Riverside Energy Park

AD Facility Emissions Mitigation Note (with track changes)

VOLUME NUMBER:

08

PLANNING INSPECTORATE REFERENCE NUMBER:

EN010093

DOCUMENT REFERENCE:

8.02.42

September 2019 | Revision 1 (Deadline 7)

Planning Act 2008 | Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

CORY
RIVERSIDE ENERGY

Contents

Tables

Appendices

Figures

1 Introduction

1.1.1 As explained in **Paragraph 3.3.46** of **Environmental Statement (ES) Chapter 3** (**6.1, REP2-013**), the Anaerobic Digestion facility would convert organic waste into a constant and high-quality stream of biogas. There would be three potential options to utilise the biogas:

a. gas upgrading to compressed natural gas (CNG) quality vehicle fuel;

b. injection into the local gas network; or

c. combustion in a combined heat and power (CHP) engine for generation of renewable energy.

1.1.2 The air quality impacts resulting from the combustion of biogas onsite have been assessed in the air quality assessment submitted with the DCO application, **ES Chapter 7 ~~–~~Air Quality** (**6.1, APP-044**) and in an updated assessment, **ES Chapter 7 Air Quality** (**6.1, REP2-019**) Rev 1 at Deadline 2. Both of these assessments apply the assumption that the formation of nitrogen oxides (NO_x)[1] in the Anaerobic Digestion facility CHP engine would be abated using a standard modern combustion control system to control flue gas temperature and stability.

1.1.3 Since the DCO Application was submitted, the Applicant has made a commitment to invest in enhanced NO_x abatement equipment through the implementation of a selective catalytic reduction (SCR) system on the CHP engine. This enhanced mitigation will reduce the NO_x emissions associated with the Anaerobic Digestion CHP engine. In this report the Applicant considers the consequences of that improved mitigation performance on the air quality assessment undertaken as part of the Environmental Statement (ES).

1.2 Purpose of Document

1.2.1 ~~This~~ The purpose of this document is to summarise the Applicant's proposals in relation to the abatement of emissions of NO_x from the Anaerobic Digestion facility. Within this report, the Applicant will:

a. confirm the abatement technology that was assessed within the DCO application and the predicted air quality impacts associated with the abatement technology;

b. confirm the abatement technology which is now being proposed and the changes in the predicted air quality impacts associated with the proposed abatement technology~~,~~ ;

[1] Nitric oxide (NO) and nitrogen dioxide (NO_2) are together referred to as nitrogen oxides (NO_x).

c. describe how this abatement technology choice will be secured within the DCO and the Environmental Permit (EP); and

d. explain any consequences of the proposed changes to the abatement technology and how these will be mitigated.

2 Biogas combustion within the DCO Application

2.1 Conventional abatement of NOx emissions in a CHP engine

2.1.1 In a CHP engine, higher combustion temperatures will result in higher concentrations of NO_x within the flue gases. Therefore, the most important parameters to minimise the formation of NO_x in the flue gases are combustion temperature and stability.

2.1.2 The CHP engine proposed by the Applicant for the Anaerobic Digestion facility would utilise a combustion control system to control flue gas temperature and stability to minimise the formation of NO_x in the flue gases, while simultaneously recovering energy from the biogas in an efficient manner. This approach is referred to as a primary combustion control technique and is considered to represent best available technique (BAT) for NO_x emission abatement in the proposed CHP engine type.

2.2 Emissions modelling and Air Quality Impacts

2.2.1 The original source parameters for the DCO application for the emissions to air from the CHP engine are presented in **Paragraphs 7.5.52** to **7.54** and **Table 7.19** of **ES Chapter 7** (**6.1, REP2-019**). The NO_x emission limit originally proposed, and assessed within the ES, for the CHP engine as set out in **Table 7.19**, is consistent with the requirements of the Medium Combustion Plant Directive (MCPD) of 500mg/Nm^3 at 5% oxygen.

2.2.2 Dispersion modelling was undertaken for the DCO application for the NO_x emissions from the CHP engine, assuming that the CHP engine operated continuously all year round (**Paragraph 7.5.53** of **ES Chapter 7** (**6.1, REP2-01**)).

2.2.3 Contour plots of the process contributions (PCs) for hourly mean NO_2, annual mean NO_x and daily mean NO_x concentrations are shown in **Figures 7.8** to **7.10** of the **ES** (**6.2, APP-056 to APP-057**) respectively. The contour plots indicate that the effects of the anaerobic digestion CHP engine combustion were limited to the immediate vicinity of the REP site and there is no interaction (cumulative effects) with the emissions from the Energy Recovery Facility (ERF) as the impacts of emissions from the ERF are well below the levels of significance.

2.2.4 Potentially significant impacts are limited to the Crossness LNR, and only a small area of the LNR has hourly mean NO_2 concentrations above 10% of the objective and therefore considered potentially significant for human health receptors in the LNR. However, the area where the hourly mean NO_2 concentrations are above 10% is not an area where members of the public will be regularly present and therefore is not an area of relevant exposure for air quality strategy objectives.

3 Proposed biogas combustion systems

3.1 Selective catalytic reduction

3.1.1 Nitric oxide (NO) and nitrogen dioxide (NO_2) are together referred to as nitrogen oxides (NO_x). Combustion of fossil fuels is by far the dominant source of NO_x emissions. Emission concentrations are dependent on the amount of nitrogen in the fuel and on the air-fuel mix ratio. High temperatures and oxidation-rich conditions generally favour NO_x formation in combustion.

3.1.2 In order to mitigate the air quality impacts associated with the operation of the Anaerobic Digestion facility, selective catalytic reduction (SCR), in combination with a reagent (ammonia solution), has been selected as the preferred technology choice for the abatement of NO_x from the CHP engine. This is a secondary abatement technique which goes beyond the standard combustion control system referred to in **Paragraph 1.1.2** and can be employed to achieve low NO_x emission rates. This technology choice was not required or assumed at the time of the ES assessment since the relevant emissions limits could be achieved using standard combustion control techniques. However, the inclusion of SCR enables the emissions of NO_x to be reduced further.

3.1.3 SCR is a means of converting NO_x, with the aid of a catalyst, into nitrogen, water and carbon dioxide. Aqueous ammonia or urea is injected into the flue gas stream and flows across a catalytic surface, typically titanium dioxide.

3.1.4 The SCR system would include a catalyst bed in which the catalyst would be housed and is where the SCR reaction would take place. The reaction typically takes place at a temperature of 300 to 450°C which can be achieved with the selected technology.

3.1.5 SCR technology is extensively deployed throughout Europe.

3.1.6 Ammonia solution (25% concentration) would be used as a reagent for NO_x abatement in the SCR system. Ammonia would be delivered and stored in a tank in a designated storage area. The ammonia solution would be injected into the flue gases immediately upstream of the catalyst module.

3.1.7 Extensive dosing of reagent (ammonia) or low reaction temperatures can lead to ammonia slip, resulting in discharge to atmosphere of unreacted ammonia. Release of ammonia is not a controlled emission under the MCPD when operating the CHP engine. An assessment of the revised impacts from both NO_x and ammonia is presented in **Section 3.2** of this report.

3.1.8 The Applicant considers SCR to be a ‘cutting-edge’ technology in the abatement of emissions of NO_x from CHP engines and has elected to incorporate this technology in the event that biogas from the Anaerobic Digestion facility were combusted onsite in a CHP engine.

3.2 Air quality impacts

3.2.1 The proposed application of SCR to abate emissions of NO_x from the combustion of biogas in the CHP engine may also lead to emissions of ammonia due to ammonia slip. **Table 7.19** of **ES Chapter 7 Air Quality (6.1, REP2-019)** has therefore been updated (in the table below) with information on reduced NO_x emissions from the engine and the resultant ammonia emissions as a result of the introduction of SCR technology. Ammonia emissions have been modelled at the level which gives rise to insignificant impacts for ecological receptors within the Crossness Nature Reserve as this is the most stringent criteria to meet. The assumed emission levels are set out in **Table 7.1** below.

Table 7.1: Source parameters for Biogas Engine

Parameter	Model set-up
Discharge Location (m)	549391, 1807594
Stack height (m)	8
Internal Stack Diameter (m)	0.64
Flue gas velocity (m/s)	10
Oxygen (wet) (%v/v)	10
Moisture Content (%v/v)	10
Temperature (degree C)	450
Actual flow rate each (Am^3/s)	3.24
Normalized flow rate, dry, 5% oxygen (Nm^3/s)	0.754
Normalized flow rate, dry, 15% oxygen (Nm^3/s)	2.032
NOx emission concentration, 5% oxygen (mg/Nm^3)	125
NOx emission concentration, 15% oxygen (mg/Nm^3)	46.4
NOx emission rate (g/s)	0.094
NH3 emission concentration, 5% oxygen (mg/Nm^3)	60
NH3 emission concentration, 15% oxygen (mg/Nm^3)	22.3
NH3 emission rate (g/s)	0.045

3.2.2 The results of the dispersion modelling have been used to assess the impact of a lower NO_x emission from the engine and for the emissions of ammonia from the use of SCR as described in the following paragraphs. It has been assumed that the use of SCR does not alter any of the other operating parameters from the engine.

NO_x Emissions

3.2.3 Revised contour plots for hourly average NO_2 concentrations (**Figure 7.8, Rev01**), annual mean NO_x concentrations (**Figure 7.9, Rev 01**) and daily mean NO_x concentrations (**Figure 7.10, Rev 01**) have been prepared assuming that an SCR system is fitted to the CHP engine. **Figure 7.8** is relevant for human health exposure whilst **Figures 7.9** and **7.10** are relevant for impacts on terrestrial biodiversity. As there is no residential exposure in the area, annual mean NO_2 concentrations are not relevant.

3.2.4 As shown in **Figure 7.8, Rev 01** the area outside of the site boundary with predicted concentrations above 20µg/m^3 (for negligible impacts) is very small. The area extends at most 15 metres from the south and western boundaries for the south for approximately 50 metres along the site boundary. As noted in **Paragraph 2.12.3** of the **Applicant responses to ExA First Written Questions (8.02.04, REP2-055)** (ExA Q2.0.12) this area would not be a location where members of the public would be regularly present for a period of an hour or more. The impact of NO_x emissions on human health from the CHP engine is therefore not significant.

3.2.5 **Figure 7.9, Rev 01** shows that the maximum annual mean NO_x concentration in Crossness Nature Reserve is approximately 5µg/m^3 and therefore well below the critical level of 30µg/m^3 and in accordance with **Paragraph 7.5.65** of the **ES Chapter 7 Air Quality (6.1, REP2-019)**, for local nature sites the impact is insignificant.

3.2.6 **Figure 7.10, Rev ~~01~~ 02** shows that the daily mean NO_x critical level of 75µg/m^3 is not exceeded ~~approximately 6 metres into~~ in Crossness Nature Reserve ~~for approximately 15 metres on the boundary of the site~~. In accordance with the criteria set out in **Paragraph 7.5.65** of the **ES Chapter 7 Air Quality (6.1, REP2-019)**~~, only areas of Crossness Nature Reserve with concentrations above 75µg/m^3 would have potentially significant impacts~~ the impacts are therefore insignificant. ~~Guidance on the assessment of the impacts of NO_x concentrations on ecological impacts has recently been published by the Institute of Air Quality Management[2].~~

3.2.7 Paragraph D.4.10 of Appendix D.4 of the guidance to the assessment of air quality impacts on designated nature conservation sites (enclosed as **Appendix A**) recommends that only the annual mean NO_x concentration is used in assessments as long-term effects are more significant than short-term

~~[2] A guide to the assessment of air quality impacts on designated nature conservation sites. IAQM. Version 1.0, June 2019~~

effects, unless specifically requested by a regulator. Paragraph D.4.9 recommends that a value of 200µg/m^3 is used for the daily mean NO_x critical level instead of 75µg/m^3 due to the generally low ozone and SO_2 concentrations in the UK. ~~As such, even if one were to take account of the daily mean NO_x concentration in the assessment, the~~ The modelled NO_x concentration is well below 200µg/m^3 within Crossness Nature Reserve and therefore insignificant in accordance with **Paragraph 7.5.65** of the **ES Chapter 7 Air Quality (6.1, REP2-019)**.

NH_3 Emissions

3.2.8 For human health impacts, the predicted hourly mean NH_3 concentration within Crossness Nature Reserve is less than 262.5µg/m^3 which is 10.5% of the short-term Environmental Assessment Level of 2,500µg/m^3, as set out in **Table 7.7** of the **ES Chapter 7 Air Quality (6.1, REP2-019)**. In accordance with **Table 7.22** of the **ES Chapter 7 Air Quality (6.1, REP2-019)**, the impact on short-term NH_3 concentrations is ~~negligible~~Negligible.

3.2.9 For terrestrial biodiversity impacts, the maximum predicted annual mean NH_3 concentration on the site boundary with Crossness Nature Reserve is 3µg/m^3 which is equal to the critical level of 3µg/m^3 for non-lichens and bryophytes, as set out in **Table 7.8** of the **ES Chapter 7 Air Quality (6.1, REP2-019)**. The impact of ammonia emissions is therefore insignificant in accordance with **Paragraph 7.5.65** of the **ES Chapter 7 Air Quality (6.1, REP2-019)**.

3.3 Revised emission limits for the CHP engine

3.3.1 The EP application for REP was submitted to the EA on 17 December 2018. The EP application was subsequently Duly Made by the EA on 5 February 2019, with a Duly Made date of 17 December 2018 (permit number EPR/GP3535QS/A001). The EP application is therefore undergoing its determination process.

3.3.2 The Applicant ~~has been advised by the EA that they will be issuing~~ responded to a Schedule 5 Request ~~which will request that the Applicant further reviews~~ from the EA on 16th August 2019. This provided further information on the impact of REP upon the Crossness Nature Reserve. In responding to the Schedule 5 Request, the Applicant ~~intends to agree~~ agreed with the EA emission limits which are more stringent than those presented within the EP application~~, with the EA~~. The Applicant expects that these more stringent limits ~~assumed within the ES and EP application~~ are included within **Requirement 16** of the **dDCO (3.1 REP 5-003)** will be imposed by EA within the EP. The proposed emission limits will be set at a concentration where the impact of emissions from the CHP engine will have an insignificant impact on ecological receptors within the Crossness Nature Reserve, as this is the most stringent criteria.

3.4 CHP engine stack height

3.4.1 For the purpose of the Air Quality Assessment in the ES, a CHP engine stack height of 8 metres was assumed. In the revisions to the draft DCO (dDCO) submitted at Deadline 2, the minimum stack height for the CHP engine (Work No. 1(b)) was stated to be 4 metres. However, to ensure the dDCO reflects the assessments undertaken as part of the both ES and the EP, the Applicant is now proposing to increase the minimum consented height of the CHP engine stack within the dDCO to 8 metres. This amendment ~~will be~~ was made to the dDCO at Deadline 5. This amendment will ensure that emissions dispersion from the CHP engine stack is maximised.

4 Summary

4.1.1 The Applicant considers SCR to be a 'cutting-edge' technology in the abatement of emissions of NO_x from CHP engines and has elected to incorporate this technology in the event that biogas from the Anaerobic Digestion facility were combusted onsite in a CHP engine.

4.1.2 The use of SCR technology would go beyond the Environment Agency best available technique (BAT) requirement for the CHP engine and would enable NO_x emissions performance to improve beyond the level required through the relevant permitting legislation, being the MCPD.

4.1.3 Utilising SCR technology will enable NO_x emissions to be reduced from 190 mg/Nm^3 (the limit permitted under the MCPD) to 46.4 mg/Nm^3 (at 15% oxygen). The reduced figure is equivalent to 125 mg/Nm3 (at 5% oxygen) and is secured through **Requirement 16** of the dDCO. This impact has been robustly assessed by the Applicant and the revised assessment concludes that impacts on human health exposure are ~~negligible~~Negligible, and impacts on terrestrial biodiversity are insignificant.

4.1.4 Due to the requirement to apply a reagent to ensure high efficacy of the SCR process, a small risk associated with emissions of ammonia is introduced, but this is more than offset by the reduction in NO_x which results from the incorporation of SCR abatement. The net outcome in reducing NO_x emissions is beneficial for a proposed ammonia emission level of 22.3 mg/Nm^3 (at 15% oxygen). The figure is equivalent to 60 mg/Nm3 (at 5% oxygen). This impact has been robustly assessed by the Applicant and the revised assessment concludes that impacts on human health exposure are ~~negligible~~Negligible, and impacts on terrestrial biodiversity are insignificant.

4.1.5 The Applicant has elected to increase the minimum consented height for the CHP engine stack within the dDCO to 8 metres. This amendment ~~will be~~ has been made to the dDCO at Deadline 5.

4.1.6 The approach outlined above ensures that through proven abatement technology, air quality concerns associated with onsite combustion of biogas are eliminated. This commitment ~~will be~~ has been secured through the introduction of a new requirement in the dDCO to be submitted at Deadline 5 and is also secured by the EP (subject to Schedule 5 Request outcomes).

Appendix A A guide to the assessment of air quality impacts on designated nature conservation sites

into law by the Air Quality Standards Regulations 2010 and similar Regulations in the devolved administrations. The Directive defines a critical level as *"A level fixed on the basis of scientific knowledge, above which direct adverse effects may occur on some receptors, such as trees, other plants or natural ecosystems but not on humans"*. Under the Directive, assessment of compliance with the critical levels is strictly only required at locations more than 20 km from towns with more than 250,000 inhabitants or more than 5 km from other built-up areas, industrial installations or motorways[73]. In practice, however, assessment against critical levels for vegetation is frequently undertaken to inform planning and permitting processes across the country, regardless of this definition.

D.3.4 The Air Quality Strategy for England, Wales, Scotland and Northern Ireland[74] has adopted these critical levels, as national objectives for the maximum ambient air concentrations of NO_x and SO_2 (and ozone[75]) to be attained, for the aim of protection against the direct effects of air pollution.

D.3.5 The main critical levels used in air quality assessments of designated sites are set out in Table 2.1.

D.3.6 **Critical loads** relate to the potential effects of pollutant deposition [over periods of decades] and are defined by UNECE as *"a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge"*.

D.3.7 There are critical loads for nitrogen deposition (leading to eutrophication) and acid deposition (leading to acidification). Critical loads for nitrogen deposition are given as a range and quoted in units of kilograms of nitrogen per hectare per year (kg N/ha/year). A critical load for acidification is described in units of kilograms of H^+ ion equivalents per hectare per year (keq/ha/year). Most assessments consider nitrogen and sulphur deposition, but for some industrial processes, including energy from waste, other chemical species need to be considered, such as hydrogen fluoride (HF).

D.3.8 Critical loads are habitat dependent, further detail and supporting information is provided by the online resource, the Air Pollution Information Service (APIS)[76].

D.4 Oxides of nitrogen (NO_x)

D.4.1 Oxides of nitrogen (NO_x; also referred to as nitrogen oxides), are produced mainly as a result of combustion processes[77]. Almost half of the NO_x emissions in the UK are from road vehicles, mostly diesel engines; approximately one quarter is from power generation and the remainder from other industrial and domestic combustion processes. Emissions of NO_x are also produced naturally by lightning, forest fires and, to a small extent, microbial processes in soils. NO_x is a mixture of nitrogen oxides, conventionally considered to be a mixture of nitrogen dioxide (NO_2)[78] and nitric oxide (NO)[79]. The general long term UK trend in NO_x has been one of improvement (particularly since 1990) despite an increase in vehicles on the roads[80].

D.4.2 NO_x can affect plants directly or indirectly. It may directly enter a plant via the stomata (as NO or NO_2), where it has phytotoxic effects. Lower plants such as lichens and bryophytes (including mosses, landworts and hornworts) are particularly vulnerable to direct exposure to the gases in this way[81]. NO_x can also deposit onto soil and, following transformation to nitrate, enrich the soil, leading to eutrophication, as discussed later.

D.4.3 There is no published evidence for any direct toxic effect of NO_x on animals and therefore effects on animals are not directly included in ecological impact assessments, which focus on the effects on vegetation. The effects on animals are sometimes indirectly included in an assessment where species are dependent on particular habitats for their survival and an assessment will focus on this supporting habitat.

D.4.4 The effects of elevated NO_x concentrations on vegetation can be broadly categorised as[82]:

- growth effects: particularly increased biomass, changes in root to shoot ratio and growth of more competitive species, but also including growth suppression of some species;
- physiological effects: e.g. CO_2 assimilation and stomatal conductivity; and
- (bio)chemical effects: e.g. changes in enzyme activity and chlorophyll content (probably through the effects of increased nitrogen, as demonstrated in lichens[83], but also documented in higher plants).

D.4.5 The long term (annual average) critical level for NO_x is 30 µg/m^3. At concentrations above this critical level, both beneficial and adverse responses have been recorded, and there is evidence suggesting an adverse synergistic effect when plants are exposed to both NO_x and SO_2.[84].

D.4.6 The long term critical level for NO_x was set on the basis that growth effects are likely to affect vegetation diversity and survival and occur at lower annual average concentrations than other effects.

D.4.7 Data presented by the World Health Organization (WHO) 2000[82] indicates that, other than growth effects, biochemical or

physiological effects have been demonstrated in vascular plants from exposure to annual average concentrations of more than 100 µg/m^3. With regard to lower plants, Das *et al* (2011)[85] recorded evidence of chlorophyll changes in lichens, also correlated with NO_x at higher concentrations (over 260 µg/m^3). These studies have also attributed the effects to the increase in available nitrogen, but at such high concentrations NO and NO_2 can also increase cellular acidity and inhibit lipid biosynthesis (Wellburn, 1990)[86].

D.4.8 The critical level does not differentiate between the role of nitrogen deposition and NO_x in the air. It is a precautionary general threshold, not specific to a particular habitat, plant species or impact pathway, below which there is currently a high degree of confidence that no adverse effects on vegetation will arise. Long term NO_x concentrations below the critical level are therefore desirable. Some species or habitats may not show adverse effects until higher concentrations are present.

D.4.9 The long term (annual mean) concentration of NO_x is most relevant for its impacts on vegetation, as the effects, particularly through the nitrogen deposition pathway, are additive over months and years. This is reflected in the adoption of the long term guideline in the EU Air Quality Directive as a limit value for vegetation. However, atmospheric exposure to very high concentrations of NO_x for short periods (hours/days) may also have an adverse effect under certain conditions even if the long term concentrations are below the limit value. The WHO guidelines[87] include a short term (24-hour average) NO_x critical level of 75 µg/m^3. Originally set at 200 µg/m^3 as a four-hour mean, the more detailed CD-ROM version of the 2000 WHO guidelines[88] comments: *"Experimental evidence exists that the CLE decreases from around 200 µg/m^3 to 75 µg/m^3 when in-combination with O_3 or SO_2 at or above their critical levels. In the knowledge that short-term episodes of elevated NO_x concentrations are generally combined with elevated concentrations of O_3 or SO_2, 75 µg/m^3 is proposed for the 24 h mean."* Ozone and SO_2 concentrations are typically low in the UK compared to many other countries. If a regulator does require the use of the short term NO_x critical level, given the low UK SO_2 concentrations IAQM consider it is most appropriate to use 200 µg/m^3 as the short term critical load.

D.4.10 The relative importance of the long term mean compared to the short term mean is reflected in several studies which state that the *'UNECE Working Group on Effects strongly recommended the use of the annual mean value, as the long term effects of NO_x are thought to be more significant than the short term effects'*[89, 90]. This IAQM guidance, therefore, recommends that only the annual mean NO_x concentration is used in assessments unless specifically required by a regulator; for instance, as part of an industrial permit application where high, short term peaks in emissions, and consequent ambient concentrations, may occur.

D.5 Sulphur dioxide (SO_2)

D.5.1 The main anthropogenic source of sulphur dioxide (SO_2) is the combustion of sulphur containing fuel in electricity generation, other industry and domestic heating. Since the 1970s, UK emissions have fallen by 95% with the largest reductions occurring between 1990 and 2000, when emissions reduced by 70%[91].

D.5.2 SO_2 is directly toxic to both higher and lower plants. Lower, non-vascular, plants such as lichens and bryophytes are particularly vulnerable. In the UK, however, many lichen species have increased in abundance after the return to low ambient concentrations (<10 µg/m^3).

D.5.3 The critical level for protection of all vegetation types from the effects of SO_2 is 20 µg/m^3, as an annual mean, except for lichens and bryophytes (including mosses, landworts and hornwarts) for which the criterion is 10 µg/m^3, reflecting their greater sensitivity.

D.5.4 Another key effect of SO_2 is through the indirect effects arising from the acidification of soils. This is discussed in more detail below.

D.6 Ammonia (NH_3)

D.6.1 Agriculture is the main source of anthropogenic ammonia (NH_3) in the UK (82% in 2016[92]). A small amount of ammonia is emitted from petrol vehicles with early three way catalysts, although this source is declining as these older vehicles are retired from the fleet. Vehicles that use Adblue to control NO_x emissions from diesel engines potentially emit ammonia, but vehicles using this technology should have an effective system to remove ammonia from the exhaust gases. Anaerobic digesters used in the waste industry are also an important source of ammonia.

D.6.2 The direct uptake of NH_3 through the stomata increases the amount of nitrogen within the plant. In addition, its alkalinity adversely affects plant biochemistry; lichens and bryophytes are particularly sensitive to this effect[93]. Ammonia also reacts in the atmosphere to produce ammonium ions (NH_4^+) which contribute to nutrient nitrogen and acid deposition. Higher plants are considered to be less sensitive and, for this reason, the annual critical level for higher plants is 3 µg/m^3 but is reduced to 1 µg/m^3 where lower plants (lichens and bryophytes, including mosses, landworts and hornwarts) are a particular interest feature of a habitat. It is the ecologist's role identify the presence of these lower plants.

D.7 Hydrogen fluoride (HF)

D.7.1 Hydrogen fluoride (HF) is an acidic gas released from industrial processes (such as coal fired power stations, waste incinerators

Figure 7.8 Predicted Hourly Average NOx Concentration

Hourly Average NO_2 ($\mu g/m^3$)

- 10
- 20
- 30
- 40
- Application Boundary
- Air Dispersion Modelling System Point Source
- Crossness LNR

10

20

40

Crossness

N

ROAD

RIVERSIDE ENERGY PARK

0 75 150 Metres

pba peterbrett

CORY RIVERSIDE ENERGY

1:2,000 @ A3

30/08/19

Drawn: AG

Checked: GH

Predicted Hourly Average NO_2 Concentration (for the proposed REP Anaerobic Digestion Facility)

Figure 7.8 | Rev 02

Figure 7.9 Predicted Annual Mean NOx Concentration

Annual Average NOx ($\mu g/m^3$)

- 1
- 5
- 8
- Application Boundary
- Air Dispersion Modelling System Point Source

1

5

8

Crossness

NORMAN ROAD

N

RIVERSIDE ENERGY PARK

0 100 200 Metres

pba peterbrett

CORY RIVERSIDE ENERGY

1:2,500 @ A3

30/08/19

Drawn: AG

Checked: GH

Predicted Annual Mean NOx Concentration (for the proposed REP Anaerobic Digestion Facility)

Figure 7.9 | Rev 02

Figure 7.10 Predicted Daily NOx Concentrations

Daily NOx (µg/m³)

- 25
- 50
- 60
- Application Boundary
- Air Dispersion Modelling System Point Source

25
50
60

ANLROAD

N

RIVERSIDE ENERGY PARK

0 75 150 Metres

pba peterbrett

CORY RIVERSIDE ENERGY

1:2,000 @ A3

30/08/19

Drawn: AG

Checked: GH

Predicted Daily NOx Concentrations (for the proposed REP Anaerobic Digestion Facility)

Figure 7.10 | Rev 02