Wressle Field Onshore UK

Lodge Farm, Clapp Gate, Appleby, North Lincolnshire, DN 15 0DB

Scope 3, Category 11 Emissions Assessment

Assessment of “use of sold product” emissions for future production from the existing Wressle development and proposed field extension

esg risk emissions engagement

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For Egdon Resources U.K. Limited

About sustain:*able*

sustain:able are a UK-based consultancy focussed on providing relevant, honest advice regarding ESG and emissions to companies in the oil & gas, mining and wider energy sectors across the globe. Our people come from geoscience, engineering, commercial, facilities, environmental and project management roles who have worked directly in either oil & gas, mining, or renewable energy, in locations all over the world. We use our industry knowledge and experience to support our clients in addressing the ever-changing ESG and emissions requirements, whilst always being mindful of their core business.

Our expert emissions team hold ISO 14064 and 14067 certifications in Greenhouse Gas Emissions Accounting and Carbon Footprint Analysis, providing emissions forecasts for future projects, accounting of annual emissions, and evaluation of Scope 3 emissions. We also support ESG risk assessment and reporting for companies across the globe, providing both the strategic planning, data and framework reporting activities relevant to their situation, and the narrative and proposed graphics for the publication of ESG information on company websites, in annual reports, sustainability reports, or through investor content.

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1 Glossary of Terms & Conversions

Abbreviation/Term	Definition
3P forecast production	Proven + Probable + Possible production forecast volumes representing the high estimate of reserves
bbl (plural bbls)	Barrel(s) of oil, equivalent to 159 litres
BCF	Billion cubic feet of gas
Category 11 emissions	Scope 3 Category 11 (use of sold product) emissions
CH_4	Methane
CO_2	Carbon dioxide
EF	Emissions factor
GHG	Greenhouse gas
GWP	Global warming potential
m^3	Cubic metres
MMbbls*	Million barrels of oil
MMscf*	Million standard cubic feet of gas
$MtCO_2e$	Million tonnes of carbon dioxide equivalent
N_2O	Nitrous oxide
tCO_2e	Tonnes of carbon dioxide equivalent

* It is common in the oil and gas industry to represent millions by the notation 'MM' (e.g. MMbbls to signify millions of barrels of oil). This may be different to other industries where millions may be represented by one 'M' only (e.g. $MtCO_2e$).

Unit	Conversion
1 bbl	159 litres
1 bbl of oil*	0.1323357 tonnes
1 scf	0.028317381 m^3
1 m^3 of gas*	0.00082 tonnes
1 scf of gas*	2.32203×10^{-5} tonnes
1 MMscf of gas*	23.22025 tonnes
Wressle 1 crude oil density	0.8323 kg/litre
Wressle 1 flare gas density	0.82 kg/m^3

* Quoted conversions use densities provided in this table supplied by Egon and are assumed to be at ambient conditions.

2 Executive Summary:

This report, prepared by sustain:*able* for Egdon Resources U.K. Limited ("Egdon"), assesses the Scope 3 Category 11 (use of sold product) emissions in relation to produced hydrocarbons from the Wressle oil production development, located onshore in the UK. The assessment includes future emissions from the existing Wressle 1 well and the proposed site extension that will enable the drilling and production of hydrocarbons from two new wells, Wressle 2 & 3, and the construction and commissioning of a new gas export pipeline.

Two main scenarios were evaluated utilising the 3P production forecast to represent a 'reasonable worst case':

A. Emissions from specific refinery products derived from sale of oil produced from Wressle, and combustion of all sold gas.

B. Resulting emissions assuming all sold oil and gas is combusted.

Future oil production from the existing Wressle 1 development is defined as the baseline for emissions. Total sold oil from **Wressle 1** from 1st January 2025 through to 2034[1] (3P forecast production) is forecast to be 311,580 barrels, or 41,233 tonnes of oil. Total Category 11 emissions from the current Wressle development are estimated to be 121,216 tCO_2e (Scenario A) and 129,885 tCO_2e (Scenario B).

The proposed field development, which includes the drilling of the **Wressle 2 & 3** wells, is assumed to commence in 2026 and forecasts total sold oil to be 1,039,733 barrels, or 137,594 tonnes (3P forecast production) across the lifespan of the development (2025-2039). Commissioning of the gas export pipeline as part of the field extension will enable produced gas to be sold, which is forecast to be 5.264 BCF or 122,221 tonnes gas. Total forecast Category 11 emissions from the proposed extension are estimated to be 759,187 tCO_2e (Scenario A) and 788,115 tCO_2e (Scenario B).

Total future Category 11 emissions for the remaining field life (including the planned development) are estimated to be 880,402 tCO_2e (Scenario A) and 917,999 tCO_2e (Scenario B).

The future Category 11 emissions from the Wressle Field represent a minor fraction of the UK Carbon Budget, with the highest impact during the 5th Carbon Budget period (2028-2032), amounting to 0.0216% and 0.0224% of the budget for Scenario A and B, respectively.

[1] In accordance with the grant of planning permission, dated 17th January 2020, which allows for the permitted use of the site for hydrocarbon production for 15 years. Cessation of production assumed to be end June 2039.

Additional sensitivity scenarios were analysed, showing that variations in emissions factors have a small impact on total emissions (less than 3%). The most significant controlling factor in the actual Category 11 emissions from Wressle will be the ultimate volume of oil and gas that is sold and combusted by end users. To account for this uncertainty the 3P 'high case' forecast has been used throughout to ensure a 'reasonable worst case' emissions estimate is presented.

3 Introduction

Egdon Resources U.K. Limited ('Egdon'), as operator of the Wressle Field (PEDL180 & PEDL182 onshore UK), has a requirement to quantify its potential Scope 3 Category 11 (use of sold product) emissions from the proposed further development at Wressle, which is to include additional oil and gas production from two new wells (Wressle 2 & 3).

Planning permission was granted by North Lincolnshire Council ('NLC') for the Wressle Field extension on 13th September 2024. However, the permission was quashed on 8th November by the High Court following the '*Finch'* decision in the Supreme Court in June 2024 (Finch v Surrey County Council, 2024) and the application (PA/SCR/2024/275) and is with NLC for redetermination.

In the *'Finch'* decision, the Supreme Court ruled that the Council's decision to grant planning permission for an oil extraction project in Surrey was unlawful because the Environmental Impact Assessment (EIA) did not consider downstream greenhouse gas (GHG) emissions arising from the eventual combustion of the extracted oil (i.e. Scope 3 Category 11 'use of sold product').

Paragraphs 6 and 7 of the High Court judgment for Wressle are helpful in understanding the context for this report:

> *Whilst in Finch, the project was unarguably required to undertake an EIA given its scale and exceedance of the threshold in Schedule 1 of the EIA Regulations, the decision has clear parallels to the circumstances of this application [at Wressle] in that extraction of hydrocarbons is proposed but the decision-maker did not consider the scale of any indirect effects arising from the combustion emissions.*
>
> *In such circumstances, the decision was taken without due consideration of the potential for likely significant effects arising from the combustion of the extracted hydrocarbons and the Council was arguably required to reconsider if the proposed development was an EIA development.*

This report provides an independent assessment of the potential Category 11 (use of sold product) emissions (hereafter referred to as "Category 11 emissions") from produced oil and gas at the Wressle Field resulting from the planned field development that will include the drilling of two new wells (Wressle 2 & 3).

The Wressle oil and gas field is located to the east of Scunthorpe in North Lincolnshire on licences PEDL180 and PEDL182 where Egdon operates with a 30% equity interest (JV partners Europa Oil & Gas Ltd has 30% equity, and Union Jack Oil plc has 40% equity). Production of oil and gas commenced from the Wressle 1 well in January 2021 from the Ashover Grit reservoir.

Oil produced from Wressle 1 is transported by road tanker to the Phillips 66 Humber refinery on Humberside, where it is sold. Currently, there is no export route for gas, therefore the gas produced from the field is largely flared (in compliance with all required permits) with a small amount used for on-site power generation.

The next stage of the Wressle Field development will include the drilling of two new wells (Wressle 2 and 3) and the construction of a 600m underground gas pipeline. For the purpose of this assessment the new facilities are assumed to be commissioned in 2026. Once the new facilities are commissioned, oil produced from Wressle 1, 2 and 3 wells will continue to be transported to the same refinery and sold. A small volume of produced gas will be used for power generation (included in Scope 1 emissions), but the remaining gas will be sold and exported via the new pipeline. This study considers all future production from the field from 1st January 2025 to 2039, a 15-year production life.

Scope 3 Category 11 (GHG Protocol, 2004, 2013a, 2013b) refers to the emissions derived from combustion of gas by end-users, or combustion of the final fuel products refined from oil (i.e. use of sold product). By definition, companies have reduced influence over Scope 3 emissions, however it is a requirement for companies to understand the full impact of their operations in the wider context of climate impacts.

This assessment has been carried out to provide an estimate of the Category 11 (use of sold product) emissions in relation to the Wressle Field. Future forecast production from the existing development (comprising Wressle 1 well) and the proposed development extension (comprising Wressle 2 & 3) are considered. No other emissions categories are addressed in this study.

The UK is the first country to set legally binding carbon budgets. A carbon budget places a restriction on the total amount of greenhouse gases the UK can emit over a 5-year period. Section 8 compares the Scope 3 Category 11 emissions related to the Wressle field to these total UK carbon budgets.

4 Scope and Methodology

4.1 Scope

The scope of this assessment is limited to assessing only the Category 11 emissions for future production from the Wressle field, with comparison made to the UK Carbon Budget. Future production from the existing development (comprising Wressle 1 well) and the next phase of the field development plan (comprising Wressle 2 & 3) are considered.

The full consideration of Category 11 emissions relating to forecast sold volumes of oil and gas from the Wressle field are included (i.e. 100% basis) - equity share of these emissions has not been presented.

This study does not include an assessment of emissions from transportation of the oil to the refinery, or emissions from the refinery itself, which would be reported under different Scope 3 categories. No other emissions categories are addressed in this study. A separate assessment of Scope 1, 2 and selected Scope 3 emissions relevant to the Wressle development has been completed (Scope 1, 2 and 3 Emissions Forecast for Wressle Field Development report dated 18th February 2025).

This study assumes that all sold crude oil and the various products manufactured from it will be used within the UK. Crude oil is generally traded on an international market, but for the purposes of assessing the downstream emissions associated with the use of the final products, this assessment focuses on the impact of the Wressle GHG emissions on the UK's Carbon Budgets.

4.2 Methodology

Methodology following the Greenhouse Gas (GHG) Protocol (2013a, b) and CDP Scope 3 Category 11 Guidance for Oil & Gas (2021), has been followed for this assessment for calculation of Wressle Category 11 emissions. Key points to note:

- This study only considers the "Direct Use-Phase" emissions from the oil and gas sold from the Wressle Field that is utilised as feedstock or fuel.
- Emissions are reported in tonnes of CO_2 equivalent (tCO_2e), which includes the calculated volumes of direct greenhouse gases; CO_2, CH_4 and N_2O. To ensure alignment with the UK Government Emissions Factors Database (2024), 100-year Global Warming Potential (GWP) factors from IPCC 5th Assessment (AR5) excluding carbon feedback are used.
- Only the combustion emissions relating to the sold oil and gas are included in Category 11. Upstream emissions associated with production are excluded to avoid double counting since the upstream emissions associated with the production of the feedstock/fuel will be included in the reporting company's Scope 1 and other Scope 3 categories. Therefore, it is not appropriate to include well-to-tank (WTT) factors in the emissions factors in this study.
- Due to variations in technologies and exact fuel mixes, the GHG Protocol (2013a) requires companies to use the most representative emission factors for their fuel. Therefore, it is necessary to use several different emissions factors depending on each specific scenario. All emissions factors used are from reputable sources and clearly documented.
- Full combustion emissions factors are utilised in this study to ensure consistency across the different emissions factor databases and to present a more conservative estimate of

emissions. Combustion efficiency (oxidation efficiency) of fuels varies, but is typically >95% (CDP 2021). The emissions factor applied in this study for combustion of sold Wressle gas utilises the same compositional data as that used by Egdon for regulatory reporting of flaring emissions, and is also based on 99.9% combustion efficiency in the base scenarios.

- To ensure a conservative estimate or 'reasonable worst case', only the 3P, Proven + Probable + Possible production forecast of sold oil and gas (representing the high estimate), has been used in the emissions calculations.
- As this study is assessing forecast (predicted) emissions that have not yet occurred, there are uncertainties in the available data which are addressed through the presentation of scenarios which aim to capture a reasonable range of potential emissions. These are detailed in Sections 5 and 6 below.

4.3 Assumptions

To evaluate the sensitivity of the Category 11 emissions calculations, two main scenarios have been assessed (Table 1) both utilising the 3P production forecast from 1st January 2025 through to 2039. The assumptions for each scenario presented show outcomes intended to capture a range of potential emissions for a set of realistic 'reasonable worst' case outcomes.

Production and sales data were provided by Egdon for 3P production forecasts for the existing Wressle 1 well and the 3P forecasts for the planned Wressle 2 & 3 wells (Table 2).

The 3P forecasts represent the 'high case' production that could be extracted from the field and have been used to ensure a conservative or 'reasonable worst case' estimate of total emissions from Category 11 (use of sold product). Production is expected to vary over time and, as is typical, is higher at the beginning of a well's life and declines over time to the end of the field life when production is deemed no longer economically viable (Figure 1). Cessation of production (COP) is forecast to be at the end of June 2039.

Table 1. Summary parameters and assumptions of the two main scenarios for calculation of Scope 3 Category 11 emissions from Wressle Field.

		A	B
Summary of Scenario & Assumptions		Refinery products from oil & all gas combusted *Case incorporating emissions from combustion of specific refining products.*	All oil combusted & all gas combusted *Case assuming all hydrocarbons are combusted.*
Production	Forecast production for Wressle 1 (2025-2034)	3P forecast sales oil and gas volumes for Wressle 1	
	Forecast production for Wressle 2 & 3 (2026-2039)	3P forecast sales oil and gas volumes for Wressle 2 & 3	
Use of Products	Gas	All gas combusted	
	Oil	(1) Average UK refinery product split from government data (2) Estimated product split from Wressle 1 oil simulated distillation data and EIA estimate of distillation temperatures	All oil combusted
Emissions Factors (EF)	Gas emissions factor	Wressle 1 Flare Gas emissions factor calculation [1]	
	Oil emissions factor	EF for specific products based on UK Govt Database [2]	EF for Miscellaneous Product based on CDP (2021) [3]

[1] Calculations utilising gas composition data from Wressle-1 flare gas (provided by Egdon);
[2] UK Government GHG Conversion Factors for Company Reporting (DESNZ, DEFRA, June 2024);
[3] Based on the carbon content of Wressle 1 oil, it was determined 'Miscellaneous Product' was most comparable to Wressle 1 oil (CDP, 2021).

4.3.1 Oil

Wressle oil is currently transported to the Phillips 66 refinery at Immingham on Humberside. It is assumed future oil production from Wressle 2 & 3 will also be transported to the same refinery and ultimately generate the same range of products. However, the actual eventual use of the oil produced from Wressle is uncertain because the refinery does not provide this information due to commercial sensitivity. Therefore, average UK refinery product throughput data has been used from the UK Government (DESNZ 2024a) to generate a reasonable estimate of refinery products from Wressle oil (see Section 5.1 below). The Phillips 66 refinery at Immingham is described as the only coking refinery

in the United Kingdom, and a producer of high-quality specialty graphite and anode-grade petroleum cokes which are used in the manufacture of Lithium-Ion batteries (Phillips 66, 2024).

As can be seen in Table 2, there is a minor difference between the total forecasted volume of oil produced and the total volume of oil expected to be sold at the refinery. This change in volume is due to a correction applied at the refinery gate (ca. 0.5%) to account for entrained water content.

Table 2. Total 3P ('high case') forecasts and sales volumes for oil and gas from the Wressle Field used for calculation of Scope 3 Category 11 emissions.

	Total Forecast Oil & Gas Volumes [1]		**Sales Oil & Gas Volumes [1,2]**	
	Barrels of oil or BCF gas	**Tonnes**	Barrels of oil or BCF gas	**Tonnes**
Wressle 1 (3P) Total Oil (2025 – 2034)	313,146 bbls	41,440	311,580 bbls	41,233
Wressle 2 & 3 (3P) Total Oil (2026 – 2039)	*1,044,957*	138,285	*1,039,733*	137,594
Wressle 1, 2 & 3 (3P) Total Gas (2025 – 2039)	*5.795*	134,561	*5.264*	122,221
TOTAL Oil and Gas from Wressle Field (tonnes)		**314,287**		**301,048**

[1] 3P forecast production data provided by Egdon Resources. Conversion of oil from bbl to tonnes: 1 bbl = 159 litres; average oil density of 0.8323 kg/L (based on Wressle 1 crude oil analysis). Conversion of gas from scf to tonnes: 1 scf = 0.028317381 m^3; 1 m^3 = 0.00082 tonnes based on average Wressle 1 flare gas density of 0.82 kg/m^3. [2] Sales oil volumes include a 0.5% deduction applied at the refinery gate to account for entrained water content of the oil. Sales gas volumes exclude gas utilised on-site for power generation which are captured in the company's Scope 1 emissions. Note: values are rounded from many decimal places, therefore totals may not sum exactly.

4.3.2 Gas

It is assumed that all gas produced is ultimately combusted. There is currently no export route for the gas produced from Wressle 1. The gas currently produced from Wressle 1 is largely flared, with a volume combusted by Egdon for onsite power generation. These emissions are classified as Scope 1 emissions.

This study is considering future production from Wressle 1 between 1st January 2025 through to mid-2034, however until the new gas export pipeline is completed in 2026, there will still be no export route for gas during 2025. Therefore, it is assumed that the gas produced during 2025 will continue to be flared and used for onsite power generation which will be wholly classified as Scope 1 emissions. Flaring emissions are reported by Egdon in compliance with all environmental permits and environmental regulations.

Once Wressle 2 & 3 wells start production and the gas export pipeline is commissioned in 2026, a small volume of gas will be utilised for on-site power generation, with all remaining gas produced from Wressle 1, 2 and 3 wells to be exported. This accounts for the difference in total forecasted produced gas and total sales gas presented in Table 2. Any emissions relating to combustion of gas for on-site power generation will fall within Egdon's Scope 1 emissions. Therefore, only the "sales gas" volume exported via pipeline from 2026 onwards has been included in the Category 11 emissions calculations (Table 2).

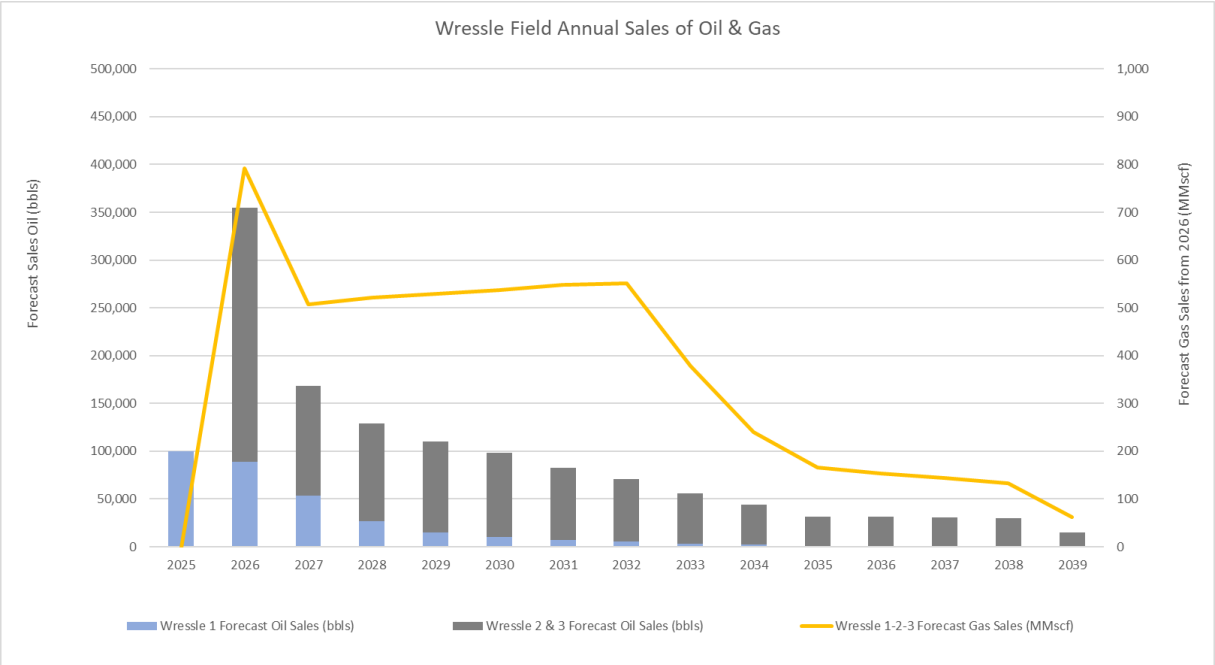


Figure 1. Total annual forecasted sales volumes for oil and gas (3P forecast) from the Wressle Field (bbls = barrels; MMscf = million standard cubic feet). Sale of gas produced from Wressle-1 does not commence until the gas pipeline is commissioned in 2026.

5 Scenarios

5.1 Scenario A - Refinery Products

The Phillips 66 refinery that receives Wressle Field oil deems the release of its product outputs to be commercially sensitive and this information was not available to Egdon for this study. Therefore, data for UK refinery throughput and output of petroleum products was sourced from the National Statistics publication "Energy Trends" (DESNZ, 2024a), which aggregates data from a number of UK refineries, including the Phillips 66 Humber refinery.

Because the proportions of products generated by refineries change over time, monthly data was extracted from January 2023 to August 2024 (most recent data available at the time of the study) in

order to capture the most recent product range and calculate the average proportion of all products. DESNZ (2024b) reports that around 90% of oil and oil products are used for energy (i.e. ultimately combusted). Refinery product categories are aggregated, therefore the proportions calculated from this data may not be a completely accurate representation of the ultimate end use of Wressle oil. However, this is intended to provide an approximation to the total emissions resulting from such a split in end product use.

Once the average proportion of each product was calculated based on the refinery throughput data, the specific emissions factor for each product was applied from the UK GHG Conversion Factors for Company Reporting, published by DESNZ and DEFRA (2024) to calculate the emissions derived from combustion (Table 3).

All gas sales are assumed to be combusted, using the emissions factor of 2.902 tCO_2e/tonne gas, calculated from Wressle 1 gas composition and to ensure consistency with the historic regulatory emissions reporting of Wressle flaring emissions. This is a common assumption for both Scenarios A and B.

Table 3. Scenario A: summary of average UK refinery products for period January 2023 – August 2024.

Fuel Type [1]	**Percentage of Refinery Product** [1]	**Ultimate Use** [2]	**Emissions Factor** [3] **tCO_2e / tonne of product**	**Emissions Factor Database Fuel Description** [3]
Refinery fuel use	5.60%	Combusted	2.944	Refinery miscellaneous
Refinery product use	5.68%	Non-Energy Use	n/a	Assume not combusted
Butane and propane	3.11%	Combusted	3.033	Butane
Other petroleum gases	0.74%	Combusted	2.578	Other petroleum gas
Naphtha (LDF)	3.25%	Combusted	3.142	Naphtha
Petrol	29.98%	Combusted	3.154	Petrol (100% mineral petrol)
Jet fuel	6.48%	Combusted	3.194	Aviation spirit
Burning oil	4.21%	Combusted	3.165	Burning oil
Gas oil	9.71%	Combusted	3.227	Gas oil
White diesel	24.06%	Combusted	3.207	Diesel (100% mineral diesel)
Fuel oil	5.85%	Combusted	3.229	Fuel oil
Lubricating oils	0.48%	Non-Energy Use	n/a	Assume not combusted
Bitumen	0.85%	Non-Energy Use	n/a	Assume not combusted
TOTAL	**100%**			
Approx. % combusted	**93%**	**of products combusted**		
Weighted Average Emissions Factor (combusted products only)			**2.940**	**tCO_2e/tonne product**

[1] Average proportion of each refinery product from all reporting UK refineries over the period Jan 2023 to Aug 2024 (source: DESNZ, 2024a).
[2] Crude oil and oil products: Data sources and methodology (DESNZ, 2024).
[3] UK Government GHG Conversion Factors for Company Reporting, published by DESNZ and DEFRA, version 1.1, 2024.
Note: values are rounded from many decimal places, therefore totals may not sum exactly.

5.2 Scenario B – Combustion of all Products

Scenario B represents the case whereby it is assumed all sold oil is combusted. There are a large number of reputable databases and sources of emissions factors which vary based on composition of the fuel in question.

A number of databases were reviewed; the carbon content of the Wressle 1 oil is closely comparable to that of the 'miscellaneous product' cited in the CDP Scope 3 Category 11 Guidance for Oil & Gas, Appendix A1 (2021) and will provide a reasonable estimate of the emissions factor for the Wressle oil. Therefore, the emissions factor of 3.15 tCO_2e/tonne oil has been used for combustion of all Wressle oil for Scenario B in this study (Table 4).

As described in the previous section (Scenario A), all gas sold is assumed to be combusted using the emissions factor of 2.90 tCO_2e/tonne gas, calculated from Wressle 1 gas composition and is a common assumption for both Scenarios A and B.

Table 4. Summary of emissions factors used in Scenario B in this study.

Scenario	Hydrocarbon Phase	Description	Emissions Factor Source	Emissions Factor tCO_2e/tonne product
B	Oil	Miscellaneous Product [1] *(carbon content 85.5%)*	CDP Scope 3 Category 11 Guidance for Oil & Gas (2021)	3.150
	Gas	Wressle 1 flare gas [2]	Egdon Resources Wressle 1 flare gas composition	2.902

[1] Oil emissions factor based on data from CDP Scope 3 Category 11 Guidance for Oil & Gas (2021). Wressle 1 oil analysis provided by Egdon has a carbon content 85.5% - 85.6%. [2] Egdon regulatory reporting of Wressle 1 flare emissions based on 99.9% flare efficiency.

6 Scope 3 Category 11 (use of sold product) emissions

6.1 Wressle 1 Development – Baseline

The current Wressle 1 development has been producing oil and gas since 2021. Continued oil production from the Wressle 1 well from 1st January 2025 through to 2034 is therefore defined as the baseline for comparison against the next phase of field development, including Wressle 2 & 3 and the gas export pipeline commencing in 2026.

Category 11 emissions representing a 'reasonable worst case' utilising the 3P forecast oil production from the existing development (Wressle-1), are estimated to be 121,216 tCO_2e based on Scenario A assumptions and 129,885 tCO_2e based on Scenario B assumptions (Table 5).

6.2 Wressle 2 & 3 Field Development

The next phase of the Wressle field development will be achieved through the drilling of two additional wells: Wressle 2 & 3, and the construction of a gas export pipeline.

Category 11 emissions from 'high case' (3P) forecast future production from the proposed development is presented in Table 6.

Table 5. Summary of Scope 3 Category 11 emissions for Scenarios A and B for the existing Wressle 1 Development (including actual and forecast oil volumes).

Emissions from Sold Products - Wressle 1 Development Oil				
3P Production Scenario		**Total Sold Product**	**Scenario A**	**Scenario B**
			Refinery Products from Oil	**All Oil Combusted**
		tonnes	**Total Emissions (tCO_2e)**	**Total Emissions (tCO_2e)**
Wressle 1	**Forecast Sold Oil (2025 – 2034)**	41,233	121,216	129,885

Note: values are rounded from many decimal places, therefore totals may not sum exactly.

Table 6. Summary of Scope 3 Category 11 emissions for Scenarios A and B for the proposed Wressle 2 & 3 planned field development (forecast oil and gas volumes).

Emissions from Sold Products - Wressle 2 & 3, planned field development				
3P Production Scenario		**Total Sold Product**	**Scenario A**	**Scenario B**
			Refinery Products from Oil All Gas Combusted	**All Oil & Gas Combusted**
		tonnes	**Total Emissions (tCO_2e)**	**Total Emissions (tCO_2e)**
Wressle 2 & 3	**Forecast Sold Oil (2026-2039)**	137,594	404,492	433,420
Wressle 1, 2 & 3	**Forecast Sold Gas (2026-2039)**	122,221	354,695	354,695
Total Sold Products		**259,815**	**759,187**	**788,115**

Note: values are rounded from many decimal places, therefore totals may not sum exactly.

6.3 Total Wressle Field Scope 3 Category 11 Emissions

The combined future emissions for the Wressle field (from Table 5 and Table 6) are presented in Table 7.

The 3P production contribution from the planned development (i.e. Wressle 2 and 3 wells and gas export pipeline), will increase the total volume of sold oil and gas over the remaining field life by 630%, compared to the existing Wressle 1 development. Consequently, this development will have a similar impact on increasing the estimated Category 11 emissions (626% increase in Scenario A, and 607% increase in Scenario B) (Table 7).

It is important to note that this includes Category 11 emissions from sales gas from 2026 onwards, which will have a direct impact on reducing the flaring emissions from Wressle 1 (reported as Scope 1 emissions if the pipeline is not constructed).

Table 7. Percentage increase in total sold product and 'reasonable worst case' Category 11 emissions for Scenarios A and B resulting from development of Wressle 2 & 3 and the gas export pipeline. Note that the percentage increase variations between the two emissions scenarios relate to the different emissions factors for oil applied to each scenario.

Emissions from Sold Products – Total Wressle Field Oil & Gas				
3P Production Scenario		**Total Sold Product**	**Total Emissions - Scenario A**	**Total Emissions - Scenario B**
		tonnes	**tCO_2e**	**tCO_2e**
Wressle 1	**Forecast Sold Oil (2025-2034)**	41,233	121,216	129,885
Wressle 2 & 3 oil Wressle 1, 2 & 3 gas	**Forecast Sold Oil & Gas (2026-2039)**	259,815	759,187	788,115
Total Sold Products		**301,048**	**880,402**	**917,999**
Percentage increase compared to existing Wressle 1 Development		**630%**	**626%**	**607%**

Note: values are rounded from many decimal places, therefore totals may not sum exactly.

7 Sensitivities

Details of additional sensitivities that were analysed are included in Appendices 1 and 2, and are summarised below. All conversion factors used in this study are summarised in Appendix 3.

The sensitivities examined were found to have a small impact on the total Category 11 emissions calculated (less than 3%). The most significant controlling factor on actual 'use of sold product' emissions will be the total volume of oil and gas produced and sold. For this reason, the 'high case' 3P production scenario has been used throughout the study to ensure a conservative ('realistic worst case') estimate of potential emissions is presented.

7.1 Scenario A sensitivities:

It is recognised that the dataset presented for refinery production (Section 5.1) is based on an average of all UK refineries, and not specific to the Wressle oil composition or Phillips 66 refinery. Therefore, in an attempt to verify if this product split was appropriate to the Wressle field, the simulated distillation profiles from a Wressle 1 oil sample analysis were assessed and the boiling ranges for various products, as published by the EIA (2023), was applied. Published breakdowns of products by boiling point was less detailed than the product range reported by the UK refineries.

It was found that total emissions resulting from the two oil refinery product cases varied by 1.2% and it was considered that using the UK average refinery product breakdown was an appropriate analogue to estimate Category 11 emissions from possible Wressle oil final products (Table 8). Details are included in Appendix 1.

Table 8. Comparison of sensitivity case for Scenario A using Wressle 1 simulated oil distillation data.

Scenario Description	Total Category 11 emissions for Sold Oil (tCO_2e)	Weighted Average Emissions Factor for Combusted Products (tCO_2e/tonne product)	Difference in total emissions between the two cases
Scenario A: UK Average Oil Refinery Product Split (see Section 5.1)	**525,708**	2.940	1.2%
Sensitivity (A1): Wressle 1 Oil Distillation Data - EIA Product Specs	**519,592**	2.906	

Note: values are rounded from many decimal places, therefore totals may not sum exactly.

7.2 Scenario B sensitivities:

Scenario B assumes all sold oil and gas is combusted, therefore the main sensitivity relates to the emissions factors that can be applied. Three sensitivity cases that applied a range of reasonable emissions factors from different sources were run (Table 9). Overall, total emissions calculated from the two sensitivity cases varied by less than 3% when compared to the selected Scenario B case. Based on this analysis, selection of reasonable alternative, full combustion emissions factors are not considered to be a material factor in the Category 11 emissions calculations – the overriding factor impacting total emissions will be the total oil and gas combusted by end-users. Details of these sensitivity cases are included in Appendix 2.

Table 9. Summary of sensitivity cases for Scenario B using different emissions factors.

Scenario Description	Source of Emissions Factors	Emissions Factor (combusted products) (tCO_2e/tonne product)	Total Category 11 Emissions for the Wressle Field (tCO_2e)	Difference in total emissions compared to Scenario B
Scenario B: • All oil assumed to be refined to 'miscellaneous product' and combusted • All gas assumed to be combusted using Wressle 1 emissions factor	Oil: CDP Scope 3 Category 11 Guidance for Oil & Gas, Appendix A1 (CDP 2021) Gas: Wressle 1 gas analysis (Egdon)	'Miscellaneous Product': 3.150 Wressle 1 Gas: 2.902	**917,999**	-
Sensitivity (B1): • All oil assumed to be refined to fuel oil and combusted • All gas assumed to be combusted using 'Natural Gas' default emissions factor	UK Government GHG Conversion Factors for Company Reporting (DESNZ, DEFRA, June 2024)	'Fuel Oil': 3.229 'Natural Gas': 2.590	**894,023**	-2.6%
Sensitivity (B2): • All oil assumed to be combusted in a diesel engine • All gas assumed to be combusted in a gas turbine	EEMS Atmospheric Emissions Calculations default emissions factors EEMS (2008)	'Diesel Engine': 3.263 'Gas Turbine': 2.944	**943,401**	2.8%

Note: values are rounded from many decimal places, therefore totals may not sum exactly.

8 Comparison to UK Carbon Budget

Scope 3 Category 11 emissions, which arise from the use of sold products, contribute to climate change through the release of GHGs. The Category 11 emissions estimated for the Wressle development are assumed, for the purposes of this study, to result entirely from the combustion of hydrocarbons within the UK. However, in practice, oil and refined products are traded on the global market, and the actual location of combustion may vary widely. As GHG emissions impact the atmosphere globally regardless of where they occur, their mitigation remains a critical challenge. In the UK, the legal framework for addressing emissions is underpinned by the Climate Change Act 2008, which sets binding targets for territorial emissions and supports broader decarbonisation efforts.

Table 10 below compares both Scenarios A and B to the 5-year periods for the 3rd to 7th UK Carbon Budgets.

The period of highest expected production and sales of oil and gas from Wressle (including production from the planned Wressle 2 & 3 wells) falls within the 5th Carbon Budget period between 2028-2032. During this time, the total Category 11 emissions will amount to 0.0216% and 0.0224% of the UK Carbon Budget for Scenario A and B, respectively.

Oil and gas from fields such as Wressle is produced for the purpose of generating energy, or as feedstock for a range of refined products from fuels to plastics to battery feedstock materials. Upstream operators such as Egdon and its JV partners do not retain ownership of the oil and gas after export and therefore have little influence on its ultimate use after sale and, hence, the Category 11 emissions resulting from such use. Egdon has advised sustain:*able* that it will continue to work to reduce those operational emissions that are directly related to the development of the Wressle Field and within its control or influence.

Table 10. Comparison of Wressle Scope 3 Category 11 emissions for Scenario A (top) and Scenario B (bottom) against the UK Carbon Budget.

Scenario A – Comparison to UK Carbon Budget

UK Carbon Budget Period	Period	Carbon Budget	% Reduction from 1990	Wressle Development		
				Total Sold Oil & Gas	Scenario A Total Cat 11 Emissions	Scenario A Cat 11 Emissions as % of UK Carbon Budget
	Years	($MtCO_2e$)	%	Tonnes	($MtCO_2e$) [1]	%
3	2018-2022	2,544	37%	0	0.000	0.0000%
4	2023-2027	1,950	51%	112,602	0.330	0.0169%
5	2028-2032	1,725	57%	127,363	0.372	0.0216%
6	2033-2037	965	78%	50,601	0.148	0.0153%
7 [2]	2038-2042	535	87%	10,482	0.031	0.0057%

Scenario B – Comparison to UK Carbon Budget

UK Carbon Budget Period	Period	Carbon Budget	% Reduction from 1990	Wressle Development		
				Total Sold Oil & Gas	Scenario B Total Cat 11 Emissions	Scenario B Cat 11 Emissions as % of UK Carbon Budget
	Years	($MtCO_2e$)	%	Tonnes	($MtCO_2e$) [1]	%
3	2018-2022	2,544	37%	0	0.000	0.0000%
4	2023-2027	1,950	51%	112,602	0.347	0.0178%
5	2028-2032	1,725	57%	127,363	0.386	0.0224%
6	2033-2037	965	78%	50,601	0.153	0.0159%
7 [2]	2038-2042	535	87%	10,482	0.032	0.0060%

[1] Category 11 emissions for Wressle are presented in million tonnes of CO_2 equivalent ($MtCO_2e$) to enable direct comparison in the same units to the UK Carbon Budget. [2] The 7th UK Carbon Budget was published on 26th February 2025 (Climate Change Committee, 2025) . Note: values are rounded from many decimal places, therefore totals may not sum exactly.

9 Conclusions

The planned Wressle 2 and 3 development, including the new gas export pipeline, will increase Category 11 emissions for the Wressle Field due to additional oil production and sale of gas. The sensitivity analysis indicates that variations in emissions factors have a minor impact on the total Category 11 'use of sold product' emissions calculated, with the largest influence being the ultimate volume of oil and gas sold and combusted. To address this uncertainty the 3P forecast has been used for estimating the potential emissions.

The total baseline emissions for the existing Wressle 1 development are estimated to be between 121,216 tCO_2e and 129,885 tCO_2e, depending on the scenario. The combined 'reasonable worst case' Category 11 emissions for the full development (including Wressle 1, 2 and 3 and the new gas pipeline) are estimated to be between 880,402 tCO_2e and 917,999 tCO_2e, depending on the scenario. Despite the increase above the current Wressle 1 baseline, these emissions represent a very small percentage of the UK Carbon Budgets, with the highest impact expected during the 5th Carbon Budget period (2028-2032) where the UK budget is 1,725 $MtCO_2e$ (million tonnes CO_2e). During this period the Category 11 emissions from the Wressle development are forecast to be 0.0224% of the budget in the worst case.

10 References

CDP (2024) CDP Technical Note: Guidance methodology for estimation of Scope 3 category 11 emissions for oil and gas companies. CDP Worldwide. Retrieved from https://cdn.cdp.net/cdp-production/cms/guidance_docs/pdfs/000/000/469/original/CDP-Scope-3-Category11-Guidance-Oil-Gas.pdf?1643046888

Climate Change Committee (2025) The Seventh Carbon Budget - Advice for the UK Government. 26th February 2025: Climate Change Committee

DESNZ (2024a) Refinery throughput and output of petroleum products. Datasheet ET_3.12_Oct24, published 31st October 2024 by DESNZ. https://assets.publishing.service.gov.uk/media/672208aa3ce5634f5f6ef49b/ET_3.12_OCT_24.xlsx#:~:text=Commentary,-A&text=In%20the%20three%20months%20to,increased%20demand%20for%20jet%20fuel.

DESNZ (2024b) Crude oil and oil products: Data sources and methodology. https://assets.publishing.service.gov.uk/media/651abe826dfda6000d8e3982/Oil___oil_products_methodology_note.pdf

DESNZ and DEFRA (2024) UK Government GHG Conversion Factors for Company Reporting, version 1.0. London: DESNZ Department for Energy Security & Net Zero and DEFRA Department for Environment Food and Rural Affairs. Retrieved from https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024

EEMS (2008) Atmospheric Emissions Calculations (published by Oil & Gas UK and Department of Energy & Climate, UK Government) https://assets.publishing.service.gov.uk/media/5a75bdb1ed915d6faf2b5551/atmos-calcs.pdf

EIA (2023) Oil and petroleum products explained - Refining crude oil. https://www.eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil-the-refining-process.php *(accessed 19/11/2024).*

Finch v Surrey County Council (2024) R (on the application of Finch on behalf of the Weald Action Group) (Appellant) v Surrey County Council and others (Respondents), before Lord Kitchin, Lord Sales, Lord Leggatt, Lady Rose, Lord Richards, judgment given on 20th June 2024 (https://supremecourt.uk/uploads/uksc_2022_0064_judgment_c3d44bb244.pdf).

Greenhouse Gas Protocol (2004) The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard. USA: World Resources Institute and World Business Council for Sustainable Development.

Greenhouse Gas Protocol (2013a) Corporate Value Chain (Scope 3) Accounting and Reporting Standard. Washington DC: World Resources Institute.

Greenhouse Gas Protocol (2013b) Technical Guidance for Calculating Scope 3 Emissions. World Resources Institute.

Phillips 66 (2024) https://www.phillips66.co.uk/emerging-energy/batteries/ (*accessed 11/12/204*).

11 Appendix 1 – Scenario A sensitivity calculations

All sensitivity calculations continue to use the same 3P 'high case' production scenario.

11.1 Scenario A: Average UK refinery products for period January 2023 – August 2024

Fuel Type [1]	Percentage of Refinery Product [1]	Ultimate Use [2]	Emissions Factor [3] tCO_2e / tonne of product	Emissions Factor Database Fuel Description [3]
Refinery fuel use	5.60%	Combusted	2.944	Refinery miscellaneous
Refinery product use	5.68%	Non-Energy Use	n/a	Assume not combusted
Butane and propane	3.11%	Combusted	3.033	Butane
Other petroleum gases	0.74%	Combusted	2.578	Other petroleum gas
Naphtha (LDF)	3.25%	Combusted	3.142	Naphtha
Petrol	29.98%	Combusted	3.154	Petrol (100% mineral petrol)
Jet fuel	6.48%	Combusted	3.194	Aviation spirit
Burning oil	4.21%	Combusted	3.165	Burning oil
Gas oil	9.71%	Combusted	3.227	Gas oil
White diesel	24.06%	Combusted	3.207	Diesel (100% mineral diesel)
Fuel oil	5.85%	Combusted	3.229	Fuel oil
Lubricating oils	0.48%	Non-Energy Use	n/a	Assume not combusted
Bitumen	0.85%	Non-Energy Use	n/a	Assume not combusted
TOTAL	**100%**			
Approx. % combusted	**93%**	**of products combusted**		
Weighted Average Emissions Factor (combusted products only)			**2.940**	**tCO_2e/tonne product**

[1] Average proportion of each refinery product from all reporting UK refineries over the period Jan 2023 to Aug 2024 (source: https://assets.publishing.service.gov.uk/media/672208aa3ce5634f5f6ef49b/ET_3.12_OCT_24.xlsx#:~:text=Commentary,-A&text=In%20the%20three%20months%20to,increased%20demand%20for%20jet%20fuel.)
[2] https://assets.publishing.service.gov.uk/media/651abe826dfda6000d8e3982/Oil___oil_products_methodology_note.pdf
[3] UK Government GHG Conversion Factors for Company Reporting, published by DESNZ and DEFRA, version 1.1, 2024 (source: https://assets.publishing.service.gov.uk/media/6722567487df31a87d8c497e/ghg-conversion-factors-2024-full_set__for_advanced_users__v1_1.xlsx)
Note: values are rounded from many decimal places, therefore totals may not sum exactly.

11.2 Sensitivity A-1: Estimated refinery products based on Wressle 1 distillation data

11.2.1 Wressle 1 crude oil simulated distillation data (IP545), provided by Egdon (Nov 2024)

IP545 Crude Oil Simulated Distillation (simdis)		
Initial Boiling Point	-18.90	°C
Temp at 1.0 % Recovery	-4.80	°C
Temp at 2.0 % Recovery	25.00	°C
Temp at 3.0 % Recovery	50.40	°C
Temp at 4.0 % Recovery	63.00	°C
Temp at 5.0 % Recovery	69.70	°C
Temp at 6.0 % Recovery	83.00	°C
Temp at 7.0 % Recovery	89.70	°C
Temp at 8.0 % Recovery	93.90	°C
Temp at 9.0 % Recovery	98.00	°C
Temp at 10.0 % Recovery	104.50	°C
Temp at 11.0 % Recovery	111.60	°C

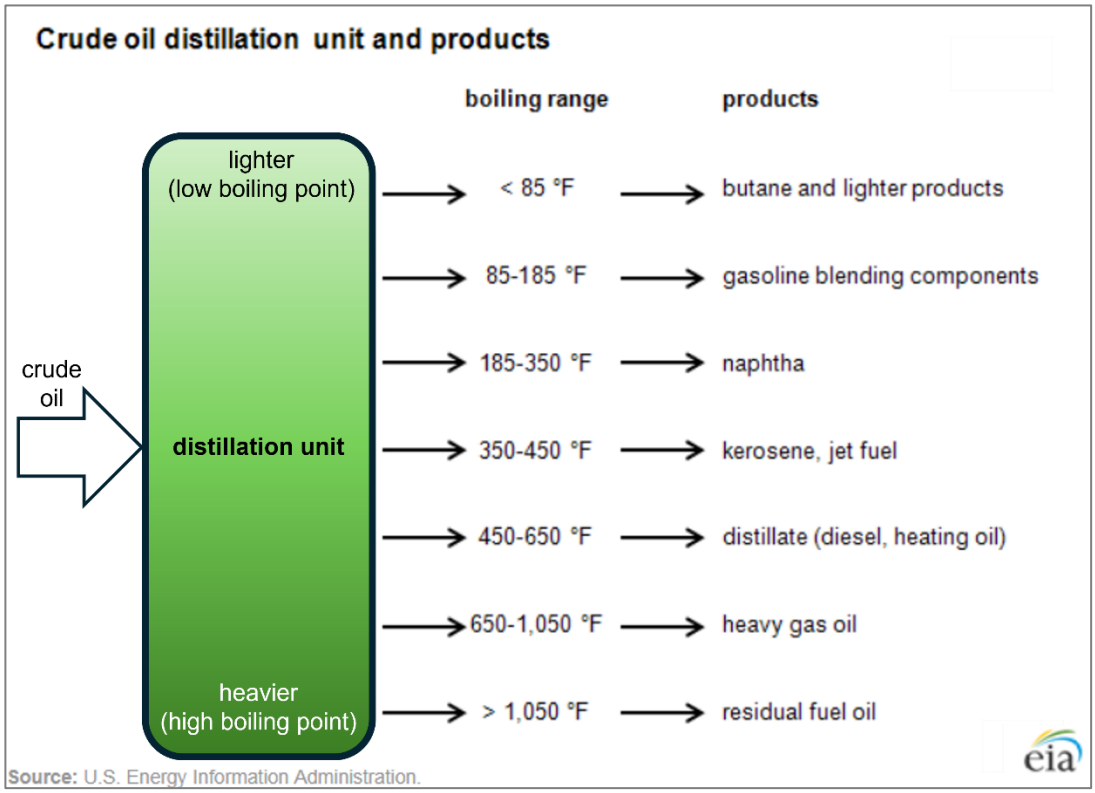
Temp at 12.0 % Recovery	115.60	°C
Temp at 13.0 % Recovery	119.70	°C
Temp at 14.0 % Recovery	127.80	°C
Temp at 15.0 % Recovery	133.70	°C
Temp at 16.0 % Recovery	138.80	°C
Temp at 17.0 % Recovery	144.80	°C
Temp at 18.0 % Recovery	150.60	°C
Temp at 19.0 % Recovery	153.10	°C
Temp at 20.0 % Recovery	158.70	°C
Temp at 21.0 % Recovery	164.60	°C
Temp at 22.0 % Recovery	168.80	°C
Temp at 23.0 % Recovery	174.20	°C
Temp at 24.0 % Recovery	178.40	°C
Temp at 25.0 % Recovery	183.30	°C
Temp at 26.0 % Recovery	189.20	°C
Temp at 27.0 % Recovery	195.60	°C
Temp at 28.0 % Recovery	197.00	°C
Temp at 29.0 % Recovery	201.60	°C
Temp at 30.0 % Recovery	207.80	°C
Temp at 31.0 % Recovery	212.30	°C
Temp at 32.0 % Recovery	216.20	°C
Temp at 33.0 % Recovery	218.90	°C
Temp at 34.0 % Recovery	222.40	°C
Temp at 35.0 % Recovery	227.30	°C
Temp at 36.0 % Recovery	230.80	°C
Temp at 37.0 % Recovery	235.20	°C
Temp at 38.0 % Recovery	237.40	°C
Temp at 39.0 % Recovery	241.40	°C
Temp at 40.0 % Recovery	245.60	°C
Temp at 41.0 % Recovery	249.30	°C
Temp at 42.0 % Recovery	253.40	°C
Temp at 43.0 % Recovery	255.10	°C
Temp at 44.0 % Recovery	259.20	°C
Temp at 45.0 % Recovery	263.60	°C
Temp at 46.0 % Recovery	267.00	°C
Temp at 47.0 % Recovery	270.90	°C
Temp at 48.0 % Recovery	273.70	°C
Temp at 49.0 % Recovery	278.60	°C
Temp at 50.0 % Recovery	283.40	°C
Temp at 51.0 % Recovery	287.10	°C
Temp at 52.0 % Recovery	290.80	°C
Temp at 53.0 % Recovery	294.90	°C
Temp at 54.0 % Recovery	300.30	°C
Temp at 55.0 % Recovery	302.80	°C
Temp at 56.0 % Recovery	306.60	°C
Temp at 57.0 % Recovery	311.40	°C
Temp at 58.0 % Recovery	316.10	°C
Temp at 59.0 % Recovery	319.00	°C
Temp at 60.0 % Recovery	324.60	°C
Temp at 61.0 % Recovery	329.80	°C
Temp at 62.0 % Recovery	333.60	°C
Temp at 63.0 % Recovery	339.90	°C
Temp at 64.0 % Recovery	344.20	°C

Temp at 65.0 % Recovery	349.70	°C
Temp at 66.0 % Recovery	355.80	°C
Temp at 67.0 % Recovery	360.40	°C
Temp at 68.0 % Recovery	366.80	°C
Temp at 69.0 % Recovery	371.40	°C
Temp at 70.0 % Recovery	378.30	°C
Temp at 71.0 % Recovery	383.30	°C
Temp at 72.0 % Recovery	390.40	°C
Temp at 73.0 % Recovery	396.00	°C
Temp at 74.0 % Recovery	402.00	°C
Temp at 75.0 % Recovery	409.10	°C
Temp at 76.0 % Recovery	415.40	°C
Temp at 77.0 % Recovery	422.00	°C
Temp at 78.0 % Recovery	429.80	°C
Temp at 79.0 % Recovery	437.00	°C
Temp at 80.0 % Recovery	444.90	°C
Temp at 81.0 % Recovery	453.20	°C
Temp at 82.0 % Recovery	461.80	°C
Temp at 83.0 % Recovery	470.90	°C
Temp at 84.0 % Recovery	480.30	°C
Temp at 85.0 % Recovery	489.70	°C
Temp at 86.0 % Recovery	499.90	°C
Temp at 87.0 % Recovery	510.40	°C
Temp at 88.0 % Recovery	522.30	°C
Temp at 89.0 % Recovery	535.10	°C
Temp at 90.0 % Recovery	549.20	°C
Temp at 91.0 % Recovery	564.20	°C
Temp at 92.0 % Recovery	580.20	°C
Temp at 93.0 % Recovery	597.50	°C
Temp at 94.0 % Recovery	616.90	°C
Temp at 95.0 % Recovery	638.90	°C
Temp at 96.0 % Recovery	664.90	°C
Temp at 97.0 % Recovery	697.00	°C
Temp at 98.0 % Recovery	737.30	°C

11.2.2 Wressle 1 crude oil distillation products based on EIA (2023) boiling temperature ranges.

Temp Min °F	Temp Max °F	Temp Min °C	Temp Max °C	Wressle Oil Cum. % Recovery	Wressle Oil Incremental % Recovery	Product (EIA, 2023)	Emissions Factor (tCO_2e/tonne product) [1]
	85	0	29	2.0%	2.0%	Butane (and lighter products)	3.033
85	185	29	85	6.0%	4.0%	Petrol	3.154
185	350	85	177	23.0%	17.0%	Naptha	3.142
350	450	177	232	36.0%	13.0%	Kerosene (jet fuel)	3.194
450	650	232	343	63.0%	27.0%	Diesel	3.207
650	1050	343	566	91.0%	28.0%	Heavy Gas Oil	3.227
1050	+	566+		100.0%	9.0%	Residual Oil (not combusted)	-
Weighted average emissions factor of combusted products (tCO_2e/tonne product)							**2.906**

[1] UK Government GHG Conversion Factors for Company Reporting (DESNZ, DEFRA, June 2024). Note: values are rounded from many decimal places, therefore totals may not sum exactly.



Source after US Energy Information Administration (EIA): https://www.eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil-the-refining-process.php

12 Appendix 2 – Scenario B sensitivity calculations

12.1 Scenario B: Wressle 1 specific factors

Scenario B assumes all sold oil is combusted with the 'high case' 3P production forecast. A number of databases were reviewed; the carbon content of the Wressle 1 oil is closely comparable to that of the 'miscellaneous product' cited in the CDP Scope 3 Category 11 Guidance for Oil & Gas, Appendix A1 (2021) and will provide a reasonable estimate of the emissions factor for the Wressle oil.

All gas sold is assumed to be combusted using the emissions factor calculated from Wressle 1 gas composition. It should be noted that there is uncertainty around the future composition of the gas produced from Wressle due to variability from the producing reservoirs. Therefore, sensitivities B-1 and B-2 have assessed the impact of variability in the gas emissions factor from the Wressle field development.

Scenario B - Wressle 1 and CDP (2021)

Emissions Factor Description	Source	Emissions Factor (tCO_2e/tonne product)
Oil - Miscellaneous Product (Carbon content 85%)	CDP (2021)	3.150
Gas - Wressle 1 flare gas (99.9% flare efficiency)	Wressle 1 flare gas data (Egdon)	2.902

3P Production Scenario		Total Sold Product	Total Emissions
		tonnes	tCO_2e
Wressle 1	Forecast Sold Oil (2025-2034)	41,233	129,885
Wressle 2 & 3	Forecast Sold Oil (2026-2039)	137,594	433,420
Wressle 1, 2 & 3	Forecast Sold Gas (2026-2039)	122,221	354,695
Total Sold Products		**301,048**	**917,999**

Note: values are rounded from many decimal places, therefore totals may not sum exactly.

Wressle Flare Emissions and Process Calculation 2024 (Flare Gas Feed 2 - Wressle, 14 Oct 2024)

Gas specification - Wressle 14th Oct 2024		Mole fraction of gas (%)	Atomic mass	Molar Mass	Mass	Effect of combustion
Component	Composition		(g/mol)	(g/mol)		
Hydrogen	H2	0.0%	2.02	2.02	0.0000	H2
Hydrogen Sulphide	H2S	0.0%	34.08	64.06	0.0000	SO2
Carbon Monoxide	CO	0.0%	28.01	44.01	0.0000	CO2
Carbon Dioxide	CO2	0.1%	44.01	44.01	0.0010	CO2
Nitrogen	N2	2.7%	28.01	28.01	0.0270	N2
Methane	CH4	67.0%	16.04	44.01	1.8380	CO2
NMVOCs	NMVOCs	31.1%	39.95	44.01	1.0218	CO2

Conversion Factor		Combustion Efficiency [1]
		99.90%
CO2	**2.862**	*Calculated from Wressle composition*
CH4	**0.00067**	*Calculated from Wressle composition*
N2O	**0.000081**	*EEMS default (Gas flaring Table 8.3)*

CO2e	**2.902**

[1] Cell V4 Uniflare enclosed flare combustion efficiency 99.9%

Note: values are rounded from many decimal places, therefore totals may not sum exactly.

12.2 Sensitivity B-1: Conservative UK Government emissions factors (2024)

The first sensitivity to Scenario B tests the impact of using other emissions factors. Reasonable emissions factors were selected for oil and gas from the UK Government GHG Conversion Factors for Company Reporting (DEFRA and DESNZ, 2024). The 'fuel oil' emissions factor was selected because this was the product with the highest emissions factor reported by the UK average refinery data, along with a generic 'natural gas' emissions factor.

Sensitivity B1 - UK Government Factors

Emissions Factor Description	Source	Emissions Factor (tCO_2e/tonne product)
Highest oil emissions factor - Fuel Oil	DEFRA-DESNZ (2024)	3.229
Generic gas emissions factor – Natural Gas	DEFRA-DESNZ (2024)	2.590

3P Production Scenario – Sensitivity B1		Total Sold Product	Total Emissions
		tonnes	tCO_2e
Wressle 1	Forecast Sold Oil (2025-2034)	41,233	133,137
Wressle 2 & 3	Forecast Sold Oil (2026-2039)	137,594	444,275
Wressle 1, 2 & 3	Forecast Sold Gas (2026-2039)	122,221	316,610
Total Sold Products		**301,048**	**894,023**

Note: values are rounded from many decimal places, therefore totals may not sum exactly.

12.3 Sensitivity B-2: Conservative EEMS emissions factors (2008)

The second sensitivity to Scenario B tests the impact of using emissions factors from EEMS (2008) assuming the oil is combusted in a diesel engine and the gas is combusted in a gas turbine. The EEMS emissions factors are conservative when compared to similar factors from the more recent DEFRA-DESNZ (2024) emissions factors, but comprise industry-specific factors (including venting and flaring) and this data source is widely used in the UK oil and gas industry.

Sensitivity B2 – EEMS (2008)

Emissions Factor Description	Source	Emissions Factor (tCO_2e/tonne product)
Oil - Diesel engine	EEMS (2008)	3.263
Gas - Gas turbine	EEMS (2008)	2.944

3P Production Scenario - Sensitivity B2		Total Sold Product	Total Emissions
		tonnes	tCO_2e
Wressle 1	Forecast Sold Oil (2025-2034)	41,233	134,558
Wressle 2 & 3	Forecast Sold Oil (2026-2039)	137,594	449,015
Wressle 1, 2 & 3	Forecast Sold Gas (2026-2039)	122,221	359,827
Total Sold Products		**301,048**	**943,401**

Note: values are rounded from many decimal places, therefore totals may not sum exactly.

13 Appendix 3 – Conversion factors

13.1 Emissions factors and data sources considered in this study

Factors used in this study are highlighted, noting the scenario or sensitivity case it was used in. Other factors were considered and are included for comparison, but were not used. Well-to-tank (WTT) factors are not included (where available) to avoid double-counting of upstream emissions.

Emission factors: Fuel combustion			DIRECT GHGs				Scenario/ Sensitivity [5]
Fuel Type	Source	Unit	tCO_2e of CO_2 per unit	tCO_2e of CH_4 per unit	tCO_2e of N_2O per unit	tCO_2e per tonne product (excl. WTT)	
Wressle 1 Flare Gas (**99.9%** flare efficiency)	Egdon Resources [1]	Tonnes	2.860	0.0188	0.0215	2.902	A & B
Flare Gas - Associated Gas	EEMS (2008) Table 8.3 [2]	Tonnes	2.800	0.2800	0.0215	3.101	
Gas Turbine	EEMS (2008) Table 8.1 [2]	Tonnes	2.860	0.0258	0.0583	2.944	B-S2
Diesel Engine	EEMS (2008) Table 8.2 [2]	Tonnes	3.200	0.0050	0.0583	3.263	B-S2
Refinery miscellaneous	UK Gov DEFRA-DESNZ (2024) [3]	Tonnes	2.930	0.0038	0.0072	2.944	A
Butane		Tonnes	3.029	0.0025	0.0016	3.033	A
Other petroleum gas		Tonnes	2.576	0.0013	0.0012	2.578	A & A-S1
Naptha		Tonnes	3.131	0.0038	0.0072	3.142	A & A-S1
Petrol (100% mineral diesel)		Tonnes	3.135	0.0110	0.0080	3.154	A & A-S1
Aviation spirit		Tonnes	3.128	0.0395	0.0265	3.194	A & A-S1
Burning oil		Tonnes	3.150	0.0084	0.0070	3.165	A
Gas oil		Tonnes	3.190	0.0037	0.0329	3.227	A & A-S1
Diesel (100% mineral diesel)		Tonnes	3.164	0.0035	0.0392	3.207	A & A-S1
Fuel oil		Tonnes	3.216	0.0054	0.0071	3.229	A & B-S1
Natural gas (100% mineral blend)		Tonnes	2.585	0.0039	0.0012	2.590	B-S1
Crude Oil (30 API oil)	CDP (2022) [4]	Tonnes	-	-	-	3.120	
Miscellaneous Product		Tonnes	-	-	-	3.150	B
Natural Gas (raw)		Tonnes	-	-	-	2.790	

[1] Calculations utilising gas composition data from Wressle-1 flare gas (November 2024)
[2] EEMS Atmospheric Emissions Calculations (UK govt, 2008) default emissions factors
[3] UK Government GHG Conversion Factors for Company Reporting (DESNZ, DEFRA, June 2024)
[4] CDP Scope 3 Category 11 Guidance for Oil & Gas, Tier 1 Production Method, using Tier 1 default values for emissions factors (CDP Appendix A1) https://cdn.cdp.net/cdp-production/cms/guidance_docs/pdfs/000/000/469/original/CDP-Scope-3-Category11-Guidance-Oil-Gas.pdf?1479754082
[5] Notation: A = Scenario A; A-S1 = Scenario A sensitivity case 1. B = Scenario B; B-S1 = Scenario B sensitivity case 1; B-S2 = Scenario B sensitivity case 2.
Note: values are rounded from many decimal places, therefore totals may not sum exactly.

13.2 Global Warming Potential factors used in this study

- All emissions factors in Appendix 13.1 include the global warming potential factors to enable reporting of total emissions in tonnes of CO_2 equivalent (tCO_2e). To ensure alignment with the UK Government Emissions Factors Database (2024), 100-year Global Warming Potential (GWP) factors from IPCC 5th Assessment (AR5) excluding carbon feedback are used.

Global Warming Potential Factors - CO_2 Equivalent, 100-year, without carbon feedbacks (AR5)				
CO_2	**CH_4**	**N_2O**	**Notes**	**Reference**
1	28	265	Excluding carbon feedbacks	GHG Protocol references these GWPs; UK Govt emissions database references IPCC AR5 GWPs.