Waste Infrastructure Delivery Programme Information Note

on

Combined Heat and Power

(Based on proposals contained in the Renewables Obligation Banding Review, and the Renewable Energy Strategy)

January 2009

4ps

PartnershipsUK

defra
Department for Environment Food and Rural Affairs

Contents

Glossary

CEN	European Committee for Standardisation
CHP	Combined Heat and Power
CHPQA	CHP Quality Assurance
ECAs	Enhanced Capital Allowances
EfW	Energy from Waste
ETCL	Energy Technology Criteria List
GQCHP	Good Quality CHP
HES	Heat and Energy Strategy
LECs	Levy Exemption Certificates
MBT	Mechanical Biological Treatment
MSW	Municipal Solid Waste
PFI	Private Finance Initiative
QI	Quality Index
RES	Renewable Energy Strategy
RI	Respiratory Index
RO	Renewables Obligation
ROC	Renewables Obligation Certificate
SRF	Solid Recovered Fuel
WIDP	Waste Infrastructure Delivery Programme
WS 2007	Waste Strategy for England 2007

Acknowledgements

WIDP acknowledges and thanks DECC, Ofgem, the Environment Agency, WRAP and the CHPQA programme for their assistance in producing this Information Note.

1. Purpose of this document

Clear evidence of the accelerating convergence of energy and waste policy was provided with the concurrent publication of the Energy White Paper and the Waste Strategy for England[1] ("WS 2007") in May 2007, which together provided a very closely aligned analysis in relation to waste and non-waste derived biomass fuels and Combined Heat and Power ("CHP") outcomes.[2] Since then there have been a number of inter-related initiatives to encourage investment in renewable energy and waste infrastructure that meet energy efficiency and carbon reduction objectives. Such measures include the banding of the Renewables Obligation ("RO"), extending enhanced capital allowances ("ECAs") to include Solid Recovered Fuel ("SRF") related equipment along with a heightened expectation for energy generated from waste management activity to achieve the most climate change friendly outcome through the use of CHP.

The purpose of this Information Note is to raise awareness of the range of inter-locking measures available to support investment in energy from waste ("EfW") facilities with CHP, using unprocessed or processed waste such as SRF or waste wood biomass. It is aimed at practitioners in both the private and public sectors and follows a Q&A format that gives the reader a short explanation of a topic and a reference to a policy document or Guidance Note, where appropriate. This Information Note is not a substitute for the relevant reference text.

2. Policy context

WS 2007 stated that where biomass waste cannot be reused or recycled, it makes economic and environmental sense to use it as a renewable fuel.[3] WS 2007 also set out that the use of residual waste as an energy source (whether SRF or otherwise) has considerable low carbon benefits as it can be used to replace oil, coal or gas.

The forthcoming consultation on a Heat and Energy Strategy ("HES") for the UK will make it clear that the waste Private Finance Initiative ("PFI") programme offers a platform for new infrastructure, particularly plants capable of handling a range of materials including SRF, waste wood as well as non-waste biomass. The waste PFI programme seeks to, other things being equal, support CHP or heat use alone in preference to electricity-only EfW plants.

The EU has set itself a target to achieve 20% of its energy from renewable sources by 2020 and the UK has committed to deliver its share of 15%. Initial analysis for the consultation on a UK Renewable Energy Strategy ("RES") indicates that biomass, including biomass derived from waste sources, will play a key role in helping the UK achieve this target.[4]

Economically, the benefits of this approach derive from the production of renewable electricity as provided for in the energy from waste with combined heat and power

[1] http://www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste07-strategy.pdf
[2] http://www.dti.gov.uk/energy/whitepaper/page39534.html - see paragraph 5.3.44
[3] The Office of Climate Change's analysis suggested that with moderate financial support in place, the potential for heat from waste could be approximately 4 TWh a year, and with more ambitious policies in place the long-term potential to generate energy from waste might be in the order of 45 TWh.
[4] http://renewableconsultation.berr.gov.uk/consultation/consultation_summary

provisions in the Renewables Obligation Order along with Levy Exemption Certificates ("LECs") as described later in this Information Note. In the future, as set out in the HES, benefit should also come from the generation of heat from low carbon sources.

Environmentally the benefits are threefold: potential displacement of fossil fuels in energy generation, greater efficiencies from the production of energy and security of fuel supply. CHP can make a contribution to the achievement of this potential - although it should be noted that only the biomass portion of SRF would count towards the UK's renewable energy targets.

3. What is CHP?

In CHP plants, the residual heat in the exhaust steam from the generation of electricity is captured and used instead of being discarded. This results in a highly efficient use of fuel and a significantly reduced level of CO_2 emissions when compared to the separate generation of electricity and heat in power stations and heat-only boilers.

Generating heat and electricity together through CHP is one way of making our energy production more efficient.[5] It can be used whenever electricity is generated through combustion of a fuel, including all types of biomass and biogas electricity generation.

4. Why is CHP important in Waste Projects?

WS 2007 set out its vision for sustainable waste management. This included two key objectives to help reduce greenhouse gas emissions by diverting greater amounts of biodegradable waste away from landfill and by increasing the recovery of energy from waste. It identified combustion as the generally preferred option for waste wood over recycling and anaerobic digestion as the preferred option for food waste. Where energy recovery is appropriate, WS 2007 sets out an expectation that the energy generated is utilised in the most climate change friendly way through the use of CHP schemes.

The best CHP systems can increase the overall efficiency of an EfW plant from 20-25% to around 60-70%. Therefore, the addition of CHP significantly increases the displacement of other fuels compared to electricity-only EfW.

5. What are the potential financial benefits of CHP?

CHP is most economic when there is a continuous heat demand, such as on industrial sites in continual operation or in mixed-use community developments consisting of offices, retail space and homes. Currently, most CHP is gas-fuelled but there is potential to convert existing facilities to biomass or SRF CHP, particularly in industrial or commercial applications where there is existing heat infrastructure and where conversion from gas or oil to solid fuel firing is practicable.

Initial analysis undertaken to support RES indicates that there is potential to achieve up to 23 TWh of electricity from CHP fuelled by renewable sources. Over the past years, the

[5] http://www.defra.gov.uk/environment/climatechange/uk/energy/chp/#quality

Government has introduced a range of measures to support the growth of Good Quality CHP ("GQCHP") in the UK.[6] These include:

- Banding of the RO whose principal waste-related provisions include:
    - declared biomass content of waste;
    - measures to enable determination of higher biomass fractions;
    - making the RO neutral to SRF; and
    - revised efficiency levels for renewable CHP.
- ECAs for all GQCHP eligible expenditure with certain equipment items needed for the combustion of SRF included
- Business Rates exemption for certain GQCHP power generation plants and machinery[7]
- The intention to introduce a Renewable Heat Incentive ("RHI")

Some of the above points are explained in further detail below.

6. Renewables Obligation Certificates

The concept of banding is the principal change to the RO and represents a significant amendment to the original scheme introduced in April 2002. Banding provides different levels of incentive and aims to provide the flexibility necessary to increase renewable electricity generation in the years following 2009. It also makes some contribution towards the UK's renewable energy target for 2020.

Under the proposed reforms to the RO,[8] EfW with CHP plants continue to receive 1 ROC/MWh of electricity generated. Dedicated biomass CHP plants will receive 2 ROCs/MWh, as opposed to 1.5 ROCs/MWh for electricity-only plants. In all cases ROCs are awarded on the energy derived from the biomass content of the relevant fuel and only where the CHP achieves the GQCHP criteria as outlined below. The GQCHP criteria are detailed in the UK CHP Quality Assurance ("CHPQA") programme's Guidance Note 44.[9]

The 1 ROC/MWh allocation for EfW with CHP reflects the fact that gate fees underpin the economics of waste fired CHP. Higher Renewables Obligation Certificate ("ROC") allocations for dedicated biomass CHP are in recognition of the need for these projects to pay for their fuel and also reflect costs associated with installing heat recovery and supply equipment (along with the additional maintenance and management costs) as well as the higher risks associated with heat supply contracts.

[6] The UK has a domestic target of 10 GW of installed GQCHP capacity by 2010, where GQCHP refers to the outputs of schemes that meet the energy efficiency criteria laid down in the UK's CHPQA programme.
[7] www.chpqa.com
[8] http://www.berr.gov.uk/files/file46838.pdf
[9] https://www.chpqa.com/guidance_notes/GUIDANCE_NOTE_44.pdf

Details on the actual or proposed implementation of these measures is set out in the RO Statutory Consultation, which includes in chapter 5 a commentary on the adjusted efficiency criteria required by renewable CHP schemes over 25 MWe in order to establish their eligibility for ROCs.[10] The primary legislation required to implement the changes to the RO will be in place by April 2009.

7. Declared biomass content of waste

The consultation on reform of the RO also set out the proposal to make it easier for operators using waste for eligible electricity generation under the RO to claim ROCs on the renewable energy content of that waste. This was to address the concerns industry had raised regarding the difficulties in measuring and sampling the renewable content of mixed waste, in particular municipal solid waste ("MSW"), in a cost effective way due to the variable composition of such waste. These problems had meant that no ROCs had been issued for electricity generated from mixed waste using eligible technologies despite the fact that the EfW with CHP provision was introduced into the RO in 2006.

In order to address this, DECC announced its intention in the RO Banding Review consultation to allow Ofgem flexibility over determining the proportion of waste which is or is derived from fossil fuel, including what will constitute sufficient evidence of that proportion in any particular case.

However, DECC are not proposing to automatically deem all waste as having a renewable energy content of 50% without any additional evidence. This is because the varied nature of what can be defined as waste means that there will also be differing levels of renewable energy content and therefore such an approach would significantly increase the risk that ROCs could be issued for fossil fuel generation.

The changes DECC are proposing will allow Ofgem to award ROCs on up to 50% of the total energy content of the waste fuel stream to operators who satisfy evidential requirements without necessarily requiring those operators to directly measure the renewable energy content of the waste. Where an operator wishes to claim ROCs on more than 50% of the total energy content of the waste fuel stream they will be required to directly measure the renewable energy content of the waste.

50% has been set as the maximum level of renewable content that can be declared by a generator without any direct measurement to reflect a conservative estimate of the typical composition of MSW. DECC believes this approach strikes the right balance between improving access to the RO for generation that is truly eligible whilst retaining a cautious approach in respect of rewarding non-renewable generation.

Under the deeming provision, the level of the fossil fuel energy content of MSW is deemed to be 50% from 2009 to 2013, 60% from 2013 to 2018 and 65% from 2018. This trajectory is in line with waste policy, reflecting how the composition of residual municipal waste is expected to change over time with increased separate collection and treatment of food and other biodegradable waste streams.

[10] http://www.berr.gov.uk/files/file46838.pdf - see chapter 5 and decision trees on page 60

8. Making the RO neutral to SRF

The RO provides neutrality for SRF, which means that ROCs can still be claimed on an eligible biomass fuel stream being co-fired in a fossil fuelled power station even though it is being burnt alongside SRF. The renewable content of the SRF is not eligible for ROCs unless the combined energy content of the biomass fuel stream and the SRF is at least 90% derived from animal or plant matter which would mean the fuel stream as a whole could be treated as biomass.

It is important to note that the deeming provisions that apply to MSW do not apply to SRF. This is because SRF is a prepared fuel derived from MSW whose biomass content can vary, as described below. This does not mean a similar approach cannot be adopted for other waste streams, including SRF, just that more evidence may be required in order to agree the declared biomass content.

Industry should now look carefully at Ofgem's draft Fuel Measurement and Sampling Guidance Note and to consider how to establish an evidence-based methodology for the determination of biomass content that meets the requirements of the SRF producer and user and is acceptable to Ofgem.[11]

9. The RO and mixed fuel/technology combinations

Where SRF or MSW is combined with biomass in a boiler with CHP, the type of ROCs issued will depend on the biomass content of the overall fuel mix, i.e. if it is <90% biomass it will all be treated as waste and will receive EfW with CHP ROCs (1 ROC/MWh) on the biomass energy content and if it is equal or >90% biomass it will all be treated as biomass and will receive dedicated biomass with CHP ROCs (2 ROCs/MWh) on the biomass energy content.

These principles apply to co-firing of biomass, co-firing of energy crops and co-firing of biomass or energy crops with CHP. For example, a dedicated CHP station which uses a mixture of wood (more than 90% derived from plant or animal matter by energy) and SRF so that less than 90% of the mixture of wood and biomass is derived from plant or animal matter, would receive 1 ROC/MWh for all the electricity derived from the renewable energy content of both wood and SRF as an EfW with CHP station. However, if the same plant burned fossil fuel in a separate boiler the station would receive 1 ROC/MWh for the electricity from the wood and no ROCs for the energy derived from SRF (as a co-firing with CHP plant with neutrality to SRF).

A decision tree presentation of the ROC eligibility applicable to a number of fuel and technology options is set out on pages 58 and 59 of the RO Statutory Consultation which can be accessed through footnote 10.

[11] http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Documents1/2008%2012%2015%20FMS%20Guidance.pdf

10. What is SRF?

SRF is a waste derived fuel produced from the pre-treatment of MSW or commercial and industrial waste in a mechanical biological treatment ("MBT") plant, autoclave or other intermediate technology processing facility. A typical 100 tonne sample of MSW treated in a MBT plant comprises roughly the following outputs:

Item	**Percent**
SRF	43.0
Ferrous	3.0
Glass & stone	11.0
Compostable	17.5
Non-ferrous	0.5
Moisture	25.0
Total	**100.0**

Biomass content in SRF can vary depending upon the source of input waste and the type of intermediate technology used. For example, if the biomass content of the SRF in the above table was 65%, then plastics would account for the remaining 35%. Flexibility exists within MBT plants to alter the composition of SRF to meet the requirements of end users.

11. Why is there a need for a SRF Standard?

The British Standards Institute has issued CEN/TS 15359 as a draft standard for development based on the substantial body of work undertaken by the European Committee for Standardisation ("CEN") on methodologies for establishing standards for the composition of SRF. Defra's consultation evidence confirms that CEN/TS 15359 provides an appropriate methodology for the grading of SRF. The definition for SRF in CEN/TS 15359 is:

"Solid fuel prepared from non-hazardous waste to be utilised for energy recovery in incineration or co-incineration plants, and meeting the classification and specification requirements laid down in CEN/TS 15359 where "prepared" means processed, homogenised and upgraded to a quality that can be traded amongst producers and users."

Using the CEN framework, Defra has developed a minimum standard for the composition of SRF as part of a broader initiative to stimulate its use with different user groups. A minimum standard is required to distinguish it from minimally treated MSW because SRF composition can vary widely depending upon the nature of input waste and the treatment method. Defra also wants to ensure that SRF is a prepared fuel that can be stored, transported and traded and that any standard does not discourage behaviour consistent with the objectives of the waste hierarchy.

Discussions with industry have indicated that it would not be possible to incorporate the diverse requirements of producers and users into a single specification for SRF and so, for the purposes of definition within the RO, a minimum standard for SRF has been

developed that enables it to be distinguished from other types of waste. The criteria considered appropriate for defining a SRF under the RO are:

- it is prepared from non-hazardous waste and classified using CEN/TS 15359;
- has a maximum Respiratory Index ("RI") value from point of production to point of use of no greater than 1500 mg O2/kgVS/h; and
- has a maximum particle size of 150 mm.

Consideration has been given to extending the application of neutrality to SRF beyond use alongside biomass in a fossil fuel power station, to use in other types of generating station. There is concern, however, that such an extension could simply encourage the artificial separation and then recombination of the same waste with no added benefit to society. Defra and DECC will monitor how the SRF market develops to see what changes to this stance might be appropriate in light of the development of cost effective, on-site measurement techniques.

12. Enhanced Capital Allowances for SRF

The Government stated in Budget 2007 that it wanted to encourage investment in SRF combustion capacity by offering more generous tax allowances and the scope of the ECA regime has now been expanded to certain additional items of capital equipment.

The SRF related equipment eligible for ECAs[12] is set out in the Energy Technology Criteria List ("ETCL") used in the operation of the existing GQCHP programme which provides enhanced capital allowances for eligible projects and is administered by CHPQA/AEA. The role of the CHPQA certificate in the overall procedure for CHP schemes applying for ECAs including those firing SRF is described in Guidance Note 42.[13]

13. Renewable Heat Incentive

The Government has announced its intention to introduce a RHI. The scheme design and timing have still to be worked out in detail but the broad principles were discussed in the RES consultation. Under a RHI, the scheme would pay revenue on the basis of the quantity of heat generated and is similar in nature to the use of feed-in tariffs in electricity markets. Further details are set out in the RES.[14]

[12] The ECA scheme allows businesses to write off 100% of their investment in those energy saving technologies that are listed in the Energy Technology Criteria List against the taxable profits of the period during which they make the investment. ECAs are claimed in the same way as other capital allowances on the Corporation Tax Return for companies and the Income Tax Return for individuals and partnerships. One of the qualifying technologies is good quality CHP.

For the purposes of CHP, ECAs are available where the main intended business will be to provide heat and power for clearly identified users on site or to known third parties, and not to generate power for sale to or via unspecified third parties. Thus ECAs will not be available for companies whose core business is electricity production, insofar as they use the CHP system to produce electricity to be sold to unknown end users.

[13] https://www.chpqa.com/guidance_notes/GUIDANCE_NOTE_42.pdf

[14] http://renewableconsultation.berr.gov.uk/consultation/consultation_summary - see page 115 onwards

14. What is Good Quality CHP?

GQCHP refers to the CHPQA programme which provides a method of assessing the efficiency of CHP schemes in the UK. The outputs of schemes certified under CHPQA are designated as being of "Good Quality", and are thereby entitled to various financial incentives such as ECAs. The Quality Index ("QI") is a key parameter used by the CHPQA to assess a CHP scheme.[15]

The CHPQA programme was launched in May 2000 and provides a practical method for assessing all types and sizes of CHP scheme. The methodology and criteria can be viewed at www.chpqa.com. Progress towards the 2010 target is monitored continually under CHPQA, which provides annual statistics on both planned and installed CHP.

Entitlement to ROCs under the EfW with CHP provision within the RO is linked to the CHP Scheme achieving a CHPQA Certificate and this is discussed in more detail in the ROCs section above.[16] Where the CHPQA QI threshold is not met the entitlement to ROCs can be scaled back severely depending on the degree of deficiency.

15. How can CHP be incorporated into waste PFI and PPP schemes?

An EfW plant dedicated to burning unprocessed MSW is most likely to export its surplus heat by fixed pipe to an adjacent heat user. The heat user could be a public or private sector entity with a substantial heat load. Heat can be exported from the EfW plant in the form of steam or hot water. The EfW plant will also export electricity via the grid.

While there are a number of EfW with CHP plants operating in this mode, the approach suffers from certain rigidities, in particular the difficulty of securing adjacent sites for heat production and heat use, the captive nature of the heat use (via fixed pipe) which can cause financial difficulty in the event of failure of the heat taker and securing planning consent at the outset.

Many of the principal costs arising in relation to delivery of a fixed pipe CHP scheme are the same as an electricity only EfW scheme. However, there are certain additional costs associated with the simultaneous supply of power and heat, including costs relating to:-

- the turbine;
- the distribution of heat (pipe work and heat exchangers); and
- any requirement to have stand-by heat supply in place.

Any capital costs relating to the heat distribution network which are incurred during the construction of the EfW will feed into the initial funding requirement and hence the subsequent debt service obligation. As a result these capital costs will be amortised over the loan life and the EfW gate fee will reflect this level of debt service.

[15] https://www.chpqa.com/guidance_notes/GUIDANCE_NOTE_29.pdf
[16] https://www.chpqa.com/guidance_notes/GUIDANCE_NOTE_44.pdf

In other cases, the installation of the heat network may well proceed after the construction of the EfW plant in which event these costs would need to be financed separately against the covenant of the heat taker/user.

The production and distribution of heat will necessarily reduce the level of electricity generated and hence the income receivable from the electricity off-taker. However, there will be a new income stream from heat users and in addition income from ROCs provided the CHP scheme achieves CHPQA Certification.

The practicality of building a new heat loop while at the same time delivering an EfW plant will need to be considered case-by-case in terms of cost, timing and financeability. Examples of projects configured for CHP using unprocessed MSW include Sheffield, Nottingham and the proposed facility in Cornwall.

16. How can SRF contribute to the delivery of CHP?

An alternative approach to fixed pipe EfW with CHP is to process MSW in intermediate processes like MBT, or intermediate technologies like anaerobic digestion or autoclave whose SRF residues can then be sent to a fuel user. This solution is sometimes referred to as the “fuel producer/fuel user” model where the fuel user can be a private or public sector entity geographically remote from the fuel producer.

The fuel producer/fuel user model can enhance the prospects of a CHP outcome by providing a fuel to enable existing heat networks to convert from fossil fuel (largely gas) firing to SRF firing through: (i) conversion of an existing CHP plant; (ii) expansion of an existing installation; or (iii) supplying SRF to a cement kiln. While the last of these may not produce CHP it could provide useful fossil fuel substitution and carbon emission benefits.

The model highlighted above could also use unprocessed waste although industrial and commercial users may prefer SRF either as a consequence of how untreated waste is perceived or because of practical, technical issues related to a refined fuel’s energy efficiency and compatibility with storage and transportation conditions on industrial sites.

Waste Infrastructure Delivery Programme, Defra