# 6 Greenhouse Gases and Climate Change

## 6.1 Introduction

6.1.1 This chapter assesses the likely significant effects resulting from the K3 and WKN Proposed Developments as a consequence of greenhouse gas (GHG) emissions and the resultant impact on climate change.

6.1.2 It is supported by Appendices 6.1, 6.2 and 6.3 containing details of the GHG emissions calculations.

6.1.3 GHG emissions are normally expressed as carbon dioxide equivalents, explained in the methodology section below, and are therefore often referred to as 'carbon' as a shorthand (e.g. when speaking of 'low-carbon power' or 'carbon reduction targets').

6.1.4 With regard to potential climate change inter-relationships with other assessments reported in this ES, climate change impacts on flood risk and coastal change affecting the Proposed Developments are assessed in Chapter: 10 Water Environment. In the judgement of the authors of Chapter 11: Ecology and Chapter 12: Landscape and Visual Effects, there is not considered to be any relevant influence of climate change on the status of ecological or landscape receptors impacted by the development.

## 6.2 Regulatory and Policy Framework

### *National Climate Change and Waste Legislation and Policy*

<u>Climate Change Act, 2008</u>

6.2.1 The Climate Change Act 2008 as amended by the 2050 Target Amendment Order 2019 [Ref. 6.1] commits the UK government to reducing greenhouse gas emissions by at least 100% of 1990 levels by 2050 (a net zero carbon target for the UK), and created a framework for setting a series of interim national carbon budgets and plans for national adaptation to climate risks.

6.2.2 At present the Third, Fourth and Fifth Carbon Budgets, set through The Carbon Budget Orders 2009, 2011 and 2016, are 2.54 $GtCO_2e$ for 2018-2022, 1.95 $GtCO_2e$ for 2023-2037 and 1.73 $GtCO_2e$ for 2028-2032.

6.2.3 The Climate Change Act also created the Committee on Climate Change to give advice on carbon budgets and report on progress. The Committee through its Adaptation Sub-Committee also gives advice on climate change risks and adaptation. Its advice regarding carbon and climate policy relevant to the Proposed Development is summarised below.

Carbon Plan, 2011

6.2.4 The 2011 Carbon Plan [Ref. 6.2] is the UK's national strategy under the Climate Change Act for delivering emissions reductions through to the Fourth Carbon Budget period (2023-27) and preparing for further reductions to 2050.

6.2.5 It was expected to be updated or replaced by a national 'Emissions Reduction Plan' that the former coalition government committed to publish in 2016, but that has been delayed indefinitely. Due to the age of the Carbon Plan, certain policy expectations have been overtaken by subsequent policy decisions: in particular, the expected government funding for deployment of carbon capture and storage (CCS) technology lapsed following the failure of the second CCS competition [Ref. 6.3], though CCS support has been revived in the UK CCUS Deployment Pathway action plan [Ref 6.4], albeit with limited funding available.

6.2.6 The Carbon Plan chapter on Waste and Resource Efficiency (pages 93-99) describes a three-pronged strategy, of:

- preventing waste arising;
- reducing methane emissions from landfill; and
- efficient energy recovery from residual waste.

6.2.7 In addition to referencing the GHG emission benefits of reducing the amount of waste landfilled in general, the Carbon Plan states in paragraph 2.223 that "*The Government's aim is to get the most energy out of waste, not the most waste into energy recovery*" and in paragraph 2.224 that "*Efficient energy recovery from waste prevents some of the negative greenhouse gas impacts of waste in landfill and helps to offset fossil fuel power generation.*"

6.2.8 In Box 7 on page 41, the Carbon Plan lists CHP using fuels including waste among technology options to supply "low carbon heat" and in paragraphs 2.130 and 2.132, describes energy from waste as a sustainable biomass source and low carbon heat source for large-scale CHP opportunities.

Waste Management Plan for England, 2013

6.2.9 The Waste Management Plan 2013 [Ref. 6.5] states in its future-looking evaluation on page 34 that Defra "*prioritis[es] efforts to manage waste in line with the waste hierarchy and reduce the carbon impact of waste*".

6.2.10 On page 13 it states that "*The Government supports efficient energy recovery from residual waste – of materials which cannot be reused or recycled – to deliver environmental benefits, reduce carbon impact and provide economic opportunities.*"

Clean Growth Strategy, 2017

6.2.11 The 2017 Clean Growth Strategy for the UK [Ref. 6.6] notes the significant progress made in decreasing GHG emissions from waste going to landfill and adopts goals of being a 'zero avoidable waste economy' by 2050 and diverting all food waste from landfill by 2030. The Strategy does not discuss energy from waste and effects on GHG emissions in detail, but does have a goal for the National Infrastructure Commission to "*work with the waste sector to ensure that different waste materials going into energy recovery processes are treated in the best possible way*" (page 111).

National Infrastructure Assessment, 2018

6.2.12 Although not adopted national policy, the advice of the National Infrastructure Commission (NIC, an executive agency of the Treasury) given in the National Infrastructure Assessment [Ref. 6.7] is also considered relevant.

6.2.13 While noting the benefits of EfW for diverting waste from landfill, the National Infrastructure Assessment recommends that more use of alternative treatment for food waste and plastic in particular is encouraged to reduce GHG emissions. On page 34 it states:

> *"The successful delivery of a low cost, low carbon energy and waste system requires… encouraging more recycling, and less waste incineration."*

6.2.14 And on pages 45-46:

> *"Incinerating less, recycling more*
>
> *Energy from waste plants (incinerators) facilitated the move away from landfill, and make sense when the alternative is energy from fossil fuels. They incinerate 'black bag' waste and other wastes that cannot be recycled, producing electricity and providing heat where there is a source of demand nearby. However, lower cost, lower carbon options exist for some types of waste, in particular food waste and plastics."*

Advice of the Committee on Climate Change

6.2.15 Although not itself setting government policy, the Committee on Climate Change's statutory role to advise government under the Climate Change Act 2008 means that its recommendations or identification of policy gaps are relevant to consider in this assessment. In its 2015 advice [Ref. 6.8] on setting the Fifth Carbon Budget and on sectoral scenarios [Ref. 6.9] for achieving the budget, the Committee considered carbon reduction pathways and actions for the waste management and power generation sectors, both relevant to the K3 and WKN Proposed Developments.

6.2.16 Chapter 7 of the sectoral scenarios report concerns waste management. It describes the progress made to date in reducing GHG emissions from landfill and states that further reducing landfill emissions is the main focus of this sectoral scenario for the future. On page 201, "*incineration with energy recovery*" is listed among the technology options for landfill waste diversion.

6.2.17 Chapter 2 of the sectoral scenarios report concerns decarbonising power generation. Decarbonisation of electricity supply, to 50-100 $gCO_2$/kWh by 2030 from around 450 $gCO_2/kWh$[1], is crucial for many other sectors in achieving the UK carbon budget, including industry. Again, the importance of CCS deployment for fossil-fuelled power generation in the 2020s onwards is emphasised.

6.2.18 The Committee's 2017 and 2018 reports to Parliament identify significant policy gaps for meeting carbon budgets [Refs. 6.10, 6.11]. On page 8 in the 2017 report, the Committee stated that:

> *"New policies are needed across the economy. By 2030, current plans would at best deliver around half of the required reduction in emissions, 100-170 $MtCO_2e$ per year short of what is required by the carbon budgets."*

6.2.19 The 2018 report re-emphasises the call for urgent action, noting that aside from the power sector, national emissions reductions have largely stalled and that the fourth carbon budget will be challenging to meet. It calls for a new national strategy for CCS deployment for power and industry, for uptake of low-carbon heat and energy efficiency measures in industry, and for banning biodegradable waste from landfill by 2025 at the latest.

6.2.20 The Committee's 2019 report supporting the recommendation (now adopted) that the UK sets a net zero target for 2050 [Ref 6.12] indicates that electricity generation will need to be almost fully decarbonised by 2050 and that industry will require greater deployment of CCUS, use of hydrogen, and electrification. With regard to waste management it suggests that no biodegradable waste should be landfilled after 2025 and that recycling rates of 70% should be targeted, further reducing residual waste.

6.2.21 The UK's ratification of the Paris Agreement [Ref. 6.13] will in the advice of the Committee require more ambitious UK carbon emission reductions than had been legislated for in the Climate Change Act 2008, particularly beyond 2050. Pending further changes in emissions reduction pledges by other EU member states, the Committee had not initially recommended that the Fifth Carbon Budget should be altered [Refs. 6.14, 6.15], but this is now likely to change with the recent adoption of the UK's net zero target for 2050 when further carbon budget advice is published.

6.2.22 Concerning the implications of Brexit for UK climate change policy, the Committee notes [Ref. 6.16] that this does not affect the existence of the UK's domestically-legislated climate goals for 2050. In summary, the Committee indicates that domestic policies to achieve the equivalent effects on GHG reductions as lost EU-level policies will be required, and highlights again the existing policy gap for achieving carbon reductions required by the Fifth Carbon Budget.

[1] At the time of that document's production; subsequently the carbon intensity of electricity generation in the UK has further significantly decreased, which is shown in the following sections of this chapter, and further more ambitious reductions will be needed following adoption of the net zero carbon target for the UK.

***Planning Policies***

National Policy Statement for Energy, EN-1

6.2.23 The Overarching National Policy Statement for Energy (EN-1) [Ref. 6.17] states that while "*the UK economy is reliant on fossil fuels, and they are likely to play a significant role for some time to come… the UK needs to wean itself off such a high-carbon energy mix: to reduce greenhouse gas emissions…*" (paragraphs 2.2.5 and 2.2.6).

6.2.24 Of note also is the statement at paragraph 2.2.4 that:

> *"Not all aspects of Government energy and climate change policy will be relevant to IPC decisions or planning decisions by local authorities, and the planning system is only one of a number of vehicles that helps to deliver Government energy and climate change policy. The role of the planning system is to provide a framework which permits the construction of whatever Government – and players in the market responding to rules, incentives or signals from Government – have identified as the types of infrastructure we need in the places where it is acceptable in planning terms."*

6.2.25 The NPS discusses the challenges of balancing security and stability of energy supply with need for low-carbon/renewable generation technologies, and the benefits of a diverse energy supply mix (section 3.6). In paragraph 3.4.3 it notes that the energy produced in EfW facilities from the biomass fraction of residual waste is regarded as renewable.

6.2.26 Section 4.6 of NPS EN-1 supports CHP for thermal generating stations on grounds including the efficiency of displacing conventional fossil-fuelled separate heat and electricity generation (paragraph 4.6.8), with consequent potential for GHG emission reductions. Section 4.7 requires applicants to demonstrate readiness for future use of CCS.

6.2.27 Paragraph 5.2 states that:

> *"$CO_2$ emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided (even with full deployment of CCS technology). However, given the characteristics of these and other technologies, as noted in Part 3 of this NPS, and the range of non-planning policies aimed at decarbonising electricity generation such as EU ETS (see Section 2.2 above), Government has determined that $CO_2$ emissions are not reasons to prohibit the consenting of projects which use these technologies or to impose more restrictions on them in the planning policy framework than are set out in the energy NPSs (e.g. the CCR and, for coal, CCS requirements). Any ES on air emissions will include an assessment of $CO_2$ emissions, but the policies set out in Section 2, including the EU ETS, apply to these emissions. The IPC does not, therefore need to assess individual applications in terms of carbon emissions against carbon budgets and this section does not address $CO_2$ emissions or any Emissions Performance Standard that may apply to plant."*

6.2.28 However, it should be noted that the EU ETS does not apply to waste combustion installations and it does not appear that this would change with the introduction of carbon pricing following Brexit, with paragraph 3.51 of the Budget 2018 [Ref. 6.18] stating that in the event of departure from the EU ETS, a new carbon emissions tax introduced would apply only to installations currently participating in the ETS.

National Planning Policy Framework (NPPF)

6.2.29 With regard to climate change, the core planning principle of the NPPF [Ref. 6.19] is that the planning system should:

> *"…support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure" (paragraph 148).*

6.2.30 Under paragraph 154, applicants for energy development are not required to demonstrate the overall need for low-carbon energy. 'Low-carbon' technologies are defined in the NPPF at page 70 as *"…those that can help reduce emissions (compared to conventional use of fossil fuels)."*

Kent County Council Minerals and Waste Local Plan 2013-30, 2016

6.2.31 The Kent Minerals and Waste Local Plan 2013-30, adopted in July 2016 [Ref. 6.20], states in its spatial vision at paragraph 3.0.2 that it aims to drive waste up the Waste Hierarchy and *"ensure that requirements such as a Low Carbon Economy (LCE) and climate change issues are incorporated into new developments for minerals and waste development in Kent"*. Point 1 of the Spatial Vision (page 32) is for waste developments to *"make a positive and sustainable contribution to the Kent area and assist with progression towards a low carbon economy."*

6.2.32 The Local Plan's second strategic objective, on page 36, is to:

> *"Ensure minerals and waste developments contribute towards the minimisation of, and adaptation to, the effects of climate change. This includes helping to shape places to secure radical reductions in greenhouse gas emissions and supporting the delivery of renewable and low carbon energy and associated infrastructure."*

6.2.33 Policy DM 1: Sustainable Design states that:

> *"Proposals for minerals and waste development will be required to demonstrate that they have been designed to:*
>
> *1. minimise greenhouse gas emissions and other emissions*

*2. minimise energy and water consumption and incorporate measures for water recycling and renewable energy technology and design in new facilities where possible*
*3. maximise the re-use or recycling of materials…"*

6.2.34 The explanatory notes for policy DM 12: Cumulative Impact indicate that climate change should be in the evaluation of significant cumulative effects on the environment (see paragraph 7.10.3).

Swale Borough Council's Development Plan, 2017

6.2.35 Swale Borough Council Local Plan, adopted on 26th July 2017 [Ref. 6.21], states in paragraph 4.1.48 under the subheading of "*Meeting the challenge of climate change, flooding and coastal change*" in section 4 that:

*"Our strategy for climate change is adaptation and mitigation – resilient to future challenges and supportive of new opportunities. Businesses able to increase jobs in low carbon sectors will be encouraged and those making sustainable changes to adapt will be supported. We will also encourage existing homes and businesses to improve their energy and waste efficiencies."*

6.2.36 Paragraph 4.1.50 indicates that:

*"We also need to move beyond adaptation to the impacts of climate change, reducing greenhouse gas emissions where we can. Here, the strategy has three strands:*

*….*

*3. Encouraging the use of renewables and energy efficiency improvements (inc. micro-renewable energy and free-standing projects), identifying the potential for decentralised, renewable or low carbon energy supplies and for co-locating heat customers and suppliers."*

6.2.37 Local Plan Core Objective 1 is to "*adapt to climate change with innovation, reduced use of resources, managed risk to our communities and opportunities for biodiversity to thrive.*"

6.2.38 Policy ST1 item 10 is to:

*"Meet the challenge of climate change, flooding and coastal change through:*

*a. promotion of sustainable design and construction, the expansion of renewable energy, the efficient use of natural resources and the management of emissions;*

*b. the management and expansion of green infrastructure; and*

*c. applying planning policies to manage flood risk and coastal change."*

6.2.39 Policy CP1 states that:

> *"Development proposals will, as appropriate:*
>
> *...*
>
> *Create resilience in existing businesses to forecast changes in flood risk, climate change and natural processes or lead to an expansion of businesses in the low carbon sectors."*

6.2.40 Policy CP4 states that:

> *"Development proposals will, as appropriate:*
>
> *...*
>
> *Maximise opportunities for including sustainable design and construction techniques including the use of recycled and recyclable materials, sustainable drainage systems, carbon reduction and minimising waste."*

6.2.41 Policy DM19 states that:

> *"Development proposals will include measures to address and adapt to climate change in accordance with national planning policy and guidance and, where appropriate, will incorporate the following:*
>
> *a. Use of materials and construction techniques which increase energy efficiency and thermal performance, and reduce carbon emissions in new development over the long term unless considerations in respect of the conservation of heritage assets indicate otherwise;*
>
> *b. Promotion of waste reduction, re-use, recycling and composting, where appropriate, during both construction and the lifetime of the development;*
>
> *c. Recognition that retaining and upgrading existing structures may be more sustainable than building new whilst making the most of opportunities to improve water and energy efficiency in the existing stock;*
>
> *...*
>
> *2. Development proposals should, where appropriate, be located, oriented and designed to take advantage of opportunities for decentralised, low and zero carbon energy, including passive solar design, and, connect to existing or planned decentralised heat and/or power schemes.*
>
> *..."*

6.2.42 And Policy DM20 is that "*planning permission will be granted for the development of renewable and low carbon energy sources*" subject to the development being judged acceptable through a number of environmental, planning and social criteria listed in that policy.

## 6.3 Methodology

### *Scoping and Consultation*

6.3.1 The proposed scope and approach to this assessment were set out in sections 6.3 and 7.3 of the Scoping Report submitted as part of the formal Scoping Opinion request to the Planning Inspectorate (PINS) (Appendix 3.1). Further details of the formal scoping undertaken with PINS and consultees, including copies of the Scoping Report and Scoping Opinion, are given in Chapter 3 and its appendices.

6.3.2 On pages 19-20 (Section 4.3) of the Scoping Opinion, PINS provides comments on the proposed scope of assessment with regard to (a) climate change risks/vulnerability, adaptation and resilience and (b) greenhouse gas emissions for the K3 and WKN Proposed Developments.

6.3.3 Subsequent advice from PINS in June 2019, explained in Section 3.2 of Chapter 3, has led to the DCO application seeking permission for construction and operation of K3 as a whole (the "K3 Proposed Development", i.e. a 75 MW[2] generating station with total annual waste throughput of 657,000 tpa). The scope of assessment for the EIA has been extended where applicable to include assessment of the construction, operation and decommissioning effects of the K3 Proposed Development. However, the practical effect of the K3 Proposed Development remains an increase of generating capacity by 25 MW[2] and throughput by 107,000 tpa beyond K3 as consented (see Chapter 2 for further details). This is reflected in the K3 sub-sections of the assessment section of this ES chapter, and the Scoping Opinion responses have been interpreted with regard to both the K3 Proposed Development and the practical effect of the K3 Proposed Development.

<u>GHG emissions</u>

6.3.4 In the PINS Scoping Opinion, response ID 4.3.1 agrees that assessment of GHG emissions during construction can be scoped out for the K3 Proposed Development. Responses 4.3.1, 4.3.3 and 4.3.4 indicate that GHG emissions during construction of the WKN Proposed Development, operation and, where likely to be significant, decommissioning of the K3 and WKN Proposed Developments should be scoped in to the assessment. The impacts of GHG emissions are reported in this chapter.

<u>Climate change risks/vulnerability, adaptation and resilience</u>

6.3.5 Response ID 4.3.5 agrees that vulnerability to climate change can be scoped out of the assessment for the WKN Proposed Development save in respect of flood risk, which is assessed in Chapter: 10 Water Environment, and vulnerability of habitats to effects from nitrogen deposition. As set out in Chapter: 11 Ecology, climate change is not considered to significantly affect the vulnerability of habitats.

6.3.6 Response ID 4.3.2 indicates that climate change risks, adaptation and resilience for the K3 Proposed Development should be scoped out of the construction

[2] these are notional maximum generation figures; the actual change in electrical export used in the WRATE assessment, based on K3 design data, is a 23.1 MW increase from 38.7 MW to 61.8 MW; see paragraph 6.7.5 in this chapter.

assessment but scoped in for operation and, where likely to be significant, decommissioning. This response is difficult to interpret, as it is the opposite position to that taken for the neighbouring WKN Proposed Development[3]. It is unclear how the effect of the K3 Proposed Development application could lead to any greater likelihood of significant climate risks during operation or decommissioning than the WKN Proposed Development, particularly given that the design of the K3 Proposed Development is already consented and the practical effect of the K3 Proposed Development application involves no physical changes to the facility (which is already largely constructed and expected to be ready for operation by the end of 2019).

6.3.7 Given this, response ID 4.3.5 has been interpreted as applying to both the WKN and K3 Proposed Developments and assessment of climate change risks, adaptation and resilience is scoped out of the assessment.

6.3.8 Natural England has commented in paragraph 5 of Annex A of its consultation response to the Scoping Report that "*the ES should… identify how the development's effects on the natural environment will be influenced by climate change…*", in the context of the principles for consideration of climate change effects on biodiversity set out in the England Biodiversity Strategy. Chapter: 11 Ecology has addressed this point.

6.3.9 PINS and several statutory consultees have commented on climate change in the context of flood risk and coastal change. This is assessed in Chapter: 10 Water Environment.

***Greenhouse Gas Emission Calculations – Overview***

6.3.10 In overview, GHG emissions have been estimated on a life-cycle basis using the waste sector software tool Waste and Resources Assessment Tool for the Environment (WRATE), originally developed for the Environment Agency and now maintained by Golder Associates. This tool allows a comparison of GHG emissions from different waste management scenarios, including models of the operation of energy-from-waste (EfW) facilities (which can be customised with facility-specific parameters such as generation efficiency) and of waste decomposition in landfill.

6.3.11 In addition to $CO_2$ emissions, WRATE reports the emission of other relevant greenhouse gases expressed as $CO_2$-equivalent based on 100-year global warming potential (GWP). This is denoted by $CO_2e$ units in emissions factors and calculation results.

6.3.12 Mixed waste typically contains both 'biogenic' and 'fossil' carbon, both of which are released as $CO_2$ when the waste is incinerated. Biogenic carbon is that in plant-derived material (such as food waste) whereas fossil carbon is that in material derived from fossil fuels, such as plastics. Only fossil carbon is regarded as causing a net increase in atmospheric $CO_2$ concentration, having been released from long-term geological storage. Biogenic carbon was drawn down from the atmosphere by the plants during growth prior to being released again by

[3] It is noted that the 'Inspectorate's comments' column text of response ID 4.3.2 is identical to response ID 4.3.1 on the row above, which concerns GHG emissions rather than climate risks; one possible interpretation is that response ID 4.3.2 has resulted from an unintended duplication of table rows.

combustion, so over this short cycle does not change the net atmospheric concentration.

6.3.13 Full details of the emissions calculation with data inputs, assumptions and results, are given in the WRATE reports for the practical effect of the K3 Proposed Development and the WKN Proposed Development at Appendix 6.1 and Appendix 6.2 respectively. Appendix 6.3 provides an addendum to Appendix 6.1, calculating total GHG emissions for the K3 Proposed Development.

***Establishing Baseline Conditions***

6.3.14 The baseline conditions are the business-as-usual scenario for waste management and energy generation that would have occurred in the absence of either the WKN Proposed Development or the K3 Proposed Development (including the practical effect).

6.3.15 The Waste Hierarchy and Fuel Availability Report (application document number 4.6) shows that the current management route for residual waste that would be managed by the K3 and WKN Proposed Developments is either landfill disposal or export as RDF to continental Europe. Landfill has formed the primary baseline scenario in the WRATE assessment. Transport of waste to landfill, the greenhouses gases generated by waste decomposition and the partial capture of gas and use for electricity generation at the landfill are modelled.

6.3.16 As a sensitivity test for the WKN Proposed Development, the WRATE assessment also considers a scenario in which waste were exported to Europe for combustion in a combined heat and power (CHP) EfW facility, as is common for refuse-derived fuel (RDF) produced from residual waste at present (pre-Brexit). Shipping of waste, combustion in the EfW facility, treatment and recovery of residues (fly ash, bottom ash and metals) and the effects of heat and power export are modelled.

6.3.17 The baseline for operation of the K3 Proposed Development for the 'practical effect' assessment is its currently consented design, i.e. its waste throughput capacity and energy generation efficiency, which has been established from design information supporting its current planning permission.

6.3.18 The baseline for electricity generation that would be displaced by electricity exported by either facility is assumed in WRATE to be 0.349 $tCO_2e$/MWh (representative of a combined cycle gas turbine [CCGT] power station). The marginal source will change over time, and so for future years in the main scenario, the BEIS projections of the carbon intensity of long-run marginal electricity generation [Ref. 6.22] have also been considered in this chapter.

6.3.19 For the K3 Proposed Development, an emissions factor representative of gas-fired heating is used by WRATE for heat generation displaced by heat supplied by K3 in CHP operation. No baseline scenario for heat generation is required for the K3 Proposed Development 'practical effect' assessment, as the resultant modifications would not change its design heat export.

6.3.20 The WKN Proposed Development would not export heat, so there is no displaced baseline heat generation to assess in the main WRATE scenario. In the sensitivity test alternative baseline scenario of waste export to a European CHP (see paragraphs 6.3.16 and 6.3.35), again an emissions factor representative of gas-fired heating is used by WRATE for heat generation displaced by the European CHP plant in that scenario.

### *Significance Criteria*

6.3.21 The magnitude of impact on climate change has been quantified as mass of GHG emissions expressed as $tCO_2e$ per annum in each case for the K3 Proposed Development and for the WKN Proposed Development.

6.3.22 GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in $CO_2$-equivalents, has therefore been treated as a single receptor of high sensitivity (given the severe consequences of global climate change). This sensitivity takes into consideration the cumulative effect of all other sources of GHG emissions that contribute to the atmospheric concentration.

6.3.23 Assessment guidance for GHG emissions [Ref. 6.23] indicates that in principle, any GHG emissions may be considered to be significant, and advocates as good practice that GHG emissions should always be reported at an appropriate, proportionate level of detail in an ES. There are however no clear, generally-agreed thresholds or methods for evaluating the significance of GHG effects in EIA, with the guidance suggesting that several possible approaches could be taken.

6.3.24 For this assessment, the total GHG emissions from the operation of the K3 Proposed Development and the WKN Proposed Development have been compared to the baseline in each case in order to evaluate the net change in GHG impact[4].

6.3.25 Effects from GHG emissions are described in this chapter as being adverse, neutral/negligible or beneficial based on whether there is predicted to be an increase, little or no net change, or a decrease compared to the baseline, respectively. Adverse or beneficial effects are considered to be significant, taking into account the IEMA guidance and the high sensitivity of the receptor. Neutral/negligible effects are not considered to be significant. It is not considered possible to further differentiate degrees of significance (e.g. slight or major).

### *Assessment of Effects*

<u>Construction</u>

6.3.26 WRATE takes a lifecycle assessment approach to GHG emissions, which includes accounting for emissions associated with materials consumption (embodied carbon) and activity during the construction phase. This is based on a database of representative information for energy-from-waste facilities. The construction-

[4] following the IEMA assessment principles guidance, which states that *"…all net GHG emissions contribute to a significant negative environmental effect; however, some projects will replace existing development* [sic] *that have higher GHG profiles. The significance of a project's emissions should therefore be based on its net GHG impact, which may be positive or negative."* [Ref. 6.24]

stage emissions are then amortised over the operating lifetime of the facility in the WRATE scenario and reported as part of the total annual emissions.

Operation

6.3.27 Direct GHG emissions from operation of the K3 and WKN Proposed Developments are calculated in WRATE based on a model of EfW operation using typical EfW process data that is adjusted with development-specific information such as waste composition, calorific value and energy generation efficiency.

6.3.28 The main emissions sources assessed include:

- direct combustion emissions;
- other process inputs (consumables, parasitic load);
- nitrous oxide emissions from ammonia slip in the air pollution control system;
- management of process outputs (disposal to landfill, re-use or recycling as applicable for bottom ash, fly ash and metals); and
- transport of waste and outputs.

6.3.29 The WRATE assessment assumes 100% uptime, i.e. 8,760 hours of operation per year.

6.3.30 For the K3 Proposed Development, the WRATE analysis has assessed the full 657,000 tpa throughput and 75 MW[2] generating capacity.

6.3.31 For the practical effect of the K3 Proposed Development, an increase in waste throughput of 130,000 tonnes per annum (tpa) has been assessed in the WRATE analysis. This is based on design-point data for the consented K3, with 527,000 tpa throughput, increasing to 657,000 tpa throughput with the K3 Proposed Development. K3's consented throughput is slightly higher at 550,000 tpa, from which the increase to 657,000 tpa would only be 107,000 tpa. However, the 130,000 tpa increase from the K3 design-point throughput rather than consented throughput is considered a more realistic scenario for assessment in the WRATE analysis.

6.3.32 The operational emissions are compared with the applicable baseline scenarios for waste management and energy generation, discussed above, to calculate the net operational emissions total.

Decommissioning

6.3.33 Similarly to construction-stage emissions, decommissioning stage emissions are estimated in WRATE on a lifecycle basis and amortised over the operating lifetime of the facility in the WRATE scenario to be reported as part of the total annual emissions.

### *Limitations and Assumptions*

6.3.34 The main uncertainties and assumptions concern the baseline scenario to which the K3 and WKN Proposed Developments are compared in order to predict their net impacts. There is a wide variety of options for waste management, which are suited to different waste streams and have varying levels of deployment; however, all leave some fraction of residual waste (from a typical composition) requiring treatment and recovery or disposal. The future baseline scenario for waste management may also be affected by changes in national waste policy.

6.3.35 Although various waste management options exist, a significant fraction of residual waste is still landfilled in the UK or exported as RDF. The national policy drivers to divert waste from landfill to alternatives such as the recovery operations of both the K3 and WKN Proposed Developments are expected to continue, and Brexit could also affect RDF exports [Ref. 6.25]. Both the K3 and WKN Proposed Developments would treat residual waste and the Waste Hierarchy and Fuel Availability Report (application document number 4.6) shows that it is most likely that this waste would otherwise be landfilled or exported to continental Europe as RDF.

6.3.36 The landfill baseline is sensitive to assumptions about landfill management, specifically the ratio of $CH_4$ to $CO_2$, the gas capture rate, utilisation for energy generation, oxidisation of fugitive gas passing through the capping layer, the percentage of decomposable carbon in the waste composition, its decay rate, and sequestration of biogenic carbon. Default assumptions for these factors are used in the GasSim module in WRATE but sequestration of biogenic carbon is excluded.

6.3.37 As sensitivity tests, the WRATE assessment has also considered the following assumptions:

- an alternative indicative baseline scenario for the WKN Proposed Development of waste export to a European EfW CHP facility with a modest combined net efficiency of 34.4%;
- either 45% or 53% biogenic content in the waste composition for the WKN Proposed Development; and
- either 9.5 MJ/kg or 10.5 MJ/kg net calorific value (NCV) of the waste for the K3 Proposed Development.

6.3.38 There is uncertainty about future climate and energy policy and market responses, which affects the likely future carbon intensity of energy supplies. Government projections consistent with current national carbon budget commitments have been considered in addition to the default marginal carbon intensity factor in WRATE.

6.3.39 The calculated emissions performance of the K3 and WKN Proposed Developments is sensitive to the expected waste composition, calorific value, biogenic content and rate of metals recovery from bottom ash. Best estimates drawing from the facility design data, the Applicant's experience operating other EfW facilities and representative data in WRATE have been applied for these parameters.

## 6.4 Baseline Conditions

6.4.1 Table 6.1 shows the baseline GHG emissions from landfill disposal of waste and, as a sensitivity test, from treatment in a hypothetical European EfW CHP facility.

6.4.2 Table 6.2 shows the current baseline GHG emissions from energy generation. There would be no change in heat exported due to the K3 Proposed Development practical effect (compared to its consented operation) and no heat export from the WKN Proposed Development, so heat export is not shown in those cases. All figures are given per annum.

| Proposed development | Waste amount (t) | Net baseline GHG emissions – landfill ($tCO_2e$) | Net baseline GHG emissions – CHP EfW ($tCO_2e$) |
|---|---|---|---|
| K3 Proposed Development | 657,000 | 196,944 | n/a |
| K3 Proposed Development (practical effect) | 130,000 | 38,969 | n/a |
| WKN Proposed Development | 390,000 | 116,611 | 39,708 |

Table 6.1: Baseline GHG emissions from baseline waste management

| Proposed development | Energy exported (MWh) | Baseline GHG emissions ($tCO_2e$) |
|---|---|---|
| K3 Proposed Development | 541,667 (electricity) | 189,042 |
| | 397,222 (heat) | 100,250 |
| K3 Proposed Development (practical effect) | 202,989 (electricity) | 70,843 |
| WKN Proposed Development | 311,111 (electricity) | 108,578 |

Table 6.2: Baseline GHG emissions from baseline energy generation

### *Sensitive Receptors*

6.4.3 The sensitive receptor(s) listed in Table 6.3, below, have the potential to be affected by the K3 and WKN Proposed Developments. The assessment in this chapter has considered the effects listed in the table upon the identified sensitive receptor(s).

| Receptor | Importance/sensitivity/vulnerability to change |
|---|---|
| Global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in $CO_2$-equivalents | High |

Table 6.3: Potentially affected sensitive receptors

## 6.5 Future baseline

6.5.1 The current baseline for waste management (see Section 6.4) is assumed to be representative of the future baseline.

6.5.2 Table 6.4 shows projections of the future baseline carbon intensity of marginal electricity generation over 50 years from 2021 and 2024, the design lifetimes of the K3 and WKN Proposed Developments respectively specified by the Applicant.

| Year | | Carbon intensity ($tCO_2e/MWh$) |
|---|---|---|
| 1 | 2021 | 0.2582 |
| 5 | 2025 | 0.2045 |
| 10 | 2030 | 0.1184 |
| 15 | 2035 | 0.0761 |
| 20 | 2040 | 0.0489 |
| 25 | 2045 | 0.0371 |
| 30 | 2050 | 0.0252 |
| 31-50 | 2051 onwards | 0.0252 |
| Source: BEIS, 2018 [Ref. 6.22] | | |

Table 6.4: Projected carbon intensity of marginal electricity generation (future baseline)

## 6.6 The K3 Proposed Development Predicted Effects

### *Explanatory Note*

6.6.1 This assessment is of the K3 Proposed Development as a whole, i.e. the full waste throughput and generation capacity. Further details are provided in Section 2.8 of Chapter 2.

### *Construction Effects*

6.6.2 The K3 facility is already well advanced in construction, due for completion in 2019. Nevertheless, construction effects have been assessed. The WRATE analysis addendum reported in Appendix 6.3 indicates that the GHG emissions associated with construction of a typical facility of this capacity, taking into account the embodied carbon in materials used and on-site use of construction plant and energy consumption, is approximately 63 $ktCO_2e$.

6.6.3 Amortised over the expected 30-year operating lifetime of the K3 Proposed Development, this would be a very minor contribution to lifecycle impacts of the facility as a whole, equivalent to <1% of process emissions and substantially outweighed by the beneficial effect predicted due to GHG emission reductions caused by the completed development (see following section).

6.6.4 Construction stage effects (which have largely already been incurred) are therefore considered **negligible** to the overall GHG emission effects of the K3 Proposed development and not significant.

### *Completed Development Effects*

6.6.5 The WRATE analysis reported in Appendix 6.1 read together with the addendum reported in Appendix 6.3 indicates that the K3 Proposed Development as a whole would provide a net carbon benefit (emissions reduction) of approximately -232.1 $ktCO_2e$/annum compared to the baseline of landfill disposal of the 657,000 tpa of waste and baseline heat and electricity generation.

6.6.6 The direct process emissions from waste combustion and transport would be approximately +255 kt$CO_2$e/annum[5,6] while the electricity exported would displace approximately -189 kt$CO_2$e/annum and the heat exported would displace approximately -100 kt$CO_2$e/annum. The net total avoided landfill burden would be approximately -197 kt$CO_2$e/annum[7].

6.6.7 As a sensitivity test, the WRATE analysis has also considered a scenario with a higher waste NCV of 10.5 MJ/kg while adjusting the assumed composition to keep the 45% biogenic content constant, which is consistent with the main scenario assumption for the WKN Proposed Development. In that scenario, the net benefit of the K3 Proposed Development as a whole would increase to -244.2 kt$CO_2$e/annum due to the greater amount of electricity generated and exported from the higher-CV waste.

6.6.8 Sequestration of the potential fraction of biogenic carbon not decaying in landfill is not a parameter that forms part of the net baseline emissions in the WRATE analysis, as this has fairly high uncertainty. Significant sequestration of biogenic carbon in the landfill baseline would decrease the baseline landfill GHG emissions and hence decrease the net GHG emissions reduction attributable to the K3 Proposed Development from avoided landfill. However, in another area of uncertainty for the baseline, the lifetime landfill gas capture rate, WRATE makes a relatively optimistic assumption of 75%. A lower gas capture rate in practice would lead to higher GHG emissions in the landfill baseline, increasing the net GHG emissions reduction attributable to the K3 Proposed Development. To a degree these two points may balance out, though this cannot be stated definitively either way as the precise parameters of waste decay in landfill and management of this over a lengthy gas-generating lifetime are difficult to predict for a hypothetical baseline scenario.

6.6.9 The carbon intensity of marginal electricity generation sources displaced is projected to decrease over time in the future baseline, as discussed in Section 6.5. This would reduce the benefit of the additional electricity exported by the K3 Proposed Development. However, even under BEIS projections of very little carbon saved by displacing a marginal generator towards the end of the K3 Proposed Development's lifetime, the combination of avoided landfill emissions, electricity and heat export would continue to more than balance the combustion emissions.

6.6.10 In summary, considering the magnitude of GHG emission reductions predicted in the WRATE analysis due to the K3 Proposed Development, and the policy support for CHP and diversion of waste from landfill, the K3 Proposed Development is considered to have a **beneficial effect** that is significant, applying the definition in paragraph 6.3.25.

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[5] other factors modelled such as the consumption of process consumables (other than the waste fuel) and management of the bottom ash (including metals recycling) make relatively small positive and negative contributions to the emissions that tend to roughly balance out. The overall net process emissions total is 254,173 kt$CO_2$e/annum.
[6] of fossil carbon. Short-cycle biogenic carbon, having a net neutral effect on atmospheric concentration, would be an additional 78,248 kt$CO_2$e/annum.
[7] excluding biogenic carbon sequestration

### *Decommissioning Effects*

6.6.11 The WRATE analysis indicates that decommissioning would make a very minor contribution to lifecycle impacts, equivalent to <0.1% of process emissions, so this is considered negligible and not significant. Furthermore:

- it is possible that foundations and structures for the K3 Proposed Development could be re-used, incurring no additional GHG emissions attributable to it;
- it is likely that much of the K3 Proposed Development's structure and energy generation components have been constructed of steel and other metals with good potential for recycling, in which case the benefits of recycling are attributed to the new material user in BEIS GHG reporting guidance (i.e. not attributed to the K3 Proposed Development); and
- if disposed of and not recycled, the K3 Proposed Development's construction materials are likely to be mainly inert waste (e.g. metals, concrete), not of a nature to generate GHG emissions from decomposition or incineration.

### *Summary of Effects*

| Effect Identified | Receptor Sensitivity | Impact Magnitude | Nature | Duration | Degree of Effect |
|---|---|---|---|---|---|
| **Construction Effects** | | | | | |
| GHG emissions | High | Negligible | Adverse | Short-term | Not significant |
| **Completed Development Effects** | | | | | |
| GHG emissions | High | -232.1 $ktCO_2e$/annum | Beneficial | Long-term | Significant |
| **Decommissioning Effects** | | | | | |
| GHG emissions | High | Negligible | Beneficial or adverse | Short-term | Not significant |

Table 6.5: Summary of Effects Prior to Mitigation

## 6.7 The Predicted Practical Effect of the K3 Proposed Development

### *Explanatory Note*

6.7.1 This assessment represents the practical effect of the K3 Proposed Development application. While the application seeks development consent for the construction and operation of a 75 MW generating station, in reality a 49.9 MW generating station has been constructed and will be operating by end of 2019. Further details are provided in Section 2.8 of Chapter 2.

### *Construction Effects*

6.7.2 No additional construction is required for the practical effect of the K3 Proposed Development and this is scoped out of the assessment.

### *Completed Development Effects*

6.7.3 The WRATE analysis reported in Appendix 6.1 indicates that the K3 Proposed Development practical effect, increasing the energy output of the consented K3 development and also increasing its waste throughput by 130,000 tonnes per annum (tpa), would provide a net carbon benefit (emissions reduction) of approximately -59.5 $ktCO_2e$/annum compared to the baseline of consented K3 operation and landfill disposal of the 130,000 tpa of waste.

6.7.4 The waste throughput and hence thermal input to the facility would increase by 24.7% while the net electricity export efficiency would increase by 28.3% from 24.4% to 31.2% (a 6.9 percentage point rise). Heat export would be unchanged.

6.7.5 Of the total net -59.5 $ktCO_2e$/annum benefit, -21.3 $ktCO_2e$ is from the improvement to the efficiency of the K3 operation, primarily the approximately 60% increase in electricity output from 38.7 MW to 61.8 MW. The avoided burden of landfill disposal contributes -39.0 $ktCO_2e$ while a slight increase in transport accounts for the balance of +0.8 $ktCO_2e$.

6.7.6 As a sensitivity test, the WRATE analysis has also considered a scenario with a higher waste NCV of 10.5 MJ/kg while adjusting the assumed composition to keep the 45% biogenic content constant, which is consistent with the main scenario assumption for the WKN Proposed Development. In that scenario, the net benefit of the K3 Proposed Development practical effect would increase to -63.3 $ktCO_2e$/annum due to the greater amount of electricity generated and exported from the higher-CV waste.

6.7.7 Sequestration of the potential fraction of biogenic carbon not decaying in landfill is not a parameter that forms part of the net baseline emissions in the WRATE analysis, as this has fairly high uncertainty. Significant sequestration of biogenic carbon in the landfill baseline would decrease the baseline landfill GHG emissions and hence decrease the net GHG emissions reduction attributable to the K3 Proposed Development from avoided landfill. However, in another area of uncertainty for the baseline, the lifetime landfill gas capture rate, WRATE makes a relatively optimistic assumption of 75%. A lower gas capture rate in practice would lead to higher GHG emissions in the landfill baseline, increasing the net GHG emissions reduction attributable to K3. To a degree these two points may balance out, though this cannot be stated definitively either way as the precise parameters of waste decay in landfill and management of this over a lengthy gas-generating lifetime are difficult to predict for a hypothetical baseline scenario.

6.7.8 The carbon intensity of marginal electricity generation sources displaced is projected to decrease over time in the future baseline, as discussed in Section 6.5. This would reduce the benefit of the additional electricity exported by the K3 Proposed Development. However, even under BEIS projections of very little carbon saved by displacing a marginal generator towards the end of the K3 Proposed Development's lifetime, the combination of avoided landfill emissions and electricity export would continue to balance the combustion emissions associated with the additional 130,000 tpa throughput. And K3 as consented, with the practical effect of the K3 Proposed Development, would remain a high-efficiency CHP facility that would offer GHG benefits compared to the future baseline over its operating lifetime, as has been shown in Section 6.6.

6.7.9 In summary, considering the magnitude of GHG emission reductions predicted in the WRATE analysis due to the practical effect of the K3 Proposed Development, and the policy support for CHP and diversion of waste from landfill, it is considered to have a **beneficial effect** that is significant, applying the definition in paragraph 6.3.25.

### *Decommissioning Effects*

6.7.10 The WRATE analysis indicates that decommissioning would make a very minor contribution to lifecycle impacts, equivalent to <0.1% of process emissions, so this is considered negligible and not significant. Furthermore:

- it is possible that foundations and structures for the K3 Proposed Development could be re-used, incurring no additional GHG emissions attributable to it;
- it is likely that much of K3's structure and energy generation components have been constructed of steel and other metals with good potential for recycling, in which case the benefits of recycling are attributed to the new material user in BEIS GHG reporting guidance (i.e. not attributed to K3); and
- if disposed of and not recycled, K3's demolition materials are likely to be mainly inert waste (e.g. metals, concrete), not of a nature to generate GHG emissions from decomposition or incineration.

### *Summary of Effects*

| Effect Identified | Receptor Sensitivity | Impact Magnitude | Nature | Duration | Degree of Effect |
|---|---|---|---|---|---|
| **Construction Effects** | | | | | |
| *Scoped out* | | | | | |
| **Completed Development Effects** | | | | | |
| GHG emissions | High | -59.5 kt$CO_2$e/annum | Beneficial | Long-term | Significant |
| **Decommissioning Effects** | | | | | |
| GHG emissions | High | Negligible | Beneficial or adverse | Short-term | Not significant |

Table 6.6: Summary of Effects Prior to Mitigation

## 6.8 Mitigation

### *Mitigation of Demolition and Construction Effects*

6.8.1 No mitigation recommendations are applicable as the construction for the K3 Proposed Development is already largely completed and no additional construction is required for the practical effect of the K3 Proposed Development.

### *Mitigation of Completed Development Effects*

6.8.2 Carbon capture and storage (CCS), if feasible for the K3 Proposed Development in future, could offer substantial further GHG emissions reductions[8], further mitigating climate change effects of the K3 Proposed Development's direct GHG emissions from that point in its lifetime onwards and making its direct emissions carbon negative due to the sequestration of biogenic carbon. However, the K3 Proposed Development is not required to provide for future CCS readiness in its design, as it falls below the 300 MWe capacity threshold in NPS EN-1 (paragraph 4.7.10).

6.8.3 The K3 Proposed Development will be required under its Environmental Permit to seek continuous improvement in energy efficiency and to provide reports on this to the Environment Agency. The consented K3 facility would already be a high-efficiency CHP facility and the practical effect of the K3 Proposed Development would be to further increase its electrical generation efficiency.

6.8.4 Changes in the composition of waste combusted in the facility to increase the biogenic to fossil carbon ratio, which would be likely if for example the plastic content were reduced in future, would reduce its process emissions and have a beneficial effect provided that the waste CV remained high. This is not within the Applicant's direct control, but maximising residual biogenic content while retaining an appropriate CV could be influenced through waste supplier contracts.

6.8.5 Overall, however, no further mitigation that is within the Applicant's control at the K3 site has been proposed or is considered to be required.

### *Mitigation of Decommissioning Effects*

6.8.6 No significant decommissioning-stage effects have been predicted. Nevertheless, in consideration of IEMA guidance that all GHG emissions are potentially significant, and government policy seeking GHG emissions reductions across all economic sectors including construction/demolition, it is recommended that the Decommissioning Environmental Management Plan when written in due course gives consideration to:

- use of an established methodology, such as PAS2080 [Ref. 6.25] and/or life-cycle analysis to consider whole-life impacts of design, including how this will affect decommissioning;
- maximising opportunities for re-use and recycling of materials at the time of decommissioning; and
- efficiencies in decommissioning that can reduce energy, fuel and transport requirements at the time.

[8] The specific level of GHG emissions reduction would depend on the scale of CCS scheme feasible at this site (if any), its own energy requirements, and the energy/fuel requirements for transport and injection of captured carbon at a disposal point. These factors are not known and cannot be predicted for this assessment, but in general terms the carbon and energy policy referenced in section 6.2 recognises the substantial GHG emissions mitigation that CCS has the potential to provide.

## 6.9 Residual Effects

6.9.1 Residual effects are those that are predicted to remain after implementation of secondary mitigation measures. The significant residual effects in this case are unchanged as no secondary mitigation of operational emissions is proposed or required.

| Significant residual effect | Receptor sensitivity | Impact magnitude | Nature | Duration | Degree of effect | Level of certainty |
|---|---|---|---|---|---|---|
| **K3 Proposed Development** | | | | | | |
| GHG emissions | High | -232.1 kt$CO_2$e/annum | Beneficial | Long-term | Significant | Limited |
| **K3 Proposed Development (practical effect)** | | | | | | |
| GHG emissions | High | -59.5 kt$CO_2$e/annum | Beneficial | Long-term | Significant | Limited |

Table 6.7: Residual Effects

## 6.10 The WKN Proposed Development Predicted Effects

### *Construction Effects*

6.10.1 The WRATE analysis indicates that the embodied carbon of construction materials used would make a very minor contribution to lifecycle impacts, equivalent to <1% of process emissions. Construction stage effects are therefore considered **negligible** to the overall GHG emission effects and not significant.

### *Completed Development Effects*

6.10.2 The WRATE analysis reported in Appendix 6.2 indicates that the WKN Proposed Development, combusting 390,000 tpa of waste to export up to approximately 311,000 MWh/annum of electricity (35.5 MW), would provide a net carbon benefit (emissions reduction) of approximately -63.8 kt$CO_2$e/annum compared to the baseline of landfill disposal of that waste and alternative electricity generation.

6.10.3 Direct process emissions from waste combustion and transport would be approximately +163 kt$CO_2$e/annum[9,10] but this would be offset by the electricity exported, displacing approximately -109 kt$CO_2$e/annum, and by the net total avoided landfill burden of approximately -117 kt$CO_2$e/annum[11].

6.10.4 As a sensitivity test, the WRATE analysis has also considered a scenario with a higher biogenic content of 53% while adjusting the assumed composition to keep the waste NCV of 10.5 MJ/kg constant. In that scenario, the net benefit of the WKN Proposed Development would increase to -98.3 kt$CO_2$e/annum due to the lower fossil carbon emissions from the higher biogenic content waste.

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[9] other factors modelled such as the process consumables (other than the waste fuel) and management of the bottom ash (including metals recycling) make relatively small positive and negative contributions to the emissions that tend to roughly balance out. The overall net process emissions total is 161,583 kt$CO_2$e/annum
[10] of fossil carbon. Short-cycle biogenic carbon, having a net neutral effect on atmospheric concentration, would be an additional 245,120 kt$CO_2$e/annum.
[11] excluding biogenic carbon sequestration

6.10.5 In a further test, an alternative baseline scenario has been considered in the WRATE analysis in which waste were exported to a typical European EfW with CHP instead of being disposed of in landfill. As would be expected, the higher energy generation efficiency of CHP means that the electricity-only WKN Proposed Development would not achieve carbon savings compared to that baseline, notwithstanding the greater transport-related GHG emissions from waste export.

6.10.6 Sequestration of the potential fraction of biogenic carbon not decaying in landfill is not a parameter that forms part of the net baseline emissions in the WRATE analysis, as this has fairly high uncertainty. Significant sequestration of biogenic carbon in the landfill baseline would decrease the baseline landfill GHG emissions and hence decrease the net GHG emissions reduction attributable to the WKN Proposed Development from avoided landfill. However, in another area of uncertainty for the baseline, the lifetime landfill gas capture rate, WRATE makes a relatively optimistic assumption of 75%. A lower gas capture rate in practice would lead to higher GHG emissions in the landfill baseline, increasing the net GHG emissions reduction attributable to the WKN Proposed Development. To a degree these two points may balance out, though this cannot be stated definitively either way as the precise parameters of waste decay in landfill and management of this over a lengthy gas-generating lifetime are difficult to predict for a hypothetical baseline scenario.

6.10.7 The carbon intensity of marginal electricity generation sources displaced is projected to decrease over time in the future baseline, as discussed in Section 6.5. This would reduce the benefit of the additional electricity exported by the WKN Proposed Development. Under BEIS projections the ‘crossover point’ at which the WKN Proposed Development would no longer be predicted to provide a carbon reduction compared to the baseline (on an annual emissions basis) would be around 2034, 10 years into its 50 year design operating lifetime. In the alternative scenario with higher biogenic carbon content in the waste composition, however, this would not occur and GHG emission reductions compared to landfill and alternative electricity generation throughout the Proposed Development lifetime would continue to be predicted. This illustrates the high sensitivity of the assessment to assumed waste composition and biogenic carbon content.

6.10.8 In summary, considering the magnitude of GHG emission reductions predicted in the WRATE analysis due to the WKN Proposed Development and the policy support for diversion of waste from landfill, the Proposed Development is considered to have a **beneficial effect** that is significant, applying the definition in paragraph 6.3.25.

***Decommissioning Effects***

6.10.9 The WRATE analysis indicates that decommissioning would make a very minor contribution to lifecycle impacts, equivalent to <0.1% of annual process emissions, so this is considered negligible and not significant. The points made in paragraph 6.7.10 for the K3 Proposed Development are also applicable to the WKN Proposed Development.

### *Summary of Effects*

| Effect Identified | Receptor Sensitivity | Impact Magnitude | Nature | Duration | Degree of Effect |
|---|---|---|---|---|---|
| **Construction Effects** | | | | | |
| GHG emissions | High | Negligible | Adverse | Short-term | Not significant |
| **Completed Development Effects** | | | | | |
| GHG emissions | High | -63.8 kt$CO_2$e/annum | Beneficial | Long-term | Significant |
| **Decommissioning Effects** | | | | | |
| GHG emissions | High | Negligible | Beneficial or adverse | Short-term | Not significant |

Table 6.8: Summary of Effects Prior to Mitigation

## 6.11 Mitigation

### *Mitigation of Construction Effects*

6.11.1 Construction-stage effects are not predicted to be material to the total life-cycle effect of the WKN Proposed Development. Nevertheless, in consideration of IEMA guidance that all GHG emissions are potentially significant, and government policy seeking GHG emissions reductions across all economic sectors including construction, in general terms it is recommended that the Applicant considers implementing the following additional mitigation measures during detailed design:

- seek a reduction in total materials required and hence embodied carbon through lean/efficient design;
- specify materials with low embodied carbon (e.g. based on data in the BRE Green Guide to Specification [Ref. 6.26] or product EPDs);
- source materials locally where possible to reduce transport GHG emissions; and
- consider use of an established methodology, such as BREEAM New Infrastructure [Ref. 6.27], PAS2080 [Ref. 6.28] and/or life-cycle analysis to guide low-carbon design and construction, set a feasible reduction target and quantify its achievement.

6.11.2 Mitigation measures recommended in Section 5.11 of Chapter 5: Air Quality for inclusion in the CEMP to reduce air pollutant emissions during construction will also offer mitigation of GHG emissions from construction plant and waste.

### *Mitigation of Completed Development Effects*

6.11.3 CCS, if feasible for the WKN Proposed Development in future, could offer substantial further GHG emissions reductions[12], further mitigating climate change effects of the WKN Proposed Development's direct GHG emissions from that point in its lifetime onwards and making its direct emissions carbon negative due to the sequestration of biogenic carbon. However, the WKN Proposed Development is not required to provide for future CCS readiness in its design, as it falls below the 300 MWe capacity threshold in NPS EN-1 (paragraph 4.7.10).

6.11.4 Changes in the composition of waste combusted in the WKN Proposed Development to increase the biogenic to fossil carbon ratio, which would be likely if for example the plastic content were reduced in future, would reduce its process emissions and have a beneficial effect provided that the waste CV remained high. This is not within the Applicant's direct control, but maximising residual biogenic content while retaining an appropriate CV could be influenced through waste supplier contracts. Paragraphs 6.10.4 and 6.10.7 highlight the benefits that this could provide.

6.11.5 The WKN Proposed Development is designed to be CHP-ready and also has potential to act as a standby for the K3 CHP facility when that is undergoing maintenance. Future CHP opportunities for the WKN Proposed Development would have the potential to significantly increase its energy efficiency, providing greater carbon reductions due to displaced heat generation and ameliorating the decline in carbon reductions afforded by electricity export over time as the future baseline for this decarbonises. This would be similar to the case for the K3 Proposed Development, discussed in paragraph 6.7.7. CHP opportunities aside, the WKN Proposed Development will have a general duty under its Environmental Permit to seek continuous improvement in energy efficiency and to provide reports on this to the Environment Agency.

6.11.6 Overall, however, given the GHG emission benefits that the WKN Proposed Development is predicted to offer during its initial years of operation, no further mitigation that is within the Applicant's control at the development site has been proposed or is considered to be required at this stage.

### *Mitigation of Decommissioning Effects*

6.11.7 No significant decommissioning-stage effects have been predicted. Nevertheless, the recommended considerations for the K3 Proposed Development specified in paragraph 6.8.6 apply equally to the WKN Proposed Development.

## 6.12 Residual Effects

6.12.1 Residual effects are those that are predicted to remain after implementation of secondary mitigation measures. The significant residual effects in this case are unchanged as no secondary mitigation of operational emissions is proposed or required.

[12] As with the K3 Proposed Development, the specific level of GHG emissions reduction would depend on the details of a feasible CCS scheme: see footnote 8.

| Significant residual effect | Receptor sensitivity | Impact magnitude | Nature | Duration | Degree of effect | Level of certainty |
|---|---|---|---|---|---|---|
| GHG emissions | High | -63.8 kt$CO_2$e/annum | Beneficial | Long-term | Significant | Limited |

Table 6.9: Residual Effects

## 6.13 Cumulative Effects

6.13.1 The sensitive receptor affected by the effects of both the K3 and WKN Proposed Developments is the '*global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in $CO_2$-equivalents*' and its 'high' sensitivity has been defined taking into consideration the cumulative effects of all anthropogenic GHG emissions.

6.13.2 The atmospheric concentration of GHGs and resulting climate change is affected by all sources and sinks globally, anthropogenic and otherwise. As GHG impacts are global rather than affecting one localised area, all cumulative sources are relevant: this is taken into account in the defined 'high' sensitivity of the receptor to impacts from any development.

6.13.3 With regard to the interactions of the K3 or WKN Proposed Developments with other GHG emission sources affected (i.e. other waste treatment and energy generation), this has formed part of the assessment and the net change in emissions has been reported above.

6.13.4 Cumulative effects from other specific individual developments are therefore not separately assessed. No additional cumulative effects of greater significance than reported above, due to other specific local development projects or the combination of the K3 and WKN Proposed Developments, are predicted.

## 6.14 Summary

6.14.1 The likely significant effects of greenhouse gas (GHG) emissions from the K3 and WKN Proposed Developments have been assessed in this Environmental Statement chapter. The global atmospheric mass of relevant GHGs and consequent warming potential, expressed in $CO_2$-equivalents, has been considered as a high sensitivity receptor affected by each of the K3 and WKN Proposed Developments.

6.14.2 Net total GHG emissions from operation of the K3 and WKN Proposed Developments have been calculated based on their waste throughput, combustion processes and treatment of residues. These emissions have been compared to baseline GHG emissions from landfill disposal of waste and from conventional electricity and heat generation.

6.14.3 Construction– and decommissioning–stage impacts have also been evaluated and are considered not to be material to the total GHG emissions over the K3 and WKN Proposed Developments' lifetimes, which are dominated by the combustion of waste and generation of energy. The K3 Proposed Development is in any case already largely constructed.

6.14.4 The significance of the impacts of net GHG emissions from the K3 and WKN Proposed Developments has been evaluated with regard to change from the baseline and in the context of climate change and waste policy.

6.14.5 All calculations of GHG emissions have been undertaken with the waste sector life-cycle analysis software tool 'WRATE'. The WRATE calculations are reported in Appendices 6.1, 6.2 and 6.3.

6.14.6 Key uncertainties and limitations to the assessment concern the estimate of GHG emissions from landfill in the baseline scenario, the carbon intensity of marginal electricity generation in the baseline that is displaced, and the characteristics of the waste managed (its biogenic to fossil carbon ratio and its energy content), which affect both the baseline and the K3 and WKN Proposed Development scenarios.

6.14.7 The K3 Proposed Development is predicted by the WRATE analysis to cause total emissions of approximately 255 thousand tonnes of fossil carbon-dioxide equivalent ($ktCO_2e$) per year of operation. However, compared to the baseline of landfill waste disposal and electricity generation that it would avoid, the net effect of the K3 Proposed Development as a whole is predicted to be a reduction in GHG emissions of 232 $ktCO_2e$/annum, which would be a beneficial effect that is considered significant.

6.14.8 The practical effect of the K3 Proposed Development, increasing the energy output of the consented K3 development and also increasing its waste throughput by 130,000 tonnes per annum, is predicted by the WRATE analysis to cause a net total GHG emissions reduction of approximately 60 $ktCO_2e$ per year of operation. This is the balance of process emissions from waste combustion, transport and facility operation compared to the baseline of landfill waste disposal and electricity generation that it would avoid. The predicted 60 $ktCO_2e$ per annum net GHG emission reduction would be a beneficial effect that is considered significant.

6.14.9 Although unavoidable uncertainties in the estimation of baseline waste management and displaced electricity generation emissions limit the precision and certainty with which the net benefits of the K3 Proposed Development practical effect (increases to the consented K3 facility waste throughput and electricity generation) can be predicted, the K3 Proposed Development as a whole can be said with higher confidence to perform well in GHG emission terms due to its efficiency as a combined heat and power (CHP) facility.

6.14.10 The WKN Proposed Development is predicted by the WRATE analysis to cause a total of approximately 163 $ktCO_2e$ per year of operation.

6.14.11 However, compared to the baseline of landfill waste disposal and electricity generation that it would avoid, the net effect of the WKN Proposed Development is predicted by WRATE be a GHG emissions reduction of approximately 64 $ktCO_2e$ per annum. The predicted 64 $ktCO_2e$ per annum net GHG emission reduction would be a beneficial effect of the WKN Proposed Development that is considered significant.

6.14.12 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.

6.14.13 In the case of both the K3 and WKN Proposed Developments, potential further mitigation measures have been considered, but no additional mitigation for the operational phase that is within the Applicant's control at the development site has been proposed or is considered to be required.

6.14.14 Notwithstanding the limited materiality of construction- and decommissioning-stage emissions to the total, good-practice measures to reduce GHG emissions have been recommended for the WKN Proposed Development, consistent with IEMA guidance that any GHG emissions (and hence opportunities for reductions) may be significant.

6.14.15 As GHG impacts are global, all cumulative sources are relevant: this is taken into account in the defined 'high' sensitivity of the receptor and statement that any additional GHG emissions may be considered significant. Additional cumulative effects of greater significance than reported above, due to other specific local development projects or the combination of the K3 and WKN Proposed Developments, are therefore not predicted.

# References

6.1 *Climate Change Act 2008 (c. 27)* as amended by *The Climate Change Act 2008 (2050 Target Amendment) Order 2019* [SI 2019 No. 1056].

6.2 HM Government (2011): *The Carbon Plan: Delivering our low carbon future*, London: Department of Energy and Climate Change.

6.3 National Audit Office (NAO) (2017): *Report by the Comptroller and Auditor General. Carbon Capture and Storage: the second competition for givernment support. (HC 950)*, London: HMSO.

6.4 HM Government (2018): *Clean Growth. The UK Carbon Capture, Usage and Storage deployment pathway: An Action Plan*, London: Department for Business, Energy & Industrial Strategy.

6.5 Department for Environment, Food & Rural Affairs (Defra) (2013): *Waste Management Plan for England.* London: HMSO.

6.6 Department for Business, Energy & Industrial Strategy (BEIS) (2017): *The Clean Growth Strategy. Leading the way to a low carbon future*, London: HMSO.

6.7 National Infrastructure Commission (NIC) (2018): *National Infrastructure Assessment*, [online] available at: https://www.nic.org.uk/wp-content/uploads/CCS001_CCS0618917350-001_NIC-NIA_Accessible.pdf [Accessed 26 November 2018].

6.8 Committee on Climate Change (2015): *The Fifth Carbon Budget. The next step towards a low-carbon economy*, London: Committee on Climate Change.

6.9 Committee on Climate Change (2015): *Sectoral scenarios for the Fifth Carbon Budget. Technical report*, London: Committee on Climate Change.

6.10 Committee on Climate Change (2017): *Meeting Carbon Budgets: Closing the policy gap. 2017 Report to Parliament*, London: Committee on Climate Change.

6.11 Committee on Climate Change (2018): *Reducing UK emissions. 2018 Progress Report to Parliament*, London: Committee on Climate Change.

6.12 Committee on Climate Change (2019): *Net Zero. The UK's contribution to stopping global warming*, London: Committee on Climate Change.

6.13 FCCC/CP/2015/L.9/Rev.1: *Adoption of the Paris Agreement*, Geneva: United Nations Framework Convention on Climate Change (UNFCCC).

6.14 Committee on Climate Change (2016): *Letter to the Right Honourable Amber Rudd, MP, Secretary of State for Energy and Climate Change, 28 January 2016. Implications of the Paris Agreement for the fifth carbon budget*, London: Committee on Climate Change.

6.15 Committee on Climate Change (2016): *UK climate action following the Paris Agreement*, London: Committee on Climate Change.

6.16 Committee on Climate Change (2016): *Meeting Carbon Budgets – Implications of Brexit for UK climate policy. Briefing note,* London: Committee on Climate Change.

6.17 Department of Energy and Climate Change (DECC) (2011): *Overarching National Policy Statement for Energy (EN-1),* London: HMSO.

6.18 HM Treasury (2018): *Budget 2018*. London: HMSO.

6.19 Ministry of Housing, Communities and Local Government (MHCLG) (2018): *National Planning Policy Framework*, London: HMSO.

6.20 Kent County Council (2016): *Kent Minerals and Waste Local Plan 2013-30, [online] available at: http://consult.kent.gov.uk/file/4073744 [accessed 18/01/19].*

6.21 Swale Borough Council (2017): *Bearing Fruits 2031: The Swale Borough Council Local Plan, Full Council Item, 26th July 2017*, [online] available at: http://services.swale.gov.uk/meetings/documents/s7987/FULL%20COUNCIL%2026%20JULY%20Local%20Plan%20Item%20Appdx%201%20Bearing%20Fruits%202031%20The%20Swale%20Borough%20Local%20Plan.pdf [accessed 22 November 2017].

6.22 BEIS (2018): *Valuation of Energy Use and Greenhouse Gas: Supplementary guidance to the HM Treasury Green Book and supporting data tables and background papers*, [online] availabe at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal [accessed 26 November 2018].

6.23 Institute of Environmental Management and Assessment (IEMA) (2017): *Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance*, [online] available at: https://www.iema.net/policy/ghg-in-eia-2017.pdf [accessed 28 July 2017].

6.24 Institute of Environmental Management and Assessment (IEMA) (2010): *IEMA Principles Series: Climate Change Mitigation & EIA, v1.1*, [online] available at https://www.iema.net/assets/templates/documents/climate20change20mitigation20and20eia.pdf [accessed 22 January 2018].

6.25 Walsh, L. (2019): *RDF industry raises post-Brexit ports concern. ENDS Waste and Bioenergy* [online], available at: https://www.endswasteandbioenergy.com/article/1522723/rdf-industry-raises-post-brexit-ports-concern [accessed 18/01/19].

6.26 BRE (not dated): *Green Guide to Specification* [online] available at https://www.bre.co.uk/greenguide/podpage.jsp?id=2126 [accessed 11/01/18].

6.27 BRE (2015): *BREEAM New Construction: Infrastructure (pilot)* [online] available at: https://tools.breeam.com/filelibrary/breeam_infrastructure_int.pdf [accessed 11/01/18].

6.28 BSi (2016): *PAS 2080:2016*, London: BSi.