISIONS ON THE OPERATION OF THE CHPQA PROGRAMME

Definitions and assessment criteria for 'Good Quality' CHP:

- Almost all responses supported weighting power more than heat and the broad structure of the Quality Index (QI) approach will be retained. However, more explanation was clearly needed about how the QI approach is grounded in the primary energy requirements of alternative electricity-only and heat-only supplies (paras 2.2-2.11).

- The final QI definitions appear in Table 2. For a CHP scheme to be certified as ‘Good Quality’ for its entire capacity and output, it will need, in operation, to achieve a Quality Index of at least 100 and an electrical efficiency of at least 20%. Most calculations for Self-Assessment require just three sets of data: fuel used, electricity generated and heat supplied (all data is on a Gross Calorific Value or Higher Heat Value basis). From these, the electrical efficiency, heat efficiency and QI are calculated.
- Most schemes will meet the threshold criteria for QI and electrical efficiency. Some schemes which generate electricity and recover heat may not. For such schemes the electricity generation or fuel input qualifying as ‘Good Quality’ CHP is scaled back to recognise the reduced environmental benefits (para 2.15 and outlined in full in Annex A).
- If a CHP scheme achieves an electrical efficiency of less than 20%, the fuel use that qualifies as an input to ‘Good Quality’ CHP is calculated (the CHP Equivalent Fuel Input or CHP_{EFI}).
- If a CHP scheme achieves a QI of less than 100, the electricity generation that qualifies as an output from ‘Good Quality’ CHP is calculated (the CHP Equivalent Generation Limit or CHP_{EGL}). The capacity that qualifies as ‘Good Quality’ CHP is also calculated (the CHP Equivalent Capability or CHP_{EC}).
- There was general agreement that the proposed CHP Equivalent Generation Limit (CHP_{EGL}) methodology provides a robust basis for determining the entitlement to certification as ‘Good Quality’ for schemes with a QI of less than 100. But respondents argued that the threshold used in the calculations for a scheme should be 100, rather than the figure of 110 in the consultation proposals. The Government accepts the case for this.
- During the initial period of CHP scheme operation (12 months for industrial schemes and 24 months for Community Heating schemes) the QI threshold for ‘Good Quality’ will be 95 (paras 2.16 to 2.18).
- Schemes will be guaranteed a period for which the criteria existing at the time the scheme was commissioned will apply (paras 2.19 to 2.21).
- Guidance on the definitions and conditions for Self-Assessment is outlined in paras 2.22 to 2.76.
- Applicants should measure the gross electrical outputs ignoring parasitic electrical loads and useful heat supplied to the site ignoring condensate return (paras 2.23 to 2.25).
- The need for clear guidance on monitoring and metering is addressed (paras 2.26 to 2.37).
- Applicants will determine their own CHP scheme(s) boundaries on sites with multiple generation sets connected in parallel, or with auxiliary and back-up heat supply, subject to two conditions. First, that appropriate monitoring supports the scheme boundaries used. Second, as long as the scheme achieves the threshold minimum electrical efficiency (paras 2.38 to 2.42).

Special arrangements for particular classes of CHP scheme

- Responses supported simplification of the proposals in general, but particularly for small-scale CHP. The threshold has been increased from 1 MWe in the consultation proposals to 2 MWe, covering almost 90% of schemes. Below this level, simplified arrangements will operate:
 - Small-scale schemes with no heat rejection facility will require gas and electricity monitoring and a clear statement of the site heat demands and heat production and distribution systems.
 - Schemes with heat rejection facilities will need to measure gas used and electricity generated. A clear statement of the site heat demands and heat production and distribution systems must be provided and from April 2004, applicants will need to install systems to monitor the useful heat supplied to a site (paras 2.43 to 2.62).
- Transitional arrangements will apply for steam turbine schemes (or that portion of a steam turbine scheme based on conventional fuels) until April 2005. Up until then, steam turbine schemes will have transitional criteria (paras 2.13 and 2.63 to 2.66).
- Arrangements for schemes using alternative fuels are designed to recognise the environmental benefits of such schemes. Waste heat from high temperature processes will be treated as a waste fuel (paras 2.67 to 2.69).
- CHP serving Community Heating can be assessed over a 7 month heating season (paras 2.70 to 2.73).
- CHP schemes providing mechanical rather than electrical power may use a 5% increase in X factor when calculating QI (para 2.74).

MANAGEMENT OF THE CHPQA PROGRAMME

- The CHPQA programme will be developed, implemented and initially operated as part of the Energy Efficiency Best Practice Programme. Government will, in due course, consider the longer term options for the management and funding of CHPQA and consult on any proposals. One option may be opening the management of the programme to competitive tender. Any future arrangements would continue to provide commercial confidentiality to operators using the programme and assurance to Government that tax benefits do, in practice, secure environmental benefits. The Government will carry out the functions necessary to maintain effective standards and guarantee the integrity of the CHPQA programme. Such functions would include arranging for the validation of applicants' Self-Assessment of scheme QI (and where necessary CHP_{EFF} , CHP_{EGL} and CHP_{EC}), Auditing and Certification. It will also meet the costs of the production of official statistics for the DTI Digest of UK Energy Statistics.

SECTION 3 OUTLINES THE IMPLEMENTATION AND PLANNED USES OF THE CHPQA PROGRAMME

- From April 2001, Assessment and Certification under *CHPQA* will determine the eligibility of CHP schemes for Climate Change Levy exemption, Enhanced Capital Allowances (both subject to EU State Aids clearance) and, it is proposed, exemption of plant and machinery from rating.
- Where an organisation has an energy services partner, applications to *CHPQA* can be from either party. However, only one application can be made for each CHP scheme. Certification may be used by either party for a number of purposes. Self-Assessment will be based on annual data and Registration must be renewed annually (paras 3.1 to 3.6).
- In order to be eligible for these benefits from April 2001 (the earliest date at which any of them are available), the timetable for application is tight and the deadlines outlined in Table 3 must be achieved. Assessments will be processed in the order they are received and late, incomplete or incorrect applications cannot be guaranteed to be dealt with in time for April 2001.
- Respondents expressed particular concern over the proposed treatment under Climate Change Levy of electricity exported from CHP. The treatment of electricity exported by CHP depends on the Finance Bill, the Utilities Bill and the licensing and license exemption arrangements, as well as contractual issues for individual schemes. These issues are beyond the scope of this response to consultation.

SECTION 4 SUMMARISES THE COSTS AND BENEFITS OF *CHPQA*

- A scheme with a QI of 100 will typically make primary energy savings of 16 to 26% over current alternative electricity and heat-only supplies. However, most schemes achieve a QI in excess of 100 and will thus make even higher savings.
- The combined benefit for CHP of Exemption from Climate Change Levy, Enhanced Capital Allowances and exemption from Business Rates is estimated to be in excess of £100 million in the tax year 2001/2. Exemption from Climate Change Levy accounts for around two-thirds of this.
- Compliance costs for all 1300-or-so existing CHP schemes are estimated at just over £1 million a year.
- The net effect is to reduce payback periods by around 30% for new schemes.

ANNEX A OUTLINES THE METHODOLOGIES FOR CALCULATION OF A SCHEME'S CHP EQUIVALENT FUEL INPUT, CHP EQUIVALENT GENERATION LIMIT AND CHP EQUIVALENT CAPABILITY.

ANNEX B CONTAINS A SERIES OF WORKED EXAMPLES.

These examples illustrate the calculation of the Quality Index, CH_{EFI} , CHP_{EGL} and CHP_{EC} for CHP schemes using conventional and alternative fuels.

ANNEX C CONTAINS A LIST OF RESPONDENTS TO THE CONSULTATION.

THE FIRST STAGE FOR ANY APPLICANT IS TO COMPLETE THE *CHPQA* FORM F1 (REQUEST FOR *CHPQA* APPLICATION PACK) ENCLOSED AS ANNEX D.

It is important that an application is made at the earliest possible date. Applicants that register using this form will be sent the full Application Pack in August (including the Standard, Guidance Notes and Self-Assessment Forms).

SECTION 1

The consultation

The consultation paper

- 1.1 'Good Quality' CHP schemes are energy efficient in operation, providing very significant fuel savings and thus cost and emissions savings, over conventional forms of electricity generation and heat supply. The UK currently has around 4,300 MWe of CHP in operation, estimated to save around £800 million and 4 million tonnes of carbon (MtC) per annum. CHP provides one of the most cost-effective approaches for reducing CO₂ emissions and, with further savings of as much as 6 MtC per annum by 2010, will play a crucial role in the UK Climate Change programme. In formulating the future UK strategy for CHP, Government is working to achieve a target of at least 10,000 MWe by 2010.
- 1.2 The Chancellor announced in November 1999 that 'Good Quality' CHP would be exempt from the Climate Change Levy (CCL)¹. The proposals for determining 'Good Quality' were outlined in a consultation paper in January 2000 and comments on the proposals invited². The aims of the proposals were 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.
- 1.3 The elements of the proposals in the consultation paper were:
- A Quality Index, related to the primary energy that would have been used in generating heat and power in alternative electricity-only and heat-only sources. Given that power is 'harder won' than heat, the proposed index values power more than heat. The index also reflects the fact that CHP displaces boiler and electricity generation plant with a range of fuels, sizes, technologies and load factors. Particular arrangements were proposed for alternative fuels, e.g. renewables and wastes; for high temperature applications where waste heat is an input to power generation; and for Community Heating.

1 See Technical Briefing number 2, issued following the Chancellor's November 1999 Pre-Budget Report, <http://www.hmce.gov.uk/bus/excise/ccl-tec2.htm>.

2 *CHPQA A Quality Assurance programme for Combined Heat and Power. A Consultation Paper.* Available from the Environment and Energy Helpline (0800 585794) or downloadable from <http://www.chpqa.com>.

- Transitional arrangements were proposed to allow existing steam turbine schemes to upgrade and to allow new schemes to bed-down during the initial periods of operation.
 - It was recognised that CHP scheme boundaries need to be clearly defined and the energy flows appropriately monitored.
 - Some schemes which generate electricity and recover heat may not achieve the 'Good Quality' thresholds. For these schemes mechanisms were proposed to scale back benefits to recognise the environmental benefits delivered. Benefits could be based on output (Equivalent Generation Limit, CHP_{EGL}) or capacity (Equivalent Capability CHP_{EC}).
 - In operation, it was proposed that applications would be Self-Assessed, reporting to a single point of contact capable of Validating and, if necessary, Auditing sites and providing Certification.
 - Simplified Assessment and Reporting were recognised as being needed for smaller schemes.
- 1.4 The consultation paper was posted on the DETR and Energy Efficiency Best Practice Programme web sites. It was sent to over 2000 users and potential users, equipment manufacturers, suppliers, installers, electricity and gas suppliers and other Government Departments and Agencies. In addition, the Combined Heat and Power Association (CHPA) supplied the paper to all members and electronic copies were supplied to all participants involved in Negotiated Agreements as part of the Climate Change Levy package. Subsequently, thirty five enquiries were received through the Environment and Energy Helpline. Several seminars or meetings were held to discuss the proposals with particular industry groups and trade organisations including the CHPA Community Heating and Small-Scale CHP Developers Fora, the Chemical Industries Association, the Paper Federation and the Salt Manufacturers Association. In addition, the Scottish Executive organised a presentation of the proposed programme in Scotland.
- 1.5 A list of the respondents is included at Annex C. The Government undertook to treat individual responses with the appropriate level of commercial confidentiality. Accordingly, no single response is referred to here, though the individual responses were studied carefully. The responses were of a very high standard with valuable evidence. The Government is grateful for the valuable contribution from CHP users, suppliers and other interested parties in developing these arrangements.
- 1.6 Responses on different issues fell into three categories:
- Responses on some issues were unanimous (for example, on how CHP_{EGL} is best calculated)
 - On other issues, respondents expressed a range of views (for example, on whether type approval was sufficient to assure environmental and other benefits from small-scale CHP or whether the proposed type approval arrangements would still prove too onerous for small schemes).

- On several issues, respondents merely noted that solutions to issues were needed (for example, on alternative treatments for Community Heating) without making specific proposals.
- Several respondents provided valuable evidence (for example, on what would constitute appropriate metering arrangements).

1.7 In finalising these proposals, the Government has taken into account the range of views and strength of the case presented by respondents and has made a number of important amendments to the proposals (summarised in the Executive Summary and expanded in Section 2). In developing its proposals, the Government has tried to ensure that the CHPQA programme gives very clear signals about rewarding environmental benefits without undue interference in commercial decisions or burden on business.

1.8 The Government's decisions following the consultation were announced by the Minister for the Environment, Michael Meacher, in a statement to the House on 17 May³. This document sets out the decisions in full.

³ Hansard 17 May 2000 : Column: 137W, Question 123005, and www.chpqa.com

SECTION 2

Decisions on operation of CHPQA

2.1 Section 2 outlines a number of revisions to the proposals for implementing the *CHPQA* programme, namely:

- Criteria for ‘Good Quality’ CHP (minimum Quality Index and electrical efficiency, paras 2.2 to 2.14).
- Methods for the assessment of schemes which do not achieve either or both threshold criteria. For such schemes the electricity generation or fuel input qualifying as ‘Good Quality’ CHP is scaled back to recognise the reduced environmental benefits (para 2.15).
- Initial period of operation and longevity of these criteria (paras 2.16 to 2.21).
- Guidance on the definitions and conditions for Self-Assessment, such as treatment of parasitic loads (paras 2.23 to 2.25), monitoring of energy performance (paras 2.26 to 2.37) and definition of scheme boundary (paras 2.38 to 2.42).
- Special cases (where different circumstances apply to particular applications) include:
 - Simplified monitoring arrangements and reporting obligations for small-scale schemes of below 2 MWe (paras 2.43 to 2.62).
 - Transitional arrangements for steam turbine CHP schemes (paras 2.63 to 2.66).
 - Treatment of renewable or waste fuels and the waste heat from high temperature processes which is used as an input to electricity generation (paras 2.67 to 2.69).
 - CHP serving Community Heating (paras 2.70 to 2.73).
 - Schemes where power output is mechanical rather than electrical (para 2.74).
- Administration of the programme (paras 2.77 to 2.80).

Decisions about the operation of the programme are highlighted in bold to help scheme managers consider what action they may need to take in advance of full *CHPQA* Guidance Notes being published in August.

Definitions and criteria for assessing the quality of CHP

THE QUALITY INDEX

- 2.2 Many respondents commented on the underlying philosophy of the Quality Index (QI) approach. There was general agreement that the proposed QI approach provides a sound basis for measuring the energy and environmental performance of the range of CHP schemes of different size, type and fuel use and for assessing the quality of CHP. However, two main points were raised:
- Why was a simple efficiency target not used? The CHPA and Government have both recognised that 'Good Quality' CHP often achieves efficiencies in excess of 70%. However, a simple efficiency target does not provide a clear indication of the environmental benefits of a particular CHP scheme. For example, a scheme with 10% electrical efficiency and 60% heat efficiency has the same overall efficiency as one with 35% electrical efficiency and 35% heat efficiency. Both reach the same level of simple efficiency but the second has much greater environmental benefits than the first, since schemes with low electrical efficiency offer much reduced environmental benefits compared to conventional energy supplies.
 - Why was a method based on avoided CO₂ emissions not used? The main problem with such a method is in defining the assumptions for electricity displaced and hence carbon saved. Accounting for avoided emissions is not determinate, but is controversial and a moving target.
- 2.3 By comparison, a primary energy efficiency based system such as the proposed Quality Index is directly measurable and will, by recognising that electricity is harder won than heat, always offer the greatest rewards to those schemes which save the most fuel and displace the most CO₂ emissions. The proposed index is a good measure of environmental performance. Moreover, the QI definitions do not need to change annually to track changes in the generating market, which gives certainty to those examining substantial, long term investment decisions.
- 2.4 **The Government therefore proposes to retain the proposed QI approach to determining CHP quality, but with minor modifications. It was also clear that many respondents would have preferred more explanation of the basis for deriving QI definitions and this is provided in paras 2.5-2.11.**
- 2.5 The system proposed is based around assuring significant savings over the primary energy requirements of alternative heat and electricity sources. However, it is not appropriate that the comparison in every case is with electricity-only combined cycle gas turbine plant (CCGT) and high efficiency boilers. In practice, CHP displaces a range of plant and a comparison is most sensibly drawn with a mix of alternative plant of appropriate size, technology, fuel and load factor. This leads to the factors X and Y in the QI definitions varying for different sizes of CHP scheme. Table 1 illustrates the (empirical) basis for deriving factors X and Y for different power and heat generation technologies. In each case, the X and Y factors are derived from the number of units of fuel input to derive 100 units of useful energy output.

Table 1: The basis for X and Y Factors in the Quality Index

To achieve 100 units of electrical energy out using:	Units of energy in	X
Next available technology, close to market but not yet proven (CCGT at 54% GCV projected efficiency and 5% transmission and distribution losses)	100/0.51	195
Most efficient current technology (at just over 50% GCV efficiency and 5% transmission and distribution losses)	100/0.48	210
Current average efficiency fossil fuel-fired plant (average fossil plant generating in 1998 achieved 40% GCV before 5% transmission and distribution losses)	100/0.38	260
Mid-merit plant (average efficiency steam turbine plant or smaller, simple cycle gas turbines at around 36% GCV, before 5% transmission and distribution losses)	100/0.34	290
Electricity-only, municipal waste-fired schemes (at around 20% electrical efficiency, GCV)	100/0.20	500
To achieve 100 units of heat energy out using:	Units of energy in	Y
Newer, efficient boilers (typically 80% efficiency GCV)	100/0.80	125
Typical UK installed boiler stock (average efficiency 75% GCV)	100/0.75	130
Best available waste-fuel boilers (low calorific value or wet fuels, around 70% efficiency GCV)	100/0.70	140

- 2.6** Considering electrical efficiency first (the X factor), the largest, most efficient and newest electricity-only schemes usually operate at baseload. This is the comparator for large-scale industrial CHP designed to meet steady heat loads of around 8000 hours a year. To supply 100 units of electricity from a next-to-market or best electricity-only scheme would require 195-210 units of fuel.
- 2.7** Smaller CHP schemes are typically highly embedded and often operate at lower load factors. They are not compared exclusively with CCGT, but also with existing mid-merit steam turbine plant (coal, gas or oil-fired) which incurs transmission and distribution losses and new embedded gas turbines achieving around 36% electrical efficiency (GCV). To supply 100 units of electricity would require 210-290 units of fuel.
- 2.8** Renewable or waste fuels in the form of gas can be utilised in reciprocating engines or gas turbine-based CHP schemes. Most alternative fuels in the form of liquids or solids are normally used in steam turbine-based schemes. Such fuels often have a low calorific value and high moisture content and the scheme typically achieves a lower electrical efficiency. At the same time, these schemes have environmental benefits in that they often produce little or no net greenhouse gas emissions. Furthermore, using waste fuels often avoids the greater environmental damage that their release or disposal could cause. To supply 100 units of electricity may require in excess of 500 units of fuel.

- 2.9 For heat supply (the Y factor), the alternative to CHP is heat-only boilers which, to supply 100 units of heat, would typically require between 125 and 140 units of fuel depending on technology and fuel (as well as temperature and pressure of steam or hot water supplied).
- 2.10 A QI of 100 and a minimum electrical efficiency together guarantee that a scheme offers significant energy and environmental benefits. To make any threshold challenging (and for it to remain challenging given the marginal but continuous improvements in electrical generation efficiency), X factors have been tightened by between 25 and 60 points compared to the equivalent for conventional fuels and technologies. Hence the X factor varies from 160 to 230 for conventionally fuelled schemes. Thus it is not possible for electricity-only plant to achieve the primary energy efficiency which these factors imply. It only becomes possible when schemes co-generate and make use of available heat.
- 2.11 The Government's proposals are for a suite of definitions designed to cover the full range of types and sizes of CHP. There was general agreement on the factors for electricity (X) and heat (Y) in QI definitions, but a QI of 100 was thought to be the appropriate threshold for 'Good Quality' (as opposed to 110 as suggested in the original proposals). Within this general agreement, there was a range of views on the relative values of X and Y for schemes of varying size and there were also arguments for different Y factors for different grades of heat. Respondents also argued strongly for simplicity and transparency and **the Government has concluded that the 12 definitions proposed effectively cover the key parameters with a bearing on the environmental quality of CHP. The Government does not therefore propose to introduce any additional QI definitions, nor alternative factors for different grades of heat.**

Criteria for 'Good Quality' CHP

- 2.12 The evidence received and analysed during the consultation confirms that a QI of 100 is challenging but achievable for most schemes and yet still assures the environmental and other benefits of CHP over alternatives outlined in paragraphs 2.5-2.10. Weakened QI definitions for any given class of scheme (large or small, gas turbine or steam turbine) would not provide sufficient assurance of the environmental benefits of CHP and would undermine the case for favourable treatment. The only amendment proposed is to reduce the Y factor from 130 to 125 for reciprocating engine and steam turbine schemes to bring them in line with other technologies. This has very little effect on QI values (in most cases QI is reduced by 1-2 points). **The final QI definitions, based on the above approach, are shown in Table 2.**

Table 2: Quality Index Factors (X and Y) for the Final QI Definitions

The general form	$QI = (X \times \text{Efficiency}_{\text{power}}) + (Y \times \text{Efficiency}_{\text{heat}})$
Gas Turbine, Steam Turbine or Combined Cycle Schemes	
≤ 1 MWe	$QI = (230 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
> 1 – ≤ 10 MWe	$QI = (220 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
> 10 – ≤ 25 MWe	$QI = (205 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
> 25 – ≤ 50 MWe	$QI = (190 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
> 50 – ≤ 100 MWe	$QI = (185 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
> 100 – ≤ 200 MWe	$QI = (180 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
> 200 to ≤ 500 MWe	$QI = (170 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
> 500 MWe	$QI = (160 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
Reciprocating Engine schemes	
All sizes	$QI = (200 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
Transitional arrangements for existing Steam Turbine schemes to April 2005 (paras 2.63-2.66)	
All sizes	$QI = (240 \times \text{Efficiency}_{\text{power}}) + (125 \times \text{Efficiency}_{\text{heat}})$
Alternative fuels with any generation technology or prime mover (paras 2.67-2.69)	
Biogas, waste gas or waste heat	$QI = (300 \times \text{Efficiency}_{\text{power}}) + (140 \times \text{Efficiency}_{\text{heat}})$
Biomass or solid or liquid Waste	$QI = (400 \times \text{Efficiency}_{\text{power}}) + (140 \times \text{Efficiency}_{\text{heat}})$

2.13 In addition to the threshold QI of 100, the consultation paper proposed a minimum electricity generation efficiency requirement. **In order to assure the environmental benefits of CHP compared to alternative sources, a threshold minimum electrical efficiency of 20% will apply to all schemes. A transitional threshold of 15% will apply for steam turbine schemes until April 2005.**

2.14 Most calculations for Self-Assessment require just three sets of data: fuel used, electricity generated and heat supplied (all data is on a Gross Calorific Value or Higher Heat Value basis). From these, electrical efficiency, heat efficiency and QI are calculated. Guidance on the definitions and conditions for the Self-Assessment of each scheme is outlined in paragraphs 2.16 to 2.76 below. Complete Guidance Notes will be published in August 2000.

Schemes which do not achieve the criteria for 'Good Quality' CHP

- 2.15 Most schemes will meet the threshold QI and electrical efficiency and thus qualify as 'Good Quality' for their entire capacity, fuel input and energy output. Some schemes which generate electricity and recover heat may not achieve either or both criteria. For such schemes the electricity generation or fuel input qualifying as 'Good Quality' CHP is scaled back to recognise the reduced environmental benefits. Since only a small number of schemes are involved, the revised methodologies are outlined in Annex A. However, decisions following consultation are summarised below.
- Schemes with low electrical efficiency, even with a QI over 100, do not provide long term assurance of significant environmental benefit. **If a CHP scheme achieves an electrical efficiency of less than 20%, the fuel use that qualifies as an input to 'Good Quality' CHP is calculated (the CHP Equivalent Fuel Input or CHP_{EFI}).**
 - **If a CHP scheme achieves a QI of less than 100, the electricity generation that qualifies as an output from 'Good Quality' CHP is calculated (the CHP Equivalent Generation Limit or CHP_{EGL}).** There was general agreement that the proposed CHP Equivalent Generation Limit (CHP_{EGL}) methodology provided a robust basis for determining the scale back of benefits for schemes with a QI of less than 100. But respondents argued that the threshold used in the calculations for a scheme should be 100, rather than the figure of 110 in the consultation proposals. The Government accepts the case for this.
 - **If a CHP scheme achieves a QI of less than 100, the capacity that qualifies as 'Good Quality' CHP is calculated (the CHP Equivalent Capability or CHP_{EC}).**

Initial period of operation of new CHP

- 2.16 The consultation paper asked (paragraph 2.13) whether it was appropriate to allow a commissioning period for new schemes, during which a less stringent QI may be sufficient for a scheme to be eligible for full benefits? If so, for how long and at what level? Most respondents recognised the need for flexibility during periods of commissioning new schemes. Often during commissioning, not all the scheme operates at any one time. In general, respondents suggested periods of between 6 months and 2 years, depending mostly on size and complexity of the scheme.
- 2.17 **For a new scheme undergoing commissioning, a lower QI of 95 will be required (alongside the normal electrical efficiency) to qualify as 'Good Quality'. This will apply for an initial period of 12 months for an industrial scheme and 24 months for a CHP scheme serving Community Heating, where the heat load may take some time to build up. During these periods, should a scheme not achieve a QI of 95, CHP_{EGL} shall be calculated against a threshold QI of 95 rather than 100.**
- 2.18 **The initial period of operation starts from when an applicant informs the CHPQA programme that a scheme is being commissioned. The date of this is in the hands of the applicant. It is in the interests of the applicant to inform the programme as soon as significant quantities of fuel are burned, however, in order to be certified and qualify for benefits.**

Future criteria for 'Good Quality' CHP

- 2.19 There was concern from many respondents that once QI definitions and minimum thresholds for electrical efficiency were fixed, the definitions at the time of scheme installation should apply for the substantial portion of a scheme's life.
- 2.20 Government may, from time to time, review these criteria in the light of developments, to assure the significant 'environmental and other benefits' of 'Good Quality' CHP compared to conventional sources.
- 2.21 **But the Government also accepts that a secure basis for long-term investment decisions in CHP is required and will work on the basis of the following rules:**
- **The minimum electrical efficiency and QI, as determined under the conditions outlined in the CHPQA Guidance Notes to be published in August 2000, will remain in force until April 2006 for schemes commissioned before January 1st 2000.**
 - **New or upgraded schemes, commissioned after 1 January 2000, are guaranteed a period of 10 years against the criteria in effect at the time the CHPQA programme is notified of commissioning (e.g. for a scheme commissioned in June 2003, the threshold electrical efficiency and QI will remain in force until June 2013).**
 - **Beyond these periods, any revisions to QI and minimum electrical efficiency criteria will apply. A change in these criteria will normally be notified two years before coming into effect.**

Conditions for the Self-Assessment of CHP

- 2.22 Respondents provided a range of detailed and persuasive evidence with regard to the treatment of parasitic electrical and heat loads and on definition of scheme boundaries for sites with multiple prime movers. In the light of these responses, the determination of scheme boundaries has been designed firstly to minimise unnecessary burdens for business in implementing and managing compliance and secondly to provide the right signals to improve efficiency (for example, by recovering condensate where possible). Final details on conditions for Self-Assessment will be published in the CHPQA Guidance Notes in August 2000.

PARASITIC ELECTRICAL LOADS

- 2.23 Parasitic electrical loads can include:
- Pumps, fans and monitoring equipment which supports both the included and excluded plant such as boilers. (It would add unnecessary complexity to separate out parasitic loads which are included or excluded from the scheme definition).
 - Electric drives for mechanical handling of solid fuels, etc. (For example, at municipal waste incinerators. However, not all mechanical handling in such circumstances can be attributed to the operation of the CHP scheme).

- Many sites will also require gas compressors, although larger schemes and conventional large-scale electricity-only plant will be connected to the gas mains at high pressure. By contrast, much small and medium scale CHP is connected at lower pressure and needs gas compression. Since the energy used in gas compression is not accounted for in the assessment of efficiency for large-scale plants it could be discriminatory to introduce it for smaller plant.

2.24 For the purposes of calculating electrical efficiency and hence QI, parasitic electrical loads should be ignored. The measurement of electricity generation for the purposes of assessing QI will be at the generator terminals. For selecting the relevant QI definition, the relevant figure is the rated electrical capacity of the scheme (under ISO conditions).

PARASITIC HEAT LOADS AND DETERMINATION OF USEFUL HEAT SUPPLIED

2.25 Heat from steam can be used within the CHP scheme *before* the steam is supplied to site and can also be returned to the CHP scheme as condensate *after* the steam has given up most but not all of its useful energy. In broad terms, the aim is to determine the useful heat supplied to the site (i.e. excluding the heat rejected in condensers, heat rejection radiators, and other facilities) and to encourage the use of heat from condensate. Full details will be provided in the Guidance Notes to be published in August. However, to provide an early indication of the Government's thinking:

- Where steam is used within the CHP scheme for duties such as de-aeration, condensate heating, make-up water and boiler feedwater heating, it should not be counted as part of the useful heat supplied to site.
- Where practicable, recovery of heat from condensate and re-use of condensate in a closed loop steam network is considered best practice. Excluding condensate heat from the total heat supplied to the user would tend not to encourage the recovery of heat from condensate. The Government therefore proposes that the heat content of condensate return is not taken into account in determining the QI.
- Steam used for injection into gas turbines is not useful heat supplied to site. The value of this energy is reflected in increased electrical output.

MONITORING ENERGY PERFORMANCE

2.26 Most calculations for Self-Assessment require just three sets of data: fuel used, electricity generated and useful heat supplied (all data is on a Gross Calorific Value or Higher Heat Value basis). The consultation paper emphasised the importance of monitoring arrangements for these parameters. This included the need for meter positions and serial numbers to be recorded and for meters to be calibrated. Comments were invited on appropriate tolerances.

2.27 There was widespread agreement on a need for clear guidance on metering. Some general principles can be drawn:

- An appropriate level of monitoring is nothing more than good practice in terms of monitoring and improving performance. However, installation of metering is expensive and must be justified by need.

- The metering installation should be designed, installed, built and validated to an acceptable standard and sound practice as given by British and European Standard (ISO) Guides.
- Validation procedures for the monitoring system should be in place either by direct calibration or by validating each of the components within the measurement system.
- Frequency of calibration should be carried out in line with manufacturers' recommendations to ensure monitoring system uncertainties are maintained within meter specifications.
- Metering should be tamper-proof.
- Simplified arrangements should apply for CHP schemes below 2 MWe (paras 2.43 to 2.62).
- Where commercial transactions or tax arrangements (e.g. custody transfer of crude petroleum products) are based on metered or measured quantities, this should be stated and such metering or measurement will normally be regarded as sufficient for CHPQA purposes. However, where heat supplies are not sold, monitoring arrangements may not exist (for example, where an organisation owns the CHP scheme and the site). In such cases, CHPQA will require effective monitoring systems.

Evidence of the integrity of monitoring arrangements, including proper meter calibration, would normally be inspected as part of a CHPQA site audit. Such issues may form part of a site's existing quality assurance system (such as ISO 9001).

Monitoring fuel use

- 2.28** In terms of metering natural gas, there are a number of specific requirements. Natural gas volumes fuelling CHP should be recorded by meter with an uncertainty no greater than $\pm 1\%$ (SI 1983/684 & subsequent amendments). The volume measured must be corrected for the temperature and pressure of the gas (to 15°C and 1.01325bar) to enable direct comparison with billed gas to the site. Whilst there are no statutory regulations surrounding the necessary 'correction', there are well-defined commercial agreements between shippers, suppliers and purchasers, as laid down within the UK Network Code and related documents, which are accepted as good practice. Calorific Values (CV) of natural gas change significantly across the UK from zone to zone and with time of year. An annually averaged calorific value for the gas used must be estimated and where not measured directly should be based on the daily data published by Transco for the Local Distribution Zones (LDZ). Overall uncertainty in fuel energy input should be less than $\pm 2\%$.
- 2.29** For coal, an appropriate sampling regime for CV and usage should be established in conjunction with the company coal purchase documentation to ensure overall uncertainty in fuel energy input is less than $\pm 2\%$, consistent with current industry practice.

- 2.30** Oil products burned either as a main or standby fuel will need to be monitored and recorded for use in the Self-Assessment of a scheme. Oil products are usually sold by the litre. The volume of oil burned in a CHP scheme will need to be recorded. This may require a volume flow meter ($\pm 1\%$). In contrast CV is generally determined per unit mass. Conversion between mass and volume using standard charts can introduce a significant error, ($\pm 1.5\%$) and actual average densities and CVs are preferable. If fuel purchase documentation is used as evidence of oil used, oil inventories will need to be recorded at the beginning and end of claim periods. Overall uncertainty in fuel energy input should be less than $\pm 2\%$.
- 2.31** Accurate estimation of the CV of some alternative fuels (such as raw municipal waste) is extremely difficult. Where the uncertainty in CV input exceeds $\pm 2\%$, indirect means should be used, for example using the 'losses method' to reduce the uncertainty to less than $\pm 2\%$ ⁴. Alternatively, the higher value of the uncertainty range should be used (e.g. 100 MWh $\pm 5\%$ of fuel becomes 105 MWh).

Monitoring power

- 2.32** For metering electricity, clearly labelled commercial/industrial 3 phase electricity meters of billing quality should be used. Appropriate kWh meters should be installed to provide direct read-out of both imported and exported electrical power, where typically uncertainties in readings should not be greater than $\pm 0.5\%$.
- 2.33** In some circumstances, the engine shaft will provide mechanical power. Typical applications will be for driving pumps or gas compressors. For gas turbines or engines, it will be possible to estimate the shaft power output from the fuel consumed and an energy balance using the exhaust gas conditions. For steam turbine drives, the mechanical output may be estimated from the turbine steam flow and conditions, provided these are recorded, or from mean values if loads are steady.

Monitoring useful heat supplied

- 2.34** For measurement of steam, meters with an accuracy of $\pm 1.5\%$ of full scale over a turndown range of 4:1 are required. Where appropriate (variable pressure and temperature) correction for steam pressure and temperature (superheated steam only) is required. Orifice plates, nozzles and venturi tubes shall be designed and installed in accordance with BS 1042 Part 1 (or equivalent) and the mass flow calculation shall be based on actual (not nominal) dimensions. The calculation of overall accuracy shall take into account the accuracy associated with transmitters, integrators, etc. Other types of flowmeter, capable of the required accuracy (or better) are permitted. Where a manufacturer's specification is available, it is proposed that the quoted lower error band figure be used in determining steam load (e.g. for a meter with error $\pm 5\%$, a reading of 100 MWh of steam would become $100 \text{ MWh} - 5\% = 95 \text{ MWh}$). Where a calculation of accuracy to BS 1042 is carried out, again the lower error band figure shall be used. Evidence of calibration in line with manufacturers recommendations will be expected to be available if a site is audited. Where meters are not installed or meters are not able to provide the required accuracy, an estimate of steam flow based on indirect methods will be acceptable until April 2004.

⁴ In the "losses method" all of the possible losses from the scheme are summed, for example flue losses, case losses, etc. Losses are usually capable of evaluation to around $\pm 5\%$, so if the losses account for say 40% of input energy, the overall uncertainty in efficiency should be $\pm 2\%$. The method is explained in BS 845: Part2: 1987, or equivalent DIN or ASME methods.

- 2.35** The accuracy of high pressure hot water meters is dependent upon both the water flow meter and the energy integrator. Regular calibration regimes and strict compliance with manufacturers installation practice is essential to ensure uncertainties fall within $\pm 2\%$.
- 2.36** In some industrial processes, the heat exhaust from the turbine or engine is used directly for drying purposes. In order to estimate the heat used, one approach is to measure exhaust temperature and estimate mass flow from the gas turbine specification. Alternatively, determination may be via an energy balance.
- 2.37** Where heat is transferred across a site boundary or boundaries, monitoring must be in place to support full accounting via an energy balance.

SITES WITH MULTIPLE PRIME MOVERS

- 2.38** Several respondents commented that it was unfair to treat (say) a site with three 5 MWe gas turbines, connected or operated in parallel, in the same way as one with a single 15 MWe gas turbine. An array of smaller turbines in a scheme could give security of supply advantages compared to a single larger turbine. An array of turbines could also provide a range of steam supply conditions and output could more closely match demand, thus improving efficiency. The Government has considered this issue carefully. A site could make significant reductions in capital costs and maintenance costs by installing a single turbine instead of an array of turbines and therefore users have to have compelling commercial reasons to install a number of smaller turbines rather than one single turbine with the same output.
- 2.39** Where prime movers are connected in parallel the Government will allow an applicant to draw their own scheme definition, to support either one single application, or a number of separate applications for individual prime-movers, subject to the minimum electrical efficiency (paras 2.12 to 2.14) and appropriate metering (para 2.42). Where prime movers are connected in series, in combined cycle mode (where the heat from one prime mover is converted to steam to supply a steam turbine), the prime movers cannot be considered separately.

AUXILIARY AND BACK-UP HEAT

- 2.40** Government received strong representation on the treatment of back-up/auxiliary and supplementary firing. Respondents noted that top-up and back-up arrangements for heat systems are an essential part of any scheme, given that CHP has a typical availability of 90% and some down-time is essential for maintenance. There is already a significant economic incentive to return the scheme to operation in the shortest possible time. On sites where security of steam supply is paramount it can be necessary to maintain boilers in a hot state in order to provide back-up. Some respondents therefore proposed that up to 20% input fuel allowance be made for boilers. Anything over this level might imply that the CHP may not have been appropriately sized to maximise heat utilisation.
- 2.41** Another approach is to allow non-CHP fuels to count in the QI calculation. The more back-up, top-up or supplementary firing included in the scheme, the lower will be the QI – in other words, this is self-limiting. Whilst supplementary firing improves efficiency of heating to a very high level, in many cases it also implies a lost opportunity for additional

power generation and therefore for additional environmental benefit. To ensure that significant environmental benefits are offered by 'Good Quality' CHP, this approach is underpinned by the minimum electrical efficiency threshold.

- 2.42 The Government intends to follow this approach. In order to avoid a prescriptive rule-based system for defining scheme boundaries, applicants (regardless of scheme size) will be able to determine their own CHP scheme(s) boundaries on sites with multiple prime movers connected in parallel, as well as auxiliary and back-up heat, as long as appropriate monitoring supports the scheme boundaries proposed.**

Special cases

SMALL-SCALE CHP

- 2.43** The consultation paper proposed a system of product type approval for packaged CHP schemes and a simplified, one-off audit for bespoke CHP schemes below 1 MWe.
- 2.44** There was widespread agreement on the need for a simplified system for smaller schemes, but there was a range of views concerning the definition of small scale and how simplified rules might be implemented.
- 2.45** It was suggested that simplified arrangements could apply to schemes up to 10 MWe. To extend the simplified arrangements to schemes as large as this would, in the Government's view, not provide the required assurance, for example, that tax benefits were only bestowed where there was significant environmental benefit.
- 2.46** It is recognised however, that many reciprocating engine based schemes up to around 800 kWe have no facility to reject heat – their electrical and thermal output is modulated when the heat demands of the host site are reduced. The vast majority of such schemes also has a single heat recovery circuit for both High Temperature Hot Water (HTHW) and Low Temperature Hot Water (LTHW). Clearly, very simple arrangements could be implemented for such sites.
- 2.47** Above around 800 kWe, reciprocating engine based schemes are more bespoke in their installation, often have separate heat recovery circuits for exhaust gases producing HTHW (or sometimes steam) and for engine jacket water producing LTHW. At this size, schemes have a heat rejection facility, so the gross heat available for supply is not the same as total heat supplied to site. Many smaller gas turbine based schemes will also be capable of rejecting heat and would fall into this category.
- 2.48** Above around 1.3 MWe, the market changes again. At this scale, site demands are increasingly likely to include steam and gas turbines become an important option. At 2 MWe and over, schemes become more complex with varied steam conditions, frequently more than one fuel and several competing technologies.
- 2.49 Any scheme less than 2 MWe can be assessed using the simplified arrangements. This would provide simplified arrangements for almost 90% of schemes but only 4% of capacity.**

- 2.50** However CHP users with schemes below 2 MWe may wish to opt for the flexibility to include more than one prime mover operated in parallel, or other facilities (back-up and top-up boilers or standby generation) within the definition of the scheme boundary. If an applicant chooses this option, compliance with the full CHPQA programme arrangements for monitoring, reporting and auditing will be necessary.
- 2.51** There were several suggestions on how the simplified arrangements might be implemented. The main advantage of product type approval would be to shift the burden of proof to the body most capable of providing proof, e.g. the supplier, installer or operator.
- 2.52** However, a number of responses noted that type approval alone would not offer sufficient confidence in whether the actual operation of such schemes would deliver environmental benefits. Achieving environmental benefit depends on how the scheme is installed and operated, particularly in relation to the extent to which heat is utilised. According to respondents, small schemes in buildings applications could operate under one or more of the following conditions:
- Schemes could be designed to maximise electricity generation, rather than heat recovery. This would mean operation with reduced QI levels (and reduced environmental benefits) for some of the time, although the scheme would still be economically attractive.
 - CHP schemes sized to provide electrical supplies in an emergency may in some cases be larger than if they were optimised for overall efficiency.
 - The building heating system may not be suitably designed for operation with a CHP scheme. For example, the temperatures required for particular parts of a building heating system may restrict the extent to which CHP heat could be utilised and thus the heat rejection facility may operate for longer and reject more heat than envisaged.
 - CHP reliability or maintenance arrangements may not be adequate.
- 2.53** Any of these operational conditions would reduce the environmental benefits delivered from a given scheme compared to alternative conventional sources and benefits should, as for other schemes, be scaled back to recognise the environmental benefits delivered.
- 2.54** At the same time, there were several persuasive responses from installers of such schemes who were responding on behalf of their many clients. They were concerned about the burden of implementation and, in particular, about resourcing, both in terms of manpower and in terms of capital. To paraphrase one respondent, *“A swimming pool manager wants to be in the business of managing his swimming pool, not in the business of running a power station”*.
- 2.55** Installation of dedicated fuel and electricity metering is good practice since, as several respondents pointed out, there can be no assurance that a scheme is performing to specification if such monitoring is not installed. At least two-thirds of small schemes are thought to have some form of fuel and electricity monitoring in place. The most common fuel is natural gas. Gas consumption data can be provided via remote monitoring equipment and cross-referenced where necessary to the incoming Transco meter reference number. For this type of application, a natural gas meter with remote reading capability would cost around £1500 to buy and install.

- 2.56 In discussion with small-scale CHP manufacturers and users, the major issue was clearly the cost of installing and maintaining heat metering (estimated at around £3,000 to install and £200 a year to maintain). However, amongst the parameters monitored remotely are flow rate and output and return water temperatures. It would be relatively simple to modify such systems to calculate the heat supplied by the scheme to the site, net of heat lost in the heat rejection facility. Monitoring arrangements for net heat supplied should be of a standard equivalent to other sensors used for remote monitoring, costs for which are estimated at less than £1000 per site.
- 2.57 Based on these responses and the need to strike a balance between simplification on the one hand and rewarding good environmental performance on the other, the Government proposes the following arrangements.

Schemes below 2 MWe with no heat rejection facility

- 2.58 Small-scale CHP with no heat rejection facility will be certified as ‘Good Quality’ if, each year, evidence is provided of:
- Annual fuel input to the CHP scheme (monitored separately from other uses such as boilers, burners, etc.) This is a basic requirement for producing a certificate, for example, for a fuel supplier.
 - Annual electricity generated by the scheme. Together with the fuel use and capacity, basic checks can be performed on electrical efficiency and on load factor. Electrical efficiency must be at least 20%.
 - Annual heat supplied. When heat demand falls, schemes with no heat rejection facility must regulate their output and finally shut down, otherwise serious engine failure will occur. In these circumstances, no heat can be supplied beyond the site demand. For existing schemes, a simple statement will be required confirming the site winter and summer heat demands and heat production and distribution systems. The statement may be based substantially on design data. The CHP scheme should be matched to heat demands, operating as the lead boiler in an installation and modulating according to demand.
 - Calculation of QI will be required using the above three sets of data.
 - If a scheme modulates its output when heat demand is low, the QI will not fall below 100, so calculation of CHP_{EGL} and CHP_{EC} will not be required.
 - Full guidance will be issued in August in the *CHPQA* Guidance Notes.

Schemes below 2 MWe with heat rejection facility

- 2.59 Small gas turbine-based schemes and some reciprocating engine-based schemes are capable of rejecting heat. At certain times it is economic to operate the scheme without heat utilisation. However, in doing so a scheme dilutes the environmental benefits over alternatives.
- 2.60 Reciprocating engines in this size bracket usually have separate engine exhaust (HTHW) and engine jacket (LTHW) water systems and a number of these schemes do not recover LTHW. Such schemes achieve an electrical efficiency in the range 29-35% and a thermal efficiency of 20-22% (achieving a QI of around 90). A typical 1 MWe scheme which did

not recover LTHW would be throwing away heat that, if generated in conventional boilers would be worth around £40,000 a year including CCL. Such a scheme would only maximise its environmental and other benefits over alternative sources of electricity and heat if the LTHW from the engine cooling jacket is also recovered, increasing heat recovery to around 40% and thus QI to above 100.

2.61 The Government proposes that up to April 2004, CHP schemes below 2 MWe with a heat rejection facility will be certified as ‘Good Quality’ on the basis of evidence of the following:

- **Annual fuel input to the CHP scheme (monitored separately from other uses such as boilers and burners, etc).** Some schemes in this range include back-up fuels, such as oil fed from a common tank also supplying oil-fired boilers. Separate monitoring or other measurement will also be required for back-up fuels.
- **Annual electricity generated** by the scheme.
- **Annual heat supplied.** Up to April 2004, a simple statement will be required confirming the site winter and summer heat demands, heat production and distribution systems, heat rejection facilities and the use made of such facilities. The statement may be based substantially on design data. The CHP scheme should be matched to heat demands and operating as the lead boiler in an installation. However, the use of monitoring equipment is best practice, both in terms of environmental performance and in terms of ensuring installed equipment maintains the savings claimed at the time of installation. Schemes will be required to either modify the existing remote monitoring system, or install a new monitoring system, by April 2004.
- Calculation of QI will be required using the above three sets of data.
- Calculation of CHP_{EFI} , CHP_{EGL} and CHP_{EC} will only be required (where appropriate) after April 2004.
- Full guidance will be issued in August in the *CHPQA* Guidance Notes.

2.62 These provisions give applicants the time to modify or to install appropriate monitoring systems and the encouragement to seek ways of maximising efficiency. Improvements might include, for example, recovery of LTHW, installation of absorption chilling or changed operating strategy.

TRANSITIONAL ARRANGEMENTS FOR EXISTING STEAM TURBINE CHP SCHEMES

2.63 Many users of steam turbine CHP schemes (including paper manufacturers, salt manufacturers, sugar producers and refineries) objected to the proposed minimum electrical efficiency of 15% and the proposed method of scaling back fuel input. These, typically, were sites where the heat demand of the host far outstripped electrical demand, and a steam turbine scheme with high heat to power ratio was seen as a good match to site energy demands.

- 2.64** These schemes, typically installed two, three or four decades ago, offered significant environmental benefits compared to alternative sources available at the time. A steam turbine scheme with (say) 15% electrical efficiency and 55% heat recovery (overall efficiency of 70% GCV) and with a transitional QI of 108 makes around 11% savings over current average installed conventional sources, but does not offer a significant saving over best available technology⁵. However, where schemes burn alternative fuels, they may still offer benefits over conventional fossil-fired plant and such schemes should be assessed accordingly (see paragraphs 2.67-2.69).
- 2.65** **The Government sees no reason to offer benefits to schemes which cannot provide long term assurance of significant environmental benefits. However, the Government accepts the rationale for transitional arrangements which might facilitate upgrade, for example, to gas turbine or combined cycle gas turbine-based CHP. On such sites, modern gas-fired CHP, sized appropriately to the heat load to achieve high efficiency, would result in significantly greater electrical capacity. Some of these schemes may be capable of exporting significant amounts of power. Paragraphs 3.10 to 3.11 discuss this issue. Another upgrade route for steam turbine schemes is to increase use of alternative fuels.**
- 2.66** **The proposed transitional criteria for existing steam turbine schemes will operate until April 2005. Up until then, steam turbine CHP schemes will be required to achieve a transitional minimum threshold electrical efficiency of 15%. The proposed transitional QI definition for steam turbine schemes results in a QI increase of 5-10 points over the standard QI definitions.**

SCHEMES USING ALTERNATIVE FUELS (INCLUDING WASTE HEAT)

- 2.67** Conventional fuels are those described either by the Finance Bill 2000 as a taxable commodity, or by the Hydrocarbon Oil Duties Act 1979 and covered by Excise Duty. Such fuels include:
- Any gas in a gaseous state that is of a kind supplied by a gas utility;
 - any petroleum gas, or other gaseous hydrocarbon, in a liquid state;
 - coal and lignite;
 - coke, and semi-coke, of coal or lignite;
 - petroleum coke;
 - Hydrocarbon oil or road fuel gas within the meaning of the Hydrocarbon Oil Duties Act 1979.

⁵ The current average efficiency of boilers installed is 75%. The current average efficiency of fossil fuel plant supplied via the network and including transmission and distribution losses is 38%. Best available boilers are 80% efficient and best available electrical efficiency currently generating CCGT at 50.5% with 5% transmission and distribution losses assumed. All figures are GCV and based on annual average operating conditions, not ISO conditions.

2.68 Alternative fuels are all other fuels. Examples include

- renewable fuels (solid, such as woodchip, liquid, or gaseous such as sewage gas)
- wastes or by-products from industrial processes (solid, liquid or gaseous such as carbon monoxide or hydrogen)
- Waste heat from high temperature processes, or as a product of exothermic chemical reactions.

2.69 Definitions of QI have been structured so as to reflect the additional environmental benefit of maximising use of alternative fuels alongside conventional fuels. Where a mix of conventional and alternative fuels is used the following methodology will be used (see Examples 6 and 9 in Annex B for an illustration of the benefits of alternative fuels).

1. Calculate the electrical and heat efficiencies of the scheme.
2. Calculate weighted mean values for the factors X and Y on a proportional basis for conventional and alternative fuels.
3. Using the weighted QI definition, calculate QI and electrical efficiency.
As for other CHP schemes, to be certified as 'Good Quality' for its entire capacity and output, a scheme must achieve a Quality Index in operation of at least 100 and an electrical efficiency of at least 20% (or 15% for steam turbine schemes until April 2005).

CHP SERVING COMMUNITY HEATING

2.70 CHP Community Heating schemes may serve anything from a single block of flats to thousands of domestic heat users as well as public sector, commercial and industrial customers where the heating requirements are usually very seasonal in nature.

2.71 Criteria for 'Good Quality' need to reflect the characteristics of particular applications in order to ensure incentives remain firmly linked to energy and environmental performance. CHP schemes serving Community Heating schemes operate typically for 5000 hours a year or less and therefore do not tend to compete with base-load CCGT, but more with coal or gas-fired steam turbines or with embedded simple cycle gas turbines. In addition, they displace a mix of conventional sources including domestic electric heating, individual domestic gas central heating and community heating boilers and at peak heat demand can achieve very high efficiencies. Hence the environmental benefits of CHP serving Community Heating are generally greater than for other CHP applications.

2.72 In recognition of these special characteristics, the Government proposes that CHP schemes serving Community Heating schemes with a capacity of 2 MWe and over can undertake their Self-Assessment over a continuous 7 month heating season, with dates determined at the applicant's discretion. The relevant QI definition should be taken from Table 2 according to CHP size and technology. The Guidance Notes will contain details of the definition used to determine which schemes will be eligible to use this arrangement. The Government has concluded that alternative approaches to assessment of Community Heating, for example to create a new suite of QI definitions, would add complexity and provide poorer incentives.

- 2.73 Schemes below 2 MWe may elect to base their assessment on 7 months, but would need to comply with the normal CHPQA metering and reporting requirements.

MECHANICAL POWER

- 2.74 With regard to mechanical power, the majority of electricity generated in CHP is used to run electric motors which turn pumps, fans, compressors etc. By driving a pump, fan or compressor directly, the losses in turning mechanical energy into electrical energy and then back into mechanical energy again can be avoided. **A number of responses suggested that the factor X for mechanical power should be multiplied by 1.05, to reflect the savings compared to conventional approaches. The Government accepts this proposal.** However, where mechanical power is provided by a CHP scheme prime mover it will not usually be possible to measure the shaft power directly. Paragraph 2.33 discusses appropriate monitoring methods.

OTHER CASES

- 2.75 One possible special case raised in the consultation paper was absorption chilling driven by heat from CHP. An economic analysis and environmental impact study carried out on behalf of the Energy Efficiency Best Practice Programme has shown that the benefit to the site from reduced electricity use and high heat utilisation (thus high QI for the CHP scheme) will substantially reward the environmental benefits offered by driving chillers from CHP heat. **The Government does not propose a further incentive for absorption chilling.**
- 2.76 CO₂ produced in CHP can be put to some use in horticulture to encourage crop growth. The consultation asked whether additional benefit should be given to such schemes. There were only four responses on this issue. They recognised that the benefits would be difficult to measure. Analysis shows that these schemes should not have difficulty in achieving a high QI in any case, typically based on reciprocating engines with high shaft efficiency, with every opportunity to use both high temperature exhaust gases and low temperature hot water from engine jackets. The lack of an additional benefit for CO₂ would not prevent 'Good Quality' CHP in greenhouses from achieving a high QI. **No additional recognition of CO₂ supplied will be included in the assessment of 'Good Quality'.**

Management of the programme

- 2.77 Respondents were generally content that the Energy Efficiency Best Practice Programme had the technical resources to implement the programme and were content that this would give sufficient guarantee of commercial confidentiality.
- 2.78 **The CHPQA programme will be developed, implemented and initially operated as part of the Energy Efficiency Best Practice Programme.** Government will, in due course, consider the longer term options for the management and funding of CHPQA and consult on any proposals. One option may be to open the management of the programme to competitive tender. Any future arrangements would continue to provide commercial confidentiality to operators using the programme and assurance to Government that tax benefits do, in practice, secure environmental benefits. The Government will carry out the

functions necessary to maintain effective standards and guarantee the integrity of the CHPQA programme. Such functions would include arranging for the Validation of applicants' Self-Assessment of scheme QI (and where necessary CHP_{EFI} , CHP_{EGL} and CHP_{EC}), Auditing and Certification. It will also meet the costs of the production of official statistics for the DTI Digest of UK Energy Statistics.

- 2.79** The use of electronic forms for the submission of QI data would save considerable time for both applicants and the programme. This option will be investigated for future years but, given the tight timescales for setting up the programme, the decision was taken to retain a paper-based system in the first instance.
- 2.80** The programme will, in due course, form the core of data collection for the DTI's Annual Survey on CHP. However, provisional certification at the outset of the programme may in many instances be based on data covering only part of a year. The decision has been taken to run the DTI's Annual and Quarterly surveys alongside the CHPQA programme for the first year and to review this for subsequent years.

SECTION 3

Use of CHPQA

- 3.1 Application to CHPQA is entirely voluntary, but the programme will be used as the basis for determining the eligibility of a CHP scheme for Climate Change Levy (CCL) exemption, Enhanced Capital Allowances (ECAs) and exemption from Business Rating for plant and machinery. Each of these is considered briefly below.
- 3.2 In order to be eligible for these benefits from April 2001 (the earliest date at which any of them are available), the timetable for application is tight and the deadlines outlined in Table 3 must be achieved. Assessments will be processed in the order they are received and whilst late, incomplete or incorrect applications may be dealt with in time for April 2001, no guarantee can be offered.

Provision of Self-Assessment to CHPQA

- 3.3 Many schemes (both large and small) are owned and operated by, or have a maintenance contract with, a CHP or energy services provider who monitors remotely a large number of parameters. For most of these schemes, the energy services provider will be in a position to supply the necessary data on behalf of the client. Whilst an application can come from either party, only one application can be made for any given scheme. Certification will be provided to the applicant and may be used by several parts of the client or energy services organisations to qualify as 'Good Quality' for different purposes.
- 3.4 Schemes must undergo an annual Self-Assessment based on data for the calendar year. The assessment of one year's performance will provide certification for the year ahead. Following Validation by CHPQA, CHP schemes will be Registered and issued with appropriate Certification. The Certificate will last for one year and provide scheme details such as the QI, CHP_{EFF} , CHP_{EGL} and CHP_{EC} and meter serial numbers necessary to facilitate benefits. A site may not be audited every year, but when it is audited, data to support Self-Assessments for previous years (up to a maximum of 7 years) must be provided.
- **Form F1 (Request for CHPQA Application Pack) is included as Annex D.** This form is used to notify the programme that an organisation wishes to apply and to nominate the person responsible for managing the application. All future communication will be with that named person. **F1 needs to be returned to the CHPQA programme at the earliest possible date. A CHPQA Application Pack (including the Standard, Guidance Notes and Self-Assessment Forms), together with a unique CHPQA reference number, will be sent to this person as soon as the packs are available (expected in August).**
 - **Self-Assessment Form F2** will require a description of the scheme, a schematic, definition of the scheme boundaries (e.g. where supplementary firing or auxiliary boilers or black-start engines are included), existing and proposed monitoring arrangements and relevant QI definition calculation. Should, at some point after

submitting Form F2, the CHP scheme changes or the applicant wishes to change the scheme boundaries to include or exclude other elements, then Form F2 must be re-submitted. **It is advised that this form is completed and returned to the CHPQA programme by 11th September. Form F2 will be used by CHPQA as part of the Validation and early submission will facilitate the processing of Form F3.**

- **Self-Assessment Form F3** enables Self-Assessment of each CHP scheme. 12 months operating data will normally be required in order to establish QI, though a full 12 months data may not be available in the first instance. In order to make Self-Assessment easy, there is step-by-step guidance for schemes below 2MW, simple schemes (such as gas turbine CHP \geq 2MW) and complex schemes (such as CCGT or multiple fuel schemes). **For schemes to be sure of Certification in time for April 2001, Form F3 (and, if not supplied earlier, F2) must be correctly completed and with the CHPQA programme by 2nd October. Forms will be dealt with in the order in which they are received and incorrect or incomplete forms, or those which arrive after 2nd October, may not be processed in time.**

3.5 From August 2000, the full Application Pack (Standard, Guidance Notes and Self-Assessment Forms) will be downloadable from www.chpqa.com.

Table 3: Timetable for implementation of CHPQA

	Government actions	CHP Users actions
July 2000	Response to CHPQA Consultation published. CHPQA programme starts.	Form F1 is included as Annex D and must be returned to CHPQA at the earliest possible date.
August 2000	Finance Bill introducing Climate Change Levy gains Royal Assent. Application Pack including Standard, Guidance Notes and Self-Assessment Forms sent to applicants who have completed form F1 at the back of this document.	It is advised that Self-Assessment Form F2 is completed and returned to CHPQA by 11th September.
October 2000	Associated Statutory Instruments published.	Self-Assessment Form F3 <u>must</u> be returned to CHPQA by 2nd October 2000 to ensure benefits from April 2001.
Oct-Jan 2001	Validation by CHPQA. CHPQA certificates sent out during December and January 2001. Where possible, priority will be given to applicants whose fuel bills are paid quarterly.	Confirm Certification to Fuel Supplier.
April 2001	Levy introduced from April 1st 2001.	From April 1st 2001: Pay Climate Change Levy on fuel use above CHP_{EFL} and on electricity above CHP_{EGL} used on site or sold direct.
Ongoing	Manage the programme.	Maintain monitoring systems in readiness for Audit. Maintain Registration and Certification.

- 3.6 Assessment and Certification of a given scheme under CHPQA is a necessary condition for achieving benefits. However, the exemption from CCL and Enhanced Capital Allowances are a matter for European Commission State Aids clearance and, as such, the Commission has sole competence to decide whether these instruments are acceptable and what conditions should apply.

Climate Change Levy exemption

- 3.7 The Chancellor announced further details on the design of the Climate Change Levy (CCL) in the November 1999 Pre-Budget Report, following an extensive consultation exercise. Details included:
- A levy rate of 0.15 p/kWh for coal and gas and 0.43 p/kWh for electricity.
 - An exemption from the levy for electricity generated from renewable sources of energy and 'Good Quality' Combined Heat and Power.
 - An 80 per cent discount for energy intensive sectors that sign Negotiated Agreements on energy efficiency.
 - A trebling of support for energy efficiency measures under the CCL package to around £150m in 2001-02, to allow for the introduction of a system of Enhanced Capital Allowances for energy saving investments.
- 3.8 All schemes which apply to the CHPQA programme and which generate electricity and recover heat will be exempt from CCL on:
- Fuel used up to the Equivalent Fuel Input (CHP_{EFI}).
 - The heat supplied.
 - Electricity supplied from CHP schemes which are certified 'Good Quality' for their entire capacity and output, where that electricity is consumed onsite or sold direct to other customers.
 - For schemes with a $\text{QI} < 100$, electricity up to the Equivalent Generation Limit (CHP_{EGL}), where such electricity is consumed onsite or sold direct to other customers. Electricity supply above the level of CHP_{EGL} , whether used on-site or off-site, will be subject to CCL at the appropriate rate.
 - These issues will be covered in the CHPQA Guidance Notes.
- 3.9 Applicants not complying with the conditions of the scheme will have their certification withdrawn. In addition, cases involving dishonesty will be subject to penalties administered by HM Customs and Excise.

EXPORTS FROM 'GOOD QUALITY' CHP

- 3.10 Many respondents pointed out that, where a site has a large heat demand and low electricity demand, schemes that are sized to satisfy the heat load, and so maximise environmental benefits, may be capable of significant electricity exports. Sites in the refining, chemicals, paper, sugar and salt industries frequently follow this pattern. Encouragement of such schemes will be important in delivering the Government's CHP targets (and thus CO₂ targets) by 2010.
- 3.11 The Government proposes that electricity sales via a licensed electricity supplier will attract the levy at the appropriate rate. It will be the responsibility of the licensed supplier to pay the levy in this case, not the CHP scheme operator. Direct sale of unlicensed electricity supplies, taken together with on-site use, up to the CHP Equivalent Generation Limit (CHP_{EGL}) will not be liable to levy. Hence the treatment of electricity exported by a CHP scheme depends on the Utilities Bill and licensing and licence exemption arrangements, as well as contractual issues for individual schemes. These are issues that are beyond the scope of this response to consultation. The Department of Trade and Industry are presently considering their conclusions on the future arrangements for electricity supply licence exemption, following the consultation on *Electricity (Class Exemption from the Requirements for a Licence Order 1997)*. These arrangements may affect the circumstances surrounding the supply of electricity from CHP schemes direct to other customers.
- 3.12 There may be benefits for CHP schemes from other exemptions and exclusions from Climate Change Levy, for example, for those schemes using renewable fuels.

CHP SCHEMES USING ALTERNATIVE FUELS

- 3.13 Only the fuels listed in paragraph 2.67 are liable to Climate Change Levy. The CHPQA Guidance Notes will outline the treatment of schemes which use alternative fuels, or a combination of alternative and conventional fuels, but do not achieve the threshold criteria for 'Good Quality' (and therefore need the calculation of CHP_{EFI} or CHP_{EGL}). Electricity generated from approved renewable sources such as biomass can be used on site or sold direct to other customers free of levy, above the level of the CHP_{EGL}, provided certain conditions are met. These conditions are outside the scope of the consultation, but may include limitations on the amount of electricity which can be considered to be derived from renewable fuels, where the scheme uses both renewable and conventional fuels.
- 3.14 It should be noted that definitions of QI have been structured so as to encourage the maximum use of renewable fuels alongside conventional fuels (see examples 6 and 9 in Appendix A).

COMMUNITY HEATING

- 3.15 The supply (or that portion of a supply) from a community heating scheme to domestic customers will be excluded from Climate Change Levy⁶. Larger schemes may also supply organisations that are liable for CCL, e.g. a local authority, hospital, or university.

⁶ See Schedule 6 Clause 9 (2)(a) of the Bill, <http://www.parliament.the-stationery-office.co.uk/pa/cm199900/cmbills/097/00c97—g.htm#30>

AUTOGENERATION

- 3.16 Further proposals will be brought forward to clarify the definition, under Climate Change Levy, of autogeneration⁷ which is neither based on CHP nor renewable generation.

Negotiated Agreements

- 3.17 A range of industrial sectors are developing proposals for Negotiated Agreements with DETR. In addition to exemption for 'Good Quality' CHP, industry sectors can negotiate an 80% reduction in CCL liable on fuel and power from conventional sources in return for a commitment to reduce energy use or carbon emissions to a given target value. In many sectors, CHP represents the largest and most cost-effective opportunity to make savings which may contribute to reaching the targets.
- 3.18 Sites which are covered by a Negotiated Agreement might have a CHP scheme which exports electricity and/or heat to other sites. Sites may also – where there is no opportunity for CHP – choose to buy heat and or power from a nearby CHP scheme as one means of achieving their targets. In such cases, the fuel use, emissions and thus savings will need to be allocated between sites. An assessment under the CHPQA programme will assist in validating the energy consumption data which will need to be reported at the milestones within the agreements.

Enhanced Capital Allowances

- 3.19 At present, businesses are able to claim capital allowances on investment in plant and machinery. Small and medium size enterprises can claim 40% and larger businesses can claim 25% in the accounting period in which the expenditure is incurred. In both cases the balance of unrelieved expenditure is carried forward and written off at 25% pa on a reducing balance. For example, if a business buys a piece of equipment for £100, it will be able to receive a capital allowance of 25% of this cost i.e. it will obtain tax relief on £25 in the first year, £19 in the second, £14 in the third and so on until the balance is zero. At this point it would have received an allowance of £100. The new Enhanced Capital Allowances (ECAs) programme is intended to give 100% allowance in the first year on plant and machinery that meets energy efficiency criteria and businesses will be entitled to relief on the full £100 in the year the equipment is acquired. Thus, even though the new programme is tax neutral overall, there is a valuable cash flow benefit for the purchaser of energy efficient equipment over and above any other savings that can be made.
- 3.20 Applications for ECAs for CHP schemes will be assessed by the CHPQA programme. The final criteria for eligibility will be published in the Chancellor's Pre-Budget Report in November 2000, along with criteria for a range of other energy efficient equipment.
- 3.21 The costs of maintenance of a CHP scheme, including like-for-like replacement of components of a scheme or to ensure better compliance with the requirements of the CHPQA programme, will generally be a revenue expense that can be set against profits that are chargeable to income or corporation tax. These costs are relieved in full for each period in which sums are expended.

⁷ Autogeneration is the generation of electricity by companies whose main business is not electricity generation, the electricity being produced mainly for that company's own use.

Exemption of plant and machinery from Business Rates

- 3.22 The exemption of CHP plant and machinery from business rates was announced on 6 March 2000⁸. Plant and machinery used to generate electricity (such as turbines and engines) in all 'Good Quality' CHP will benefit from a 'tools of the trade' exemption from 1 April 2001 when the *CHPQA* programme will be in operation. Buildings used to house CHP or items which are large enough to be in the nature of a building will continue to be rated. The exemption will require a change in secondary legislation which will be published in draft later in the year.
- 3.23 The purpose of the exemption is to level the playing field with conventional generation, which already benefits from a 'tools of the trade' exemption.

Other possible uses for the *CHPQA* programme

- 3.24 Other parts of Government (including local or regional Government as well as Government Agencies) may, in future, take powers to use *CHPQA* for a variety of purposes requiring assessment of the quality of a CHP scheme. Whilst different users of the programme may thus use the same Standard methodologies and Guidance, they could choose to apply different threshold levels to qualify for particular benefits.

⁸ Hansard Q 113426 Column: 455W.

SECTION 4

Cost benefit analysis

- 4.1 The purpose of the *CHPQA* programme is to:
- Assess and certify the quality of a CHP scheme and thereby determine entitlement to tax and other benefits.
 - Provide clear signals to users and suppliers of CHP, to develop new schemes and upgrade or improve existing schemes to realise the 'environmental and other benefits' of CHP.
 - Achieve the above at the least cost of compliance. Many respondents to the consultation highlighted the need for simplification and this has strongly influenced the revised proposals.
- 4.2 The benefits which 'Good Quality' CHP brings will depend on the exact details of each individual scheme. A scheme with a QI of 100 would typically make primary energy savings of between 16% and 26% (depending on technology, size and fuel) over current alternative electricity and heat-only plant. However, most schemes achieve a QI in excess of 100 and will thus make even higher savings.
- 4.3 The combined benefit for CHP of exemption from CCL, ECAs and Business Rates is estimated to be in excess of £100 million in the tax year 2001/2. Exemption from CCL accounts for around two-thirds of this.
- 4.4 It is good Government to keep compliance costs as low as possible, but in proportion to the amount of revenue at risk to the Government. Some costs, such as monitoring, do not vary in proportion to the size of the scheme but are almost independent of scheme size. This has had a strong effect on the compliance regime. Schemes should already be managed to maximise efficiency and it is good practice to install appropriate metering. Costs are estimated as being the additional costs of data collection and applying to the *CHPQA* programme. Improvements in scheme efficiency or output will pay for themselves from the savings in energy costs.
- 4.5 For schemes of 2 MWe and over, annual costs of compliance are estimated at less than 1% of savings from CCL exemption. For schemes below 2 MWe, even with very much simplified requirements, annual costs of compliance are estimated to be 3-5% of annual savings. For schemes that apply for CCL exemption, the additional cost of applying for other benefits is close to zero.
- 4.6 It is estimated that the total cost for all 1300 or so existing CHP schemes to comply with *CHPQA* (over and above existing monitoring, management and administration costs) is just over £1 million a year.
- 4.7 Based on current energy prices, the net effect of these benefits for new schemes is that payback periods fall by around 30% (currently typically 5 years, falling to just less than 4 years).

ANNEX A

Calculations for schemes which do not achieve the threshold criteria for ‘Good Quality’ CHP

- A1** For a CHP scheme to be certified as ‘Good Quality’ for its entire capacity and output, it must achieve a Quality Index of at least 100 and an electrical efficiency of at least 20%. Most schemes will meet these criteria. Some schemes which generate electricity and recover heat may not achieve either or both criteria. For such schemes, the electricity generation or fuel input qualifying as ‘Good Quality’ CHP is scaled back to recognise the reduced environmental benefits.
- If a CHP scheme achieves an electrical efficiency of less than 20%, the fuel use that qualifies as an input to ‘Good Quality’ CHP is calculated (the CHP Equivalent Fuel Input or CHP_{EFI}).
 - If a CHP scheme achieves a QI of less than 100, the electricity generation that qualifies as an output from ‘Good Quality’ CHP is calculated (the CHP Equivalent Generation Limit or CHP_{EGL}) and the capacity that qualifies as ‘Good Quality’ CHP is also calculated (the CHP Equivalent Capability or CHP_{EC}).

This annex outlines the methods used to calculate CHP_{EFI} , CHP_{EGL} and CHP_{EC} .

Equivalent Fuel Input (CHP_{EFI})

- A2** Equivalent Fuel Input (CHP_{EFI}) is the fuel that is considered to be used in ‘Good Quality’ CHP. If the scheme achieves the relevant electrical efficiency threshold, all fuel used is considered to be in ‘Good Quality’ CHP. For CHP schemes with electrical efficiency below the threshold the fuel input is scaled back to the level at which the scheme *would have achieved the electrical efficiency threshold*. The remainder is not considered to be an input to ‘Good Quality’ CHP.
- A3** To determine the CHP_{EFI} for a scheme, the calculation starts from the definition for calculating the annual electrical efficiency of the scheme:

$$\text{Annual Electrical Efficiency (\%)} = \frac{\text{Annual Gross Electrical Output (MWh)}}{\text{Annual Fuel Input (MWh)}} \times 100$$

If annual electrical efficiency is above the electrical efficiency threshold then all fuel input qualifies. If it is below the threshold, a further calculation is needed to determine how much of it qualifies as an input to 'Good Quality' CHP (CHP_{EFI}):

$$\text{CHP}_{\text{EFI}} \text{ (MWh)} = \frac{\text{Annual Electrical Efficiency (\%)} \times \text{Annual Fuel Input (MWh)}}{\text{Electrical Efficiency Threshold (\%)}}$$

For most schemes this becomes:

$$\text{CHP}_{\text{EFI}} \text{ (MWh)} = \frac{\text{Annual Electrical Efficiency (\%)} \times \text{Annual Fuel Input (MWh)}}{20\%}$$

Under the transitional arrangements for existing steam turbine CHP schemes, this becomes:

$$\text{CHP}_{\text{EFI}} \text{ (MWh)} = \frac{\text{Annual Electrical Efficiency (\%)} \times \text{Annual Fuel Input (MWh)}}{15\%}$$

- A4** Some schemes use a mix of conventional fuels on which the levy may be due and alternative fuels which are not subject to the levy. If such a scheme does not meet the relevant electrical efficiency threshold, the CHP_{EFI} must be calculated. The treatment of such cases will be outlined in the Guidance Notes and will reflect the environmental benefits of the scheme.

CHP Equivalent Generation Limit

- A5** Equivalent Generation Limit (CHP_{EGL}) is the electricity that is considered to be generated in 'Good Quality' CHP. If the scheme achieves a QI of 100 or more, all electricity is considered to be generated in 'Good Quality' CHP. For CHP schemes with a QI below 100 the Equivalent Generation Limit is annual electrical generation (MWh) from a scheme that *would have achieved* a QI of 100 given the actual annual heat supply. The balance of electricity is not considered to be generated in 'Good Quality' CHP.

To calculate CHP_{EGL} first calculate QI:

- Select the QI definition from Table 2 for the type and size of scheme in question.
- Determine the fuel use, electricity generated and heat used from the scheme over a year.
- Calculate the QI.

For schemes with $\text{QI} < 100$, the next step is to calculate the increase in heat recovery that *would have enabled the scheme to achieve* a QI of 100. For schemes where the prime mover is a reciprocating engine or gas turbine, the electrical output is fixed regardless of the amount of heat recovered. For schemes with a back pressure steam turbine, the heat-to-power ratio is fixed. So for these prime movers the calculation of CHP_{EGL} is as follows:

Step 1 – Calculate the new heat efficiency needed to reach a Quality Index of 100. For these prime movers the electrical efficiency is fixed regardless of heat recovery, hence the calculation uses the basic definition for the Quality Index:

$$100 = X \times \text{Efficiency}_{\text{power}} + Y \times \text{New Efficiency}_{\text{heat}}$$

This equation can be rearranged to give:

$$\text{New Efficiency}_{\text{heat}} = \frac{(100 - (X \times \text{Efficiency}_{\text{power}}))}{Y}$$

Step 2 – Calculate the equivalent heat-to-power ratio for the scheme as if it had achieved this new level of heat utilisation and hence a Quality Index of 100: This is

$$\text{Equivalent heat-to-power ratio at a QI of 100} = \frac{\text{New Efficiency}_{\text{heat}}}{\text{Efficiency}_{\text{power}}}$$

Step 3 – Calculate CHP_{EGL} as follows:

$$\text{CHP}_{\text{EGL}} (\text{MW}_{\text{e}}\text{h}) = \frac{\text{Heat actually supplied (MW}_{\text{th}}\text{h)}}{\text{Equivalent heat-to-power ratio at QI} = 100}$$

A6 For schemes with a pass-out condensing steam turbine (including CCGT CHP schemes) and a given fuel input, electrical efficiency will decline as the quantity of steam exported for use on site increases. There is a balance between increasing heat recovery and reducing electrical output. This also makes calculations more complex because there are two variables rather than one, but the basic method is the same.

Step 1 – Calculate the new heat efficiency needed to reach a Quality Index of 100. For a scheme with a pass-out condensing steam turbine the electrical efficiency will fall as the heat used efficiency rises. This ratio of trading between heat and electricity (known as the Z ratio) is explained in more detail in paragraphs A9-13 below. The Z ratio depends on size and pass-out pressure, but a typical Z ratio is 4.1:1, in other words, for every 4.1 units of steam extracted from the turbine, one unit of electricity will be foregone. The Z ratio allows the trade between heat and electricity to be calculated.

$$\text{Change in Efficiency}_{\text{heat}} = \frac{\text{Change in QI}}{Y - \frac{X}{Z \text{ ratio}}}$$

To calculate the new heat utilisation efficiency, add the $\text{Change in Efficiency}_{\text{heat}}$ needed to achieve a QI of 100 to the actual $\text{Efficiency}_{\text{heat}}$ to give the total $\text{New Efficiency}_{\text{heat}}$ at $\text{QI} = 100$.

$$\text{New Efficiency}_{\text{heat}} \text{ at QI of 100} = \text{Change in Efficiency}_{\text{heat}} + \text{Actual Efficiency}_{\text{heat}}$$

As the heat efficiency has increased, the corresponding reduction in electrical efficiency is:

$$\text{Change in Efficiency}_{\text{power}} = \frac{\text{Change in Efficiency}_{\text{heat}}}{Z \text{ ratio}}$$

Note that the change in electrical efficiency must be regarded as negative as $\text{Efficiency}_{\text{power}}$ will have fallen, so to calculate the overall new electrical efficiency:

$$\text{New Efficiency}_{\text{power}} \text{ at QI of 100} = \text{Actual Efficiency}_{\text{power}} - \text{Change in Efficiency}_{\text{power}}$$

Step 2 – Calculate the equivalent heat-to-power ratio for the scheme as if it had achieved this level of heat efficiency and hence a Quality Index of 100. This is:

$$\text{Equivalent heat-to-power ratio at a QI of 100} = \frac{\text{New Efficiency}_{\text{heat}}}{\text{New Efficiency}_{\text{power}}}$$

Step 3 – Calculate CHP_{EGL} as follows:

$$\text{CHP}_{\text{EGL}} (\text{MW}_e\text{h}) = \frac{\text{Actual heat supplied (MW}_{\text{th}}\text{h)}}{\text{Equivalent heat-to-power ratio}}$$

CHP Equivalent Capability

- A7** CHP_{EC} will be used for monitoring CHP capacity for the purposes of collecting and collating annual CHP statistics. In addition to this, some benefits may in future depend on the measurement of CHP Capability.

The proposed definition of Equivalent Capability in the original consultation paper has been revised in line with the current practice for monitoring UK CHP capacity. It closely follows the methodology for calculating CHP_{EGL} , but uses performance measurements at maximum heat supply under normal operating conditions (MW of fuel, MW electricity generated, MW heat supplied)⁹. The CHP_{EC} for a given scheme will not usually vary from year to year.

If a scheme achieves a QI of 100 or more at these conditions ($\text{QI}_{\text{Maxheat}}$), the CHP_{EC} is the entire electrical output of the scheme. For Schemes with a $\text{QI}_{\text{Maxheat}}$ below 100, CHP_{EC} must be calculated.

To calculate CHP_{EC} first calculate $\text{QI}_{\text{Maxheat}}$:

- Select the QI definition from Table 2 for the type and size of scheme in question.
- Determine fuel used (MW), electricity generated (MW) and heat supplied (MW), at maximum heat supply conditions. Calculate the QI at these conditions ($\text{QI}_{\text{Maxheat}}$).

For schemes with $\text{QI}_{\text{Maxheat}} < 100$, the next step is to calculate the increase in heat recovery that would have enabled the scheme to achieve a $\text{QI}_{\text{Maxheat}}$ of 100. For schemes where the prime mover is a reciprocating engine or gas turbine, the electrical output is fixed regardless of the amount of heat recovered. For schemes with a back pressure steam turbine, the heat-to-power ratio is fixed. So for these prime movers the calculation of CHP_{EC} is as follows:

⁹ Maximum heat supplied under normal operating conditions may be based on current loads, or anticipated loads in the near future. Evidence would be required of future loads, for example, projected build-up of a Community Heating scheme. Normal Operating Conditions imply that the maximum heat demand is measured when the scheme is in steady state operation.

Step 1 – Calculate the new heat efficiency needed to reach a $QI_{Maxheat}$ of 100. For these prime movers the electrical efficiency is fixed regardless of heat recovery. The calculation uses the basic definition for the Quality Index:

$$QI_{Maxheat} \ 100 = X \times \text{Efficiency}_{power} + Y \times \text{New Efficiency}_{maxheat}$$

This equation can be rearranged to give:

$$\text{New Efficiency}_{maxheat} = \frac{(100 - (X \times \text{Efficiency}_{power}))}{Y}$$

Step 2 – Calculate the equivalent heat to power ratio for the scheme as *if it had achieved* this new level of heat utilisation and hence a $QI_{Maxheat}$ of 100: This is

$$\text{Equivalent heat-to-power ratio at a QI of 100} = \frac{\text{New Efficiency}_{maxheat}}{\text{Efficiency}_{power}}$$

Step 3 – Calculate CHP_{EC} as follows:

$$CHP_{EC} \text{ (MWe)} = \frac{\text{Maxheat actually supplied (MW}_{th})}{\text{Equivalent heat-to-power ratio at QI} = 100}$$

A8 For schemes with a pass-out condensing steam turbine and a given fuel input, electrical efficiency will decline as the quantity of steam exported for use on site increases. There is a balance between increasing heat recovery and reducing electrical output. This also makes calculations more complex because there are two variables rather than one, but the basic method is the same.

Step 1 – Calculate the new heat efficiency needed to reach a $QI_{Maxheat}$ of 100. For a scheme with a pass-out condensing steam turbine, steam turbine the electrical efficiency will fall as the heat supplied increases. This trading between heat and electricity (known as the Z ratio) is explained in more detail in paragraphs A9 to A13. The Z ratio can vary from one circumstance to another, but a typical Z ratio is 4.1:1, in other words, for every 4.1 units of steam extracted from the turbine, one unit of electricity will be foregone. Typical Z ratios for a range of steam turbines are given in paragraph A10. Assuming a fixed Z ratio allows the trade between heat and electricity to be calculated.

$$\text{Change in Efficiency}_{maxheat} = \frac{\text{Change in QI}}{Y - \frac{X}{Z \text{ ratio}}}$$

To calculate the new heat utilisation efficiency, add the Change in Efficiency_{heat} needed to achieve a $QI_{Maxheat}$ of 100 to the actual Efficiency_{heat} to give the total New Efficiency_{heat} at $QI_{Maxheat} = 100$:

$$\text{New Efficiency}_{heat} \text{ at } QI_{Maxheat} \text{ of } 100 = \text{Change in Efficiency}_{heat} + \text{Actual Efficiency}_{heat}$$

As the heat efficiency has increased, the corresponding reduction in electrical efficiency is:

$$\text{Change in Efficiency}_{power} = \frac{\text{Change in Efficiency}_{maxheat}}{Z \text{ ratio}}$$

Note that the change in electrical efficiency must be regarded as negative as Efficiency_{power} will have fallen, so to calculate the overall new electrical efficiency:

$$\text{New Efficiency}_{\text{power}} \text{ at } QI_{\text{Maxheat}} \text{ of } 100 = \text{Actual Efficiency}_{\text{power}} - \text{Change in Efficiency}_{\text{power}}$$

Step 2 – Calculate the equivalent heat-to-power ratio for the scheme as if it had achieved this level of heat efficiency and hence a Quality Index of 100: This is

$$\text{Equivalent heat-to-power ratio at a } QI_{\text{Maxheat}} \text{ of } 100 = \frac{\text{New Efficiency}_{\text{maxheat}}}{\text{New Efficiency}_{\text{power}}}$$

Step 3 – Calculate CHP_{EC} as follows:

$$\text{CHP}_{\text{EC}} \text{ (MWe)} = \frac{\text{Maxheat actually supplied (MW}_{\text{th}})}{\text{Equivalent heat-to-power ratio at a } QI_{\text{Maxheat}} \text{ of } 100}$$

The Z Ratio

- A9** As part of the calculation of the CHP_{EGL} and CHP_{EC}, the heat recovery necessary to achieve a QI of 100 must be calculated. For schemes which include a pass-out condensing steam turbine, an increase in steam extraction is accompanied by a corresponding decline in electrical efficiency. Thus:

$$\text{Change in QI} = X \times \text{Change in Efficiency}_{\text{power}} + Y \times \text{Change in Efficiency}_{\text{heat}}$$

Where X and Y are the factors appropriate to the scheme.

- A10** The trade between heat supplied to site and electricity generated for schemes with pass-out condensing steam turbines is known as the Z ratio. The Z ratio can be derived from actual measurements of the scheme in question and depends on the pressure and temperature of the steam supplied to site, the steam turbine generating set's thermodynamic (isentropic) and mechanical efficiencies and the vacuum (or pressure) maintained in the condenser. Table 4 below shows Z ratios for different steam export pressures and for turbine thermodynamic efficiencies that are typical in operation for steam turbines in the size ranges shown. This Table is illustrative. The Z ratio that is applicable to each scheme must be determined and evidence supplied. Manufacturers' specifications are not generally representative of normal operation. Further information will be provided in the forthcoming CHPQA Guidance Notes, including determination of Z ratio for schemes with pass-out at more than one pressure.

Table 4: Typical Z ratios for given steam turbines and steam pass-out pressures¹⁰

Steam turbine size range	2-5 MWe	5-10 MWe	10-25 MWe	25-50 MWe	>50 MWe
Typical thermodynamic (isentropic) efficiency	65%	70%	75%	80%	84%
Steam export pressure					
21.7 bar (315 psia)	5.0	4.7	4.4	4.1	3.9
14.8 bar (215 psia)	5.4	5.0	4.7	4.4	4.2
11.4 bar (165 psia)	5.7	5.3	4.9	4.6	4.4
7.9 bar (115 psia)	6.1	5.7	5.3	5.0	4.7
3.8 bar (55 psia)	7.2	6.7	6.3	5.9	5.6
2.4 bar (55 psia)	8.1	7.5	7.0	6.6	6.3

A11 For example, for a typical CCGT scheme with a steam turbine rated at 60 MWe with a single pass-out pressure of 11.4 bar the Z ratio is 4.4:1. This means that for every 4.4 units of steam extracted from the turbine, one unit of electricity will be foregone.

A12 The Z ratio allows the trade between heat and electricity to be calculated. Thus the efficiency of power generation can be restated in terms of heat and Z ratio (note the minus sign indicating that the change in electrical efficiency is negative).

$$\text{Change in QI} = (Y \times \text{Change in Efficiency}_{\text{heat}}) - \frac{X \times \text{Change in Efficiency}_{\text{heat}}}{\text{Z ratio}}$$

Rearranging this equation gives:

$$\text{Change in QI} = \text{Change in Efficiency}_{\text{heat}} \times Y - \frac{X}{\text{Z ratio}}$$

Rearranging this equation gives:

$$\text{Change in Efficiency}_{\text{heat}} = \frac{\text{Change in QI}}{Y - \frac{X}{\text{Z ratio}}}$$

A13 This is the additional heat recovery necessary for any given scheme to achieve any given change in QI. In calculating CHP_{EGL} the change in QI is equal to 100 minus the QI actually achieved by the scheme.

¹⁰ These figures are different from those in the consultation paper, since the earlier figures were net of a typical 70% condensate return from site. The figures in this document ignore condensate return. Sites determining Z ratio for themselves should similarly ignore condensate return.

ANNEX B

Example calculations

- B1** These examples have been worked using the final methodologies, definitions and criteria provided in this document. In all these calculations,
- Calculations are on a Gross Calorific Value basis (higher heat value).
 - Electricity is measured at the terminals, not counting electrical parasitic loads (paras 2.23 to 2.24).
 - Heat efficiency is the useful heat supplied to the site, net of heat rejected in heat rejection radiators or other facilities and ignoring condensate return (para 2.25).
 - Electricity is assumed to be used onsite or supplied direct to customers.
 - For these examples, the levy is at the full rate and does not include the 80% discount which will be available to those sites which are covered by a Negotiated Agreement.

Quality Index for schemes below 2 MWe

- B2** An operator of a scheme without a heat rejection facility will only need to measure fuel used and electricity generated and provide a statement confirming the design heat load. A scheme with a heat rejection facility will have similar criteria until April 2004. From that date, if a scheme with a heat rejection facility does not achieve the threshold criteria (a QI ≥ 100 and an electrical efficiency $\geq 20\%$), the applicant must calculate CHP_{EFI} or CHP_{EGL} and CHP_{EC} as appropriate (para 2.15 and Examples 5 – 9).

Example 1 A 250 kWe reciprocating engine in a hospital for 5,000 hours a year

1. The appropriate QI definition is based on the maximum continuous rated electrical capacity of the scheme (maximum electricity generating conditions). For reciprocating engines this is

$$QI = 200 \times P + 125 \times H$$
2. For schemes of this size, fuel use and electricity generated must be measured. Over the year, the metered fuel use is 3,333 MWh. The scheme has no heat rejection facility and output modulates when heat demands fall. In this case, the annual average electrical output is 200 kWe and annual electricity generated is 1000 MWh. Where a scheme has no heat rejection facility, efficiency will be high as long as the scheme has been matched to the load. A statement of the design heat load will be needed, such as the original design analysis. According to the design statement, average annual heat supplied will be 1,333 MWh.
3. Thus electrical efficiency over the year is 30% (1,000/3,333) and the electrical efficiency threshold is achieved. Heat supplied efficiency is 40% (1,333/3,333). Overall efficiency is 70% GCV.
4. The Quality Index is $200 \times 30\% + 125 \times 40\%$, which is 110.0, so the QI threshold is also achieved.
5. The value of levy exemption compared to electricity bought from the network and heat generated in heat-only boilers at 75% efficiency is $(1,000 \times 1,000 \times (0.43/100)) + (1,333 \times (1,000/0.75) \times (0.15/100))$, which is £6,966 p.a.

Quality Index for schemes of 2 MWe and over

B3 Applicants with schemes of 2 MWe and over must measure fuel used, heat supplied and electricity generated and will be required to calculate electrical efficiency and heat efficiency and hence QI. If a scheme of 2 MWe or over does not achieve the threshold criteria (a QI ≥ 100 and an electrical efficiency $\geq 20\%$) the applicant must calculate CHP_{EFI} or CHP_{EGL} and CHP_{EC} as appropriate. Examples have been worked for the following:

- A 4.5 MWe gas turbine in a factory, a 49 MWe gas turbine in a factory and a 160 MWe CCGT CHP scheme at an oil refinery that all achieve the threshold criteria (Examples 2 to 4).
- A 15 MWe steam turbine scheme burning conventional fuels with an electrical efficiency below the threshold and the same scheme using a mix of conventional and alternative fuels (Examples 5 and 6). For a scheme with an electrical efficiency below 20% (or 15% for steam turbine CHP schemes), the equivalent CHP fuel input (CHP_{EFI}) must be calculated. CHP_{EFI} is the portion of the fuel which will be considered an input to 'Good Quality' CHP (paras A2 to A4).
- A 49 MWe gas turbine and a 160 MWe CCGT CHP scheme which achieve a QI < 100 (Examples 7 and 8). For a scheme with a QI below 100, only a portion of the capacity and output can be described as 'Good Quality'. For these schemes, CHP_{EGL} and CHP_{EC} must be calculated. In the gas turbine example, electrical efficiency does not change with increasing heat recovery. In the CCGT example, electrical efficiency does change with increasing heat recovery and this must be taken account of using the Z ratio (see Annex A).
- A 65 MWe CCGT CHP scheme with a QI of less than 100 and burning a mix of conventional and alternative fuels (Example 9).

Example 2 A 4.5 MWe gas turbine in a food factory for 6000 hours a year

1. The appropriate QI definition is based on the maximum continuous rated electrical capacity of the scheme (maximum electricity generating conditions). For gas turbine schemes between 1 and 10 MWe this is

$$QI = 220 \times P + 125 \times H$$

2. Over the year, the metered fuel use is 105,000 MWh. The average electrical output over the year is 4.2 MWe and the total electricity generated over 6,000 hours is 25,200 MWh. The scheme supplies 47,250 MWh of heat.
3. Thus electrical efficiency over the year is 24% (25,200/105,000) and the electrical efficiency threshold is achieved. Heat supplied efficiency is 45% (47,250/105,000). Overall efficiency is 69% GCV.
4. The Quality Index is $220 \times 24\% + 125 \times 45\%$, which is 109.1, so the QI threshold is also achieved.
5. The value of levy exemption compared to electricity bought from the network and heat generated in heat-only boilers at 75% efficiency is $(25,200 \times 1,000 \times (0.43/100)) + (47,250 \times (1,000/0.75) \times (0.15/100))$, which is £202,860 p.a.

Example 3 A 49 MWe gas turbine at a factory for around 7,000 hours a year

1. The appropriate QI definition is based on the maximum continuous rated electrical capacity of the scheme (maximum electricity generating conditions). For gas turbine schemes between 25 and 50 MWe this is:

$$QI = 190 \times P + 125 \times H$$

2. Over the year, the metered fuel use is 952,000 MWh. Electricity generated over 7,000 hours is 325,850 MWh (so the scheme produces an average output of 46.5 MWe) and heat supplied is 308,000 MWh.
3. Thus electrical efficiency over the year is 34.2% (325,850/952,000) and so the electrical efficiency threshold is achieved. Heat supplied efficiency is 32.4% (308,000/952,000). Overall efficiency is 66.6% GCV.
4. The Quality Index is $190 \times 34.2\% + 125 \times 32.4\%$, which is 105.5, so the QI threshold is also achieved.
5. The value of levy exemption compared to electricity bought from the network and heat generated in heat-only boilers at 75% efficiency is $(325,850 \times 1,000 \times (0.43/100)) + (308,000 \times (1,000/0.75) \times (0.15/100))$, which is £2,017,155 p.a.

Example 4 A 160 MWe CCGT at an oil refinery, 8,500 hours operation p.a.

1. The appropriate QI definition is based on the maximum continuous rated electrical capacity of the scheme (maximum electricity generating conditions). In this case, the CCGT scheme can supply up to 160 MWe under maximum electricity generating conditions. For CCGT schemes between 100 and 200 MWe the appropriate QI definition is:

$$QI = 180 \times P + 125 \times H$$

2. Over the year the metered fuel use is 3,099,638 MWh. Under average heat supply conditions, when steam is extracted from the steam turbine for supply to site, electrical output falls to 131 MWe. Total annual electricity generated is 1,115,870 MWh and heat supplied 1,000,935 MWh.
3. Thus electrical efficiency over the year is 36% (1,115,870 /3,099,638) and the electrical efficiency threshold is achieved. Heat supplied efficiency is 32.3% (1,000,935/3,099,638). Overall efficiency is 68.3% GCV.
4. The Quality Index is $170 \times 36\% + 125 \times 32.3\%$, which is 105.2, so the QI threshold is also achieved.
5. The value of levy exemption compared to electricity bought from the network and heat generated in heat-only boilers at 75% efficiency is $(1,115,870 \times 1,000 \times (0.43/100)) + (1,000,935 \times (1,000/0.75) \times (0.15/100))$, which is £6,800,109 p.a.

CHP Equivalent Fuel Input

- B4** Example 5 shows a steam turbine scheme fired by conventional fuels which falls below the minimum electrical efficiency of 15%. If the scheme used alternative fuels (Example 6), it would deliver greater environmental benefits and achieve a higher QI.

Example 5 CHP_{EFI} for 15 MWe ST operating 5200 hours a year with conventional fuels

1. The appropriate QI definition is based on the maximum continuous rated electrical capacity of the scheme (maximum electricity generating conditions). For steam turbine CHP schemes this is:

$$QI = 240 \times P + 125 \times H$$

2. Over the year, the metered fuel use is 650,000 MWh (a combination of coal and natural gas). The scheme operates at partial load and produces an average of 10 MWe for 5,200 hours per annum. Electricity generated is 52,000 MWh and heat supplied 429,000 MWh
3. Electrical efficiency over the year is 8% (52,000/650,000) and heat utilisation efficiency is 66% (429,000/650,000). Overall efficiency is 74% GCV. Heat-to-power ratio is 8.25:1
4. The Quality Index is $240 \times 8\% + 125 \times 66\%$, which is 101.7.
5. The scheme has $QI > 100$, so all electricity is exempt. However, the scheme is a steam turbine and electrical efficiency is $< 15\%$, so CHP_{EFI} must be calculated.

6. CHP_{EFI} is calculated as follows:

$$CHP_{EFI} \text{ (MWh)} = \frac{\text{Annual Electrical Efficiency (\%)} \times \text{Annual Fuel Input (MWh)}}{15\%}$$

$$CHP_{EFI} = 8\%/15\% \times 650,000 = 346,667 \text{ MWh, which is 53\% of the total fuel in.}$$

7. In levy terms, the levy paid on fuel input to this scheme would be $(650,000 - 346,667) \times 1000 \times (0.15/100)$ which is £455,000.
8. The levy that would otherwise have been payable on electricity and heat supplied in conventional boilers using conventional fuels at 75% efficiency would have been $(52,000 \times 1000 \times 0.0043) + (429,000 \times 1000/0.75 \times 0.0015)$, which is £1,081,600. The levy saving for this CHP is £626,600 p.a.

Example 6 CHP_{EFI} for the same 15 MWe steam turbine described in Example 5, but burning a mix of conventional and alternative fuel.

1. This example repeats Example 5, except that the scheme in question burns some alternative fuels. (The method is equally appropriate for a steam turbine or for a Combined Cycle scheme which includes waste fuel burnt in a boiler which supplies steam to the steam turbine, except in this latter case, the minimum electrical efficiency is 20%.)
2. The appropriate QI definition is based on the maximum continuous rated electrical capacity of the scheme (maximum electricity generating conditions). For schemes with mixed fuels (conventional and alternative fuels), a weighted QI definition has to be calculated. The relevant definitions are:

Alternative Fuels	$QI = 300 \times P + 140 \times H$
Steam Turbines	$QI = 240 \times P + 125 \times H$

3. Over the year, the metered fuel use is 400,000 MWh natural gas and 250,000 MWh waste gas. Electricity generated is 52,000 MWh and heat supplied 429,000 MWh.
4. Thus total fuel used is $(400,000 + 250,000) = 650,000$ MWh. Percentage waste fuel is 38.5% $(250,000/650,000)$.
5. The two QI definitions must be combined proportionately:
6. **Step 1** Using the fuel percentages to weight the definition

$$QI_{new} = 38.5\% \times (300 \times P + 140 \times H) + 61.5\% \times (240 \times P + 125 \times H)$$

7. **Step 2** Rearrange the definition

$$QI_{new} = ((38.5\% \times 300 + 61.5\% \times 240) \times P) + ((38.5\% \times 140 + 61.5\% \times 125) \times H)$$

$$QI_{new} = 263.1 \times P + 130.8 \times H$$

8. Electrical efficiency over the year is 8% $(52,000/650,000)$ and heat utilisation efficiency is 66% $(429,000/650,000)$. Overall efficiency is 74%. Heat-to-power ratio is 8.25:1
9. The Quality Index is $263.1 \times 8\% + 130.8 \times 66\%$, which is 107.4 (compared to 101.7 in Example 5).
10. The scheme has $QI > 100$, so all electricity is exempt. However, the electrical efficiency is $< 15\%$, so further calculations are necessary. This involves an extra calculation compared to Example 5, since some of the fuel is conventional (and otherwise liable to levy), and some is alternative fuel which has environmental benefits over conventional fuels (and is not liable for levy).
11. Calculate the fuel input required to achieve an electrical efficiency of 15%,

$$CHP_{EFI} \text{ (MWh)} = \frac{\text{Annual Electrical Efficiency (\%)} \times \text{Annual Fuel Input (MWh)}}{15\%}$$

$$CHP_{EFI} = 8\%/15\% \times 650,000 = 346,667 \text{ MWh}$$
12. Of the total fuel input to this scheme, 400,000 MWh (or 61.5%) is conventional and 250,000 MWh (38.5%) is alternative. The treatment of these fuels for the purposes of CCL depends on a number of factors which will be explained in the Guidance Notes for the CHPQA programme. However, treatment will reflect the fact that the use of alternative fuels has environmental benefits over use of conventional fuels.

CHP Equivalent Generation Limit and Equivalent Capability

B5 Examples 7 and 8 (a 49 MWe gas turbine and a 160 MWe CCGT CHP scheme) illustrate schemes with an electrical efficiency in excess of 20% but with lower levels of heat recovery. They achieve a $QI < 100$ and CHP_{EGL} and CHP_{EC} must be calculated.

Example 7 A 49 MWe gas turbine at a factory for around 7,000 hours a year (CHP_{EGL} and CHP_{EC})

CHP Equivalent Generation Limit (CHP_{EGL})

- This scheme is identical to Example 3 except that heat recovery is halved. The appropriate QI definition is based on the maximum continuous rated electrical capacity of the scheme (maximum electricity generating conditions). For gas turbine schemes with electrical capacity between 25 and 50 MWe this is:

$$QI = 190 \times P + 125 \times H$$
- Over the year, the metered fuel use is 952,000 MWh, electricity generated is 325,850 MWh and heat utilisation is 154,000 MWh.
- Thus electrical efficiency over the year is 34.2% (325,850/952,000) and the electrical efficiency threshold is achieved. Heat utilisation efficiency is 16.2% (154,000/952,000). Overall efficiency is 50.4% GCV.
- The Quality Index is $190 \times 34.2\% + 125 \times 16.2\%$, which is 85.3. Since this scheme has a $QI < 100$, further calculations are necessary to determine the conditions necessary to achieve the threshold of a QI of 100.
- For gas turbines, electrical generation efficiency is fixed, regardless of heat load.

So, following **Step 1** from the method shown in Annex A:

$$\text{New Efficiency}_{\text{heat}} = \frac{(100 - (X \times \text{Efficiency}_{\text{power}}))}{Y}$$

$$\text{New Efficiency}_{\text{heat}} = (100 - (190 \times 34.2\%))/125 = 28.0\%$$

Step 2 is to calculate the equivalent heat-to-power ratio at $QI = 100$

$$\text{Equivalent heat-to-power ratio at a QI of 100} = \frac{\text{New Efficiency}_{\text{heat}}}{\text{Efficiency}_{\text{power}}}$$

$$\text{Equivalent heat-to-power ratio at a QI of 100} = 28.2\%/34.2\% = 0.817$$

Step 3 is to calculate CHP_{EGL}

$$CHP_{EGL} (MW_{e,h}) = \frac{\text{Heat actually supplied (MW}_{th})}{\text{Equivalent heat-to-power ratio at QI} = 100}$$

$$CHP_{EGL} = 154,000/0.817 = 188,432 \text{ MWh}$$

Example 7 (continued)

6. The annual electricity generation qualifying for benefits is 188,432 MWh, which represents 57.8% (188,432/325,850) of the electricity generated.
7. The levy saved by this scheme compared to the supply of electricity and heat from conventional sources (the network and boilers at 75% efficiency) would be $(188,432 \times 1000 \times (0.43/100)) + (154,000 \times (1000/0.75) \times (0.15/100))$, which is £1,118,257 p.a.
8. The levy due on electricity from the scheme would be $(325,850 - 188,432) \times 1000 \times (0.43/100)$ which is £590,898. The levy is paid by the end-user of the electricity. If all the electricity is used on site the net saving of levy is £527,359 p.a.

CHP Equivalent Capability (CHP_{EC})

9. CHP Equivalent Capability is determined on the basis of the maximum heat demand under normal operating conditions (MW_{th}). The scheme supplies 154,000 MWh heat over 7,000 hours, or an annual average of 22 MW_{th} . Maximum heat demand (which exists for around 1000 hours a year) is 50 MW_{th} . At this time, fuel input is 143.2 MW, electrical efficiency is 49/143.2 or 34.2% and heat efficiency is 35% (50/143.2). Overall efficiency is 69.2%.
10. Calculation of $QI_{Maxheat}$ uses the same QI equation hence:

$$QI_{Maxheat} = 190 \times 34.2\% + 125 \times 35\% = 108.6$$
11. Since, at conditions of $QI_{Maxheat}$, this scheme achieves a QI in excess of 100 the CHP_{EC} is equal to the installed capacity.

Example 8 A 160 MWe CCGT operating 8500 hours a year at an oil refinery (CHP_{EGL} and CHP_{EC})**CHP Equivalent Generation Limit (CHP_{EGL})**

1. This scheme is the same as Example 4 except that heat recovery is halved. Because less heat is extracted from the steam turbine, a higher portion of the steam energy is converted to electricity. The appropriate QI definition is based on the maximum continuous rated electrical capacity of the scheme (maximum electricity generating conditions). For schemes with electrical capacity between 100 and 200 MWe this is

$$QI = 180 \times P + 125 \times H$$

2. Over the year, the metered fuel use is 3,099,638 MWh. Under average heat supply conditions, when steam is extracted from the steam turbine for supply to site, electrical output falls to an average of 146 MWe (compared to 131 MWe in example 4). Total annual electricity generated is 1,237,935 MWh and heat supplied 500,467 MWh.
3. Thus electrical efficiency over the year is 39.9% (1,237,935 / 3,099,638) and the electrical efficiency threshold is achieved. Heat utilisation efficiency is 16.1% (500,467/3,099,638). Overall efficiency is 56.1%.
4. The Quality Index is $180 \times 39.9\% + 125 \times 16.1\%$, which is equal to 92.1. Since this scheme has a QI <100, further calculations are necessary.
5. For schemes which include pass-out steam turbines, electrical generation efficiency declines with increasing heat supply. To calculate the conditions necessary to achieve the threshold of QI of 100, both the new electrical and new heat efficiency must be calculated.

Example 8 (continued)

6. Annex A shows Z ratios for a range of steam turbines and steam pass-out pressures. For a CCGT with a steam turbine rated up to 50 MWe and a pass-out pressure of 21.7 bar, the Z ratio is 4.1

Step 1 Calculate the change in heat efficiency:

$$\text{Change in Efficiency}_{\text{heat}} = \frac{\text{Change in Q1}}{Y - \frac{X}{\text{Z ratio}}}$$

with the Z ratio for this scheme of 4.1:

$$\text{Change in Efficiency}_{\text{heat}} = \frac{100-92.1}{125 - \frac{180}{4.1}} = 9.8\%$$

Thus the increase in heat efficiency from 16.1% is 9.8%, making a total of 25.9% of the fuel input recovered as useful heat. The corresponding decline in electrical efficiency is

$$\text{Change in Efficiency}_{\text{power}} = \frac{\text{Change in Efficiency}_{\text{heat}}}{\text{Z ratio}}$$

$$\text{Change in Efficiency}_{\text{power}} = \frac{9.8}{4.1} = 2.4\%$$

So the new electrical efficiency at Q1 = 100 is 39.9 – 2.4 = 37.6%.

This gives an overall efficiency of 63.5% and, to confirm,

$$Q1 = 180 \times 37.6\% + 125 \times 25.9\%, \text{ which is equal to } 100$$

Step 2 The equivalent heat-to-power ratio is 25.9%/37.6% = 0.69

Step 3 Calculate CHP_{EGL}

$$\text{CHP}_{\text{EGL}} (\text{MW}_e\text{h}) = \frac{\text{Actual heat supplied (MW}_{\text{th}}\text{h)}}{\text{Equivalent heat-to-power ratio}}$$

$$\text{CHP}_{\text{EGL}} = 500,467/0.69 = 724,999 \text{ MWh}$$

7. The annual electricity generation qualifying for benefits is 724,999 MWh, which represents 58.6% (724,999/1,237,935) of the total electricity generated.
8. The levy saved by this scheme compared to supply of electricity and heat from conventional sources (the network and boilers at 75% efficiency) would be (724,999 x 1000 x (0.43/100)) + (500,467 x (1000/0.75) x (0.15/100)), which is £4,118,429 p.a.
9. The levy due on electricity from the scheme would be (1,237,935 – 724,999) x 1000 x (0.43/100), which is £2,205,626. The levy is paid only by the end-user of the electricity. If all the electricity is used on site the net saving in levy is £1,912,803 p.a.

Example 8 (continued)**CHP Equivalent Capability (CHP_{EC})**

10. CHP Equivalent Capability is determined on the basis of the maximum heat supply under normal operating conditions (MW_{th}). The scheme supplies 500,467 MWh over 8,500 hours, or an annual average of 58.9 MW_{th} . In this case, the heat load is fairly steady throughout the year and even under maximum continuous heat supply conditions, the maximum heat supply does not exceed 80 MW_{th} . At this time, fuel input is 364.66 MW, electrical efficiency is 140/364.6 or 38.5% and heat efficiency is 21.9% (80/364.6). Overall efficiency is 60.5%.

11. Calculation of $QI_{Maxheat}$ uses the same QI equation hence:

$$QI_{Maxheat} = 180 \times 38.5\% + 125 \times 21.9\% = 96.8$$

12. At conditions of $QI_{Maxheat}$ this scheme achieves a QI below 100, so for the purposes of calculating CHP Equivalent Capability it must be scaled back against a QI of 100.

$$\text{Change in Efficiency}_{maxheat} \text{ to give a QI of 100} = \frac{\text{Change in QI}}{Y - \frac{X}{Z \text{ ratio}}}$$

$$\text{Change in Efficiency}_{heat} = \frac{3.2}{125 - \frac{180}{4.1}} = 4\%$$

This change results in New Efficiency_{heat} becoming 25.9% and a corresponding decline in electrical efficiency:

$$\text{Change in Efficiency}_{power} = \frac{\text{Change in Efficiency}_{maxheat}}{Z \text{ ratio}}$$

$$\text{Change in Efficiency}_{power} = \frac{4.1}{4} = 1$$

Thus there would be a 1% drop in electrical efficiency (to 37.6%) to achieve a QI of 100. New Efficiency_{power} = 37.6%.

Step 2 – Calculate the equivalent heat-to-power ratio for the scheme as if it had achieved this level of heat efficiency and hence a Quality Index of 100.

$$\text{Equivalent heat-to-power ratio at a QI of 100} = \frac{\text{New Efficiency}_{maxheat}}{\text{New Efficiency}_{power}}$$

$$\text{Equivalent heat-to-power ratio} = \frac{25.9}{37.6} = 0.69$$

Step 3 – Calculate CHP_{EC} as follows:

$$CHP_{EGL} (MW_e) = \frac{\text{Maxheat actually supplied } (MW_{th})}{\text{Equivalent heat-to-power ratio at QI} = 100}$$

$$CHP_{EC} = \frac{80}{0.69} = 115.9 \text{ MWe}$$

Thus the CHP_{EC} for this scheme represents 72% (115.9/160) of capacity

B6 Given the QI definitions in Table 2, a scheme which makes use of alternative fuels (but otherwise with the same features) will achieve a higher QI than a scheme which uses only conventional fuels. In the example below, using 22% alternative fuels increases QI by 7 points (although in practice a scheme utilising alternative fuels, which may be wetter or have a lower calorific value, will tend to achieve a lower efficiency).

Example 9 A 65 MWe CCGT operating 8500 hours a year burning natural and waste gases. The scheme achieves a QI <100, so CHP_{EGL} and CHP_{EC} must be calculated

1. The appropriate QI definition is based on the maximum continuous rated electrical capacity of the scheme (maximum electricity generating conditions). For schemes with mixed conventional and alternative fuels, a weighted QI definition has to be calculated. For schemes between 50 and 100 MWe the relevant definitions are:

$$\begin{aligned} \text{Other Technologies} \quad QI &= 185 \times P + 125 \times H \\ \text{Alternative Fuels} \quad QI &= 300 \times P + 140 \times H \end{aligned}$$

2. Over the year, the metered fuel uses is 1,173,595 MWh natural gas and 342,380MWh alternative fuel. Thus total fuel use is (1,173,595 + 342,380) = 1,515,975 MWh. Percentage alternative fuel is 22.6% (342,380/1,515,975) and conventional fuel 77.4% (1,173,595/1,515,975).

3. Electricity generated is 378,994 MWh and heat supplied is 394,154 MWh. Annual average electrical efficiency for the scheme is 25% (378,994/1,515,975) and annual average heat utilisation efficiency is 26% (394,154/1,515,975). Overall efficiency is 51%.

4. Combine the two QI definitions:

Step 1 Using the fuel percentages to weight the definition

$$QI_{\text{new}} = 22.6\% \times (300 \times P + 140 \times H) + 77.4\% \times (185 \times P + 125 \times H)$$

Step 2 Rearrange the definition

$$QI_{\text{new}} = ((22.6\% \times 300 + 77.4\% \times 185) \times P) + ((22.6\% \times 140 + 77.4\% \times 125) \times H)$$

$$QI_{\text{new}} = 211 \times P + 128.4 \times H$$

5. The Quality Index is 211 x 25% + 128.4 x 26%, which is 86.1. (Had this scheme used only conventional fuels, the QI would have been 185 x 25% + 125 x 26% which is only 78.8).

6. The electrical efficiency is greater than 20% so all fuel input is exempt, but this scheme has a QI <100, so further calculations are necessary.

7. For schemes which include pass-out steam turbines, electrical generation efficiency declines with increasing heat supply. To calculate QI of 100, both the new electrical and heat efficiency must be calculated.

8. Annex A shows Z ratios for a range of turbine sizes and steam pressures. For this scheme, the steam turbine has a Z ratio of 4.5

Step 1 Calculate the change in heat efficiency:

$$\text{Change in Efficiency}_{\text{heat}} = \frac{\text{Change in QI}}{Y - \frac{X}{Z \text{ ratio}}}$$

With the Z ratio for this scheme of 4.5:

$$\text{Change in Efficiency}_{\text{heat}} = \frac{100-86.1}{128.4 - \frac{211}{4.5}} = 18.0\%$$

Thus the increase in heat efficiency from 26% is 18.0%, making a total of 44% of the input which must be recovered as useful heat to achieve a QI of 100.

Example 9 (continued)

Step 2 Calculate the change in power efficiency

$$\text{Change in Efficiency}_{\text{power}} = \frac{\text{Change in Efficiency}_{\text{heat}}}{\text{Z ratio}}$$

$$\text{Change in Efficiency}_{\text{power}} = \frac{18.0\%}{4.5} = 4.4\%$$

So the new electrical efficiency at QI = 100 is $25 - 4.4 = 20.6\%$.

This gives an overall efficiency of 64.6%, and, to confirm,

$$\text{QI} = 211 \times 20.6\% + 128.4 \times 44\%, \text{ which is equal to } 100$$

Step 3 The new equivalent heat-to-power ratio is $(44\%/20.6\%) = 2.14$

Step 4 Calculate CHP_{EGL} :

$$\text{CHP}_{\text{EGL}} (\text{MW}_e\text{h}) = \frac{\text{Actual heat supplied (MW}_{\text{th}}\text{h)}}{\text{Equivalent heat-to-power ratio}}$$

$$\text{CHP}_{\text{EGL}} = 394,154/2.14 = 184,387 \text{ MWh}$$

If all fuels had been conventional fuels, the annual electricity generation qualifying for benefits would have been 184,387 MWh, which represents 49% (184,387/378,994 MWh) of the total electricity generated.

9. Of the total fuel input, 22.6% of fuel is alternative and 77.4% conventional fuel. The treatment of these fuels for the purposes of levy depends on a number of factors which will be explained in the *CHPQA* Guidance Notes. However, treatment will reflect the fact that the use of alternative fuels has environmental benefits over use of conventional fuels.

CHP Equivalent Capability (CHP_{EC})

10. CHP Equivalent Capability is determined on the basis of the maximum heat supply under normal operating conditions (MW_{th}). The scheme supplies 394,154 MWh over 8,500 hours, or an annual average of 46 MW_{th} . The maximum heat supply is 70 MW, at which point the scheme achieves 64% overall efficiency. At this time, fuel input is 178.3 MW, electrical efficiency is $(44.6/178.3)$ or 25%, and heat efficiency is $(70/178.3)$ or 39.2%. Overall efficiency is 64.2%. Calculation of $\text{QI}_{\text{Maxheat}}$ uses the same QI equation hence:

$$11. \text{QI}_{\text{Maxheat}} = 211 \times 25\% + 128 \times 39.2\% = 103.1$$

12. Since, at conditions of $\text{QI}_{\text{Maxheat}}$, this scheme achieves a QI in excess of 100, the CHP_{EC} is equal to the installed capacity.

ANNEX C

List of respondents to the consultation

ABB Alstom Power, Bolton
 Acordis UK Ltd, Grimsby
 AirCogen Limited
 Alta Estate Services Ltd, Birmingham
 Anglian Water, Huntingdon
 Atco Power, London
 Aventis CropScience, Norfolk
 Avesta Sheffield Ltd, Sheffield
 Aylesford Newsprint, Kent
 BAA PLC, West Sussex
 BAE Systems, Cumbria
 BASF PLC, Middlesbrough
 BBC Resources, London
 BG Group
 Birds Eye Walls, Surrey
 BNFL
 Boots Contract Manufacturing, Nottingham
 Boots Plc, Nottingham
 BP Amoco Gas & Power, London
 BP Exploration, Shetland
 Bracknell Forest Borough Council
 Brighton & Hove Council
 Bristol City Council
 British Gypsum Ltd, Leicestershire
 British Salt Ltd, Cheshire
 British Sugar, Peterborough
 Brunner Mond, Cheshire
 Buro Happold
 Bury Health Care NHS Trust
 Caledonian Paper Plc
 Canataxx Energy Ventures Ltd, Kent
 Capita Property Services Ltd, Worcestershire
 Cargill Plc, Essex
 CCH Consulting, Stockport
 Centrica, Middlesex
 Centrica Energy Management Group, Slough
 Chemicals Industries Association, London
 CHPA, London
 Coca Cola and Schweppes Beverages Ltd
 Combined Power Systems Ltd, Salford
 Confederation House, Wakefield
 Confederation of UK Coal Producers
 Conoco Global Power, London
 Corporation of London
 Corus (formerly British Steel)
 Cryovac UK Ltd, Cambridgeshire
 Dalkia, Middlesex
 Deane Building Design Group, Somerset
 East Cheshire NHS Trust
 Electricity Association, London
 Energy Management Services
 Energy Saving Trust, London
 Enron, London
 Enviro Energy, Nottingham
 Estates Business Agency, Coventry
 Exxon Chemicals Olefins Inc., Fife
 Fellside Heat and Power Ltd, Cumbria
 Fine Organics, Middlesbrough
 Fine Organics
 Glaxo Wellcome, Kent
 Greenpeace, London
 GTC Consultants, West Yorkshire
 Health Care Solutions
 Hoare Lea & Partners, Bristol
 Huntsman ICI Petrochemicals (UK) Ltd
 ICI, London
 ICI Chemicals & Polymers Ltd, Cheshire
 Imerys Minerals Ltd, Cornwall
 Independent Energy UK Ltd, Solihull
 Institute of Civil Engineers, London
 Intergen, Edinburgh
 Jaguar Cars Ltd, Coventry
 James Cropper PLC, Cumbria
 Kemira Agro UK Ltd, Chester
 Kodak Ltd, Harrow
 Kvaerner Oil and Gas, Surrey
 Lean Gate Building, Nottingham
 Lothian and Borders Police, Edinburgh
 Lucas Aerospace
 Major Energy Users Council, Devon
 McLellan and Partners, Surrey
 National Power Cogen, Birmingham
 New Cheshire Salt Works Ltd, Cheshire
 NIFES, Glasgow
 Northern Electric, Tyne
 Orchard Partners, London
 PB Power, Manchester
 Plymouth Community Services
 PowerGen CHP Ltd, Coventry
 Powerminsters Limited, Sheffield

RJB Mining (UK), Doncaster
Rolls Royce, Derby
Royal & Sun Alliance, Manchester
RSPB, Bedfordshire
Safeway Stores, Hayes
Scottish and Southern, Perth
Scottish Energy Efficiency Office, Glasgow
Sheffield Heat and Power Ltd
Shell Gas Direct Ltd, London
Shell UK Oil Products Ltd, S. Wirral
Shotton Paper Company PLC, Deeside
Slough Heat and Power Limited
South West Water, Exeter
Southwark Housing, London
Sullom Voe Terminal, Shetland
Sutton Community Leisure Ltd, Surrey
Symonds Power Group, Nottinghamshire
Tanaris Energy Ltd, Buckinghamshire
Thames Water, Reading
The Paper Federation, Swindon
The Salt Manufacturers Association, Manchester

The Scotch Whisky Association, Edinburgh
The University of Birmingham
Thermodyne, Wiltshire
TXU Europe, London
Unilever Research, Port Sunlight
United Hospitals, Antrim
Urenco Ltd, Chester
Utilicom, West Sussex
Vale Royal Borough Council, Cheshire
Vauxhall
Viridian Power, Garforth
Viterra, West Yorkshire
Volvo Aero Turbines UK Ltd, Coventry
Wartsila NSD UK Ltd, Cheshire
Waterman Gore, London
Watford Council
Welsh Health Estates
Whitbread Plc, London
William Grant & Sons
Zeneca, Huddersfield

ANNEX D

CHPQA Form F1 (request for CHPQA application pack)

Applicants should see paras 3.3 to 3.5 on applying to CHPQA before completing this form.

Do NOT
write in
margin,
for office
use only.



Quality Assurance for Combined Heat & Power Form F1 – Request for CHPQA Application Pack

1. Please return the completed form to The Administrator, CHPQA programme, ETSU, Harwell, Didcot, Oxfordshire OX11 0QJ.
2. Information in this form will be stored electronically and will be used only by the Government or its agents for the sole purpose of the CHPQA programme, including the collection and collation of national statistics. This information will be treated in the strictest commercial confidence.
3. This form will have to be re-submitted only if the details in section 1 or 2 change.

1. SCHEME LOCATION DETAILS

Site Name		Site reference [Office use only]
Company Name		
Address		
Town		
County		Postcode:

2. NOMINATED RESPONSIBLE PERSON

Enter details of the person who is the nominated responsible person for energy management of the above scheme, to whom the application pack should be sent. All future communication will be with this person.

Organisation Name		
Contact Name	Position held:	
Address		
Town		
County		Postcode:
Telephone No.		Fax No:
Email		

Further information on the CHPQA programme, including the Government's decisions following the consultation on CHPQA and detailed Guidance on applying to the programme, can be obtained from the Energy and Environment Helpline (0800 585794) or from the CHPQA website: www.chpqa.com

I confirm that to the best of my knowledge I am the only person requesting a CHPQA Application Pack for the above scheme and that all details in this form are correct. I confirm I shall inform the CHPQA programme should any of the above details change.

Signature _____ Date _____
Name _____ (block capitals) Position held _____
Company _____ Telephone No. _____
Address _____

The CHPQA programme is carried out on behalf of the Department of the Environment, Transport and the Regions, in consultation with the Scottish Executive, The National Assembly for Wales and the Northern Ireland Department of Enterprise, Trade and Investment.