Commission for Energy Regulation
An Coimisiún um Rialáil Fuinnimh

Certification Process for High Efficiency CHP
Consultation Paper

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Commission for Energy Regulation
An Coimisiún um Rialáil Fuinnimh

The Commission for Energy Regulation,
The Exchange,
Belgard Square North,
Tallaght,
Dublin 24.

www.cer.ie

CER – Information Page

Abstract:

This paper sets out the CER's proposed approach to certifying high efficiency CHP, in accordance with the Electricity Regulation Act, 1999, as amended.

Target Audience:

Operators of CHP generators and interested parties

Related Documents:

- S.I. No. 499 of 2009
- S.I. No. 299 of 2009
- S.I. No. 298 of 2009
- Decision 2008/952/EC
- Decision 2007/74/EC
- Energy (Miscellaneous Provisions) Act, 2006
- Directive 2004/8/EC

Responses to this consultation should be returned by email, post or fax and marked for the attention of James Mc Sherry at the Commission by **17.00 on Monday, December 12th 2011.**

The Commission intends to publish all submissions received. Respondents who do not wish part of their submission to be published should mark this area clearly and separately or enclose it in an Appendix, stating the rationale for not publishing this part of their comments.

1 Executive Summary

The CER has been appointed under the relevant legislation to certify high efficiency CHP ("HE CHP"). Accordingly the CER wishes to put in place a standardised process for applications from generators to be certified as HE CHP. This process involves the initial application for existing and new plants that have not been certified previously, the annual recertification of those plants previously certified and an auditing regime to ensure the robustness of the certification process.

The certification process for CHP is designed to collect robust, reliable operational data and information in order to calculate key indicators of CHP plant operation including efficiency. HE CHP is defined on the basis of primary energy savings (PES). The legislation requires that the overall efficiency exceeds a defined threshold of 75% (or 80% for 'Combined cycle gas turbines with heat recovery' and 'Steam condensing extraction turbines-based plants'). Where this threshold is not met the PES is calculated on the basis of 'electricity from high efficiency CHP'.

The focus of the Directive is to establish a common methodology for the evaluation of CHP as HE CHP based on an economically justifiable demand for heat – i.e. useful heat. Whether or not the heat produced by the unit can be defined as useful heat is a key consideration in the certification process. Therefore, applicants will be required to provide full details of heat demands supplied and to provide evidence of their economic justification in that regard. Two alternative approaches to implementing the definition of 'useful heat' are set out in this paper for consideration.

It is proposed that applicants requesting an initial certification will be processed on request and certified based on available data (actual or projected data). All HE CHP units will then be reassessed each year based on operational data (where available) for the previous calendar year. Generators wishing recertification will be required to submit a completed application form by the 31st January each year. Generators meeting the criteria will be issued with a new certificate by the end of March of the same year. Generators who, having been certified, subsequently fail to meet the criteria and consequently are not issued with a certificate for a given year will no longer be considered HE CHP. Such a generator may apply for certification again in January of the following year and will be considered HE CHP once again if the criteria are met for that year based on the operational data.

An annual audit will be also carried out each year, selection of the generators to be audited will vary from year to year. However, it is expected that large generators will be audited regularly (perhaps every year), smaller generators will be randomly selected and some generators will be specifically selected to verify anomalous, inconsistent or noteworthy applications. Should discrepancies be found between a generator's application and the results of the audit the CER reserves the right to revoke the current certification and to apply more rigorous scrutiny to any subsequent applications for certification.

As outlined in this paper, applicants will be required to provide:

- details of plant specification;
- demonstration of useful heat demand and that this demand is economically justifiable;
- details of measurement and metering arrangements;
- operational data for reporting period (one year in general); and
- calculated parameters.

The reliability and quality of operational data measurements is essential to establishing a robust and non-discriminatory HE CHP certification scheme. The measurement methods used must therefore conform to transparent and objective accuracy and reliability criteria. Details of certification, calibration and accuracy of measurement methods must be provided.

Calculations of efficiency and other key operational parameters are carried out according to methods prescribed in the Act, the Directive and supporting documentation. The principal calculations are:

- electrical, thermal and overall efficiency (all on a NCV[1] basis);
- power to heat ratio;
- electricity from HE CHP; and
- the primary energy savings.

Applicants will be required to submit all relevant information to substantiate and support their application and to demonstrate qualification as HE CHP. The CER may require additional information from the applicant in order to certify the unit as HE CHP.

[1] NCV: Net Calorific Value

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2 Introduction

2.1 The Commission for Energy Regulation

The Commission for Energy Regulation ('the CER') is the independent body responsible for overseeing the regulation of Ireland's electricity and gas sectors. The CER was initially established and granted regulatory powers over the electricity market under the Electricity Regulation Act, 1999. The enactment of the Gas (Interim) (Regulation) Act, 2002 expanded the CER's jurisdiction to include the regulation of the natural gas market, while the Energy (Miscellaneous Provisions) Act 2006 granted the CER additional powers in relation to gas and electricity safety. The Electricity Regulation Amendment (SEM) Act 2007 outlined the CER's functions in relation to the Single Electricity Market (SEM) for the island of Ireland. This market is regulated by the CER and the Northern Ireland Authority for Utility Regulation. The Petroleum (Exploration and Extraction) Safety Act 2010 provides the CER with responsibility to regulate the activities of petroleum undertakings with respect to safety. The CER is working to ensure that consumers benefit from regulation and the introduction of competition in the energy sector.

2.2 Purpose of this Paper

The purpose of this paper is to seek the view of the public and relevant stakeholders on the CER's approach to the certification of High Efficiency CHP (HE CHP)**.** The CER considers that there are two principal areas that must be examined regarding the certification of HE CHP in the context of the CER's duties as certifier of HE CHP as outlined in legislation.

The first of these is the CER's assessment of the heat demand outlined to be served as useful heat within the meaning of the Directive and relevant Irish legislation. In order for the CER to certify that a given heat load is useful heat within the definition of the Directive and relevant Irish legislation, the CER must be satisfied that the heating/cooling demand does not exceed that which would otherwise be satisfied at market conditions by energy generation processes other than cogeneration. The CER notes at the outset that the onus is on the applicant to prove to the CER that the heat is useful heat. In examining the question of useful heat the CER is mindful of the need to meet the legislative requirements whilst also putting in place processes and procedures that are proportionate, appropriate and pragmatic to address the matter in hand. To that end, the CER sets out what it proposes in relation to the assessment of useful heat in this document.

Secondly, the CER must put in place a calculation process for certifying the plant as HE CHP based around the principles of determining PES, the power to heat ratio and determination of electricity from HE CHP using the methodology as laid out in the Act, the Directive and associated decisions.

The CER notes that this issue is a complex and detailed one and encourages responses on all matters set out in this paper, including the above two key issues, to inform the CER's decision on HE CHP certification.

2.3 Background Information

Under S.I. No. 499 of 2009 the CER is required to certify HE CHP and the system operator is required to give such generation priority when dispatching the system. Therefore, the CER must now put in place a certification process.

2.4 Legislative Background

There are several pieces of legislation relating to the CER's role in certifying HE CHP. These are:

- Directive 2004/8/EC;
- Decision 2008/952/EC;
- Decision 2007/74/EC;
- Section 7 of the Electricity Regulation Act, 1999, as amended by Section 6 of (Miscellaneous Provisions) Act, 2006;
- S.I. No. 298 of 2009;
- S.I. No. 299 of 2009; and
- S.I. No. 499 of 2009.

Directive 2004/8/EC was transposed into Irish legislation by Section 6 of the Energy (Miscellaneous Provisions) Act 2006 which inserts Section 7 into the Electricity Regulation Act, 1999. S.I. No. 298 of 2009 commences section 6 of the Energy (Miscellaneous Provisions) Act 2006. S.I. No. 299 of 2009 appoints the CER to calculate and certify the actual power-to-heat ratios of the cogeneration technologies specified in Annex 1 to Directive 2004/8/EC. This appointment was made by the Minister in the exercise of the powers conferred on him by Section 7(2) of the Electricity Regulation Act, 1999.

S.I. No. 499 of 2009 has the purpose of giving effect to Article 8(1) of the Directive and provides that where the CER calculates and certifies the actual power-to-heat ratios the CER shall also calculate the relative amount of primary energy savings ("PES") for that CHP unit in accordance with section 7 of the Act. Based on this calculation the CER must include a statement in the certificate as to whether the CHP unit is high efficiency. In S.I. No. 499 of 2009 "certificate" is defined as "a certificate certified by the Commission appointed under, to calculate actual power to heat ratios as specified in, the Electricity Regulation Act 1999 (Appointment of Person to Calculate Power to Heat Ratios of Combined Heat and Power Units) Order 2009 (S.I. No. 299 of 2009)". A copy of this Certificate (or any amendment) must be provided to the transmission system operator (TSO). Where the TSO receives such a certificate the TSO must give priority dispatch to high efficiency CHP (HE CHP) insofar as the operation of the transmission system permits. This gives effect to Article 8(1) of the Directive as Article 8(1) refers to priority dispatch provisions elsewhere in EU law[2].

Therefore it can be seen that the CER has the duty to certify the actual power to heat ratios, and calculate the relative amount of primary energy savings of HE CHP units. And to ensure compliance with Article 8(1) of the Directive must provide the TSO with the HE CHP certificates. The TSO must give these units priority dispatch.

2.5 Structure of this Paper

This section, Section 2, provides background information. Section 3 outlines potential approaches with regard to useful heat and information requirements in that regard, whilst Section 4 outlines the calculation methodology for applicants. Section 5 outlines the information requirements in the context of the calculation methodology. Section 6 outlines the proposed application process. Section 7 sets out the proposed approach to the auditing regime. The conclusion and next steps are set out in Section 8.

2.6 Responding to this Paper

Comments are requested from interested parties on the matters raised in this paper, specifically the CER's proposals. Comments on this paper should be submitted, preferably in electronic format, by **17.00 on Monday, December 12th, 2011** to James Mc Sherry (jmcsherry@cer.ie).

2 Article 8(1) of the Directive: "For the purpose of ensuring the transmission and distribution of electricity produced from high-efficiency cogeneration the provisions of Article 7(1), (2) and (5) of Directive 2001/77/EC as well as the relevant provisions of Directive 2003/54/EC shall apply"

Please note that the CER intends to publish all responses. Therefore confidential responses should be clearly marked as such and where possible placed in a separate annex to the response. For further information on the issues set out in this paper please contact:

James Mc Sherry
Renewables
Commission for Energy Regulation
The Exchange
Belgard Square North
Tallaght
Dublin 24

E-Mail: jmcsherry@cer.ie
Tel: +353 1 4000 800

3 Useful Heat

3.1 Useful Heat Introduction

There are two principal areas that the CER considers must be addressed when processing an application for certification as HE CHP in the context of its duties as outlined in legislation. This first of these, the question of what qualifies as 'useful heat' is examined in this section. The second, which involves an examination of the technical data provided by the applicant and requirements around same and is outlined in sections 4 and 5.

In order for the CER to certify that a given heat load is useful heat within the definition of the Directive and relevant Irish legislation, the CER must be satisfied that the heating/cooling demand does not exceed that which would otherwise be satisfied at market conditions by energy generation processes other than cogeneration. The CER proposes that this requires an assessment by the CER of information provided by the applicant (section 3.4). The CER notes at the outset in this context that the onus is on the applicant to prove to the CER that the heat is useful heat.

The useful heat question is both complex and key and the CER encourages comments from interested parties on this issue. Two potential approaches to this issue in the context of legal requirements are set out in section 3.3 below and the CER welcomes comments on these approaches and others from responding parties.

3.2 Useful Heat Overview

Useful heat is defined in the legislation as:

> *'useful heat' means heat produced in a cogeneration process to satisfy an economically justifiable demand for heat or cooling'.*
>
> *'economically justifiable demand' means the demand that does not exceed the needs for heat or cooling and which would otherwise be satisfied at market conditions by energy generation processes other than cogeneration.*

The EU Commission Decision (2008/952/EC) establishing guidelines for the implementation and application of Annex II to the Directive provides the following examples of useful heat:

> *'heat that is used for process heating or space heating and/or delivered for subsequent cooling purposes; heat delivered to district heating/cooling networks; exhaust gases from a cogeneration process that are used for direct heating and drying purposes'*

The following examples of heat other than useful heat are given:

> *'heat rejected to the environment without any beneficial use; heat lost from chimneys or exhausts; heat rejected in equipment such as condensers or heat-dump radiators; heat used internally for de-aeration, condensate heating, make-up water and boiler feed-water heating used in the operation of boilers within the boundaries of the cogeneration unit, such as heat recovery boilers.'*

Heat rejected without beneficial use is further defined as including '*non-economically justifiable demanded*' heat produced by the co-generation unit.

All of the above is in the context of increasing energy efficiency and improving security of supply as set out in Article 1 of the Directive.

3.3 Classification of Useful Heat

Having considered the governing legislation the CER considers that useful heat is heat (or cooling) that exists or would exist in the absence of a CHP plant and which would otherwise be met by alternative energy generation processes at market conditions. The intention of the Directive is that an existing need for heat generation is displaced by the more efficient HE CHP process. The CER therefore considers it necessary and appropriate that applicants must be able to demonstrate that the heat demand is indeed useful heat and that the process requiring heat is required independent of a CHP generator.

The CER outlines two alternative potential approaches below regarding the classification of useful heat and acknowledges there may be other approaches that meet legal requirements in this regard. The CER welcomes comments and suggestions on the approaches set out below to the classification of useful heat and any other potential approaches regarding this complex issue.

Approach 1: All Economically Justified Heat is Considered Useful Heat

Under this approach applicants would have to demonstrate to the CER that the heat demand is economically justifiable and would otherwise, i.e. in the absence of the CHP unit proposed, be met at market conditions. This would have to be shown to the satisfaction of the CER fulfilling the requirements ultimately required under a decision arising from this consultation process. For the purpose of this discussion, the requirements set out in relation to the above in section 3.4 below would need to be fulfilled to the satisfaction of the CER.

Once the CER was satisfied that the relevant heat demand is economically justifiable as above, all heat produced by the CHP unit would then be eligible for assessment as useful heat. This would include any heat which is re-cycled back into the CHP unit itself. This approach could be read as consistent with the requirements under the governing legislation and associated EU decisions and guidelines as one interpretation of these is that there is nothing in these documents to support the exclusion of recycled heat from being considered as eligible for assessment as useful heat and that to do so would go beyond what is required of the CER. This approach would appear to be supported by the approach being adopted by the authorities in the U.K. regarding 'good quality CHP' under the CHP Quality Assurance Programme.[3]

For the sake of clarity, under this approach, electricity associated with this re-cycled heat would be considered for certification as HE CHP electricity.

Approach 2: Re-Cycled Heat is not Considered Useful Heat

Under this approach, as with the previous one , applicants would have to demonstrate to the CER that the heat demand is economically justifiable and would otherwise, i.e. in the absence of the CHP unit proposed, be met at market conditions. This would have to be shown to the satisfaction of the CER fulfilling the requirements ultimately required under a decision arising from this consultation process. For the purpose of this discussion, the requirements set out in relation to the above in section 3.4 below would need to be fulfilled to the satisfaction of the CER.

Under this approach any heat output from the CHP unit that is recycled back into the CHP unit, whether through internal processes or through the processing of fuel required by the unit would not be considered useful heat. It is considered that this approach could also be seen as consistent with the EU Commission Decision 2008/952/EC, notably with Annex 5.7 and 5.8. and with section II (2.) which describes the cogeneration system boundaries and the consumer area in that context.

[3] Ref: http://chp.decc.gov.uk/cms/faq/?phpMyAdmin=ff232c1d3b302ac6e951f554eeeaefdf

For clarity, under this approach in the event that the heat load in question, or part of that heat load, is linked to an operation associated with fuel re-used in the CHP plant itself, such as fuel processing, fuel drying or conversion technologies for biomass (anaerobic digestion, pyrolysis, gasification), the heat load associated with the re-used fuel would not be considered "useful heat". The remaining heat load could be considered "useful heat" provided it can be demonstrated as such in accordance with this paper. Here, the proportion of the heat load not recycled back into the CHP unit itself would be metered separately or determined in proportion to the relative amounts of fuel used in the CHP unit and used elsewhere.

If such a heat demand were to be considered useful heat for the purposes of certification this approach proposes it could create a self-reinforcing calculation where the applicant would be incentivised to increase electricity production due to the fact that the heat demand is a function of electricity generation. It may be argued such a state of affairs would be contrary to the purpose of the Directive as stated in Article 1 thereof and may lead to the creation of heat demands for the purpose of gaining the benefits certification as HE CHP confers.

The CER welcomes views on the key question of useful heat, the above approaches, and on any alternative approaches to the useful heat question considered appropriate in the context of the governing legislation.

3.4 Required Information for Assessing Useful Heat

The CER is required under legislation to assess that the heat demand is 'economically justifiable' and acknowledges that this has the potential to be a difficult and detailed task. On the face of it, the requirements in this regard mean that the CER must vet detailed business plans and associated documentation for each applicant in relation the alternative (to CHP) means of meeting the heat demand in order to be satisfied that it would proceed to construction at market conditions. The proposed approach set out below is one that seeks to meet the requirements of the legislation in an appropriate manner that allows for an appropriate level of assessment by the CER whilst seeking to provide applicants with sufficient guidance as to the nature of the information that is required. The CER sees the challenges with this proposed approach for an energy regulator but, having considered this issue, does not see an alternative approach other than examination of detailed business plans and associated information on a case by case basis. In addition, the CER acknowledges that applying the proposed approach set out here regarding existing operational sites with existing heat loads is potentially easier than for a planned CHP plant and associated heat load.

In this context, the CER considers that it must put in place a framework that will facilitate this by:

a) enabling the CER to appropriately assess the validity of the alternative[4] (to cogeneration) heat generation process presented by the applicant at market conditions;

b) allowing the CER to be satisfied that in the absence of CHP, the business using the alternative means of meeting the heat demand would proceed at market conditions, and;

c) providing the CER with general information regarding the CHP unit that is or is proposed to be installed.

For clarity, the CER interprets the term 'at market conditions' to mean market conditions in the absence of support/subsidy.

The CER's proposals for what is required in respect of each of the above criteria is outlined further below. The CER may request information which is additional to that proposed below if it deems such information is required to adequately complete its assessment of the useful heat application made by the applicant. Parties which have been granted HE CHP certification before a decision following this consultation has issued will have to be re-assessed under the final framework set out in the relevant decision. The CER welcomes respondent's comments on this proposed approach and on the nature of the information from applicants as proposed below.

Criteria (a): Validity of the Alternative

In order to demonstrate the validity of the alternative heat generation process it is proposed applicants must provide:

- a catalogue of heat loads claimed as useful heat, quantify the heat loads in the entire process, and provide confirmation that the heat demand intended to be met by the CHP process does not exceed the demand outlined for the alternative heat generation process;
- costings at market conditions for the alternative heat generation process, including relevant capital costs for the unit, annualised capital costs, rates of return and operating costs. The basis for all costings should be provided;
- quantity and cost of fuel to supply the useful heat demand at relevant market conditions[5]; and
- Where there is more than one viable alternative, the required information on such additional alternatives should also be provided.

[4] Please note that more than one alternative can be provided here.
[5] The value of the processed fuel should be comprehensively established indicating the current market in terms of market size and average price. References to price indices, market studies or other objective information on markets and prices should be included.

Where the useful heat demand claimed relates to the processing of fuel, a proportion of which is used/proposed to be used in the CHP plant, the following must be provided for the alternative (to CHP) heat generation process as appropriate:

- quantify the amount of fuel produced or treated by the process and the quantity not re-used/recycled and the heat demand associated with processing fuel that is not re-used/recycled;
- added value of fuel generated or treated by the process at market conditions and the basis for this added value;
- avoided cost of disposal of feedstock (including processing requirements) or value of feedstock at market conditions as appropriate; and
- detail the counterfactual route for use, processing, or disposal of the feedstock (e.g. landfilling, land spreading) and associated costs or revenues and the basis for these costs/revenues;
- Where there is more than one viable alternative, such additional alternatives should be demonstrated.

It is proposed that the catalogue of useful heat demands referred to above which may be claimed shall include the following information:

- *For industrial processes* (i.e. heat demands other than space heating/cooling and hot water):
    - the annual volume of production of products whose production process uses the heat;
    - the exact consumption of heat in the various stages of that production process and temperature at which heat is required;
    - reference to industry standards detailing benchmark or normal heat demands (e.g. BAT Reference Notes[6]);
    - details on historic heat demands and fuel and heat supply for existing processes; and
    - where the useful heat is used in conjunction with an absorption chiller to provide a cooling load, the above information should be provided for the cooling load together with details of the absorption chiller (rated capacity, output, range of operating temperatures).
- *For commercial applications* (i.e. supplying space heating/cooling and hot water):
    - nature and use of premises (e.g. hotel, office, retail etc);
    - floor area, year of construction;
    - reference to benchmark data on typical heat loads (e.g. CIBSE Guide F); and

[6] BAT reference notes for a range of industrial processes are available - http://eippcb.jrc.es/reference/

  - where the useful heat is used in conjunction with an absorption chiller to provide a cooling load, the above information should be provided for the cooling load together with details of the absorption chiller (rated capacity, output, range of operating temperatures).
- *For district heating applications*:
  - nature of end uses;
  - method of metering and billing of end users. Details of heat metering system and data collection system used;
  - demonstration that the cost of heat supplied is comparable to the cost of heat provided by alternative fuels or processes at market conditions;
  - confirmation that the CHP plant operator does not have or share a commercial interest with any of the heat customers or procure goods or services from any of the heat customers, and;
  - for existing systems records of total heat delivered to the district heating scheme and billing to end users.

Criteria (b): Business Information Regarding the Alternative to CHP

For cases where the heat demand is already being served by means other than CHP, it is proposed that applicants submit information regarding the current means by which the heat demand is being served. In such cases, CER proposes that evidence is provided to the CER that a heat load exists and that the heat load is being met by a heat generation process as part of an economically viable business.

Where the heat demand identified is not currently being served by the applicant as above, the CER proposes that a business case for the business using the alternative heat generation process should be submitted. This should include key information on capital costs, operating costs, rate(s) of return for the business at market conditions and an overview of market conditions for the product. The applicant should clearly demonstrate why, based on the information presented to the CER, the business is considered economically justified using the alternative(s) heat generation process. The CER reserves the right to request further information in this regard if it deems necessary.

For clarity, the information above and CER assessment of the alternative (to CHP) business case in that regard is also required for applicants which are, at the time of application, meeting their heat loads with CHP as part of their business.

The CER wishes to ensure that the business case presented to it for the business using the alternative heat generation process is reasonable and premised on assumptions at market conditions. Where there are clear, comparable examples of similar businesses using heat generation processes which are analogous to that which would serve the applicant in the absence of CHP, examples of same should be provided where possible. The CER notes that this will inevitably result in detailed examination of information provided by applicants on a case by case basis.

The CER has attempted to compile an approach to this issue that is appropriate, proportionate to the issue in hand given the CER's role in this regard under the legislation and is also as pragmatic as possible. Recognising the challenges posed by this approach, the CER seeks comments on it and suggestions regarding alternative approaches that would meet legal requirements.

Criteria (c) General Information

The CER will require general information relating to the CHP unit which is proposed to be constructed and the useful heat load to be served in that context.

A process flow diagram or piping schematic indicating the CHP plant and the heat loads claimed as useful heat demands should be provided. This should include any other heat supply (e.g. boilers), an indication of the boundary around the CHP plant, supply to useful heat end uses and location of heat metering. Where heat is provided by extraction steam the process flow diagram should indicate points of extraction and pressure and temperature.

The CER welcomes views on the above and on alternative approaches to the issue in hand that would meet the requirements under the governing legislation and would be both robust and proportionate whilst supporting objective assessment.

4 Calculation Methodology

4.1 Introduction

This section deals with the calculation methodology based around the principles of determining PES, the power to heat ratio and determination of electricity from HE CHP as laid out in the Act, the Directive and associated decisions. The principal results of the calculation methodology will be:

- Power to Heat Ratio
- Primary energy savings
- Determination of HE CHP electricity as per Schedule 3 of the Act.

The calculation methodology will derive the following calculated parameters:

- Electrical efficiency;
- Heat efficiency;
- Overall efficiency;
- Power to heat ratio;
- High efficiency CHP electricity generated; and

Primary energy savings (PESThe certification process for HE CHP is designed to collect robust and reliable operational data and information required to calculate efficiency and other key indicators of HE CHP plant operation. The certification process will address the requirements for certification and the CER's obligations as provided for in Irish legislation

In the first instance, applicants will have to demonstrate to the CER that the heat demand is 'useful heat', as defined in Directive 2004/8/EC and outlined in section 3. above.

The calculation methodology and the technical parameters determining qualification as HE CHP is based on those defined in legislation. Qualification or otherwise is determined primarily on the basis of overall efficiency and primary energy savings.

Applicants for certification as HE CHP will be required to:

- complete and submit the relevant application forms and provide the required operational and supporting data;

- maintain operational records and where appropriate install metering and measurement systems;

- provide full access to operational data; and

- provide access and facilitate inspection of plant and records by auditors appointed by the CER.

Where units have not yet been commissioned and for units which do not have actual operational data, evaluation of applications will be based on the design and operational information submitted by applicants in the first instance. Audits of certified HE CHP installations will be carried out by the CER or bodies appointed by the CER. Certification may be revoked should audits reveal inaccuracies in submitted applications.

An overview of the application, evaluation and auditing process is shown in Figure 1 below.

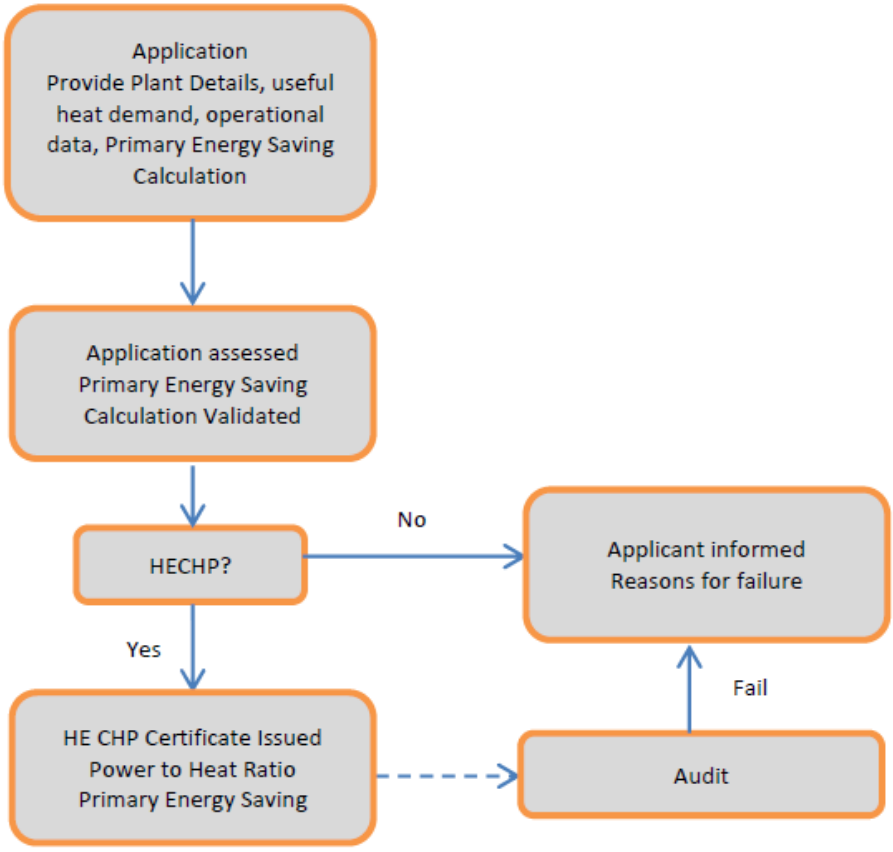

Figure 1 – Overview of Process

4.2 Definition of High Efficiency CHP (HE CHP)

The Act defines HE CHP as follows:

'high efficiency combined heat and power' means combined heat and power production which on an annual basis—

(*a*) in the case of small scale combined heat and power and micro-combined heat and power, achieves primary energy savings calculated in accordance with paragraphs 3 and 4 of Schedule 3, and

(*b*) in the case of all other combined heat and power, achieves primary energy savings calculated in accordance with paragraphs 3 and 4 of Schedule 3 of at least 10 per cent compared with the references for separate production of heat and electricity;

HE CHP is defined on the basis of primary energy savings (PES). The legislation requires that the overall efficiency exceeds a defined threshold of 75% (or 80% for 'Combined cycle gas turbines with heat recovery' and 'Steam condensing extraction turbines-based plants'). Where this threshold is not met the PES is calculated on the basis of 'electricity from high efficiency CHP'.

PES is a function of the heat efficiency and the electrical efficiency of the process relative to the reference values for separate heat and electricity production. Key to this equation is the amount of heat that can be defined as 'useful heat'. The following section discusses each component of the calculation and parameters in detail.

4.3 Overall Efficiency

Overall efficiency is calculated as the ratio of energy outputs (electricity, mechanical energy and useful heat) to fuel input, both measured over the same defined reporting period.

$$Overall\ Efficiency = \frac{Electricity + Mechanical\ Energy + Useful\ Heat}{Fuel\ Input}$$

If the overall efficiency is above the thresholds set in Annex II of the Directive all the measured electrical and useful heat output is taken into account when calculating the PES and determining qualification and HE CHP. The thresholds are:

- 80% for 'Combined cycle gas turbines with heat recovery' and 'Steam condensing extraction turbines-based plants', and
- 75% for the other types of CHP units,

If the overall efficiency does not meet the above criteria, the CHP and the non-CHP electricity outputs will have to be determined. This requires the output of the power to heat ratio calculation. It should be noted that the power to heat ratio will be calculated in every case but the output of the calculation will only be used where overall efficiency of below the above thresholds.

4.4 Power to Heat Ratio

The actual power to heat ratio is determined based on the measured actual heat and electricity outputs when the plant is operating in 'full CHP mode' i.e. when the useful heat output is maximised. The plant operator shall measure and record the electricity and useful heat outputs during periods of operation with no heat rejection and with maximum heat output. A test report detailing the test process and measurements should be provided as an attachment to the application form. The actual power to heat ratio (C_{actual}) is then determined as:

$$Actual\ Power\ to\ Heat\ Ratio\ (C_{Actual}) = \frac{Electricity\ Output\ measured\ in\ HECHP\ Mode}{Useful\ Heat\ measured\ in\ HECHP\ Mode}$$

For CHP plant with no dump load facility and without the capacity to operate in condensing mode or otherwise alter the power to heat ratio, the actual power to heat ratio will be the ratio of annual electricity generated to useful heat. CHP plant which seeks certification on the basis of design data prior to operation should submit the design power to heat ratio (C_{design}) in full CHP mode.

The electricity from high efficiency CHP, subject to meeting the PES criterion, is then:

$$E_{CHP} = C_{Actual} \times H_{CHP}$$

Where:

- E_{CHP} is the amount of electricity form cogeneration
- C_{actual} is the power to heat ratio

- H_{CHP} is the amount of useful heat from cogeneration (calculated for this purpose as total heat production minus any heat produced in separate boilers or by live steam extraction from the steam generator before the turbine.

If the actual power to heat ratio of the cogeneration unit is not known, the plant operator can use the default power to heat ratio, as specified in Annex II of the Directive to calculate CHP electricity. In that case however, the operator must submit the reasons for not having a known actual power to heat ratio, the period for which data are lacking and the measures taken to remedy the situation.

4.5 Non-CHP Fuel

In order to calculate the PES for the CHP electricity, the non-CHP fuel must be calculated and deducted from the total fuel to determine the 'fuel input used to produce the sum of useful heat output and electricity from CHP'.

This is calculated as the amount of non-CHP electricity divided by 'the plant specific efficiency value for electricity production'.

The means of calculating the 'the plant specific efficiency value for electricity production' is not prescribed in the guidelines on the implementation of Annex II (2008/952/EC). However, the approach taken in the DG TREN report[7] published in 2007 is to calculate the efficiency on the basis of production at maximum electrical output, and is consistent with 2008/952/EC. Accordingly, that is:

$$Efficiency\ Electricity\ Production = \frac{Electricity\ output\ (\ electricity\ generation\ mode)}{Fuel\ input\ (electricity\ generation\ mode)}$$

For CHP plants without power loss the plant specific efficiency for electricity generation is the same as the electrical efficiency. For CHP plant with power loss and for which the electrical efficiency varies according to the heat generation, the plant specific efficiency for electricity production should be determined by operation of the plant at maximum electrical output or by the determination of the power loss coefficient. A test report detailing the measurements and calculations determining the plant specific efficiency for electricity production should be provided as an attachment to the application.

The non-CHP fuel is then:

$$non-CHP\ Fuel = \frac{E_{total} - E_{CHP}}{Efficiency\ for\ Electricity\ Production}$$

[7] Guidelines for Implementation of the CHP Directive 2004/8/EC: Guidelines for implementation of Annex II and Annex III - March 2007

4.6 Primary Energy Savings (PES)

As noted above the essence of the determination of HE CHP is PES. This is determined according to the following formula.

$$PES = \left(1 - \frac{1}{\frac{CHPH\eta}{refH\eta} + \frac{CHPE\eta}{refE\eta}} \right) \times 100$$

Where:

CHPHη Is the heat efficiency of the combined heat and power defined as annual useful heat output divided by the fuel input used to produce the sum of useful heat output and electricity production from combined heat and power.

refHη Is the efficiency reference value for separate heat production

CHPEη is the electrical efficiency of the combined heat and power, defined as annual electricity production from combined heat and power divided by the fuel input used to produce the sum of useful heat output and electricity production from combined heat and power.

refEη Is the efficiency reference value for separate electricity production

The reference values for the separate production of electricity and heat should be taken from the Commission Decision establishing harmonised efficiency reference values for separate production of electricity and heat (2007/74/EC) with the application of appropriate correction factors contained therein.

The electricity generated from the plant shall be deemed to be from HE CHP if the PES exceeds the prescribed thresholds:

- For CHP with a capacity < 1 MWe, PES > 0
- For CHP with a capacity ≥ 1 MWe, PES > 10%

4.6.1 Summary and Examples

The calculation methodology is summarised in Figure 2 below.

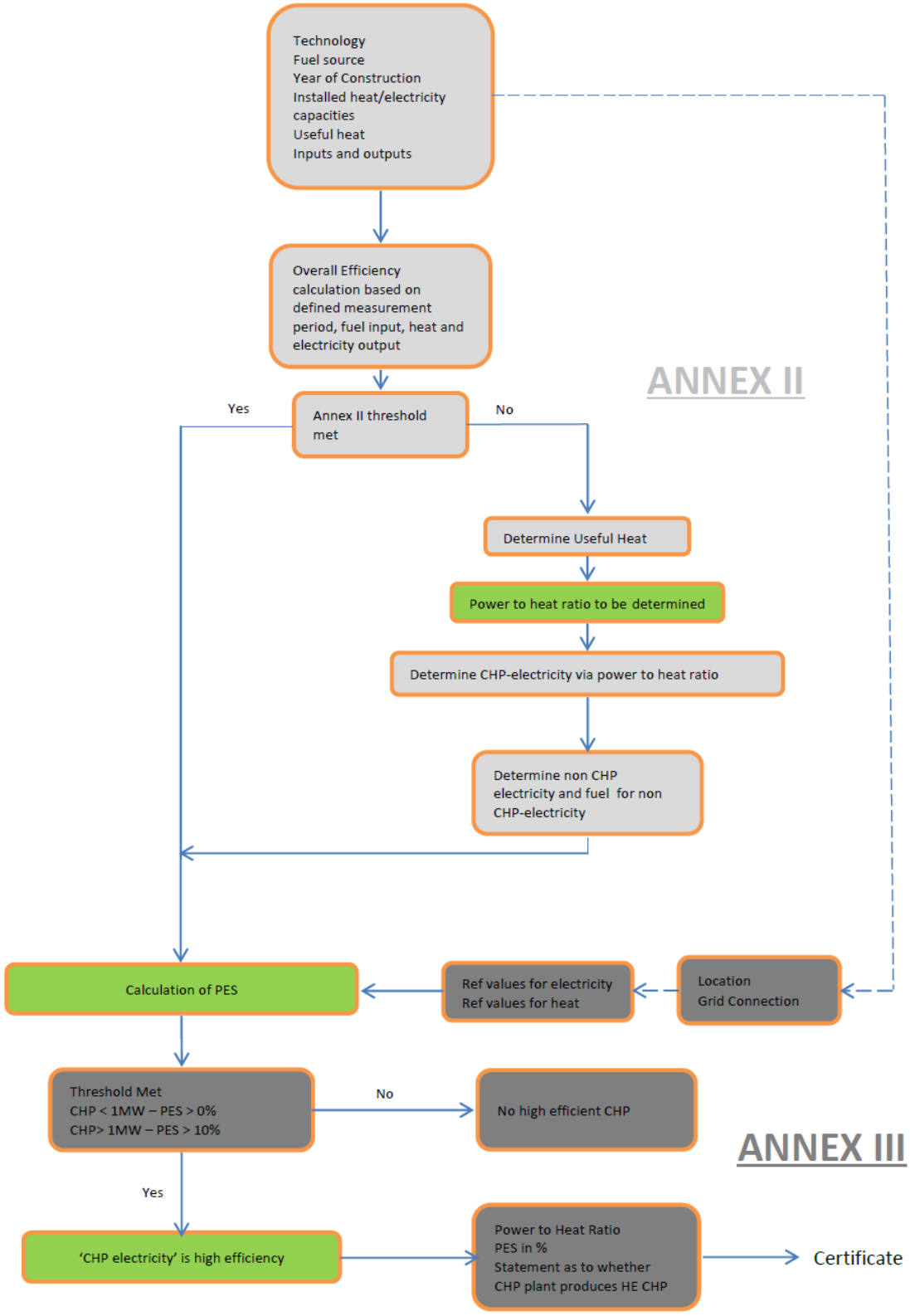

Figure 2 – Summary of Calculation Methodology

Worked examples of potential qualifying HE CHP installations are provided in Table 2 following with full details in Appendix B.

Plant	1 ICE	2 GT	3 CCGT	4 Biomass CHP	5 WTE
Design Specification					
Rated Electrical Output	900 kW	10 MW	270 MW	5 MW	20 MW
Rated Heat Output	1,000 kW	18 MW	280 MW	3 MW	15 MW
Operational Data					
Annual Electricity Generation (MWh/yr)	4,500	117,000	1,574,000	24,000	100,000
Annual Useful Heat (MWh/yr)	5,200	188,000	1,488,000	14,400	90,000
Power to Heat Ratio	0.86	0.55	0.9	0.6	0.83
Calculated Parameters					
Overall Efficiency	75%	73%	71%	35%	39.6%
High Efficiency CHP Electricity	4,500	103,400	1,339,200	8,640	75,000
% of Total Electrical Output	100%	88%	85%	36%	75%
PES	14%	12%	15%	12%	10%

Table 2 – Examples of HE CHP

The examples provided are as follows:

1. Internal combustion engine operating primarily in ‘high efficiency CHP’ mode (for example on large commercial or small industrial site)

2. Gas turbine operating primarily in ‘high efficiency CHP’ mode (for example on large industrial site)

3. Combined cycle gas turbine operating primarily in ‘high efficiency CHP’ mode (for example on large, energy intensive industrial site)

4. Biomass CHP plant operating on an industrial site or adjacent to a significant heat load

5. Waste to energy plant adjacent to a significant heat load or district heating scheme)

It is notable that in only one case, that of the internal combustion engine, does the CHP plant meet the efficiency criteria of 75%/80% for electricity production from HE CHP specified in the CHP Directive and Schedule 3 of the Electricity Act. In all other cases the electricity from high efficiency CHP must be calculated and the PES calculated on the basis of fuel used for HE CHP production. These examples are for illustrative purposes.

5 Calculation Methodology Information Requirements

5.1 Introduction

The information requirements for an application for certification as HE CHP vary depending on the scale and nature of the CHP plant and the type and nature of the useful heat load. This section deals with the proposed information requirements for the certification of the plant as HE CHP based on the calculation methodology outlined in section 4.

The Directive specifies the following three scales of CHP plant:

- Large scale: ≥ 1 MW
- Small scale: ≥ 50 kW and < 1 MW
- Micro scale: < 50 kW

Certification of both small scale and large scale CHP must be based on actual operational data taken from measured inputs and outputs collected over the reporting period. For new plants for which operational data is not available, certification can be based on expected operational values.

The Directive provides that PES and electricity generation from micro-CHP may be calculated on the basis of certified data. Certified performance data should be according to an appropriate test standard and certified by an appropriately accredited test facility.

For CHP plants that are capable of dumping heat, operating in condensing power generation mode or otherwise altering the power to heat ratio, additional information on operating parameters when operating in HE CHP mode and at maximum electrical output must be provided. This will enable the calculation of the 'actual power to heat ratio' and the plant specific electrical efficiency.

HE CHP plants will typically be certified annually on the basis of a full year's operational data. CHP plants that have been in operation for less than one year, or for which a full year's operational data is not available, may be certified on the basis of design data and available operational data. Where a full year's operational data is not available reasons for the lack of data should be provided and actions to ensure the future availability of data should be detailed. However, it should be noted that the CER may request an applicant to re-submit an application that does not include all the requested information.

CHP plants that are not yet installed or operational may be certified as HE CHP on the basis of design data. In these cases it should be noted that while a CHP plant may be certified on the basis of design data this in no way guarantees that future evaluations, based on operational data, will result in re-certification.

5.2 CHP Plant Design

The following information is required for all applicants:

- description of the CHP plant;
- primary fuel source (and secondary source where applicable);
- prime mover type, make, model and rating;
- heat loads and demonstration of economically justified useful heat demand;
- schematic diagram of CHP indicating boundaries as per Annex II of the 2008/952/EC and location of meters and measurement devices; and
- specification of measurements and recording provisions including quality of meters and calibration certificates.

5.3 Operational Data and Measurement

Operational Measurements required as per Part IIa of the draft application form are:

- Fuel input on a net calorific value (NCV) basis. Natural gas NCV should be reported as a weighted average of the gas NCV reported by Bord Gáis Networks. Oil and LPG NCVs should be on the basis of supplier's information. For solid fuels with varying moisture content and varying NCV, the moisture content and NCV should be sampled and tested and details of this testing regime provided.
- Electricity generation measured at the generator terminals both over the reporting period and over the period(s) of operation in HE CHP mode, where applicable.
- Useful heat output measured as indicated on the process flow and piping diagram both over the reporting period and over the period(s) of operation in HE CHP mode, where applicable.

  For steam boilers with condensate return, the heat content of the condensate returned may be deducted from the useful heat output. Applicants shall specify the method used to determine the rate of condensate return and record the energy content of returned condensate.

The reliability and quality of operational data measurements is essential to establishing a robust and non-discriminatory HE CHP certification scheme. The measurement methods used must therefore conform to transparent and objective accuracy and reliability criteria. In general it is expected that measuring instruments should comply with the provisions of the Measuring Instruments Directive 2004/22/EC ("MID") and the detailed requirements for meter types specified in Annex MI of the Directive. Relevant provisions are outlined in Table 1.

Measuring Instrument	**Relevant Annex to MID**
Gas meters	Annex MI-002
Active electrical energy meters	Annex MI-003
Heat meters	Annex MI-004
Measurement of quantities of liquids other than water	Annex MI-005
Exhaust gas analysers	Annex MI-010

Table 1 –Summary of Relevant Measurement Specification in the MID

The applicant should detail the make and model of the relevant meter identified, specify the class to which the meter conforms and provide relevant supporting documentation (e.g. calibration certificates, type approval certification, manufacturer's specification). Where the measurement does not conform to the relevant provisions of the MID, the plant operator shall detail relevant standards (IS, EN or ISO) to which the measurement conforms and detail the class where applicable.

For measurement of inputs and outputs not covered by the MID, the following requirements apply.

- Steam meters should have an accuracy of ± 2% of measured flow. While there is a range of methods of measuring steam flow, it is expected that the most common are differential pressure meters (orifice plate, venturi and nozzle). Meters of this type should conform to ISO 5167. Where meters of other types are used, details of meter accuracy and standards to which the meter conforms should be provided. Manufacturer's data sheets should be provided and calibration certificates should be available if requested.

- Solid fuels should be measured by scales or belt weighing machines and measurements of continuous input by mass should be correlated with delivery records. The fuel should be analysed for calorific value by external accredited laboratories at appropriate intervals. The moisture content should be analysed for each delivery/batch of fuel. This analysis may be carried out internally but should be validated by external analysis by an accredited laboratory at appropriate intervals.

- For gaseous alternative fuels (e.g. biogas), regular samples should be taken with external analysis by an accredited laboratory at appropriate intervals. Continuous gas analysis may also be carried out and the calorific value determined according to the composition of the gas. If moisture is removed before sampling and/or analysis, this must be quantified to determine the calorific value. Such analysis must be carried out and certified by an appropriately accredited body.

While it is required that certification is carried out on the basis of actual measured data (as per 2008/952/EC), it is recognised that measurements and metering arrangements should be appropriate to the scale and complexity of CHP installations.

Large scale CHP would be expected to have accurate and reliable metering of fuel usage and electricity and heat generation and applications can be based on actual metered data. It is expected that metering should be of a defined accuracy and resolution according to relevant standards and that calibration certificates or type approval certificates can be made available.

Small scale CHP is required to be provided with metering. However it is possible that this metering may be less comprehensive than that installed in large scale CHP. Although, the Directive and associated decisions do not specify required accuracy for meters it is considered that all meters and measurement devices should be calibrated, tested and capable of measuring to a reasonable level of accuracy. Applicants should provide details of the testing and calibration of metering including manufacturer's specification and other available information.

5.4 Performance Indicators

Applicants are required to calculate the principal performance parameters following. Calculation templates will be made available. The performance parameters required are:

- Electrical efficiency, thermal efficiency and overall efficiency

- Actual power to heat ratio

- Electricity from HE CHP
- Primary energy savings (PES)

6 Application Process

6.1 Application submission

Plant operators seeking certification as HE CHP should submit a completed application form and provide relevant supporting documentation to the CER for review and evaluation. The submission should be made in electronic form wherever possible and information that cannot be submitted electronically may be submitted in hard copy.

Completion of the application form will require the provision of prescribed information and appropriate guidance on the completion of the application form in Appendix B.

6.1 Application Review

The processing of applications will involve checking for completeness in the first instance, reviewing the information provided in respect of the 'useful heat' question and also examining the quality of the supporting documentation (for example, assessing the adequacy and appropriateness of metering and measurement. The operational data submitted will be checked for anomalies (e.g. large variations in efficiency) and the efficiency calculations submitted checked for accuracy. The final key indicators (overall efficiency, power to heat ratio and PES) will be validated.

The above are the high level steps that will be taken in the processing of an application for certification as HE CHP. Further to these steps a certification of HE CHP will issue or not based on the assessment performed. Please note that further information may be requested by the CER at any time during the processing of an application.

6.2 Initial and Annual Application Process

For initial certification, full details of the design of the CHP plant, detail of useful heat loads and measurement provisions will be evaluated in addition to operational data for the reporting period. In the case where a CHP plant applies for initial certification prior to operation, details on the useful heat loads, the heat load profile and the predicted operating parameters should be provided in place of operational data records.

For subsequent annual applications for certification, operational data for the period will be evaluated, subject to confirmation that the design of the plant, useful heat loads and measurement arrangements remain unaltered is provided by the operator. Where units have received HE CHP certification based on design and operational information in the first instance, audits of certified HE CHP installations will be carried out by the CER or bodies appointed by the CER. Certification may be revoked should audits reveal inaccuracies in submitted applications.

Once certified, the CER reserves the right to review the certification of a heat load for a plant as useful heat within the meaning set out in the Directive, the relevant Irish legislation and the proposals in this paper. The CER considers this may be appropriate for example if the heat load is significantly different from that certified as useful heat by the CER, or if the business to which the heat load is attached materially changes from that used to certify the heat load as useful heat.

6.3 Timeframe of the Process

The initial application for a CHP plant will be processed upon receipt.. Evaluations may require site visits and meetings with the applicants.

Once the evaluation is complete the applicant will be issued with a certificate for HE CHP or will be informed in writing of the reasons why the application was unsuccessful.

Initial certifications will be issued as valid until the end of the first quarter of the next calendar year. The onus will be on the holders of a HE CHP certificate to apply for subsequent certifications. All subsequent applications must be received by the CER by the 31st January each year; no applications will be accepted after that date. The applications will be evaluated by the 31st March of the same year and certificates or notice of an unsuccessful application, as applicable, will be issued before this date.

6.4 Implementation Post Decision Paper

It is proposed to process applications as a batch when first implementing the process proposed in this paper. This will include parties which have been certified as HE CHP to date and will be required to be re-assessed post final decision on HE CHP certification.

All complete applications which are received up to and within ten working days of the decision paper's publication will be processed in a single batch and will be certified, or notified of the CER's refusal to certify, on the same day. The CER anticipates this process will take no longer than two months, noting however that this will be driven by the volume of applications received and the nature and complexity of those applications. Any application received after the initial two week period will be processed individually as received in accordance with the timeline proposed in the previous section. Final timelines for the processing of the first batch of applications will be clarified in the decision paper on HE CHP certification when it issues.

7 Auditing Regime

The CER will implement an annual auditing programme and all operators of certified plants must facilitate the audit process if required. Audits will ensure that the CHP plant is designed, metered, operates and performs as per the details provided in the application and the plant meets the criteria for qualification as HE CHP.

The auditing regime will be appropriate to the scale of the CHP plants registered as HE CHP and will include:

- all large scale plants registered as HE CHP may be audited at least once a year;
- routine auditing of certified HE CHP plants on the basis of random sampling;
- auditing of selected registered HE CHP plants triggered by anomalies in performance data submitted; and
- newly commissioned HE CHP plants may be specifically selected for audit.

Audits will typically involve a site-based evaluation of a registered HE CHP plant but may include any activity or requests for information to confirm the validity of applications for registration and performance data submitted. The CER may require spot audits and this may necessitate site visits by the CER and/or its agents.

A site-based audit will include:

- Confirmation of plant design - name plate make, model and rating of all components
- Review of commissioning records and performance parameters measured during commissioning
- Review of metering arrangements, location of meters and name plate make and model of meter where available. Documentation including meter calibration certificates will be inspected. Record of all meter readings from meters
- Confirmation of useful heat demand (i.e. identification of the demand that boilers would otherwise have provided), confirmation that the demand exists independently of the CHP plant and is not being in some way wasted.
- Inspection of piping arrangements and distribution of heat to ‘useful heat’ loads and validation of schematic and ‘as built’ pipework drawing

- Inspection of data acquisition and recording arrangements and verification against meter readings where possible
- Record of operational data (from meters and from data acquisition system) during period of audit
    - Fuel input at intervals (e.g. 30 min)
    - Electricity generation
    - 'CHP heat' output and any 'non-CHP heat' output
- Calculation of performance parameters on the basis of total meter readings and meter readings recorded during the period of the audit. Investigation and comment on any discrepancies between submitted and observed data and performance.
- Identification of factors that may affect CHP efficiency (e.g. lower than design heat loads).

8 Conclusion

The CER has been appointed under the relevant legislation to certify high efficiency CHP ("HE CHP"). Accordingly the CER wishes to put in place a standardised process for applications from generators to be certified as HE CHP. This process involves the initial application for existing and new plants that have not been certified previously, the annual recertification of those plants previously certified and an auditing regime to ensure the robustness of the certification process.

It is proposed applicants for certification as HE CHP will be required to:

- Demonstrate that the heat load is useful heat within the meaning of the Directive, Irish legislation and the proposed required criteria set out in this paper;
- complete and submit the relevant application forms and provide the required operational and supporting data;
- maintain operational records and where appropriate install metering and measurement systems where necessary;
- provide full access to operational data; and
- provide access and facilitate inspection of plant and records by auditors appointed by the CER.

The calculation methodology is based around the principles of determining PES, the power to heat ratio and determination of electricity from HE CHP as laid out in the Act, the Directive and associated decisions. The principal results of the calculation methodology will be:

- Power to Heat Ratio
- Primary energy savings
- Determination of HE CHP electricity as per Schedule 3 of the Act.

The calculation methodology will derive the following calculated parameters:

- electrical Efficiency;
- heat Efficiency;
- overall Efficiency;
- power to heat ratio;
- high efficiency CHP electricity generated; and
- primary energy savings (PES).

8.1 Summary of the Proposed Process

The application process includes the following information requirements and evaluation steps for the applicant.

1. Plant specification and design by applicant, described in application
2. Compile case for useful heat demand using heat sources alternative to CHP as required by relevant legislation and CER decision(s).
3. Compile details of measurement and metering arrangements as required by relevant legislation and CER decision(s).
4. Collection and submission of operational data as required by relevant legislation and CER decision(s).
5. Submit HE CHP application to CER as required by relevant legislation and CER decision(s). CER assesses and may request for further information if necessary
6. CER issues certification or notifies the applicant that the certification will not issue.
7. Auditing and validation of application details annually in accordance with the above steps relevant legislation, and CER decision(s).

Appendix A: Application Checklist

CHP Plant Design	
Completed application form Part I	☐
Evidence of prime mover rating	☐
Process flow diagram and piping diagram indicating useful heat demands, dump loads and metering arrangements	☐
Useful Heat	
Catalogue of useful heat loads and reference to standard loads (e.g. kWh per unit production, kWh/m2 etc) **and/or**	☐
Demonstration of economically justifiable heat load	☐
Measurement Details (as identified on piping diagram)	
Measurement/metering arrangements for fuel input including relevant standards, accuracy and resolution, type test approval and/or calibration certificates	☐
Measurement/metering arrangements for electricity generation including relevant standards, accuracy and resolution, type test approval and/or calibration certificates	☐
Measurement/metering arrangements for useful heat including relevant standards, accuracy and resolution, type test approval and/or calibration certificates	☐
Operational Data (or projected data/design for units not yet operational)	
Fuel input, useful heat and electricity generation over reporting period	☐
Fuel input, useful heat and electricity generation over period of operation in HE CHP mode (test report included)	☐
Actual power to heat ratio	☐
Plant specific electrical efficiency and test report (for CHP with power loss that does not meet the efficiency threshold in Annex II of the Directive)	☐
Calculated Parameters	
Overall efficiency	☐
Primary energy savings	☐

Appendix B: Application Form

Applicants for certification as HE CHP will be required to:

- Complete and submit this application form and provide the required operational data.
- Maintain appropriate operational records and where appropriate metering systems are not installed to install such metering.
- Provide full access to operational data
- Provide access to and facilitate inspection of plant and records by auditors as may be appointed by the CER.

Part I – Design specification, detail of useful heat loads

Part II (a) – Operational data for units in operation

Part II (b) – Projected operational data for units not in operation

Part III – Key performance parameters (Electrical efficiency, thermal efficiency, overall efficiency, actual power to heat ratio, electricity for HE CHP and PES)

Notes:

This application form should be completed with reference to the CER's decision paper. Calculations of efficiency and primary energy savings should be done using the excel calculation template.

The following Attachments are required to accompany this form:

- Process flow diagram (indicating metering and measurement arrangements and useful heat loads)
- Piping diagram (indicating metering and measurement arrangements and useful heat loads)
- Certification, test reports, specification for prime mover detailing rating
- Certification, test reports, specification for meters and measurement
- Annual heat profile
- Daily heat profile
- Heat load duration curve

- Test report detailing power to heat ratio in HE CHP mode
- Test report detailing plant specific electrical efficiency or power loss coefficient

Application forms should be submitted to hechp@cer.ie, . Supporting material should be provided in electronic form wherever possible. Hard copies, where required, should be addressed to James McSherry at the CER at the following address:

James Mc Sherry
Renewables
Commission for Energy Regulation
The Exchange
Belgard Square North
Tallaght
Dublin 24

8.2 Part I – Design specification, detail of useful heat loads

Site Name		
MPRN		
Operator Company Name		
Address		
Contact Name		Position held:
Address		
Telephone No:		Fax No:
Email		

8.2.1 Description of CHP plant (Prime mover type(s), model(s) and rating, schematic diagram and piping diagram to be provided

8.2.2 Power to Heat Ratio

Is the power to useful heat ratio fixed (Yes/No)	
If no	
Is there a dump heat load (Yes/No)	
Is there a condensing steam turbine and condenser (Yes/No)	
Is the power to heat ratio otherwise capable of being controlled?	
Please describe means of control	

8.2.3 Primary fuel source (and additional sources where applicable)

Primary Fuel Type	
Secondary Fuel Type	
Is fuel supply to CHP metered and billed separately or as part of site overall supply (Separately/Combined)	
Is condensate returned to boiler feedwater (Yes/No)	

8.2.4 Useful Heat Outputs

Please Include a catalogue of heat loads claimed as useful heat and justification of these as typical loads.

Please include a process flow diagram or piping schematic indicating the CHP plant and the heat loads claimed as useful heat demands. This should include any other heat supply (e.g. boilers), an indication of the boundary around the CHP plant, supply to useful heat end uses and location of heat metering. Where heat is provided by extraction steam the process flow diagram should indicate points of extraction and pressure and temperature.

8.2.5 Economically Justifiable Useful Heat Demand

Please provide details of economic evaluation and justification of heat loads with reference to objective information on markets and prices. Please refer to the CER decision paper for guidance.

8.2.6 Measurement Details (please copy these tables where there are multiple inputs or outputs)

Fuel Input	
Meter/measurement type	

Meter/measurement make and model	
Standard to which meter/measurement conforms	
Class to which meter/measurement conforms	
Describe measurement method and data recording provisions. Type approval/calibration certs/manufacturer's data sheet to be provided. For steam cycles measurement of condensate return to be detailed)	
Electricity	
Meter/measurement type	
Meter/measurement make and model	
Standard to which meter/measurement conforms	
Class to which meter/measurement conforms	
Describe measurement method and data recording provisions. Type approval/calibration certs/manufacturer's data sheet to be provided.	
Useful Heat	
Meter/measurement type	

Meter/measurement make and model	
Standard to which meter/measurement conforms	
Class to which meter/measurement conforms	
Describe measurement method and data recording provisions. Type approval/calibration certs/manufacturer's data sheet to be provided. The location of the meter should be indicated on the process flow diagram.	

8.3 Part II(a) – Operational Records (Annual)

8.3.1 Annual Summary

Summary of Annual Production to be provided. Monthly records to be provided following.

CHP Total Fuel Input (MWh)	
CHP Total Electricity Output (MWh)	
Condensate Return (MWh)	
CHP Total Useful Heat Output (MWh)	

Operation in HE CHP Mode (Where power to heat ratio varies) Test report to be provided as an attachment.

Period #1 - Summary of production

Start of period (time/date)	
End of period (time/date)	

Duration (hours)	
CHP Total Fuel Input (MWh)	
CHP Total Electricity Output (MWh)	
CHP Total Useful Heat Output (MWh)	

Period #2 - Summary of production (copy for additional periods)

Start of period (time/date)	
End of period (time/date)	
Duration (hours)	
CHP Total Fuel Input (MWh)	
CHP Total Electricity Output (MWh)	
CHP Total Useful Heat Output (MWh)	

Summary of total production in HE CHP Mode

Total Duration (hours)	
CHP Total Fuel Input (MWh)	
CHP Total Electricity Output (MWh)	
CHP Total Useful Heat Output (MWh)	
Actual power to heat ratio in HECHP Mode	

Plant Specific Electrical Efficiency (For CHP with power loss failing to meet the efficiency threshold in Annex II to the Directive. Details of test and calculation method and test results to be appended)

Plant specific Electrical Efficiency	
Power loss coefficient	

8.3.2 Production Records

Month #	Month/Year	Fuel Input (MWh) (net of condensate return etc)	Useful Heat Output (MWh)	Electricity Generation (MWh)	Overall Efficiency (%)	Power to Heat Ratio
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
Total Energy Capacity (as electrical output) = CHP_{TPC}						

8.4 Part II (b) – Projected operational data for units not in operation

Provide a general description of the proposed Scheme

(e.g. ownership, operation and maintenance arrangements, normal running hours, typical operation, and uses of heat and power outputs).

What is the state of development of the proposed Scheme?

(e.g. specification/tendering/detail design/procurement/construction/commissioning)

Maximum projected Useful Heat Demand*	MW
Minimum projected Useful Heat Demand*	MW
Average projected Useful Heat Demand	MW
CHP Total Power Capacity under MaxHeat conditions	kW_e

*Useful heat output measured as indicated on the process flow and piping diagram

Provide a detailed description of heat loads (Please describe the annual heat profile, daily heat profile, heat load duration curve and provide detailed load profiles as attachments).

Summary of Projected Annual Production.

CHP Total Fuel Input (MWh)	
CHP Total Electricity Output (MWh)	
CHP Total Useful Heat Output (MWh)	

Projected total production in HE CHP Mode (Where power to heat ratio varies)

Total Duration (hours)	
CHP Total Fuel Input (MWh)	
CHP Total Electricity Output (MWh)	
CHP Total Useful Heat Output (MWh)	
Actual power to heat ratio	

8.5 Part III – Key performance parameters (Electrical efficiency, thermal efficiency, overall efficiency, actual power to heat ratio, electricity for HE CHP and PES)

8.5.1 Summary Parameters

Electrical efficiency (%)	
Thermal efficiency (%)	
Overall efficiency (%)	
Actual power to heat ratio	
Electricity from HE CHP (MWh)	
Primary Energy Savings (%)	

8.6 Part VI - Declaration

I hereby declare that:

I will respond to any requests for information from the CER;

I will provide full access to the plant and records for the purposes of auditing by the CER;

the information provided is accurate and complete in all respects;

Signed

Full name(s) of Signatory

Position held

Date:

Appendix C: Worked examples

The following tables provide details of the full calculations for the worked examples summarises in Section 3.3.7 of the consultation document.

These are:

1. Internal combustion engine operating primarily in ‘high efficiency CHP’ mode (for example on large commercial or small industrial site)

2. Gas turbine operating primarily in ‘high efficiency CHP’ mode (for example on large industrial site)

3. Combined cycle gas turbine operating primarily in ‘high efficiency CHP’ mode (for example on large, energy intensive industrial site)

4. Biomass CHP plant operating on an industrial site or adjacent to a significant heat load

5. Waste to energy plant adjacent to industrial site or district heating scheme

Description

Type	Internal combustion engine
Fuel	Natural gas
Rating	900 kWe, 1,000 kWth
Year of construction	2001
Grid Connection	0.4-50 kV
On-site electricity use	80%

Overall Efficiency

Electricity Generation	4,500	MWh
Useful Heat Output	5,200	MWh
Fuel Input	12,900	MWh
Electric Efficiency	35%	
Thermal Efficiency	*40%*	
Overall Efficiency	75%	
Threshold Efficiency	75%	

Actual Power to Heat Ratio (measured during period of full CHP operation)

Heat output	5,200	MWh
Electricity output	4,500	MWh
C_{actual}	0.865	

Electricity from HE CHP

Useful Heat Output	5,200	MWh
E_{CHP}	4,500	MWh
E non-CHP	-	MWh

Primary Energy Savings

non-CHP Fuel	-	MWh
CHP Fuel	12,900	MWh
CHP Hn	40.3%	
Ref Hn	90.0%	Note 1
CHP En	*35%*	
Ref En	51.1%	
Climate Adjustment	0.6%	
Grid loss correction	0.929	
Ref En (Adjusted)	48.0%	Note 2
PES	15%	

Notes

1) NG from Annex II of 2007/74/EC

2) NG, 2001 adjusted from Annex I of 2007/74/EC

Worked Example 1 – Internal Combustion Engine

Description	
Type	Gas turbine
Fuel	Natural gas
Rating	10 MWe, 18 MWth
Year of construction	2005
Grid Connection	0.4-50 kV
On-site electricity use	90%

Overall Efficiency		
Electricity Generation	117,000	MWh
Useful Heat Output	188,000	MWh
Fuel Input	417,000	MWh
Electric Efficiency	*28.1%*	
Thermal Efficiency	*45%*	
Overall Efficiency	*73%*	
Threshold Efficiency	80%	

Actual Power to Heat Ratio (measured during period(s) of operation in full CHP mode)		
Heat output	90,909	MWh
Electricity output	50,000	MWh
Fuel input	177,936	MWh
C_{actual}	0.550	

Electricity from HE CHP		
Useful Heat Output	188,000	MWh
E_{CHP}	103,400	MWh
E non-CHP	13,600	MWh

Primary Energy Savings		
Plant Specific efficiency for elec production	28.1%	
non-CHP Fuel	48,472	MWh
CHP Fuel	368,528	MWh
CHP Hn	51.0%	
Ref Hn	90.0%	Note 1
CHP En	28%	
Ref En	52.4%	
Climate Adjustment	0.6%	
Grid loss correction	0.927	
Ref En (Adjusted)	49.1%	Note 2
PES	12.1%	

Notes

1) NG from Annex II of 2007/74/EC

2) NG, 2005 adjusted from Annex I of 2007/74/EC

Description	
Type	CCGT with steam extraction
Fuel	Natural Gas
Rating	270 MWe, 280 MWth
Year of construction	2000
Grid Connection	100-200 kV
On-site electricity use	30%

Overall Efficiency		
Electricity Generation	1,574,000	MWh
Useful Heat Output	1,488,000	MWh
Fuel Input	4,295,000	MWh
Specific Elec Efficiency	*37%*	
Thermal Efficiency	*35%*	
Overall Efficiency	*71%*	
Threshold Efficiency	80%	(a) CCGT

Actual Power to Heat Ratio		
(measured during period(s) of operation in full CHP mode)		
Heat output	1,111,111	MWh
Electricity output	1,000,000	MWh
Fuel input	2,857,143	MWh
C_{actual}	0.900	

Electricity from HE CHP		
Useful Heat Output	1,488,000	MWh
E_{CHP}	1,339,200	MWh
E non-CHP	234,800	MWh

Primary Energy Savings		
Plant Specific efficiency for elec production	37%	
non-CHP Fuel	640,703	MWh
CHP Fuel	3,654,297	MWh
CHP Hn	40.7%	
Ref Hn	90.0%	
CHP En	*37%*	
Ref En	51.4%	
Climate Adjustment	0.6%	
Grid loss correction	0.979	
Ref En (Adjusted)	50.9%	Note 2
PES	14.7%	

Notes

1) NG from Annex II of 2007/74/EC

2) NG, 2005 adjusted from Annex I of 2007/74/EC

Worked Example 3 – CCGT

Description	
Type	Biomass CHP
Fuel	Wood Residues
Rating	5 MWe, 3 MWth
Year of construction	Post 2006
Grid Connection	0.4-50 kV
On-site electricity use	60%

Overall Efficiency		
Electricity Generation	24,000	MWh
Useful Heat Output	14,400	MWh
Fuel Input	109,091	MWh
Electrical Efficiency	22%	
Thermal Efficiency	13%	
Overall Efficiency	35%	
Threshold Efficiency	80%	Note 1

Note - (c) Condensing extraction turbine

Actual Power to Heat Ratio		
(measured during period(s) of operation in full CHP mode)		
Heat output	1000	MWh
Electricity output	600	MWh
Fuel Input		
C_{actual}	0.600	

Electricity from HE CHP		
Useful Heat Output	14400	MWh
E_{CHP}	8640	MWh
E non-CHP	15,360	MWh

Primary Energy Savings		
Plant Specific efficiency for elec production	22%	
non-CHP Fuel	69,818	MWh
CHP Fuel	39,273	MWh
CHP Hn	36.7%	
Ref Hn	86.0%	Note 1
CHP En	22%	
Ref En	32.6%	
Climate Adjustment	0.6%	
Grid loss correction	0.933	
Ref En (Adjusted)	31.0%	Note 2
PES	12%	

Notes

1) Wood Fuel from Annex II of 2007/74/EC

2) Wood Fuel, 2005 from Annex I of 2007/74/EC

Worked Example 4 – Biomass CHP

Description	
Type	Waste to Energy
Fuel	Municipal waste
Rating	20 MWe, 15MWth
Year of construction	Post 2006
Grid Connection	0.4-50 kV
On-site electricity use	20%

Overall Efficiency		
Electricity Generation	100,000	MWh
Useful Heat Output	90,000	MWh
Fuel Input	480,000	MWh
Elec Efficiency	*20.8%*	
Thermal Efficiency	*18.8%*	
Overall Efficiency	*39.6%*	
Threshold Efficiency	80.0%	

Actual Power to Heat Ratio		
(measured during period(s) of operation in full CHP mode)		
Heat output	1,200	MWh
Electricity output	1,000	MWh
Fuel input	5,000	
C_{actual}	0.8330	

Electricity from HE CHP		
Useful Heat Output	90,000	MWh
E_{CHP}	74,970	MWh
E non-CHP	25,030	MWh

Primary Energy Savings		
Plant Specific efficiency for elec production	25%	
non-CHP Fuel	100,120	MWh
CHP Fuel	379,880	MWh
CHP Hn	23.7%	
Ref Hn	80.0%	Note 1
CHP En	20%	
Ref En	24.1%	Note 2
PES	10.3%	

Notes

1) Municipal waste from Annex II of 2007/74/EC

2) Municipal waste, post 2006 adjusted from Annex I of 2007/74/EC

Appendix D: Glossary of Terms

Combined Heat and Power means the simultaneous generation in one process of—

(a) thermal energy and electrical energy,

(b) thermal energy and mechanical energy, or

(c) thermal, electrical and mechanical energy

Economically justifiable demand means the demand that does not exceed the needs for heat or cooling and which would otherwise be satisfied at market conditions by energy generation processes other than cogeneration

Efficiency means efficiency calculated on the basis of 'net calorific values' of fuels

Electricity production from combined heat and power means electricity produced from combined heat and power calculated in accordance with section 7 of the Electricity Regulation Act, 1999

Full CHP mode occurs when the CHP unit operates with maximum heat recovery (i.e. no heat dumped, for example as turbine exhaust gas or condensed steam turbine exhaust steam)

High efficiency combined heat and power means combined heat and power production which on an annual basis—

(a) in the case of small scale combined heat and power and micro-combined heat and power, achieves primary energy savings calculated in accordance with paragraphs 3 and 4 of Schedule 3 of the Electricity Regulation Act, 1999, and

(b) in the case of all other combined heat and power, achieves primary energy savings calculated in accordance with paragraphs 3 and 4 of Schedule 3 of at least 10 per cent compared with the references for separate production of heat and electricity"

Overall efficiency means the annual sum of electricity and mechanical energy production and useful heat output divided by the fuel input used for heat produced in a cogeneration process and the gross electricity and mechanical energy production

Power to heat ratio means the ratio between electricity from cogeneration and useful heat when operating in full cogeneration mode using operational data of the specific unit

Total fuel energy is the total fuel energy based on lower heating value (LHV) needed in a CHP plant to generate electrical/mechanical energy and useful heat in a reporting period -(not defined in the Directive)

Useful heat means heat produced in a cogeneration process to satisfy an economically justifiable demand for heat or cooling