FICHTNER
Consulting Engineers Limited

Powerfuel Portland ERF

Climate Change, Air Quality, Health and Permit

Proof of Evidence of Stephen Othen

13 November 2023

ENGINEERING CONSULTING

APPEAL AGAINST THE REFUSAL OF AN APPLICATION FOR CONSTRUCTION OF AN ENERGY RECOVERY FACILITY WITH ANCILLARY BUILDINGS AND WORKS AT PORTLAND PORT, CASTLETOWN, PORTLAND DT5 1PP

PINS REF: APP/D1265/W/23/3327692

LPA REF: 20/00692/DCC

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1 Introduction

1.1 Qualifications and experience

1.1.1 I, Stephen Othen, am the Technical Director of Fichtner Consulting Engineers Ltd. I hold a Master of Engineering degree in Chemical Engineering from the University of Cambridge and I am a Chartered Chemical Engineer and Member of the Institute of Chemical Engineers.

1.1.2 Fichtner Consulting Engineers Ltd is an engineering and environmental consultancy working mainly in the fields of waste management and renewable energy. We predominantly provide services to waste management operating and development companies and to banks and other financing bodies. We act as Owner's Engineer for developers, which means that we provide specifications for Energy from Waste (EfW) plants, review tenders and designs and provide project management and engineering support during construction.

1.1.3 I have worked at Fichtner Consulting Engineers Ltd since 1998 and I have worked for a variety of clients in a number of industries, but my main focus has been the waste industry. I have provided services for all of the major EfW plant operators and developers in the UK, including Urbaser, Veolia, Suez (previously SITA), FCC Environmental (previously Waste Recycling Group), Amey Cespa, Encyclis (previously Covanta) and Viridor, as well as to most of the leading investors and lenders in this space. These services have included reviews of proposed projects and technologies, reviews of operational facilities and development of upgrade and improvement programmes, covering both technical and environmental aspects of projects and technologies.

1.1.4 Amongst other responsibilities, I am responsible for all environmental consultancy within Fichtner UK, having carried out air quality assessments and permit applications for over twenty years. I and my team have carried out air quality assessments for multiple combustion and waste plants, as well as other developments where the primary concern has been traffic emissions, and climate change/carbon assessments for various types of power stations and waste management facilities. I and my team also been responsible for the preparation of permit applications under the Integrated Pollution Control, Integrated Pollution Prevention and Control and Environmental Permitting regimes for over sixty combustion plants processing municipal waste, refuse-derived fuel or biomass.

1.1.5 I have given evidence at twelve public inquiries, covering air quality impacts, carbon assessment and the technical design and operation of energy from waste plants.

1.1.6 I am a member of the Environmental Services Association Energy from Waste Working Group. In this role, I have been involved in discussions with the Environment Agency on the implementation of the waste incineration BREF in the UK.

1.1.7 I have been working on the Portland ERF specifically since March 2020, providing services, with my colleagues, in all of the areas which I am covering in this proof of evidence.

1.1.8 I understand my duty to the Inquiry to help the Inspector on matters within my expertise and that this duty overrides any obligation to the person from whom I have received instructions or by whom I am paid. I confirm that my fees are not conditional on the outcome of the Inquiry. I have complied, and will continue to comply, with that duty. I confirm that this evidence identifies all facts which I regard as being relevant to the opinion that I have expressed and that the Inquiry's attention has

been drawn to any matter which would affect the validity of that opinion. I believe that the facts stated within this proof are true and that the opinions expressed are correct.

1.1.9 The evidence which I have prepared and provide for this planning appeal (PINS Reference APP/D1265/W/23/3327692) in this Proof of Evidence is to the best of my knowledge and belief true and I confirm that the opinions expressed are my true and professional opinions.

1.2 Scope and structure of evidence

1.2.1 My evidence will cover a number of areas. These do not directly relate to the reasons for refusal, but they provide supporting evidence for the planning balance (considered by Mr Roberts) as well as responding to concerns raised by the Rule 6 parties and other interested parties.

1.2.2 Firstly, to assist the Inquiry, I have explained a number of overarching technical issues in section 2.

1.2.3 In section 3, I have considered the effect that the Appeal Proposal would have on greenhouse gas emissions.

1.2.4 In section 4, I have explained the impacts of emissions from the Appeal Proposal on air quality, health and ecology in the local area, including in relation to transportation associated with the operation of the facility. In this section, I have taken account of the benefits of providing shore power in reducing other emission sources in the port.

1.2.5 I have responded to points made in written representations by other parties falling in my technical fields in section 5.

1.2.6 My conclusions are in section 6.

2 Technical Issues

2.1 Introduction

2.1.1 During the process of applying for planning consent and an environmental permit, there have been a number of technical changes to the plant. I have explained these in this section, as they affect other parts of my proof and Mr Roberts' evidence.

2.2 Plant Efficiency

2.2.1 The planning application in September 2020 was based on a proposed plant design from a specific contractor which had been prepared in 2019. The basis for this design was that there was a limited grid export capacity of 15.2 MW. Therefore, the plant designers had not focussed on optimising the plant efficiency but had ensured that the plant would be classified as a recovery plant. (EfW facilities which process non-hazardous residual waste which are granted R1 status can be described as "Recovery" operations in accordance with the waste hierarchy. This applies to facilities where the R1 factor of the plant is greater than 0.65 (for plants permitted after January 2009). The R1 factor of the Appeal Proposal in 2020 was calculated as 0.68 and so met the criteria for R1 status.)

2.2.2 Since the application was submitted, it has become apparent that there are a number of electricity users at or close to the port which could be supplied with power directly. These include the following:

- Shore power. This is discussed in the next sub-section but, in discussions with the port, it is clear that there would be at least one ship drawing power virtually all of the time.
- Other port users. There are a number of companies on the port which draw power from the port's grid and ultimately from the national grid, which could be supplied directly from the ERF, thus reducing the overall import to the port. This is relevant because, as explained by Mr Roberts and demonstrated by the grid offer in his Appendix NR3, grid upgrade works to deliver more power to the Isle of Portland cannot take place before 2037.
- The Ministry of Justice prisons.
- Todd Technology Ltd.

2.2.3 Exporting power to these users via a private wire would not use the limited grid export capacity, and so would allow the plant to export more than 15.2 MW. At present, we are confident that there would be at least 2 MW of demand continuously, with the potential for more. Therefore, the Applicant commissioned Fichtner to review the current plant design and identify ways to improve the plant efficiency. We identified some simple improvements in the plant design – preheating the combustion air before it is fed to the plant and purchasing a more efficient turbine – which would allow the plant to generate 20.1 MW, rather than the current 18.2 MW. This would give export of 17.1 MW, rather than 15.2 MW.

2.2.4 We also identified that a more fundamental optimisation of the boiler, with higher steam temperatures and pressures, would have the potential to improve the plant efficiency further, with the potential to generate 22.2 MW and export 19.2 MW. If and when the Portland ERF is granted planning permission, the Appellant would be able to conclude agreements with Portland Port and

other users to export power, which would enable the Appellant to commit to higher power output. However, since we cannot confirm, at this point, that this amount of power could be exported continuously, the Appellant has decided to conservatively base the design for this appeal on export of 17.1 MW. This means that the plant would have a gross efficiency of at least 28.8%, a net efficiency of at least 24.5% and an R1 value of at least 0.76. I can confirm that the changes to the plant could be accommodated within the current building envelope and would not affect any of the environmental assessments, except for the carbon assessment as I have considered in my proof.

2.2.5 Fichtner has prepared and submitted an application for R1 status on behalf of the Appellant, on the basis of this design. The application was submitted on 6 November 2023. The R1 calculation for this application is attached as Appendix SO1.

2.3 Shore Power

2.3.1 The original planning application was supported by a Shore Power Strategy Report[1], prepared by Arup. This explained the general benefits of shore power, the specific benefits to Portland Port due to the constrained grid infrastructure around Portland, and the types of ship which could be connected, which were considered to the Royal Fleet Auxiliary (RFA) ships and cruise ships. The potential benefits of shore power were estimated in the carbon assessment (which I discuss in section 3 of this proof) and the potential air quality benefits were mentioned but not quantified (and are further discussed in section 4 of this proof). However, shore power was not considered certain at this point as discussions were ongoing with the port.

2.3.2 Dorset Council requested additional information in a letter dated 30 April 2021[2]. Questions 16-18 requested more detail on how the shore power element of the proposal would work and the benefits. In response, Arup prepared a revised Shore Power Strategy Report[3], which was submitted in August 2021. This referred to a letter of support from the Port Operator, dated July 2021, which emphasised the increasing importance of shore power. This letter specifically referred to the driver for the RFA ships to use shore power as "governmental policy to reduce CO_2 emissions from the HMG estate and activities" and noted that cruise ship operators have commercial drivers due to "cruising clientele demanding a greener experience". The Port Operator also noted a surge in bookings for cruise ships in 2021 and 2022 and noted that RFA berth days had been increasing.

2.3.3 Arup quantified the likely ships as follows:

- RFA ships – 260 berthing days per year (noting that two ships berthed for a day would count as two berthing days), with typical demand of 2.75 MW per ship.
- Cruise ships – 36 ships (60% of the 60 visits) connecting to shore power in 2024, rising to 65 (100% of visits) from 2044 as more ships are converted to being shore-power capable, with average demand of 8 MW per ship. These ships tend to stay for 11 hours a day, as they arrive in the morning and leave in the evening.

[1] CD1.32 – Shore Power Strategy Report, Arup, 3 September 2020.

[2] CD2.17b ES Addendum Appendix 1-1.

[3] CD2.8 – Updated Shore Power Strategy Report, Arup, August 2021.

- Total power demand of 20 GWh per year in 2024, rising to over 24 GWh in 2045.

2.3.4 The cruising industry was significantly disrupted by the Covid epidemic, but it is now expanding again. I have obtained data from the Port Operator which shows that there were 84 cruise ship visits in 2022, although there will be fewer in 2023 and 2024 due to some redeployment of ships from the Ukraine War. This means that the original estimate of cruise ship demand looks to be reasonable and potentially conservative.

2.3.5 However, the RFA ships have used the port more. Arup noted that the Port Operator's supporting letter indicated in 2021 that actual berthing days were more than 260 per year and data provided by the Port Operator supports this. Total berthing days from the RFA were 390- 505 in each year from 2018-2022 and the incomplete data for 2023 suggests that the total will be above 500 again. Therefore, I am confident that it is realistic to assume that the RFA ships would have at least 390 berthing days per annum. This increases the demand from the RFA ships to 26,000 MWh per annum and the total demand to 29,639 MWh per annum in 2024, increasing to 32,931 MWh by 2047.

2.3.6 The Port Operator has also informed me that there is interest in shore power from other cargo operators in the port. A number of companies deliver materials from ships which remain berthed for a number of days. This means that the actual demand for shore power would be higher than indicated above.

2.4 District Heating

2.4.1 The original planning application was supported by a Heat Report prepared by Arup[4]. This report identified five potential heat users (Osprey Leisure Centre, Portland Hospital, HMP The Verne, Comer Homes and YOI Portland) with a total peak demand of 11 MWth and an average heat demand of 2.6 MWth.

2.4.2 Dorset Council requested additional information in a letter dated 30 April 2021[5]. Question 12 requested more detail on how the two prisons could be connected to a district heating system. In response, the Appellant prepared a District Heating Paper[6], which was submitted in August 2021. This paper provided further technical details of the proposed district heating network, including the pipe route to the two prisons. The report noted that the two prisons are particularly advantageous heat users, as they provide a consistent heat demand which can be expected to remain for the long term, they are close to the ERF and the counterparty is effectively the government, which has very strong financial standing. The report also noted that the majority of other district heating networks linked to ERFs in the UK are partly or fully supported by local or national governments (or parties linked to the government, such as the Devonport Dockyard), for this reason.

2.4.3 The District Heating Paper explains that the district heating network would be developed in phases, expanding to other users once the two prisons had been connected. As I explain later, this has been taken into account in the carbon assessment, particularly the lifetime assessment. The paper also explains that the network is economically viable, with a nominal internal rate of return of 11.7%

[4] CD1.27 ERF Portland – Heat Report, Arup, 2 September 2020.

[5] CD2.17b ES Addendum Appendix 1-1.

[6] CD2.7 – District Heating Paper, August 2021.

which would be attractive for a project supported by long term heat supply contracts with government-related parties.

2.4.4 The Appellant has been discussing the potential for heat export to HMP The Verne and HMP YOI Portland (the Prisons) since September 2020, and has provided details of the engagement in a separate statement to me which is included in Appendix SO2. This confirms that, by October 2021, a memorandum of understanding had been agreed between the Ministry of Justice and Powerfuel Portland under which the two parties would collaborate to develop the supply of heat from the Portland ERF to the prisons, with the aim of heat being delivered as soon as the plant was operational. This memorandum of understanding was not signed because the Ministry of Justice did not want to appear to be influencing the outcome of the planning application.

2.4.5 I consider that the Appeal Proposal is in a strong position to deliver heat from the outset compared to other ERFs, since the anchor users (the prisons) have clear reasons for connecting to a district heating network, have made a commitment to facilitate the connection and would be regarded as a very reliable counter-party.

2.5 Carbon Capture

2.5.1 When the planning application was submitted in September 2020, carbon capture was not part of the application.

2.5.2 Since September 2020, there have been a number of significant developments in the UK Government's approach to carbon emissions from ERFs.

2.5.3 The UK Emissions Trading Scheme (UK ETS), which is a carbon trading scheme for industrial emissions, was established in January 2021 to replace the EU ETS when the UK left the EU and, initially, it replicated the EU ETS. This meant that ERFs processing municipal waste were excluded from the UK ETS, as they had been excluded from the EU ETS. In March 2022, the government consulted on changes to the UK ETS, one of which was a proposal to include ERFs in the UK ETS[7]. In June 2023, the government published its response to the consultation and announced that it intended to include all forms of energy from waste, including waste incineration, gasification, pyrolysis and other waste to fuel technologies, in the UK ETS from 2028[8]. (I note that the EU is consulting on similar changes to the EU ETS.)

2.5.4 The effect of this change will be that ERFs will be required to purchase emission credits for fossil-fuel derived carbon emissions. The industry anticipates that the additional costs of these credits will be passed to the waste producers, on the polluter pays principle. However, this also means that an ERF which installs a carbon capture system will be able to avoid the need to purchase the carbon credits, which provides an economic incentive to install such a scheme. This incentive did not exist at the time of the planning application.

2.5.5 In parallel with this, the government has been developing an incentive scheme to promote the initial development of carbon capture and storage. This is focused on two planned clusters (in Merseyside and Teesside), where multiple power stations, energy from waste plants and industrial

[7] CD12.21 Developing the UK ETS, DEFRA, March 2022

[8] CD12.22 Developing the UK ETS – Main Response, DEFRA, June 2023

companies could capture carbon and send it via a combined pipeline to planned storage areas in the Irish Sea and the North Sea respectively. The intention is that the government will provide initial capital funding and a guaranteed price for the captured carbon, so that some projects can proceed and demonstrate the technology commercially. However, the proposed contracts are written so that these projects do not, ultimately, receive more income than they would have received under the UK ETS.

2.5.6 The Government is also proposing to expand the existing carbon capture readiness (CCR) requirements. Since 2009, developers of new power stations with a capacity of 300 MWe of more have been required to demonstrate, when applying for a section 36 consent or a Development Consent Order, that the power station is carbon-capture ready. In the 2020 Energy White Paper, the government committed to consulting on an expansion to these requirements. This led, in July 2021, to a call for evidence on the expansion of the requirements and then, in March 2023, to the publication of a consultation document on decarbonisation readiness[9]. This included the following relevant proposals.

- Moving the requirements from the planning consent process to the environmental permitting process.
- Expanding the requirements to include alternative decarbonisation options (primarily hydrogen production) and so renaming the requirement "decarbonisation readiness".
- Removing the 300 MWe minimum threshold, and effectively reducing the threshold so that all plants which require an environmental permit are captured.
- Expanding the scope of the requirements to biomass, biogas, energy-from-waste and CHP plants.
- Include all new plants which are put into operation after 1 July 2024.

2.5.7 The government is proposing that developers would need to pass four tests to demonstrate that a plant is decarbonisation ready through the provision of CCS. These are:

- that sufficient space is available on the site to accommodate any equipment necessary to facilitate CCUS;
- that it is technically feasible to retrofit a CCUS plant to the combustion power plant;
- that the site's location enables access to offshore permanent storage for the CO_2 (the transport and storage test);
- and that it is likely to be economically feasible, within the power plant's lifetime, to retrofit CCUS.

2.5.8 However, the government is proposing that the economic feasibility test would be non-mandatory to pass, and that the transport and storage test would be non-mandatory for energy-from-waste plants. Having said that, I note that the government is proposing, in section 8.3.5 of the consultation

[9] Decarbonisation Readiness - Consultation on updates to the 2009 Carbon Capture Readiness requirement, March 2023, DESNZ.

document, that the transport and storage test can be met by identifying that a suitable area of deep geological storage offshore exists for the storage of captured CO_2 from the proposed power plant and demonstrate that a feasible route exists from the site to the storage area, and that the feasible route can involve a pipeline and/or shipping but not, at present, road or rail transport. This means that a port location is a significant advantage in demonstrating decarbonisation readiness.

2.5.9 The Appellant commissioned Fichtner to assess the potential for installing a carbon capture plant adjacent to the Portland ERF. The study was carried out by specialists in Fichtner under my direction. The report from this study was submitted to Dorset Council in August 2021[10]. It concluded that post-combustion carbon capture was technically feasible and would require a land area of around 4,000 m^2. I can confirm that land is available adjacent to the Appeal Proposal site and my client has informed me that it is in discussions with the port to develop this land if and when it is needed.

2.5.10 The report also noted that Portland Port has a key locational advantage. As outlined above, the carbon capture hubs which are being developed are not close to Dorset and so there is no easily accessible carbon pipeline. For an inland site, this means that any captured carbon would need to be removed from the site by road. However, CO_2 captured at Portland could be discharged into a liquefaction plant and then delivered directly to a ship and from there for onward delivery to a geological repository.

2.5.11 Since August 2021, there has been extensive interest in carbon capture for ERFs and biomass plants across the industry. Fichtner has completed or is currently working on feasibility studies on 11 sites (in addition to Portland) and is providing support for planning and permit applications for a further 4 sites, so we have an extensive knowledge base on the subject which has expanded since August 2021. None of this changes our views expressed in August 2021. I continue to consider that there is sufficient space adjacent to the Appeal Proposal to accommodate a carbon capture plant and that the Appeal Proposal is well located to export CO_2 to offshore storage via a ship from the port.

2.6 Environmental Permit Progress

2.6.1 Fichtner is managing the environmental permit application on behalf of the Appellant. To assist the Inquiry, I am giving an update on the current status of the application.

2.6.2 The permit application was submitted on 23 December 2020. On 20 April 2021, the EA requested some further information before the application could be duly made. This was submitted in May 2021 and the EA confirmed that the application was duly made on 18 May 2021.

2.6.3 On 5 November 2021, the EA asked for further information to be submitted on the air quality modelling and on the emergency diesel generator. This information was submitted on 3 December 2021. The EA then asked for clarification on the approach to modelling the emergency diesel generator on 24 February 2022; this was submitted to the EA on 23 March 2022.

2.6.4 At the start of May 2022, the permitting officer assigned to the application informed us that he would be moving to a different role within the EA and so would be passing the application to a new permitting officer. We understood at this stage that the permit determination process was virtually complete, with the only remaining issues being some questions on the fire prevention plan and

[10] CD2.10 Portland ERF Post Combustion Carbon Capture Plant – pre feasibility assessment, Fichtner, August 2021.

engagement with Natural England. It has been common in recent years for permit applications for ERFs to take around a year to be determined and so we had expected that a decision would have been made soon after this. However, progress has been slow since then.

2.6.5 On 9 September 2022, the EA asked for further information to be submitted on the fire prevention plan. A revised fire prevention plan was submitted on 10 October 2022. There have been no further requests for further information on this subject and so I consider that the EA is now satisfied.

2.6.6 On 3 October 2022, following discussions with Natural England in relation to the planning application, we submitted further information on the impact of emissions from the emergency diesel generators on ecological receptors which had already been submitted to Natural England. On 14 March 2023, the EA permitting officer confirmed that she had completed the Habitats Regulation Assessment and submitted it to Natural England for comment. Natural England responded by 14 July 2023 to confirm that Natural England agreed with the EA's position.

2.6.7 At this stage, 26 months after the permit application had been duly made, we understood that the EA had sufficient information to make its decision. However, on 3 August 2023, the EA informed us that it was concerned about the potential for impacts on asylum seekers on the Bibby Stockholm, which was a new receptor. On 8 September 2023, the EA duly requested further information on the impacts of noise and odour emissions on the occupants of the barge. This information was submitted to the EA on 20 October 2023. The noise assessment is attached to Mr Roberts proof as appendix NR12. The odour mitigation strategy is attached to my proof as Appendix SO7 and discussed in section 4.7

2.6.8 I consider that the EA now has sufficient information to make a decision on the permit application. One of my colleagues has spoken to the permitting officer, who has confirmed that the new information is being reviewed by technical specialists. It is hoped that the EA will be able to reach a draft decision before the end of the Inquiry, and I will update the Inquiry when I give oral evidence. However, I am not aware of any aspect of the application that would result in the EA not reaching a provision decision to grant a permit and the EA has not indicated that there is any need to request any further information that could lead to further delay.

2.6.9 As explained in the Supplementary Statement of Case, the waste which would be treated at the ERF would be RDF and also residual waste from the same municipal and commercial and industrial sources. This waste would be covered by additional waste codes which were not included in the permit application, but are included in permits for virtually all other similar plants across England. While it would be possible, in theory, to modify the permit application to include additional waste codes, the EA has informed my colleague that it is not willing to accept the change at this late stage in the determination process, as it would delay the determination further. The EA has confirmed that an application to vary the permit if and when it has been granted would be more appropriate. I can confirm that variations to add waste codes to permits for ERFs are common and where, as in this case, the waste codes being added cover similar waste to that already included in the permit, the variation applications are generally approved quickly.

2.6.10 Fichtner has prepared a note to confirm that the change to the waste codes will not have a significant effect on the environmental assessments. This is attached as Appendix SO8.

3 Climate Change

3.1 Introduction

3.1.1 The Appeal Proposal would generate low carbon energy. A carbon assessment was included in the ES as Appendix E[11], which I prepared.

3.1.2 Dorset Council requested additional information in a letter dated 30 April 2021[12]. Questions 22 and 23 related to the carbon assessment:

> *22. Additional information on the baseline scenarios requested by the council. These should have particular reference to points raised through the consultation on the robustness of the carbon balance scenarios set out in the current version of the ES. Additional clarification should also be provided in respect of the approach to carbon capture for the facility itself, and the circumstances under which it might be installed and operated.*
>
> *23. A report has been submitted by UKWIN which makes a variety of technical points in relation to the suitability of the proposed technology and the robustness of some the claims made in respect of its effectiveness and environmental benefits. An assessment should be made of the technical points made in this report, and an appropriate response should be provided in respect of the issues raised.*

3.1.3 In response to question 22, an updated carbon assessment was submitted in August 2021[13]. There were no changes to the overall methodology, but the comparison between the Appeal Proposal and various alternative approaches to the treatment of Dorset's waste was widened.

3.1.4 In response to question 23, Fichtner prepared a detailed response to UKWIN's submissions, which was included in the Consultation Response Summary document, dated August 2021.[14] I have responded to some additional points made by UKWIN in section 3.5.

3.1.5 Since the revised carbon assessment was prepared in July 2021, there have been a number of developments in the project and the wider context.

1. As I explained above, the efficiency of the Appeal Proposal will be higher than originally anticipated.
2. As I also explained above, the ability of the Appeal Proposal to deliver power to ships has become clearer and the potential power to be displaced will be higher than originally anticipated.

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[11] CD1.37g Appendix E Carbon Assessment, 2 September 2020

[12] CD2.17b ES Addendum Appendix 1-1.

[13] CD2.17g ES Addendum Appendix 4-1, 28 July 2021

[14] CD2.4 Consultation Response Summary Document, August 2021

3. The government has published newer versions of various statistical publications from which I drew some assumptions, so I have used the latest versions.

3.1.6 Therefore, I have updated the carbon assessment to take these into account. The revised assessment is attached as Appendix SO3 and summarised in section 3.2. This was submitted in advance of completing this proof of evidence, to allow other parties to take account of it in their evidence.

3.1.7 Since submitting the carbon assessment, I have considered the sensitivity of the results to two issues which were not originally considered.

1. I have taken account of information in the recent planning application for an EfW plant at Canford, as this was one of the alternatives considered originally.

2. I have considered the sensitivity of the lifetime benefits to changes in waste composition.

3.2 Carbon Assessment

3.2.1 The principles of the methodology are supported by the DEFRA document "Energy-from-Waste: A Guide to the Debate"[15], published in February 2014, which explains the approach in paragraphs 35-46. A more detailed document commissioned from Golders Associates by DEFRA at the same time, entitled "Energy recovery for residual waste – a carbon-based modelling approach"[16], explains the assumptions in the approach in more detail, although I note that this report was prepared for a slightly different purpose.

3.2.2 In simple terms, the carbon assessment compares the carbon releases for two methods of managing residual waste. In the energy recovery facility case (the Appeal Proposal), I consider the following processes:

1. Waste and other raw materials are transported to the ERF, leading to the release of greenhouse gases from vehicles.

2. The waste is processed in the ERF. Carbon dioxide and other greenhouse gases are released from the combustion of waste. The carbon dioxide from biogenic waste is ignored, in accordance with the DEFRA guidance referenced above.

3. Electricity is generated from the waste. Some is used in the ERF and the rest is exported, displacing the generation of power by another power station and hence displacing greenhouse gas emissions from that power station. (Some of the power may displace electricity used on ships as well.)

4. Residues from the ERF are transported to recovery or disposal facilities, leading to the release of greenhouse gases from vehicles.

[15] CD9.8

[16] CD9.26

3.2.3 The counter-factual case is what is actually happening to residual waste at the moment. In the primary counter-factual case, where I assume that the waste would otherwise be sent to landfill and which is consistent with "A Guide to the Debate", I consider the following processes:

1. Waste is transported to landfill, leading to the release of greenhouse gases from vehicles.

2. The waste is deposited in landfill. Over time, some of the biogenic waste breaks down to produce landfill gas, consisting of methane and carbon dioxide.

3. Some of the landfill gas is captured and flared, converting it to carbon dioxide. As this is derived from biogenic sources, it is ignored in accordance with the DEFRA methodology.

4. Some of the landfill gas is captured and burned to generate electricity. Again, the carbon dioxide emissions from burning landfill gas are derived from biogenic sources and so ignored. The power is exported, displacing the generation of power by another power station and hence displacing greenhouse gas emissions from that power station.

5. Some of the landfill gas is released to atmosphere, releasing methane (a powerful greenhouse gas) to atmosphere.

3.2.4 I also consider a wide range of alternative counter-factual cases. These cover the treatment of waste in potential alternative ERFs in Dorset, operational alternative ERFs in adjacent counties and further afield, and an alternative baseline representing current treatment routes for residual waste in Dorset.

3.2.5 There are four key assumptions made in the calculation which I would like to discuss. These are (a) waste composition; (b) grid displacement and shore power; (c) landfill gas capture rates; and (d) the various counter-factual treatment routes for the waste.

Waste Composition

3.2.6 An energy from waste plant is actually sized on thermal input, not waste throughout, and this means that the amount of waste processed by a given energy from waste plant will vary depending on the net calorific value (NCV) of the waste and how many hours it operates for (its availability). The design capacity of the Appeal Proposal is 182,640 tonnes per annum, on the basis of waste with a NCV of 11 MJ/kg and an availability of 91.3%. The maximum capacity of the Appeal Proposal, used throughout the ES, is 202,000 tpa, which would be achieved by processing waste with a NCV of 9.95 MJ/kg. Therefore, for consistency with the rest of the ES, the carbon assessment considered both of these cases.

3.2.7 The waste for the Appeal Proposal, as explained in the Supplementary Statement of Case[17], will be residual waste from municipal sources and commercial and industrial sources, which will be subject to some form of pre-treatment, which includes source segregation and/or further mechanical and/or biological treatments. The composition of waste is inherently variable, and so I used the latest available published data on waste compositions.

1. For C&I waste, I used the WRAP Cymru report "Commercial and Industrial Waste in Wales", published in January 2020. (I am not aware of any more recent data for England.) This report

[17] CD11.2

gives an estimate for C&I waste for 2017. Given that waste management policies have changed since 2017, I adjusted the composition by removing 90% of plastic bags to account for the effect of the charges on single use plastic bags. I also removed 90% of glass and WEEE and 80% of bricks and rubble, as this would typically be removed before coming to the Appeal Proposal.

2. For municipal waste, I used the WRAP report "National Municipal Waste Composition, England 2017", also published in January 2020. This includes a Residual Municipal Waste composition from Table 3, which is a mixture of household and commercial waste. Again, I adjusted the composition by removing 90% of plastic bags, glass and WEEE and 80% of bricks and rubble.

3.2.8 I then took a mixture of these two waste compositions (68.24% municipal waste and 31.76% C&I Waste) to achieve an average NCV of 11 MJ/kg. I consider that this was an appropriate way to determine a suitable waste composition for the plant processing 182,640 tpa of waste.

3.2.9 For the maximum tonnage case, I reduced the NCV of the waste by focussing on municipal waste alone and removing 23% of dense plastics, given the government's focus on this material.

3.2.10 Given developments in waste management policies since the original carbon assessment was submitted, including some proposals in October 2023, and since I appreciate that there are other ways in which waste composition could change while still reaching the same NCV, I have carried out some further sensitivity calculations on waste composition. These are discussed later in my proof (from paragraph 3.2.65.)

Grid Displacement and Shore Power

3.2.11 Both of the residual waste processes (Energy from waste and landfill) lead to the generation of electricity. I have assumed that this electricity would displace electricity generated by the marginal generation type, which is combined cycle gas turbines (CCGT), leading to the displacement of 0.372 kg CO2e/MWh of power exported. As this is a fundamental assumption, I have explained below why it is correct to assume the CCGTs will be displaced and why this is supported by government guidance, by previous decisions at planning inquiries and by recent data on the UK electricity mix.

3.2.12 Electricity is generated in the UK by a limited type of facilities and a combination of operational realities and the incentive regimes mean that most (but not all) of these facilities would be unaffected by the proposed facility, as outlined below.

1. Older nuclear plants are also being phased out, but they run all the time that they can as the marginal operating costs are low.

2. If and when any new nuclear plants are built, these will be supported by high guaranteed prices for their electricity (known as strike prices) while still having low marginal operating costs, so they will again run all the time that they can. The primary costs for a nuclear plant are the original construction costs and the decommissioning costs so owners of nuclear plants need to run them as much as possible to pay off these high fixed costs.

3. Wind and solar run whenever they can as, again, the marginal operating costs are low, and they are supported by generous subsidies in many cases.

4. Combined cycle gas turbines are the primary flexible electricity source. Since wind and solar are intermittent, with the electricity supplied varying from essentially zero (on still nights) to more than 20 GW (on windy and sunny days), CCGTs supply a variable amount of power. However, there are always some CCGTs running to provide power to the grid.

5. Coal plants are being phased out and so have been ignored. If they do continue to operate, they are more carbon intensive than CCGTs and so excluding them is more conservative. However, at the time of writing, I note that the government is considering using coal plants to ensure that the UK has enough power through the winter. If the Appeal Proposal had been operating now, this would have reduced the need for coal power under those circumstances.

6. Gas engines, diesel engines and open cycle gas turbines also make a small contribution to the grid. These are mainly used to support short term demand. As they are more carbon intensive than CCGTs, it is more conservative to ignore these. I do note, however, that EfW plants have been bidding into the capacity market, which means that they are competing primarily with CCGTs, gas engines and diesel engines.

3.2.13 This means that the effect of ERFs running is that CCGTs operate less. Baseload plants (nuclear, biomass and ERFs) will operate all the time apart from maintenance periods as their business models support that. Intermittent plants (wind and solar) will operate whenever they can but their output will vary. Finally, flexible plants (mainly CCGTs, but also coal, OCGTs and diesel generators) operate when required to make up the different between the baseload and intermittent plants and the power demand. In addition, there are a number of interconnectors with Ireland, Belgium, France, Holland and Norway which can be used to balance supply and demand.

3.2.14 The effect of increased baseload generation is that the need for flexible generation is reduced. Hence, as long as the total of baseload generation and intermittent generation is less than the total demand, any increase in baseload generation will reduce the operation of CCGTs. I have checked and analysed the operational data from 1 January 2021 to 31 December 2022 (at https://www.bmreports.com/bmrs/?q=generation/fueltype/current) and this shows that CCGTs generated 12,239 MW on average in 2021 and 12,694 MW in 2022, with a maximum of 24,500 to 25,200 MW in each year. The generation from CCGTs only fell below 2,000 MW on four occasions – for a few hours over the Christmas and New Year period in 2021 and 2022 when demand was low and wind generation was high, in the early hours of 25 February 2022 when wind generation was very high and for three hours on 27 February 2023 when it was very windy and very sunny – and was above 4,300 MW for 90% of the time in 2022. Hence, it is clear that an increase in baseload generation from the Appeal Proposal would lead to a reduction in power from CCGTs.

3.2.15 Inspectors at previous Inquiries, discussed below, have concluded that the correct figure to use is the marginal electricity source, which should be taken to be a CCGT plant at the present time. The reason for this conclusion is the correct interpretation of footnote 29 in the DEFRA "Energy from Waste - A Guide to the Debate". This is the key document because the DEFRA "Energy recovery for residual waste" report is referenced from the EfW Guide but does not change the key footnote. Footnote 29 states *"A gas fired power station (Combined Cycle Gas Turbine – CCGT) is a reasonable comparator as this is the most likely technology if you wanted to build a new power station today. When conducting more detailed assessments the energy offset should be calculated in line with DECC guidance using the appropriate marginal energy factor"*.

3.2.16 The interpretation of footnote 29 was considered at the Public Inquiries into the Javelin Park EfW plant and the New Barnfield EfW plant in Hatfield. Both of these inquiries took place before the latest version of the EfW Guide was published, and in both cases, material was submitted on the change to footnote 29 in the current version before the decisions were reached. The issue has subsequently been considered at the Public Inquiry into the Ratty's Lane EfW plant, in the Examination for the application for a Development Consent Order (DCO) for the Riverside Energy Park and at the Public Inquiry into the Waterbeach EfW plant.

3.2.17 The Javelin Park decision[18] was given on 6 January 2015, following the Inspector's report of 6 June 2014. The Secretary of State stated in paragraph 19 that he *"has given careful consideration to the Inspector's assessment of greenhouse gas emissions IR1020-1032. In terms of whether the proposal would be inherently better than landfill with regard to greenhouse gas emissions, the Secretary of State agrees with the Inspector that the EfW facility proposed would be better than landfill since there can be no methane released to the atmosphere as a result of the process (IR1033)."* The Inspector said, in paragraph 1023, that *"The assumption in the model that the electricity exported from the appeal proposal would displace that otherwise produced by a CCGT should not be criticised. This is what Guide to the Debate identifies as the current standard comparator since this is the marginal technology choice if building a new power station"*. He then continued in paragraph 1024 to say *"In contrast to GlosVAIN, the change to Footnote 29 in the Guide to the Debate that Mr Watson draws attention to (PINQ4) still does not advocate the use of the long run marginal supply as the comparator."*

3.2.18 The Hatfield decision was given on 16 July 2015, although a previous decision had been given on 7 July 2014 but quashed at the High Court, and the Inspector's report was dated 19 February 2014. At Hatfield[19], the Secretary of State stated that he *"agrees with the Inspector's assessment of carbon balance and climate change issues at IR984-989. In reaching this view, he has had regard to post inquiry representation in 2014."* The Inspector stated, at IR989, that *"Herts WoW also challenged the use of CCGT as an appropriate comparator for electricity generated by the proposed RERF in Veolia's WRATE analysis. However, the recent DEFRA Document "Energy from Waste – a Guide to the Debate Feb 2013" provides support for the use of CCGT in making such as assessment at the present time…. It is reasonable to make the assessment of benefits using the marginal technology at the present time as the appropriate comparator."*

3.2.19 The Ratty's Lane decision (ref 7/0067-17)[20] was given on 19 July 2019. The Secretary of State states in Paragraph 19 *"For the reasons given in IR17.54-17.64 and IR18.3-18.4, the Secretary of State agrees with the Inspector that there would be a saving in greenhouse gas emissions compared to the status quo."* The Inspector considered the use of gas CCGT as the counterfactual in IR17.57.

> *"As set out above, the figure referred to by the applicant takes account of the 'build margin' or counterfactual referred to by the GIG, namely a Combined Cycle Gas Turbine (CCGT). Herts Without Waste challenged the use of that as an appropriate comparator for electricity generated by the proposed ERF. However, since electricity generated by the ERF would be exported to the grid, I see no reason why, consistent with DEFRA's Guide to the Debate, that energy should not be assumed to substitute electricity that would otherwise have been generated by a CCGT. The same argument was also put to the New Barnfield Inspector who noted that the Guide to the Debate provides specific support for the use of CCGT in making such an assessment. That Guide is still current, with footnote 29 on page 18 confirming that 'A gas fired power station (Combined Cycle Gas Turbine – CCGT) is the current standard comparator as this is the 'marginal' technology if you wanted to build a new power station'. As noted by the New Barnfield Inspector, it is not disputed that the absolute level of climate change benefit will vary over time, as the energy mix changes and decarbonises. However, it is reasonable to make the assessment of benefits using the marginal technology at the*

[18] Appendix SO4 (1)

[19] Appendix SO4 (2)

[20] Appendix SO4 (3)

present time as the appropriate comparator. In light of the current guidance, I have no reason to take a different view and consider that the appropriate counterfactual has been used by the applicant."

3.2.20 I note that Herts without Waste, a rule 6 party to the Inquiry, argued that the BEIS marginal emissions factor should be used (IR12.15 to 12.20). As I discuss later in paragraph 3.5.16, UKWIN has also made this point. The Inspector in the Ratty's Lane case specifically rejected this argument, as shown in the quote above.

3.2.21 The Examining Authority's recommendation report for the Riverside Energy Park DCO (ref. EN010093)[21] was published on 9 January 2020. The Applicant presented evidence that CCGT was the correct comparator and UKWIN presented evidence that a lower marginal emissions factor should be used. The Examining Authority concluded the following in paragraphs 5.3.23 and 5.3.24.

"The second area of disagreement is on the counterfactual assumed for electricity generation. The Applicant has assumed that the ERF, as a new generator, will displace electricity generated by an existing CCGT plant, in line with DEFRA advice. CCGT is taken as the marginal generating technology with CO2 emissions of 357g of CO2/kWh. The GLA argued that the counterfactual for CO2 emissions should be taken as the long run marginal emissions rate from new plant which is shown in BEIS projections to decline significantly in coming years.

Although CO2 emissions from plant built in coming years may be lower than CO2 emissions from the ERF, that plant is not, in my view, the plant that will be displaced from generating if the ERF comes into operation. The plant displaced would be plant which has a higher marginal operating cost than the ERF and which is flexible enough for its output to be ramped up or down in response to market conditions. I consider that CCGTs are currently the plant meeting those conditions and are therefore the appropriate counterfactual against which to compare the ERF in making calculations of CO2 emissions."

3.2.22 The Secretary of State agreed with the Examining Authority, stating in paragraph 4.12 of the final decision letter that *"The Secretary of State agrees with the ExA's conclusion that the current CIF level is the relevant minimum level of carbon emissions against which the Development should be assessed [ER5.3.22], CCGT is the appropriate counterfactual against which the Development should be assessed [ER 5.3.24]."*

3.2.23 Finally, the Waterbeach decision (Ref S/3372/17/CW)[22] was given on 15 June 2020. The Inspector concluded, at IR 557:

"CBWIN/UKWIN also query the appellant's use of CCGT as the marginal electricity source for the grid displacement factor. The energy mix for electricity generation on the grid is changing and with increasing decarbonisation the appropriate comparator for electricity generated by the WWRF would change. Whilst becoming more dated with the passage of time, Defra's 2014 advice that CCGT is a reasonable comparator as the most likely technology for new power stations, remains extant guidance (CD17.33 page 21). It is therefore reasonable to apply this comparator in making carbon assessments today, but to

[21] Appendix SO4 (4)

[22] Appendix SO4 (5)

also acknowledge that the rate of future decarbonisation of electricity generation for the grid could have a significant effect on the outcome of these assessments in the longer term."

3.2.24 In summary, in all five cases, the Secretary of State agreed with the Inspector or Examining Authority that the correct comparator was a CCGT plant and this agreement post-dated the February 2014 issue of the Guide. The final case was agreed in June 2020.

3.2.25 I am aware of three other cases where the carbon impacts of Energy-from-Waste plants were discussed, but where the regulatory authority did not take a view on the marginal energy source. Firstly, I would like to consider the Public Inquiry into the proposed EfW plant at Brookhurst Wood in West Sussex (APP/P3800/W/18/3218965) (27 Feb 2020)[23]. The inspector says at paragraph 90.

"The appellant has indicated that at present, residual active waste arising from the process stream of which the existing appeal site operation forms part, is converted to RDF and exported to continental Europe for recovery. Furthermore, it identifies that much of the residual waste arising within the catchment for the proposed facility is now exported to energy from waste facilities in Holland and Germany. It appears to me that dealing with the residual waste in an energy from waste facility onsite rather than exporting the RDF to a similar facility in continental Europe would be likely to provide transport related carbon savings, which would help to mitigate climate change in keeping with the aims of the Framework and local policies such as HDPF Policy 24, 35 and 36."

3.2.26 This shows that there is a key difference between Brookhurst Wood and the Appeal Proposal. The Brookhurst Wood plant was being built to specifically treat 180,000 tonnes per annum of RDF which would be produced from 230,000 tpa of waste which was already being delivered to the site and then sent to an EfW plant in continental Europe. Therefore, the Inspector considered that the Brookhurst Wood plant would not divert waste from landfill. The Appeal Proposal may divert some waste from other ERFs (and this is considered in the various baseline cases) but is not certain to do this.

3.2.27 Having come to this conclusion, the Inspector decided (paragraph 90) that *"the merits of landfilling versus energy from waste in GHG terms cannot be determined with certainty at this stage. Nonetheless, to my mind, this particular comparison between landfilling and the proposed process is anyway of limited relevance in this case."* Therefore, he did not need to consider the marginal electricity source and so made no comment on the matter. The Inspector's final conclusion on carbon was in paragraph 92.

"I conclude overall, as the precise mix of feedstock it would handle cannot be known at this stage, there is significant uncertainty around the credentials of the facility in terms of a low carbon technology. However, in the particular circumstances of this case, it would be likely to deliver carbon savings when a wider view is taken. I conclude that the proposal would be likely to help to mitigate the impact of climate change, in keeping with the aims of the Development Plan and the Framework. However, given the uncertainties involved regarding the scale of any such benefits, I give this matter little weight. Whilst National Policy Statements EN-1 and EN-3 give support to technologies of the type proposed, notwithstanding the associated CO2 emissions, I give those provisions little weight, not least

[23] Appendix SO4 (6)

as the appeal scheme falls below the threshold for Nationally Significant Infrastructure Projects to which the Policies are directly relevant."

3.2.28 I would also like to comment on paragraph 89 in the Inspector's Report: *"There is no dispute that the carbon intensity of the electricity generated by the proposal would be likely to be lower than that associated with coal fuel and in that context could be considered to be low carbon in my view. However, the appellant acknowledges that is not the case in relation to all fossil fuels, for example, electricity generated by a Combined Cycle Gas Turbine in baseload mode would represent a lower carbon source of electricity than the proposal. Viewed solely in that context, the low carbon credentials of the proposal would appear to be relatively poor."* I do not have access to the evidence submitted, but I note that the Inspector appears to be comparing the carbon intensity of an EfW plant with coal and gas-fired power stations directly without taking account of the benefits of avoiding landfill. If this is being done, this is incorrect. An EfW plant carries out two functions, both of which have implications for carbon emissions. It diverts residual waste from landfill, and it generates electricity. Any assessment of the carbon benefits or costs of EfW needs to consider both of these functions, as I have done in Appendix NRE-5A.

3.2.29 I agree that it could be helpful to compare the carbon intensity of power generated by an EfW plant with the carbon intensity of power generated by other means. However, the carbon intensity calculation needs to consider the avoided emissions from landfill, as other forms of power generation, such as CCGTs, wind or solar, do not displace waste from landfill. The calculation also needs to take account of the power which would have been generated if the waste had been sent to landfill, so that the calculation is effectively calculating the carbon intensity of the additional power generated by sending the waste to an EfW plant rather than landfill. I have carried out this calculation in Appendix NRE5-A and shown that the effective carbon intensity of the additional power is between -0.0174 tCO_2e/MWh and +0.0072 tCO_2e/MWh, which is effectively zero carbon electricity.

3.2.30 Secondly, carbon issues were considered at the Kemsley DCO Examination (EN010083) (19 November 2020)[24]. The Examining Authority report has a number of references to the marginal electricity source. In paragraph 4.14.36, it is stated "*There are unavoidable uncertainties in the estimation of baseline waste management and displaced electricity generation emissions which could affect the net GHG balance predicted for the WKN Proposed Development. Based on the WRATE analysis, a net GHG emissions reduction is considered more probable than a net emissions increase compared to the baseline, but the amount can only be stated with limited confidence as it is highly sensitive to the assumptions applied."* In paragraph 4.14.64, where the Examining Authority is moving on to its conclusions, it is stated "*The netting off of a proportion of GHG is not an unreasonable approach where there is a clear baseline alternative from which like can be compared with like with a high degree of confidence. However, the levels of carbon benefit impact relating to the Proposed Development, as the Applicant accepts, is subject to several key uncertainties and limitations, such as the estimate of GHG emissions from landfill, the carbon intensity of marginal electricity generation and the proportions of waste types to be managed. All the available evidence casts considerable doubt on whether the "net benefit" can be ascertained with any great certainty, given it is highly sensitive to the assumptions applied."*

3.2.31 While I agree that the precise value of the net benefit from an EfW plant is sensitive to the assumptions applied, I have demonstrated later in this proof that the Appeal Proposal continues to

[24] Appendix SO4 (7)

have a net benefit under a wide range of assumptions. I do not know if this was the case for the Kemsley WKN development.

3.2.32 I note that Kent County Council, in opposing the Kemsley WKN development, drew on Brookhurst Wood, as reported in paragraph 4.14.46.

> *"KCC in its D2 Submission of 23 March 2020 [REP2-044] drew attention to the Brookhurst Wood appeal decision [REP5-039] in contrast to which the Proposed Development is being promoted as an energy scheme through the DCO process, rather than a waste management facility through the established local waste planning process. The appeal decision noted the precise mix of feedstock the scheme would handle could not be known, there was significant uncertainty around the credentials of the facility in terms of a low carbon technology. Electricity generated by a Combined Cycle Gas Turbine (CCGT) in baseload mode would represent a lower carbon source of electricity than the proposal and the low carbon credentials of the proposal were of little weight as the scheme was a waste management facility not an energy generating scheme, therefore NPSs were given little weight. The Inspector also noted that if not handled at the proposed facility, residual waste would likely be exported for recovery, not sent to landfill. Thus, KCC argues that as the WKN Proposed Development is not an NSIP, compliance with NPSs ought only to be given greater weight with respect to consideration of Project K3."*

3.2.33 However, I consider that this is not an accurate reading of Brookhurst Wood. Firstly, KCC quoted only part of paragraph 92, which I have quoted in full above, but misses out the key words *"it would be likely to deliver carbon savings when a wider view is taken."* Secondly, it is not correct that the low carbon credentials of the proposal were of little weight "*as the scheme was a waste management facility not an energy generating scheme"*; they were given little weight because of the uncertainties around the scale of the benefits, specifically the benefits of treating waste at Brookhurst Wood rather than exporting the waste to Europe. Thirdly, while the Inspector did note that "*residual waste would likely be exported for recovery, not sent to landfill"*, this was in the context of an EfW plant being built on the site where the RDF was going to be produced. Fourthly, as I mentioned above, the statement that "*Electricity generated by a Combined Cycle Gas Turbine (CCGT) in baseload mode would represent a lower carbon source of electricity than the proposal"* does not take account of the displacement of landfill.

3.2.34 The Examining Authority also referred to the Brookhurst Wood decision in paragraph 4.14.69.

> *"The Brookhurst Wood appeal decision [REP5-039] is significant because although consent was granted for an EfW plant with 230,000 tpa of C&I and/or Municipal Solid Waste (MSW) of which 50,000 tpa would be recycled, and 180,000 tpa residual waste being combusted to generate electricity and potentially heat, the Inspector found that as an electricity production scheme fired by fuel that is primarily fossil-derived material, it had poor carbon credentials, compared with other energy generators such as CCGT, and as a waste management scheme it had poor carbon credentials compared with export of RDF, the accepted alternative waste management solution for the proposed feedstock."*

3.2.35 Again, the Examining Authority appears to have misread the appeal decision. The Examining Authority said that the Inspector said that the Brookhurst Wood scheme had poor carbon credentials compared with other energy generators, such as CCGT, but this would only make sense if he had ignored the displacement of landfill. The Examining Authority also said that the Inspector said that the Brookhurst Wood scheme had poor carbon credentials compared with the export of

RDF, but the Inspector concluded exactly the opposite in paragraphs 90 and 92, which I quoted above.

3.2.36 Thirdly, climate change was considered at the Inquiry into the proposed Consett ERF (DM/20/03267/WAS)[25], which was refused permission by the Secretary of State on 26 June 2023, contrary to the recommendation of the inspector. The inspector and the Secretary of State agreed that *"the proposed development would likely result in lower GHG emissions compared to landfill over a 25-30 year lifetime, during which period it would also facilitate the availability of localised decarbonised power and heat."*(IR12.134) The inspector did not comment on the type of power to be displaced by the ERF, but I note that the inspector lists a number of uncertainties and did not include the type of power to be displaced in the list, despite the fact that this issue was raised by the Rule 6 party.

3.2.37 Given all of these previous cases, I continue to consider that an EfW plant constructed now would reduce the generation from CCGT because this is the marginal source. Furthermore, I do not consider that this has changed since the EfW Guide was published. To illustrate this, I have extracted data from the publication Digest of UK Energy Statistics (DUKES), specifically tables 5.6B and 5.13 to produce the figures below, which shows the total electricity generation in the UK each year from different power sources.

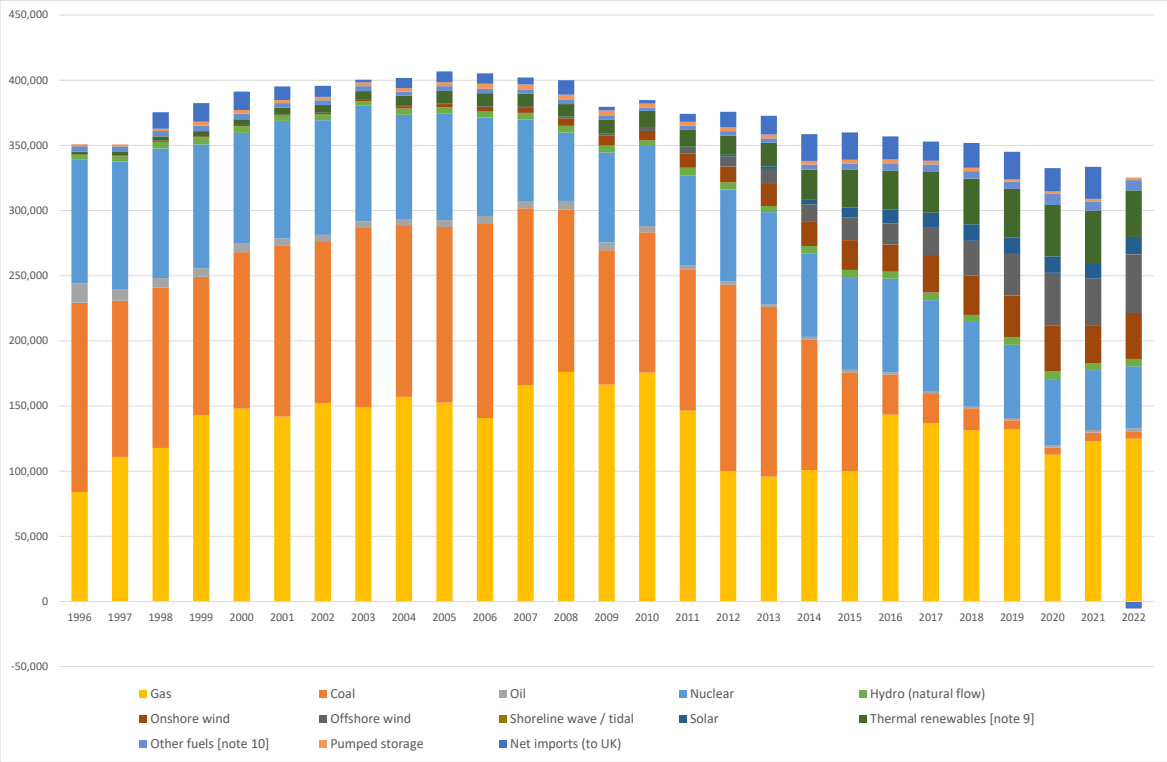
3.2.38 Figure 1 shows the changes since 1996. It can be seen that the UK generation mix has moved from being almost entirely gas (yellow), coal (orange) and nuclear (blue) in 1996, to being gas (yellow), less nuclear (blue) and a mixture of different renewable sources by 2022, along with an increase in imported electricity (dark blue at the top of the columns). Hence, I agree that the overall mix has been decarbonised. However, it is also clear that the power generated from gas has stayed quite consistent. It was between 140,000 and 175,000 GWh from 1999 to 2011, before dropping to 100,000 GWh in 2012-2015 (possibly due to coal being cheaper than gas at that time and some coal plants running additional hours to complete their operational life) and then returning to 120,000 to 140,000 GWh after 2016.

3.2.39 Figure 2 shows the same figures, but focusing on the period from the publication of the EfW Guide in 2014. This makes it even clearer that the change since 2014 has been the replacement of coal and some nuclear plants with renewables and imported electricity, but with gas continuing almost unchanged (apart from 2020, which was affected by Covid).

3.2.40 Therefore, it can be seen that the situation has not changed since the previous decisions as the importance of gas as the effective marginal source of electricity has remained. I would also note that nuclear power continues to be an important zero-carbon part of the energy mix, but that this has declined from around 70,000 GWh a year in 2009-2015 to around 50,000 GWh in 2020-22 and may decline further as four of the UK's five remaining nuclear plants are scheduled to close by 2028, although it is possible that Hinkley Point B will be operational by then to replace them.

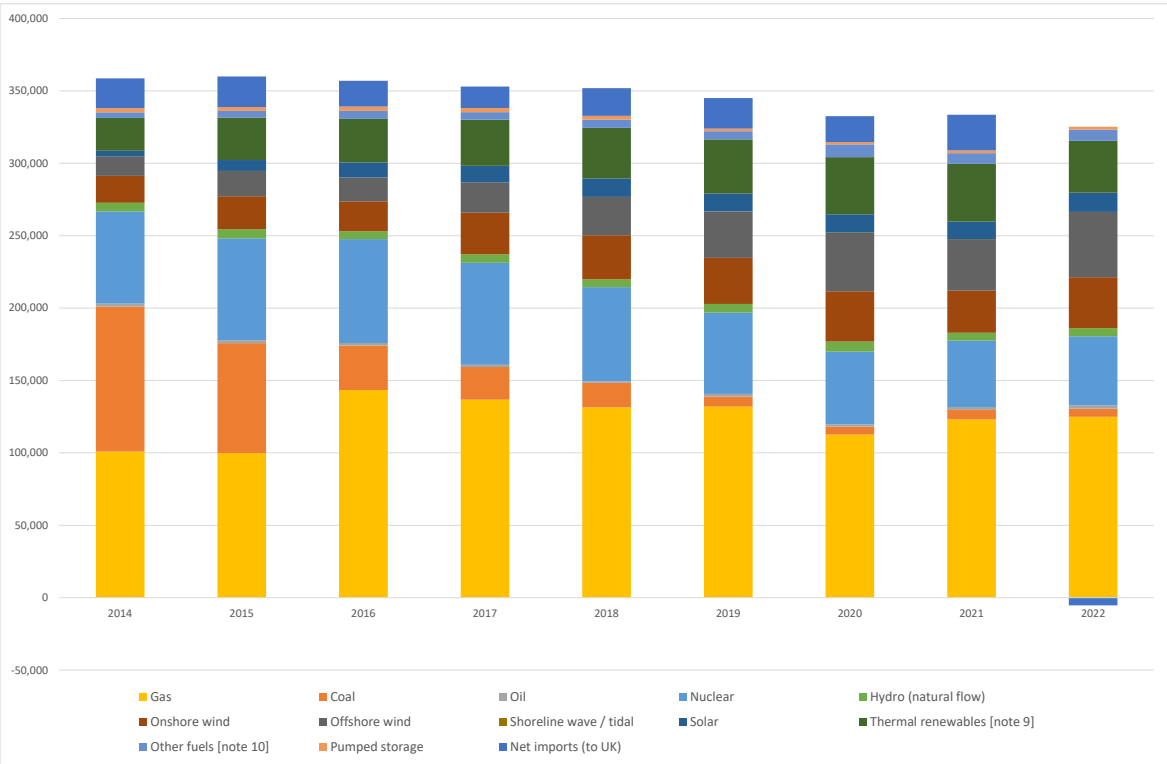
[25] Appendix SO4 (8)

Figure 1: Electricity Generation, UK, 1996-2022, GWh per annum



Source: DUKES

Figure 2: Electricity Generation, UK, 2014-2022, GWh per annum



Source: DUKES

3.2.41 In addition, the Appeal Proposal is expected to export power to ships berthed in Portland Port which currently run their own engines. As explained in section 3.1.3.2 of the carbon assessment, the engines on cruise ships and Royal Fleet Auxiliary (RFA) ships have a specific diesel fuel consumption of 180-200 g/kWh. The carbon intensity of diesel fuel is 3,203.9 kgCO2e/te, which means that the carbon intensity of power from ships is 0.577 tCO_2e/MWh or more, which is considerably higher than the carbon intensity of CCGTs.

Landfill Gas Capture Rates

3.2.42 The reason that landfill has a detrimental effect on climate change is that methane in landfill gas is a greenhouse gas which has 25 times more global warming effect than carbon dioxide. While some of the landfill gas is captured, not all of it is and the calculation is sensitive to the assumption for the percentage of the landfill gas which is captured.

3.2.43 In "Energy from waste – a carbon based modelling approach"[26], it is assumed that 75% of landfill gas generated is captured and that 10% of the remaining 25% is oxidised in the landfill cap before being released to atmosphere. Hence, 22.5% of the landfill gas is released to atmosphere. 50% of the captured landfill gas is used to generate electricity and the remainder is flared.

3.2.44 In November 2014, which is after the publication date of "Energy from waste – a carbon based modelling approach", Golders Associates produced a report for DEFRA entitled "Review of Landfill Emissions Modelling"[27]. This report is a comprehensive review of assumptions for landfill modelling. It states that the estimated landfill gas collection efficiency for a subset of 43 large modern UK landfills is 68%. For all UK landfills, the figure would be 52%. The report supports the assumption of 10% oxidation in the landfill cap, meaning that 28.8% of landfill gas would be released to atmosphere from large modern landfill sites and 43.2% from all UK landfill sites.

3.2.45 The report also estimates that, at active sites with landfill gas engines, 92% of the landfill gas would be used to generate electricity. This does not take account of sites which do not have gas engines, but should be representative of the 43 large, modern landfills for which the collection efficiency figure was derived.

3.2.46 In the carbon assessment submitted with the planning application, and the refreshed carbon assessment in Appendix SO3, I have used a capture rate of 68%, which is consistent with the Golders Associates report for large modern UK landfill sites, but I have also considered the sensitivity of the calculation to capture rates of 75% and 52%.

Results of assessment compared to landfill

3.2.47 In section 3.4 of the carbon assessment, I show that the net benefit of processing waste at the Appeal Proposal, compared to sending the same waste to landfill and generating power in a CCGT, would be 29,700 tCO_2e/y in the design case or 41,800 tCO_2e/y in the maximum capacity case. This benefit increases when the benefits of shore power and district heating are taken into account, meaning that I would expect the overall benefit to reach 39,500 tCO_2e/y in the design case or 51,700 tCO_2e/y in the maximum capacity case.

[26] CD9.26

[27] CD12.16

3.2.48 I have assessed the sensitivity of this conclusion to changes in landfill gas capture rates (52% to 75%) and to changes in the grid displacement factor, down to 0.157 tCO2e/MWh which is the low run marginal generation-based emission factor for 2027 (the likely opening year) taken from the "Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal", published by BEIS. This shows that the Appeal Proposal has a net benefit except in the case when there is no shore power, no district heating, a high landfill gas recovery rate and a low grid displacement factor. I consider that this is an extremely unlikely scenario.

Counterfactual Cases

3.2.49 For the planning application, Dorset Council asked for the carbon impacts of the Appeal Proposal to be compared with a number of different counter-factual cases. Most of these cases concern the processing of waste at an ERF located elsewhere and the final case concerns processing the waste at a mixture of facilities. For the avoidance of doubt, I continue to consider that landfill is the most appropriate counter-factual route. This because there is currently more residual waste being generated in the UK than can be treated at ERFs and so some residual waste is being sent to landfill. If the Appeal Proposal were operational and treating 182,600 tpa of waste, this would mean that a similar amount of waste would not be going to landfill.

3.2.50 In section 4 of the carbon assessment, I have compared the net carbon emissions from treating waste from Dorset at the Portland ERF with the net carbon emissions from treating waste from Dorset at each of the following potential or existing ERFs. Details of the assumptions for each of these ERFs can be found in section 4.2 of the carbon assessment.

1. Marchwood ERF, which is the closest operational ERF to Canford Magna and receives some waste from Dorset Council.
2. Lakeside ERF in Slough, which receives some waste from BCP Council.
3. Bridgwater ERF, which is reportedly due to complete construction later this year.
4. An ERF in or close to Rotterdam.
5. An ERF in or close to Gothenburg.
6. An ERF (equivalent to the Appeal Proposal in size and efficiency) at one of the allocated sites in the Dorset Local Plan (Eco Sustainable Solutions, Canford Magna, Mannings Heath and Binnegar). I note, however, that ERFs of the same scale as the Appeal Proposal might not be deliverable at these sites.

3.2.51 For the Portland ERF, I considered three cases:

a. Exporting power to the grid only.
b. Exporting power to the grid and to ships.
c. Exporting power to the grid and to ships, and exporting heat to district heating users.

3.2.52 Table 19 in the carbon assessment shows the result of this assessment. The options are ranked as follows.

- The net emissions associated with the other existing UK ERFs are higher than for the Appeal Proposal. This is because they are slightly less efficient than the Appeal Proposal and the transport emissions for Lakeside and Bridgwater are higher.

- The net emissions associated with ERFs at the allocated waste sites in Dorset are 450-650 tCO_2e/y lower than for the Appeal Proposal, due to reduced transport emissions. However, this is easily outweighed by the emissions displaced by shore power of 6,700 tCO2e/y.

- The net emissions associated with either of the European ERFs are similar to those associated with the Appeal Proposal with shore power, with Rotterdam giving an improved benefit of around 500 tCO_2e/y. However, this is mainly because the European ERFs are assumed to export heat as well. If this is taken into account for the Appeal Proposal, then the overall net benefit is the highest of all the options.

3.2.53 I note that MVV has submitted a planning application for a new ERF at Canford Magna and this proposes a plant with a higher electrical efficiency. I have, therefore, updated my assessment using the proposed efficiency of 28.35%. The result is that processing waste at Canford would give a benefit compared to the Portland ERF with no shore power and no district heating of around 8,500 tCO_2e/y. However, this is still 1000 tCO_2/y lower than the benefit of Portland ERF with shore power and district heating.

3.2.54 Dorset Council also asked us to consider a baseline case representing the current combination of waste management processes used for residual waste from Dorset. Mr Roberts, in his proof[28], has presented the results of an assessment by Tolvik based on data from Waste Data Interrogator and multiple other information sources. As this is more recent data than was available when the planning application was submitted, I have updated this baseline case for the Inquiry. I have now assumed that 70,000 tpa of waste would be diverted from landfill, 70,000 tpa of waste would be diverted from export abroad and the remainder (42,640 tpa for the design case, 61,912 tpa for the maximum case) would be diverted from existing UK ERFs. I have also considered a future baseline in which the 70,000 tpa of waste which is currently being sent to European ERFs would be sent to the Bridgwater ERF instead.

3.2.55 The net benefit of processing waste at the Appeal Proposal, compared to the existing baseline case, would be 9,900 tCO_2e/y in the design case or 13,600 tCO_2e/y in the maximum capacity case. This benefit increases when the benefits of shore power and district heating are taken into account, meaning that I would expect the overall benefit to reach 19,700 tCO_2e/y in the design case or 23,400 tCO_2e/y in the maximum capacity case. The benefit compared to the future baseline case would be around 4,500 to 5,000 tCO_2e higher.

3.2.56 I have assessed the sensitivity of this conclusion to changes in landfill gas capture rates (52% to 75%) and to changes in the grid displacement factor, as before. This shows that the Appeal Proposal again has a net benefit except in the case when there is no shore power, no district heating, a high landfill gas recovery rate and a low grid displacement factor. I consider that this is an extremely unlikely scenario.

[28] PPL1, paragraph 4.4.23, 4.4.28 and Table 3.2

Lifetime benefit

3.2.57 I acknowledge that all of the figures which I have presented above represent a snapshot in time. In reality, the benefits of the Appeal Proposal would vary over time, as shore power and district heating would be gradually built up and the grid displacement factor may gradually reduce over time. Clearly, these factors could change in many ways and so I have considered a single lifetime case in section 5 of the carbon assessment, which considers the cumulative benefits over the first 25 years of the plant's operation, starting in 2027. This case is intended to be illustrative and realistic.

3.2.58 Firstly, I have assumed that the government's policy to decarbonise grid electricity will continue. I consider that the correct comparator at present is power from CCGTs and I consider that this will continue to be the case for some time as there is always a significant quantity of CCGTs running to supply power. DESNZ has published a set of UK long run marginal generation-based emission factors for each year until 2010. These start at 0.157 kg CO2e/kWh in 2027 and drop to 0.002kg CO2e/kWh by 2051, and I have used these as a possible trajectory for the grid displacement factor.

3.2.59 However, these factors were first established in 2012. The principle is that the emissions factor for CCGT was used in 2010 and BEIS (now DESNZ) used a model (in 2012) to predict the marginal factors for 2030, based on policies in 2010. For the period between 2010 and 2030, an exponential extrapolation was used, which gives a long run marginal generation based emissions factor of 0.227 $kgCO_2e/kWh$ for the current year, 2023. However, as I have explained in paragraph 3.2.13 above, there was a significant amount of gas-fired generation running throughout 2021 and 2022 and so the marginal power source was still CCGTs. Hence, it would appear that the extrapolation carried out in 2012 was overly optimistic about the decarbonisation of the grid by 2022 and so the figures are too high. Therefore, in order to present a more realistic picture which reflects the current position but continues to recognise the UK Government's targets for net zero (and 0.002 tCO2e/MWh grid displacement factor) by 2050, I have created a set of adjusted factors which start from 0.372 tCO2e/MWh in 2023 and follow the same rate of change to 2050 as the original DESNZ factors. I have used these as a sensitivity case for the lifetime assessment.

3.2.60 I have assumed that shore power would be connected from the start of plant operations and would ramp up linearly from 29,639 MWh in 2027 to 32,931 MWh in 2047.

3.2.61 I have assumed that district heating would take longer to be developed. First users are assumed to be connected in 2027, with a linear ramp up to the full heat export of 18,307 MWh by 2037, 10 years after the plant opens. However, I consider that this is highly conservative as the Ministry of Justice is interested in a heat supply to the prisons much sooner and, as explained in Appendix SO2, the memorandum of understanding envisaged that the heat supply could be available as soon as the ERF is operational.

3.2.62 I have assumed that landfill gas capture rates will increase gradually from 68% in 2027 to 75% in 2047, as it is likely that landfill performance will improve.

3.2.63 With these assumptions, the Appeal Proposal is shown to have a benefit over landfill until 2043, with a cumulative benefit over 25 years of 124,349 tCO_2e. With the adjusted grid displacement factors, the cumulative benefit increases to 154,697 tCO_2e, with the increase concentrated in earlier years.

3.2.64 I have also considered the lifetime benefit of the Appeal Proposal compared to the current baseline scenario (70,000 tpa to landfill, 70,000 tpa to European ERFs and 42,000 tpa to UK ERFs). There is a

net benefit in every year considered, with a cumulative benefit over 25 years of 276,900 tCO_2e. With the adjusted grid displacement factors, the cumulative benefit increases slightly to 282,900 tCO_2e.

Further waste composition sensitivities

3.2.65 The original and revised carbon assessments used two different waste compositions, but I accept that there are other waste compositions which could have been used. Therefore, I have considered whether a different waste composition would lead to a different result.

3.2.66 Firstly, I have considered an alternative waste composition following extensive removal of food waste (given the government's focus on this waste stream) with a NCV at the design point of 11 MJ/kg. This waste composition was derived from English Residual Municipal Waste only (discussed in paragraph 3.2.7), adjusted by removing 90% of plastic bags and WEEE and 51.14% of food waste. This gives waste with a carbon content of 27.97% (compared to 28.42% for the design waste in the original assessment) and a biocarbon content of 53.89% (compared to 55.93%). Using this waste, and with all other assumptions unchanged, the Appeal Proposal has a benefit of 23,500 tCO_2e/y over landfill, a slight reduction from the base case of 29,700 tCO_2e/y, and a benefit of 7,570 tCO2/y over the current Dorset waste scenario (compared to 9,900 tCO_2e/y). The addition of shore power improves all of the benefits, of course.

3.2.67 Secondly, I have considered an alternative waste composition following extensive removal of plastics waste, as this is the other area of government focus, with a NCV at the alternative design point of 9.95 MJ/kg. This was derived from English Residual Municipal Waste only (discussed in paragraph 3.2.7), adjusted by removing 90% of plastic bags, glass and WEEE, 80% of rubble (as before), 50% of dense plastic and 13.16% of food waste (noting that Dorset already provides weekly food collections to most households). This gives waste with a carbon content of 26.22% (compared to 26.07% for the low CV waste in the original assessment) and a biocarbon content of 61.92% (compared to 59.97%). Using this waste, and with all other assumptions unchanged, the Appeal Proposal has a benefit of 48,100 tCO_2e/y over landfill, a slight increase from the base case of 41,800 tCO_2e/y, and a benefit of 15,800 tCO2/y over the current Dorset waste scenario (compared to 13,600 tCO_2e/y).

3.2.68 These two examples, which are intended to cover two realistic extremes given the current direction of government policy, demonstrate that waste composition has an effect on the results, but does not change the overall conclusion.

3.2.69 The lifetime assessment assumed that the waste composition would not change, as it is hard to predict what would happen in the future. However, I have now considered some possible projections. I note that government policy has a particular focus on removing plastics and food waste from the residual waste stream.

1. The 2018 Resource and Waste Strategy[29] had policies to "Stimulate demand for recycled plastic by introducing a tax on plastic packaging with less than 30% recycled plastic"; "Ban plastic products where there is a clear case for it and alternatives exist"; and "Improve the quality of plastics exported for recycling through the Basel and Stockholm Conventions".

[29] CD9.9

2. The Waste Management Plan for England[30] refers back to the Resource and Waste Strategy and says that it "is our blueprint for eliminating avoidable plastic waste over the lifetime of the 25 Year Environment Plan, doubling resource productivity, and eliminating avoidable waste of all kinds by 2050."

3. The Plan (p11-p12) also identifies the five strategic ambitions of the Resource and Waste Strategy. I have numbered these for convenience below.

    a. *To work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025;*

    b. *To work towards eliminating food waste to landfill by 2030;*

    c. *To eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan;*

    d. *To double resource productivity by 2050; and*

    e. *To eliminate avoidable waste of all kinds by 2050.*

4. The Net Zero Strategy[31] also considers this issue. In paragraph 44 on page 179, it is stated that "We will therefore explore policies to work towards the near elimination of biodegradable municipal waste to landfill by 2028. To support this commitment, we are bringing forward £295 million of capital funding which will allow local authorities in England to prepare to implement free separate food waste collections for all households from 2025." Paragraph 46 includes a commitment to introduce a plastic packaging tax, in order to encourage more recycling of plastics, and paragraph 43 includes a commitment to introduce consistent collections of household waste and to require local authorities to have separate collections of specific waste types.

3.2.70 It is clear that it is the government's aim to increase recycling in general and to remove food waste and plastics, in particular, from the residual waste stream. Therefore, I have added an additional change to the current lifetime assessments, by assuming a removal rate of 2% per year (for 15 years) for plastics and 3% per year (for 17 years) for food waste, starting in 2028. I have also considered the effect of each of these changes individually.

Table 1: Results of additional lifetime assessments

Changes in waste	**Benefit against landfill (tCO_2e)**		**Benefit against current Dorset waste baseline (tCO_2e)**	
Grid displacement	*DESNZ*	*Adjusted*	*DESNZ*	*Adjusted*
None	124,350	154,700	276,900	282,900
Plastics reduced by 2% per year	284,900	315,000	344,100	349,900
Food reduced by 3% per year	1,800	3,200	208,100	214,400

[30] CD9.7

[31] CD9.18

Changes in waste	Benefit against landfill (tCO_2e)		Benefit against current Dorset waste baseline (tCO_2e)	
Both reductions	161,200	191,600	281,200	287,300

Source: My calculations

3.2.71 It can be seen that there is a lifetime benefit in all cases, although the benefit over landfill is marginal in the case where food waste is reduced rapidly but there is no reduction in plastics waste. In the final case, where both food waste and plastics waste are gradually removed from the residual waste stream, the benefit of the Appeal Proposal over landfill and the Dorset waste baseline is higher than with a constant waste composition.

Conclusion

3.2.72 I consider that I have demonstrated that the Appeal Proposal will lead to a reduction in overall carbon emissions, and that this conclusion is true against a variety of counter-factual cases, for a mixture of waste compositions and a variety of assumptions. One reason for this is the unique advantage for the Appeal Proposal of being able to export power to ships, thus displacing the use of fossil fuels in diesel engines on those ships.

3.3 Response to the Council

3.3.1 The Council's statement of case does not indicate any disagreements on the carbon assessment.

3.4 Response to Rule 6 Party

3.4.1 The Rule 6 party makes a number of statements around climate impacts in its Statement of Case[32]. I assume that evidence will be presented to substantiate these statements, but I have made some initial comments below.

3.4.2 In paragraph 4.3, the Rule 6 party states that *"The purported "low carbon" benefits of the Incinerator have been overstated by Powerfuel."* I have presented evidence to show that this is not the case. The Rule 6 party also refers to *"the expected decarbonization of the national grid over time"*, which I have addressed in the lifetime assessment section.

3.4.3 In paragraph 4.4, the Rule 6 party states that the Appeal Proposal would increase emissions from HGV movements. As I have explained above, while this is true the benefits of shore power are 10 times higher than the emissions from additional HGV movements.

3.4.4 In paragraph 4.7, the Rule 6 party states that the Appeal Proposal "would not in any event represent an effective or acceptable means of providing onshore power. The power that would be generated by [the Appeal Proposal] would not provide enough capacity to utilize the full onshore connections capability without drawing from the National Grid. And the stated amount of power that [the Appeal Proposal] would produce would not be so significant to outweigh the harm that [the Appeal Proposal] would cause." I do not agree with any of these statements.

[32] CD11.4 SPWI/TPA Statement of Case, 10 October 2023.

- The Appeal Proposal would be a baseload plant which would be a very suitable method for providing shore power, compared to an intermittent source such as wind or solar.
- The Appeal Proposal, with its increased power generation, could provide enough power for a cruise ship and two RFA ships simultaneously.
- The benefits of shore power, in terms of displacing carbon emissions and other emissions, contribute to the planning balance.

3.5 Response to UKWIN

3.5.1 UKWIN submitted a statement dated October 2023. This was submitted after the Appellant had informed UKWIN that it was the intention to submit a revised carbon assessment, stating that "assumptions will be reviewed to take account of any changes since the assessment was completed over two years ago". The revised carbon assessment was submitted to the planning inspectorate on 26 October 2023 and is attached as Appendix SO3. For the avoidance of doubt, I wish to make it clear that the revisions to the assessment were made without reference to comments from UKWIN or any other party; as I explain in paragraph 3.1.6, the updates relate to specific changes to the Appeal Proposal and updated government publications.

3.5.2 I note that UKWIN has submitted other comments throughout the planning process, including a submission to the planning authority in February 2021. I prepared a response to that submission, which was Appendix A to the Consultation Response summary document, submitted by the Appellant to Dorset Council with the first ES Addendum in August 2021[33]. There is some overlap between the UKWIN submissions and I stand by everything in the original response.

3.5.3 I have responded to UKWIN's comments on climate change below. Mr Roberts has responded to UKWIN's comments on need. I have not responded to every single point made by UKWIN, but this should not be taken to mean that I agree with any specific points. In particular, I have not commented on the summary section (up to para 24), but on the detailed discussion which follows the summary.

3.5.4 UKWIN has also submitted a Supplementary Climate Submission, dated November 2023, with comments on the revised carbon assessment. This builds on points in the first submission without making any new points, although I have commented on a small number of assertions later in this section of my proof. However, as I mentioned earlier, I wish to emphasise that I prepared the revised carbon submission without reference to UKWIN's submissions and so the alleged failure to include the sensitivities which UKWIN requested in the revised carbon submission should not be taken as an unwillingness to do them.

Previous planning cases

3.5.5 In paragraph 25, UKWIN asserts that "Previous planning cases have come to the conclusion that uncertainties regarding the claimed climate change benefits of Energy from Waste proposals, some of which are inherent uncertainties regarding changing feedstock composition, the alternative fate of the waste, and the displacement of other forms of electricity generation, mean that only limited

[33] CD2.4 Consultation Summary Response.

weight should be given to claimed climate change benefits". UKWIN refers specifically to the planning inquiry for the proposed Consett ERF and the DCO decision for the proposed Kemsley ERF. I have commented on both of these decisions earlier in this proof.

3.5.6 For Consett, UKWIN fails to draw attention to paragraph 12.134 of the Inspector's Report[34], which says:

> *"Whilst uncertainties exist, and having carefully considered the views of UKWIN, I am of the view that the GHG Assessment, as supplemented by further evidence in Mr Caird's rebuttal proofs, provides a relatively robust analysis of the impact of the proposed development on climate change and is based partly on modelling advocated by Defra. Notwithstanding the uncertainties highlighted above, I consider that a reasonable assessment of the evidence submitted in the Inquiry suggests that the proposed development would likely result in lower GHG emissions compared to landfill over a 25 - 30 year lifetime, during which period it would also facilitate the availability of localised decarbonised power and heat."*

3.5.7 This is relevant as it means that the Inspector explicitly rejected UKWIN's position, mentioned in paragraphs 12.130 and 12.131 of the Inspector's report, that the Consett proposal may have a more adverse impact than sending the same waste to landfill. The only uncertainty was over the extent of the benefit and, hence, over the degree of positive weight to be given to this. Also, in the part of paragraph 12.135 which UKWIN does not quote, the inspector concludes that the proposal would be consistent with paragraphs 154 and 155 of the Framework, which relate to planning for climate change.

3.5.8 While I agree that there are uncertainties associated with the carbon benefits for ERFs, I have addressed these uncertainties in the multiple sensitivities in the carbon assessment, and the additional sensitivities which I described in paragraphs 3.2.65ff. I have demonstrated that the Appeal Proposal has a net benefit over landfill, over multiple alternative ERFs and over the current Dorset baseline and that this continues to be the case over a wide range of assumptions.

Waste Composition and uncertainties

3.5.9 In paragraph 33, UKWIN asserts that RDF is not the type of waste that could be expected to go to landfill. I agree that forms of RDF which are very processed are less likely to go to landfill, but RDF is a broad term and can include residual waste which has been subject to limited separation. This type of RDF can and does go to landfill. However, as UWKIN acknowledges, the Appeal Proposal will now be taking RDF and also residual waste from the same municipal and C&I sources, which means that landfill remains a reasonable counterfactual. More importantly, as UKWIN does not acknowledge, I have demonstrated that the Appeal Proposal gives a carbon benefit over alternative ERFs due to the export of heat and the use of shore power.

3.5.10 In paragraph 70, UKWIN suggests that by considering alternative baselines, the Appellant adds new uncertainties, reducing the weight that should be placed on these scenarios. This is a strange argument. Notwithstanding the point that the current and future baseline scenarios were included as a direct result of a request from Dorset Council, I cannot see how demonstrating that the Appeal Proposal has a benefit over multiple baseline scenarios can possibly make the benefits more uncertain.

[34] Appendix SO4 (8)

3.5.11 Looking at the specific uncertainties which UKWIN mentions, firstly there are the second order effects (para 74). UKWIN has misunderstood the point here. My overall view is that building a new ERF will lead to less waste going to landfill somewhere else, even if the specific waste which comes to a new ERF is being diverted from another ERF. This is because there is insufficient ERF capacity across the UK and Europe and so millions of tonnes of residual waste is currently going to landfill. By ignoring these second order effects, I am essentially assuming that the ERFs from which waste has been displaced will operate at a lower capacity, which is highly unlikely, but by including th second order effects I would simply revert to the landfill baseline, albeit with slightly different transport emissions. However, I considered alternative baselines because Dorset Council requested them.

3.5.12 Secondly, in paragraphs 80-93, UKWIN effectively criticises me for using, in the July 2021 carbon assessment, the latest available published data on the efficiency of Lakeside and Marchwood. In the revised carbon assessment, I have used more recent data and this has given an increase in efficiency. I have also considered the Canford Magna planning application in my proof (para 3.2.53).

3.5.13 In paragraphs 95 to 118, UKWIN makes a number of points around waste composition. I agree that waste composition has an effect on the carbon benefits, but I do not agree with UKWIN's approach, which is to simply assume a lower biogenic carbon content of waste without any attempt to justify this. I have clearly explained how I have developed the waste composition used in the carbon assessment from published sources and I have now considered some alternatives, including one alternative waste composition with a significant reduction in food waste. The Appeal Proposal continues to have a benefit over landfill and the current Dorset baseline.

3.5.14 In paragraph 104, UKWIN quotes from a report called "Greenhouse gas removal methods and their potential UK deployment". This was a report commissioned by BEIS from Element Energy and the UK Centre for Ecology and Hydrology to analyse the costs and deployment potential for greenhouse gas removal methods. No analysis was done on waste composition; UKWIN's quote that *"40-60% of the CO2 generated from current EfW plants in the UK is of biogenic origin"* is unreferenced in the Element Energy report and is inconsistent with monitoring data which I have seen (which has a range of 49% to 65% and an average of around 55%). The two base waste compositions which I have used in my studies (English residual waste and Welsh C&I waste) have biogenic carbon contents of 56% and 51% respectively, and the removal of plastics waste and food waste tend to balance out.

3.5.15 Therefore, simply using a biogenic carbon content of 40% without a waste composition to support this is unreasonable and I do not accept the basis of any of UKWIN's calculations.

Grid Intensity and Lifetime benefits

3.5.16 In paragraphs 119 to 124, UKWIN comment on the carbon intensity of power displaced by the ERF. UKWIN also considers this in paragraphs 7 to 35 of its supplementary submission. I have discussed this at length earlier in my proof.

3.5.17 In paragraph 188, UKWIN refers back to their February 2021 submission where they presented a calculation of the carbon intensity of power generated by the Appeal Proposal. This was done by dividing the direct carbon emissions from the Appeal Proposal by the power generated, to produce a figure of 738 gCO2e/kWh. UKWIN then compares this figure with carbon intensities for other forms of power generation. However, this approach is fundamentally flawed. An energy from waste plant carries out two functions, both of which have implications for carbon emissions. It diverts

residual waste from landfill, and it generates electricity. Any assessment of the carbon benefits or costs of ERFs needs to consider both of these functions.

3.5.18 In paragraph 189, UKWIN rejects my approach to carbon intensity, set out in section 3.4.1 of the carbon assessment, on the grounds that this deviates from standard practice. I agree that this approach is not standard practice for power generation plants, but I developed it as I agree that it could be helpful to compare the carbon intensity of power generated by an ERF with the carbon intensity of power generated by other means. However, the carbon intensity calculation needs to consider the avoided emissions from landfill, as other forms of power generation, such as CCGTs, wind or solar, do not displace waste from landfill. The calculation also needs to take account of the power which would have been generated if the waste had been sent to landfill.

3.5.19 Therefore, I consider that it is more helpful and correct to consider the carbon intensity of the additional power generated by sending residual waste to an EfW plant rather than landfill. This is done by calculating the following quantities for a fixed amount of waste:

- The direct carbon emissions from the EfW plant. (C_{EFW})
- The power exported by the EfW plant. (E_{EfW})
- The direct carbon emissions from landfill. ($C_{landfill}$)
- The power exported by the landfill. ($E_{landfill}$)

3.5.20 This means that:

- the effective increase in direct carbon emissions from sending waste to an EfW plant is C_{EFW} - $C_{landfill}$;
- the effective increase in power generation is E_{EFW} - $E_{landfill}$; and
- The effective carbon intensity of the additional power is $\frac{C_{EfW}-C_{landfill}}{E_{EfW}-E_{landfill}}$.

3.5.21 This effective carbon intensity is a fairer reflection of the carbon performance of an ERF when compared to other forms of power generation and is the figure presented in section 3.4.1 of Appendix SO3. For the design waste composition, the effective carbon intensity is 0.09 tCO_2e/MWh, which is very close to zero, and for the lower waste CV, it is below zero, at -0.036 tCO_2e/MWh.

3.5.22 In paragraphs 125-134, UKWIN suggests that the lifetime benefits of the ERF might be reduced now that the start date has been delayed by the protracted planning application process. I have updated the lifetime assessment for the new likely starting year, but I have also allowed for the increased certainty and quantity of shore power and reflected a more realistic grid decarbonisation trajectory. Hence, I continue to consider that the Appeal Proposal will have a benefit over its lifetime.

3.5.23 In paragraphs 135-146, UKWIN asserts that the lifetime benefit would be reduced if the lifetime of the plant were to be 30 years, on the grounds that the ERF has a disbenefit against landfill in the latter years. This is partially true. In the lifetime assessment against landfill in the revised carbon assessment, the disbenefit of the ERF in 2051 is around 3,300 tCO_2e/y and so, if the ERF continued to operate for five more years and nothing else changed, the lifetime benefit would be reduced by around 16,500 tCO_2e to 107,800 tCO_2e. However, I note that there is a benefit against the current baseline throughout the life of the Appeal Proposal, and so the lifetime benefit would increase if

the ERF operated for longer. More importantly, 2051 is a long way away and it is highly likely, given current government policy, that some form of carbon capture and storage would have been implemented by then.

3.5.24 Moving to the supplementary submission, UKWIN has carried out some further calculations. I have carried out sensitivities on carbon intensity and so have no comments on UKWIN's calculations. However, I do not accept UKWIN's assertions.

3.5.25 In paragraph 8, UKWIN says that my changes make the assessment less accurate. I do not accept this. I have updated the assessment to use the latest figure for the carbon intensity for CCGT, I have explained why I consider that the DESNZ factors do not reflect the types of power station which would be displaced by the ERF in the short to medium term and I have carried out a sensitivity using the latest DESNZ figures. This makes my assessment more accurate.

3.5.26 Building on the last point, UKWIN alleges in paragraph 25 that I have used the trajectory of the 2021 BEIS grid displacement factors rather than the 2023 DESNZ factors. This is incorrect. It is possible that UKWIN has misunderstood my reference to "original DESNZ factors"; this was intended to refer to the 2023 factors which I had quoted in the sentences before and specifically referenced in my footnote.

3.5.27 I also reject UKWIN's allegation that I have changed my approach to "flatter their proposal". The approach which I have taken is consistent with the approach that I took when giving evidence at Northacre last year and in a number of other carbon assessments over the last two years, mainly because of the evidence from published data (from DUKES) that the amount of power from CCGTs has simply not reduced over the last 25 years.

Sequestration of biogenic carbon

3.5.28 In paragraphs 147-169, UKWIN argues that landfill should be given a credit for the sequestration of biogenic carbon. This point was made by UKWIN in their July 2021 submission and has been made by UKWIN on multiple occasions. I consider, as set out in section 3.2.1 of the carbon assessment in Appendix SO3, that this would be wrong as *"it is not considered appropriate to give additional credit for sequestered carbon as this would result in an overly conservative assessment."* A more detailed response to this assertion can be found in Appendix A to the Consultation Response summary document, which I have restated here.

3.5.29 Section 6.3 of the Defra Report "Energy Recovery from Residual Waste – A carbon-based modelling approach" (CD9.26), read as a whole, clearly indicates that the authors did not recommend that the potential carbon sink effect be included:

1. While the impact of the sequestration effect on the carbon model was considered in paragraphs 172-184, CD9.26 notes that there was considerable uncertainty around the calculation. Paragraph 179 states:

> *"A range of different values exist in the literature for the amount of biogenic carbon that is sequestered in landfill. The baseline assumptions used in this model result in a very high level of sequestration, around 53% for the baseline composition. The outcome will be sensitive to the level of sequestration in two ways. Reducing the level of sequestration will require less biogenic carbon to be included in the EfW side of the model and will also result in more methane being emitted from the landfill side. Both factors will favour EfW over landfill."*

2. In the carbon assessment for the Appeal Proposal (included as Appendix SO3), I have used a sequestration rate of 50%, which is considered to be a conservative assumption. The Government report "Energy from Waste – A Guide to the Debate" suggests that up to half of the biogenic carbon would be sequestered. As I illustrate later, the waste compositions which I have used have sequestration rates below 50%.

3. Paragraph 184 of CD9.26 concludes that further work is required to understand sequestration levels:

> *"There is an additional complicating factor regarding the assumptions around sequestration levels. The proportion of landfill gas captured is difficult to measure directly so assumed levels have previously been derived from a combination of measurement of the amount of landfill gas captured as a proportion of the amount modelled as being produced. However, the modelling for this also contains assumptions on sequestration. Therefore, any lowering in the sequestration assumptions will also inherently reduce the assumed level of landfill gas capture. This interaction has not been captured in the above analysis. As a result the scenarios outlined above will be particularly sensitive to sequestration levels with any drop in assumed sequestration significantly favouring EfW over landfill. Given all of these interactions there is a high degree of uncertainty and further work is required."*

4. I consider that this section of CD9.26, taken as a whole, provides an explanation that the assumed landfill gas capture rates in CD9.6 are based on a high sequestration rate, which may not be correct, and which is at the higher end of rates in the literature (as stated in paragraph 179). If the sequestration rates are lower, then more landfill gas is being generated than expected and so the capture rates would be lower, making the impact of landfill considerably worse. Hence, the approach used in the carbon assessment (i.e., using high sequestration and landfill gas capture rates and not giving an additional credit for sequestered carbon) is considered to be conservative, in that it will tend to favour landfill over EfW facilities.

3.5.30 I have checked whether my assumption of a sequestration rate of 50% is conservative by using figures for the Degradable Decomposable Organic Carbon content (DDOC) from the MelMod model used by Golders in "Review of Landfill Emissions Modelling".[35] (This is the same source of data as that which was described as resulting in a very high rate of sequestration in paragraph 179 of CD9.26, as quoted above.) My calculations show that the fraction of biodegradable carbon which would be sequestered is 47.63% for the design waste and 46.87% for the maximum tonnage waste, remaining below 50% for all of the other waste compositions which I have used. This confirms that assuming 50% was conservative.

3.5.31 The landfill gas capture rates which I have used also come from CD12.16. The amount of landfill gas captured is known, as this is measured, but the amount of landfill gas which is not captured is not known, for obvious reasons, and so is derived from modelling. This uses the same DDOC assumptions as I have used to confirm that a sequestration rate of 50% is conservative, and which the two DEFRA reports say lead to sequestration rates which are at the higher end of rates in the literature. If the correct sequestration rate is lower, then the amount of landfill gas which has been generated is higher and the landfill gas capture rates would be lower.

[35] CD12.16 DEFRA Review of Landfill Methane Emissions Modelling (WR1908) (2014).

3.5.32 This can be illustrated with a simple example. The base assumptions in the carbon assessment are that 50% of biogenic carbon is sequestered and 68% of the released landfill gas is captured. This means that, for every 200 tonnes of biogenic carbon in the waste, 100 tonnes is sequestered, 68 tonnes is used to generate power and 32 tonnes is released as landfill gas. If, instead, only 45% of the biogenic carbon is sequestered, then 90 tonnes of the biogenic carbon would be sequestered and 110 tonnes would form landfill gas. In this example it is known, from measurements, that 68 tonnes is used to generate power and so the landfill gas capture rate would be 68/110 = 61.8%. At a sequestration rate of 29.5% (which is the sensitivity figure used in CD9.26), only 59 tonnes of the biogenic carbon would be sequestered and so the landfill gas capture rate would be 68/141 = 48.2%.

3.5.33 I have done some sensitivity calculations to show the impact of this assumption, based on sequestration rates of 50%, 47.63% or 46.87%, 45%, 40% and 29.5% and allowing for the changes in landfill gas capture rates which are implied. It can be seen that the results are very sensitive to the sequestration rate and that only a slight reduction in sequestration rate is sufficient to mean that the Appeal Proposal has a net benefit compared to landfill, even allowing for a sequestration credit, and even excluding shore power and district heating. With shore power, the benefits are larger (as before).

Table 2: Sequestration sensitivity

Sequestration Rate	**50%**	**Calc**	**45%**	**40%**	**29.5%**
Design Waste (11 MJ/kg)		**(47.63%)**			
Benefit of Appeal Proposal (no sequestration credit)	29,674	41,453	54,497	79,320	131,449
Benefit of Appeal Proposal (with sequestration credit)	-23,554	-9,249	6,592	36,739	100,045
Benefit of Appeal Proposal (with sequestration credit and shore power	-16,831	-2,508	13,333	43,479	106,786
Maximum tonnage waste (9.95 MJ/kg)		**(46.87%)**			
Benefit of Appeal Proposal (no sequestration credit)	41,838	58,753	68,831	95,824	152,509
Benefit of Appeal Proposal (with sequestration credit)	-16,041	4,500	16,740	49,521	118,360
Benefit of Appeal Proposal (with sequestration credit and shore power	-9,300	11,241	23,481	56,262	125,101

3.5.34 The alternative Dorset waste baseline includes less landfill, which means that the inclusion of a credit for sequestration in landfill has less effect on the benefits of the Appeal Proposal compared to that baseline.

3.5.35 In addition, it is not certain that carbon will remain sequestered in landfill over the long term. The Environmental Services Association, in its Net Zero Strategy, notes that "landfill science does not yet provide a dataset to support the concept that materials are sequestered in them within a long-term timeframe."

3.5.36 UKWIN makes two slightly new arguments. The first is that I should have followed good practice set out in the UKWIN Good Practice Guidance. For obvious reasons, I do not accept that guidance from UKWIN, an organisation whose aim is to prevent all ERFs from being built, is of any relevance.

3.5.37 The second is that my approach goes against the latest IEMA Guidance[36]. I do not accept this. UKWIN's quotes in paragraph 162 merely show that the IEMA Guidance requires the inclusion of all material emissions; I do not agree, for the reasons alluded to above, that the sequestration of biogenic carbon in landfill should be taken into account in the manner which UKWIN suggests. UKWIN then takes a small reference in the IEMA Guidance to "sequestered GHG Emissions" out of context. The full quote, from the section considering the current baseline on page 17, is as follows:

> *"It may not always be possible to report on current baseline emissions, particularly with projects situated in areas with no physical development or activity. In this instance there would be zero GHG emissions to report at a site level, although particular attention should be paid where changes in land use are expected. For example, land use and land-use change such as woodland creation can sequester carbon over their lifetime and therefore contribute to climate change mitigation. Their disturbance or removal through construction will release previously sequestered GHG emissions."*

3.5.38 In other words, the IEMA guidance is noting that if a project involves a change in land use by adding additional woodland, then the ability of trees to sequester carbon over their lifetimes should be taken into consideration. Conversely, if the change in land use involves the removal of trees, then this could release sequestered GHG emissions. This is entirely different from the argument that additional credit should be given for the sequestration of biogenic carbon in landfill, over and above the conservative position which I have already taken.

3.5.39 In paragraph 173, UKWIN asserts that "To the extent that the Appellant adopts new assumptions in a belated attempt to flatter their proposal, this should be taken as further evidence of the inherent uncertainties in the calculation and the caution that ought to be taken when giving too much credence to the assumptions adopted by the Appellant." I do not accept this assertion; by updating the carbon assessment for new information, I am reducing the uncertainty associated with the calculation and ensuring that the inspector can make his recommendation to the Secretary of State based on the latest information.

Committee on Climate Change

3.5.40 In paragraphs 181-187, UKWIN includes a number of short quotes from the Committee on Climate Change (CCC). These are selective quotes, as they exclude the many places where the CCC suggests that CCS would also make a contribution.

1. In paragraph 182(a), UKWIN quotes from the 2020 Progress Report to Parliament, specifically from the section on pages 182-183 which covers the CCC's recommendations for priorities for DEFRA. While I agree that the CCC supports an increase in recycling, it is noticeable that two of the five bullet points in the sub-section on waste relate to the need for CCS on ERFs. "When regional CO_2 infrastructure becomes available, operational plants above a certain scale should be incentivised or required to retrofit CO_2 capture. New plants (and plant expansions) above a

[36] Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance – 2nd Edition, IEMA, February 2022.

certain scale should only be constructed in areas confirmed to soon have CO_2 infrastructure available, and should be built 'CCS ready' or with CCS".

2. In paragraph 182 (b), UKWIN quotes from the CCC's "Local Authorities and the Sixth Carbon Budget". Again, UKWIN fails to continue the quote, which says "Local councils will need to consider how current and new EfW plants will fit carbon capture and storage (CCS) equipment in the future, plus the impact of waste reductions and improved recycling (which will remove high calorific value materials from the feedstock)."

3.5.41 However, I agree with UKWIN that the CCC has taken a position that it is necessary to reduce the use of ERFs in order to decarbonise the waste sector. However, the CCC's role is only to advise the government and I note that the government does not appear to agree with the CCC. This can be seen by the government's response to the CCC's 2023 Progress Report[37]. The CCC's priority recommendation on ERFs was Recommendation 2023-73:

> *"Implement a whole-systems approach to address Energy from Waste (EfW) emissions, including setting out the implications of rising EfW use for waste decarbonisation and confirming plans to include EfW within the UK ETS. A moratorium on additional EfW capacity should be introduced subject to a review of capacity needs and how they align with Government emissions pathways. Further clarity is also needed on how decisions on allowing further EfW plants will be made."*

3.5.42 The Government's response to this recommendation is as follows:

> *"The Government is already undertaking several actions to reduce emissions from Energy from Waste (EfW). For example, the waste Industrial Carbon Capture (ICC) business model has been designed to incentivise the deployment of carbon capture technology in the residual waste management sector, where there is no viable alternative to achieve deep decarbonisation. Two waste carbon capture and storage (CCS) projects have been shortlisted on the Track-1 Project Negotiation List to proceed to the negotiations phase of the CCUS Cluster Sequencing Process. These projects will, subject to negotiations, demonstrate the commercial viability of CCUS in the residual waste management sector and help facilitate future deployment of the technology and decarbonisation of the sector.*
>
> *Furthermore, to ensure future new build EfW plants are built ready to decarbonise, we have consulted on including EfW within Decarbonisation Readiness requirements and later this year we will be publishing an addendum to the Resources and Waste Strategy, which will focus on net zero.*
>
> *The UK Emissions Trading Scheme (ETS) Authority has announced its intention to include EfW installations in the ETS from 2028, preceded by a 2-year monitoring, reporting and verification (MRV) period. The ETS sets a cap on emissions that can be released by covered sectors, and the cap will reduce in line with Net Zero targets.*
>
> *In line with the commitment in the Resources and Waste Strategy to monitor residual waste capacity, officials are currently assessing planned incinerator capacity against expected future residual waste arisings so we can understand what future incineration capacity may*

[37] Responding to the Climate Change Committee's (CCC) 2023 Annual Progress Report to Parliament, 26 October 2023. Extracts in Appendix SO9.

be required following implementation of key commitments in the Resources and Waste Strategy. This further assessment of residual waste treatment capacity needs will be published in due course.

Planning consent for large EfW plants (>50MW) in England & Wales is determined by the SoS in accordance with the National Policy Statement for Renewable Energy Infrastructure. For an application to be granted the Secretary of State should be satisfied, with reference to the relevant waste strategies and plans, that the proposed plant is in accordance with the waste hierarchy."

3.5.43 This response shows, firstly, that the government will be considering what future incineration capacity may be needed nationally, in the context of the overall needs for residual waste treatment. The government already considers this for large EfW plants. I note that Mr Roberts has presented data to show that there is a need for the Appeal Proposal, which would appear to be consistent with the government's approach. Importantly, this means that the government has not accepted the CCC's approach, which is to ban all new ERFs immediately. This is consistent with the statement by Rebecca Pow MP, Parliamentary Under Secretary of State at DEFRA, to parliament on 1st December 2022 which is quoted in full by Mr Roberts in sub-section 8.4 of his proof that *"DEFRA has no plans to introduce a moratorium on new energy-from-waste capacity in England, because we expect the market itself to assess the risks and determine the economic viability and deliverability of developing the new infrastructure. There is no financial advantage for the public sector or the market in delivering overcapacity in the energy-from-waste provision in England."*

3.5.44 Secondly, the response shows that the government considers that carbon emissions from ERFs can be reduced through CCS, and that the government is implementing policies to encourage the use of CCS. (This is consistent with CCC recommendation 2022-304.)

3.5.45 Thirdly, the government will be including emissions from ERFs within the UK ETS, which would mean that emissions from ERFs would be treated in the same manner as for other sectors covered by the UK ETS. The aim of the UK ETS is that a cap is set and gradually reduces, so that the sectors covered by the UK ETS can decarbonise in the most economically favourable manner.

Conclusion on UKWIN

3.5.46 UKWIN has made a number of assertions, almost all of which have been made by UKWIN previously at other inquiries. I continue to reject all of UKWIN's assertions, as a result of which I consider the UKWIN consistently understates the benefits of the Appeal Proposal, and I have demonstrated that the Appeal Proposal would lead to a reduction in carbon emissions when it opens and over its lifetime.

4 Air Quality and Health

4.1 Introduction

4.1.1 Dorset Council does not object to the air quality assessment. Impacts on air quality did not form part of the reasons for refusal. The planning officer's report to the planning committee[38] considered air quality in a number of places.

4.1.2 In section 8.7, the response of Dorset Council Environmental Health is reported:

> *Air Quality - early consideration relating to the stack height, potential emissions and control measures for gas and particulate emissions from the facility will not be addressed by Environmental Health as this legislative responsibility lies with the Environment Agency and will be addressed as part of their own planning considerations under the environmental permitting application process. Dorset Council's Environmental Protection team will make suitable representation on the permit application as required. Similarly Environmental Protection cannot comment upon ecological matters. The air quality review of 25th of May 2022 written by TetraTech is considered to have been found to be robust, competent and sufficient to determine that there is not expected to be a significant adverse impact as a result of the application. Environmental Protection support this report and have no objections.*

4.1.3 Similarly, in section 8.6, the planning officer reports that Dorset Public Health has asked the EA to review and comment on the modelling.

4.1.4 These consultation responses lead to the planning officer's conclusions on air quality in paragraphs 14.129 to 14.134, in which the planning officer concludes that air quality matters should be covered by the Environmental Permitting regime. I have explained the situation with regard to the environmental permit in section 2.6 above.

4.1.5 However, a number of written representations, including those from the Rule 6 parties, have raised concerns about the effect of energy from waste on air quality and human health. Therefore, although this has not been raised as a concern by Dorset Council and was not part of the reasons for refusal, I have explained in this section why these concerns are misplaced. I have started by summarising the results of the air quality assessment and human health risk assessments in the ES and supplementary documents. I have then explained the position of the Health Protection Agency/Public Health England with particular reference to three scientific papers which were referred to in the ES.

4.1.6 Due to the protracted nature of the planning application determination process, a number of different documents relating to air quality and health were submitted. To assist the inquiry, I have summarised these documents below. I have then, in subsequent sections of my proof, presented the results of the final versions of the various documents.

[38] CD5.1, Strategic and Technical Planning Committee Report 24 03 23

4.1.7 The air quality assessment was carried out by Fichtner under my direction. It is described in chapter 4 of the Environmental Statement (ES)[39]. It is supported by three appendices.

- Appendix D1 – Baseline Analysis describes the current air quality in the local area.
- Appendix D2 - Process Emissions Modelling provides technical details of the process emissions modelling.
- Appendix D3 - Roads Emissions Modelling provides technical details of the process emissions modelling.

4.1.8 The health impact assessment was carried out by ERM and is described in chapter 6 of the ES and appendix G.

4.1.9 Dorset Council requested additional information in a letter dated 30 April 2021[40]. Questions 18-21 and 35 related to air quality issues. These were addressed in the ES Addendum[41], section 3.

1. Dorset Council asked for the benefits of displacing emissions from ships due to shore power to be quantified. Fichtner prepared a technical note on this, which was attached as Appendix 3.1 to the ES Addendum. This note also set out the cumulative impacts of road emissions, process emissions and other plans and projects on nearby ecological sites.
2. Dorset Council requested additional traffic modelling, which was addressed in the ES Addendum, section 3.
3. Dorset Council requested additional information on the operation of the back-up diesel generators. This was also addressed in section 3 of the ES Addendum.
4. Dorset Council asked for responses to any relevant points made in the first consultation. These were addressed in the ES Addendum, and some typographical errors in the original assessment were addressed in Appendix 3.2 to the ES Addendum.
5. As part of the EP application determination process, the EA had asked for additional air quality modelling to cover the impacts at specific human health receptors. Fichtner prepared a technical note for the EA and this was provided to the council as Appendix 3.3 to the ES Addendum.

4.1.10 In November 2021, new versions of Appendix D2 to the ES (CD2.19), Appendix 3-1 to the ES Addendum (CD2.22) and the main ES Addendum document (CD2.21) were submitted to correct some transcription errors, which had no effect on the conclusions to the assessments. A second erratum version of Appendix 3-1 to the ES Addendum (CD2.24) and the main ES Addendum document (CD2.23) were submitted in December 2021 to correct some references to “critical level” which should have read “critical load”. In all cases, Dorset Council requested that complete versions of the amended documents should be submitted, rather than addendum sheets.

[39] CD1.37d,e,f

[40] CD2.17b ES Addendum Appendix 1-1.

[41] CD2.17a ES Addendum, and CD2.17d,e,f

4.1.11 In January 2022, Dorset Council asked for further information on a number of subjects, including air quality, which led to the production of a second ES Addendum[42]. This was supported by five technical appendices on air quality and two technical appendices on health impacts, which were prepared by Fichtner.

1. Appendix 3.1 was a technical note submitted to the EA to address the air quality impacts of the emergency diesel generators.

2. Appendix 3.2 was a technical note submitted to the EA to clarify a few technical points raised by the EA's technical specialists, and to justify why the dispersion modelling approach was appropriate.

3. Appendix 3.3 addressed emissions of $PM_{2.5}$s from the ERF, as requested by Dorset Council.

4. Appendix 3.4 was an update to Appendix 3.1 to the first ES Addendum, to take account of a revised list of cumulative projects.

5. Appendix 3.5 was an updated to Appendix D3 to the original ES, again to take account of a revised list of consented developments.

6. Appendix 5.1 was a comparison of the impact of dioxins, furans and dioxin-like PCBs against the Tolerable Daily Intake criteria. This was requested by Public Health England as it was not set out in the original health impact assessment.

7. Appendix 5.2 was a similar assessment for the impact of metals.

4.1.12 Air Quality Consultants (AQC), on behalf of SPWI, commented on the air quality assessment documents in February 2022. Fichtner prepared a response to these comments, which was submitted in March 2022. While this did not provide any new information or change any of the conclusions of the assessment, AQC did identify some transcription errors in three tables in Appendix 3-3 to the ES Addendum, and so a revised version of this Appendix was submitted (CD2.30). In addition, a technical note which was prepared for the EA relating to the emissions modelling methodology for the diesel generators was also submitted to Dorset Council (CD2.34).

4.2 Air Quality Assessment – process emissions

4.2.1 My team used atmospheric dispersion modelling software, ADMS5.2, to model the dispersion of emissions from the exhaust stack. The model takes account of the impact of buildings on air flows across the land. The model also takes account of the effects of terrain, using Ordnance Survey data. We used five years of weather data from the Portland weather station to ensure that variability in weather conditions would be fully taken into account. The EA requested further information as part of the EP application process to justify the assumptions and this was provided as Appendix 3.2 to the Second ES Addendum, as mentioned earlier. This demonstrated that the conclusions of the air quality assessment were robust to different choices of input parameters.

4.2.2 The Waste incineration BAT Conclusions were published in December 2019. These applied to new plants, such as the Appeal Proposal, immediately. The BAT Conclusions introduce BAT-Associated

[42] CD2.29a Second ES Addendum and CD2.29c-i

Emission Limits (BAT-AELs) which are more stringent than the emission limits currently set out in the IED. It has been assumed that emissions from the Appeal Proposal will comply with the BAT-AELs, or the emission limits from Annex VI Part 3 of the IED for waste incineration plants where BAT-AELs are not applicable, and I note that the emission limits requested in the EP application are consistent with this approach.

4.2.3 The assessment was intended to be conservative.

1. It was assumed that the Appeal Proposal would operate at the emission limits for the entire year. In reality, the Appeal Proposal would be taken offline for an annual maintenance shutdown and it is expected to operate below the emission limits for most of the time.

2. The worst-case conversion of NO_x to NO_2 has been applied.

3. The entire dust emissions are assumed to consist of either PM_{10} or $PM_{2.5}$.

4. All of the Volatile Organic Compound (VOC) emissions are assumed to consist of either benzene or 1,3-butadiene.

5. Cadmium is assumed to be released at the combined emission limit value for cadmium and thallium.

6. Initially, no account was taken of the offset of emissions from ship engines which would be displaced by shore power.

4.2.4 As explained in paragraphs 4.23 to 4.28 of the ES, the results of the modelling have been assessed using the IAQM guidance document "Land-Use Planning & Development Control: Planning for Air Quality" (2017). This is provided to assist professionals operating within the planning system.

4.2.5 The results of the modelling are shown in Tables 12 and 13 of Appendix D2 to the ES and summarised in paragraphs 4.56 to 4.60 of the ES. Paragraph 4.60 states

> *"The first stage analysis has shown that the annual mean impact is less than 0.5% of the AQAL and the short term impact is less than 10% of the AQAL at the point of maximum impact except for the following:*
>
> - *Annual mean nitrogen dioxide impacts;*
> - *Annual mean VOC impacts;*
> - *Annual mean cadmium impacts;*
> - *99.79th percentile of 1 hour NO_2 impacts assuming operation at the half-hourly ELV;*
> - *99.73rd percentile of 1 hour SO_2 assuming operation at the half-hourly ELV;*
> - *99.9th percentile of 15 minute mean SO_2 assuming operation at the half-houtlu ELV."*

4.2.6 For the six exceptions, further analysis was undertaken. The results of this analysis for long term impacts are explained in paragraphs 4.61 to 4.69, which came to the following conclusions:

- *The magnitude of change in annual mean NO2 concentrations associated with the ERF will be negligible at all areas of relevant exposure and no significant effects are predicted. (4.63)*

- *The magnitude of change in annual mean VOC concentrations associated with the ERF will be negligible at all areas of relevant exposure and no significant effects are predicted. (4.66)*

- *If it is assumed that the ERF would perform similarly to existing plants, the impact would be less than 0.5% of the AQAL at the point of maximum impact and at all areas of relevant exposure. Therefore, the magnitude of change in annual mean cadmium impacts associated with the ERF will be negligible at all areas of relevant exposure and no significant effects are predicted (4.69).*

4.2.7 For short term impacts, assuming that the Appeal Proposal will operate at the half-hourly emission limit at all is conservative, given that the daily emission limits for SO_2 and NO_2 will be lower than for previous plants, and assuming that this will happen at the same time as the weather conditions which lead to the highest ground level impacts is even more conservative. Therefore, my team considered the impacts of more realistic short term emissions and demonstrated that no significant impacts were predicted.

4.2.8 Dorset Council asked the Appellant to consider whether the conclusions of the assessment would change in the light of the Environment Act 2021, which required the government to set a reduced air quality target for PM2.5. I and my team addressed this in Appendix 3.3 to the Second ES Addendum[43]. We compared the predicted impact from the ERF with the WHO's latest guideline value of 5 ug/m^3, as we considered that this was the lowest target that the UK Government would be likely to set. We demonstrated that the highest predicted contribution to ground level concentrations on land would 0.64% of the WHO's guideline, but this assumed that the ERF would operate for the whole year at the particulate emission limit and that all of the particulate emissions would be in the PM2.5 size range. We provided evidence from a comparable facility that these assumptions were very conservative and, therefore, we concluded that there would be no change to the ES conclusions.

4.2.9 Hence, the overall process emissions associated with the operation of the Appeal Proposal are predicted to have a 'negligible' and 'not significant' effect on human health.

Ship Emissions

4.2.10 As I noted above, Dorset Council asked for the benefits of displacing emissions from ships due to shore power to be quantified. Fichtner prepared a technical note on this, which was attached as Appendix 3.1 to the first ES Addendum (CD2.17d). I and my team carried out dispersion modelling of the emissions from ships berthed in Portland Port, predicting the annual average ground level concentrations at every grid point across the modelled domain. We then subtracted these predicted ground level concentrations from the impacts of emissions from the ERF. The results are shown graphically in a series of figures in Appendix 3.1 to the first ES Addendum.

[43] CD2.29e.

4.2.11 For particulate matter, we concluded that displacing emissions from ships led to a small net benefit across the whole of the modelled domain.

4.2.12 For nitrogen dioxide, there was a net benefit across virtually the whole of the modelled domain, with the exception of a small area on the breakwater and a small area around The Verne. However, the net increase on land was very small – 0.05 µg/m^3 – which can be compared with the background concentration of 22 µg/m^3 and the predicted impact of the ERF alone of about 0.3 µg/m^3.

4.2.13 For sulphur dioxide, there was a net impact across most of Portland and Weymouth, but the impact is reduced compared to the ERF alone. The highest net increase on land was 0.05 µg/m^3, compared to the impact of the ERF alone of 0.075 µg/m^3.

4.2.14 The analysis carried out in 2021 was based on the displacement of 36 cruise ships and 260 berthing days for RFA ships. My team has repeated the calculation with an increase to the displacement of 43 cruise ships and 390 berthing days for RFA ships, which is consistent with the figures for the carbon assessment for 2027. The results are shown graphically in Appendix SO5.

4.2.15 For particulate matter, we continue to conclude that displacing emissions from ships would lead to a small net benefit across the whole of the modelled domain. The net benefit has increased marginally.

4.2.16 For nitrogen dioxide, there is now a net benefit across the whole of the modelled domain, although the net benefit on the Verne is small.

4.2.17 For sulphur dioxide, there is now a net benefit across most of Weymouth and the north and east sides of Portland, closest to the harbour. There is a net impact further away, with the highest net increase on land of 0.05 µg/m^3 limited to a very small area around the Verne.

4.2.18 Hence, I conclude that displacing emissions from ships, as well as leading to a carbon benefit, will mean that the overall impact on air quality for particulate matter, sulphur dioxide and nitrogen dioxide from the operation of the ERF will be slightly beneficial across Weymouth and Portland.

Emergency Diesel Generator

4.2.19 The Appeal Proposal will include an emergency diesel generator (EDG). This is provided solely to allow the ERF to close down safely in the event of a loss of grid connection. (Under normal circumstances, the ERF generates its own power but, when starting up or shutting down, it would draw power from the grid.) The ERF may not need to close down if there is a loss of grid connection, as it could continue to run in island mode, but it needs to be able to shutdown under these circumstances. The EDG also needs to be tested periodically to ensure that it will operate in an emergency.

4.2.20 This means that the EDG would operate under two scenarios.

- In the event of a loss of grid connection during which the ERF needs to shut down, the EDG would run at full load for an hour, then gradually reduce load as the power requirements of the ERF reduce during shutdown. It would operate for no more than four hours. I understand from Portland Port that there had been only three grid outages over the six years to 2021, so this would be an unlikely occurrence.

- The EDG would be tested every two weeks, operating for less than 30 minutes each time.

4.2.21 A number of parties raised concerns about the environmental impact of the EDG and, as a result, I and my team carried out dispersion modelling which was submitted to the EA and included as Appendix 3.1 to the second ES Addendum (CD3.1). However, I would like to emphasise that the attention paid to the EDG is out of proportion to the actual impacts. The EDG would operate for 13 hours a year for testing and maybe 4 hours a year in emergency operation, so it would operate for 0.2% of the year. The only pollutant released by the EDG is nitrogen oxides and the release rate for these is about the same as for the ERF for the first 10 minutes of EDG operation and then is about a quarter of the ERF emissions. This means that the annual emissions of nitrogen oxides from the EDG would be at least 500 times smaller than the emissions from the ERF.

4.2.22 In Appendix 3.1 to the second ES Addendum, the focus was on short term impacts, given that the long term impacts were clearly negligible. It was demonstrated that while it was theoretically possible for the short term AQAL to be exceeded if the EDG happened to operate during poor conditions for dispersion, the chance of this occurring was less than 0.1%. Under EA guidance, this means that an exceedance would be highly unlikely to occur. The modelling also showed that any such exceedances would not occur in any areas where the public would have regular access.

4.3 Air Quality Assessment – traffic emissions

4.3.1 As explained in paragraph 4.38 of the ES, IAQM document 'Land-Use Planning & Development Control: Planning for Air Quality' (2017) states that an air quality assessment is required where a development would cause a "significant change" in light duty vehicles (LDVs) or heavy goods vehicles (HGV). The IAQM guidance document includes indicative criteria for identifying a significant change in terms of numbers of LDVs or HGVs. In paragraph 4.76 of the ES, the operational vehicle numbers are compared with the screening criteria and shown to be well below the IAQM screening criteria and so further detailed analysis of traffic impacts was not considered to be necessary.

4.3.2 However, it was noted in paragraph 4.77 of the ES that existing levels of traffic-related pollutants in the Boot Hill area of Weymouth were elevated. Although this is not an Air Quality Management Area (AQMA), Dorset Council asked for it to be treated as an AQMA for screening purposes. As the expected number of HGV movements on the A354 through the Boot Hill area slightly exceeded the IAQM screening criteria, a detailed assessment was undertaken.

4.3.3 As stated in paragraph 4.78 of the ES, the assessment concluded that the largest change as a result of traffic associated with the Appeal Proposal would be less than 0.5% of the AQAL and so the effect would be negligible and not significant. This was based on the assumption that traffic emissions would not change from 2017 whereas, in reality, it would be expected that older vehicles would be replaced with newer vehicles and so emissions would be lower.

4.3.4 Dorset Council asked for the cumulative impacts of process emissions and traffic emissions in the Boot Hill area to be assessed. This was done in the first ES Addendum (CD2/17a, paragraphs 3.29 to 3.31) and it was shown that this did not change the conclusions of the assessment.

4.4 Impacts on Ecology

4.4.1 There are a number of sites of ecological importance within the relevant screening distances of the Appeal Proposal. These are listed in Table 6 of Appendix D2 to the ES (CD1.37e). The most important

sites are the Isle of Portland to Studland Cliffs SAC (which incorporates the Isle of Portland SSSI and the Nicodemus Heights SSSI) and Chesil and The Fleet SAC, SPA and Ramsar site, which incorporates Chesil and The Fleet SSSI. There are also a number of locally-designated sites.

4.4.2 The impact of process emissions from the ERF was considered in section 8 of Appendix D2 to the ES. The potential impacts considered were atmospheric concentrations of oxides of nitrogen, sulphur dioxide and ammonia, nitrogen deposition and acid deposition. Where the long term process contribution from the ERF was less than 1% of the long term critical load or level, and where the short term process contribution was less than 10% of the short term critical load or level, the impact could be screened out as insignificant.

1. For Isle of Portland to Studland Cliffs SAC (and its incorporated SSSIs), a number of different impacts exceeded the screening criteria. However, in all cases, when combined with background levels the total predicted environmental concentrations were less than 70% of the relevant critical load or level. As a result, the shadow appropriate assessment submitted with the planning application concluded that there will be no significant effects on the interest features of the SAC. As reported by Mr Picksley in his written statement[44], the Environment Agency came to the same conclusion in its Appropriate Assessment and Natural England has accepted this position.

2. For Chesil and the Fleet SAC, the only impact which was not screened out as insignificant was acid deposition on acid grasslands. Again, when combined with background levels the total predicted environmental concentrations was less than 70% of the relevant critical load or level. As a result, the shadow appropriate assessment submitted with the planning application concluded that there will be no significant effects on the interest features of the SAC, SPA or Ramsar site. Again, as reported by Mr Picksley in his written statement, the Environment Agency came to the same conclusion in its Appropriate Assessment and Natural England has accepted this position.

3. For the locally-designated sites, the impacts were screened out as insignificant in most cases but there were marginal increases in nitrogen oxides at Verne Yeates SNCI, ammonia at most LNRs and SNCIs and nitrogen and acid deposition at Osprey Quay Bunds. As explained in paragraphs 10.142 to 10.145 of Chapter 10 of the ES, the effects of these marginal increases on the locally designated sites is considered to be negligible to slight and so not significant.

4.4.3 The impact of traffic emissions on ecological receptors was initially considered in Appendix D3 to the ES, which was subsequently revised (in January 2022, CD2.29g) to include a revised list of consented developments. It was shown that emissions from traffic alone led to impacts which were less than 1% of the relevant critical load or level. When combined with the emissions from the ERF, the total impacts could not be screened out everywhere.

1. For Isle of Portland to Studland Cliffs SAC, the combined impact was greater than 1% of the Critical Level for oxides of nitrogen and greater than 1% of the critical load for nitrogen deposition, but only within 25m of the road to the site.

2. For Chesil Beach and The Fleet SAC, combined impact was greater than 1% of the critical load for nitrogen deposition, but only within 50m of the road.

[44] CDXXX

4.4.4 The dispersion modelling for roads considered three scenarios for the intended opening year, 2023:

- "Do nothing" – 2019 baseline traffic flows, increased for general traffic growth only.
- "Do minimum" – "Do nothing" flows plus traffic flows associated with consented development.
- "Do something" – "Do minimum" plus traffic flows associated with the Appeal Proposal.

4.4.5 Appendix D3 to the ES presented the impact of traffic emissions associated with the Appeal Proposal only, being the difference between the "Do something" and "Do minimum" scenarios. Dorset Council asked for the cumulative impact to be presented, being the difference between the "Do something" and the "Do nothing" scenarios. This was provided in Appendix 3.1 to the First Addendum ES, which was subsequently revised (in January 2022, CD2.29g) to include a revised list of consented developments. The results showed that the impacts from consented developments were significantly larger than the impacts from the Appeal Proposal.

4.4.6 The significance of the impacts of traffic emissions is considered in Mr Picksley's written statement.

4.4.7 The impact of emissions from the EDG on the Isle of Portland to Studland Cliffs SAC and SSSI was considered in Appendix 3.1 to the second ES Addendum. As the EDG, as I noted earlier, would only run for 0.2% of the year, it is clear that the impact on annual mean assessment levels would be insignificant. Therefore, only short term impacts were considered. It was shown in Appendix 3.1 to the second ES Addendum that there was a chance of an exceedance of the daily mean Critical Level for nitrogen oxides during emergency operation, but not during testing. However, the weather conditions which led to an exceedance are rare, which meant that the chance of an exceedance was shown to be 1.4% in the Isle of Portland to Studland Cliffs SSSI and 0.2% in the SAC. (The difference is because the SSSI is slightly larger than the SAC and so the border of the SSSI is slightly closer to the EDG than the border of the SAC.)

4.4.8 The Environment Agency was concerned about the accuracy of the dispersion modelling in one specific area. The EDG would be located to the north of the main site buildings. If the wind were to blow from the north, then emissions from the EDG could be carried over these buildings into the area to the south of the buildings, known as the building cavity region. This is a region of high turbulence due to building downwash and the uncertainty associated with dispersion modelling is known to be high in this situation. As this region extends slightly into the SSSI and SAC, the EA was concerned that concentrations might be higher and so the chance of an exceedance might be higher.

4.4.9 My team and I prepared a technical note to the EA to address this concern, which was submitted to the council in March 2022 (CD2.34). The note includes a diagram at the end which illustrates the area of the SSSI and SAC which might be affected. As Mr Picksley says in paragraph 1.22 of his written statement, these areas do not contain any features for which the SAC is designated and so, even if there were to be exceedances of the daily mean critical level, these would not affect the integrity of the site.

4.5 Health Risk Assessment – process emissions

4.5.1 Typically, concern about health effects for EfW plants, such as the Appeal Proposal, relates to emissions of persistent pollutants. Dioxins and furans will remain in the environment and have the potential to accumulate in the soil, unlike, for example, nitrogen oxides which do not accumulate but convert to nitrogen in the soil.

4.5.2 Once in the soil the persistent pollutants can be taken into plants through the roots, and then work their way into the food chain through animals and into humans. Humans receive virtually all of their exposure to dioxins through food, as an example. Therefore, a human health risk assessment, using a methodology developed by the US Environmental Protection Agency, was carried out by ERM. This models all potential exposure routes for dioxins, so that the level of exposure to these substances can be estimated.

4.5.3 The results of this modelling, described in Appendix B to Appendix G to the ES (CD1.37j), showed that the emissions from the Appeal Proposal would not have an appreciable health risk. Similarly, the results of this modelling, when compared to the TDI in Appendices 5.1 and 5.2 to the second ES Addendum (CD2.17h and CD2.17i), showed that the contribution of dioxins, furans and metals to the most impacted receptor would be less than 0.2% of the TDI, confirming that there would not be an appreciable health risk.

4.5.4 This conclusion concurs with the view of the Health Protection Agency (HPA), now Public Health England (PHE). The HPA published a note RCE-13 "The Impact on Health of Emissions to Air from Municipal Waste Incinerators" in 2009[45]. The summary of this note is as follows:

> *"The Health Protection Agency has reviewed research undertaken to examine the suggested links between emissions from municipal waste incinerators and effects on health. While it is not possible to rule out adverse health effects from modern, well regulated municipal waste incinerators with complete certainty, any potential damage to the health of those living close-by is likely to be very small, if detectable. This view is based on detailed assessments of the effects of air pollutants on health and on the fact that modern and well managed municipal waste incinerators make only a very small contribution to local concentrations of air pollutants. The Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment has reviewed recent data and has concluded that there is no need to change its previous advice, namely that any potential risk of cancer due to residency near to municipal waste incinerators is exceedingly low and probably not measurable by the most modern techniques. Since any possible health effects are likely to be very small, if detectable, studies of public health around modern, well managed municipal waste incinerators are not recommended." (Summary, page 1)*

4.5.5 While I consider that this statement is clear, and has been referred to in many planning decisions, PHE commissioned further research in 2012, while continuing to state that the conclusions of RCE-13 remain applicable. These studies were commissioned from the Small Area Health Statistics Unit (SAHSU), which is based at Imperial College London and Kings College London. Details of the study can be found on their website, with a printout attached as Appendix SO6. The following statement from the website describes the aims of the study:

> *"The study has been commissioned to extend the evidence base and to provide further information to the public about any potential reproductive and infant health risks from MWIs [municipal waste incinerators]. The study proposes to investigate the following questions:*

[45] CD12.11

Are the emissions from incinerators required to operate under the standards set by the EU Waste Incineration Directive (WID) (2000/76/EC) linked with adverse reproductive and infant health outcomes?

Is living near a municipal waste incinerator linked with adverse reproductive and infant health outcomes?"

4.5.6 The methodology and results of the studies have been published in a series of papers in scientific journals. The three most recent papers are the most relevant.

4.5.7 The primary paper which provides the results of the main study is known as Ghosh et al (2018)[46]. It considered a range of health outcomes for babies and infants - term birth weight, small for gestational age (SGA) at term, stillbirth, neonatal, post-neonatal and infant mortality, multiple births, sex ratio and preterm delivery – covering 1,025,064 births and 18,694 infant deaths. The study considered outcomes close to all 22 UK municipal energy-from-waste plants which operated at some point between 2003 and 2010.

4.5.8 An earlier part of the study had involved carrying out dispersion modelling of emissions from these EfW plants over the period 2003-2010[47]. The modelling used actual operating data from all plants to calculate the average ground level concentration of particulates down to postcode level (i.e. an area of about 12 households). As explained in Ghosh et al (2018), particulates were used as a proxy for all emissions, as all emissions to atmosphere will disperse in a similar manner. The authors of Ghosh et al (2018) then used this data and the health data to look for associations between predicted particulate concentrations and health outcomes. No associations were found.

4.5.9 The authors also looked for associations between the listed health outcomes and proximity to an EfW plant. This was done by identifying whether the mother's usual residence at date of birth registrations was within 10 km of an operational EfW plant at the date of birth. This is a less sophisticated method of analysis, as it does not take account of operational data or atmospheric dispersion patterns, but it is more similar to previous studies carried out by others. Again, no associations were found.

4.5.10 The conclusion of the study (on page 157) is clear:

"This large national study found no evidence for increased risk of a range of birth outcomes, including birth weight, preterm delivery and infant mortality, in relation to either MWI emissions or living near an MWI operating to the current EU waste incinerator regulations in Great Britain. The study should be generalisable to other MWIs operating to similar regulations and with similar waste streams."

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[46] Ghosh RE, Freni Sterrantino A, Douglas P, Parkes B, Fecht D, de Hoogh K, Fuller G, Gulliver J, Font A, Smith RB, Blangiardo M, Elliott P, Toledano MB, Hansell AL. Fetal growth, stillbirth, infant mortality and other birth outcomes near UK municipal waste incinerators; retrospective population based cohort and case-control study. Environment International. 2018. CD12.12

[47] Reported in Douglas, P., Freni-Sterrantino, A., Leal Sanchez, M., Ashworth, D.C., Ghosh, R.E., Fecht, D., Font, A., Blangiardo, M., Gulliver, J., Toledano, M.B., Elliott, P., De Hoogh, K., Fuller, G.W., Hansell, A.L. Estimating Particulate Exposure from Modern Municipal Waste Incinerators in Great Britain, Environ. Sci. Technol.201751137511-7519, 2017, CD12.13

4.5.11 The second paper was published in April 2019 and is known as Freni-Sterrantino et al (2019)[48]. The objective of this paper was to determine whether it was possible to observe a change in infant mortality rates before and after an EfW plant is opened. The authors considered eight EfW plants which opened over the time period considered (1996-2012). For each facility, the authors identified all neighbourhoods within 10 km, working at the level of Middle Layer Super Output Area (MSOA), which is an area with a population of about 7,500 people. This gave a base area. The authors then identified comparator MSOAs within the same region which had similar characteristics to those within the 10 km radius in terms of deprivation, ethnicity, population density and nitrogen dioxide emissions, in order to give a comparator area.

4.5.12 The authors then compared infant mortality rates in the area around the EfW plant and the comparator area for five years before the opening of the EfW plant and five years afterwards. The data showed that infant mortality rates after the EfW plants opened were lower than before the plants opened, both in the areas around the EfW plants and the comparator areas. The difference was actually slightly greater in the areas around the EfW plants (i.e. infant mortality improved faster in the areas within 10 km of EfW plants), but the difference was not statistically significant. The authors considered a smaller buffer distance of 4 km and found the same result.

4.5.13 The authors carried out a similar study for the sex-ratio of births (i.e. the number of boys compared to the number of girls) and found no change between the periods before and after the opening of an EfW plant.

4.5.14 Hence, the authors concluded (on page 114) *"we did not find an association between the opening of a new MWI and changes in infant mortality trends or sex ratio at birth for 10 and 4 km buffers, using distance as proxy of exposure, after taking into account temporal trends in comparator areas and potential confounding factors."*

4.5.15 The third paper was published in June 2019 and is known as Parkes et al.[49] The objective of this paper was as follows: *"To conduct a national investigation into the risk of congenital anomalies in babies born to mothers living within 10 km of an MWI associated with: i) modelled concentrations of PM10 as a proxy for MWI emissions more generally and; ii) proximity of residential postcode to nearest MWI, in areas in England and Scotland that are covered by a congenital anomaly register."* Under objective (i), which related congenital anomalies to modelled concentrations and so would be considered the more representative approach, the study found no association with congenital abnormalities. Under objective (ii), there was a small excess risk, but the paper's authors note that this may be due to residual confounding.

4.5.16 The Imperial College website includes Frequently Asked Questions on this study[50]. One of these is "Does the study show that MWIs are causing increased congenital anomalies in populations living nearby?" The answer is as follows.

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[48] Freni-Sterrantino, A; Ghosh, RE; Fecht, D; Toledano, MB; Elliott, P; Hansell, AL; Blangiardo, M. Bayesian spatial modelling for quasi-experimental designs: An interrupted time series study of the opening of Municipal Waste Incinerators in relation to infant mortality and sex ratio. Environment International. 128 (2019) 106-115 (Freni-Sterrantino et al, 2019) CD12.14

[49] Parkes B, Hansell A.L., Ghosh R.E, Douglas P., Fecht D., Wellesley D., Kurinczuk J.J., Rankin J., de Hoogh K., Fuller G.W, Elliot P., and Toledano M.B. "Risk of congenital anomalies near municipal waste incinerators in England and Scotland: Retrospective population-based cohort study". Environment International (Parkes et al). CD12.15

[50] In Appendix SO6

"No. The study does not say that the small excess risks associated with congenital heart disease and genital anomalies in proximity to MWIs are caused by those MWIs, as these results may be explained by residual confounding factors i.e. other influences which it was not possible to take into account in the study. This possible explanation is supported further by the fact that the study found no increased risk in congenital anomalies due to exposure to emissions from incinerators."

4.5.17 The researchers issued a statement[51] on the Imperial College website which takes account of the full body of work. I note the following extracts.

> *"Professor Anna Hansell, Director of the Centre for Environmental Health and Sustainability at the University of Leicester, who previously led the work while at Imperial College London, added: "Taken together, this large body of work reinforces the current advice from Public Health England – that while it's not possible to rule out all impacts on public health, modern and well-regulated incinerators are likely to have a very small, or even undetectable, impact on people living nearby."*
>
> *"Professor Mireille Toledano, Chair in Perinatal and Paediatric Environmental Epidemiology at Imperial, said: "In these studies we found a small increase in risk for children living within 10 km of an MWI being born with a heart defect, or a genital anomaly affecting boys, but did not find an association with the very low levels of particulates emitted. This increase with proximity to an incinerator may not be related directly to emissions from the MWIs. It is important to consider other potential factors such as the increased pollution from industrial traffic in the areas around MWIs or the specific population mix that lives in those areas."*

4.5.18 The papers consider UK EfW plants, operating under the same regulatory regime which would apply to the Appeal Proposal and operating to current standards, noting that these will be tightened further in December 2023. Accordingly, I consider that this independent research and evidence is the most recent, most comprehensive and most relevant research available. Given that the first two papers did not find any evidence of an association of EfW plants with the health outcomes considered, that the third paper did not find an association with modelled emissions and that the Appeal Proposal would actually operate to tighter standards than the plants considered, as it will use the reduced emissions limits from the Waste Incineration BAT Conclusions, I consider that the conclusions are directly relevant and support PHE's position statement. I note that the lead researchers also consider that the conclusions support PHE's position statement.

4.6 Plume Visibility

4.6.1 Dorset Council requested additional information on the visibility of the vapour plume in a letter dated 30 April 2021[52]. In response, I and my team carried out further modelling to confirm how often the plume from the ERF stack would be expected to be visible, and the results were provided in appendix 8.1 to the first ES Addendum[53].

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[51] https://www.imperial.ac.uk/news/191653/major-study-finds-conclusive-links-health/ In Appendix SO6.

[52] CD2.17b ES Addendum Appendix 1-1.

[53] CD2.17i ES Addendum Appendix 8.1

4.6.2 The science behind visible plumes is explained in section 1 of Appendix 8.1 to the first ES addendum. The exhaust gases from the combustion of waste (and, indeed, from the combustion of other fuels) contain water vapour, which comes partly from the moisture content of the waste and partly from hydrogen in the waste which is combusted into water. The exhaust gases are released to atmosphere at around 140°C, which means that the water is gaseous. As the flue gases mix with air, the water vapour cools and condenses. At the same time, the plume disperses. If the liquid water content of the plume is high enough, then the plume can become visible. This means that plumes tends to become visible on cold days (when the water vapour cools more quickly) and in stable, calm weather conditions (as the plume disperses less quickly).

4.6.3 The dispersion model ADMS5.2 includes a module to model plume visibility, based on the liquid water content of the plume. My team and I used this model to predict how often the plume would have been visible over the five years 2014-2018. As the main reason for this modelling was to consider whether the visible plume might adversely affect views over the island, we only considered whether the plume would be visible during daylight hours. Also, as the visual impact of the plume would be significantly reduced during high levels of cloud cover, we identified how often the plume would become visible on non-cloudy days.

4.6.4 The results of the modelling are set out in section 2 of Appendix 8.1 to the first ES Addendum.

1. Over five years, the plume was predicted to be visible for 205 hours over five years of weather data, which is less than 1% of daylight hours.

2. Of these hours, 84 occurred during high cloud conditions, leaving 121 daylight non-cloudy days with a visible plume, or 0.55% of daylight hours.

3. The weather conditions in 2018 were unusual. This is because there were two periods when the temperature remained at or below 0°C for extended daylight periods – the Beast from the East and Storm Emma from 26 February to 2 March and a follow-up on 17 to 19 March. In contrast, the recorded temperature was above 0°C for the whole of 2014-2017. Given that the visibility of the plume was unlikely to be a concern under such weather conditions, we removed 36 hours of visible plumes, of which 10 were during non-cloudy hours, leaving 111 visible plumes on non-cloudy non-freezing daylight hours, or 0.51% of daylight hours. (This is 22 hours per year, on average.)

4. Finally, we noted that virtually all of the 205 visible plumes occurred over the winter, which might affect the sensitivity of the visual impacts.

4.6.5 The significance of the visible plumes, in landscape terms, has been considered by Mr Mason.

4.7 Odour

4.7.1 The environmental permit application included an odour risk assessment and a number of odour mitigation measures. These measures are reproduced below.

> *"Odour will be controlled and contained within the waste reception area by maintaining these areas at a negative pressure. Air from the waste reception areas (bale storage area and waste storage bunker) will be extracted to be used as combustion air within the waste incineration plant.*

During normal operation of the Facility, daily inspections will be undertaken to monitor for odour and will include the following:

- *waste reception area;*
- *external boundary;*
- *monitoring the position of louvres; and*
- *monitoring combustion air flow, with odorous air extracted via the boiler and the stack.*

During periods of shutdown the frequency of the above inspections would be extended, including monitoring combustion air flow if the Induced Draft fan operation can be maintained, for instance during periods of maintenance. In addition, during shutdown, a daily 'sniff test' and inspection around the boundary of the Facility would be conducted.

Waste management procedures for the bale storage area and the waste storage bunker, will be employed to avoid the development of anaerobic conditions and decomposition which could potentially generate further odorous emissions. These management procedures will include the frequent mixing and rotation of waste, and periodic emptying and cleaning. Waste rotation would be carried out on a rotational sequence, with the use of designated 'zones' to ensure regular and well distributed turnover of the incoming waste within the waste storage bunker. The process also results in a more homogeneous fuel, which would increase fuel efficiency in the incineration process. During periods of shutdown, bunker management procedures would not normally be implemented as this will avoid the generation of odorous emissions especially when waste volumes within the bunker are low.

Prior to periods of planned maintenance, bunker management procedures will reduce the amount of incoming waste within the waste storage bunker prior to the shutdown. In the event of an extended unplanned shutdown, if unacceptable levels of odour are identified at the installation boundary waste will be unloaded from the waste storage bunker, or the bale storage area, for transfer off-site to a suitably licensed waste management facility."

4.7.2 Given these mitigation measures, and that the nearest residential receptor to the installation is located around 600m away, the odour risk assessment concluded that the risk of adverse impacts due to odour was not significant. The EA had not asked for any further information on this subject, and so I consider that the proposed mitigation measures were acceptable to the EA. However, as mentioned earlier, the EA noted that the Bibby Stockholm was moored within 500 m of the installation boundary and so was now the closest receptor. Therefore, the EA asked the Appellant to *"Submit an updated odour risk assessment and management plan to consider potential impacts at the barge."* This has been submitted to the EA and is attached as Appendix S07.

4.7.3 The updated odour risk assessment includes more details of the odour mitigation measures proposed. In particular, while the barge is located 300 m from the installation boundary, it is noted in the assessment that the access doors to the reception hall are located on the northern elevation of the building, over 500 m away from the barge and with the building in between. The overall conclusions of the risk assessment are unchanged, in that any releases of odour from the ERF will not have a significant impact on the barge, or on any other sensitive receptors within the port of Portland.

5 Responses to third parties

5.1 Introduction

5.1.1 There have been many written objections made by individuals and by community organisations or their representatives at various stages of the planning process. The issues raised are listed in appendix C to the Appellant's Statement of Case. In this section of my proof, I focus on a selected number of named respondents and respond to a small number of specific points made by individuals which I consider are not explicitly covered earlier in my proof. In doing so I mean no disrespect to other organisations or individuals not specifically named who may have made similar points or whose objections, which tend to be worded more generally, I consider have been effectively covered elsewhere in my proof.

5.2 Stop Portland Waste Incinerator (SPWI) and the Portland Association (TPA)

5.2.1 The Rule 6 parties are intending to give evidence on a number of matters which I cover in my proof. I reserve the right to respond to their evidence in due course. At this stage, I have commented on some points in their Statement of Case.

5.2.2 In paragraph 4.3, SPWI/TPA asserts that the low carbon benefits of the ERF have been overstated. I consider that the low carbon benefits of the ERF are evident, as explained in section 3. Therefore, I disagree with SPWI/TPA's other assertions in this area.

5.2.3 In paragraph 4.7, SPWI/TPA states "*The power that would be generated by the Incinerator would not provide enough capacity to utilize the full onshore connections capability without drawing from the National Grid."* This is not correct. The power that would be generated by the ERF would be sufficient to power two RFA ships and one cruise ship simultaneously.

5.2.4 SPWI/TPA go on to state *"And the stated amount of power that the Incinerator would produce would not be so significant to outweigh the harm that the Incinerator would cause."* This is incorrect, in two ways. Firstly, as I have demonstrated earlier, the ERF would lead to a carbon benefit initially and over its lifetime and this is, at least partly, due to the benefit of displacing the use of diesel fuel onboard ships moored in the port. Secondly, as I explained in paragraphs 4.2.10ff, switching off the diesel engines on board ships would reduce emissions of nitrogen dioxide and particulate matter and this would indeed outweigh the emissions of these substances from the ERF, leading to an overall improvement in air quality across Weymouth and Portland.

5.3 MVV

5.3.1 MVV, the developer of the Canford Magna ERF, has submitted an interested party objection. I would like to comment on a small number of points in that objection.

5.3.2 In paragraph 1.4.11, MVV asserts that *"Supplying cruise ships does not sit well with the baseload power generation characteristics of an EfW because their demand for power is irregular (ie only when they are in harbour)."* MVV may not appreciate that the Portland ERF will be supplying power to RFA ships, which spend around 390 berthing days in port each year and so provide a consistent

power demand. I agree that the cruise ship demand is irregular, but the ERF will be able to export power to the National Grid when cruise ships are not present.

5.3.3 MVV also states in paragraph 1.4.11 that *"Other sites including Canford can also demonstrate possible power and heat offtakes directly to local customers and these are therefore not unique benefits at Portland."* This is partially true, but there are few if any other sites in Dorset where the power from an ERF can be delivered to users which are currently using diesel engines to generate power. This is significantly different from supplying power to a user which would otherwise take power from the National Grid. In terms of heat, the Portland ERF has the advantage of delivering heat to a public sector client with a consistent heat load.

5.3.4 In paragraph 1.4.13, MVV notes that the Canford Magna planning application includes space for carbon capture. While this is true, the space allocated is inadequate, based on Fichtner's experience and knowledge base (which I explained in paragraph 2.5.11) and is already allocated to another use.

5.3.5 In paragraph 1.4.17, MVV notes that the Portland ERF ES is based on 2017 IEMA Guidance, rather than the 2022 IEMA Guidance. This is clearly true, due to the date of the ES. I agree that the carbon benefits of the Portland ERF would not be described as significant under the 2022 IEMA Guidance, due to the change in approach in that guidance which states that only projects which actively cause GHG emissions to be avoided or removed from the atmosphere can be described as having a significant beneficial effect.

5.3.6 I do not agree with MVV that the Canford proposals would have a positive effect in reducing GHG emissions that Portland. I agree that the Canford proposals may have fewer lorry miles for waste from Dorset although, as noted by Mr Roberts, the Canford proposals are larger and so may need to draw in waste from further afield. However, emissions from transport are a relatively small part of the overall carbon emissions. Although the Canford proposals are more efficient than I am assuming for Portland, displacing shore power leads to a higher displacement of carbon emissions than displacing grid power. This is why I note, in paragraph 3.2.53, that the Portland proposal has a slightly higher benefit than Canford overall although the difference is small.

5.4 Other Interested Persons

5.4.1 Professor Atkinson, in his submission to the inquiry, is concerned that the air quality assessment has focussed on prevailing south-westerly winds. I can confirm that I and my team considered five years of weather data and took account of winds from all directions, although it is true that the greatest annual impacts are found in the direction of the prevailing winds. Professor Atkinson also refers to Douglas et al 2017, which I have also referenced (CD12.13) as one of the papers produced following the studies commissioned by Public Health England. As I note earlier, and as stated in the abstract of Douglas et al, the modelling in Douglas et al was used in the more detailed epidemiological study reported in Ghosh et al (CD12.12), which concluded:

> *"This large national study found no evidence for increased risk of a range of birth outcomes, including birth weight, preterm delivery and infant mortality, in relation to either MWI emissions or living near an MWI operating to the current EU waste incinerator regulations in Great Britain. The study should be generalisable to other MWIs operating to similar regulations and with similar waste streams."*

5.4.2 Mrs Jenny Cooper is concerned that the air quality assessment did not take account of local weather patterns. I can confirm that the weather data was taken from Portland, albeit the far end of Portland, and that weather data was also taken from the breakwater in Portland port. I can also

confirm that the dispersion modelling software adapts the measured weather data to take account of terrain and models the impacts of temperature inversions (an issue which other interested parties have also mentioned). Mrs Cooper also suggests that the Bibby Stockholm is taking power from the grid, but my understanding is that power is being provided by temporary diesel generators due to the limited grid infrastructure available.

5.4.3 James Nicholson asks whether the dispersion of emissions over Tophill, Portland has been considered. I can confirm that the terrain of Portland was taken into account in the dispersion modelling and that the impact at all residential areas, including Tophill, has been determined to be insignificant.

5.4.4 Portland Town Council (PTC) makes a number of comments on the air quality and health assessments. In general, I consider that these are addressed earlier in my proof and in the various air quality assessment documents included in the application. However, I would like to comment on a few specific points.

5.4.5 PTC includes a quote from the Health Impact Assessment, as amended with the first ES Addendum: "Vulnerable groups in society will be affected most by the increase in traffic levels. Those such as young children and the elderly may experience negative health impacts. The elderly may experience annoyance from increased noise, whereas young children are at higher risk of road accidents and health impacts associated with potential air pollution." However, this is merely a statement of the potential impacts. The HIA actually concludes, on traffic impacts, that "*it is not expected that the impacts from the proposed development will exacerbate the mental health issues or current health inequalities within the local communities.*"

5.4.6 PTC refers to the "unique Portland weather conditions", "considers that wholly insufficient attention has been given to the topography of the site" and refers to temperature inversions. These are all, in effect, criticisms of the accuracy and suitability of the atmospheric dispersion modelling. I note that the dispersion modelling has been thoroughly audited by the EA's technical specialists, AQMAU, as part of the permit application. The EA asked for additional information to justify the modelling approach and quantify the modelling uncertainties, and I and my team prepared a technical report on this matter, which was also submitted to the planning authority as Appendix 3.2 to the second ES Addendum[54]. This considered the sensitivity of the results to terrain and to different weather data, which are the two concerns which PTC has raised, as well as to some other parameters. The report also demonstrated that the dispersion model is suitable for the topography of the site.

5.4.7 The conclusions of the modelling uncertainty assessment can be found in section 5.3 of CD2.29d and are quoted below.

> *The conservative assumptions explained above mean that the overall impacts presented in the DMA [Dispersion Modelling Assessment] will be overestimates.*
>
> 1. *Annual mean impacts are overstated by around 10% due to plant availability, by around 10% when inter-annual variability is considered and by at least 10% when allowing for operation below the emission limits. This means that, overall, the annual mean impacts in the DMA have inbuilt conservatism of at least 30%.*

[54] CD2.29d.

2. *For short term impacts, selecting the worst case weather conditions across all five years of weather data introduces conservatism of at least 5%, and assuming operation at the short term ELVs introduces conservatism of as much as 50-70%.*

3. *The validation documentation shows that the levels of uncertainty in the model are on average within 10% of the hourly and daily concentrations, with accuracy over long time frames expected to be at least as high as this.*

4. *The sensitivity analysis shows that variations in modelling assumptions leads to changes in the peak concentrations of 5-15%.*

Therefore, it is considered that the results presented in the DMA are robust as the inbuilt conservatism is of a similar order to the uncertainty in the modelling.

5.4.8 Portland Town Council states that it *"is advised that Public Health England has referred to the failure of adequate modelling on both topographical and meteorological grounds."* While it is correct that PHE (now UKHSA) asked for some additional information, it stated that it satisfied by its final consultation response on the planning application in February 2022. As reported in paragraph 8.4 of the planning committee report[55]:

> *UKHSA has reviewed the additional documents and considers that they provide adequate information to satisfy concerns posed previously. In relation to the backup diesel generator the further information provided means that it is considered that an exceedance in air quality thresholds would be highly unlikely and there would be no appreciable health risks. Based on the information supplied, the UKHSA has no significant concerns regarding the risk to health of the local population from the proposed development.*

5.4.9 Barry Walsh draws on his experience as a Fellow of the Royal Meteorological Society to make two meteorological points. Firstly, he suggests that the wind measurements at Portland Bill are not representative of the Appeal Proposal site. While I agree with this, the meteorological pre-processing module with ADMS adjusts the measured data by taking account of the terrain, so that the weather data used for modelling is not simply the measured data. In addition, as explained in Appendix 3.2 to the second ES Addendum[56], I had access to wind speed and direction data from one of the breakwaters in the harbour. This allowed my team and I to carry out a sensitivity analysis using this data and demonstrate that it did not change the conclusions.

5.4.10 Secondly, Mr Walsh describes the phenomenon of temperature inversions in very stable weather conditions. I agree with his description of these and can confirm that the dispersion modelling software identifies when these conditions occur and takes account of them in the modelling. This is discussed in the technical note from CERC, the developers of ADMS, which was attached to Appendix 3.2 to the second ES Addendum.

[55] CD5.1

[56] CD2.29d.

6 Conclusions

6.1.1 The Appeal Proposal now has an increased efficiency, following some optimisation of the design and because a number of electricity users on or close to the port have been identified. Conservatively, the ERF would export at least 17.1 MWe and could export 19.2 MWe if sufficient users can be identified.

6.1.2 The Appeal Proposal would be carbon capture ready. Carbon could be captured from the flue gases, liquified and directly exported to offshore geological storage by ships from the port, which is not an option for any other potential ERF sites in Dorset.

6.1.3 I have demonstrated that the Appeal Proposal will lead to a reduction in greenhouse gas emissions by displacing landfill and the use of fossil fuels to generate electricity, and that this conclusion is robust to a wide range of sensitivities. I have also demonstrated that the Appeal Proposal would lead to a reduction in greenhouse gas emissions compared to the current management of residual waste in Dorset. The benefit of the Appeal Proposal will increase further by exporting power to ships moored in the port, as this would displace the use of diesel fuel.

6.1.4 I have also demonstrated that the Appeal Proposal will not have a significant impact on air quality and does not pose an appreciable risk to human health. This is consistent with other ERFs. However, exporting power to ships moored in the port would enable those ships to switch off their engines while in port, reducing emissions of pollutants. As a result, there would be a net reduction in concentrations of nitrogen dioxide and particulate matter across Weymouth and Portland.

6.1.5 On the basis of my evidence, and the other evidence presented to the Inquiry on behalf of the Appellant, I respectfully ask the Inspector to grant planning permission for the planning application.

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