Conclusions on BAT from the Energy Efficiency (EE) BAT Reference Document

READ ME:

The Energy Efficiency BAT Reference Document' February 2009 is a horizontal BREF which addresses energy efficiency techniques regardless of the sector or industry.

In this case, you are required to identify the Conclusions on BAT, set out in section 4.2 of this document ('Best Available Techniques') relevant to your installation. Please use the 'Scope' box to describe the relevant activities/processes that come within the scope of this BREF and clearly identify the Conclusions on BAT (sections and subsections) that are 'Not Applicable'.

For each applicable BAT, in the following table, state the status; 'Yes' or 'Will be' as appropriate in the 'State whether it is in place or state schedule for implementation' box. The use of each of these terms is described below.

Information on compliance in the 'Applicability Assessment' box should include, where applicable, the following:

(i) Identification of the relevant process/ activity or individual emission points that the BAT requirement applies to at your installation;

(ii) Where BAT is to use one or a combination of listed techniques, specify the technique(s) implemented/proposed at your installation to achieve the BAT; and

(iii) A comment on how the requirements are being met or will be met, e.g., a description of the technology/operational controls/management proposed to meet the requirements.

Use of terms:

(a) 'Yes' – To be entered where the installation is currently complaint with this BAT requirement.

(b) 'Will be' – To be entered where a further technique is required to be installed to achieve compliance with the BAT requirement. In this case you must also specify the date by which the installation will comply with the BAT Conclusion requirement.

Dublin Waste to Energy assessment of compliance - Conclusions on BAT from the Energy Efficiency BAT Reference Document

The full and complete Energy Efficiency BAT reference document (February 2009) is available at the EIPPC Bureau website: http://eippcb.jrc.ec.europa.eu/reference/

SCOPE
Dublin Waste to Energy Limited (DWtE) export electricity generated on site to the national grid, minus whatever is used on-site by the 'house loads'. In the future, some of this heat will be exported to the Dublin District Heating Scheme (DDHS), when the external infrastructure is completed. Heat export pipework and shell and tube heat exchangers are installed and ready for connection at the lower level of the DWtE facility. The DDHS is currently being developed and is expected to be in operation within 18 months. The DWtE facility will be the baseload for the DDHS which on its own will supply a heat source for over 50,000 homes. Once this is operational the DWTE facility is expected to have net energy efficiency of over 88%.

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
BAT 1. BAT is to implement and adhere to an energy efficiency management system (ENEMS) that incorporates, as appropriate to the local circumstances, all of the following features (see Section 2.1. The letters (a), (b), etc. below, correspond those in Section 2.1): a. commitment of top management (commitment of the top management is regarded as a precondition for the successful application of energy efficiency management); b. definition of an energy efficiency policy for the installation by top management;	Applicable DWtE is implementing a formal ENEMS reflecting the full requirements of BAT1. The recommendation to implement an ENEMS was made in an energy audit report prepared by Powetherm Solutions in June 2018. This audit was repeated in 2020. These energy audits were undertaken in accordance with Condition 7.3 of the site IE Licence. As required by Condition 7.4 of the site IE Licence recommendations of the audit have been incorporated in DWtE's schedule of objectives and targets. Notwithstanding this, DwtE has commenced implementation of certain BAT1 requirements, mainly:	Q4 2021.

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c. planning and establishing objectives and targets (see BAT 2, 3 and 8) ; d. implementation and operation of procedures paying particular attention to: i) structure and responsibility ii) training, awareness and competence (see BAT 13); iii) communication iv) employee involvement v) documentation vi) effective control of processes (see BAT 14) vii) maintenance (see BAT 15) viii) emergency preparedness and response ix) safeguarding compliance with energy efficiency-related legislation and agreements (where such agreements exist). e. benchmarking, f. checking performance and taking corrective active g. review of EMS	• A communications strategy to deal with the needs and expectations of interested parties as well as raising and investigating non-conformances; • A methodology for establishing and monitoring objectives and targets, aspects and impacts, Key Performance Indicators and IE Licence monitoring requirements; • A training programme to ensure staff are adequately trained and competent; • A variety of standard operating procedures to ensure the compliant running of the facility with the site IE Licence and in accordance with BAT 1 d; • Documented maintenance schedules and programmes; • A documented Emergency Response Plan (ERP) and Accident Prevention Policy (APP) as per the site IE Licence; • A change request procedure which considers the environmental impact of proposed site changes; • A review and audit programme. Specifically with respect to benchmarking (BAT 1 e) an Energy Efficiency Audit of the Facility was conducted in April 2018 and repeated in 2020. A benchmarking exercise was undertaken during this audit. The DWtE facility was assessed against similar European facilities in terms of its energy performance. The result of this benchmarking was that DWtE was rated above the other facilities in terms of electrical efficiency. The DWtE facility had a 35% higher measured export efficiency compared to the best other facility researched.	

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	Overall process energy efficiency is a key performance indicator for the entire facility (and there is a minimum EPA licence requirement of 65% overall energy efficiency) and so is closely monitored.	
BAT 2. BAT is to continuously minimise the environmental impact of an installation by planning action & investments on an integrated basis and for the short, medium and long term, considering the costs/benefits & cross media effects.	Applicable Energy Efficiency (EE) is considered for applicable site changes such as upgrades or the installation of new Significant Energy Users (SEUs). As part of the setting of Objectives and Targets, projects identifying energy reduction are considered and implemented where energy savings can be realised. These objectives and targets consider both short and medium term objectives but also longer term objectives as required by the site EMS. Part of the reasoning behind the selection of the site on the Poolbeg Peninsula was its close proximity to a potential future district-heating network in the Dublin Docklands Area. The Facility was constructed with built-in provisions for the supply of district heating to the city of Dublin when the district heating scheme comes into place.	Yes
BAT 3. BAT is to identify the aspects of an installation that influence EE by means of an audit.	Applicable An energy audit was completed on the 20th of April 2018 by Powertherm Solutions (report date June 2018). This audit was repeated in 2020. The audit reports contains information and recommendations on energy saving opportunities at the DWtE facility. This audit reported an energy efficiency of 71.5%	Yes

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	which is above the 65% efficiency required by the IE Licence in Condition 7.2.	
BAT 4. When carrying out an audit, BAT is to ensure that the audit identifies the following aspects (See BREF Section 2.11) : This BATC lists the aspects to be considered (a) - (f): a. energy use and type in the installation and its component systems and processes; b. energy-using equipment, and the type and quantity of energy used in the installation; c. possibilities to minimise energy use, such as: • controlling/reducing operating times, e.g. switching off when not in use (e.g. see Sections 3.6, 3.7, 3.8, 3.9, 3.11) • ensuring insulation is optimised, e.g. see Sections 3.1.7, 3.2.11 and 3.11.3.7 • optimising utilities, associated systems, processes and equipment (see Chapter 3); d. possibilities to use alternative sources or use of energy that is more efficient, in particular energy surplus from other processes/ systems, see Section 3.3; e. possibilities to apply energy surplus to other processes and/or systems, see Section 3.3; f. possibilities to upgrade heat quality (see Section 3.3.).	Applicable The energy audit referred to in BAT1 and BAT3 above which addresses the requirements of BAT4 where relevant. The audit report also contains a number of recommendations for improved energy efficiency / energy minimisation. In the future, DWtE plan on exported heat to the Dublin District Heating Scheme, when the external infrastructure is completed. Heat export pipework and shell and tube heat exchangers are installed and ready for connection at the lower level of the DWtE facility. The Dublin District Heating system (DDHS) is currently being developed and is expected to be operation within 18 months. The DWtE facility will be the baseload for the DDHS which on its own will supply a heat source for over 50,000 homes. Once this is operational the DWTE facility will have net energy efficiency of over 88%.	Yes

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
BAT 5. BAT is to use appropriate tools/methods to identify/quantify energy optimisation, e.g. models databases & balances; techniques such as pinch technology, thermoeconomics; estimates & calculations.	Applicable The following requirements consistent with BAT5 are implemented at the DWtE facility: • The DWtE facility was designed as an integrated facility using state-of-the art thermodynamic and design software to optimise design and energy consumption. • Trends are available of all monitoring data (e.g., steam flow rate and waste flow rates) to identify loss of efficiency thereby allowing corrective action to be implemented. • DWtE management regularly assesses plant energy efficiency against IE licence condition 7.2. • Performance improvement management techniques such as 6-sigma are being considered to systematically analyse unit operation performance to assess opportunities for increased operational efficiency (which in turn increases energy efficiency)	Yes
BAT 6. BAT is to Identify opportunities to optimise energy recovery within and between systems at the installation, including 3rd parties as per BREF 3.2-3.4	Applicable The DWtE facility was designed to optimise energy recovery from the feed waste and to implement control and monitoring systems to make adjustments to continue to optimise energy recovery. Through the implementation of performance improvement, DWtE continues to identify opportunities for energy recovery.	Yes

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	Refer to BAT 4 for a discussion on DDHS. Refer to BAT 11 and BAT 17 below for a discussion on energy efficiency.	
BAT 7. BAT is to Optimise EE through a systems approach to energy management. Systems to be considered for optimising as a whole are, for example: • Process units (see sector BREFs) • Heating systems such as: o steam (see Section 3.2) o hot water • Cooling and vacuum (see the ICS BREF) • Motor driven systems such as: o compressed air (see Section 3.7) o pumping (see Section 3.8) • Lighting (see Section 3.10) • Drying, separation and concentration (See Section 3.11).	Applicable Refer to BAT 1	
BAT 8. BAT is to establish EE indicators by carrying out all of the following: to be developed as per section 4.2.2.4 a. identifying suitable energy efficiency indicators for the installation, and where necessary, individual processes, systems and/or units, and measure their change over time or after the implementation of energy efficiency measures. b. identifying and recording appropriate boundaries associated with the indicators. c. identifying and recording factors that can cause variation in the energy efficiency of the relevant process, systems and/or units.	Applicable DWtE has established baseline energy conditions via the energy audit of April 2018 and the repeat audit in 2020. DWtE has robust energy improvement targets in place based on this baseline condition. Once DWtE has implemented an ENEMS, energy boundaries will be established. The site ENEMS will document factors that can cause a variation in site energy efficiency including weather conditions and combustion schedules. Boiler efficiency, electrical efficiency (turbine, steam), and overall site efficiency are monitored currently by DWtE.	DWtE commit to the commencement of implementation of an ENEMS during 2019.
BAT 9. BAT is to carry out sectoral/regional/national benchmarking.	Applicable	Yes

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	Refer to BAT 1	
BAT 10. BAT is to optimise EE when planning a new installation, unit, system or significant upgrade by considering the list in 4.2.3: a. the energy efficient design (EED) should be initiated at the early stages of the conceptual design/basic design phase b. the development and/or selection of energy efficient technologies c. additional data collection may need to be carried out to supplement existing data or fill gaps in knowledge d. the EED work should be carried out by an energy expert e. the initial mapping of energy consumption should also address which parties in the project organisations influence the future energy consumption and should optimise EED of the future plant with them.	Applicable Energy conservation has been incorporated in the facility design (including abatement equipment). Plume suppression was not proposed due to excess energy requirements. The use of a water cooling condenser instead of an air cooling condenser was implemented as it is more energy efficient. The on-site boilers are designed to have a thermal conversion efficiency of c.90%. The facility is also designed to provide for the export of heat (e.g. district heating). For a further discussion please refer to BAT 11 and BAT 17 below.	Yes
BAT 11. Optimise EE/Energy recovery between systems/processes /parties at installations.	Applicable The facility is designed to optimise heat recovery and power output. The facility is also designed to accommodate future district heating and when a district heating system comes into operation this can be implemented with minor modifications to the equipment. Electricity is generated on-site from the thermal energy produced by the combustion of waste. The two lines supply steam to one complete turbine/generator set with a high-voltage system that is connected to the electrical grid. A small portion of this electricity is used to power the plant with the remainder	Yes

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	exported to the national grid. The turbine design optimises the electrical power output. Cooling of the exhaust steam from the turbine takes place in a seawater-cooled condenser. The condenser temperature is minimised using cooling water from the River Liffey estuary thus securing a higher electrical efficiency compared to that obtained with air-cooled condensers and/or wet cooling towers. The design results in the net (electrical) power output from the DWtE site of approximately 62-63MW equivalent to a net power efficiency of approximately 32%. The Dublin District Heating system (DDHS) is currently being developed and is expected to be in operation within 18 months. The DWTE facility will be the baseload for the DDHS which on its own will supply a heat source for over 50,000 homes. Once this is operational the DWTE facility is anticipated to have a net energy efficiency of over 88%. .	
BAT 12. BAT is to maintain the impetus of the energy efficiency programme by using a variety of techniques, such as: a. implementing a specific energy efficiency management system (see Section 2.1 and BAT 1) b. accounting for energy usage based on real (metered) values, which places both the obligation and credit for energy efficiency on the user/bill payer (see Sections 2.5, 2.10.3 and 2.15.2) c. the creation of financial profit centres for energy efficiency (see Section 2.5) d. benchmarking (see Section 2.16 and BAT 9) e. a fresh look at existing management systems, such as using operational excellence (see Section 2.5)	Applicable All energy usage at the facility is metered. DWtE undertakes benchmarking as discussed in BAT 1. DWtE has included EE in its objectives and targets as discussed in BAT 1.	DWtE commit to the commencement of implementation of an ENEMS during 2019.

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f. using change management techniques (also a feature of operational excellence, see Section 2.5).		
BAT 13. Maintain expertise in EE/energy using systems through recruitment/training; use of specialist staff/systems/functions; resource sharing.	Applicable DWtE has a site Energy Lead (Process Engineer) who is supported in their role by suitably skilled and qualified staff members. External expertise is utilised when required. The site is also supported at a Global level by a Corporate Energy Team where there is an active network of specialists that DwtE has access to.	Yes
BAT 14. Implement effective process control through: compliance with procedures; EE performance parameters identified & optimised, and documented/recorded. a. having systems in place to ensure that procedures are known, understood and complied with. b. ensuring that the key performance parameters are identified, optimised for energy efficiency and monitored. c. documenting or recording these parameters	Applicable DWtE has prepared a defined set of energy SOPs and these appear on the training curricula of identified staff members whose role could have an impact on site energy efficiency. The site also monitors site wide energy consumption Key performance parameters include: • Waste input rate and calorific value; • Mass of steam produced and associated variables (temperature, pressure, etc); and • Electrical energy exported onto the national grid These parameters are continuously monitored and analysed and is central to the commercial operation of the facility.	Yes
BAT 15. Carry out maintenance to optimise EE through measures specified in 4.2.8.	Applicable DWtE has designed and implement a strict preventative maintenance regime. This regime established maintenance	Yes

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a. clearly allocating responsibility for the planning and execution of maintenance. b. establishing a structured programme for maintenance based on technical descriptions of the equipment, norms, etc. as well as any equipment failures and consequences. Some maintenance activities may be best scheduled for plant shutdown periods. c. supporting the maintenance programme by appropriate record keeping systems and diagnostic testing. d. identifying from routine maintenance, breakdowns and/or abnormalities possible losses in energy efficiency, or where energy efficiency could be improved. e. identifying leaks, broken equipment, worn bearings, etc. that affect or control energy usage, and rectifying them at the earliest opportunity.	schedules including responsibilities for all key equipment at the DWtE facility.	
BAT 16. Establish & maintain documented procedures to measure characteristics of operations with a significant impact on EE.	Applicable Ref to BAT 1	DwtE commit to the commencement of implementation of an ENEMS during 2019.
BAT 17. BAT is to optimise EE of combustion by related techniques such as: i) Advanced computer control of combustion conditions. ii) reduced excess air. iii) pre-heating of fuel gas. iv) pre-heating of combustion air.	Applicable The flue gas is recirculated, the supply of primary and secondary combustion air and the grate speed are controlled by an advanced combustion control system which measures flow rate, flue gas oxygen and combustion temperature in order to obtain the best possible operational conditions and maximise steam production. Integral furnace boilers are used at the Facility.	Yes

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
	The boilers are equipped with water-cooled panel walls in the grate furnaces and the secondary combustion chamber. The boiler is further equipped with adequate internal/external insulation. Flue gas is recirculated. Incineration bottom ash is discharged into a water bath. Heat recovery from plant unit operations (e.g., the baghouse and from the turbines via turbine bleeds) is deployed to pre-heat feed water and/or primary combustion air. Boilers were designed taking into account flue gas velocity and distribution, water/steam circulation and convection bundles. The heat from flue gas is used in the boilers to generate steam and that steam is utilised for electricity generation.	
BAT 18. BAT for steam systems is to optimise EE by using techniques such as: those measures listed in 4.2 in regard to design, operation/control, generation and distribution, recovery of condensate.	Applicable The boiler thermal conversion was designed to archive at least 90% energy efficiency. The turbine design was selected in order to optimise the power output. However, the Facility was constructed with built-in provisions for the supply of district heating to the city of Dublin when the district heating scheme comes into place. Refer to BAT 11 and 17.	Yes
BAT 19. Maintain heat exchanger efficiency by monitoring efficiency & preventing/removing fouling.	Applicable Heat exchangers are routinely monitored and maintained as per the PM system.	Yes

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
BAT 20. BAT is to seek possibilities for cogeneration inside and /or outside the installation (with a third party).	Applicable Part of the reasoning behind the selection of the site on the Poolbeg Penisula was its close proximity to a potential future district-heating network in the Dublin Docklands Area. The Facility was constructed with built-in provisions for the supply of district heating to the city of Dublin when the district heating scheme comes into place.	Yes
BAT 21. Increase power factor according to local power distributor requirements: a. Installing capacitors in the AC circuits to decrease the magnitude of reactive power. or lightly loaded motors. Minimising the operation of idling. b. Avoiding the operation of equipment above its rated voltage. c. When replacing motors, using energy efficient motors.	Applicable The site minimises idling, avoids using equipment above its rated voltage and when replacing motors uses energy efficient replacements.	Yes
BAT 22. Check for harmonics & apply filters if required.	Not Applicable	Not Applicable
BAT 23. Optimise various power supply efficiency measures. a. Ensure power cables have the correct dimensions for the power demand. b. Keep online transformer(s) operating at a load above 40 50 % of the rated power. c. Use high efficiency/low loss transformers.	Applicable The facility keeps online transformers operating at a load above 40% and use high efficiency/low loss transformers.	Yes
BAT 24.	Applicable	Yes

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
Optimise electric motors as per section 4.3.6a. a. Using energy efficient motors (EEM). b. Proper motor sizing c. Installing variable speed drives (VSD) d. Installing high efficiency transmission/reducers e. Use direct coupling where possible, synchronous belts or cogged V-belts in place of V belts and helical gears in place of worm gears. f. Energy efficient motor repair (EEMR) or replacement with an EEM. g. Rewinding: avoid rewinding and replace with an EEM, or use a certified rewinding contractor (EEMR). h. Power quality control I. Integrate lubrication, adjustments and tuning into system operation and maintenance.	Variable speed drives and high efficiency transformers were installed at the facility. Where applicable, all motors are optimised as per section 4.3.6a of the BREF.	
BAT 25. Optimise compressed air systems (CAS) as per table 4.6.	Applicable Where applicable all CAS are optimised as per section 4.6 of the BREF.	Yes
BAT 26. Optimise pumping systems as per 4.3.8	Applicable Where applicable all pumping systems are optimised as per section 4.3.8 of the BREF.	Yes
BAT 27. Optimise HVAC systems as per 4.3.9	Applicable Where applicable all HVAC systems are optimised as per section 4.3.9 of the BREF.	Yes
BAT 28. Optimise lighting systems as per 4.3.10.	Applicable Lighting is LED throughout and is controlled by motion sensors.	Yes
BAT 29. BAT is to optimise drying, separation and concentration processes by using techniques such as those in Table 4.10 according to applicability, and to seek	Not applicable	Not applicable

Conclusions on BAT	Applicability Assessment (describe how the technique applies or not to your installation)	State whether it is in place or state schedule for implementation
opportunities to use mechanical separation in conjunction with thermal processes.		