

**EP Lynemouth**

Lynemouth Power Station  
Ashington  
Northumberland  
NE63 9NW  
England

---

**EP Lynemouth**

# IED Article 15(4) Derogation Request

Environmental Permit EPR/FP3137CG  
Lynemouth Power Station

---

20/03/2026

## Contents

1	Executive Summary .....	4
2	Current Emissions Performance .....	8
2.1	Oxides of Nitrogen (NO <sub>x</sub> ): .....	8
2.2	Particulates (Dust):.....	9
2.3	Improvement in Performance Levels .....	10
2.4	Constraints Affecting Emissions Performance .....	11
3	Life Extension & pBECCS Summary .....	11
3.1	pBECCS Technical Summary .....	13
4	Applicable BAT-AEL .....	15
4.1	IED Annex V ELVs .....	15
4.2	Applicable BAT-AEL.....	15
5	Derogation Justification.....	17
5.1	NO <sub>x</sub> BAT-AEL Derogation Request.....	18
5.1.1	BAT Options Assessment (NO <sub>x</sub> ) .....	20
5.1.2	Primary NO <sub>x</sub> Reduction Techniques:.....	21
5.1.3	Fuel Staging (NO <sub>x</sub> ): .....	21
5.1.4	Flue Gas Recirculation (NO <sub>x</sub> ): .....	21
5.1.5	Selective Non-Catalytic Reduction (SNCR): .....	22
5.1.6	Selective Catalytic Reduction (SCR):.....	26
5.2	Dust BAT-AEL Derogation Request.....	31
5.2.1	BAT Options Assessment (Dust).....	33
5.2.2	Fuel Choice and Other Techniques: .....	34
5.2.3	Electrostatic Precipitators:.....	34
5.2.4	Bag Filters: .....	38
5.3	Derogation Request Environmental Context .....	38
5.3.1	Human Health Impact:.....	38
5.3.2	Ecological Impacts: .....	40
5.3.3	Mass Emissions:.....	40
6	Cost Benefit Analysis (CBA) .....	42
6.1	Overview of CBA.....	42
6.2	CBA Input Data .....	42
6.3	CBA Results .....	43
7	Conclusions .....	45
7.1	NO <sub>x</sub> BAT-AEL Derogation (BAT 24).....	45

7.2	Dust BAT-AEL Derogation (BAT 26).....	45
7.3	Timeline and Derogation End Date.....	45
8	Appendices .....	46

## 1 Executive Summary

This document provides the technical, environmental and economic justification for EP Lynemouth's request for derogations from Best Available Techniques (BAT) conclusions BAT 24 (NO<sub>x</sub>) and BAT 26 (Dust) for the Lynemouth Power Station installation under Article 15(4) of the Industrial Emissions Directive (IED, 2010/75/EU).

Lynemouth Power Station is a large combustion plant (LCP) comprising 3 x 140 MWe generating units with a total gross electrical output of 420 MWe. Lynemouth power station was commissioned in 1972, at which time it was designed to burn Northumberland coal and primarily provide electricity to the adjacent aluminium smelter. Following the closure of the smelter in 2012 Lynemouth Power Station supplied baseload power to the local distribution network. Coal burning permanently ceased in December 2015 and Lynemouth Power Station was subsequently converted to enable 100% solid biomass-fired generation. This was made possible by the award of a Contract for Difference (CfD) which has provided revenue support since June 2018 and will continue through to March 2027. Following the conversion, the Lynemouth Power Station installation remains an 'existing plant', i.e. not a 'new plant', under the definitions of the Large Combustion Plan (LCP) BAT conclusions (2010/1442/EU).

Finalisation of the conversion project design, during 2015, pre-dated the 2017 publication of the LCP BAT conclusions and therefore the design performance levels for emissions of NO<sub>x</sub> and dust were specified to comply with the relevant IED Annex V emission limit values (ELVs). Following the request submitted to the Environment Agency on 15/11/2018, two derogations were issued to Lynemouth Power Limited for LCP BAT Conclusions 24 (NO<sub>x</sub> BAT-AEL) and 26 (Dust BAT-AEL) under Article 15(4) of the Industrial Emissions Directive. The derogation limits are listed in Table 2 and are applicable until 31/03/2027 or until the next permit review, whichever is sooner. The expiry date of 31/03/2027 of these derogations aligns with the expiry of EP Lynemouth's (CfD), under which Lynemouth Power Station currently operates.

Combustion Unit	Substance	Yearly Average ELV (mg/Nm <sup>3</sup> )	Daily Average ELV (mg/Nm <sup>3</sup> )
Solid fuels – biomass > 300 MW <sub>th</sub>	NO <sub>x</sub>	160	200
Solid fuels – biomass > 300 MW <sub>th</sub>	Dust	10	16

Table 1: LCP BAT Conclusion AELs for existing plant

Combustion Unit	Substance	Monthly Average ELV (mg/Nm <sup>3</sup> )	Daily Average ELV (mg/Nm <sup>3</sup> )
Solid fuels – biomass > 300 MW <sub>th</sub>	NO <sub>x</sub>	200	220
Solid fuels – biomass > 300 MW <sub>th</sub>	Dust	20	22

Table 2: Current derogation limits (IED Annex V)

To support the UK Government's Net Zero Strategy, EP Lynemouth has been considering options to extend the operation of the power station post-2027, and are developing a post-combustion carbon capture and storage (pBECCS – Power Bioenergy Carbon Capture and Storage) project. The project was confirmed as meeting the UK Government's Eligibility and Deliverability criteria for Phase 2 of Cluster Sequencing in March 2023, however, it was not included on the Track 1 Project Negotiation List. EP Lynemouth has been in discussion with the UK Government since then to (a) determine how the power station may operate after the end of the current CfD contract in 2027, and (b) a later deployment of BECCS at Lynemouth. If BECCS were deployed at Lynemouth the greenhouse gas reductions provided by the carbon capture plant would support delivery of Carbon Budgets 6 (2033 - 37) and 7 (2038 – 42). A full carbon life-cycle assessment has been carried out for the pBECCS project

and the results of this study indicate that the pBECCS project could provide net negative emissions of circa 2.25 million tonnes of CO<sub>2</sub> annually.

The pBECCS plant is not predicted to be operational until 2034. In order to bridge the gap between the end of the current CfD and start of operation of the pBECCS project, EP Lynemouth intend to continue operation as a 100% solid biomass-fired generation station, under the Transitional Support Mechanism confirmed by the UK Government on 10<sup>th</sup> February 2025. This proposed period of operation is supported by recent announcements from the Department of Energy Security (DESNZ)<sup>1</sup> and the National Energy System Operator (NESO). EP Lynemouth are currently in formal, bi-lateral negotiation with Government in relation to a Low Carbon Dispatchable CfD to apply from April 2027, both parties are aligned on objectives to reach an investable value-for-money deal.

To continue to operate after the expiry of the current derogation, a new derogation is required to cover the period of operation under the new Low Carbon Dispatchable CfD.

Despite significant reductions in emissions compared to the legacy coal-fired operation, EP Lynemouth is unable to consistently comply with the BAT associated emission limits (BAT-AELs) for NO<sub>x</sub> and dust due to the configuration of its three boilers.

Additionally, in order to a secure supply of 100% sustainable biomass fuel, EP Lynemouth must burn a range of fuels from various suppliers with varying compositions including in moisture content, calorific value, nitrogen content and ash content. These variations, driven by supply chain diversity and seasonal factors, directly influence combustion behaviour and emission profiles. Optimising combustion parameters for each fuel batch is complex and cannot always be achieved instantaneously, especially when balancing efficiency, emissions, and plant reliability.

Whilst the EP Lynemouth installation already applies a combination of BAT techniques to reduce emissions of NO<sub>x</sub> and dust to air, the applicability of other techniques is constrained by the design and configuration of the existing power station infrastructure.

The difficulties in retrofitting additional secondary abatement to existing plant are recognised in the LCP BRef Note and in the UK BAT Conclusions TWG Split Views 'BAT-AELs for NO<sub>x</sub> from biomass fired plant' and 'SCR on Biomass Plant'. The findings of the supporting technical reviews for application of the various BAT techniques are summarised in this document.

The EP Lynemouth biomass conversion project implemented an enhanced combination of BAT techniques to reduce primary emissions of NO<sub>x</sub>, however, as noted above the configuration/design of the boilers and performance constraints prevented the effective retrofit of further NO<sub>x</sub> abatement techniques, including selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR), at the time of the conversion.

As part of this derogation request further investigation regarding the retrofit of NO<sub>x</sub> abatement techniques was undertaken. The investigation indicated that whilst existing NO<sub>x</sub> emission levels may be able to be reduced, any reduction would not be guaranteed.

SNCR implemented at Lynemouth would have a low NO<sub>x</sub> abatement efficiency with projected emissions still not compliant with the BAT-AEL. However, for these limited emissions improvements, SNCR would result in reduced boiler efficiency, increased plant corrosion risk and the release of ammonia through the flue gases and subsequent contamination of ash.

---

<sup>1</sup> Department of Energy Security and Net Zero, 2025, 'Transitional support mechanism for large-scale biomass generators - Government response to the consultation', available at: <https://www.gov.uk/government/consultations/transitional-support-mechanism-for-large-scale-biomass-electricity-generators> (accessed: 03 Apr 2025)

SCR could not be implemented without complex and costly engineering solutions and would again result in a reduction in boiler and electrical efficiency, and high OPEX costs due to accelerated catalyst deactivation with biomass fuels.

In addition, both SNCR and SCR, whilst reducing NO<sub>x</sub> emissions, would introduce additional emissions to air associated with ammonia slippage, increasing impacts from nitrogen nutrient and acid deposition at nearby ecological sites.

The options for retrofit of further dust abatement have been assessed and these are again severely constrained by the existing plant configuration. Upgrading the existing Electrostatic Precipitators (ESPs) would not significantly increase the capture efficiency and moreover, would not achieve the dust BAT-AEL. The use of fabric filters was also investigated but this option was rejected due to the difficulty of retrofitting new fabric filters with the existing plant infrastructure and the unacceptable fire risk associated with capture of biomass ash dusts with high unburnt carbon content. The latter assessment relating to the unacceptable fire risks associated with fabric filters has been confirmed based on operational experience of the plant since commissioning on biomass in 2018.

The NO<sub>x</sub> and dust derogation requests are therefore both being made on the criteria of the **technical characteristics of the installation** and specifically on the basis that the configuration of the plant makes it technically more difficult, that the costs of complying with the NO<sub>x</sub> and dust BAT-AEL are disproportionate to the environmental benefits and that the current combination of techniques is considered BAT for the installation.

Additional factors that support the derogation application include:

- Recent history of pollution control with respect to the pollutants for which the derogation is sought.
- The general investment cycle.
- The effect of reducing the excess emission(s) upon other pollutants, energy efficiency and waste arisings.
- The intended remaining operational lifetime of the installation as a standalone LCP. i.e. under the Low Carbon Dispatchable CfD
- The expected dispatchable operational profile of the plant, as will be mandated by the UK government as part of the transitional support mechanism decision. Operation will be at lower load factors than historically, thereby reducing mass emissions of pollutants, but including increased start-up/shut-down cycles.
- The most likely outcome of the cost of complying with NO<sub>x</sub> and dust BAT-AEL would be to materially increase the cost of the extension of the life of Lynemouth after 2027 to the extent that the cost of a Low Carbon Dispatchable CfD does not provide value for money for consumers, leading to the loss of both the biomass generation at Lynemouth from 2027 and the loss of the potential for net negative carbon emissions from 2034.
- The technical specification and performance of NO<sub>x</sub> and dust abatement required for the pBECCS project is still to be confirmed pending detailed FEED studies. However, proposals will be designed to integrate the Lynemouth Power Station with the pBECCS facility and achieve applicable BAT AELs at that time. Any additional abatement installed for the Low Carbon Dispatchable CfD period is likely to become redundant and require removal if found not to be suitable for integration with the pBECCS plant.

An air quality impact assessment has been completed to compare emissions under various BAT-AEL scenarios against the preferred derogation scenario. The outcome of the impact assessment is that, when compared against the relevant air quality standard (AQS) or environmental assessment level (EAL), the human health and ecological impacts are considered insignificant for the derogation scenario with no material environmental benefits from retrofit of additional techniques for NO<sub>x</sub> and dust abatement.

Assessment of the mass emissions of NO<sub>x</sub> in the context of the National Emissions Ceiling (NEC) Regulations show that for both BAT and derogation scenarios the contribution is insignificant (0.16%

and 0.20% of the 2019 NEC respectively) with no significant difference in contribution between the two scenarios.

A cost-benefit analysis (CBA), using the EA's BAT CBA tool, has been completed for comparison of the applicable BAT techniques against the preferred scenario of extending existing derogations. The CBA results demonstrate that the costs of complying with the NO<sub>x</sub> and dust BAT-AEL are disproportionate to the environmental benefits and that the current combination of techniques for the limited extended period is considered BAT for the installation.

As for all carbon capture projects participating in the Government's Cluster Sequencing and Track process, the Lynemouth pBECCS project is unlikely to go ahead without Government support. The baseline assumption for the pBECCS project is that captured CO<sub>2</sub> would be permanently stored in the Northern Endurance Partnership's Endurance store (or future expansion), part of the East Coast Cluster (ECC). Government support for the project would be gained through the Track 1 Expansion process for the ECC. At the time of this derogation application, Government has not confirmed when the Track 1 Expansion process for the ECC will start, furthermore, an Independent Review of Greenhouse Gas Removals, was submitted to the DESNZ Secretary of State (SoS) in October 2025<sup>2</sup>, with the timeline for the SoS's response currently to be confirmed. Based on the uncertainty regarding the timeline for announcement of the Track 1 Expansion process, the SoS's response to the Greenhouse Gas Removals (GGRs) review and the development and construction period of the pBECCS project, a derogation is sought to 31 Dec 2035.

---

<sup>2</sup> Department of Energy Security and Net Zero, 2025, 'Independent report, Independent Review of Greenhouse Gas Removals: terms of reference', available at: <https://www.gov.uk/government/publications/greenhouse-gas-removals-ggrs-independent-review/independent-review-of-greenhouse-gas-removals-terms-of-reference> (accessed: 03 Apr 2025)

## 2 Current Emissions Performance

Despite significant reductions in emissions compared to the legacy coal-fired operation, EP Lynemouth are unable to consistently guarantee compliance with the BAT-AELs for NO<sub>x</sub> and dust under all operational conditions. Details on the current measures for controlling NO<sub>x</sub> and dust and associated emissions performance are set out in the sections below.

### 2.1 Oxides of Nitrogen (NO<sub>x</sub>):

EP Lynemouth utilises a combination of primary measures associated with BAT for the control of NO<sub>x</sub> emissions. These measures include low NO<sub>x</sub> burners, low nitrogen-content fuel and boosted over fire air (BOFA) fans. The baseline NO<sub>x</sub> performance of each of the three units is relatively consistent with any notable difference between the three units emanating from various influences, including the number of running hours since the last major maintenance outage and the boiler conditions.

For the period since commissioning on biomass the station average NO<sub>x</sub> concentration was **174.5 mg/Nm<sup>3</sup>**, reported at 100% of measured value (accounting for the 95% confidence interval 139.6 mg/Nm<sup>3</sup>-C). Figure 1 below shows NO<sub>x</sub> daily averages since commissioning at 100% of the measured value.

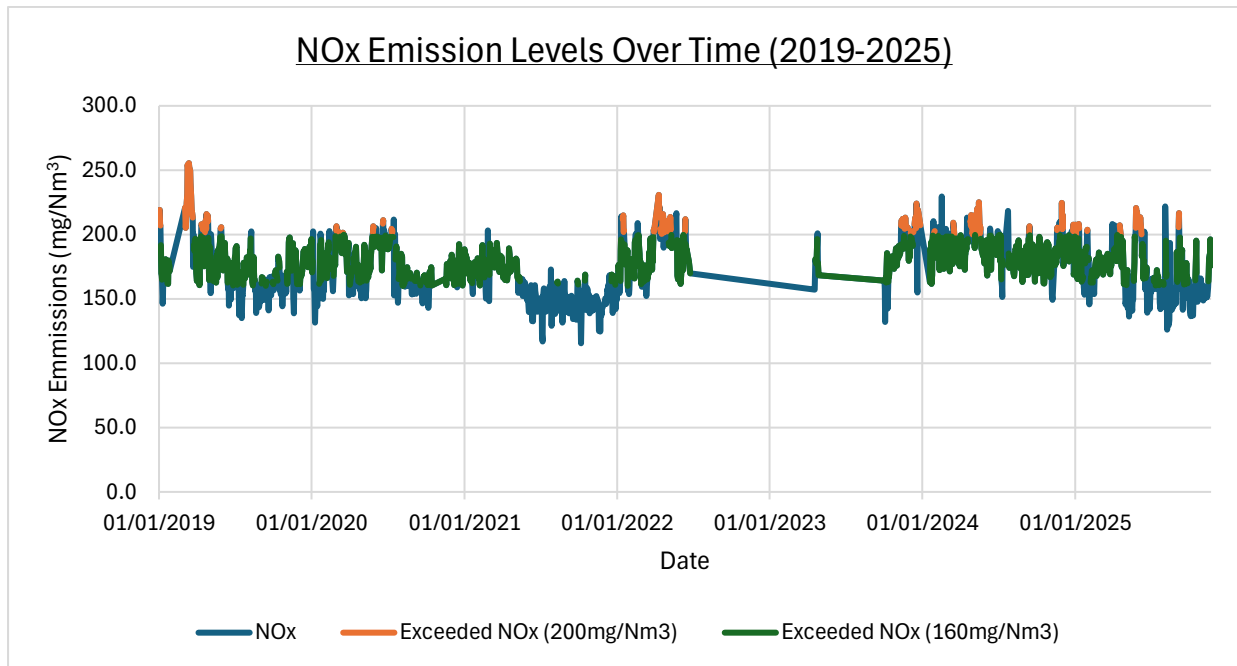


Figure 1: Daily Average NO<sub>x</sub> Emissions

As shown in Figure 1, there are 255 instances where EP Lynemouth would breach the daily BAT-AEL of 200 mg/Nm<sup>3</sup> in the period. After accounting for the 95% confidence factor the number of breaches reduces to 4. It is clear that EP Lynemouth would rely heavily on the 95% confidence factor in order to comply with NO<sub>x</sub> emission limits. Any change in a regulatory approach of implementing a confidence factor for reporting purposes would present a significant risk to EP Lynemouth’s ability to supply low carbon dispatchable energy to the grid.

Table 3 below presents the annual average NO<sub>x</sub> emissions post biomass conversion. It once again shows how EP Lynemouth would be relying on the 95% confidence factor in order to comply with BAT-AELs, where in 6 of the 7 years EP Lynemouth would breach the annual BAT-AEL for NO<sub>x</sub> at the 100% measured value.

NO <sub>x</sub> Annual Average	2019	2020	2021	2022	2023	2024	2025
95% Confidence Interval (mg/Nm <sup>3</sup> -C)	140.8	140.5	126.3	140.5	151.3	150.1	137.6
100% Measured Value (mg/Nm <sup>3</sup> )	176.0	175.6	157.9	175.6	189.1	187.6	172.0

Table 3. Annual Average NO<sub>x</sub> Emissions

### 2.2 Particulates (Dust):

EP Lynemouth utilises ESPs to abate emissions of particulates. The unit dust emissions performance depends upon several factors including the characteristics of the fuel, the frequency of unit start-up and shut-downs, boiler conditions etc.

For the period since commissioning on biomass the station average dust concentration, reported at 100% of measured value, was **11.4 mg/Nm<sup>3</sup>** (accounting for the 95% confidence interval 8.0 mg/Nm<sup>3</sup>-C)

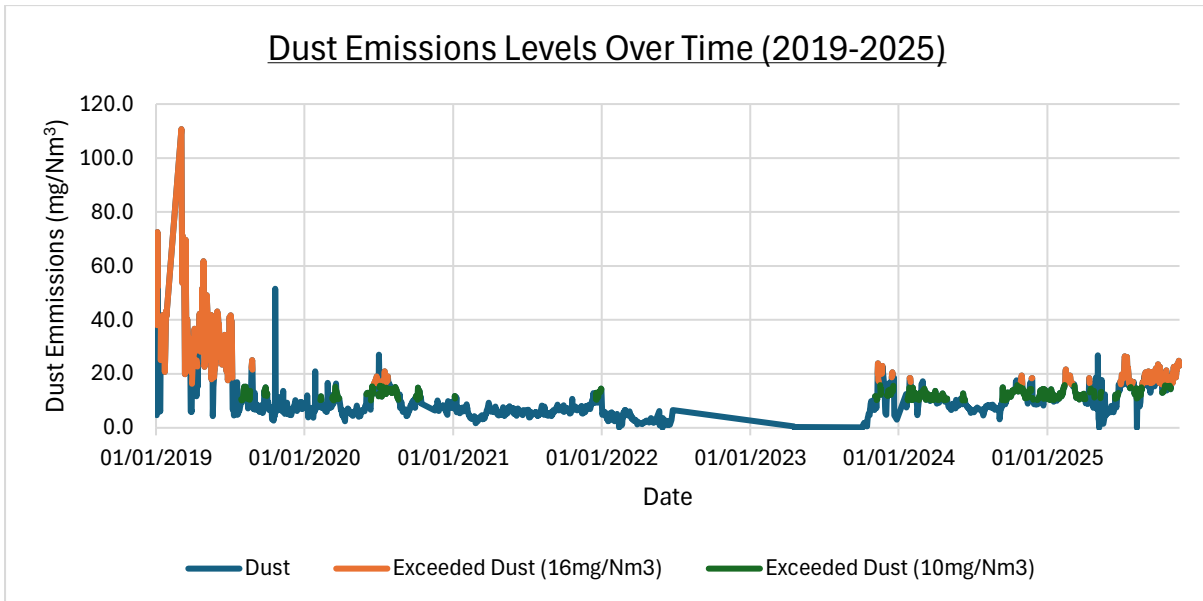


Figure 2: Daily Average Dust Emissions

As shown in Figure 2, there are 366 instances where EP Lynemouth would breach the daily BAT-AEL of 16 mg/Nm<sup>3</sup> in the period. After accounting for the 95% confidence factor the number of breaches reduces to 202. It is clear that even after accounting for the confidence factor that EP Lynemouth would be unable to comply with the daily BAT-AEL for dust.

Table 4 below presents the annual average dust emissions post biomass conversion. It once again shows how EP Lynemouth would be relying on the 95% confidence factor in order to comply with BAT-AELs, where in 3 of the 7 years EP Lynemouth would breach the annual BAT-AEL for dust at the 100% measured value. In addition, in two of the years post conversion EP Lynemouth would breach the annual BAT-AEL even after accounting for the confidence factor.

Dust Annual Average	2019	2020	2021	2022	2023	2024	2025
95% Confidence Interval (mg/Nm <sup>3</sup> -C)	13.5	6.6	4.5	4.2	5.6	7.4	10.8
100% Measured Value (mg/Nm <sup>3</sup> )	19.3	9.4	6.4	6.0	8.0	10.6	15.4
1. 2025 data presented January-September							

Table 4. Annual Average Dust Emissions

## 2.3 Improvement in Performance Levels

Despite not meeting the BAT-AEL for NO<sub>x</sub> and Dust, EP Lynemouth has significantly reduced emissions compared to pre-conversion coal firing whilst continuing to supply baseload electricity to the grid.

Emission	Average 2010-2015 (mg/Nm <sup>3</sup> )	Post-conversion average (mg/Nm <sup>3</sup> )	Percentage Reduction (%)
NO <sub>x</sub>	574	174.5	70%
Dust	47	11.4	76%
Notes: a) At 100% measured value			

Table 5: Comparison of pre and post-conversion emissions

Post conversion to biomass there has been continuing emissions reductions, this is shown in Table 6 below by comparing emissions data from 01/01/2019 to the introduction of the BAT-AEL limits against data from the introduction of these limits to present. Particulate emissions have been improved by a further 11.4%, whilst NO<sub>x</sub> emissions have remained at similar level increasing by 2%.

Emission	Average 01/01/19-16/08/21 (mg/Nm <sup>3</sup> )	Average 17/08/21-Present (mg/Nm <sup>3</sup> )	Percentage change (%)
NO <sub>x</sub>	172.8	176.3	+2.0%
Dust	12.3	10.9	-11.4%
Notes: b) At 100% measured value			

Table 6. Comparison of pre and post BAT-AEL compliance date

## 2.4 Constraints Affecting Emissions Performance

Although EP Lynemouth implement a range of best available techniques in order to reduce emissions as far as reasonably practicable the data presented above shows that there are various constraints that affect EP Lynemouth's ability to comply with BAT-AELs.

Compliance with BAT-AEL limits for NO<sub>x</sub> and dust is assessed using the 95% confidence interval approach. This methodology recognises that short-term fluctuations do not necessarily indicate systemic non-compliance. Any change in a regulatory approach of implementing a confidence factor for reporting purposes would present a significant risk to EP Lynemouth's ability to supply low carbon dispatchable energy to the grid.

Biomass fuel sources exhibit significant variability in moisture content, calorific value, and ash composition. These variations, driven by supply chain diversity and seasonal factors, directly influence combustion behaviour and emission profiles. Optimising combustion parameters for each fuel batch is complex and cannot always be achieved instantaneously, especially when balancing efficiency, emissions, and plant reliability.

The nature of the low-carbon dispatchable CfD will mean the power station will operate less frequently at baseload and experiences greater variability in generation load, duration, and cycling, including more frequent start-ups and shut-downs. EA guidance acknowledges that such operational patterns, driven by the need to support dispatchable renewable energy, can increase transient emissions compared to steady-state operation. These changes are system-driven and unavoidable for grid stability, presenting additional challenges in maintaining emissions within BAT-AEL limits under all operating conditions.

Another critical factor impacting compliance is the progressive degradation of boiler surfaces and abatement equipment between scheduled maintenance outages. Over time, fouling and wear reduce heat transfer efficiency and limit the effectiveness of combustion control systems and electrostatic precipitators. This degradation is unavoidable, despite proactive cleaning and maintenance regimes. While major overhauls restore performance, interim periods can see temporary increases in NO<sub>x</sub> and particulate emissions.

## 3 Life Extension & pBECCS Summary

To support the UK Government's Net Zero Strategy, since 2021 EP Lynemouth has been considering options to extend the operation of the power station post-2027 and has developed a post-combustion carbon capture and storage (pBECCS – Power Bioenergy Carbon Capture and Storage) project, which, if deployed could support delivery of Carbon Budgets 6 (2033 - 37) and 7 (2038 – 42).

A full carbon Life-Cycle Assessment (LCA) has been carried out for the pBECCS project and the results of this study indicate that the pBECCS project could provide net negative emissions of circa 2.25 million tonnes of CO<sub>2</sub> annually.

In March 2023 the UK Government confirmed that the EP Lynemouth's pBECCS project had met the eligibility and deliverability requirements of the Cluster Sequencing Track-1 application process, however EP Lynemouth was not included in the Project Negotiation List for 2027 deployment. EP Lynemouth is currently in discussions with the UK Government on the optimum deployment timescale of the pBECCS plant, our current assessment is that the pBECCS plant will not be operational until March 2034 at the earliest.

EP Lynemouth has also been in discussion with the UK Government on the need for a policy intervention to support economically viable power-only operation in the period between the expiry of the CfD in March 2027 and the availability of pBECCS.

In January 2024, the UK government launched a consultation in which it proposed a form of 'transitional support mechanism' (bridge/bridging support), as noted previously, Government published its response to the consultation in February 2025<sup>1</sup>, in which it stated:

*'The last government consulted on introducing a mechanism which could provide short-term support for large-scale biomass generators from 2027. Having considered the responses to the consultation we are planning to provide short-term support to these generators, subject to a rigorous economic assessment to ensure this provides value for money for consumers.'*

The final eligibility criteria were set out in the consultation response and EP Lynemouth meets all required criteria.

EP Lynemouth are currently in formal, bilateral negotiation with Government in relation to a Low Carbon Dispatchable CfD to apply from April 2027. Both parties are aligned on objectives to reach an investable value-for-money deal and EP Lynemouth are expecting significant progress in the coming months, aligning DESNZ discussions with the plant's overall life extension project (asset strategy, fuel strategy, etc). It is expected that the outcome of these discussions be a Low Carbon Dispatchable Contract for Difference (LCD CfD), substantially similar to that in place for Drax. The term of the LCD CfD will be for four years from April 2027.

As noted previously the timeline for implementation of the pBECCS project is dependent on Government announcements regarding Track 1 Expansion for the ECC and its response to the Independent GGR review, indicative key dates from the current project programme for the pBECCS project are provided in Table 77 below.

Milestone	Date
Agreement of HoTs with Government for a LCD CfD	Q1 2026
Finalisation of LCD CfD	Q2 2026
Works required to extend life of station to end of a Low Carbon Dispatchable CfD.	Through 2026/2027
Start of preparation of pBECCS Development Consent Order (DCO)	Q1 2026
Submission of DCO	Q2-2027
DCO Award	Q4 2028
Start of Tendering for EPC for pBECCS project	Q1 2026
EPC FEED	Q4 2027 – Q4 2028
pBECCS Financial Investment Decision	Q1 2029
pBECCS Start of Construction	Q3 2029
Power Station pBECCS Life Extension works	Q3 2029 – Q4 2033
pBECCS Commercial Operation	Q1-2034

Table 7: Life extension and pBECCS key dates

### 3.1 pBECCS Technical Summary

The pBECCS Carbon Capture Plant (CCP) proposed for EP Lynemouth is a post-combustion carbon capture single train unit, using a proprietary amine solvent. The CCP shall comprise all facilities required to capture CO<sub>2</sub> in the flue gases from the existing steam raising boilers in a CO<sub>2</sub> capture unit and treat the captured CO<sub>2</sub> in common dehydration and compression plant to meet the quality and process requirements necessary for onward transportation into the CO<sub>2</sub> storage network. The CCP will be fully integrated with the existing power station, which will provide major utilities from existing infrastructure.

The configuration of the CCP is shown in Figure 3 below.

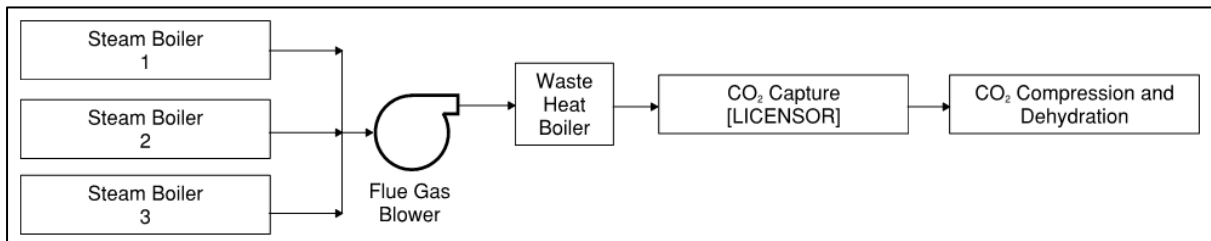


Figure 3: Indicative Carbon Capture Plant Configuration

An indicative Block Flow Diagram (BFD) is shown in Figure 4 and provides an indicative representation of the CCP process and utilities to be provided from the existing power station.

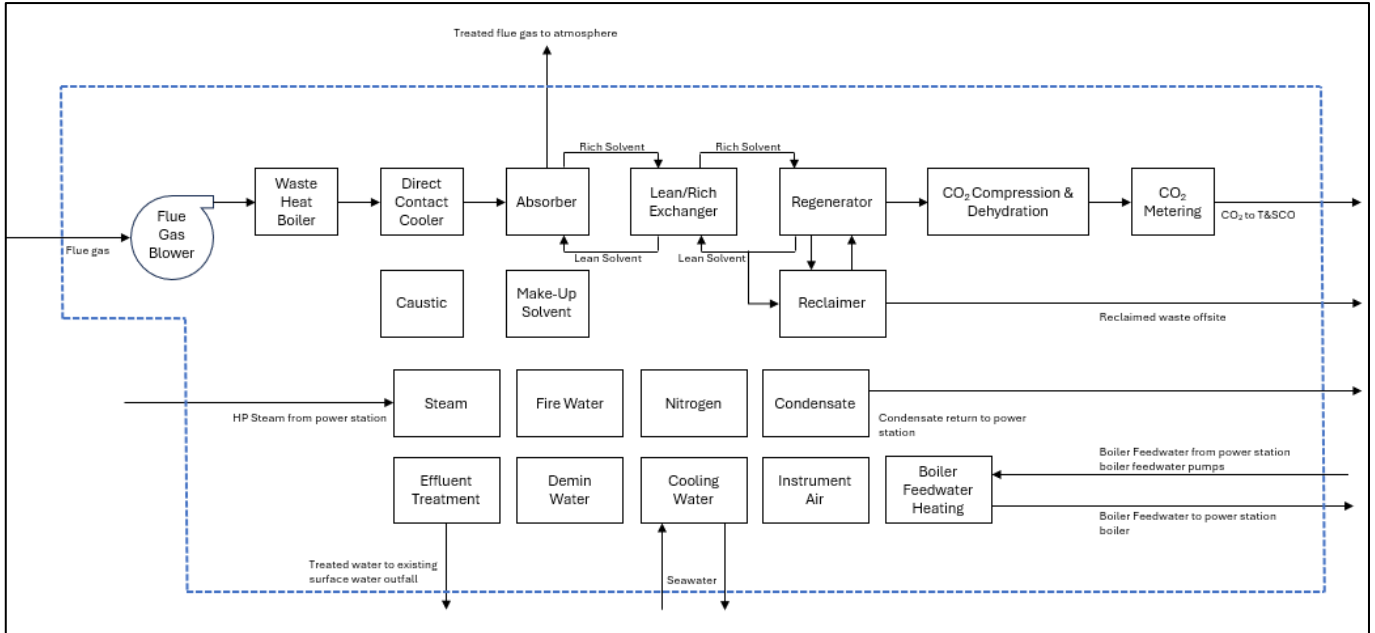


Figure 4: Proposed Carbon Capture Plant Block Flow Diagram

Steam required for heating in the CCP is provided from the existing power station boilers via new tie-ins to existing steam systems, high pressure steam is let-down to the required pressure in a new CCP steam turbine that will generate electricity for use in the CCP and export.

The current baseline for providing cooling to the CCP is to use seawater, fed from the existing onsite cooling water infrastructure, other utility water required by the CCP will be provided by a new desalination plant.

Suitable process effluent streams will be treated and discharged through the existing common surface water outfall. Process effluent streams unsuitable for treatment will be sent to suitable off-site processing facilities. Surface water will be discharged to the existing common surface water outfall through a suitable oil water separator as required.

The requirement for upstream treatment of the flue gas is still to be confirmed but it is likely that some form of emissions abatement, potentially including NO<sub>x</sub>, and dust, may be required to ensure the capture of CO<sub>2</sub> is optimised and to prevent degradation of the proprietary amine used in the CCP. The requirement for upstream emissions abatement will be driven by the choice of the Licensor/proprietary amine chosen for the pBECCS project and as previously noted, this decision has not been made. Therefore, further details regarding upstream emissions abatement are not known at this time.

It should be noted that any installation of new abatement equipment following the end of the current derogation on 31 Mar 2027 in order to comply with BAT-AELs may not be suitable for operation of the pBECCS plant and will therefore need to be removed and/or replaced with alternative technologies. This would come at significant cost to the business in terms of equipment costs, impact to the pBECCS programme and electricity generation.

The details provided in this report for the CCP are indicative and subject to change and are not to be relied upon.

## 4 Applicable BAT-AEL

The BAT conclusions which EP Lynemouth will not be able to comply with and are therefore requesting Article 15(4) derogations for all generating units, i.e. units 1, 2 & 3, from are BAT 24 (NO<sub>x</sub>) and BAT 26 (dust).

### 4.1 IED Annex V ELVs

The Lynemouth Power Station biomass conversion project was specified to comply with the relevant IED Annex V ELVs which, as the Lynemouth Power Station installation was granted a permit before 07/01/2013 and is an existing plant, under IED Article 30(2) are as specified below:

Combustion Unit	Substance	Monthly Average ELV (mg/Nm <sup>3</sup> )	Daily Average ELV (mg/Nm <sup>3</sup> )
Solid fuels – biomass > 300 MW <sub>th</sub>	NO <sub>x</sub>	200	220
	Dust	20	22

Table 8: Applicable IED Annex V ELVs

### 4.2 Applicable BAT-AEL

In relation to the BRef Conclusions, EP Lynemouth’s Power Station installation is considered an existing plant where<sup>3</sup>:

Term Used	Definition
Plant – existing	A combustion plant that is not a new plant
Plant – new	A combustion plant first permitted at the installation following the publication of the BAT conclusions or a complete replacement of a combustion plant on the existing foundations following the publication of these BAT conclusions
Unit – existing	A combustion unit that is not a new plant
Unit – new	A combustion unit first permitted at the installation following the publication of the BAT conclusions or a complete replacement of a combustion plant on the existing foundations following the publication of these BAT conclusions

Table 9: LCP BRef Definition of Existing and New Plant

<sup>3</sup> Commission Implementing Decision (EU) 2017/1442 of 31 July 2017, establishing best available techniques (BAT) conclusions under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants.

Additionally, under BAT 24 Table 9 Footnotes 7 & 8, the plant was put into operation no later than 07/01/2014 and therefore the following BAT-AEL are applicable:

	Substance	Daily Average BAT-AEL (mg/Nm <sup>3</sup> )	Annual Average BAT-AEL (mg/Nm <sup>3</sup> )	BAT Conclusion
Solid fuels – biomass > 300 MW <sub>th</sub>	SO <sub>2</sub>	<20 – 85	<10 – 50	BAT 25
	NO <sub>x</sub>	95 – 200	<40 – 160	BAT 24
	CO	<30 - 80	<30 – 80	BAT 24
Existing plant put into operation not later than 07/01/2014	Dust	2 – 16	2 – 10	BAT 26
	HCl	1 – 12	1 – 5	BAT 25
	HF	<1	<1	BAT 25
	Mercury	<1 – 5 (µg/Nm <sup>3</sup> )	<1 – 5 (µg/Nm <sup>3</sup> )	BAT 27

Table 10: Applicable BAT-AELs

Under the relevant regulatory guidance<sup>4</sup> the UK Regulators' approach to setting ELVs is that the top of the range will be taken as the permitting value, unless compliance with an Air Quality Standard (AQS) requires a lower value. All supporting assessments have therefore been completed for the relevant BAT upper ranges only. See Section 5.3 for the air quality impact assessment.

---

<sup>4</sup> Best Available Techniques (BAT) Reference Document for Large Combustion Plants 2017

## 5 Derogation Justification

The IED enables a competent authority to allow derogations from BAT AELs stated in BAT Conclusions under specific circumstances as detailed under Article 15(4):

*'By way of derogation from paragraph 3, and without prejudice to Article 18, the competent authority may, in specific cases, set less strict emission limit values. Such a derogation may apply only where an assessment shows that the achievement of emission levels associated with the best available techniques as described in BAT conclusions would lead to disproportionately higher costs compared to the environmental benefits due to:*

- a) the geographical location or the local environmental conditions of the installation concerned; or*
- b) the technical characteristics of the installation concerned.*

*The competent authority shall document in an annex to the permit conditions the reasons for the application of the first subparagraph including the result of the assessment and the justification for the conditions imposed.*

*The emission limit values set in accordance with the first subparagraph shall, however, not exceed the emission limit values set out in the Annexes to this Directive, where applicable.'*

Further guidance on the application of these criteria is provided in the relevant Defra Part A Guidance Note<sup>5</sup>. Potentially relevant technical characteristics for a derogation include:

- the recent history of pollution control investment in the installation in respect of the pollutant(s) for which the derogation is sought;
- the general investment cycle for a particular type of installation;
- The effect of reducing the excess emission(s) upon other pollutants, energy efficiency and waste arisings; and
- The intended remaining operational lifetime of the installation as a standalone LCP. i.e. before operation as a pBECCS plant; and
- the configuration of the plant on a given site, making it more technically difficult and costly to comply;
- the practicability (particularly bearing in mind Health & Safety and other relevant legal obligations) of interrupting the activity so as to install improved emission control upon the pollutant(s)
- the effect of reducing the excess emission(s) upon other pollutant emissions, energy efficiency, water use or waste arisings from the installation as a whole; and
- the intended remaining operational lifetime of the installation as a whole or of the part of it giving rise to the emission of the pollutant(s), where the operator is prepared to commit to a timetable for closure.

---

<sup>5</sup> Industrial emissions Directive EPR Guidance on Part A installations, Defra, February 2013

### 5.1 NO<sub>x</sub> BAT-AEL Derogation Request

EP Lynemouth are requesting Article 15(4) derogations from the BAT Conclusion 24 (NO<sub>x</sub> BAT-AEL).

The derogations from the NO<sub>x</sub> BAT-AEL for all three generating units are being made on basis of the **technical characteristics of the installation**. While EP Lynemouth believe that derogation request has merit under a number of the accepted derogation criteria as summarised in

<b>Variability in Biomass fuel sources:</b>	Biomass fuel sources exhibit significant variability in moisture content, calorific value, and nitrogen composition. These variations, driven by supply chain diversity and seasonal factors, directly influence combustion behaviour and emission profiles. Optimising combustion parameters for each fuel batch is complex and cannot always be achieved instantaneously, especially when balancing efficiency, emissions, and plant reliability.
<b>Low-carbon dispatchable CfD:</b>	The nature of the low-carbon dispatchable CfD will mean the power station will operate less frequently at baseload and experiences greater variability in generation load, duration, and cycling, including more frequent start-ups and shut-downs. EA guidance acknowledges that such operational patterns, driven by the need to support dispatchable renewable energy, can increase transient emissions compared to steady-state operation. These changes are system-driven and unavoidable for grid stability, presenting additional challenges in maintaining emissions within BAT-AEL limits under all operating conditions.
<b>Degradation of performance between outages</b>	Another critical factor impacting compliance is the progressive degradation of boiler surfaces and combustion control equipment (low NO <sub>x</sub> burners, BOFA fans) between scheduled maintenance outages. Over time, fouling and wear reduce heat transfer efficiency and limit the effectiveness of combustion control systems. This degradation is unavoidable, despite proactive cleaning and maintenance regimes. While major overhauls restore performance, interim periods can see temporary increases in NO <sub>x</sub> emissions.

Table 1111 below, this derogation request is being made on the basis that **the configuration of the plant makes it more technically difficult and costly to comply**, combined with a limited duration to allow alternative improvements which are expected to have longer term environmental benefits..

Aspect	Summary of Evidence
<p><b>Recent history of pollution control with respect to the pollutants for which the derogation is sought:</b></p>	<p>The biomass conversion project (2016-18) has resulted in significant reductions in NO<sub>x</sub> emissions.</p> <p>Various BAT techniques would require recently installed plant and equipment to be scrapped.</p>
<p><b>The general investment cycle:</b></p>	<p>Following the end of the current CfD, significant resource and investment is intended to be focussed on works required to extend the life of station to the end of the Low Carbon Dispatchable CfD.</p> <p>In parallel and dependent on Government announcements regarding Track 1 Expansion for the ECC, the development of the pBECCS project will continue, including assessment of upstream treatment of the flue gas required for the carbon capture plant.</p> <p>Assuming a Low Carbon Dispatchable CfD is agreed for continued operation of the plant post 2027, there will be limited opportunity to design, install, commission and test and verify the effectiveness of additional BAT techniques for each unit without impacting the operation of the unit/plant.</p> <p>Extended outage periods resulting from the implementation of the required additional BAT techniques would result in significant lost generation and revenue.</p>
<p><b>The configuration of the plant making it more technically difficult and costly to comply:</b></p>	<p>As a biomass conversion of an existing coal-fired installation, significant space and plant performance related constraints restrict applicability of BAT techniques.</p> <p>SNCR would have low NO<sub>x</sub> reduction efficiency at the Lynemouth Power Station and would not achieve the BAT-AEL.</p> <p>Constraints due to the existing infrastructure prevent SCR being applied without complex and costly engineering solutions.</p>
<p><b>The effect of reducing the excess emission(s) upon other pollutants energy efficiency, water use or waste arisings:</b></p>	<p>Impacts of SCR and SNCR include reduced boiler efficiency, increased auxiliary electrical consumption, ammonia slip and ammoniated ash.</p>
<p><b>The intended remaining operational lifetime of the installation:</b></p>	<p>The proposed pBECCS project, expected to be operational in 2034 is expected to significantly change the emissions profile of the plant and potentially require various abatement upstream of the carbon capture equipment. Any abatement equipment installed prior to the end of the existing CfD in 2027 in order to comply with BAT-AELs may need to be removed and replaced prior to operation of the pBECCS plant, at great cost and generating significant amounts of waste.</p>
<p><b>Reliance on confidence factors to comply with BAT-AELs:</b></p>	<p>Compliance with BAT-AEL limits for NO<sub>x</sub> is assessed using the 95% confidence interval approach. This methodology recognises that short-term fluctuations do not necessarily</p>

Aspect	Summary of Evidence
	indicate systemic non-compliance. Any change in a regulatory approach of implementing a confidence factor for reporting purposes would present a significant risk to EP Lynemouth’s ability to supply low carbon dispatchable energy to the grid.
<b>Variability in Biomass fuel sources:</b>	Biomass fuel sources exhibit significant variability in moisture content, calorific value, and nitrogen composition. These variations, driven by supply chain diversity and seasonal factors, directly influence combustion behaviour and emission profiles. Optimising combustion parameters for each fuel batch is complex and cannot always be achieved instantaneously, especially when balancing efficiency, emissions, and plant reliability.
<b>Low-carbon dispatchable CfD:</b>	The nature of the low-carbon dispatchable CfD will mean the power station will operate less frequently at baseload and experiences greater variability in generation load, duration, and cycling, including more frequent start-ups and shut-downs. EA guidance acknowledges that such operational patterns, driven by the need to support dispatchable renewable energy, can increase transient emissions compared to steady-state operation. These changes are system-driven and unavoidable for grid stability, presenting additional challenges in maintaining emissions within BAT-AEL limits under all operating conditions.
<b>Degradation of performance between outages</b>	Another critical factor impacting compliance is the progressive degradation of boiler surfaces and combustion control equipment (low NO <sub>x</sub> burners, BOFA fans) between scheduled maintenance outages. Over time, fouling and wear reduce heat transfer efficiency and limit the effectiveness of combustion control systems. This degradation is unavoidable, despite proactive cleaning and maintenance regimes. While major overhauls restore performance, interim periods can see temporary increases in NO <sub>x</sub> emissions.

Table 11: NO<sub>x</sub> Derogation Request Criteria

### 5.1.1 BAT Options Assessment (NO<sub>x</sub>)

As part of the original derogation request in 2018, EP Lynemouth commissioned two technical assessments, referenced here as [RWE]<sup>6</sup> and [AECOM]<sup>7</sup>, to assess the site-specific applicability of the BAT techniques listed in the BRef conclusions. The technical characteristics of the plant have not

<sup>6</sup> Lynemouth Power Station: Appraisal of BAT for NO<sub>x</sub>, Dust and CO, TECH/TEF/3026/18, RWE, November 2018

<sup>7</sup> Technical Brief on Application of BAT for NO<sub>x</sub> and Particulates, Lynemouth Biomass Conversion Project, 60565526-430-RP-PE-00001, AECOM, 25<sup>th</sup> October 2018

significantly changed from this time and therefore the justifications for applicability of BAT techniques are considered to be the same.

In order to prevent or reduce emissions of NO<sub>x</sub> to air from the combustion of solid biomass (BAT 24), while limiting CO emissions, BAT is to use one or a combination of the techniques listed in Table 1212 below. An additional column has been included to provide a high-level summary of the site-specific applicability of each technique in relation to this derogation request:

Technique	BRef Conclusions Applicability	EP Lynemouth Notes
Combustion optimisation	Generally applicable	Applied at Lynemouth Power Station
Low-NO <sub>x</sub> burners (LNB)	Generally applicable	Applied at Lynemouth Power Station
Air staging	Generally applicable	Applied at Lynemouth Power Station; Boosted overfire air (BOFA)
Fuel staging	Generally applicable	Not appropriate for Lynemouth: Low efficiency for NO <sub>x</sub> <200mg/Nm <sup>3</sup> , LNB operation outside of performance envelope, fossil fuel use would invalidate CfD contract. (see section 4.1.3) <b>Not taken forward to CBA.</b>
Flue-gas recirculation	Generally applicable	Not appropriate for Lynemouth: Low efficiency for NO <sub>x</sub> <200mg/Nm <sup>3</sup> , reduction in efficiency and capacity; LNB operation outside of specification performance envelope (see section 4.1.4) <b>Not taken forward to CBA.</b>
Selective non-catalytic reduction (SNCR)	For existing combustion plant, applicable within the constraints associated with the required temperature window and residence time for the injected reactants [UK TWG Split View].	Not appropriate for Lynemouth: Residence time below minimum in reaction zone; corrosion risk to boiler tubes; low NO <sub>x</sub> reduction efficiency (predicted 15%) will not achieve BAT-AEL; ammoniation of ash. (see section 5.1.5). <b>Taken forward for CBA.</b>
Selective catalytic reduction (SCR)	[UK TWG Split View]	Not appropriate for Lynemouth: Significant retrofit constraints due to existing infrastructure and site configuration, complexity, catalyst deactivation with biomass fuels. (see section 5.1.6). <b>Taken forward for CBA.</b>

Table 12: BAT-AEL Techniques for NO<sub>x</sub> Emissions

A summary of the applicability of these techniques is included in sections 5.1.2 - 5.1.6 below, with further details included in the supporting technical reports.

## 5.1.2 Primary NO<sub>x</sub> Reduction Techniques:

An integral component of the EP Lynemouth biomass conversion project was upgrading of the combustion and emissions system to enable efficient combustion of 100% biomass fuel with emissions complying with the IED Annex V ELVs. This has included either upgrade or implementation of combustion optimisation, biomass specific LNB and air staging in the form of BOFA.

## 5.1.3 Fuel Staging (NO<sub>x</sub>):

Fuel staging, also termed reburning, is based on the creation of different zones in the furnace by the staged injection of fuel and air. The flame temperature is reduced and localised hot spots mitigated through the creation of several combustion zones in the combustion chamber with different injection levels of fuel and air. Typically, natural gas is used as the reburning fuel with a reburning combustion zone installed between the final biomass burner level and the BOFA level.

Fuel Staging is not considered applicable for Lynemouth Power Station as:

- Use of fossil fuels including natural gas is not permitted under EP Lynemouth's existing CfD contract and is unlikely to be permitted under any future contract following the end of the CfD;
- There is no natural gas supply to the installation;
- The installation already has low baseline primary NO<sub>x</sub> emissions reducing the technique's effectiveness;
- The technique has not been widely applied to wall fired pulverised biomass fired tower boilers of the type installed;
- There is limited space for installation of an additional combustion zone between the upper biomass burner level and the BOFA ports;
- Use of fuel staging is likely to result in the biomass LNBS operating outside of their design parameters.

## 5.1.4 Flue Gas Recirculation (NO<sub>x</sub>):

Flue gas recirculation (FGR) recirculates part of the cooled flue-gas taken after the air preheaters to the combustion chamber to replace part of the fresh combustion air. This has the dual effect of cooling and limiting the O<sub>2</sub> content available for NO<sub>x</sub> generation.

Installation of FGR at Lynemouth Power Station would require a new FGR fan after the air preheater, new gas ducting and modifications to existing air ducting to accommodate the increased flow. Flue gas would be supplied to the burners or the BOFA system, which would require modification. The ID fans would also require modification to cope with an increase in gas volume.

FGR is not considered an applicable technique for Lynemouth Power Station as:

- The installation has low baseline primary NO<sub>x</sub> emissions reducing the technique's effectiveness;
- An increase in flue gas flow through the boiler will decrease boiler efficiency and reduce achievable generation;
- Use of FGR is likely to result in the biomass LNBS operating outside of their design parameters;
- FGR would result in higher gas temperatures to the Electrostatic Precipitators (ESPs) which are already operating at their upper temperature range and will impact negatively on dust emissions.

## 5.1.5 Selective Non-Catalytic Reduction (SNCR):

The BRef conclusions state that SNCR is applicable for existing combustion plant within the constraints associated with the required temperature window and the residence time for the injected reactants. The constraints inherent in existing combustion plant imposed on the applicability of selective non-catalytic reduction (SNCR) to existing biomass power plant were formally raised as split views during the BRef

review process by the UK BRef Technical Working Group (TWG): UK Split View – BAT AELs for NO<sub>x</sub> from biomass fired plant<sup>8</sup>:

*The UK supports the proposal by the Bureau that the daily BAT-AEL for NO<sub>x</sub> should be in the range of 95 – 200 mg/Nm<sup>3</sup> for plant >300MW<sub>th</sub> put into operation no later than 7<sup>th</sup> January 2014.*

*The UK proposes that the upper range of the annual BAT-AEL for plant >300 MW<sub>th</sub> put into operation not later than 7<sup>th</sup> January 2014 be amended to be 180mg/Nm<sup>3</sup> from the proposed 160mg/Nm<sup>3</sup>.*

*This is because the majority of UK plant in this class are units that have been converted from coal fired units to biomass fired units and even when applying a range of the proposed techniques, the proposed BAT-AEL of 160 mg/Nm<sup>3</sup> is not achievable under all conditions. The UK proposes that the upper end of the range for the annual BAT-AEL for plant >300MW<sub>th</sub> be amended to 180mg/Nm<sup>3</sup>, this aligns more closely with the draft proposed daily BAT-AEL of 200mg/Nm<sup>3</sup> for this class of plant.*

*Rationale:*

*NO<sub>x</sub> emissions of 180mg/Nm<sup>3</sup> are below the guarantee level for plant currently being designed and are below the levels experienced with existing biomass conversions. An AEL of 180mg/Nm<sup>3</sup> as an annual average will be challenging for these plant to meet, and there is limited data for plant of this size which have been converted from coal to biomass on which to base AELs. The BRef now acknowledges that SNCR may not be appropriate for retrofitting to certain boilers. However, the value of 160mg/Nm<sup>3</sup> cannot be achieved by primary measures alone. The case for not fitting SCR is set out in a separate split view. Emission performance of converted coal plant will be very site specific and, therefore, the prediction of emissions values where there is a lack of data represents an unacceptable commercial risk on the basis of operating experience and performance guarantees.*

The two technical assessments commissioned by EP Lynemouth support this view of the applicability of SNCR due to the particular characteristics of the EP Lynemouth installation.

SNCR uses ammonia solution, either dosed directly or through a water diluted urea solution, to reduce NO<sub>x</sub> to nitrogen and water vapour. The temperature window and residence time in this window is critical to the effectiveness of the SNCR system and is therefore highly site specific. Although the LCP BRef states that temperature window for SNCR is 800°C to 1,100°C, the optimum temperature window is typically much smaller, i.e. 950°C – 1,000°C and depends upon the reagent used.

At lower temperatures the reduction reaction will not occur causing the reagent to 'slip' with the flue gas out of the boiler. Reagent injection rates must therefore be limited to minimise ammonia slip in compliance with the NH<sub>3</sub> BAT-AEL. If the temperature range is exceeded the reagent will dissociate resulting in an increase in NO<sub>x</sub> emissions.

The LCP BRef identifies an optimum residence time in the SNCR reaction window of 1.0 seconds to allow complete reaction of the reagent for effective NO<sub>x</sub> reduction and reduction of ammonia slip to acceptable levels. A minimum residence time of 0.2 seconds is recommended within the BRef.

In general sources with stable temperatures in the range 850°C to 1,065°C, with primary NO<sub>x</sub> emissions greater than 400 mg/Nm<sup>3</sup> and residence times of 1.0s or greater are well suited for SNCR and achieve the highest levels of NO<sub>x</sub> control. There will be a lower reduction in NO<sub>x</sub> as the baseline decreases and approaches the equilibrium NO<sub>x</sub> concentration.

The Lynemouth Power Station installation has small tower boilers which complicates the application of SNCR as the temperature is highly stratified by the rapid temperature drop across the superheater bundles close above the likely location of the SNCR reagent injection ports. Additionally, areas close to the boiler walls are cooler which can allow high levels of ammonia slip.

---

<sup>8</sup> UK Split View – BAT AELs for NO<sub>x</sub> from biomass fired plant, Solid biomass and/or peat – BAT-AELs for NO<sub>x</sub> (1/7) – BP 1.4.3.2.1-1.4.3.2.5

The calculated temperature profile in the Lynemouth boilers at full load gives flue gas temperatures at various sections of the boiler – these are shown at Table 133 below.

Location	Approximate Average Gas Temperature
Between Platen Superheat (PSH) and Final Superheat (FSH)	1,164°C
Between Final Superheat and Final Reheat (FRH)	1,017°C
Between Final Reheat and Primary Superheat (PrSH)	915°C

Table 13: Approximate Average Boiler Temperatures

The ideal temperature window for SNCR would be between the final superheater (FSH) and final reheater (FRH) at 1,000°C. However, with only a 1m gap between the FSH to FRH, this temperature window is extremely narrow and the average residence time in the reaction zone has been variously determined as 0.05s [AECOM] and 0.15s [RWE], well below the recommended minimum reaction time of 0.2s and significantly lower than the optimum reaction time identified in the BRef of 1s. A further injection window could be located between the final reheat and primary superheat, but this again has a distance between banks of only ca. 1m and a maximum residence time of 0.15s [RWE] presenting similar residence time issues.

Experience of biomass combustion has shown that a significant build-up of slag can occur in this area of the boiler, which increases the gas temperatures throughout the boiler. Various cleaning methods are employed to remove slag and improve boiler efficiency, but the initial build-up of slag is unavoidable with the operating regime used at Lynemouth Power Station. This causes instability in the gas temperatures and will cause uncertainty in the effect of any abatement technology installed.

Additionally, less frequent baseload operation and increased frequency dispatchable operations will further increase the difficulty of maintaining a stable temperature regime within the boiler and therefore increase the difficulty of maintaining consistent effective operation of any abatement equipment installed.

These temperature windows and the configuration of the various tube bundles are illustrated in Figure below. Figure shows the practical constraints to the installation of nozzle lances on the side walls using the example of the boiler side walls at the final reheat level. The potential for any retrofit of additional equipment in these areas is severely restricted by the configuration of other existing equipment, including the soot blowers which are visible in this photograph.

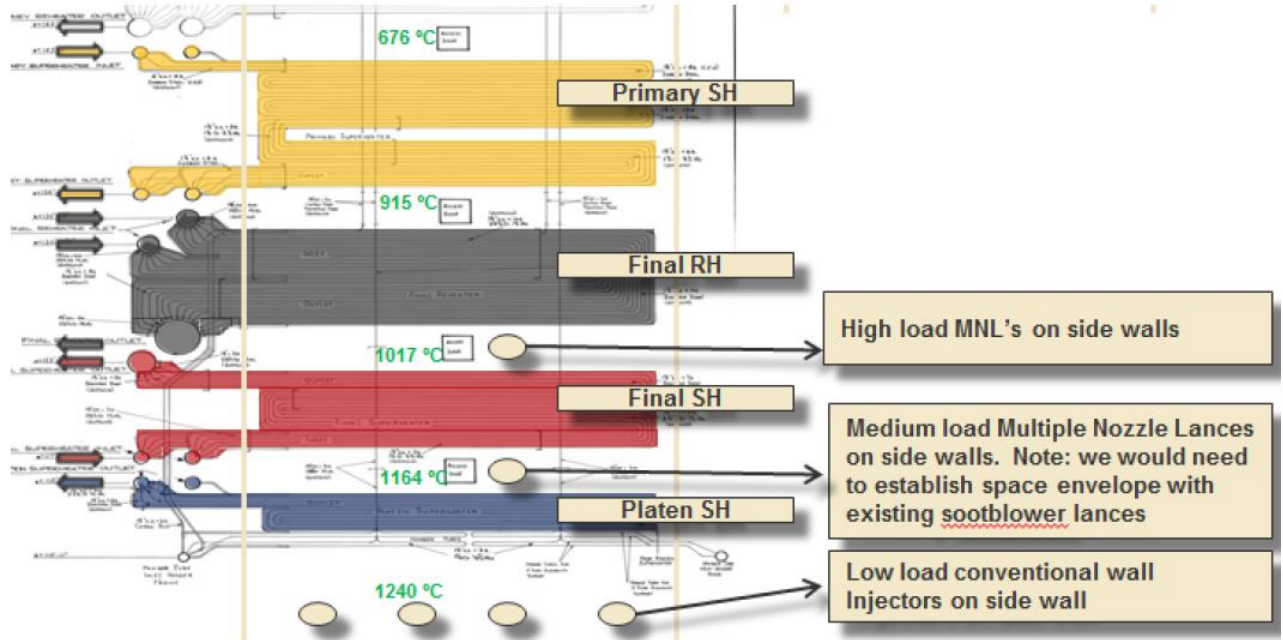


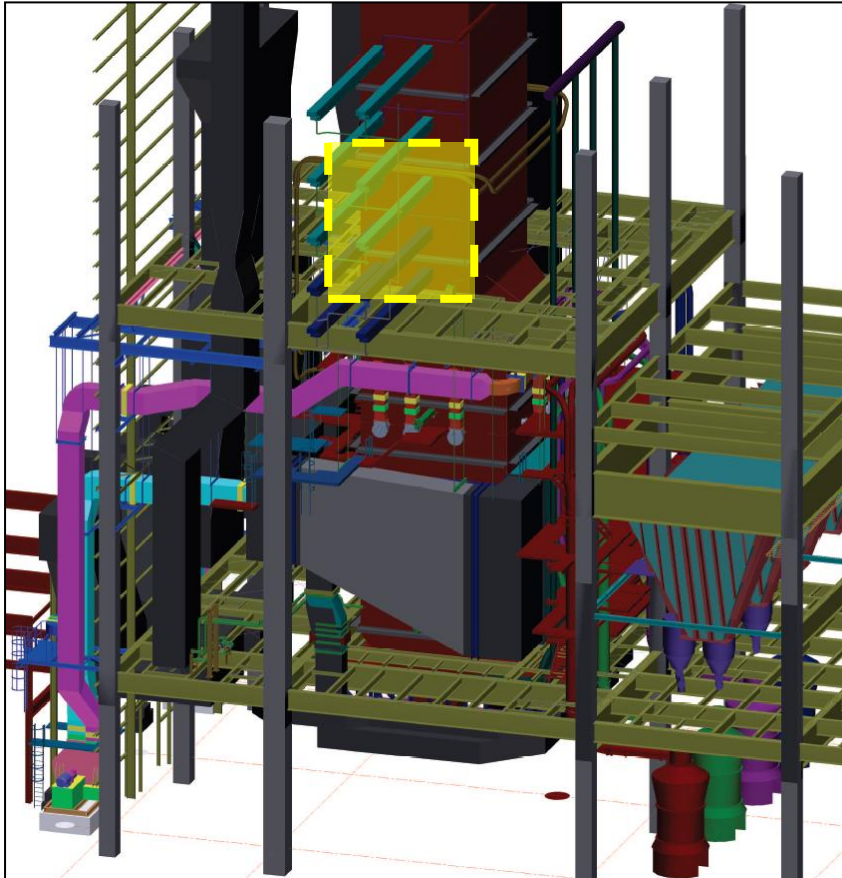
Figure 5: Modelled Flue Gas Temperatures and Potential Reagent Injection Locations



Figure 6: Potential Boiler Sidewall Reagent Injection Locations Demonstrating Restricted Access Due to Existing Sootblowers (Unit 1 Final Reheat Level)

Figure shows the configuration of the boiler. The area highlighted in yellow at the top of the furnace (with the soot blowing systems visible) is the location of the SNCR ideal temperature window and demonstrates its restricted physical dimensions.

Figure 7: Lynemouth Power Boiler General Arrangements (3D Model - Unit 3) – Approximate



Location of SNCR Temperature Window Highlighted

Options for multi-level injection have been considered but an optimum distribution of the reagent is still considered difficult. Above the injection zone there are 27 reheat (RH) elements with a 0.35m pitch between the tubes. Due to the small gap and proximity to the injection zone this would make preventing urea impingement on tubes very difficult. The likely location for injection of urea close to the unprotected heat transfer surfaces would cause increased rates of local corrosion due to droplet impingement on the unprotected tubes from localised eddies.

While the BRef states that SNCR typically achieves NO<sub>x</sub> reduction of 30-50% from baseline levels on coal-fired LCP, considering the constraints imposed by the existing power station infrastructure the projected NO<sub>x</sub> reduction efficiency for Lynemouth Power Station has been estimated to be in the range 12% - 15% [AECOM and RWE, respectively]. It is important to note that these figures are estimates only and cannot be definitively proved until the system has been installed and commissioned and is in normal operation.

Using a primary NO<sub>x</sub> concentration of 200 mg/Nm<sup>3</sup> this level of abatement would not guarantee the NO<sub>x</sub> BAT-AEL of 160 mg/Nm<sup>3</sup><sup>9</sup> could be met and consequently compliance with BAT AELs for NO<sub>x</sub> using this SNCR cannot be guaranteed.

To achieve these modest levels of NO<sub>x</sub> reduction there would be various detrimental impacts, well recognised in the literature, arising from SNCR implementation including:

- Reduction in boiler efficiency of ca. 0.25-0.5% due to heat sink effect of reagent water;
- Liquid urea droplet impingement on unprotected tubes resulting in increased localised corrosion;
- Risk of ammonia slip during periods of non-ideal boiler operation, e.g. load variations, soot-blowing, boiler slagging/ fouling due to fuel characteristics etc.;
- Risk of air heater fouling due to the formation of ammonium bisulphate deposits;
- Contamination of fly ash with ammonia.

Costs estimates for SNCR implementation vary but both CAPEX and OPEX costs would be significant, as summarised in Table 14 below.

CAPEX (£M)	OPEX (£M/yr)
12.2	0.49
<p>Notes:</p> <ol style="list-style-type: none"> <li>1. CAPEX costs exclude lost revenue from unplanned outages required for installation.</li> <li>2. OPEX costs exclude increased lost generation or increased fuel burn to mitigate for reduction in boiler efficiency.</li> <li>3. OPEX costs exclude likely requirement to treat/ dispose of ammonia contaminated ash off-site if continued disposal in EP Lynemouth ash lagoons is not acceptable.</li> </ol>	

Table 14: Estimated CAPEX and OPEX Costs for SNCR Implementation

### 5.1.6 Selective Catalytic Reduction (SCR):

Similar to SNCR, SCR utilises the injection of a reagent such as ammonia or urea to reduce the NO<sub>x</sub> that is present in the flue gas. However, SCR relies upon a reduction catalyst to promote the reaction at lower temperatures and to a greater degree of completeness. SCR is most economical when it is included in the original design of a new boiler as retrofit to an existing boiler can be complex, resulting in high capital costs. As such, retrofits are best suited for units with high baseline NO<sub>x</sub> emissions requiring high NO<sub>x</sub> reduction rates. The applicability of selective catalytic reduction (SCR) to existing biomass power plant was formally raised as a split view during the BRef review process by the UK TWG.

UK Split View – SCR on Biomass fired plant<sup>10</sup>:

*There may be technical and economic restrictions for retrofitting existing plant of >300 MW<sub>th</sub>.*

*Rationale:*

*There are two significant reasons for this split view:*

---

<sup>9</sup> Yearly average

<sup>10</sup> UK Split View – SCR on biomass fired plant, Solid biomass and/or peat – Techniques to reduce NO<sub>x</sub> and CO emissions (1/4) – BP 1.4.3.1

1. **Economic feasibility:** *The life of the SCR catalyst is significantly reduced when burning the typical range of commercially available biomass fuels within boilers >300 MW<sub>th</sub>. The reduction in life of catalysts can be up to 50% of that expected from a catalyst on a comparable coal unit. The replacement of a catalyst is in the order of several million Euros per unit.*
2. **Technical feasibility:** *The proposed NO<sub>x</sub> BAT-AELs for plant >300 MW<sub>th</sub> may be achievable using a range of other NO<sub>x</sub> reduction techniques in some cases. As current biomass plant >300 MW<sub>th</sub> in the UK are coal to biomass conversions, the configuration of the plant may render the installation of SCR as technically infeasible.*

There are a number of possible SCR configurations depending upon the characteristics of the plant but the ideal temperature window for SCR ranges from just under 300°C up to 400°C. Additionally, SCR installation requires a significant amount of space. High dust SCR, the most commonly implemented arrangement, is located upstream of the ESPs and avoids the need to reheat flue gas to the temperatures required by the catalyst. This puts the ideal SCR location on the flue gas ductwork between the economiser and the airheater sections. Reference SCR vertical flow reactors for comparably sized units typically require a 15m linear duct run for installation. However, as shown in

Figure 8 and Figure 9, the available ductwork at Lynemouth Power Station is less than 9m in length.



Figure 8: Boiler House at 114' Level showing Economiser to Air Heater Ductwork (High Dust SCR Location)

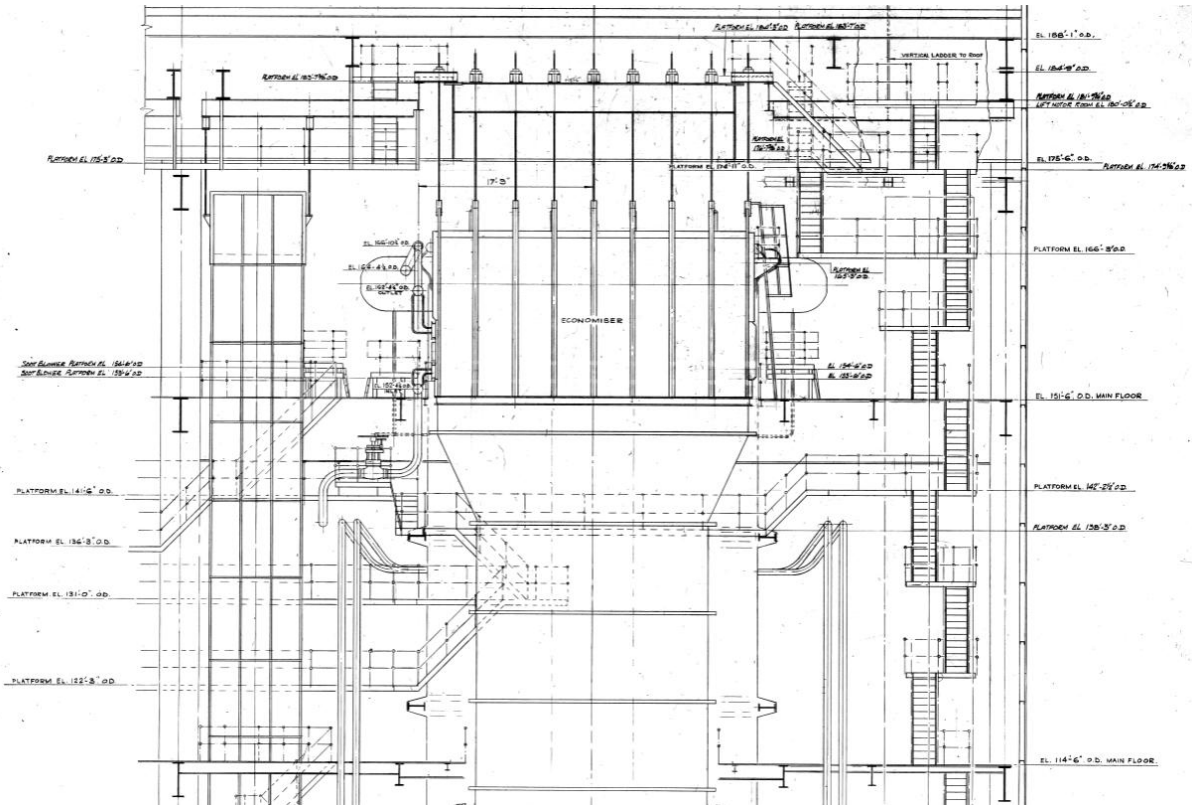


Figure 9: Drawing showing Boiler House Economiser to Air Heater Ductwork (High Dust SCR Location)

Due to the space constraints at the 114' level, new ductwork would be required for a high dust SCR retrofit in this location. The new ductwork would be installed from the 114' level to the high dust SCR section located outside of the boiler house above the existing flue gas ducting to the ESPs. Figure shows the location of the new external ductwork/SCR equipment, noting that new support structures would also be required. Following abatement in the SCR, new ductwork would then return the flue gases back to the existing air heaters.

The flue gas velocity downstream of the economisers is too high for the catalyst to operate efficiently and to avoid erosion from the dust in the gas stream, the cross section of new ductwork to the SCR must be increased to reduce the velocity, requiring further space. The pressure drop across the catalyst would also require an increase in the capacity of the ID fans, most likely involving replacement of the ID fans installed during the conversion project.



Figure 10: Indicative location of new ductwork/SCR for high dust option [Unit 3 shown, other units identical]

A 'low-dust' SCR system would be located downstream of the ESPs and would suffer from the same issues as the conventional high-dust installation with the added complication that a reheat system would be required to raise the temperature of the flue gas at the ESP outlet to the temperature required for efficient NO<sub>x</sub> reduction. This would result in a significant heat rate penalty of the order 0.25-0.50%.

An additional significant complication is the lack of available space at the ESP outlet for installation of the SCR system. The most likely engineering solution would be to install additional ductwork to transfer the flue gases to a remote SCR unit at the nearest available laydown area which is located approximately 100m east of the stack, on the opposite side to the main power station building and the ESPs, as shown in Figure . This would result in significant pressure drop and a requirement to replace the existing ID fans to accommodate this.

In addition, the area shown in Figure 11 forms part of the area proposed for the location of the main process equipment (direct contact cooler, absorbers, stripper, etc.) of the CCP. Location of any abatement technology in this area will have significant negative impacts on the pBECCS project, including increased cost for relocation of any abatement equipment in this area and/or changes to the CCP layout, leading to inefficiencies in its operation due to increased flue gas duct lengths.



Figure 11: Potential location for Low-Dust SCR (Red Boundary)

In view of the significant space constraints for installation of low-dust and high-dust SCR, one final option is the rarely implemented and lower efficiency 'in-duct' or 'hybrid' SCR system. In this arrangement a single layer of catalyst located in the existing ductwork is combined with a SNCR system to consume the remaining reagent. Although this system requires less space, it is still not clear that the 9m section of duct between the economiser and airheater would be sufficient to inject the reagent and ensure sufficient mixing with the flue gas, before passing through the catalyst layer.

Again, this system would result in a significant pressure drop across the SCR reactor and a requirement to replace the new ID fans. The hybrid SCR system would be subject to the same issues that make both SNCR and SCR unsuitable for installation at the Lynemouth Power Station.

All SCR implementation options would require an extended outage of at least 12 months, per unit, to complete the modifications and commission the new abatement system. This outage duration is significantly longer than the currently proposed major outage durations, which typically last for 12 weeks. Between the time of this application and proposed end of the derogation, the outages shown in Table 155 are proposed for each unit. The planned outage dates for 2027/8 are dependent on securing a new low carbon CfD from Government. Whilst LPL and Government are aligned on objectives to reach an investable value-for-money deal an agreement has not been finalised and therefore outage dates for 2027 are unconfirmed at this time.

	Unit No. 1	Unit No. 2	Unit No. 3
Planned Outage	Apr-Sep 2027	Apr-Sep 2027	Apr-Sep 2028

Table 15: Proposed major outage dates for each unit (non-binding)

In addition to the difficulties described above for retrofit of SCR, there would be a number of negative impacts which are well recognised in the literature, including:

- Reduction in boiler efficiency of ca. 0.25-0.50% due to flue gas reheat requirements;
- Increase in auxiliary power usage for new ID fans to balance increased pressure drop across catalyst; and
- Accelerated catalyst deactivation due to the high levels of alkali metals in biomass fuels.

The estimated CAPEX and OPEX costs for implementation of SCR are summarised in Table 166 below. The CAPEX costs in particular are considerable, even excluding lost revenue from the extended outages which would be required for installation.

Option	CAPEX (£M)	OPEX (£M/yr)
SCR @ 160 mg/Nm <sup>3</sup> NO <sub>x</sub>	13.7	0.22
SCR @ 40 mg/Nm <sup>3</sup> NO <sub>x</sub>	13.7	0.88
Notes:		
1. CAPEX costs exclude lost revenue from unplanned outages required for installation.		
2. OPEX costs exclude increased lost generation or increased fuel burn to mitigate for reduction in boiler efficiency.		

Table 16: Estimated CAPEX and OPEX Costs for SCR Implementation

## 5.2 Dust BAT-AEL Derogation Request

EP Lynemouth are requesting Article 15(4) derogations from BAT Conclusion 26 (dust BAT-AEL):

The derogations from the dust BAT-AEL for all three generating units are being made on basis of the **technical characteristics of the installation**. While EP Lynemouth believe that the derogation request has merit under a number of the accepted derogation criteria as summarised in Table 177 below, this derogation request is being made on the basis that **the configuration of the plant makes it more technically difficult and costly to comply**.

Aspect	Summary of Evidence
<b>Recent history of pollution control with respect to the pollutants for which the derogation is sought:</b>	The biomass conversion project (2016-18) resulted in significant reductions in dust emissions.  Various BAT techniques would require recently installed plant and equipment to be scrapped.
<b>The general investment cycle:</b>	Following the end of the CfD, significant resource and investment is intended to be focussed on implementation of pBECCS, supporting the governments transition to net zero. In this period there is one opportunity to implement additional BAT techniques, a planned 8-week outage on each generating unit in 2027/28.  Implementation of additional BAT techniques could not be achieved during these short outages resulting in significant lost generation and revenue.

Aspect	Summary of Evidence
<p><b>The configuration of the plant making it more technically difficult and costly to comply:</b></p>	<p>As a biomass conversion of an existing coal-fired installation significant space and plant performance related constraints restrict applicability of BAT techniques.</p> <p>Further ESP upgrades would have low dust capture efficiency at the Lynemouth Installation and would not achieve the BAT-AEL and constraints due to the existing infrastructure prevent ESP upgrade without complex and costly engineering solutions.</p> <p>The use of fabric filters would present an unacceptable fire risk due to the high unburnt carbon content of biomass ash and the likelihood of sparks and hot embers in the flue gas.</p> <p>Although bag filters are used in wood pellet fired plants elsewhere, these examples are using fluidised bed boiler technologies. The nature of the ash from Lynemouth’s PF boilers is such that the introduction of bag filters would present a significant fire risk.</p>
<p><b>The intended remaining operational lifetime of the installation:</b></p>	<p>The implementation of the pBECCS project, expected to be operational in 2034 is expected to significantly change the emissions profile of the plant and potentially require various abatement upstream of the carbon capture equipment. Any abatement equipment installed in 2027 in order to comply with BAT-AELs may need to be removed and replaced prior to operation of the pBECCS plant, at great cost and generating significant amounts of waste.</p>
<p><b>Reliance on confidence factors to comply with BAT-AELs:</b></p>	<p>Compliance with BAT-AEL limits for dust is assessed using the 95% confidence interval approach. This methodology recognises that short-term fluctuations do not necessarily indicate systemic non-compliance. Any change in a regulatory approach of implementing a confidence factor for reporting purposes would present a significant risk to EP Lynemouth’s ability to supply low carbon dispatchable energy to the grid.</p>
<p><b>Variability in Biomass fuel sources:</b></p>	<p>Biomass fuel sources exhibit significant variability in moisture content, calorific value, and ash composition. These variations, driven by supply chain diversity and seasonal factors, directly influence combustion behaviour and emission profiles. Optimising combustion parameters for each fuel batch is complex and cannot always be achieved instantaneously, especially when balancing efficiency, emissions, and plant reliability.</p>
<p><b>Low-carbon dispatchable CfD:</b></p>	<p>The nature of the low-carbon dispatchable CfD will mean the power station will operate less frequently at baseload and experiences greater variability in generation load, duration, and cycling, including more frequent start-ups and shut-downs. EA guidance acknowledges that such operational patterns, driven by the need to support dispatchable renewable energy, can increase transient emissions compared to steady-state operation. These changes are system-driven and unavoidable for grid stability, presenting additional challenges in maintaining emissions within BAT-AEL limits under all operating conditions.</p>

Aspect	Summary of Evidence
<b>Degradation of performance between outages</b>	Another critical factor impacting compliance is the progressive degradation of boiler surfaces and abatement equipment (ESPs) between scheduled maintenance outages. Over time, fouling and wear reduce heat transfer efficiency and limit the effectiveness of ESPs. This degradation is unavoidable, despite proactive cleaning and maintenance regimes. While major overhauls restore performance, interim periods can see temporary increases in dust emissions.

Table 17: Accepted derogation criteria for dust

### 5.2.1 BAT Options Assessment (Dust)

The two technical assessments, [RWE] and [AECOM], evaluated the site-specific applicability of the BAT techniques listed in the BRef conclusions for reduction of dust emissions. In order to prevent or reduce emissions of dust to air from the combustion of solid biomass (BAT 26), BAT is to use one or a combination of the techniques listed in

Fuel choice	Applicable within the constraints associated with the availability of different types of fuel	Already applied at Lynemouth Power Station (Fuel contract specification includes maximum ash content %, etc.) (see section 5.2.2).
-------------	---	--

Table 188 below, an additional column has been included to provide a high-level summary of the site-specific applicability of each technique in relation to this derogation request.

To prevent or reduce emissions of dust to air from the combustion of solid biomass (BAT 26), BAT is to use one or a combination of the following techniques:

Technique	BRef Conclusions - Applicability	EP Lynemouth Notes
Electrostatic precipitators (ESP)	Generally applicable	Applied at Lynemouth Power Station: Installation of additional field(s) complex due to existing plant configuration, specifically with reference to the lack of a suitable duct section and may not deliver BAT-AEL compliance (see section 5.2.3). <b>Taken forward for CBA.</b>
Bag filter	Generally applicable	Not applicable for Lynemouth: Existing ID fans would require replacement; the ESPs upgraded as part of the conversion would require partial or complete demolition and a significant outage would be required on each unit of the order of 6-12 months minimum (see section 5.2.4).  High risk of fire with biomass ash in pulverised fuel combustion plant and therefore <b>not taken forward to CBA.</b>

Technique	BRef Conclusions - Applicability	EP Lynemouth Notes
Dry or semi-dry flue-gas desulphurisation (FGD) system	This technique is mainly used for SO <sub>x</sub> , HCl and/or HF control	Not applicable as not installed pre-conversion. Primarily used for abatement of acid gases but these are within the BAT-AEL ranges (see section 5.2.2). <b>Not taken forward to CBA.</b>
Wet FGD	This technique is mainly used for SO <sub>x</sub> , HCl and/or HF control	Not applicable as not installed pre-conversion. Primarily used for abatement of acid gases but these are within the BAT-AEL ranges (see section 5.2.2). <b>Not taken forward to CBA.</b>
Fuel choice	Applicable within the constraints associated with the availability of different types of fuel	Already applied at Lynemouth Power Station (Fuel contract specification includes maximum ash content %, etc.) (see section 5.2.2).

Table 18: Dust abatement techniques

### 5.2.2 Fuel Choice and Other Techniques:

FGD is listed as a BAT technique for dust abatement, however it is principally an abatement technology used for reduction of SO<sub>2</sub> and other acid gases emissions. The biomass fuel fired at EP Lynemouth is inherently low in sulphur, chlorine and fluorine and therefore compliant with BAT-AEL SO<sub>2</sub>, HCl and HF levels and FGD is not considered an applicable BAT technique.

EP Lynemouth has imposed contractual limits, within the biomass supply chain, on various fuel parameters of significance for dust emissions, including most significantly the proportion of ash in the fuel, presented as a percentage of the as-received weight.

### 5.2.3 Electrostatic Precipitators:

The Lynemouth installation is equipped with ESPs which have been subject to successive, significant upgrades since construction, including electrical upgrades and the installation of additional upstream banks between the boiler house and ESP (A0 & B0) for each unit, to ensure compliance with the tighter emission limits under successive regulatory regimes. During the biomass conversion project, the ESPs were overhauled and upgraded with new high frequency switched integrated rectifier (SIR) technology, including larger power supplies to increase the particulate collection efficiency and reduce particulate emissions, taking into account the differing dust capture characteristics of biomass ash. The ESP ash hoppers were also modified to ensure free flow of fly ash into the fly ash collection system and prevent re-entrainment into the flue gas.

In view of these historical modifications and the compact configuration of the power station, particularly around the gas treatment plant, flue gas ductwork and stack, this area does not have any remaining sections of ductwork where the installation of additional ESP banks could be accommodated without significant modifications to ESP ductwork and ID fan locations.

This lack of space for the installation of additional abatement equipment is illustrated in Figure 1 to Figure 13.



*Figure 1: Electrostatic Precipitators (Unit 1 A0 & B0 Fields – Boiler House Visible to Right)*



Figure 3: Electrostatic Precipitators (Unit 1 ESP from Boiler House - right, to ID Fan Inlet - left)



Figure 2: Electrostatic Precipitators (Showing Close Proximity of Unit 1 & 2 ESP Outlets and ID Fan Ductwork to Stack Inlet)



*Figure 4: Electrostatic Precipitators (Boiler House Rear, ESPs and Stack Ductwork)*

The options for upgrade of the ESPs to achieve the dust BAT-AEL were assessed, taking into account the constraints imposed by the existing installation. The general approach to increasing the efficiency of ESPs is to maximise the collector electrode surface area that is available for dust collection. Options considered therefore included the construction of a new ESP field, installation of additional collector plates in maintenance spaces in the existing fields and the addition of an additional ESP pass. However, limitations apply to this approach as the existing fields remove the bulk of the inlet dust burden and any additional collector area will therefore be less efficient at removing the remaining dust.

Taking into account the limited options available for upgrade of the ESPs within the constraints of the existing installation and the low stack dust emissions when firing biomass, assuming a design level of  $20 \text{ mg/Nm}^3$ , both [AECOM] and [RWE] conclude that upgrading the ESPs would not guarantee dust emissions to be reduced to the BAT-AEL of  $10 \text{ mg/Nm}^3$ .

To realise the marginal reduction in dust emissions, any significant upgrades to the ESPs would require significant downtime for the unit in question, estimated at 6 – 12 months minimum for each unit. For comparison, significant rebuild of the EP Lynemouth unit 2 ESPs following a fire which occurred during late-August 2012 resulted in an outage of 9 months (from September 2012 to May 2013). During the construction period it is not possible to operate resulting in significant lost generation and revenue.

Table 199 summarises the estimated costs for ESP upgrade, as reported by [AECOM] and [RWE]. However, EP Lynemouth consider that these costs are significant underestimates. The rebuild of unit 2 ESP during 2012 resulted in a final cost of £4.6M. Additionally, the outages to plant operation to carry out the work and impact on plant revenue would increase these installation costs significantly.

CAPEX (£M)	OPEX (£M/yr)
7.4	0.3
<p>Notes:</p> <ol style="list-style-type: none"> <li>1. CAPEX costs exclude lost revenue from unplanned outages required for installation.</li> <li>2. OPEX costs exclude increased lost generation or increased fuel burn to mitigate for reduction in boiler efficiency.</li> </ol>	

Table 19: Estimated CAPEX and OPEX costs for ESP upgrade

### 5.2.4 Bag Filters:

The remaining listed BAT technique for dust abatement is installation of bag or fabric filters, either replacing the existing ESPs or downstream of them. Bag filters consist of one or more isolated compartments containing rows of bag filter bags or tubes. Dust-laden flue gases enter the compartment, particles are retained on the upstream face of the filter bags and the treated flue gases exit for discharge via the stack. The filter is operated cyclically, alternating between relatively long periods of filtering and short periods of cleaning. During cleaning, dust that has accumulated on the bags is removed from the fabric surface and deposited in a hopper for subsequent disposal. In view of the high differential pressure across the filter bags this option would require replacement of the existing ID fans installed as part of the conversion, with larger capacity units.

There is limited knowledge regarding the suitability of installing bag filters to large scale pulverised fuel biomass boilers, such those at EP Lynemouth. The majority of plants utilising bag filters operate fluidised bed biomass boilers.

The principal concern over the use of bag filters is in the risk of sparks or glowing particles reaching the bag filter due to the potentially high unburnt carbon content of the ash combined with the higher combustion temperatures used in pulverised fuel boilers. There is significant UK biomass industry experience of hot embers being collected in precipitator hoppers and ash handling systems.

EP Lynemouth has had operational experience of this, seeing hot ash enter precipitator hoppers and be conveyed into pulverised fuel ash (PFA) skips. In order to allow the ash to cool to a safe temperature to tip, the skips must be left to stand and are quenched with water to reduce the risk of fire. Hot ash such as this would present a major fire risk to any bag filter installation, therefore this option has not been taken forward to CBA.

## 5.3 Derogation Request Environmental Context

EP Lynemouth have carried out an air quality impact assessment<sup>11</sup> for both the proposed derogation position and for the scenario of the plant operating at the upper BAT-AEL range. A summary of the findings is included below:

The Lynemouth Power Station is not located in an air quality management area (AQMA).

### 5.3.1 Human Health Impact:

Air dispersion modelling has been undertaken in accordance with the relevant EA guidance<sup>12</sup>. The scenarios modelled were:

<sup>11</sup> Dispersion Modelling and Impact Assessment, BRef Compliance, Lynemouth Power Limited, AECOM, Revision date 24/10/2018

<sup>12</sup> Air Emissions Risk Assessment for your Environmental Permit, EPR Guidance, 2016

- Proposed derogation position for NO<sub>x</sub> and particulates;
- BAT emissions at the upper BAT-AEL range for NO<sub>x</sub> and dust;
- Emissions of NH<sub>3</sub> through SNCR slip for implementation of BAT-AEL.

The models were run for both short and long-term averages based on the release concentrations shown in Table 2020 below.

Scenario	Emission Concentration (mg/Nm <sup>3</sup> )			
	NO <sub>x</sub>	Dust (total)	NH <sub>3</sub>	Notes
Proposed derogation (Short-term avrg.)	220	20	-	-
Proposed derogation (Long-term avrg.)	200	20	-	-
BAT-AEL (Upper range)	200	16	10 (SNCR)	-
BAT-AEL (Upper range)	160	10	10 (SNCR)	-
Notes:				
1. Emission concentrations are reported at reference conditions: 6% O <sub>2</sub> , dry, STP.				

Table 20: Air Quality Impact Assessment Modelling Scenarios

**Nitrogen Dioxide (NO<sub>2</sub>):**

For both derogation and BAT-AEL scenarios the maximum predicted hourly mean NO<sub>2</sub> process contribution (PC), as a 99.79<sup>th</sup> percentile, are insignificant (i.e. <10% of the short-term AQS14).

For both derogation and BAT-AEL scenarios the predicted long-term mean NO<sub>2</sub> PC is insignificant (i.e. <1% of the long-term AQS) at sensitive human receptors.

The maximum long-term off-site PC was 2.5% of the AQS for the derogation scenario and 2.0% for the BAT scenario. Under both scenarios the maximum process environmental contribution (PEC) of 22% is well below the AQS so the impacts of the proposed derogation position are predicted to have an insignificant impact on human health.

**Particulates (as PM<sub>2.5</sub> and PM<sub>10</sub>):**

For both derogation and BAT-AEL scenarios the maximum predicted daily mean PM<sub>10</sub> PC, as a 90.4<sup>th</sup> percentile, are insignificant (i.e. <10% of the short-term AQS).

For both derogation and BAT-AEL scenarios the predicted long-term mean PM<sub>10</sub> and PM<sub>2.5</sub> PC are insignificant (i.e. <1% of the long-term AQS). A highly conservative assumption was made in the modelling study that all particulates were present in the form of PM<sub>10</sub> & PM<sub>2.5</sub>, as appropriate.

For impacts on human health the assessment demonstrates that none of the modelled scenarios risk compliance with AQS and that there are negligible air quality benefits from implementing BAT over the derogation scenario.

### 5.3.2 Ecological Impacts:

Dispersion modelling was used to assess maximum ground level concentrations and deposition rates for comparison with recognised limits and criteria for the protection of ecological features. Identified ecological receptors, including designated sites, were modelled as discrete locations and the impact at each site assessed using accepted methodologies.

#### Atmospheric Pollutants:

Predicted ground level NO<sub>x</sub> concentrations are predicted to be insignificant in terms of the daily critical load. Maximum daily mean critical loads are predicted to be 32% for the BAT scenario and 35% for the derogation scenario.

The predicted annual mean PC at all identified protected sites are insignificant in terms of the long-term threshold (i.e. <1% of the annual mean critical load).

Atmospheric concentrations of NO<sub>x</sub> (and NH<sub>3</sub> for the SNCR BAT scenario) are considered insignificant in terms of ecological impacts for both the derogation and BAT scenarios.

#### Deposition to Land:

Nutrient nitrogen and acid deposition was modelled and compared to habitat-specific critical loads for the most sensitive features of each identified protected area.

The nutrient nitrogen PC is predicted to be insignificant (i.e. <1% Critical Load) for all scenarios.

The acid deposition PC is predicted to be insignificant (i.e. <1% Critical Load) for all sensitive habitats that have been verified as present in the protected areas.

The Environmental Risk Assessment identifies both derogation and BAT scenarios as equally ranked.

### 5.3.3 Mass Emissions:

The revised NECD<sup>13</sup> which entered into UK legislation on 01/07/2018 sets out emission reduction commitments for each Member State for total emissions of NO<sub>x</sub>, oxides of sulphur, non-methane volatile organic compounds, ammonia and particulate matter (as PM<sub>2.5</sub>). The total emissions within the UK of each relevant pollutant should not exceed the amount specified in the relevant Schedule of the Regulations, the National Emissions Ceiling (NEC). This is illustrated in Table 2121 below.

---

<sup>13</sup> National Emissions Ceiling Directive (2016/2284/EU) transcribed as the National Emissions Ceilings Regulations 2018 (SI/2018/129)

Option	NEC 2020-2029	Annual Emissions (EP Lynemouth)	% of NEC
NO <sub>x</sub> : Proposed Derogation	641,850 tonnes	2,164 tonnes	0.34%
NO <sub>x</sub> : BAT-AEL Upper Range	641,850 tonnes	1,732 tonnes	0.27%
Dust [Total Particulate] Proposed Derogation	-	216 tonnes	
[Dust as PM <sub>2.5</sub> ] Proposed Derogation	-	60 tonnes	
Dust [Total Particulate] BAT-AEL Upper Range	-	108 tonnes	
[Dust as PM <sub>2.5</sub> ] BAT-AEL Upper Range	-	30 tonnes	
Notes: Particulate size fractionation (PM <sub>2.5</sub> / Total Particulate) determined from 2024 emissions testing			

Table 21: Projected mass emissions for derogation and BAT Scenarios

Therefore, it is considered that the marginal decrease in NO<sub>x</sub> emissions resulting from implementation of BAT-AEL at the Lynemouth Power Station would not have a significant impact on the UK's ability to comply with the NEC. It should be noted that the evaluation presented above for the Lynemouth Power Station assumes the facility is running at all times. Based on operational data over recent years the plant has operated for only 56.34% of the year. On this basis the percentage of the NEC from the Lynemouth Power Station will be even smaller, and similarly the benefit in reductions from additional abatement would be reduced.

## 6 Cost Benefit Analysis (CBA)

### 6.1 Overview of CBA

The Article IED 15(4) derogation may be permitted on the basis that ‘Such a derogation may apply only where an assessment shows that the achievement of emission levels associated with the best available techniques as described in BAT conclusions would lead to disproportionately higher costs compared to the environmental benefits’. EP Lynemouth has carried out a CBA for selected derogation and BAT scenarios for the Lynemouth Power Station installation, post-2027, using the EA IED CBA tool (Version 6.25, September 2024). The full details of the CBA are reported separately.

The scenarios assessed are shown in Table 2222 below.

Scenario	Description
<b>NO<sub>x</sub> Option 1</b>	Business as usual. Emissions at current levels
<b>NO<sub>x</sub> Option 2</b>	Derogation scenario at Annex V ELVs
<b>NO<sub>x</sub> Option 3</b>	Achievement of BAT-AEL (Upper range) using SNCR
<b>NO<sub>x</sub> Option 4</b>	Achievement of BAT-AEL (Upper range) using SCR
<b>NO<sub>x</sub> Option 5</b>	Achievement of 40 mg/Nm <sup>3</sup> using SCR
<b>Dust Option 1</b>	Business as usual. Emissions at current levels
<b>Dust Option 2</b>	Derogation scenario at Annex V ELVs
<b>Dust Option 3</b>	Achievement of BAT-AEL (Upper range) using upgraded ESPs

Table 22: Scenarios assessed in CBA

Other potential scenarios were not taken forward to CBA from the technical review, e.g. the use of fabric filters due to the unacceptable fire risk.

### 6.2 CBA Input Data

The full range of CBA input data is detailed in the CBA report. Where there are uncertainties over CAPEX and OPEX costs a conservative approach has been taken.

An assumption has also been made that the listed BAT techniques are available and would enable the required emissions performance to be guaranteed to comply with the BAT-AEL. The technical review, summarised earlier, provides evidence that this is not likely to be the case due to the site-specific characteristics of Lynemouth Power Station.

Lost revenue due to unplanned outages has been determined from the gross margin for generation under the CfD contract and the lost revenue resulting from any shut-downs required to install additional abatement additional to planned outages for normal maintenance and compliance purposes.

For the purposes of the CBA this lost revenue has been incorporated into the CAPEX costs of the BAT scenarios in contrast to the CAPEX costs presented in Table 144, Table 166 and Table 199.

For the purposes of the CBA the additional waste costs (due to disposal route for ammoniated ash) has been incorporated into the OPEX costs of the BAT scenarios in contrast to the OPEX costs presented in Table 14, Table 16 and Table 19.

The CBA assumes operation through to the end of 2034 for reasons explained previously in this report.

### 6.3 CBA Results

For the CBA model a positive net present value (NPV) indicates that the benefits exceed the costs, whilst a negative NPV demonstrates that the costs outweigh the benefits. The results of the CBA are summarised in Table 233 below.

Scenario(s)	ELV/AEL (mg/Nm <sup>3</sup> )	CAPEX including lost revenue (£M)	OPEX (£M)	NPV (£M)
1 & 2: NO <sub>x</sub> derogation Position (BAU)	200	0	0	-
3: NO <sub>x</sub> upper BAT-AEL (SNCR)	160	28.4	36.9	-65.27
4: NO <sub>x</sub> upper BAT-AEL (SCR)	160	194.4	4.4	-198.78
5: NO <sub>x</sub> lower BAT-AEL (SCR)	40	194.4	17	-211.39
1 & 2: Dust derogation Position (BAU)	20	0	0	-
3: Dust upper BAT-AEL (ESP Upgrade)	10	189.2	1.4	-190.56
<p>Note:</p> <p>1. CAPEX costs includes lost revenue from extended outages to install additional abatement calculated using gross margin.</p>				

Table 23: Summary of CBA results

The CBA output for NO<sub>x</sub> emissions demonstrates that NO<sub>x</sub> Scenarios 3 (SNCR), 4 & 5 (SCR) show significantly disproportionate additional costs when considering the environmental benefit gained from the additional NO<sub>x</sub> removed over Scenarios 1 (BAU) and 2 (Derogation) due to:

- CAPEX costs for retrofit of abatement;
- Lost revenue due to extended outages to install abatement;
- OPEX costs for de-NO<sub>x</sub> reagent and additional auxiliary power requirements;
- Environmental damage costs from ammonia slip; and
- Increased waste management costs due to off-site treatment/ disposal of ammoniated ash;

For the SNCR scenario the environmental benefits are likely to be over-stated due to the predicted low efficiency of SNCR at the Lynemouth installation.

The CBA output for dust emissions demonstrates that dust Scenario 3 (additional ESP upgrades) show significantly disproportionate additional costs when considering the environmental benefit gained from the additional dust removed over Scenarios 1 (BAU) and 2 (Derogation) due to:

- CAPEX costs for retrofit of abatement;
- Lost revenue due to extended outages to install abatement;
- OPEX costs for upgraded ESPs due to additional auxiliary power requirements;

For the ESP Scenario, the environmental benefits are likely to be over-stated due to the predicted lower returns in efficiency for any ESP collector area added over the existing ESPs.

## 7 Conclusions

### 7.1 NO<sub>x</sub> BAT-AEL Derogation (BAT 24)

EP Lynemouth are requesting a derogation from the NO<sub>x</sub> BAT-AEL for units 1, 2 & 3 of Lynemouth Power Station. The derogation request is being made on the basis that **the configuration of the plant makes it more technically difficult and costly to comply.**

The requested derogation position is for ELVs aligned with the Annex V ELVs as shown in Table 244.

Combustion Unit	Substance	Yearly Average ELV (mg/Nm <sup>3</sup> )	Daily Average ELV (mg/Nm <sup>3</sup> )
Solid fuels – biomass > 300 MW <sub>th</sub>	NO <sub>x</sub>	200	220

Table 24: Requested Derogation NO<sub>x</sub> ELVs

### 7.2 Dust BAT-AEL Derogation (BAT 26)

EP Lynemouth are requesting a derogation from the dust BAT-AEL for units 1, 2 & 3 of Lynemouth Power Station. The derogation request is being made on the basis that **the configuration of the plant makes it more technically difficult and costly to comply.**

The requested derogation position is for ELVs aligned with the Annex V ELVs as shown in Table 255

Combustion Unit	Substance	Yearly Average ELV (mg/Nm <sup>3</sup> )	Daily Average ELV (mg/Nm <sup>3</sup> )
Solid fuels – biomass > 300 MW <sub>th</sub>	Dust	20	22

Table 25: Requested Derogation Dust ELVs

### 7.3 Timeline and Derogation End Date

Based on the technical information summarised in this report and detailed in the associated technical reports, EP Lynemouth cannot comply with the NO<sub>x</sub> and dust BAT-AEL prior to operation of pBECCS.

Between the date of issue of this report and the end of 2035 the only major unit outages are those provisionally scheduled for 2027 of approximately 8-weeks duration for each of the three generating units allowing for statutory inspections.

The delivery of any project to retrofit further abatement would require a highly accelerated project programme which will not be able to deliver a FEED, final design and fully optimised process to meet the end date of the current derogation on 31 Mar 2027. Furthermore, this would require significant unplanned outages, resulting in significant lost generation and revenue. The CBA has therefore modelled the scenario where abatement would be installed during the 2027 outages and not before.

## 8 Appendices

- Technical Brief on Application of BAT for NO<sub>x</sub> and Particulates, Lynemouth Biomass Conversion Project, AECOM Project # 60565526, October 2018
- Lynemouth Power Station: Appraisal of BAT for NO<sub>x</sub>, Dust and CO, RWE Report TECH/TEF/3026/18, Issue #1, November 2018;
- Dispersion Modelling and Impact Assessment, BRef Compliance - Lynemouth Power Limited, AECOM, November 2018
- BAT and Options Appraisal for Biomass Generation – Lynemouth Power Station, AECOM Project #60566526, November 2018

