ADURA

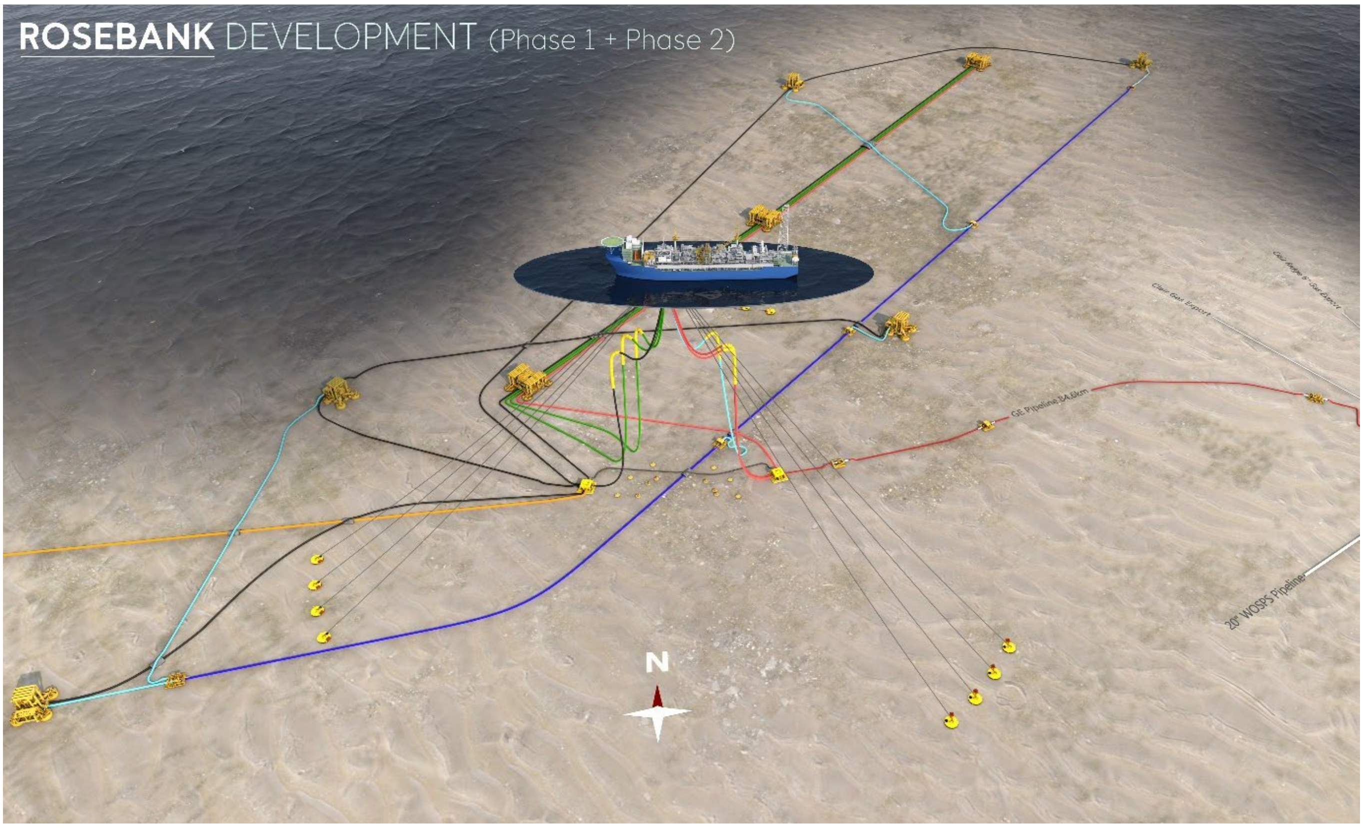
ROSEBANK DEVELOPMENT

RESPONSES TO REG 12(1) NOTICE (27TH MARCH 2026)

19th June 2026

ES Ref: ES/2022/001 (August 2022).

Further information required under DESNZ Regulation 12(1) Notice dated 27th March 2026.



Disclaimer

Note on Text

The Supplementary Guidance sets out guidance on the assessment of the effects of downstream GHG emissions on climate from an offshore oil & gas project. It is intentionally not prescriptive in the approach to be taken and invites developers to make an assessment which is appropriate for the particular project that is being assessed. It confirms that OPRED accepts that alternative approaches may be possible or even preferable. Consequently, consideration must be given to the appropriate approach for a particular project on a 'case by case' basis and this may result in different, though equally valid, approaches being adopted.

CONTENTS

ABBREVIATIONS

Abbreviation	Definition
%	Percent
°C	Degrees Celsius
API	American Petroleum Institute
APS	Announced Pledges Scenario
AR6	Sixth Assessment Report
BAT	Best Available Technique
bbl/d	Barrels per day
bcm/yr	Billion cubic metres per year
BECCS	Bioenergy combined with carbon capture
BEIS	Department for Business, Energy and Industrial Strategy
BIM	Budget Imbalance
BNZP	Balanced Net Zero Pathway
boe	Barrels of Oil Equivalent
CAPEX	Capital Expenditure
CCC	Climate Change Committee
CCS	Carbon Capture and Storage
CCUS	Carbon, Capture, Usage and Storage
CDD	Consecutive Dry Days
CDR	Carbon Dioxide Removal
CEA	Cumulative Effects Assessment
CH_4	Methane
CMIP6	Coupled Model Intercomparison Project 6
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2eq	Carbon Dioxide Equivalent
CO_3^{2-}	Carbonate
COP	Conference of the Parties
CPS	Current Policies Scenario
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CurPol	Current Policies
DACS	Direct Air Capture and Storage
DESNZ	Department for Energy Security and Net Zero
DUKES	Digest of UK Energy Statistics
EDGAR	Emissions Database for Global Atmospheric Research
EEMS	Environmental and Emissions Monitoring System
EEZ	Exclusive Economic Zone
EF	Emission Factor
EIA	Environmental Impact Assessment
EJ/yr	Exajoules per year
EPA	Environment Protection Agency
EPL	Energy Profits Levy
EPOs	Environmental Protection Objectives
ERSSTv5	Extended Reconstructed Sea Surface Temperature, Version 5
ES	Environmental Statement
ETCs	Extratropical Cyclones
EU	European Union
FPSO	Floating Production Storage and Offloading Vessel
FTE	Full-Time Equivalent
GEC	Global Energy and Climate Change

Abbreviation	Definition
GHG	Greenhouse Gas
GPP	Government Plans and Projections
GSAT	Global Surface Air Temperature
Gt	Gigatonnes
Gt/yr	Gigatonnes per year
$GtCO_2$/yr	Gigatonnes of CO_2 per year
GVA	Gross Value Added
H^+	Hydrogen ion
HadSST4	Hadley Centre's sea surface temperature dataset, Version 4
HCO_3^-	Bicarbonate
IAMs	Integrated Assessment Models
IEA	International Energy Agency
IEMA	Institute of Environmental Management and Assessment
IISD	International Institute for Sustainable Development
IMPs	Illustrative Mitigation Pathways
IMP-GS	Illustrative Mitigation Pathways - Gradual Strengthening
IMP-LD	Illustrative Mitigation Pathways - Low Demand
IMP-Neg	Illustrative Mitigation Pathways - Net Negative Emissions
IMP-Ren	Illustrative Mitigation Pathways - Renewables
IPCC	Intergovernmental Panel on Climate Change
Ips	Illustrative Pathways
ISEP (formerly IEMA)	Institute of Sustainability end Environmental Practitioners (formerly Institute of Environmental Management and Assessment)
JAXA	Japan Aerospace Exploration Agency
km^2	Kilometres squared
$kgCO_2e$/boe	Kilograms of Carbon Dioxide Equivalent per Barrels of Oil Equivalent
Kg/Sm^3	Kilograms per Standard Cubic Meter
kW	Kilowatt
LOF	Life of Field
LTOBM	Low Toxicity Oil-Based Mud
m	Meter
m^2	Meter Squared
m^3	Meter Cubed
Mb/d	Million Barrels per Day
MEMW	Marine Environmental Modelling Workbench
mm/yr	Millimetres per year
mmscf/d	Million Standard Cubic Feet per Day
ModAct	Moderate Action
MODU	Mobile Offshore Drilling Unit
Mt	Million Tonnes
MWe	Megawatts Electric
NDC	Nationally Determined Contributions
NGL	Natural Gas Liquid
N_2O	Nitrous Oxide
NESCoL	North East Scotland College
NOAA	National Oceanic and Atmospheric Administration
NORSOK	Norsk Sokkels Konkurranseposisjon
NSFP	North Sea Future Plan
NSIDC	National Snow and Ice Data Centre
NSTA	North Sea Transition Authority
NZE	Net Zero Emissions
OEUK	Offshore Energies UK

Abbreviation	Definition
OGMP 2.0	Oil and Gas Methane Partnership 2.0
OPEC	Organisation of Petroleum Exporting Countries
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OPEX	Operating Expenses
OPITO	Offshore Petroleum Industry Training Organisation
OSI SAF	Ocean and Sea Ice Satellite Application Facility
OSPAR	Oslo Paris Convention
PE	Production Efficiency
PINS	Planning Inspectorate
ppb	Parts Per Billion
PPC	Pollution Prevention and Control
PPM	Parts Per Million
RCPs	Representative Concentration Pathways
RSC	Royal Society of Chemistry
SACFOR	Superabundant, Abundant, Common, Frequent, Occasional, Rare
SCAP	Supply Chain Action Plan
SEI	Stockholm Environment Institute
SET	Standard Economic Template
SINTEF	Stiftelsen for industriell og teknisk forskning
SO_2	Sulphur Dioxide
SPEI	Standardised Precipitation-Evapotranspiration Index
SPI	Standardised Precipitation Index
SSP	Shared Socioeconomic Pathways
STEM	Science, Technology, Engineering and Mathematics
STEPS	Stated Policies Scenario
Tcm/yr	Trillion cubic meters per year
TCRE	Transient climate response to cumulative emissions of carbon dioxide
TCs	Tropical cyclones
TFP	Total Factor Productivity
UAV	Unmanned aerial vehicle
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UNCC	United Nations Climate Change
UNEP	United Nations Environment Programme
USA	United States of America
VOC	Volatile Organic Compound
VOCIC	VOC Industry Cooperation
WBM	Water Based Mud
WDCGG	World Data Centre for Greenhouse Gases
WGI	Working Group I
WGII	Working Group II
WGIII	Working Group III
WMO	World Meteorological Organisation
WSI	Water Scarcity Index
WTT	Well To Tank
ZJ	Zettajoules

INTRODUCTION

This document provides the response to the request for further information under The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020, Notice Under Regulation 12(1) received on the 27th March 2026.

For each OPRED comment received, Adura has considered the comment, presents a response to address the comment and (where relevant) states whether the further information provided affects the conclusions of the original downstream Scope 3 emissions presented in Equinor (2025).

PART 1: SCOPE 3 EMISSIONS ASSESSMENT DOCUMENT

1 ITEM 1

> "Page 9 of the supplementary guidance for assessing the effects of downstream scope 3 emissions on climate from offshore oil and gas projects ("supplementary EIA guidance") notes that: "a realistic and reasonable description of the current state of the environment (baseline scenario) should be presented" and that "the effects of a project would be assessed against" this baseline scenario. For scope 3 greenhouse gas (GHG) emissions the location of the emissions is not relevant and a global baseline in a global context must be considered.
>
> Section 3.2 of the further information provided sets out global GHG emissions and historic trends but does not further describe the baseline scenario in relation to the current state of the environment. *Please describe the current state of the climate and the environment, noting the baseline scenario will not be static over the lifetime of the project*
>
> In line with the supplementary EIA guidance and Schedule 6(3), the baseline scenario should include a reasonable future estimate of global GHG emissions affecting the climate over the lifetime of the project, reflecting the expected trajectory of climate conditions and the environment.
>
> Where illustrative emissions pathways are used to help describe a baseline scenario, then the likely trajectory of emissions and associated climate effects across the life of the field, should be considered (for example, but not limited to illustrative emissions pathways under IPCC AR6 such as CurPol/ModAct pathways[1]).
>
> The baseline scenario should consider all relevant environmental information and scientific knowledge (e.g. IPCC, 2023[2]) related to climate and the effects of climate over the lifetime of the project. This could acknowledge the effects of emissions and climate change currently and over the lifetime of the project on, for example, but not limited to:
>
> – global and local marine environment (e.g. sea temperatures, marine heatwaves, ocean chemistry, impacts on carbon sequestration capacity);
> – biodiversity, human health, climate-related tipping points; socio-economic implications
> – extreme weather events."

The comment is noted and has been taken into account in the review of the assessment (Equinor, 2025). The response below has been prepared to provide additional information on the current state of the global climate and the environment over the lifetime of the Rosebank Development.

Sections 1.1 and 1.2 below provide additional information to describe the global baseline scenario using relevant environmental information and scientific knowledge. The global baseline scenario describes the state of the climate and the effects of Greenhouse Gas (GHG) emissions and climate change currently and over the lifetime of the Rosebank Development. This additional information should be read in conjunction with, and builds upon, Section 3 of Equinor (2025) which details both the current environmental baseline as it relates to global GHG emissions (Section 3.2; Equinor, 2025) and also a reasonable future estimate of global GHG emissions over the lifetime of the Development utilising Shared Socio-economic Pathways (SSPs) narrative scenarios (Section 3.3; Equinor, 2025).

1.1 CURRENT STATE OF THE ENVIRONMENT

1.1.1 GREENHOUSE GAS CONCENTRATIONS

This section, in accordance with the Supplementary Guidance for Assessing the Effects of Downstream Scope 3 Emissions on Climate from Offshore Oil and Gas Projects (DESNZ, 2025a) (the "Supplementary Guidance") and Schedule 6(3) of the Regulations, describes the current state of the environment as referred to in the sources listed by OPRED in Item 1.

The IPCC is the international body for assessing the science related to climate change. The IPCC was set up to "*provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation*" (IPCC mandate).

IPCC assessments provide a scientific basis for governments at all levels to develop climate related policies. The assessments present projections of future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options.

The IPCC Annual Report 6 (AR6) (IPCC, 2023) Working Group I states that it is *"unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred."*

Human activities have contributed to significant changes in the environment over the past century. One of the most notable indicators is the rising concentration of GHG emissions, particularly carbon dioxide (CO_2), in the atmosphere. Global monitoring stations, such as the Mauna Loa Observatory in Hawaii and those operated by NOAA (National Oceanic and Atmospheric Administration), continuously track CO_2, methane (CH_4) and nitrous oxide (N_2O) concentrations to assess trends and guide efforts to reduce GHG emissions. The World Data Centre for GHG emissions compiles data from various sources to estimate global GHG levels (Met Office, 2026a).

Since 1750 (representative of the pre-industrial period), global concentrations of CO_2, CH_4 and N_2O have increased by approximately 47%, 156% and 23%, respectively (IPCC, 2023).

1.1.1.1 CARBON DIOXIDE (CO2) CONCENTRATIONS

Recent measurements indicate that atmospheric CO_2 has surpassed 420 parts per million (ppm) (Lan *et al.*, 2026). This represents approximately a 47-50% increase since pre-industrial times, primarily driven by fossil fuel combustion, deforestation, and industrial processes (IPCC, 2023; Lindsey, 2025). Emissions from fossil fuel combustion are largely attributable to economically developed, densely populated regions, with around 82% of these emissions attributed to the industrialised northern extratropics (Jacobson *et al.*, 2023).

Seasonal variations are also observed: CO_2 levels tend to rise during winter and spring in the Northern Hemisphere and decrease in summer and early autumn due to increased plant photosynthesis. Despite these seasonal fluctuations, the overall trend is a consistent increase in atmospheric CO_2 over time (Met Office, 2026a). Figure 1 presents monthly atmospheric CO_2 concentrations from four datasets: Mauna Loa, NOAA marine global, Kennaook/Cape Grim (CSIRO, 2025), and WDCGG, and shows an upwards trend in concentration since the 1950s (Met Office, 2026a).

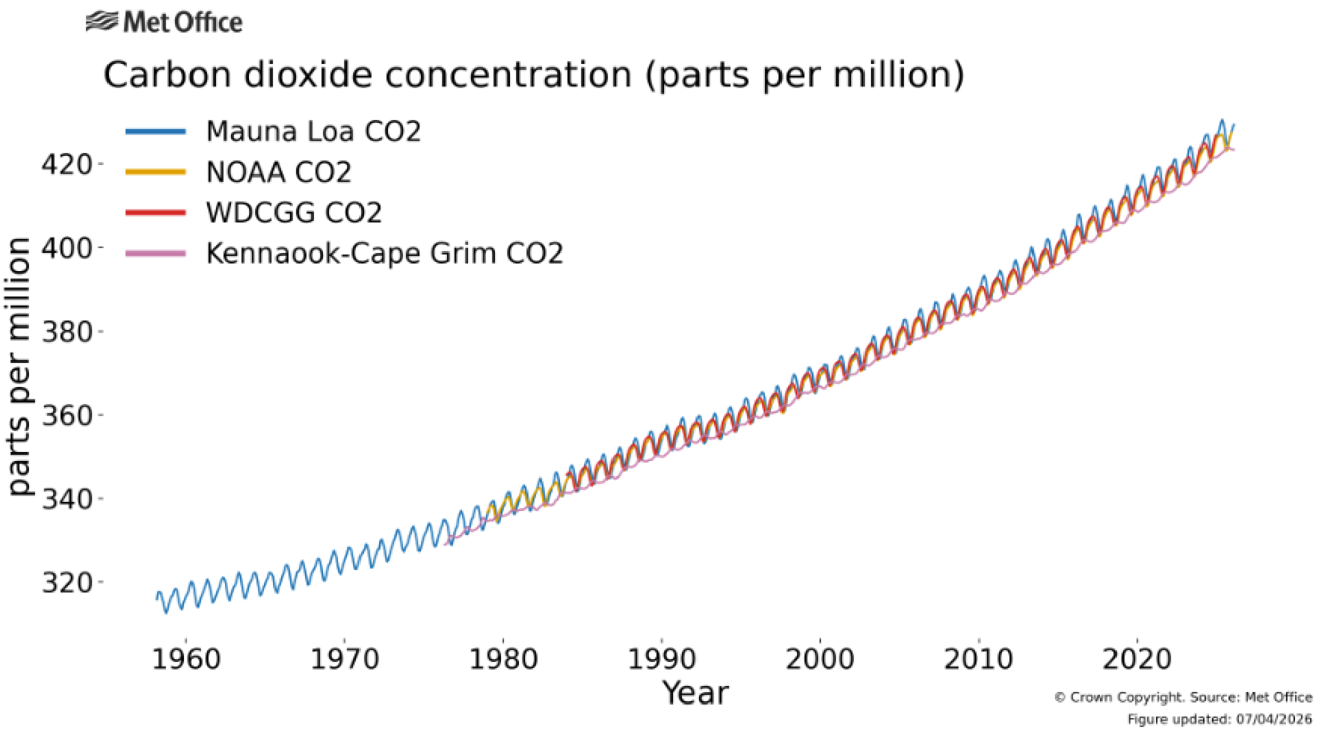


Figure 1: Monthly carbon dioxide concentration in the atmosphere. Four data sets are shown: Mauna Loa, NOAA marine global, Kennaook/Cape Grim (CSIRO), and WDCGG (Met Office, 2026a).

During the 1960s, atmospheric CO_2 increased at an average rate of approximately 0.8 ppm per year. This rate rose to about 1.6 ppm per year in the 1980s and remained elevated at around 1.5 ppm per year through the 1990s. In the most recent decade (2015-2024), the annual increase has further accelerated to approximately 2.6 ppm per year. Consequently, the annual rate of increase in atmospheric CO_2 over the last 60 years is estimated to be 100-200 times faster than the natural increases observed at the end of the last ice age, between 11,000 and 17,000 years ago (Lindsey, 2025).

1.1.1.2 METHANE (CH4) CONCENTRATIONS

Although CH_4 has a shorter atmospheric lifetime than CO_2 (and eventually oxidises to form CO_2), it is a considerably more powerful GHG due to its higher radiative efficiency, resulting in a greater warming effect per unit mass (IPCC, 2021).

The Global Monitoring Division of NOAA's Earth System Research Laboratory has monitored atmospheric CH_4 concentrations since 1983. Recent observations indicate a continuing increase in CH_4 concentration, which reached approximately 1,946 parts per billion (ppb) in November 2025, up from around 1,940 ppb in November 2024 (Lan *et al.*, 2026).

Recent increases in atmospheric CH_4 concentrations have accelerated since 2006, increasing by an average of about 7.6 ppb per year between 2010 and 2019, with a faster rise of roughly 9.3 ppb per year from 2014 to 2019 (IPCC, 2021). Figure 2 presents monthly global atmospheric CH_4 concentrations from three datasets: NOAA, CSIRO, and WDCGG, all of which show a consistent overall trend, with a more rapid increase evident from around 2006 onward (Met Office, 2026a).

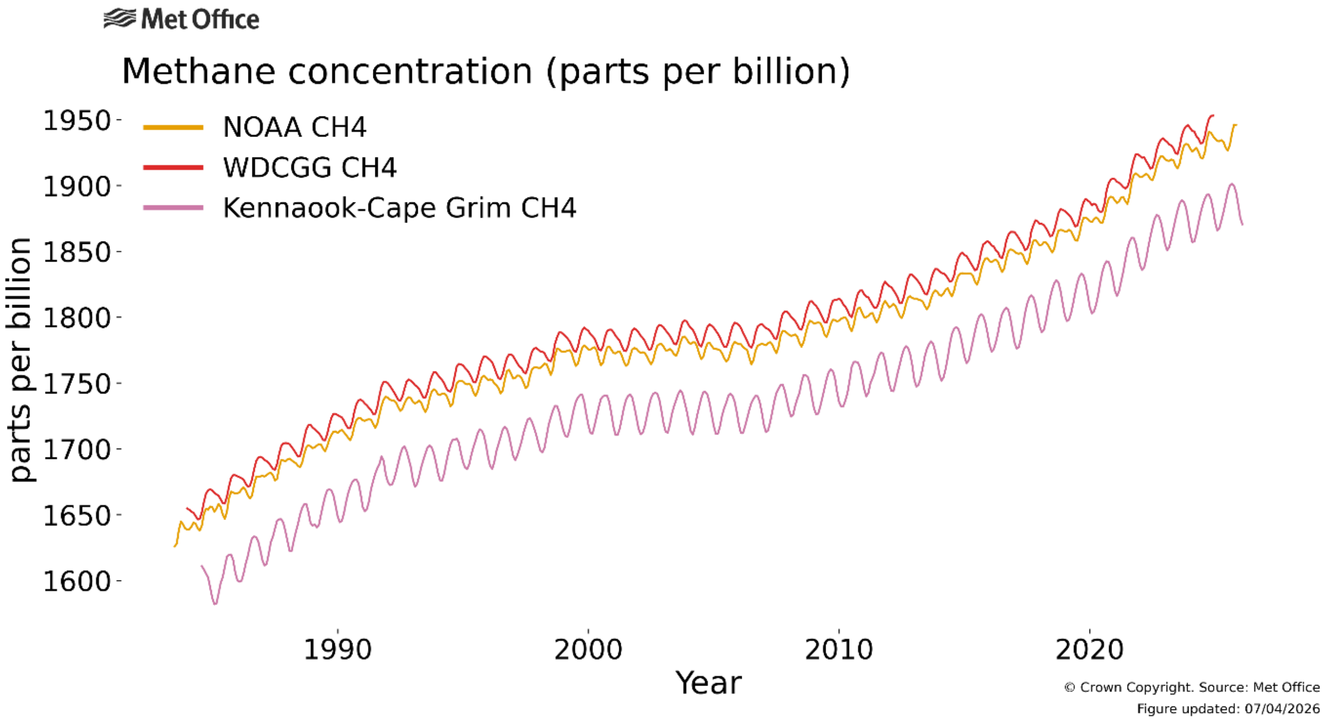


Figure 2: Monthly global methane concentration in the atmosphere. Three data sets are shown: NOAA, Kennaook/Cape Grim (CSIRO) and WDCGG (Met Office, 2026a).

Large uncertainties in CH_4 emission sources and sinks have made it difficult to accurately quantify global CH_4 concentrations and determine the main drivers of CH_4 increases since the 1980s. Despite these uncertainties, assessments indicate that "*the multi-decadal growth trend in atmospheric CH_4 is dominated by anthropogenic activities, and the growth since 2007 is largely driven by emissions from both fossil fuels and agriculture (dominated by livestock).*" (IPCC, 2021). However, other studies suggest "*that increased emissions from microbial sources are the strongest driver, with a relatively smaller contribution from other processes, e.g. fossil fuel exploitation*" (Lan *et al.*, 2021).

1.1.1.3 NITROUS OXIDE (N_2O) CONCENTRATIONS

The NOAA Global Monitoring Laboratory has monitored N_2O concentrations since 1997 and available data shows concentrations are steadily increasing. A global average atmospheric N_2O concentration of 339.46 ppb was observed in November 2025 (an increase from 338.08 ppb in November 2024) (Lan *et al.*, 2026).

Between 1995 and 2019, N_2O concentrations increased by an average of about 0.85 ppb per year, rising further to around 0.95 parts per billion (ppb) per year during 2010 – 2019 (IPCC, 2021). As noted by the IPCC, *"This increase is dominated by anthropogenic emissions, which have increased by 30% between the 1980s and the most recent observational decade (2007–2016). Increased use of nitrogen fertilizer and manure contributed to about two-thirds of the increase during the 1980–2016 period, with the fossil fuels/industry, biomass burning, and wastewater accounting for much of the rest.*" (IPCC, 2021).

Figure 3 presents the monthly N_2O concentration in the atmosphere from the Kennaook/Cape Grim (CSIRO, 2025) and WDCGG, highlighting a long term increase in N_2O levels (Met Office, 2026a).

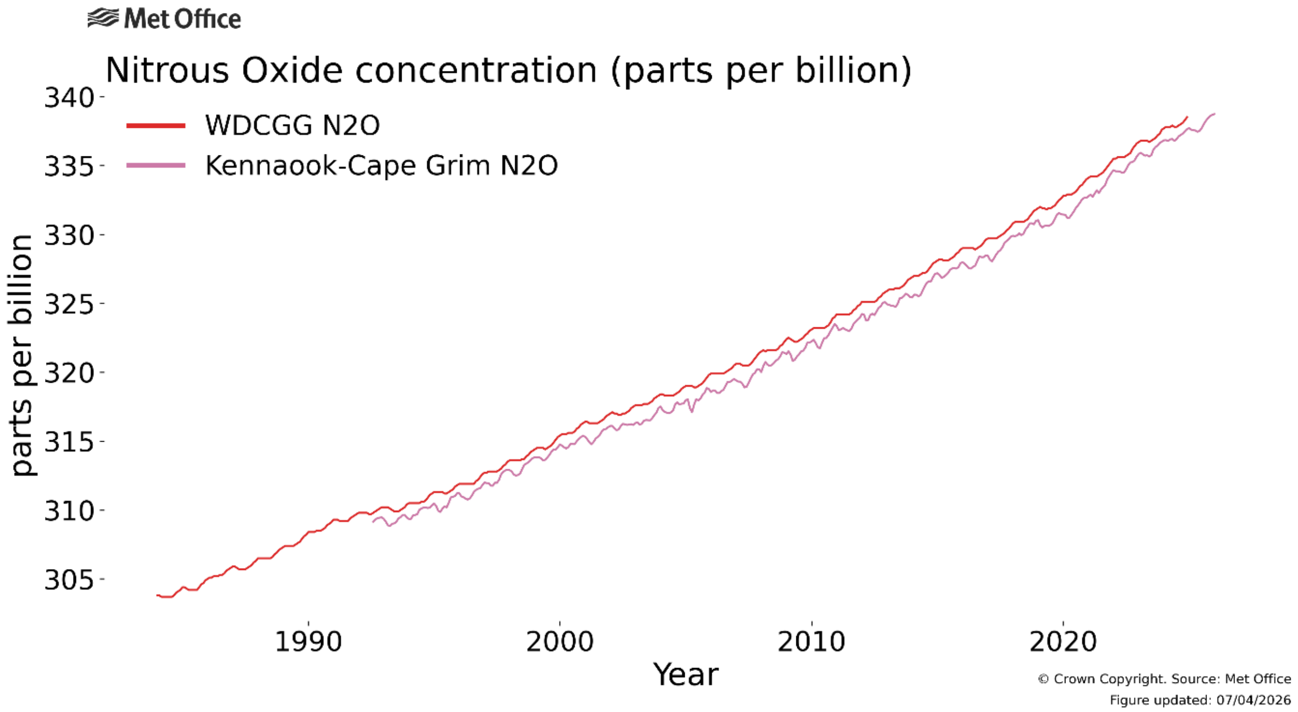


Figure 3: Monthly nitrous oxide concentration in the atmosphere as calculated by Kennaook/Cape Grim (CSIRO) and WDCGG (Met Office, 2026a).

1.1.2 CURRENT STATE OF THE ENVIRONMENT – ENVIRONMENTAL INDICATORS

The IPCC AR6 (IPCC, 2023) Working Group I states that it is *“unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.”*

“*Tipping points refer to critical thresholds in a system that, when exceeded, can lead to a significant change in the state of the system, often with an understanding that the change is irreversible. An understanding of the sensitivities of tipping points in the physical climate system, as well as in ecosystems and human systems, is essential for understanding the risks associated with different degrees of global warming.*” (IPPC, 2018).

Table 1 provides a high level summary of relevant scientific literature relating to the current state of the environment based on the environmental observations described in Appendix 1 and focusing on key indicators linked to potential climate tipping points. These indicators span the cryosphere, biosphere, ocean, and atmosphere, highlighting recent changes and emerging signals of heightened climate risk. Table 1 and Appendix 1 have been prepared by Adura by drawing on a range of respected, publicly available scientific sources. This summarises and paraphrases information from those sources and does not express the views or opinions of Adura, or Ithaca. While efforts have been made to reflect the content of the underlying sources accurately, the summaries necessarily involve simplification and are not intended to constitute an exhaustive description of every aspect of that source. Readers should refer to the original sources for the full analysis.

Table 1: Summary of environmental baseline indicators with reference to 2020 Regulations Schedules 6(3) and 6(5): current global observations.

Environmental Indicator (EIA Regulation Schedule 6(5)(a))	Current Global Observations	Appendix 1 Sub-Sections
Surface Temperature *(Schedule 6(5)(a)(iii))*	Global average temperature has increased by around 1.1°C compared with pre-industrial levels (1850-1900 baseline). Recent years have been among the warmest on record; notably, 2024 was the warmest year on record at around 1.55°C above the 1850–1900 baseline.	Global Surface Temperature
Extreme Weather and Climate Events *(Schedule 6(5)(a)(iii))*	Extreme weather events are rare events at a specific place and time, while extreme climate events persist for some time, such as a season. Recent decades show an increased frequency and intensity (compared to 1850-1900 baseline) in heatwaves, heavy rainfall, droughts, and tropical cyclones globally. **Temperature extremes:** Since the 1950s, hot extremes and heatwaves have become more frequent, intense, and longer lasting worldwide, while cold extremes have declined. Land minimum temperatures have increased around 3 times more than global surface temperatures since the 1960's, particularly in the Arctic. **Heavy precipitation:** The frequency and intensity of heavy rainfall events have increased across most land regions, particularly in North America, Europe, and Asia, though confidence is lower for very short duration events due to limited data. **Drought trends:** Agricultural and ecological droughts have increased globally since the 1950s, becoming more widespread, intense, and long-lasting, with particularly strong effects in mid-latitude and subtropical regions.	Extreme Weather and Climate Events
Sea Level Rise *(Schedule 6(5)(a)(iii))*	Global mean sea level rose by approximately 0.16 m between 1902–2015. The rate of sea level rise has increased significantly in recent decades, with the rate accelerating from around 1.4 mm/yr (1901–1990) to around 3.6 mm/yr (2006–2015) and around 4.75 mm/yr during 2015–2025. In recent years, satellite data has shown rapid sea level rise of approximately 5 mm in 2023–2024 influenced by El Niño. By 2025, global mean sea level was around 11 cm higher than in 1993.	Global Mean Sea Level

Environmental Indicator (EIA Regulation Schedule 6(5)(a))	Current Global Observations	Appendix 1 Sub-Sections
Cryosphere Changes *(Schedule 6(5)(a)(iii))*	**Ice mass loss:** During 2006-2015, the Greenland Ice Sheet lost approximately 278 Gt/yr (equivalent to 0.77 mm/yr sea level rise) and the Antarctica Ice Sheet lost around 155 Gt/yr (equivalent to 0.43 mm/yr), reflecting rapid cryosphere ice loss. **Permafrost thaw:** Permafrost temperatures have risen by around 0.29°C (±0.12 °C) since the 1980s across polar and high mountain regions, increasing ground instability and potentially affecting approximately 1460–1600 Gt of carbon stored in frozen soils. **Sea-ice decline:** Arctic sea ice has decreased across all months throughout the year since 1979, with September extent declining by around 12.8% per decade. In 2025, Arctic sea ice averaged around 10.10 million km^2 (approximately 0.9 million km^2 below normal) and Antarctic sea ice around 10.81 million km^2, the third lowest on record.	Cryosphere Changes
Oceanic Changes *(Schedule 6(5)(a)(iii))*	**Rising sea surface temperatures:** Global ocean surface temperatures have increased by around 0.88°C since pre-industrial times, with most warming occurring since 1980, indicating an acceleration of ocean warming in recent decades. **Increasing ocean heat content:** Ocean heat content has risen steadily since the 1970s, reaching record levels in 2025; the rate of warming in the upper 2,000 m has more than doubled since the mid-20th century. **Marine heatwaves and stratification:** Marine heatwaves are becoming more frequent, longer lasting, and more intense, while surface warming and freshening have increased upper ocean stratification, reducing vertical mixing and affecting circulation and ecosystems. **Ocean acidification:** The ocean has absorbed approximately 20–30% of anthropogenic CO_2 since the 1980s, causing surface ocean pH to decline by around 0.017–0.027 pH units per decade. Ocean acidification is widespread, exceeds natural variability, and is strongest in parts of the Indian, Southern, Pacific, and Atlantic Oceans.	Oceanic Changes

Environmental Indicator (EIA Regulation Schedule 6(5)(a))	Current Global Observations	Appendix 1 Sub-Sections
Biodiversity *(Schedule 6(5)(a)(ii))*	**Ecosystem disruption:** Widespread changes have been observed across terrestrial, freshwater, and marine ecosystems, including shifts in species ranges, altered seasonal timing, and ecosystem reorganisation. **Biodiversity decline:** Global wildlife populations show high declines, with average vertebrate abundance falling by around 73% since 1970, indicating widespread ecosystem stress and reduced resilience. **Coral reef loss:** Coral reefs are experiencing rapid degradation, with the ongoing global bleaching event (since 2023) affecting around 84% of reefs, threatening biodiversity and ecosystem functioning.	Biodiversity
Population and Human Health *(Schedule 6(5)(a)(i))*	**Rising health risks:** Physical health, mental well-being, nutrition, and longevity are all impacted with growing pressure on healthcare systems. **Climate sensitive diseases:** Observed changes in temperature, rainfall, and extreme events are linked to the spread of vector and water borne diseases (e.g. dengue, malaria at higher altitudes, diarrhoeal diseases), and increased respiratory and mental health impacts following floods, storms, and wildfires. **Heat related impacts:** More frequent and intense heat extremes are increasing heat-related illness, reducing safe working capacity, and negatively affecting mental health, cognitive performance, and wellbeing. **Food and nutrition insecurity:** Climate variability and extremes are associated with increased food insecurity and multiple forms of malnutrition, particularly in low- and middle-income regions affected by droughts, floods, and storms.	Population and Human Health
Material Assets *(Schedule 6(5)(a)(iv))*	There are increasing risks to buildings, infrastructure, and physical assets due to more frequent and intense flooding, heatwaves, storms, erosion, and wildfires. Many assets were designed for historic climate conditions and are increasingly vulnerable to accelerated degradation, reduced performance, and shorter lifespans. **Energy and Industrial Water Use:** Water scarcity and rising temperatures are reducing the performance and utilisation of energy infrastructure, particularly hydropower	Material Assets, Cultural Heritage and the Landscape

Environmental Indicator (EIA Regulation Schedule 6(5)(a))	Current Global Observations	Appendix 1 Sub-Sections
	and thermoelectric power plants, with increased operational disruptions and economic losses. **Extreme events and costs:** Growing frequency and intensity of extreme weather events are driving rising economic losses through infrastructure damage, supply-chain disruption, and recovery costs, placing pressure on public finances, insurance systems, and development pathways. **Food and resource systems under stress:** Reduced crop yields, fishery productivity, and forest outputs in multiple regions have been observed, with extreme events increasingly causing large-scale food production losses and threatening food security and livelihoods.	
Cultural Heritage *(Schedule 6(5) (iv))*	Cultural heritage assets, including historic buildings, archaeological sites, cultural landscapes, and traditional practices, are increasingly exposed to climate-related pressures such as erosion, flooding, wildfires, sea level rise, and changing soil moisture. Traditional land-use and farming practices are being eroded, particularly Indigenous and small-scale systems, leading to loss of cultural knowledge and reduced resilience of cultural landscapes.	Material Assets, Cultural Heritage and the Landscape
The Landscape *(Schedule 6(5) (iv))*	Widespread change has been observed across terrestrial, freshwater, coastal, and marine landscapes through rising temperatures, altered rainfall patterns, sea-level rise, and more frequent extreme events. **River Landscapes and Connectivity:** River landscapes are being altered by changing flow regimes, with increased drying, reduced connectivity, and shifts from permanent to intermittent watercourses in many regions. **Lake Landscapes:** Lake landscapes are changing unevenly, with lake levels rising, falling, or stabilising depending on location, and growing evidence of loss of small temporary ponds, resulting in simplified freshwater landscapes. Mountain and high altitude landscapes are being reshaped by glacier retreat, permafrost thaw, and altered runoff, leading to new lake formation, changed drainage patterns, and increased landscape instability.	Material Assets, Cultural Heritage and the Landscape

Environmental Indicator (EIA Regulation Schedule 6(5)(a))	Current Global Observations	Appendix 1 Sub-Sections
Note: The following references were used to develop the content in Table 1: (Burton *et al.*, 2024; EDGAR, 2025; European Parliamentary Research Service, 2024; Forster *et al.*, 2025; Historic England, 2026; IPCC, 2019; IPCC, 2021; IPCC, 2022; IPCC, 2023; Jacobson *et al.*, 2023; Lan *et al.*, 2021; Lan *et al.*, 2026; Lindsey, 2025; Met Office, 2026a; Met Office, 2026b; Munich Re, 2026; National Geographic, 2019; NOAA, 2025; OECD, 2025; Ortiz-Bobea *et al.*, 2021; Rodell and Li, 2023; Vicente-Serrano *et al.*, 2022; UNESCO World Heritage Centre, n.d.; WMO, 2025; WMO, 2026; WWF, 2024).		

1.2 FUTURE ESTIMATE OF GHGS AFFECTING CLIMATE OVER THE LIFETIME OF THE ROSEBANK DEVELOPMENT

1.2.1 GREENHOUSE GAS CONCENTRATIONS

The IPCC Shared Socioeconomic Pathways (SSPs) are a set of alternative socioeconomic future projections designed to support climate change analysis. Their purpose is to provide a consistent framework for exploring how different patterns of societal development influence future GHG emissions and are used in scenario-based projections to compare how different development pathways lead to different climate outcomes and risks (IPCC, 2022a).

The projected CO_2 emissions from 2015 to 2100 under five IPCC Shared Socioeconomic Pathways (SSPs) are presented in Figure 4. The projected atmospheric CO_2 concentrations under the different SSP futures are also shown in Figure 4.

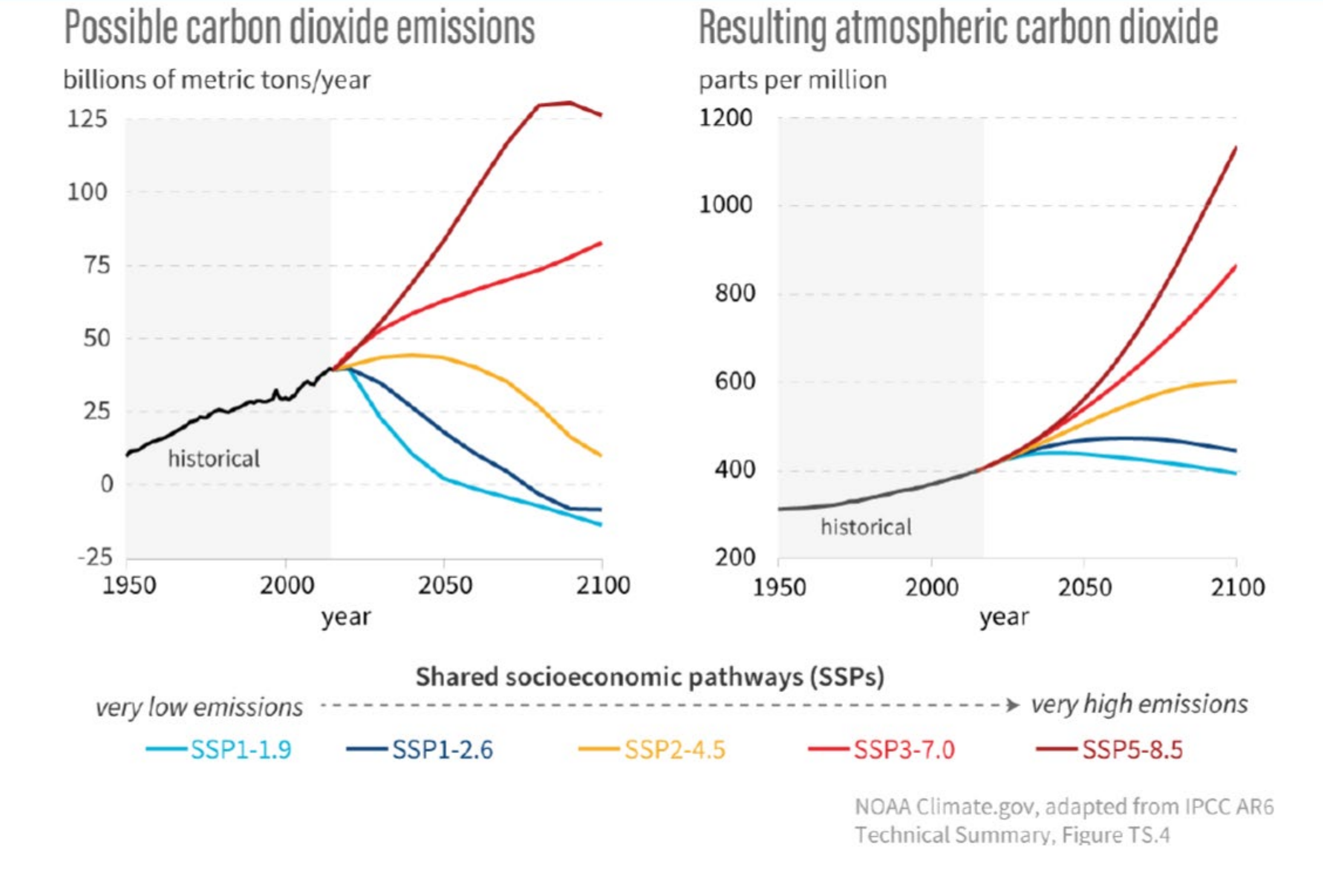


Figure 4: Potential future pathways for annual global CO_2 emissions (left) and the resulting atmospheric CO_2 concentrations through the end of the century (right) (Lindsey, 2025).

For the five different SSPs, Figure 4 shows:

- **SSP1-1.9 and SSP1-2.6:** Rapid CO_2 emissions cuts with Net Zero reached by mid century. The CO_2 concentrations peak and then stabilise, with a slight decline by 2100. These pathways align with 1.5–2°C long term warming limits.
- **SSP2-4.5:** CO_2 emissions decline at a slower rate compared to SSP1-1.9 and SSP1-2.6. CO_2 concentrations continue to accumulate in the atmosphere, locking in higher long term warming.
- **SSP3-7.0 and SSP5-8.5:** CO_2 emissions continue rising with the resulting CO_2 concentrations accelerating upwards. This leads to very high warming which is largely irreversible over century-scale time horizons.

Figure 5 panel (a) presents the projected emissions trajectories for CO_2 and additionally presents the emission pathways from 2015 to 2100 for three key non-CO_2 drivers included in the SSPs: methane (CH_4), nitrous oxide (N_2O) and sulphur dioxide (SO_2). SO_2 is a contributor to cooling aerosols but is not considered further in this assessment. The lower-emissions pathways (SSP1-1.9, SSP1-2.6) project declining emissions of most non-CO_2 gases while the higher emissions pathways (SP3-7.0, SSP5-8.5) project sustained or increasing emissions for CH_4 and N_2O. SO_2 emissions decline across all scenarios, reflecting improved air-quality controls.

Panel (b) in Figure 5 illustrates the projected contributions to global surface temperature increase from CO_2 and non-CO_2 GHG emissions for the five SSPs in 2081-2100 (relative to the 1850-1900 baseline). In all scenarios, CO_2 is shown as the largest contributor to total warming, with non-CO_2 GHG emissions contributing to additional warming. Net cooling contributions are also presented across all scenarios from other anthropogenic drivers, primarily aerosols and land-use changes, which partially offset GHG-related warming.

1.2.2 ENVIRONMENTAL RECEPTORS

Future predictions of how environmental receptors (such as human health, biodiversity, oceans, the cryosphere etc.) will respond in a warming world are inherently difficult to define with precision. The climate system is complex and influenced by numerous interacting physical, biological, and socio-economic processes operating across different spatial and temporal scales. While the direction of change is often well understood (for example, increasing temperatures, sea-level rise, and changes in precipitation patterns), the magnitude, timing, and regional expression of these changes remain uncertain. These uncertainties arise from limitations in observational records, natural climate variability, differences between climate models, and uncertainty around future human activities and emissions trajectories.

The IPCC has addressed these challenges through a structured and evidence-based assessment process. Working Group I (WGI) focuses on the physical science basis of climate change, using observations, paleoclimate records and climate model simulations to project future changes in temperature, precipitation, sea level, cryosphere extent and extreme weather events. These IPCC WG1 projections are not exact predictions of what will happen. Instead, they describe a range of possible future outcomes and include confidence ratings that assess how strong and consistent scientific evidence is.

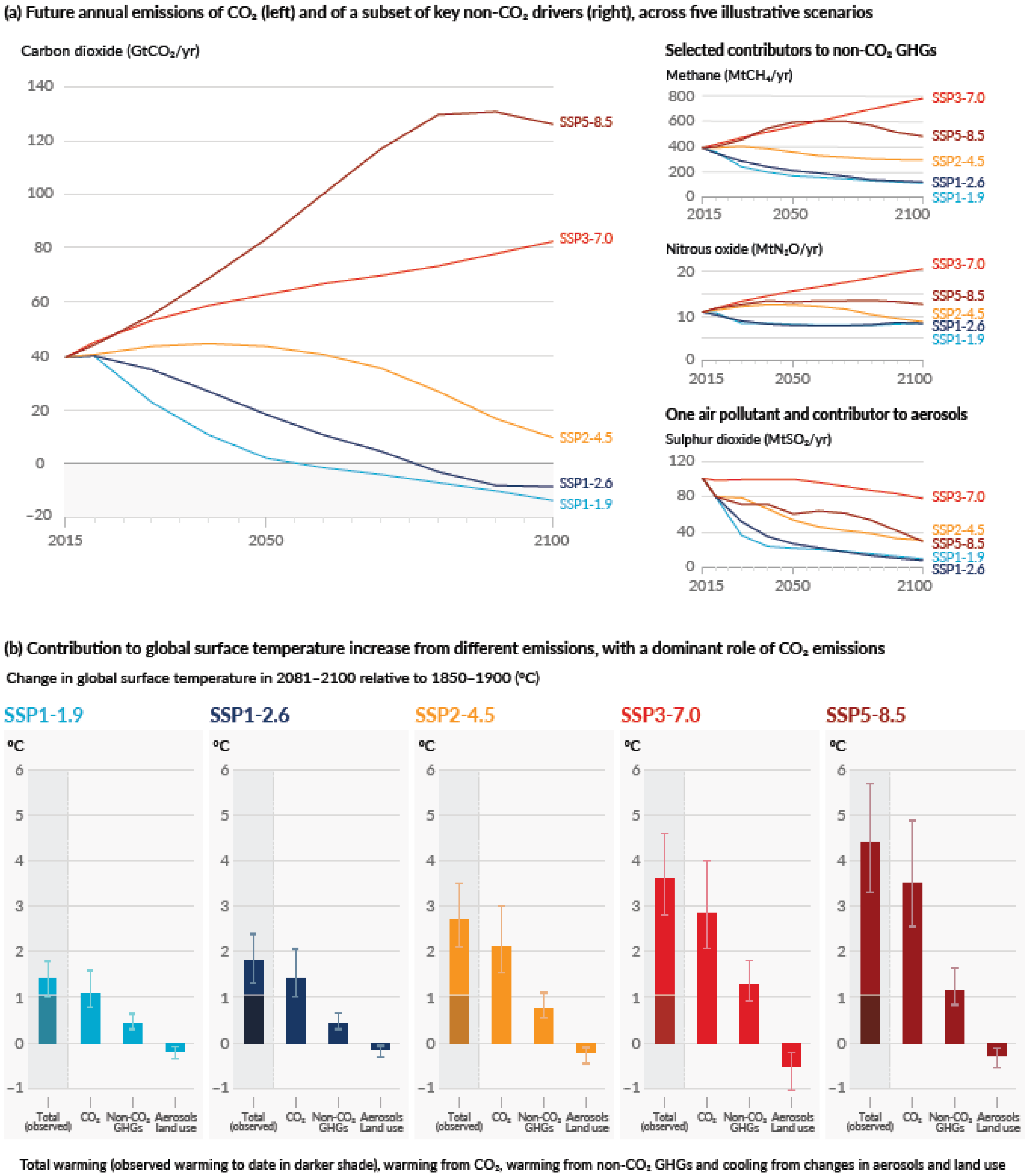


Figure 5: Projected emissions trajectories in panel (a) for CO_2 from all sectors, expressed in gigatonnes of CO_2 per year ($GtCO_2$/yr), shown in the left panel. The right-hand panels show emissions pathways for a subset of three key non-CO_2 climate drivers included in the scenarios: CH_4, in $MtCH_4$/yr, top-right), N_2O, in MtN_2O/yr, middle-right, and SO_2, in $MtSO_2$/yr, bottom-right. The contribution to global surface temperature in 2081-2100 shown in panel (b) across all scenarios (IPCC, 2021a).

The IPCC Working Group II (WGII) builds on the WGI climate projections to examine how climate change may affect ecosystems, biodiversity and human communities. It considers how environmental receptors may change at different levels of global warming, recognising that impacts do not increase linearly with temperature and can vary widely depending on local conditions. WGII also highlights that uncertainty increases when moving from climate changes to real-world impacts, because impacts depend not only on the climate itself but also on how exposed and sensitive systems are, how well they can adapt, and how societies develop in the future. For this reason, WGII presents its findings as ranges of risk and confidence, rather than exact predictions.

In combination, the assessments from IPCC Working Groups I and II provide a robust scientific framework for understanding likely future changes while clearly acknowledging uncertainty. This is summarised at a high-level in Table 2, which shows the projected state of the environment under lower-, intermediate- and higher-warming futures across key environmental receptors. Further detail, including underlying assumptions, confidence levels, and region-specific scientific assessments, is available from the IPCC, particularly through the assessments of Working Groups I and II.

1.2.2.1 IPCC SCENARIOS

The projections shown in Table 2 are mainly based on the IPCC's SSPs from the Sixth Assessment Report (AR6). However, where appropriate, projections derived from the IPCC's Representative Concentration Pathways (RCPs), which formed the basis of climate projections in the Fifth Assessment Report (AR5), have been used where SSP-based data for certain key environmental receptors is not available.

RCPs describe trajectories of GHG concentrations and radiative forcing, while SSPs combine socio-economic development pathways with different levels of radiative forcing to explore a broader range of possible future climate outcomes.

Table 2 provides a high-level summary of relevant scientific literature relating to the projected state of the environment under lower-, intermediate- and higher-warming futures across key environmental receptors. More detailed information is provided in Appendix 2. Table 2 and Appendix 2 have been prepared by Adura by drawing on a range of respected, publicly available scientific sources. This summarises and paraphrases information from those sources and does not express the views or opinions of Adura, or Ithaca. While efforts have been made to reflect the content of the underlying sources accurately, the summaries necessarily involve simplification and are not intended to constitute an exhaustive description of every aspect of that source. Readers should refer to the original sources for the full analysis.

Table 2: Summary of the projected baseline state of the environment under lower-, intermediate- and higher-warming futures across key environmental receptors and by reference to 2020 EIA Regulations Schedules 6(3) and 6(5).

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	Aligns with: SSP2-4.5 and RCP4.5	Aligns with: SSP3-7.0 and SSP5-8.5 and RCP8.5
Mean Global Surface Temperature *(Schedule 6(5)(a)(iii))*	Increase by between 1.0°C to 1.8°C (relative to 1850-1900 baseline) by 2100.	Increase by between 2.1°C to 3.5°C (relative to 1850-1900 baseline) by 2100.	Increase by between 3.3°C to 5.7°C (relative to 1850-1900 baseline) by 2100.
Extreme Weather and Climate Events *(Schedule 6(5)(a)(iii))*	**Hot temperature extremes** are projected to become more frequent, intense, and longer-lasting across most inhabited regions, while cold extremes are projected to become less frequent, even if warming is limited to 1.5°C, with much larger changes at higher warming levels. **Heavy precipitation:** Under SSP1, increases in the frequency and intensity of heavy precipitation are projected to occur, but these changes are relatively moderate, with present day one in 10 year events becoming more frequent (around 1.3–1.5 times) at lower levels of global warming. The frequency of present day one in 10 year events is projected to increase by around 1.5 times at lower global warming levels.	**Hot temperature extremes** are projected to at least double in intensity at 2°C, alongside increases in hot days, warm nights, and heatwave duration across most land areas. **Heavy precipitation:** Increases in the frequency and intensity of heavy precipitation are projected to be more pronounced. The frequency of present day one in 10 year events becoming significantly more frequent (around 1.5–1.7 times) as global warming approaches ~2°C. **Droughts:** Frequency of present day one in 10 year agricultural and ecological drought events is projected to increase by around 2.4 times.	**Hot temperature extremes** are projected to quadruple in intensity at 3°C, with widespread increases in hot days, warm nights, and heatwave duration. **Heavy precipitation:** Heavy precipitation events become more frequent and more intense globally, particularly for rarer events. One in 10 year and one in 50 year events are projected to approximately double and triple in frequency, respectively. **Droughts:** Frequency of present day one in 10 year agricultural and ecological drought events is projected to increase by around 4.1 times.

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	Aligns with: SSP2-4.5 and RCP4.5	Aligns with: SSP3-7.0 and SSP5-8.5 and RCP8.5
	Droughts: Frequency of present day one in 10 year agricultural and ecological drought events is projected to double.		
Sea Level Rise ***(Schedule 6(5)(a)(iii))***	Global mean sea level rise is projected at ~2–3 m if warming is limited to 1.5°C over the next 2000 years.	2–6 m of sea level rise over the next 2000 years is projected if warming is limited to 2°C.	Global mean sea level rise is projected to exceed the likely range, reaching nearly 2 m by 2100 and over 15 m by 2300.
Cryosphere Changes ***(Schedule 6(5)(a)(iii))***	**Ice sheets:** Projected contribution to global mean sea level rise by 2100 will be 0.01–0.10 m (from the Greenland Ice Sheet) and 0.03–0.27 m (from the Antarctic Ice Sheet). **Glaciers:** Evidence is limited and confidence is low, but projections indicate that with sustained warming of 1.5–2°C, around 50–60% of glacier mass could remain, mostly in the polar regions. **Permafrost:** For every 1°C increase in Global Average Surface Temperature, the volume of permafrost in the top 3 metres of soil is reduced by about 25% (±5% uncertainty).	At sustained warming of 2–3°C, the Greenland and West Antarctic ice sheets are projected to be lost almost completely and irreversibly over multiple millennia. **Ice sheets:** Projected contribution to global mean sea level rise by 2100 is 0.04–0.13 m (from the Greenland Ice Sheet) and 0.03–0.29 m (from the Antarctic Ice Sheet). **Glaciers** are projected to lose around 29,000 Gt (9,000-49,000 Gt) which represents around 18% (range of 5-31%) of their early 21st century mass. **Glaciers:** Around 50–60% of glacier mass outside Antarctica is projected to be lost.	**Ice sheets:** Projected contribution to global mean sea level rise by is 0.09–0.18 m (from the Greenland Ice Sheet) and 0.03–0.34 m (from the Antarctic Ice Sheet). **Glaciers** are projected to lose around 58,000 Gt (28,000-88,000 Gt) which represents around 36% (range of 16-56%) of their early 21st century mass. **Glaciers:** An estimated 60–75% of glacier mass outside Antarctica is projected to disappear. At this level of warming, there is medium confidence that nearly all glacier mass in low latitudes, Central Europe, the Caucasus, western Canada and the United States of America (USA),

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	Aligns with: SSP2-4.5 and RCP4.5	Aligns with: SSP3-7.0 and SSP5-8.5 and RCP8.5
	Permafrost: By 2100, near-surface permafrost area (within 3–4 m depth) is projected to decrease by 24 ± 16%. Lower emissions substantially dampen permafrost-carbon release relative to higher-warming scenarios.	**Permafrost:** By 2100, near surface permafrost is projected to decline by 15-87%.	North Asia, Scandinavia, and New Zealand will be lost. **Permafrost:** By 2100, near-surface permafrost area is projected to decline by 69 ± 20%. Thawing permafrost is projected to result in the cumulative release of tens to hundreds of gigatonnes of carbon as CO_2 and methane to the atmosphere by 2100, with the potential to further amplify climate change.
Oceanic Changes *(Schedule 6(5)(a)(iii))*	**Ocean surface temperature** is projected to increase by around 0.86°C (likely range: 0.43–1.47°C) between 2081–2100. **Ocean heat content** is projected to increase by around 2–4 times by 2100 (compared to 1971–2018 baseline). **Marine heatwaves** are projected to become around 4 times more frequent (likely range: 2–9) in 2081–2100 (compared to 1995–2014 baseline). **Ocean acidification:** It is virtually certain that surface ocean pH will	Specific changes under intermediate-warming futures are not directly detailed within the AR6 report as it is an intermediate scenario. However, the following information can be derived from the IPCC Regional Fact Sheet (IPCC, 2021): **Ocean surface temperature** is projected to increase further with a likely range of 1.5 to 2.5°C. **Ocean heat content** is projected to continue to increase throughout the 21st Century.	**Ocean surface temperature** is projected to increase by around 2.89°C (likely range: 2.01–4.07°C) between 2081-2100. **Ocean heat content** is projected to increase by around 4–8 times by 2100 (compared to 1971–2018 baseline). **Marine heatwaves** are projected to become around 8 times more frequent (likely range: 3–15) in 2081–2100 (compared to 1995–2014 baseline). **Ocean acidification:** It is virtually certain that surface ocean pH will

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	Aligns with: SSP2-4.5 and RCP4.5	Aligns with: SSP3-7.0 and SSP5-8.5 and RCP8.5
	decline by 0.036 to 0.042 pH units by 2081-2100 (relative to 2006-2015 baseline).	**Marine heatwaves** become more frequent and intense. **Ocean acidification** continues steadily.	decline by 0.287 to 0.29 pH units by 2081-2100 (relative to 2006-2015 baseline). There are elevated risks for aragonite (carbonate mineral) shell-forming species as aragonite-corrosive conditions is likely over about 16–20% of the surface ocean by 2081–2100, mainly affecting the Arctic and Southern Oceans and parts of the northern Pacific and northwestern Atlantic.
Biodiversity ***(Schedule 6(5)(a)(ii))***	**Terrestrial ecosystems:** An estimated 3–14% of assessed species are projected to face a very high risk of extinction. **Ocean and coastal ecosystems:** Risks of biodiversity loss range from moderate to very high. **Biodiversity hotspots:** Very high extinction risk for endemic species is estimated at around 2%.	**Terrestrial ecosystems:** The proportion of species at very high extinction risk increases to 3–18%. **Ocean and coastal ecosystems:** Risks of biodiversity loss remain moderate to very high, with more ecosystems at high and very high risk. **Biodiversity hotspots:** Very high extinction risk for endemic species doubling to at least 4% (relative to 1.5°C).	A very high extinction risk for endemic species (i.e. species exclusively confined to a single, specific geographic region) in biodiversity hotspots. Extinction risk is projected to increase at least tenfold as warming rises from 1.5°C to 3°C. **Terrestrial ecosystems:** The proportion of species at very high extinction risk increases to 3–18%. **Ocean and coastal ecosystems:** Risks of biodiversity loss increases to high to very high.

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	Aligns with: SSP2-4.5 and RCP4.5	Aligns with: SSP3-7.0 and SSP5-8.5 and RCP8.5
			Biodiversity hotspots: Very high extinction risk for endemic species is 10 times higher than at 1.5°C.
Population and Human Health *(Schedule 6(5)(a)(i))*	**Climate-sensitive diseases:** Malaria: Increased distributional range and vectorial capacity of malaria in parts of sub-Saharan Africa, Asia and South America. Aedes borne diseases (dengue, Zika, chikungunya, yellow fever): Projected increased global abundance of Aedes mosquito by around 20% by the end of the century. Europe largely avoids widespread exposure increases. **Food and nutrition insecurity:** Increased frequency, intensity and severity of droughts, floods and heatwaves, together with continued sea-level rise, are projected to increase risks to food security. In vulnerable regions, food security risks increase from moderate to high, assuming no or low levels of adaptation.	**Climate-sensitive diseases:** Malaria: Clear increases in malaria transmission risk in many endemic regions. Aedes borne diseases: Around half of global population exposed to transmission risk by 2050, with most of Europe experiencing significant increases in exposure compared to pre-industrial conditions. **Food and nutrition insecurity:** Food security risks become more severe. Impacts include increased malnutrition and micronutrient deficiencies. Risks are concentrated in Sub-Saharan Africa, South Asia Central and South America, and Small Island states.	**Climate-sensitive diseases:** Malaria: Severe and widespread increases in transmission risk. Aedes borne diseases: Overall exposure to mosquito-borne disease transmission continues to increase, with Aedes aegypti (yellow fever mosquito) abundance projected to increase by around 30% by the end of the century. **Food and nutrition insecurity:** Compared with warming of 2°C or less, climate-related hazards are projected to affect much larger areas, intensifying regional inequalities in food security and disproportionately impacting vulnerable regions.

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	Aligns with: SSP2-4.5 and RCP4.5	Aligns with: SSP3-7.0 and SSP5-8.5 and RCP8.5
Material Assets *(Schedule 6(5)(a)(iv))*	**Impacts on energy and industrial water use:** Hydropower and thermoelectric power plants adaptations are projected to be most effective at lower levels of warming. **Increasing Adaptation Limits:** Beyond 1.5°C of global warming, limited freshwater availability may create hard limits for Small Islands and regions that rely on glacier and snowmelt. **Productivity loss:** Estimated global GDP reduction of around 0.5% due to climate-related productivity losses. **Food production loss:** By 2100, less than 8% of current global agricultural areas are projected to become climatically unsuitable.	**Impacts on energy and industrial water use:** The effectiveness of adaptation measures for hydropower and thermoelectric plants decreases at higher levels of warming. This may be due to reduced water availability for hydropower, lower cooling efficiency from higher river temperatures, and greater disruption from droughts and floods. **Increasing Adaptation Limits:** Soft adaptation limits are expected to affect major crops in many areas, particularly in tropical regions. **Flood-related damages** are projected to rise substantially without adaptation, at around 1.4 to 2 times higher at 2°C warming compared to 1.5°C.	**Increasing Adaptation Limits:** Some water management measures are projected to become less effective across many regions, with certain areas of Europe reaching hard limits to adaptation. **Flood-related damages** are projected to rise substantially without adaptation, at around 2.5 to 3.9 times higher at 3°C warming compared to 1.5°C. **Productivity loss:** Estimated global GDP reduction of around 2.4%, relating to greater heat exposure and productivity losses. **Food production loss:** A substantial share of current crop and livestock areas is projected to become climatically unsuitable. Approximately 10% of current global agricultural areas become unsuitable by 2050 and more than 30% become unsuitable by 2100.
Cultural Heritage	Predicting impacts on cultural heritage is inherently challenging, as heritage assets are highly location-specific, and there is limited consistent data available on their condition and vulnerability. However, key projected risks include:		

<table>
<tr><th rowspan="2">Receptor
(EIA Regulation Schedule 6(5) Topic)</th><th>Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)</th><th>Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)</th><th>Higher-Warming Futures (continued high emissions; >3°C</th></tr>
<tr><th>Aligns with:
SSP1-1.9 and SSP1-2.6 and RCP2.6</th><th>Aligns with:
SSP2-4.5 and RCP4.5</th><th>Aligns with:
SSP3-7.0 and SSP5-8.5 and RCP8.5</th></tr>
<tr><td>(Schedule 6(5)(a)(iv))</td><td colspan="3">Coastal risks: Sea-level rise and storm-driven coastal erosion threatening archaeological and heritage sites worldwide. Rising sea levels are projected to increase the risk of flooding and erosion, threatening World Heritage sites across regions such as Africa, the Arctic and the Mediterranean.
Physical damage and loss: Direct damage to cultural and natural heritage sites from flooding, erosion, and other climate hazards.
Loss of intangible heritage: Disruption or loss of traditional cultures, ways of life, and community identities. This may include the loss traditional knowledge systems.
Arctic impacts: Increasing permafrost thaw and flooding affecting heritage sites and altering tourism patterns linked to cultural heritage in Arctic regions.</td></tr>
<tr><td>The Landscape
(Schedule 6(5)(a)(iv))</td><td>More frequent and severe droughts could transform perennial rivers into intermittent ones and lead to the complete loss of already intermittent rivers (medium evidence, medium agreement). This would put freshwater fish at greater risk in environments that are already prone to heat and drought.
Loss of scenic value: Higher temperatures, lower rainfall, and more frequent fires are expected to reduce the scenic quality. Scenario analysis estimates a projected reduction in aesthetic visual experience by 18–28% by 2050.</td><td>Changes in freshwater ice: River ice duration is projected to decrease by around 7.3 days between 2009-2029 and 2080-2100.</td><td>Impacts on water quality and availability: Wildfire frequency is expected to rise by around 30%. More frequent fires, together with soil erosion linked to deforestation could negatively impact water quality and availability.
Increased areas of drier landscapes: In ecosystems that historically experience few fires, a 4°C increase in global temperatures significantly elevates fire risk, potentially leading to greater tree mortality and the transformation of large areas of the Amazon rainforest into drier landscapes with lower biomass.</td></tr>
</table>

Receptor (EIA Regulation Schedule 6(5) Topic)	Lower-Warming Futures (rapid emissions reductions; ~1.5–2°C)	Intermediate-Warming Futures (Intermediate Emissions and Warming Pathway; ~2-3°C)	Higher-Warming Futures (continued high emissions; >3°C
	Aligns with: SSP1-1.9 and SSP1-2.6 and RCP2.6	Aligns with: SSP2-4.5 and RCP4.5	Aligns with: SSP3-7.0 and SSP5-8.5 and RCP8.5
			Changes in freshwater ice: Around 4.6% of ice-covered lakes in the Northern Hemisphere could shift to having only intermittent winter ice. Warmer lakes with less ice lose more water through evaporation. By 2100, annual global lake evaporation is expected to increase by about 16% (compared to a 2006–2015 baseline). As ice melts, more energy goes into evaporation rather than heating the air, further increasing water loss. River ice duration is also projected to decrease, by nearly 17 days between 2009-2029 and 2080-2100.

Note: The following references were used to develop the content in Table 2: IPCC (2019a), IPCC (2019b), IPCC (2021a), IPCC (2021b), IPCC (2022a), IPCC (2022b) and IPCC (2023).

2 ITEM 2

> "Assessment of the No Project Scenario; Page 9 of the supplementary EIA guidance states:
>
> "*OPRED expects that these downstream emissions from a new project will be presented in the ES against a no project ('do nothing') scenario (i.e. total quantity of scope 3 category 11 emissions from the project against zero scope 3 category 11 emissions for a no project scenario*)."
>
> Paragraph 3.3.3 (page 22) of the further information describes a range of potential future climate scenarios and refers to these as representative conditions without implementation of the Rosebank Development; however, it does not present any conclusions on the state of the environment or climate under a no-project ("do nothing") scenario.
>
> Please provide a clear overview and conclusion of the environmental and climate conditions under the no-project scenario over the project lifetime, to enable the assessment of the project's likely significant effects."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the points raised and provide an overview and conclusion of the no project ('do nothing') scenario over the lifetime of the Rosebank Development.

The 'do nothing' scenario, i.e. where the Rosebank Development does not occur, and production is not increased and no downstream Scope 3 emissions arise as a result of the Rosebank Development, is considered in the environmental baseline (current and future, over the lifetime of the Development) presented in Section 3 of Equinor (2025). Item 1 and Appendix 1 and 2 supplement the baseline (Section 3; Equinor, 2025) with additional environmental information and scientific knowledge in relation to climate and the effects of emissions and climate change currently and over the lifetime of the Rosebank Development (in the absence of the Rosebank Development).

The scenarios presented in Section 3.3 of Equinor (2025) and Item 1 and Appendix 1 and 2 cover a range of possible futures which could occur in the no-project ('do nothing') scenario. The realisation of these scenarios and associated emissions pathways are conditional on the fulfilment of a range of assumptions associated with human choice. Gillett (2024) reviewed the uncertainties in future emissions and climate response in light of progress on climate policy and climate science. Gillett (2024) identified that the range of plausible future emissions pathways can be reasonably narrowed to between SSP1-1.9 (aligned with C1, limiting warming to <1.5°C (>50% likelihood) with no or limited overshoot) and SSP2-4.5 (aligned with C6, limiting warming to <3°C (>50% likelihood)). Similar findings were also reported by Venmans and Carr (2024) who identified RCP 2.6 to 4.5 as being a representative range of current and announced climate pledges and also in the Emissions Gap Report 2026 (UNEP, 2025) that concluded that current policies are very likely not to exceed 3°C (refer to Item 5). This range of future emissions pathways was incorporated into Equinor (2025), see Section 3.3 and Section 6.4.

The baseline presented in Section 3 of Equinor (2025), as supplemented by Item 1, Appendix 1 and 2, represents the environmental and climate conditions under the no-project ('do nothing') scenario over the lifetime of the Rosebank Development. It is necessary to consider multiple plausible scenarios which could occur in the 'do nothing' scenario due to the uncertainty in future emissions and climate change impacts.

3 ITEM 3

> "Paragraph 3.2.1 of the further information states that the "Global climate systems have responded to the increase in CO_2 emissions through an increased uptake of CO_2 within the oceanic and terrestrial environments e.g. carbon sinks". This statement appears to be inconsistent with the conclusions of IPCC AR6 Working Group I[3]. The AR6 Working Group I report (page 19, Box B4) states that, "Under scenarios with increasing CO_2 emissions, the ocean and land carbon sinks are projected to be less effective at slowing the accumulation of CO_2 in the atmosphere." Please provide evidence to support the statement made in the further information or revise the assessment to reflect the conclusions of IPCC AR6 Working Group I as appropriate."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the points raised and provides further evidence to support the following statement made in Equinor (2025): "*Global climate systems have responded to the increase in CO_2 emissions through an increased uptake of CO_2 within the oceanic and terrestrial environments e.g. carbon sinks".*

The above statement from paragraph 3.2.1 of Equinor (2025) is consistent with the following statement in the Intergovernmental Panel on Climate Change (IPCC, 2021) AR6 Working Group I Report: *"The ocean (high confidence) and land (medium confidence) sinks of CO_2 have increased with anthropogenic emissions over the past six decades*", reflecting the historic role of land and ocean carbon sinks. The inclusion of this statement is considered appropriate within the "Current Environmental Baseline" section (Section 3.2) of the assessment in Equinor (2025).

It is acknowledged that carbon sinks may absorb a lower proportion of CO_2 emissions in the future (with this proportion declining with increasing CO_2 emissions) as per the quote referenced by OPRED from IPCC (2021): *"Under scenarios with increasing CO_2 emissions, the ocean and land carbon sinks are projected to be less effective at slowing the accumulation of CO_2 in the atmosphere."* It is further acknowledged that this is not explicitly stated in the assessment in Equinor (2025). The carbon sequestration capacity under future scenarios is further detailed herein in Appendix 2. This notwithstanding, the absence of this statement is not considered to have any material implications on the assessment in Equinor (2025) and therefore no revision of the assessment is required in this respect. The effects of carbon sinks, including projected changes in their efficiency under future scenarios, are incorporated into IPCC AR6 projections (utilised within Equinor (2025)) through Earth System Models. These models explicitly represent carbon cycle processes and feedbacks, meaning that changes in land and ocean carbon uptake are accounted for, albeit with associated uncertainties (IPCC, 2021).

4 ITEM 4

> "Paragraph 3.2.12 refers to the remaining global carbon budget but does not explain its relevance in the context of greenhouse gas emissions trajectories or the objectives of the Paris Agreement. Please provide this context, including how the remaining carbon budget relates to future emissions pathways and Paris-aligned temperature goals."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the points raised by providing additional context on remaining carbon budgets and the relationship between remaining carbon budgets, future emissions pathways and Paris-aligned temperature goals.

In summary, remaining carbon budgets from AR6 are aligned with the cumulative net CO_2 emissions listed for the global emissions pathways (C1, C3, C6 and C7 warming categories) included in Table 15 of Equinor (2025). This is further explained, as follows:

A. Relationship Between Emissions Pathways and Remaining Carbon Budgets

In order to explain the relevance of the remaining global carbon budget in the context of emissions pathways and Paris Agreement-aligned temperature goals, it is necessary to define the concepts of the global carbon budget and the remaining global carbon budget.

The global carbon budget is an estimate of the total cumulative net amount of CO_2 that can be released in order to limit global warming to a specified temperature, such as the Paris Agreement goals of 1.5 and 2°C above pre-industrial levels, with a given probability (i.e. avoidance probability). It is based primarily on the relationship between cumulative CO_2 emissions and global mean temperature increase (the transient climate response to cumulative emissions of CO_2; TCRE), together with other factors including observed warming to date and the influence of non-CO_2 climate drivers[1] (Forster *et al.*, 2026).

The remaining global carbon budget represents the future cumulative net CO_2 emissions which may be emitted from a specified reference date onward while maintaining the same temperature limit and the probability of achieving this limit. The remaining global carbon budget is calculated by subtracting estimated historical cumulative CO_2 emissions from the total global carbon budget (IPCC, 2021).

The remaining carbon budget is used to estimate the net cumulative amount of CO_2 that can be released to remain under the 1.5 and 2°C global temperature goals of the Paris Agreement. Emissions pathways compatible with these temperature goals include scenarios in the C1, C2, and C3 warming categories of the IPCC (2022) AR6 Working Group III report. The projections for net cumulative CO_2 emissions (as shown in the final column of Table 15; Equinor, 2025) differ to the remaining carbon budgets presented in IPCC (2021) AR6 Working Group I Report (Table 3 below). For instance, Box 3.4 of the IPCC (2022) Working Group III Report states that: "*unlike in WGI, cumulative emissions in WGIII are not provided for a specific peak-warming threshold or level but are instead provided for a set of scenarios in a category, representing a specific range of peak-temperature outcomes (for instance the C4 category contains scenarios with a median peak warming anywhere between approximately 1.8°C and up to 2°C."* Additionally, another key difference is the consideration of non-CO_2 warming. The remaining carbon budgets in the IPCC (2021) AR6 Working Group I Report assume a linear relationship between peak warming and warming as a result of non-CO_2 emissions. The IPCC (2022) AR6 Working Group III Report based non-CO_2 warming on the individual scenario characteristics. Nonetheless, IPCC (2022) state that the cumulative net CO_2 emissions for 2020-2100 are highly consistent with the remaining carbon budget estimates, with differences being well within the uncertainty range and mainly attributed to non-CO_2 warming.

Overall, the net cumulative CO_2 emissions presented in Table 15 of Equinor (2025) for the C1, C3, C6 and C7 warming categories, which form part of the contextualisation of Rosebank Development's downstream Scope 3 emissions for the assessment of significance, are aligned with the remaining carbon budgets in IPCC (2021) Working Group I consistent with temperature goals of the Paris Agreement. This alignment and consistency is described in detail in Box 3.4 of the IPCC (2022) Working Group III Report.

---

[1] *N_2O, CH_4 and F-gases*

Table 3: Estimated remaining carbon budget from 2020 (AR6 Working Group I Report; IPCC, 2021).

Temperature (°C)	Estimated Remaining Carbon Budgets from the beginning of 2020 ($Gt\ CO_2$)				
Avoidance probability	17 %	33 %	50 %	67 %	83 %
1.5	900	650	500	400	300
1.7	1,450	1,050	850	700	550
2	2,300	1,700	1,350	1,150	900

B. Updated Remaining Carbon Budgets

Subsection A above explains how the remaining carbon budgets from IPCC (2021) relate to the emissions pathways from IPCC (2022). Remaining carbon budgets have been re-assessed periodically since IPCC AR6 to account for more recent data and emissions estimates. Recent updates include those by Forster *et al.* (2026) (for 2026 onwards, Table 4) and Friedlingstein *et al.* (2026) (Table 5). Forster *et al.* (2026) estimates are lower than those presented in IPCC (2021) Working Group I Report, primarily due to the additional emissions between 2020 and 2025, the use of updated non-CO_2 forcing models[2] and the high observed temperatures between 2020 and 2025. Friedlingstein *et al.* (2026) provide an updated remaining carbon budget from 2026, using the approaches / methodologies of IPCC (2021) AR6 Working Group I Report, Forster *et al.* (2025) and Lamboll *et al.* (2023), accounting for additional emissions. The reported remaining carbon budget in Table 5 is an average of the updated IPCC (2021) Working Group I Report remaining carbon budget and the updated Forster *et al.* (2025) remaining carbon budget.

Table 4: Estimated remaining carbon budget, all values rounded to nearest 10 Gt CO_2 (Forster *et al.*, 2026).

Temperature (°C)	Estimated Remaining Carbon Budgets from the beginning of 2026 ($Gt\ CO_2$)				
Avoidance probability	17 %	33 %	50 %	67 %	83 %
1.5	340	210	130	80	30
1.6	630	430	320	240	170
1.7	930	650	500	390	300
2	1,800	1,310	1,050	860	690

[2] *Forster et al. (2026) use updated non-CO_2 forcing models which assumes an increased influence of aerosols on non-CO_2 GHG emissions warming which in turn decreases the remaining carbon budget.*

Table 5: Estimated remaining carbon budget (Friedlingstein *et al.*, 2026).

Temperature (°C)	Estimated Remaining Carbon Budgets from beginning of 2026 (Gt CO_2)
Avoidance probability	50 %
1.5	170
1.7	525
2	1,055

C. Uncertainties in Remaining Carbon Budgets

When using remaining carbon budgets to understand emissions constraints relevant to Paris Agreement goals, it is important to consider uncertainties and limitations. Remaining carbon budgets are associated with a number of uncertainties. For example, Box 3.4 of IPCC (2022) Working Group III Report states "*The estimates are subject to considerable uncertainty related to historical warming, future non-CO_2 forcing, and poorly quantified climate feedbacks*." Uncertainty in the global carbon budget is measured using the Budget Imbalance (BIM), which is a measure of the mismatch of estimated emissions and the estimated changes in the atmosphere, land and oceans. It describes the uncertainty of imperfect data from reported emissions and of the incomplete understanding of the carbon cycle. The BIM provides a strong indication of the limitations in observations, in understanding and representing processes in models, and/or in the integration of the carbon budget components. Known sources of uncertainty in components of the remaining carbon budget could have an effect of approximately +/- 0.3 GtC per year (approximately +/- 1.1 GtCO_2). There is also persistent unexplained variability in the BIM, which limits the validation of reported emissions and highlights the incomplete understanding of carbon cycle dynamics on large timescales (Friedlingstein *et al.,* 2026). Despite these uncertainties, this represents a consensus view and is the most appropriate data to reference.

The estimates of downstream Scope 3 emission from the Rosebank Development (presented in Section 5 of Equinor, 2025) lie within the uncertainty bounds associated with the remaining carbon budget (i.e. they are less than the uncertainty ranges).

5 ITEM 5

"Paragraphs 3.3.8 to 3.3.10 note that the emission reduction pathways presented are "narrative tools that offer a nuanced understanding of potential futures without implying certainty and do not provide probabilities or assign likelihoods to future outcomes". However, the IPCC AR6[4] report states (A.4 page 10) that it is likely that warming will exceed 1.5°C and make it harder to limit warming below 2°C. Please update the assessment to reflect the conclusion of IPCC AR6, with these findings considered alongside the emissions reduction pathways."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the points raised on the conclusions of the IPCC (2023b) AR6 Report on the likelihood of warming exceeding 1.5°C.

The statement in the IPCC (2023b) AR6 Report that global warming is likely to exceed 1.5°C under current policy trajectories is in reference to global emissions by 2030 based on Nationally Determined Contributions (NDCs). The AR6 future scenarios / emissions pathways assume varying levels of policy strengthening, alongside other socio-economic assumptions. More updated information on the likelihood of exceeding the 1.5°C warming level is provided below, reflecting updated climate policies and pledges.

In the Emissions Gap Report 2025 (UNEP, 2025), UNEP concludes that global climate action is off-track, with current pledges leading to around 2.3–2.8°C warming and an increasing emissions gap relative to Paris targets. A temporary exceedance of 1.5°C is now highly likely, and avoiding dangerous levels of warming requires large emissions cuts (35–55% by 2035). The assessment by UNEP is based on four types of scenarios that provided the foundation for estimating the emissions gap and the global temperature implications of the emissions gap. In the current policies continuing scenarios there is an 80% chance of keeping warming below 3°C over this century. This likelihood increases if unconditional NDCs are fully implemented by 2035 and similar efforts continue. UNEP (2025) finds that global warming projections over this century, based on full implementation of NDCs, are now 2.3-2.5°C, while those based on current policies are very likely not to exceed 3°C. It is still possible that warming would be kept below 1.5°C.

The information presented above identifies that exceedance of the 1.5°C warming level is likely under current policies and pledges, yet this is still possible with strengthened climate policies and pledges. The emission reductions pathways SSP1-1.9 and the C1 and C2 warming-category pathways remain consistent with limiting warming to 1.5°C (with no or limited overshoot) (refer to Table 4 and Table 13 of Equinor, 2025). These emission reductions pathways do not have a likelihood attached to them but are conditional on the fulfilment of a range of assumptions associated with human choice. In the context of emissions reduction pathways, the conclusion of IPCC (2023b) AR6 Report highlights the increasing difficulty of achieving low-warming outcomes, rather than precluding them.

The use of a range of future climate scenarios to encompass various levels of future GHG emissions and associated warming is considered to reflect best practice in downstream Scope 3 emissions assessment and recognises the uncertainty in future climate conditions and GHG emissions. Item 2 describes the conclusions of Gillett (2024) and Venmans and Carr (2024) that the range of plausible future emissions scenarios can be narrowed to between SSP1-1.9 (aligned with C1, limiting warming to <1.5°C (>50% likelihood) with no or limited overshoot) and SSP2-4.5 (aligned with C6, limiting warming to <3°C (>50% likelihood)). It is noted that the range of projected emissions level is still uncertain (projected emissions for SSP2-4.5 is approximately six times higher than SSP1-1.9 in 2050 (median of 52 $GtCO_2e$ vs 8 $GtCO_2e$)) (IPCC, 2023b).

It is concluded that the range of future scenarios considered in the assessment in Equinor (2025) encompass the range of scenarios considered to be plausible (UNEP, 2025; Gillett, 2024). Items 15 and 16 describe how the range of scenarios are used in the evaluation of significance.

6 ITEM 6

> "Table 5 is stated to summarise environmental protection objectives relevant to the consideration of the project's downstream emissions (4.3.1). It is unclear on what basis all of the objectives and policies listed are relevant or whether they have been considered, and some references are either not up to date or are not entirely accurately represented. Please clarify which objectives have been considered, including which in relation to the project's Scope 3 emissions (as well as which of the project Scope 3 emissions), and which objectives have been considered in relation to Scope 1 emissions instead."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to explains the Environmental Protection Objectives (EPOs) in Table 5 of the Equinor (2025) and clarifies the relevance to downstream Scope 3 emissions and scope 1 emissions.

The EPOs identified in Table 5 of Equinor (2025) set out the main policies and legislative instruments that are of relevance to the overall GHG emissions from the Rosebank Development, including the emissions associated with production (Scope 1) and downstream emissions (Scope 3). The relevant EPOs have been framed in the context of relevant strategies, conventions, and policies that relate to the overall reduction of emissions to the atmosphere and address the impacts and challenges of climate change. Global and national targets do not differentiate between the categories of Scope 3 emissions, rather where the emissions occur. Scope 1 emissions associated with the Rosebank Development will occur within the United Kingdom (UK) Exclusive Economic Zone (EEZ). Downstream Scope 3 emissions may occur anywhere globally. Consequently, both UK and global EPOs are considered.

The two EPOs of relevance which are considered in the assessment are the Paris Agreement and the UK Climate Change Act (2008, as amended), as indicated in the list below, with the sub-bullets representing the strategies, policies and targets supporting the implementation of the overarching EPO. Every row in Table 5 (Equinor, 2025) is included in the list below. Table 6 provides further detail on the EPOs listed above that are relevant to Scope 1 and 3 emissions, and their consideration in the assessment in Equinor (2025).

Paris Agreement (2015):

- ***United Nations Framework Convention on Climate Change*** *(1992)* provided the foundation for Paris Agreement and the annual ***Conference of the Parties*** *(COP).*
- At COP26, the ***Glasgow Climate Pact*** *(UNCC, 2021)* was signed, accelerating action to tackle climate change.
- The ***UK Nationally Determined Contribution,*** submitted most recently in 2025 under the Paris Agreement, commits the UK to GHG emission reductions.

UK Climate Change Act (2008, as amended):

- Provides a legally binding framework to reduce emissions to Net Zero by 2050, requiring the setting (12 years in advance) of a ***UK Carbon Budget*** for five year periods. Budget delivery is established via plans including the ***UK Carbon Budget Delivery Plan*** *(DESNZ, 2023a)* and the ***Clean Power 2030 Action Plan*** *(DESNZ, 2024)*.
- The ***UK Government's Net Zero Strategy: Build Back Greener*** (DESNZ, 2021) sets out the overarching approach to meeting Climate Change Act targets. The ***British Energy Security Strategy*** (DESNZ, 2022) expands on and consolidates delivery of Net Zero objectives to secure, clean and affordable British energy for the long term.
- ***Powering Up Britain: The Net Zero Growth Plan*** (DESNZ, 2023b) builds on the Net Zero Strategy (DESNZ, 2021) and responds to the recommendations made in the ***Independent Review of Net Zero*** (DESNZ and BEIS, 2023) which was commissioned to consider how the UK could better meet Net Zero commitments.
- Sector-specific delivery is supported through agreements such as the ***North Sea Transition Deal*** (DESNZ and BEIS, 2021), which operates as the Net Zero Strategy sector plan for UK Continental Shelf oil and gas[3].
- The ***Climate Change Committee (CCC) 2025 report to Parliament*** (2025b) assesses the credibility of UK emission reduction policies and plans. The CCC report is informed by the ***"Balanced Pathway" scenario***, a roadmap targeting achievement of Net Zero GHG Emissions by 2050 and guiding the UK's Seventh Carbon Budget (2038–2042).
- UK-wide climate policy interacts with devolved planning frameworks, including the ***Scottish National Marine Plan*** (Marine Scotland, 2015) that seeks to balance environmental protection and economic growth in the marine environment.

[3] *Since submission of Equinor (2025), the North Sea Future Plan has been published by the UK Government. The plan was set out to manage existing North Sea oil and gas fields, protect jobs and grow clean energy industries (DESNZ, 2025b)*

Table 6: EPOs and their relevance to Scope 1 and downstream Scope 3 emissions assessments for the Rosebank Development.

EPO	Relevance	Consideration in the Assessment in Equinor (2025)
Paris Agreement	Scope 3	International objectives are directly relevant to the Rosebank Development's downstream Scope 3 emissions (categories 9, 10 and 11) which may occur anywhere, globally. The quantification of downstream Scope 3 emissions is contextualised within global emissions reduction pathways that align with the Paris Agreement.
Climate Change Act 2008 (as amended)	Scope 1, which could lead to Scope 3	The objectives of the Climate Change Act 2008 apply specifically to UK territorial emissions (e.g. Rosebank Development Scope 1 emissions). The Scope 1 GHG emissions footprint of the Rosebank Development is of relevance in the context of UK-specific targets, as operators are responsible for producing fossil fuels with the lowest practicable carbon intensity (Scope 1). As per the Supplementary Guidance, the downstream Scope 3 assessment should be completed against national objectives and targets. Given that Scope 1 emissions will arise from the extraction of hydrocarbons with Scope 3 emissions arising from the transportation, distribution, refining and use of hydrocarbon anywhere globally, the assessment aims to contextualise the Rosebank Development not just at a global level, but to consider production and Scope 1 emissions at a national level against the objectives of the Climate Change Act 2008. This shows alignment with national objectives and energy transition pathways which align with the Paris Agreement.

This response clarifies the relevance of the EPOs in Table 5 of Equinor (2025). This clarification does not change the outcome of the assessment in Equinor (2025).

7 ITEM 7

"Paragraph 5.3.1 refers twice to Table 6, please confirm that each reference to this should read "Table 5""

In Equinor (2025), there are two tables labelled Table 5 (*Table 5 – Summary of Policy and Legislative Instruments* and *Table 5 - Estimated emissions from fuel gas, diesel and flare at the FPSO for life of field (Rosebank ES table 9-5)*). Adura confirms for the avoidance of doubt, both references to Table 6 in paragraph 5.3.1 of Equinor (2025) should refer to Table 5 (*Table 5 - Estimated emissions from fuel gas, diesel and flare at the FPSO for life of field (Rosebank ES table 9-5)*).

8 ITEM 8

"Paragraph 5.3.2 refers to Table 7, please confirm that this should be "Table 6"."

Adura confirms that paragraph 5.3.2 should refer to Table 6 (*Table 6 - Downstream GHG Protocol Categories in scope of estimation method)*.

9 ITEM 9

> "Paragraph 5.4.1 Please provide a table outlining the production data that was used to calculate the scope 3 emissions."

The P10 production data that was used as the base case to calculate the Scope 3 emissions is shown in Table 3-3 of the 2022 Rosebank Development Environmental Statement (ES; Equinor, 2022).

10 ITEM 10

> "Paragraph 5.4.2 refers to Table 8, but we note there is not a Table 8 in the further information. Please confirm that this should be Table 7."

Adura confirms that paragraph 5.4.2 should refer to Table 7 (*Table 7 - Conversion Factors used for Scope 3 Category 11).*

11 ITEM 11

> "Table 7 refers to footnote 55 for Natural Gas, but should the reference be to footnote 53, please clarify?"

Adura clarifies that the footnote 55 for Natural Gas should be footnote 53: Density of natural gas (100% mineral blend) 0.80200 kg/m^3 (DESNZ, 2025c).

12 ITEM 12

> "Footnote 52 refers to Table 5; however, Table 5 summarises scope 1 emissions and does not include P10 production data. Please clarify whether footnote 52 is intended to refer to the quantity of GHG emissions associated with fuel gas and flare gas, rather than volume of fuel gas and flare gas."

Adura confirms that the reference to Table 5 - *Estimated emissions from fuel gas, diesel and flare at the FPSO for life of field (Rosebank ES table 9-5)* in footnote 52 is correct and refers to the volume of fuel gas and flare gas. This is explained as follows:

Column 2 of Table 5 - *Estimated emissions from fuel gas, diesel and flare at the FPSO for life of field (Rosebank ES table 9-5)* in paragraph 5.3.1 of Equinor (2025) presents the Life of Field usage in tonnes of fuel gas and flare gas, which are subtracted from the total produced gas to give an export gas estimate. While Table 5 in paragraph 5.3.1 of Equinor (2025) does not show P10 production data, the values for the fuel gas and flare gas tonnes are derived from the P10 data (the basis for the ES; Equinor, 2022, refer to Item 9). Footnote 52 therefore refers appropriately to the quantity of fuel gas and flare gas (in tonnes), which is removed from subsequent calculation of downstream Scope 3 emissions based on production as combustion cannot occur twice.

13 ITEM 13

> "Paragraph 5.5.1 presents GHG emissions data for categories 9, 10 and 11. Please confirm if the scope 1 emissions have been subtracted from the categories 9, 10 and 11 emissions because those scope 1 emissions have been accounted for elsewhere."

Adura confirms that scope 1 emissions have been subtracted from the categories 9, 10 and 11 emissions because these scope 1 emissions have been accounted for in Section 9 of the Rosebank Development ES (Equinor, 2022) (refer to paragraph 5.3.1 of the assessment in Equinor ((2025)).

Paragraph 5.5.1 presents the Well to Tank (WTT) emissions estimates, which are the downstream Scope 3 Emissions associated with extraction, refining and transportation of raw fuel sources to an organisation's site (or asset), prior to combustion. As described in paragraph 5.4.4 of Equinor (2025), the estimated scope 1 emissions from the Rosebank Development, as presented in the Rosebank Development ES (Equinor, 2022), are subtracted from the WTT GHG emissions estimate to calculate the midstream GHG emissions estimate - defined as transportation, processing and refining and distribution (Scope 3 emissions categories 9 and 10, defined in the Definitions / Glossary of Equinor, 2025).

14 ITEM 14

> "Paragraph 5.6.3 and Table 12 present downstream scope 3 emissions estimates for P50 and P90 values; however, we have been unable to reproduce the data using the stated approach (i.e. applying 30% and 50% reductions to the P10 data). Please explain and demonstrate how the P50 and P90 emissions estimates have been calculated."

The following response explains how P50 and P90 emissions estimates have been calculated in Equinor (2025) and confirms the percentage reductions stated in paragraph 5.6.3.

Adura confirms that the approach to P50 and P90 emissions estimation (results presented in Table 12 of Equinor (2025)), is as described for the P10 assessment in Section 5.4 (Equinor, 2025), albeit using the P50 production profile and the P90 production profile respectively. The result of these calculations are presented in Table 12 of Equinor (2025).

The formula "change/original x 100" is applied to End User (Category 11) emissions, as shown in detail in Table 7, to obtain estimates for reductions in emissions estimates at P50 and P90 relative to P10.

Table 7: End User (Category 11) emissions estimates in tonnes CO_2eq (P10, P50 & P90) case.

Production Profile	Tonnes CO_2eq	Calculation	Percent Reduction[4]
P10	208,587,000	-	-
P50	145,753,000	[(208,587,000-145,753,000)/ 208,587,000] x 100	30.12%
P90	102,454,000	[(208,587,000-102,454,000)/ 208,587,000] x 100	50.88%

[4] *Presented to two decimal places, which may result in a slightly different P50 and P90 emissions if directly back-calculated.*

15 ITEM 15

> "The EIA Regulations require an assessment of the likely significant effects of the project on the environment, including those resulting from the cumulation of effects with other existing or approved projects, and including covering the matters listed in Schedule 6(4)(f) and 6(5).
>
> Whilst in Paragraph 6.2.1 you acknowledge the link between emissions and warming of the climate, and that the impact of emissions on climate is a likely impact, Section 6 of the Further Information does not explicitly assess the likely significant effects of the project's GHG emissions, in relation to climate change and the matters listed in Schedule 6(5), either alone or in cumulation with other existing or approved projects.
>
> The effects of climate change are well documented (e.g. IPCC (2023)[5], WMO, 2026[6]). Please ensure that the assessment of likely significant effects, including cumulative effects, covers the requirements of the EIA Regulations as relevant.
>
> This assessment should be undertaken against the baseline scenario for the environment and climate and its likely evolution over the lifetime of the project."

The comment is noted. This response provides a review of Section 6 to determine alignment with the requirements of the EIA Regulations, including the matters listed in Schedule 6(4)(f) and 6(5), and to clarify that the assessment has been undertaken against the baseline scenario over the lifetime of the Rosebank Development. The matters in OPRED's comment are addressed in the relevant Subsections of this response referred to in Table 8, sequenced to demonstrate the assessment of likely significant effects of the Rosebank Development on the environment.

Table 8: Signpost to Item 15 response.

Item 15 Text		Response Cross-reference
Overarching Question	Sub-question	
The EIA Regulations require an assessment of the likely significant effects of the project on the environment…	Please ensure that the assessment of likely significant effects, …….. covers the requirements of the EIA Regulations as relevant.	Subsection C, E.
including those resulting from the cumulation of effects with other existing or approved projects….	….. including cumulative effects……	Subsection D.
and including covering the matters listed in Schedule 6(4)(f) and 6(5)….		Subsection A, B.
This assessment should be undertaken against the baseline scenario for the environment and climate and its likely evolution over the lifetime of the project."		Subsection A, B and C.

This answer is structured in line with the presentation of a typical impact assessment, whereby we set the baseline, explain the assessment methodology (both in terms of regulatory expectations and best practice guidance), undertake the project alone and cumulative assessments, and then make a final conclusion on significance. This approach is summarised in Figure 6. The following sections provide the detail of this approach, and when the outcome of the Equinor (2025) assessment is revisited in light of the clarifying information provided, the conclusion made in Equinor (2025) that the Rosebank Development will not have a significant impact is unchanged.

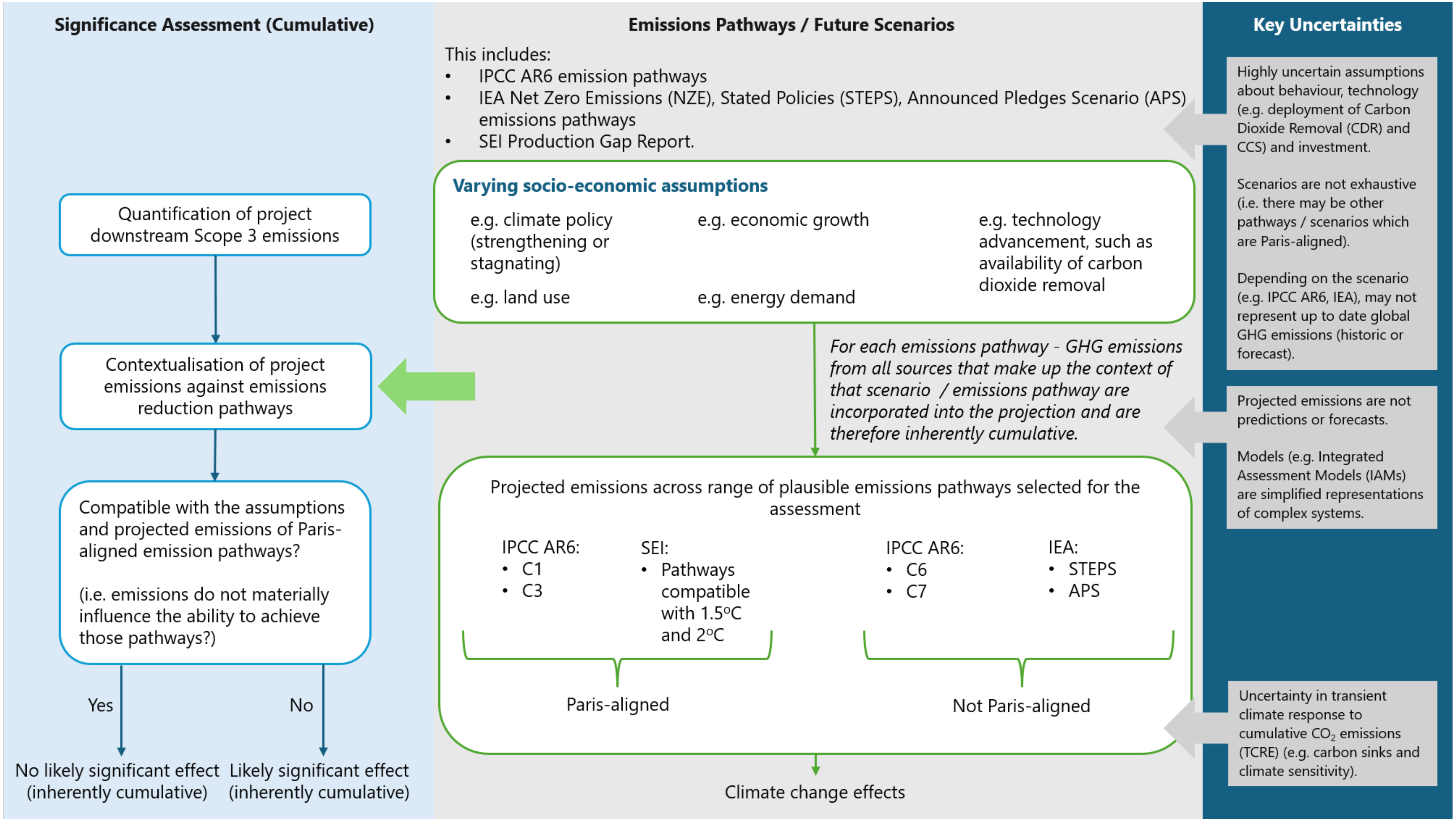


Figure 6: Overview of significance assessment using global emissions reduction pathways.

This assessment follows the principles of the ISEP (formerly IEMA) (2026) guidance, which is referenced in this particular response and more widely throughout this document. The ISEP (2026) guidance includes the IEMA (2022) guidance (issued before their re-naming), alongside supplementary guidance to the 2022 guidance. The principles of the ISEP guidance detailed in Section 2 of Equinor (2025) therefore remain applicable. The following principles (ISEP, 2026) are of particular relevance to this response, and are presented in this item or in the items referenced as follows:

- Setting the scope and extent of the assessment against the global atmosphere as the receptor.
- Developing the current and future baseline scenario (also applicable to Items 1 and 2).
- Evaluation of significance (also applicable to Item 18).
- Cumulative effects assessment (also applicable to Item 25).

A. Baseline and Future Baseline Scenario

See response to Item 1 and Item 2, which outlines the baseline scenario for the environment and climate and its likely evolution over the lifetime of the Rosebank Development.

B. Compliance with Schedule 6(4)(f) and 6(5)

Schedule 6(4)(f) requires "*An assessment of the likely significant effects of the project on the environment, including those resulting from ….(f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change;…..*" Equinor (2022) and Equinor (2025) provide this assessment, as supplemented by the information contained herein.

Guidance e.g. ISEP (2026) does not stipulate the assessment of downstream Scope 3 emissions be assessed against the receptor-based framework set out in Schedule 6(5). The focus of the assessment for downstream Scope 3 emissions is the global atmosphere as the primary receptor, with significance evaluated through alignment with recognised Paris-aligned global emissions reduction pathways and climate commitments. This approach aligns with the ISEP (2026) guidance which specifies that the evaluation of significance should involve assessing the change in GHG emissions compared to the current and future baseline. The ISEP (2026) guidance reiterates that all GHG emissions contribute to climate change with associated effects on the environment, including the topics listed in the EIA Directive.

Scenario-based approaches, such as those developed by the IPCC, provide a robust and policy-relevant framework for understanding the implications of cumulative emissions, acknowledging that all projections are inherently assumption-dependent and evolve over time. Within this context, assessing whether or not downstream Scope 3 emissions are compatible with a range of pathways offers a meaningful and proportionate basis for evaluation of the impacts on the environment and climate, noting that there are significant uncertainties in attributing a defined quantity of emissions from a single project to discrete effects on population and human health, biodiversity, land, water, air quality or receptors listed on Schedule 6(5) (e.g. due to uncertainties in future global emissions trajectories, climate system feedbacks, and natural variability). This approach satisfies the requirement of the EIA Regulations to consider climate effects, while recognising that any indirect implications for other receptors cannot be reliably disaggregated or attributed at the scale of an individual project.

C. Assessment Methodology and Significance Criteria

This section describes the assessment methodology for assessing the likely significant effects of the downstream Scope 3 emissions, as required by the EIA Regulations.

The decision process related to defining whether or not a project is likely to have a significant effect on the environment is a core principle of the EIA process and the methods used for identifying and assessing likely significant effects need to be transparent and verifiable. Assessing the significance of potential effects on a receptor considers the magnitude and likelihood of the impact and the sensitivity of the receptor. Despite the assessment of significance being a subjective process, a defined methodology makes the assessment as objective as possible. In Table 9, we review each of the inputs to the Equinor (2025) impact assessment in light of the clarifications sought as part of OPRED's Item 15.

Table 9: Review of inputs to Equinor (2025).

Receptor
Defined as the global climate (Equinor, 2025; e.g. paragraph 6.3.3)
Magnitude of Impact
– Magnitude of impact was assessed (Equinor, 2025) using a context-based methodology, rather than relying solely on the absolute quantity of GHG emissions. As outlined in Item 1 and Item 2, the future scenarios and emissions pathways presented in the baseline in Section 3 of Equinor (2025), cover a range of plausible futures which could occur in the 'do nothing' scenario (i.e. without the implementation of the Rosebank Development). The downstream Scope 3 emissions are compared against the range of scenarios and emissions pathways which form part of the baseline. Whilst the assessment in Equinor (2025) quantifies the Rosebank Development's downstream Scope 3 emissions using a conservative approach (based on a P10 production profile and assuming full combustion of hydrocarbons), the determination of magnitude is explicitly framed in terms of the Rosebank Development's alignment with Paris-aligned global emission reduction pathways, sector-specific decarbonisation strategies, and UK climate policy commitments. This reflects the principle that, for climate change, magnitude cannot be meaningfully defined by emissions volume alone, given the global and cumulative nature of GHG emissions effects. Instead, emissions are evaluated relative to internationally recognised benchmarks, including IPCC emissions scenarios and Paris Agreement objectives, such that the magnitude reflects whether the project is not inconsistent with, or diverges from, pathways required to limit global warming. The pathway-based assessment of magnitude considers the question 'If the Rosebank Development did occur, would the resultant downstream Scope 3 emissions have a material effect on the selected emission reduction pathways that form part of the baseline scenario?' – Within this framework, magnitude is categorised qualitatively (e.g. high, intermediate, low) based on the degree of compatibility with these pathways and policy frameworks. The assessment in Equinor (2025) demonstrates that the Rosebank Development's downstream Scope 3 emissions represent a very small proportion of global emissions and future oil and gas demand under Paris-aligned scenarios. Whilst acknowledging the uncertainty in the future emission pathways, the downstream Scope 3 emissions fall within the range of emissions accounted for within Paris-aligned pathways. As such, the downstream Scope 3 emissions will not impede the achievement of Paris Agreement-aligned pathways and their associated temperature outcomes (quantified in Table 16 and Table 17 of Equinor (2025)). On this basis, the magnitude of impact is determined to be low.
Likelihood of Impact
Equinor (2025) paragraph 6.2.1 states that the impact of the Rosebank Development's downstream Scope 3 emissions on the climate is considered "likely" as GHG emissions from any project will contribute to climate change.
Sensitivity of Receptor
Equinor (2025) paragraph 6.3.3 states that receptor sensitivity is high due to the contribution of GHG emissions to climate change.

Reaching Conclusion on Significance
– Evaluating the significance of GHG emissions within EIA recognises that all projects contribute, however incrementally, to climate change (ISEP, 2026). The consequences of climate change can be far-reaching, affecting human health, biodiversity, water resources, land use, and air quality. Because GHG emissions collectively approach scientifically defined environmental limits, any individual project's emissions or reductions may be considered inherently important. However, the absence of defined thresholds or universally accepted criteria means that significance cannot be determined through simple quantitative benchmarks alone. – In this context the assessment in Equinor (2025) provides proportionate, transparent and well-evidenced analysis of the Rosebank Development's downstream Scope 3 emissions within the broader policy framework. A continuing but declining level of GHG emissions is not inconsistent with national and international commitments, and a determination of significance is informed by clear contextualisation of the Rosebank Development's downstream Scope 3 emissions magnitude. The assessment in Equinor (2025) considers emissions reduction pathways and alignment with relevant transition scenarios, alongside the use of multiple sources of evidence. – A key test of significance is whether the Rosebank Development aligns with global (Paris-aligned) emissions reduction pathways. A project that demonstrates compatibility with these pathways, even if residual emissions remain, can reasonably be characterised as having a minor adverse, non-significant effect, as it can contribute to the wider energy transition. Some emissions may arise from developments driven by broader policy objectives, with governments responsible for balancing emissions across the economy. The assessment in Equinor (2025) therefore considers, in a proportionate way, whether the Rosebank Development supports or undermines achievement of climate targets. – To address inherent uncertainties and limitations in future emissions projections, the assessment of significance (Equinor, 2025) does not rely on a single pathway, but instead considers a range of plausible scenarios, including high-ambition mitigation scenarios (e.g. NZE/IMPs) and less stringent policy environments (e.g. STEPS). In Paris-aligned scenarios and pathways, fossil fuel use is more constrained, which provides a more stringent benchmark against which Rosebank Development's downstream Scope 3 emissions can be assessed. On the other hand, pathways consistent with current policies (e.g. STEPS) are consistent with higher levels of fossil fuel demand and use, but are increasingly misaligned with the goals of the Paris Agreement. The conclusions on significance take into account uncertainty across the spectrum of pathways considered, rather than assuming that any one pathway will be realised. While uncertainties remain, the consideration of multiple pathways ensures that the assessment is not dependent on any single set of assumptions and provides a transparent and robust basis for evaluating cumulative effects. This is considered as being consistent with EIA principles as it presents the magnitude of the emissions in the most conservative way because Net Zero pathways are associated with the lowest global emissions. – Across all scenarios considered, including both Paris-aligned and non-aligned futures, there remains continued, albeit declining, demand for oil and gas over the lifetime of the Rosebank Development. The contribution of the Rosebank Development's downstream Scope 3 emissions is not considered to impact achievement of Paris-aligned pathways and therefore does not give rise to effects that would be considered significant in the context of the assessment framework established in Section 6.4 of Equinor 2025).

Reaching Conclusion on Significance (continued)
– Equinor (2025) paragraph 6.3.2 states that significance of the Rosebank Development's downstream Scope 3 emissions is evaluated using a matrix approach, whereby the sensitivity of receptor and magnitude of impact are combined to derive the overall significance level. This is detailed in Table 14 (Equinor, 2025). – The assessment in Equinor (2025) therefore provides a defined assessment methodology and significance criteria.

Note on 'project alone' assessment: Equinor (2025) presented the total downstream Scope 3 emissions from the Rosebank Development (Table 11; Equinor, 2025), as a project alone value. Ordinarily, a 'project alone' assessment would form a substantial part of an impact assessment submitted to OPRED, being undertaken ahead of the cumulative assessment. However, downstream Scope 3 emissions can effect change on receptors only in a cumulative sense – the emissions from any one project in the absence of any other emissions would not be of a sufficient order to effect change on receptors through global climate change. As such, the 'project alone' assessment for the Rosebank Development can clearly state that there are no observable effects that can be attributed to the individual development, with potential effects inherently cumulative and which cannot be meaningfully separated from other emissions sources in terms of climate change impacts. The project alone impact can therefore be concluded as not significant. The assessment can then move on to the consideration of cumulative impact, following the method outlined in Subsection D below.

D. Cumulative Effects Assessment (CEA)

This section describes how cumulative effects are considered in Equinor (2025), as required by the EIA Regulations.

How to assess GHG emissions cumulatively in the context of the EIA Regulations

Schedule 6(4) and 6(5) of the EIA Regulations requires that an ES consider the cumulative effects of the proposed project and other existing or approved projects. Although the EIA Regulations set the legal requirement to consider cumulative effects, the Regulations do not specify the approach that should be undertaken.

There is no single standardised approach for cumulative effects assessments and there are a number of ways such an assessment could acceptably be undertaken. The Planning Inspectorate (PINS) (2025) advice on cumulative effects assessment is generally regarded as the best available guidance for undertaking a systematic and repeatable assessment (as identified in IEMA, 2020).

GHG emissions occupy a unique space for assessing cumulative effects. There is no meaningful 'Zone of Influence' or spatial boundary for the identification of existing and/or approved projects and no defensible basis for selecting specific projects as every activity that results in GHG emissions is relevant. This is reflected in the ISEP (2026) guidance on assessing GHG emissions and evaluating their significance which states: "*GHG emissions from specific cumulative projects therefore in general should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has GHG emissions for assessment over any other.*"

In response to these constraints, contextualisation using emissions reduction pathways (e.g. Paris-aligned) represents an appropriate and inherently cumulative assessment approach (summarised in Figure 6). These pathways incorporate assumptions relating to existing, approved and future emissions sources, thereby providing a scientifically grounded means of assessing cumulative impact without requiring an exhaustive or selective project list. Significance is determined by evaluating whether emissions are aligned or misaligned with established decarbonisation trajectories, which implicitly account for cumulative emissions;

Given the global and diffuse nature of climate effects, there is no non-arbitrary basis for selecting a discrete subset of individual projects for separate cumulative assessment. Instead, the use of global pathways ensures that all relevant emission sources are captured and that assessment avoids under- or over-representing cumulative effects through selective project inclusion. Indeed, the IPCC emissions scenarios and associated mitigation pathways and the IEA demand and supply scenarios are based on a suite of assumptions relating to expected future energy demand, existing and planned sources of supply and the rate of global decarbonisation.

Why this approach has been adopted in the assessment

The approach described above is transparent, auditable, repeatable and defensible since:

- Emissions reduction pathways are global, reflecting that GHG emissions are not geographically bounded.
- Emissions reduction pathways are not constrained by available information on project schedules (uncertainty about which is only compounded further into the future) and when combustion of Rosebank Development production may occur.
- Where sector-specific environmental protection objectives or carbon budgets do not exist, use of emissions-reduction pathways ensures all emissions are considered (i.e. no individual project or project type is singled out).

The approach is proportionate since:

- Emissions reduction pathways enable cumulative emissions to be contextualised to determine alignment or misalignment with climate commitments / goals – consistent with the recommended approach in evaluating significance in ISEP (2026) guidance. The ISEP (2026) guidance provides examples of the types of contextual information against which a project can be evaluated. However, the ISEP (2026) guidance is largely UK-focussed, whereas the assessment of Rosebank Development's downstream Scope 3 emissions necessitates evaluation at a global scale. The applicable existing agreements, pathways and policies used to contextualise the Rosebank Development's downstream Scope 3 emissions are provided in Table 10. Emissions arising from the downstream combustion of oil and gas e.g. transport (road, rail, air) and fuel (industry, power) are typically governed by sectoral plans that do not apply directly to oil and gas producers and therefore to this assessment. This assessment contextualises the magnitude of the emissions primarily using global (IPCC) emission reduction pathways. Other supporting contextualisation is provided by the IEA emission reduction pathways. While downstream Scope 3 emissions from the Rosebank Development are not necessarily accounted for within the UK carbon budget, it is appropriate to contextualise the Rosebank Development using UK policy as the Rosebank Development's downstream Scope 3 emissions only arise if the Development proceeds because it is aligned with UK policy.
- Use of emissions reduction pathways enables consideration of cumulative emissions and climate change effects – recognising that emissions effects are inherently cumulative by nature.
- An alternative approach of quantification of project by project emissions would require assumptions beyond what is reasonable or proportionate for an EIA and would be associated with large uncertainties due to data aggregation, project schedules, technology readiness and socio-economic drivers at a global scale.

- There are known uncertainties and limitations to using emissions reduction pathways to contextualise downstream Scope 3 emissions and consider cumulative effects (as discussed further in relation to Item 19, subsection A). Emissions reduction pathways are model-based and rely on socio-economic assumptions. The presence of uncertainty does not invalidate the approach; rather, it reflects the inherent characteristics of assessments conducted at a global scale, multiple years into the future.
- Acknowledging uncertainties and limitations is an essential component of good-practice environmental and cumulative effects assessment, a key subject discussed in IEMA (2020). This is also detailed in OPRED's (2021) guide to the EIA Regulations which states that "*any difficulties or uncertainties in undertaking the assessment should be recorded (e.g. lack of information or scientific understanding / evidence).*", aligned with Schedule 6(7) of the EIA Regulations which requires (bolded for emphasis): "*A description of the forecasting methods or evidence, used to identify and assess the significant effects on the environment, **including details of difficulties (for example technical deficiencies or lack of knowledge) encountered compiling the required information and the main uncertainties involved***".

The above clarifies the assessment of cumulative effects presented in Section 6.4 (Equinor, 2025), demonstrating that the assessment was undertaken credibly, while remaining proportionate and consistent with established guidance.

Table 10: Overview of the Rosebank Development's downstream Scope 3 emissions contextualisation.

Context	Applicability to the Rosebank Development	Outcome
International climate agreements	YES: Paris-aligned global emissions reduction pathways enable emissions to be contextualised to determine alignment or misalignment with climate commitments / goals – consistent with the recommended approach in evaluating significance in ISEP (2026) guidance.	Ongoing demand for oil and gas occurs within emissions reduction pathways consistent with the Paris Agreement. Production and downstream Scope 3 emissions associated with the Rosebank Development are not inconsistent with ongoing oil and gas demand and use under Paris-aligned global emissions reduction pathways.
Sectoral emissions reduction pathways	YES: IEA emissions reduction pathways enable emissions to be contextualised to determine alignment or misalignment with climate commitments / goals – consistent with the recommended approach in evaluating significance in ISEP (2026) guidance.	Ongoing demand for oil and gas occurs within emission reduction pathways defined by the IEA. Production and downstream Scope 3 emissions associated with the Rosebank Development are not inconsistent with ongoing oil and gas demand and use under these emissions reduction pathways.
UK policy	YES: While the Downstream Scope 3 emissions from the Rosebank Development are not accounted for within the UK carbon budget, the downstream emissions only arise if the Development proceeds	The UK offshore oil and gas industry operates within a well-established framework of sector-specific emissions reduction targets, decarbonisation strategies and regulatory mechanisms. Adura complies with the requirements of its

Context	Applicability to the Rosebank Development	Outcome
	because it is aligned with wider UK policy.	permits and consents, providing status on Net Zero related activities to regulators as required.

Alternative Approaches

It is acknowledged that alternative approaches may be suitable or supplement the contextualisation of GHG emissions using global pathways, as discussed in Item 19 (subsection B). However, the approach adopted in the assessment, including contextualisation of the Rosebank Development downstream Scope 3 emissions, is considered an appropriate approach to cumulative effects assessment: emissions are placed in the context of future scenarios which incorporate assumptions about future demand and supply of oil and gas, prices and constraints.

E. Assessment of Likely Significant Effects of GHG Emissions

This section summarises how the conclusion of significance is reached in the assessment.

Within the framework described in the previous subsections A-D:

- The magnitude of impact is assessed in terms of alignment with Paris Agreement–consistent emissions pathways which form part of the baseline, rather than absolute emissions alone.
- The Rosebank Development's downstream Scope 3 emissions fall within the range of emissions factored into the context of the global emissions reduction pathways, including those compatible with the Paris Agreement, which incorporate a cumulative projection of emissions from existing and planned projects, based on integrated modelling of energy systems, supply, demand and policy constraints.
- The Rosebank Development does not alter the ability to achieve pathway-defined temperature outcomes.
- Where Rosebank Development downstream Scope 3 emissions are determined not to materially alter the ability to achieve a Paris-aligned emissions reduction pathway, then the same conclusion remains valid for realisation of any other, higher emissions scenario as the Rosebank Development downstream Scope 3 emissions will form an even lower proportion of the emissions associated with other, higher emissions pathways.

On this cumulative basis, and applying the defined assessment methodology (high receptor sensitivity, low magnitude of impact, and likely impact – per Table 14; Equinor (2025)), the overall effect was concluded (and is confirmed) to be not significant. This conclusion of significance and the assessment of likely significant effects to reach this conclusion is aligned with the requirements of the EIA Regulations as relevant.

16 ITEM 16

> "Pages 11 and 12 of the supplementary EIA guidance state that: "*An ES must include an assessment of the significance of the likely effects of scope 3 emissions. The ES, when evaluating the significance of likely effects of the project on the environment must also consider and contain information on cumulative effects.*" And "*Given the global effect of GHG emissions, the ES must consider the cumulative effects of the proposed project with other existing and planned future projects, in a global context. If global reduction pathways are used to contextualise magnitude of emissions as above, this approach should be inherently cumulative, as these pathways take into account a wide range of existing and planned projects and other activities. Alternatively, or in addition, developers may choose to use information from global oil and gas datasets and inventories.*"
>
> The further information relies primarily on modelled demand and emissions reduction pathway narratives without explaining how cumulative effects with other existing or approved projects have been addressed nor the basis for the conclusion that the Rosebank Development's downstream scope 3 emissions are "not significant" under a Paris-aligned pathway.
>
> Alongside the more specific points below (paragraphs 17 to 34) please therefore:
>
> i) update the assessment of the likely significant effects of the project's downstream scope 3 emissions as appropriate, including cumulative effects with other existing and approved projects, in a global context.
>
> ii) Where emission-reduction pathways are used, clearly explain the assumptions, limitations, and uncertainties in the modelled data and how these have been taken into account when reaching conclusions on significance.
>
> iii) Explain how the assessment accounts for emissions associated with current and approved fossil fuel projects (i.e., how much demand/ emission reduction pathway "space" is already met by existing/approved supply), and how this affects your conclusions."

The comment is noted. Section 6 of Equinor (2025) has been reviewed and the following clarifications are provided, mapped to the specific points raised as per Table 11.

Table 11: Signpost to Item 16 response.

Item 16 Text	Response Cross-reference
Alongside the more specific points below (paragraphs 17 to 34) please therefore:	
i) update the assessment of the likely significant effects of the project's downstream Scope 3 emissions as appropriate, including cumulative effects with other existing and approved projects, in a global context.	See Subsection A and D below and Item 15.
ii) Where emission-reduction pathways are used, clearly explain the assumptions, limitations, and uncertainties in the modelled data and how these have been taken into account when reaching conclusions on significance.	See Subsection B below and Item 19
iii) Explain how the assessment accounts for emissions associated with current and approved fossil fuel projects (i.e., how much demand/ emission reduction pathway "space" is already met by existing/approved supply), and how this affects your conclusions.	See Subsection C and D below and Item 4, Item 23, Item 26 and Item 28

A. Cumulative Effects Assessment

See Item 15, which explains how cumulative effects with other existing and approved projects, in a global context, have been incorporated into the assessment. Contextualisation using emissions reduction pathways (e.g. Paris-aligned) represents an appropriate and inherently cumulative assessment approach. This is described in detail in Item 15 (subsection D),

B. Assumptions, Limitations and Uncertainties in Pathway-Based Assessment

This section clearly explains the assumptions, limitations, and uncertainties in the modelled scenarios and pathways used in the assessment and how these have been taken into account when reaching conclusions on significance.

There is no single dataset that can be used to predict future global GHG emissions given the range of uncertainties inherent in forecasting the future. As a consequence, modelled scenarios and pathways are used. These scenarios cover a range of plausible futures which could occur in the 'do nothing' scenario, i.e. without the implementation of the Rosebank Development. The pathway-based assessment approach considers, if the Rosebank Development did occur, would the resultant downstream Scope 3 emissions have a material effect on the selected emission reduction pathways?

The use of emissions reduction pathways is subject to inherent uncertainties, which have been clearly acknowledged and taken into account in the assessment in Equinor (2025). These include:

- Scenario uncertainty, reflecting different possible socio-economic, technological and policy futures.
- Model uncertainty, arising from differences in climate and energy system modelling approaches.
- Uncertainty in future demand for oil and gas, including the pace of decarbonisation across sectors globally.

It is recognised that emissions reduction pathways are scenarios rather than predictions, and no single pathway can be assigned a probability of occurrence. However, the pathways provide a robust and widely accepted framework for assessing cumulative climate effects, as reflected in relevant guidance (e.g. ISEP, 2026).

Uncertainty does not invalidate the assessment; rather, it is an inherent characteristic of long term projections. The conclusions on significance are therefore based on professional judgement informed by the best available scientific evidence and policy context.

Further detail is provided in Item 19 and the associated Appendix 3.

C. Consideration of Emissions Reduction Pathway "Space"

Emissions reduction pathways consistent with the Paris Agreement can be considered alongside the concept of remaining carbon budgets to define finite trajectories of allowable global emissions consistent with achieving climate objectives (e.g. limiting warming to 1.5°C or well below 2°C). All Paris-aligned pathways, including those used in this assessment (e.g. IPCC C1–C3 categories), are constructed such that cumulative future emissions across all global sources, including fossil fuel use, remain within this finite budget (further detail on carbon budgets is provided in Item 4).

Item 4 (Subsection B) presents the estimated remaining carbon budgets, from the beginning of 2026, to achieve global temperature rise limits above pre-industrial levels, based on differing likelihoods. Uncertainty in the calculation of the global carbon budget is measured using the BIM, which is a measure of the mismatch of estimated emissions and the estimated changes in the atmosphere, land and oceans (refer to Item 4). Uncertainty exists with regard to the level of emissions that will produce a given warming level (global average).

The Production Gap Report (SEI *et al.*, 2025) concludes that the governments of the 19 major producer countries considered in the report plan to produce more fossil fuels than would be consistent with achieving the goals of the Paris Agreement (Item 27 provides further detail of the Production Gap). There is, however, some uncertainty in this conclusion:

- Government plans and projections are treated as meaningful indicators of future production, even when those plans may be considered politically aspirational or potentially contradictory, and which may not be investment-backed. This could result in an overstated certainty regarding future production trajectories.
- The Production Gap Report (SEI *et al.,* 2025) does not assign probabilities to production plan outcomes, meaning any one project is assumed as being as likely to proceed as another. Local scale regulatory or economic factors, alongside competing and evolving priorities in global and regional operators, means that this likelihood may not be equal across all developments.
- Whilst hydrocarbons are typically traded in a global marketplace, regional political instability or global geopolitical interruptions mean that it is it not necessarily the case that all production will be accessible to that marketplace, and without market access, development or production may not occur.
- Small changes in the economics of projects can materially impact production:
  - Nearly 90% of annual upstream oil and gas investment since 2019 has been dedicated to offsetting production declines rather than to meet demand growth (IEA, 2025a). With only relatively small drops in upstream investment, oil and gas supply growth can become static production, and subsequently declining production.
  - Production from individual fields is dropping off more rapidly than it has historically, as reliance on unconventional hydrocarbon sources increases (IEA, 2025a). This accelerated natural decline, combined with economically driven decisions not to extend life of fields, could result in a drop in future production estimates for some fields.
- Larger changes in the macroeconomic context can also materially impact production:
  - Societal change, such as a technology driven demand collapse, would change the economics of production and affect the likelihood of any and all projects progressing to production.

Production from the Rosebank Development does not materially affect any potential oversupply (SEI *et al.*, 2025):

- The Rosebank Development's production is already included in committed future production values. For example, paragraph 6.4.22 of Equinor (2025) identifies that North Sea Transition Authority (NSTA) production projections for the UK include sanctioned but not yet producing fields, such as the Rosebank Development). The SEI *et al.* (2025) Production Gap Report uses the NSTA production projections as the source for the UK planned production under the Government Plans and Projections (GPP) pathway – consenting the Rosebank Development does not add to production forecasts (the GPP pathway is discussed further in Item 26).
- Paragraph 6.4.8 (Equinor, 2025) presented data that showed Rosebank Development production to comprise between 0.06% and 0.08% of global oil production in a 1.5°C compatible pathway (vs the 2023 Production Gap Report; SEI *et al.*, 2023[5]). Given significant uncertainties in production forecasts in the Production Gap Report (Appendix 3), production from the Rosebank Development is unlikely to be evident above statistical noise.
- Wood Mackenzie is a global leader in analytics, insights and proprietary data across the entire energy and natural resources landscape. Its data on commercially feasible hydrocarbon production fields indicates that circa two thirds of the remaining carbon budget to limit warming to 2°C could be

[5] *These values are unchanged in the 2025 Production Gap Report*

attributed to those hydrocarbons combusted in end use during the lifetime of the Rosebank Development. Rosebank production is estimated to contribute circa 0.04% of those emissions.

Within this context, the Rosebank Development has been assessed in terms of its relative contribution to projected global emissions and supply. The assessment in Equinor (2025) demonstrates that:

- The contribution of the Rosebank Development represents a very small proportion of global emissions and oil and gas demand in all modelled scenarios.
- The production profile of the Rosebank Development is consistent with the levels of supply envisaged in Paris Agreement–aligned pathways, which explicitly allow for continued, albeit declining, use of fossil fuels during the energy transition.

It is therefore concluded that the Rosebank Development does not materially affect achievement of these pathways, nor does it represent a disproportionate use of the available emissions “space” when considered alongside existing and approved developments.

D. Basis for Conclusion of Significance

This section clarifies the basis for the conclusion of Equinor (2025) that the Rosebank Development’s downstream Scope 3 emissions are “not significant”, in the context of the information provided in subsections A, B and C above and Item 15.

The assessment of significance details:

- The quantified emissions from the Rosebank Development which have been conservatively quantified assuming high-case production and full combustion of produced hydrocarbon.
- Contextualisation within global emissions reduction pathways, recognising the assumptions, limitations and uncertainties of use of those pathways.
- Alignment with international and national climate objectives.

Whilst it is acknowledged that all GHG emissions contribute to climate change and that the sensitivity of the global climate receptor is high, the key determinant of magnitude (and therefore significance) is whether the Rosebank Development is compatible with global (Paris-aligned) emissions reduction pathways.

The assessment in Equinor (2025) demonstrates that the Rosebank Development’s emissions:

- Fall within the range of emissions factored into Paris Agreement–aligned scenarios.
- Represent a small incremental contribution to total global emissions.
- Are consistent with projected residual demand for oil and gas in Net Zero transition scenarios and do not represent a material proportion of the remaining emissions “space”.

On this basis, and taking into account the cumulative nature of the pathways used, the magnitude of impact is assessed as low, and the overall effect of the Rosebank Development’s downstream Scope 3 emissions on climate is concluded to be not significant. This conclusion remains unchanged from the assessment in Equinor (2025).

17 ITEM 17

"Paragraph 6.1.1 (and footnotes 58–59) describes the approach to "cumulative effects". Please clarify whether assessment of cumulative effects has been limited to re-use of infrastructure for local projects, and—if so—update the assessment to address cumulative scope 3 effects alongside other existing or approved fossil fuel projects globally (including use of global datasets/inventories where appropriate)."

The comment is noted. Adura confirms that the cumulative effects assessment has not been limited to re-use of infrastructure / development of nearby oil and gas projects. Further details on the cumulative effects assessment are included in the response to Item 15 (subsection D).

18 ITEM 18

"Paragraph 6.3.2 states that IEMA guidance[7] has informed the evaluation of the significance of the project's scope 3 emissions, using a matrix approach. The IEMA guidance (page 24) explains:

"*The crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050* ".

Whereas paragraph 6.3.4 of the further information instead frames significance in terms of alignment with global emission-reduction pathways, without explaining how the project contributes to reducing emissions relative to a net-zero-consistent baseline. Paragraph 6.3.4 of the further information states:

"The key consideration in evaluating significance is not simply whether a project results in GHG emissions, nor the absolute volume of those emissions, but whether that project aligns with global emission reduction pathways."

Please clarify and update the assessment as appropriate to either align with the IEMA approach to evaluating significance or clearly explain where and why the evaluation does not align with that guidance."

The comment is noted. Adura clarifies that the two statements quoted in OPRED's comment are not incompatible and the assessment in Equinor (2025) does align with the ISEP (previously IEMA) (2026) approach.

The ISEP (2026) approach was cited in the Supplementary Guidance as providing a six-step assessment approach that a developer may wish to follow when assessing emissions. The ISEP (2026) guidance also provides definitions for assessing the significance of GHG emissions – albeit primarily in the context of keeping the UK on track towards Net Zero by 2050. As detailed in paragraph 2.14 and 2.15 of Equinor (2025), the guidance informed the assessment approach adopted in Equinor (2025).

Following the paragraph quoted by OPRED, subsequent paragraphs in ISEP (2026) state:

The specific context for an individual project and the contribution it makes must be established through the professional judgement of an appropriately qualified practitioner, drawing on the available guidance, policy and scientific evidence.

For the Rosebank Development, this is clarified as follows:

- While the Rosebank Development does not result in a reduction of emissions, this does not mean that the Rosebank Development is incompatible with a Net Zero consistent baseline. A trajectory towards Net Zero by 2050 requires an energy transition and even in the most ambitious decarbonisation scenarios, there will be ongoing, albeit reducing, demand for oil and gas (refer to Item 23 for further details). It is not within the remit of an EIA to determine from which projects/fields that demand is met, rather the assessment in Equinor (2025) demonstrates that the downstream emissions of the Rosebank Development are not inconsistent with the trajectory towards Net Zero by 2050.

- Global emissions reduction pathways are explained in Items 15 and 19 as being meaningful, policy-relevant benchmarks which can be used to contextualise emissions and inform assessment of significance.

The following bold text could have been inserted into paragraph 6.3.4 of Equinor (2025) to provide further clarification, but this clarification would not change the conclusions of the assessment in Equinor (2025):

*"The key consideration in evaluating significance is not simply whether a project results in GHG emissions, nor the absolute volume of those emissions, but whether that project aligns with **Paris-aligned** global emission reduction pathways."*

19 ITEM 19

> "Section 6.3 states that IPCC AR6 illustrative mitigation pathways (IMPs) are used to account for existing and planned projects. However, the IMPs referenced illustrate alternative strategies for reducing GHGs to meet specific climate goals such as limiting warming to 1.5°C. The IMPs provide useful examples of how different combinations of technologies, policies and behaviour changes could meet a climate target.
>
> Please update your assessment where any emission reduction pathways or IMPs from various sources are used, to acknowledge the assumptions and limitations for the purpose of contextualising and assessing the significance of the scope 3 emissions from the project. This assessment of the cumulative effects of the scope 3 emissions may also benefit from global oil and gas datasets and inventories. There are multiple sources of projected emissions from current plans and projects you may wish to consider, such as IISD (2022)[8], Muttitt *et al* (2025)[9], IEA (2023) [10] , UNEP (2023) - Figure 2.2[11], Trout *et al* (2022)[12]."

The comment is noted. The assumptions and limitations of emissions pathways and IMPs used in the assessment and the use of global oil and gas inventories / databases for the cumulative effects assessment are addressed in the following two subsections (A and B).

Adura has provided further information on the use of emissions pathways to contextualise the Rosebank Development's downstream Scope 3 emissions in the response to Item 15 (subsection D).

A. Assumptions / limitations of emissions pathways and IMPs used in the assessment

There is no single dataset that can be used to predict future global GHG emissions associated with existing and planned projects, therefore modelled scenarios and pathways were used to explore future emission projections in the assessment of significance (Section 6.4; Equinor, 2025). Emission pathways and IMPs[6] used within the assessment of significance include:

- AR6 scenario ensemble, including illustrative mitigation pathways (IMPs).

[6] *Emissions pathways project the evolution of GHG based on a set of socio-economic and technological assumptions for a future climate scenario. IPCC (2022a) Working Group III categorises scenarios based on their likelihood of exceeding global warming levels by 2100 (C1 to C8). IMPs are selected scenarios and projections used to explore the implications of different societal choices and possible climate policy futures. Representative quantitative projections were selected for each IP from the AR6 modelling database (based on the scenario characteristics) (IPCC, 2022a).*

- IEA STEPS/APS/NZE[7].
- SEI Production Gap Report.

The assumptions, uncertainties, and limitations for the above emission pathways were provided at a high level in Appendix A (Equinor, 2025), with additional detail provided in Appendix 3 herein. Appendix 3 also details where more recent publications have updated the scenarios used in the assessment in Equinor (2025). Across all emission pathways considered in Equinor (2025), several key limitations include:

- The pathways represent alternative futures, rather than predictions. Emissions projections are typically based on Integrated Assessment Models (IAMs), which are simplified representations of complex systems.
- IMPs and other similar pathways (e.g. NZE scenario from IEA (2023, 2024) and updated by IEA (2025a)) are normative (i.e. designed to achieve a specified outcome) and/or illustrative rather than predictive. These pathways are designed to demonstrate how temperature or emissions targets can be achieved under defined assumptions, and therefore represent ambitious (yet pragmatic), policy-driven futures.
- The pathways are based on assumptions regarding policy, technology deployment, behaviour change, and economic conditions.
- No specific likelihoods are assigned to individual pathways (refer to Item 5 which discusses the range of plausible future emissions pathways and Items 15 and 19 for a discussion on the uncertainties of emissions pathways).
- Emission pathways are not representative of up to date global oil and gas production (historic and forecast).
- The outcomes vary significantly depending on the extent and timing of global mitigation action.

Item 15 (subsection C) explains how the assessment addresses the uncertainties and limitations of emissions pathways by not relying on a single pathway and instead considering a range of plausible scenarios. Item 15 (subsection D) also outlines the uncertainties and limitations of using emissions pathways for the purpose of contextualising the downstream Scope 3 emissions and the consideration of cumulative effects within the assessment.

B. Use of global oil and gas inventories / databases for the cumulative effects assessment

Alternative approaches to GHG emissions cumulative effects assessments may be suitable, as reflected in OPRED's comments which suggests oil and gas inventories / databases could be used to supplement the cumulative effects assessment. OPRED reference IEA (2023) and SEI *et al.* (2023), both of which were considered in the assessment in Equinor (2025), albeit SEI *et al.* (2023) and the scenarios / emissions pathways presented in IEA (2023) have been updated since the assessment (refer to Appendix 3 and Item 26).

Importantly, the modelled scenarios and pathways considered in the assessment in Equinor (2025) already utilise available forecasts for oil and gas production / supply. For example, the GEC model, used for the emissions projections in IEA (2024) (presented in Table 17 of Equinor 2025) and also IEA use Rystad's UCube database to project future oil and gas production (based on historical production and decline rates) (IEA, 2025b). As described in Appendix 3, IEA (2024) has been updated by IEA (2025a).

---

[7] The IEA (2024) scenarios have since been updated. IEA (2025a) does not include the APS scenario and introduces a new Current Pledges Scenario (CPS) which is a pathway for the energy system where there is no change in energy-related policies. The NZE scenario is no longer a limited-overshoot scenario, as warming peaks above 1.6 °C and exceeds 1.5 °C for several decades before returning below 1.5 °C by 2100 (refer to Appendix 2 for further information). This does not materially impact the assessment as Rosebank's Downstream Scope 3 Emissions do not alter whether or not these pathways are achieved.

Oil and gas databases and inventories, including Rystad's UCube database, organisation / oil and gas company forecasts and other reports (e.g. IISD, 2022; Muttitt, 2025; Trout *et al.,* 2022) can provide useful insights into project-level supply outlooks but are potentially constrained by the uncertainties in predicting future production. Furthermore, these forecasts do not attempt to anticipate future regulatory changes or account for global constraints related to climate change. The production forecasts represent a snapshot at the time of use and when aggregated to country, regional or global level, uncertainties can be compounded. Notwithstanding these limitations, it is acknowledged that such datasets often indicate a continued expansion of fossil fuel supply and use that exceeds levels consistent with global climate targets, reinforcing the relevance of using climate-aligned scenarios (e.g. IMPs, NZE) to provide a policy-constrained context for assessing emissions.

Overall, the use of global emissions reduction pathways is considered an appropriate method for the cumulative effects assessment presented in the assessment in Equinor (2025), which incorporates assumptions about future demand and supply of oil and gas, prices and constraints. Therefore, there is considered to be no requirement to update Equinor (2025) and the conclusion of significance remains valid.

20 ITEM 20

"Paragraph 6.3.11 – states the IMPs referenced do not have a likelihood attached to them, yet the assessment of significance relies on these pathways to reach a conclusion on likely significant effects of the project and how they relate to the Paris Agreement. Please provide evidence of why net zero policies and Paris aligned commitments (per Paragraph 6.3.17) are then selected as more likely than the other IMP scenarios presented to support the assessment of significance."

The comment is noted. It is confirmed that the IMPs do not have a likelihood attached to them. It is clarified that, the "likelihood" term in the evaluation of significance is defined in paragraph 6.2.1 of Equinor (2025), i.e. *The impact of the Rosebank Development's Downstream Scope 3 Emissions on the climate is considered "likely" as GHG emissions from any project will contribute to climate change.*

It is further noted that:

- No probabilities are assigned to pathways because they are scenario-based and exploratory (not predictive). Given the range of uncertainties associated with any single pathway (detailed in Item 19), the assessment considers a range of plausible futures to test and contextualise the conclusion of no-significance (refer to Item 5 which discusses the range of plausible future emissions pathways and Items 15 and 19 for a discussion on the uncertainties of emissions pathways).
- Net zero policies and Paris-aligned pathways are policy-relevant benchmarks to test consistency with internationally agreed climate objectives (and are not a prediction of future outcomes).
- Realisation or exceedance of Paris alignment will occur independently of the Rosebank Development. Attainment is determined by co-ordinated system-wide transitions across all sectors and geographies (IPCC, 2023a).
- The Rosebank Development production and therefore downstream Scope 3 emissions do not materially alter achievement of Paris-aligned global emissions reduction pathways (Item 15). In any non Paris-aligned scenario (less fossil-fuel constrained and associated with higher demand and emissions), the Development's downstream Scope 3 emissions would form an even lower proportion of the emissions associated with the pathway.

It is concluded that the use of Paris-aligned pathways and commitments within the assessment is appropriate, noting that a range of plausible pathways are considered and that none of these pathways are considered to be more likely than another. The consideration of multiple pathways ensures that the assessment is not dependent on any single set of assumptions and provides a transparent and robust basis for evaluating cumulative effects (refer to Item 15 (subsection C)). This clarification does not change the conclusions of the assessment in Equinor (2025).

21 ITEM 21

"Paragraph 6.3.20 - please clarify in the matrix presented in Table 14, which project emissions have been considered under the different commitments, policies and strategies. As currently the paragraph presents in the context of downstream scope 3 emissions as a whole, whereas not all commitments, policies and strategies apply in this context. For example, those commitments related to territorial emissions will not apply in the global context."

The comment is noted. Item 6 provides clarification of the EPOs relevant to the assessment of Scope 3 emissions. The relevant and applicable EPOs in Table 14 of Equinor (2025) are the Paris Agreement and the UK Climate Change Act 2008 (as amended), which are supported by the other instruments and strategies listed in the response to Item 6.

22 ITEM 22

"Section 6.4 - The assessment of the likely significant effects of the project is based on models of oil and gas demand in different emission reduction pathways. Please update the assessment as appropriate to assess against the current state of the environment (baseline scenario) noting (as per paragraph 1 above) it will not remain static over the lifetime of a project and include the emissions (and where appropriate, production quantities) associated with other plans or projects. The assessment should consider the likely significant effects of emissions from the project, including the cumulation of effects with other existing or approved projects."

The comment is noted. To assist with clarity of response, Table 12 outlines the elements of the question and the sub-sections in which they have been answered.

Table 12: Signpost to Item 22 response.

<table>
<tr><th colspan="2">Item 22 Text</th><th rowspan="2">Response Cross-reference</th></tr>
<tr><th>Overarching Question</th><th>Sub-question</th></tr>
<tr><td rowspan="2">The assessment of the likely significant effects of the project is based on models of oil and gas demand in different emission reduction pathways.</td><td>Please update the assessment as appropriate to assess against the current state of the environment (baseline scenario) noting (as per paragraph 1 above) it will not remain static over the lifetime of a project.</td><td>See subsection A below and response to Item 15 (subsection A & B).</td></tr>
<tr><td>and include the emissions (and where appropriate, production quantities) associated with other plans or projects.</td><td>See subsection B below and response to Item 15.</td></tr>
<tr><td colspan="2">The assessment should consider the likely significant effects of emissions from the project, including the cumulation of effects with other existing or approved projects.</td><td>See subsection C below and response to Item 15 (subsection C and D).</td></tr>
</table>

A. Assessment against current and future baseline

Refer to Item 15, which explains how baseline (including future baseline scenario) and compliance with Schedule 6(4)(f) and 6(5) are incorporated into Equinor (2025).

B. Emissions associated with other plans and projects

Refer to Item 15, which explains how cumulative effects with other existing and approved projects, in a global context, have been incorporated into the assessment.

In relation to OPRED's comment to consider, where appropriate, production quantities, Table 16 (Equinor, 2025) presents the Rosebank Development's P10 annual production compared with global production volumes. These volumes represent the global production volumes related to the 2°C-consistent and 1.5°C consistent pathways. Projected emissions associated with these pathways (Table 15; Equinor, 2025) for the very low and low emissions scenarios (SSP1-1.9 and SSP1-2.6) project a rapid decline in global CO_2 emissions, limiting temperature rise to 1.5°C–2°C.

C. Likely significant effects of emissions from the Rosebank Development including the cumulation of effects with other existing or approved projects

In relation to the likely significant effects from the Rosebank Development alone, refer to Item 15 (subsection C), which explains how a 'project alone' assessment would typically form a substantial part of an impact assessment, being undertaken prior to cumulative assessment. However, downstream Scope 3 emissions can effect change on receptors only in a cumulative sense – the emissions from any one project in the absence of any other emissions would not be of a sufficient order to effect change on receptors through global climate change. As such, the 'project alone' assessment for the Rosebank Development can clearly state that there are no observable effects that can be attributed to the individual development, with potential effects inherently cumulative and which cannot be meaningfully separated from other emissions sources in terms of climate change impacts. The impact can therefore be concluded as not significant. The assessment can then move on to the consideration of cumulative impact.

Refer to Item 15 (subsection D), which explains how cumulative effects with other existing and approved projects, in a global context, have been incorporated into the assessment. Item 15 (subsection E) and Item 16 (subsection D) provides further details on the conclusions of significance.

23 ITEM 23

> "Paragraph 6.4.3 discusses global demand for oil and gas and refers to IPCC Working Group II findings that indicate ongoing demand across future scenarios. However, the IPCC AR6[13] report (B.5.3 p20) also concludes that cumulative CO_2 emissions from existing fossil fuel infrastructure—without additional abatement—already exceed the remaining global carbon budget for limiting warming to 1.5°C (high confidence), and would deplete more than a third of the remaining budget for 2°C.
>
> Please update the assessment to reflect this, by explaining how the existence of ongoing demand is reconciled with IPCC findings on the global carbon budgets, and by clarifying how emissions from other existing and approved projects have been taken into account when assessing the cumulative effects of the project alongside other existing or approved projects."

The comment is noted and has been taken into account in the review of the assessment. The response below explains how the existence of ongoing demand is reconciled in IPCC findings (subsection A) and how emissions from other existing and approved projects has been taken into account (subsection B).

A. Reconciliation of ongoing demand in IPCC findings

In their suite of AR6 publications, IPCC (2023b) identifies the misalignment of fossil fuel use and consumption with remaining carbon budgets consistent with limited warming to 1.5°C:

"Estimates of future CO_2 emissions from existing fossil fuel infrastructures without additional abatement already exceed the remaining carbon budget for limiting warming to 1.5°C (50%) (high confidence). Projected cumulative future CO_2 emissions over the lifetime of existing and planned fossil fuel infrastructure, if historical operating patterns are maintained and without additional abatement, are approximately equal to the remaining carbon budget for limiting warming to 2°C with a likelihood of 83% (high confidence)."

IPCC (2022) notes that there is ongoing demand for oil and gas in all IPCC future scenarios. The misalignment between fossil fuel use and the remaining carbon budget is reflected in Paris-aligned scenarios and emissions pathways, where fossil fuel demand steeply declines to 2050 and only persists in hard to abate sectors where use is combined with CCS or Carbon Dioxide Removal (CDR; refer to Item 19 and Appendix 3). For example, IEA (2025a) NZE Scenario assumes no new, long lead-time conventional upstream projects would need to be approved for development in order to deliver that scenario outcome. To achieve the global phase-down of fossil fuel consumption, demand and supply-side changes will be required (Figure 7). As highlighted by Edelenbosch *et al.* (2024), deep emissions reductions in hard-to-abate sectors can be achieved by demand shifts and technological interventions.

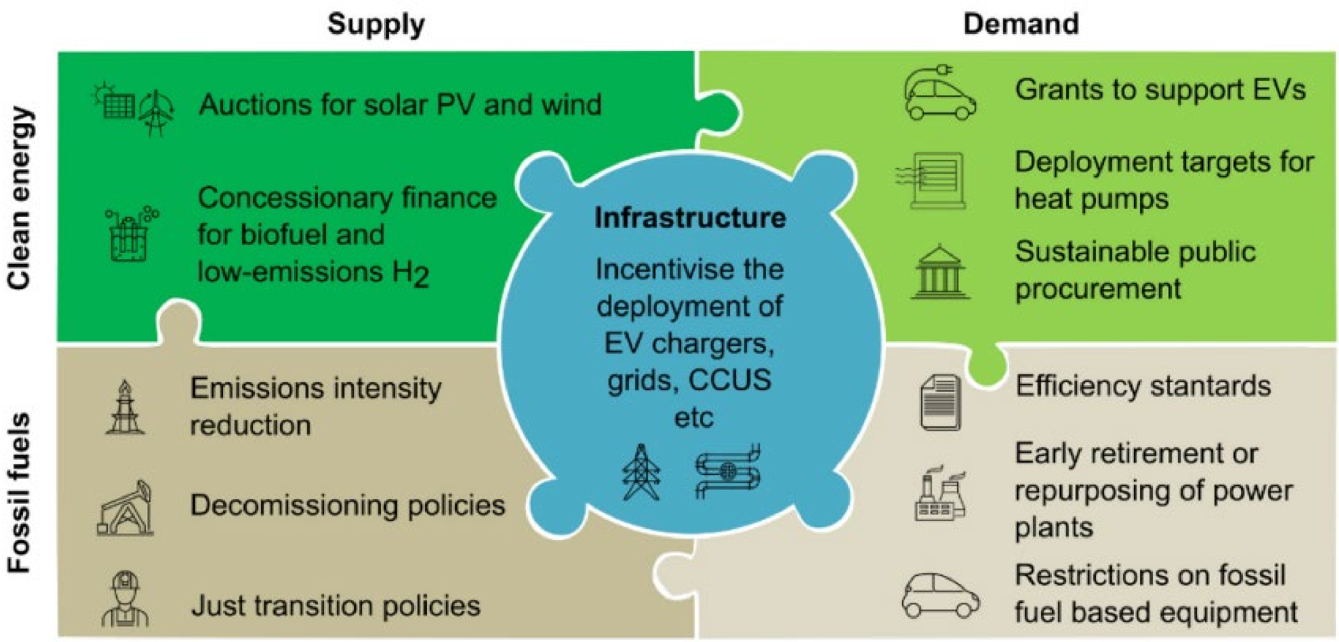


Figure 7: Supply and demand side policies for net-zero transition (IEA, 2023).

Importantly, the Rosebank Development's production profile is consistent with the gradual decline of fossil fuel use and supply in scenarios aligned with the Paris Agreement. As described in response to Item 16, the Rosebank Development production is accounted for in global supply forecasts (e.g. NSTA projections, also refer to paragraph 6.4.22 of Equinor (2025). During the lifetime of the Rosebank Development (out to 2051), Rosebank Development's annual production rates are anticipated to decline, mirroring the trend that is expected to occur globally - for example IEA (2025b) estimates that offshore fields in Europe will exhibit decline rates of approximately 9.7% per year. Table 16 and 17 of the assessment (Equinor, 2025) shows that the production of the Rosebank Development is either declining more rapidly or remaining constant with the oil and gas production levels of emissions pathways consistent with the Paris Agreement (for SEI *et al.* (2023) and IEA (2024), respectively). Therefore, the downstream Scope 3 emissions of the Rosebank Development are considered to align with the ongoing, yet declining demand of emissions pathways consistent with the Paris Agreement and with an energy transition towards Net Zero. The Rosebank Development's production will not materially alter global emissions trajectories or the ability to achieve pathway-defined temperature outcomes. As emphasised in Item 15, this forms a key part of the conclusion that the effects of the downstream Scope 3 emissions are not significant.

B. Consideration of emissions from existing and approved projects

The assessment of significance (Equinor, 2025) contextualises the Rosebank Development's downstream Scope 3 emissions against a range of global emissions reduction pathways that incorporate the cumulative effects of existing and planned projects, based on integrated modelling of energy systems, supply, demand and policy constraints (detailed in Items 15 and 19). These scenarios therefore provide an appropriate basis for assessing cumulative emissions in the context of global carbon budgets. The Rosebank Development's downstream Scope 3 emissions are potentially indistinguishable from forecast uncertainty and will not alter the assumptions (e.g. policy, technology development) that will enable Paris-aligned future scenarios and emissions reduction pathways to be realised. Item 15 (subsection E) and Item 16 (subsection D) provides further details on the conclusions of significance.

24 ITEM 24

> "Paragraph 6.4.6 presents emissions data for 2030, 2040 and 2050 (14, 10 and 4 $MtCO_2eq$ respectively). These figures do not appear to add up to the stated whole project emissions of 245$MtCO_2eq$. Please review and explain the data presented in Paragraph 6.4.6."

Adura clarifies that the values presented in paragraph 6.4.6 represent the **annual** Rosebank Development's Downstream Scope 3 Emissions for those individual years i.e. not cumulative across multiple years. The whole project emissions are equal to 254 $MtCO_2eq$ as opposed to the 245 $MtCO_2eq$ stated in the OPRED comment. The paragraph then goes on to compare those individual years against the annual GHG emissions associated with IPCC AR6 scenarios / emissions pathways, which are summarised in Table 15 of Equinor (2025).

25 ITEM 25

> "Paragraph 6.4.6 and Table 15 compares project emissions against global emissions under IPCC emissions-reduction pathways. However, the supplementary EIA guidance (page 12) explains that comparing an individual project's scope 3 emissions numerically against global emissions, due to scale differences, does not on its own provide a meaningful indication of global effects. A more meaningful assessment would be to consider the project's GHG emissions in cumulation with other existing and approved projects at a global scale.
>
> Please therefore update the assessment as appropriate to explain how cumulative global effects have been considered. In doing so, it may be useful to expand on the global carbon budget discussion in Paragraph 3.2.12 by placing the Rosebank project's GHG emissions in the context of remaining IPCC AR6 global carbon budgets, alongside emissions from other existing and planned projects over the life of the field. This would help clarify how cumulative emissions relate to a 1.5°C Paris-aligned trajectory and inform conclusions on the significance of effects."

The comment is noted and has been taken into account in the review of the assessment. This section provides further detail on how cumulative global effects have been considered in Equinor (2025) and expands on the relevance of the global carbon budget.

Item 15 (subsection C) provides further detail on the assessment methodology and evaluation of significance, including the assessment of the downstream Scope 3 emissions against emissions reduction pathways. Adura confirms that the assessment is not solely numerical and is aligned with the Supplementary Guidance.

Item 15 (subsection D) provides further detail on the consideration of cumulative effects in the Equinor (2025) assessment (also refer to Appendix 3 which outlines how the models / sources of emissions reduction pathways have accounted for the emissions of existing and planned projects).

The response to Item 4 describes the relevance of remaining carbon budgets to the future scenarios and emissions pathways used to contextualise the Rosebank Development's downstream Scope 3 emissions (Equinor, 2025). For example, the emissions projections under IPCC (2023) scenario C1 are aligned with the IPCC (2021) remaining carbon budget for maintaining warming levels below 1.5°C. Remaining carbon budgets constrain cumulative emissions to levels consistent with specific temperature outcomes, and current evidence indicates these budgets are already under significant pressure from existing and planned fossil fuel use. Emissions pathways explicitly reflect this constraint and are inherently cumulative (refer to Item 15, subsection C). Paris-aligned scenarios demonstrating how global emissions must decline to remain within these budgets.

Reports (e.g. UNEP, 2025; SEI *et al.*, 2023 and 2025) indicate pressure on global carbon budgets. There are multiple potential future scenarios, each associated with uncertainties and limitations (Item 19, Appendix 3): realisation of any individual scenario will depend on whether policy and market adjustments are made to tackle climate change. The development of Rosebank will not prevent these policy and market adjustments from being made.

It is concluded that the contextualisation of the downstream Scope 3 emissions against Paris-aligned scenarios and pathways is an appropriate method to determine alignment with remaining carbon budgets and this approach is inherently cumulative (refer to Item 15, subsection D). The Rosebank Development's downstream Scope 3 emissions are not considered to materially alter cumulative global emissions or the ability of these pathways to remain within Paris-aligned carbon budgets. For example, the Rosebank Development's downstream Scope 3 emissions will not alter the assumptions (e.g. policy, technology development) that could enable Paris-aligned future scenarios and emissions pathways to be realised. There is no change to the basis of assessment in relation to the consideration of cumulative effects, including consideration of the global carbon budget. Therefore, there are no changes to the conclusions of the assessment in Equinor (2025).

26 ITEM 26

> "Paragraph 6.4.7 refers to the production gap 2023 UNEP report[14]. The UNEP Production Gap Report 2025[15] shows that global fossil fuel production from existing and planned resources is now 120% higher than levels consistent with limiting warming to 1.5°C, compared with 110% reported in 2023. The 2025 report also provides a breakdown of the production gap for oil, gas and coal (Figure ES.2, page 4). Please update the assessment to reflect the findings of the 2025 UNEP Production Gap Report and ensure that the conclusions drawn are based on the most up-to-date evidence."

The comment is noted and has been taken into account in the review of the assessment. Adura notes that Equinor (2025) was submitted prior to publication of the updated SEI *et al.* (2025) Production Gap Report. The response below has been prepared to address the points raised on the 2025 Production Gap Report.

The assessment of significance in Equinor (2025) determines the alignment of the downstream Scope 3 emissions of the Rosebank Development with the SEI *et al.* (2023) Production Gap Report emissions pathways compatible with the Paris Agreement, and these pathways remain unchanged following publication of SEI *et al.* (2025).

Below, further detail is provided on the GPP pathway used to determine the 'production gap' in SEI *et al.* (2025), as referred to in OPRED's comment. Item 19 and Appendix 3 provide further information on how the GPP pathway was derived and Item 16 (subsection C) and Item 19 provide details on the uncertainties in the scenarios considered in SEI *et al.* (2025).

Figure 2.2 in the full SEI *et al.* (2025) report (the same as Figure ES.2 referenced by OPRED) and Table 2.2 of the SEI *et al.* (2025) report show that coal, oil and gas production is 1400%, 100% and 75% higher than 2°C-consistent emissions pathways. As described in Item 19 and Appendix 3, the GPP pathway has been updated in the SEI *et al.* (2025) report to reflect the latest information fossil fuel production plans and projections for the 19 major producing countries where data were available. The updated GPP pathway indicates, when compared to the previous iteration in 2023, that the production gap has increased (as noted in OPRED's comment). For example, global fossil fuel production in 2030 is now predicted to be 4% higher than the 2023 assessment predicted. The planned production for oil remains largely unchanged, whereas gas production under the updated GPP pathway has increased (planned production in 4% higher in 2030 compared with the 2023 analysis). Coal production is 7% higher in 2030, relative to the 2023 assessment (SEI *et al.*, 2025).

As SEI *et al.* (2025) states that the implications of the production gap remain unchanged from the previous assessment. That is the need to transition away from fossil fuel energy systems and close the 'production gap' persists. Therefore, in relation to the updated information in SEI *et al.* (2025), relative to SEI et al. (2023), no updates are required to the assessment in Equinor (2025). Item 27 provides further details on the alignment of the Rosebank Development's downstream Scope 3 emissions with the findings of SEI *et al.* (2025).

Relevant publications are regularly modified and updated. Since the September 2025 submission of Equinor (2025), a number of publications have been re-issued. For completeness, these are detailed in Table 13 which identifies where the updated information is incorporated into this response document. Table 13 is up to date as of 22nd May 2026: Adura is not aware of any relevant publications issued subsequent to this date that would materially alter the conclusions of the assessment of Equinor (2025).

Table 13: Publications referenced in Equinor (2025) and subsequent version published.

Document Referenced in Equinor (2025)	Updated Reference	Cross-reference in this Document
UK Carbon Budget Delivery Plan (DESNZ, 2023a).	UK Carbon Budget Delivery Plan (DESNZ, 2025d).	Item 6.
The Production Gap: Phasing down or phasing up? (SEI *et al.*, 2023).	The Production Gap Report (SEI *et al.*, 2025).	Items 16, 19, 26, and 27.
International Energy Agency (IEA), 2023. The Oil and Gas Industry in Net Zero Transitions, World Energy Outlook Special Report (*applicable only to selected scenarios and projections: based on the World Energy Outlook 2023 (IEA, 2023)*). World Energy Outlook 2024 (IEA, 2024).	World Energy Outlook 2025 (IEA, 2025a).	Items 16, 19, 21, 23, 28, 29, 30, and 31.
Indicators of Global Climate Change 2024 (Forster *et al.*, 2025).	Indicators of Global Climate Change 2025 (Forster *et al.*, 2026).	Item 4.

Document Referenced in Equinor (2025)	Updated Reference	Cross-reference in this Document
Global Carbon Budget (Global Carbon Budget, 2024).	Global Carbon Budget 2025 (Friedlingstein *et al.* 2026).	Items 4 and 16.
Institute of Environmental Management & Assessment (IEMA)[8] Guide: Assessing Greenhouse Gas Emissions and Evaluating their Significance. 2nd Edition (ISEP (IEMA), 2022)	Assessing Greenhouse Gas Emissions and Evaluating their Significance Edition 2.1, April 2026 with Supplementary Guidance (ISEP, 2026).	Items 15, 16, 18, and 25.

27 ITEM 27

> "Paragraph 6.4.9 makes reference to information presented in Table 16. Please clarify the source of information in Table 16 and how this data is calculated. The UNEP production gap reports state that Governments plan to produce more fossil fuels in 2030 than would be consistent with the 1.5°C or 2 °C warming scenario. Based on this, please explain the conclusion in the paragraph that the Rosebank Development P10 production profile is within a Paris Agreement aligned pathway."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the points raised to confirm the source of the information in Table 16 and to provide further information on the alignment of the Rosebank Development production with Paris Agreement aligned emissions pathways.

A. Source of Information in Table 16

Table 16 of the assessment in Equinor (2025) is sourced from the SEI *et al.* (2023) Production Gap Report and represents the median annual oil and gas production levels for pathways consistent with the Paris Agreement, based on a refined set of scenarios from the IPCC (2022) Working Group III Report. The projections for these scenarios are unchanged between the SEI *et al.* (2023) and SEI *et al.* (2025) Production Gap Reports. The production values have been converted from exajoules per year (EJ/yr) to million barrels per day (Mb/d) (oil) and billion cubic metres per year (bcm/yr) for gas in Table 16 of Equinor (2025). This conversion is completed using the conversion factors provided in the appended data to the SEI *et al.* (2025) Production Gap Report:

- Oil - 0.526 Mb/d (million barrels per day) per EJ/yr.
- Gas - 0.029 Tcm/yr (trillion cubic meters per year) per EJ/yr.

B. Alignment of downstream Scope 3 emissions with SEI et al. (2025)

The second part of OPRED's comment refers to the 'production gap' between planned / projected production and production compatible with the goals of the Paris Agreement. The comment requests an explanation of how the Rosebank Development's downstream Scope 3 emissions align with the conclusion that planned / projected production would result in global warming exceeding 1.5°C or 2 °C. The SEI *et al.* (2025) Production Gap Report GPP pathway considers the future fossil fuel production and plans for 19

[8] *At the time of publication was referred to as IEMA but is now known as ISEP*

major producing countries, and this is used to determine the 'production gap'. The production gap is detailed in Item 26, whilst Item 16 (subsection C) and Item 19 provide details on the uncertainties in the scenarios considered in the SEI *et al.* (2025) Production Gap Report.

The production levels associated with the GPP pathway are not included within the assessment of significance in Equinor (2025) which focusses on Paris-aligned pathways. It is acknowledged that the SEI *et al.* (2025) Production Gap Report reflects that the expansion of fossil fuel supply and use may exceed levels consistent with the Paris Agreement, reinforcing the relevance of using climate-aligned scenarios (e.g. IMPs, NZE) to provide a policy-constrained context for assessing emissions. As discussed in Item 16 (subsection C) the NSTA projections used for the GPP pathway for the UK include sanctioned but not yet producing fields, such as the Rosebank Development and therefore consenting Rosebank Development does not add to the production forecasts.

Government plans and projections under the GPP pathway are subject to uncertainty and do not incorporate future policy or market adjustments inherent in Paris-aligned scenarios (detailed further in Item 16 (Subsection C)). The SEI *et al.* (2025) report notes that where additional production occurs, steeper declines would be required subsequently to remain within climate targets, highlighting the constrained nature of Paris-aligned pathways. Nonetheless, the Rosebank Development's downstream Scope 3 emissions will not alter the assumptions (e.g. policy, technology development) that will enable Paris-aligned future scenarios and emissions pathways to be realised. As noted in Item 23, Table 16 of the assessment (Equinor, 2025) shows that the Rosebank Development will contribute a progressively smaller proportion of the oil and gas production levels for emission pathways compatible with the Paris Agreement in SEI *et al.* (2025) (i.e. production falls at a faster rate than the oil production consistent with the emissions pathways limiting warming to under 1.5°C and well below 2°C). The downstream Scope 3 emissions are not considered to impact achievement of Paris-aligned emission pathways. Therefore, as stated in the assessment (Equinor, 2025), the Rosebank Development's production is considered not to be inconsistent with the emissions pathways aligned with the Paris Agreement included in SEI *et al.* (2025).

28 ITEM 28

> "Paragraphs 6.4.13 to 6.4.19 – makes reference to the International Energy Agency (IEA) report [16] but does not address some of its conclusions. The IEA Net Zero scenario requires no new oil and gas projects to meet the future demand. The IEA report also discusses on p14 that there is no room for new fields and p16 discusses that it cannot be left to addressing demand solely to resolve emissions. Please ensure that the IEA report has been fully considered as part of the assessment."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to ensure that the conclusions of IEA (2023) report that are not covered in Equinor (2025) are fully considered.

Paragraphs 6.4.13 to 6.4.19 of Equinor (2025) include several quotes from IEA (2023), which focus on demand-side measures for the NZE scenario. IEA (2023) acknowledge that supply-side measures will also be required to enable Net Zero transition, including in relation to investment in new oil and gas developments. The key assumptions around the development of new oil and gas fields under the NZE Scenario from IEA (2023) and IEA (2025a) which are not explicitly stated in the assessment in Equinor (2025) are summarised in this response to address OPRED's comment, and the implications of these assumptions are considered.

A. Key assumptions for new oil and gas developments under the NZE scenario

IEA (2023) specifies that investment in oil and gas supply will be significantly reduced to a level where there is no need for long-lead time conventional oil and gas projects. The latest projections for the IEA

NZE scenario are presented in IEA (2025a) World Energy Outlook 2025 and broadly align with this by stating:

"As in previous editions of the NZE Scenario, upstream investment is directed towards maintaining the output of existing fields, as – in the absence of such investment – their natural decline rates would exceed the rate of decline of fossil fuel demand in the NZE Scenario. By 2050, the energy system still consumes some fossil fuels, with emissions from unabated fossil fuels offset by BECCS and Direct Air Capture and Storage (DACS) or fossil fuel emissions abated with CCUS. This means that fossil fuel supply investment does not drop to zero even by 2050, but it falls 90% compared to today."

IEA (2025a) NZE Scenario assumes no new, long lead-time conventional upstream projects would need to be approved for development in order to deliver that scenario outcome. IEA (2025c) highlights that production decline rates have steepened and that 90% of upstream investment has been directed to offsetting production declines rather than to expanding capacity. IEA (2025c) acknowledges that the level of new supply will depend partly on demand and that for the NZE Scenario the investment in existing and approved conventional projects is sufficient to meet demand. However, overall, the report emphasises the importance in maintaining sufficient supply to meet residual demand during the transition, while overall production declines in line with climate targets.

B. Implications for the assessment

Item 23 explains how the Rosebank Development's production aligns[9] with the ongoing demand for oil and gas compatible with emissions pathways consistent with the Paris Agreement. For the same reasons, the Rosebank Development is considered to align with the ongoing oil and gas demand and use under the NZE scenario.

As detailed in Item 23 and 27, the Rosebank Development's production will progressively decline over life of field, contributing to a smaller proportion of the oil and gas production levels for emission pathways compatible with the Paris Agreement. This declining production is considered to align with the decline in fossil fuel use which is integral to the NZE scenario, alongside other demand and supply-side mitigations. The NZE scenario is based on a range of assumptions regarding demand and supply and does not imply that the development of an individual project is incompatible with the Paris Agreement. It is important to note that the NZE scenario is normative / illustrative and is not the only pathway by which the climate goals of the Paris Agreement could be achieved (alternative future scenarios exist).

Overall, the additional information outlined above that captures the conclusions of IEA (2023, 2025a, 2025c) that were not covered in Equinor (2025) does not materially affect the conclusions of the assessment. The Rosebank Development is considered to align with ongoing demand in the NZE scenario which includes both demand and supply-side measures.

---

[9] *In this context, align is used to indicate that Rosebank production will fit within overall demand required in the NZE scenario, and there is no conclusive evidence that Rosebank would cause the level of supply to exceed that future demand.*

29 ITEM 29

> "Paragraph 6.4.16 compares IEA future oil and gas demand scenarios with expected production from the Rosebank project to assess likely effects. However, due to scale differences, this comparison alone does not provide a meaningful assessment (see page 12 of the supplementary EIA guidance as mentioned in paragraph 25 above). In addition, the assessment does not consider the climate effects associated with the different scenarios.
>
> Please update the assessment to explain how the climate effects of the IEA scenarios have been considered, including emissions from other existing and approved projects, and how these scenarios inform conclusions on likely effects on the environment (for example, by reference to projected temperature outcomes such as those presented in Figure 1.5 of the IEA *World Energy Outlook*[17])."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the request for clarification on how the climate implications of the IEA scenarios have been considered, including their associated emission profiles and temperature outcomes. Further details on the climate effects of GHG emissions are included in Appendix 2. Item 15 (subsection B) also explains how climate effects are considered within the Equinor (2025) assessment. The response below relates specifically to the climate change projections within IEA (2025a) and the implications on the Equinor (2025) assessment.

A. Climate change outcomes discussed in IEA (2025a)

The NZE scenario is the only scenario considered within IEA (2025a) that is considered Paris-aligned. The scenario is no longer a limited-overshoot scenario, as warming peaks above 1.6°C and exceeds 1.5°C for several decades before returning below 1.5°C by 2100.

All scenarios considered in IEA (2025a), including the NZE scenario, may result in additional warming relative to pre-industrial levels, with associated climate change impacts. As shown in Figure 1.5 of IEA (2025a), the NZE scenario results in peak warming of 1.65°C and then declines slowly thereafter to below 1.5°C by 2100. The other scenarios, Current Policies (CPS) and STEPS, result in warming that is 2°C above pre-industrial levels in 2050 and 2060, respectively. As discussed in Item 15 and 19, the scenarios in IEA (2025a) are considered inherently cumulative and incorporate emissions from existing and approved projects in the context of the assumptions of each scenario.

IEA (2025a) consider the implications of the prolonged period of overshoot above 1.5°C for the NZE scenario, including to ecosystems and human systems, largely derived from reports by IPCC. IEA (2025a) also note that climate change impacts will be exacerbated under the STEPS and CPS scenarios. These future climate change impacts are summarised in Appendix 2 as part of the future baseline scenario, recognising that the state of the environment will evolve over the lifetime of the Rosebank Development in line with global emissions trajectories. Furthermore, IEA (2025a) acknowledge that there are uncertainties in the climate response to future GHG emissions.

B. Implications for the assessment

Item 15 (subsection B) explains why the appropriate focus of the assessment for downstream Scope 3 emissions is the global atmosphere as the primary receptor, with significance evaluated through alignment with recognised emission reduction pathways and climate commitments. While all the IEA scenarios involve continued climate change impacts to varying degrees, the Rosebank Development does not materially influence the scale or nature of those impacts. This approach satisfies the requirement to consider climate effects, while recognising that any indirect implications for other receptors cannot be reliably disaggregated or attributed at the scale of an individual project.

On this cumulative basis, and applying the defined assessment methodology (high receptor sensitivity, low magnitude of impact, and likely impact – per Table 14; Equinor (2025)), the overall effect was concluded (and is confirmed) to be not significant. For the reasons outlined above, this conclusion is unchanged from the consideration of the climate effects of IEA scenarios.

30 ITEM 30

> "Table 17 and paragraph 6.4.17 also compare future oil and gas demand scenarios from the IEA with expected production from Rosebank. The table does not include GHG emissions. As indicated in paragraph 6.4.17, some scenarios in the future demand models do not always consider full combustion of the hydrocarbons. The supplementary EIA guidance on p9 indicates that the starting point should be that all produced hydrocarbons will eventually be combusted and where scenarios for non-combustion use are presented, evidence must be provided. The scope 3 assessment needs to assume that all oil and gas is combusted as the end use cannot be guaranteed and therefore, comparison to these scenarios where not all oil and gas is combusted would not fully assess the effects of scope 3 emissions on the environment.
>
> Please re-visit the assessment to ensure that consideration is given to the assumptions and limitations of any model when used in support of characterising and assessing the environmental effects of the scope 3 emissions. Where you choose to present non-combustion use, provide evidence."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the points raised, including in relation to the assumptions and limitations of future demand scenarios and the assumptions related to the end use of hydrocarbons (i.e. combustion or non-combustion).

Adura acknowledges OPRED's comment that comparisons with future demand scenarios must be underpinned by a conservative assumption of full combustion of produced hydrocarbons, unless robust evidence is provided to justify non-combustion uses, and that the limitations and assumptions of such models must be clearly reflected in the Scope 3 assessment.

It is the case that Table 17 and paragraph 6.4.17 of Equinor (2025) compare future oil and gas demand scenarios from the IEA with expected production from the Rosebank Development (not emissions). As can be seen from Table 17 of Equinor (2025), the Rosebank Development's production is a relatively small percentage of oil and gas demand across the different scenarios.

The different scenarios (as stated in paragraph 6.4.14; Equinor, 2025) are not predictions and do not contain a single view about what the long term future might hold. The assumptions and limitations of the models underpinning these scenarios are considered in Item 16, Item 19 and Appendix 3.

It was assumed in the assessment in Equinor (2025) that all produced hydrocarbons over the lifetime of the Rosebank Development would eventually be combusted, consistent with the Supplementary Guidance. No assumptions were made of non-combustion, where no deduction is made for oil or gas that may be destined for non-energy uses (paragraph 5.3.4). Emissions reduction pathways do contain assumptions around non-combustion use (Item 19). Comparison of 100% combustion of all hydrocarbons from the Rosebank Development with global emissions reduction pathways which account for non-combustion use of hydrocarbon is inherently conservative/precautionary. Comparing the Rosebank Development's Downstream Scope 3 emissions to global emissions reduction pathways that assume all hydrocarbons are combusted would result in the Rosebank Development's downstream Scope 3 emissions forming an even smaller proportion of these pathways, as these are associated with a higher level of GHG emissions than pathways that contain non-combustion use.

The conclusions of the assessment in Equinor (2025) remain unchanged following this clarification on the consideration of scenarios that include non-combustion of some produced hydrocarbons.

31 ITEM 31

> "Paragraph 6.4.19 (including 6.4.19.1 & 6.4.19.2) concludes that based on the significance matrix the consequence of the project is assessed as low and therefore not significant in terms of effect on climate. This conclusion is based on stating that the Rosebank project aligns with net zero oil and gas demand pathways published by the IEA, under the assumption that a decline in demand results in the decline of emissions. However, earlier in the further information you state that the emission reduction pathways do not have a likelihood attached to them, therefore, it is unclear why you have selected the net zero pathway to make the conclusion that the significance is low.
>
> The conclusion on significance should be revisited based on the references you have cited in the further information and include an assessment relating to downstream emissions from the combustion of project hydrocarbons (assuming all produced hydrocarbons are combusted) and the emission reduction pathways including for other existing plans and projects (please see also paragraphs 20 and 34)."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the points raised regarding the basis for the significance conclusion in paragraph 6.4.19 of Equinor (2025) and the need to further clarify the use of emissions pathways, including the treatment of downstream emissions and the selection of scenarios in the assessment.

Firstly, it is clarified that the IEA (2024) NZE scenario is used within the Rosebank Development's assessment as a policy-aligned benchmark rather than as a most likely scenario. As confirmed in the response to Item 16, the pathways against which assessment was conducted (Section 6.4; Equinor, 2025) do not have a likelihood attached to them (also refer to Item 20). It is clarified that, the "likelihood" term in the evaluation of significance is defined in paragraph 6.2.1 of Equinor (2025), i.e. *The impact of the Rosebank Development's Downstream Scope 3 Emissions on the climate is considered "likely" as GHG emissions from any project will contribute to climate change.* As clarified in the response to Item 5, realisation of the emissions pathways are conditional on the fulfilment of a range of assumptions associated with human choice. The assessment of significant does not rely on a single pathway to address the uncertainties in future emissions projections and instead a range of plausible scenarios are used (refer to Item 15 (subsection C).

Items 15 and 16 outline the assessment methodology and basis for conclusion of significance, including how cumulative effects are accounted for. As clarified in the response to Item 16 (subsection D), the evaluation of significance details:

- The quantified emissions from the Rosebank Development which have been conservatively quantified assuming high-case production and full combustion of produced hydrocarbon (paragraph 5.3.4 of the assessment in Equinor (2025).
- Contextualisation of the downstream Scope 3 emissions with global emissions reduction pathways (which are inherently cumulative in nature as discussed in Items 15 (subsection D)).
- Alignment with international and national climate objectives.

The conclusion on significance is therefore robust, emissions-based, scenario-aware, and not dependent on a single assumed pathway or demand narrative.

32 ITEM 32

"Paragraph 6.4.20 to 6.4.22 please confirm which of the listed EPOs, as described in the further information, have been considered in the assessment of the scope 3 emissions (as also covered in points 6 and 21)."

Table 6 in the response to Item 6 identifies the relevant EPOs against which the assessment has been undertaken. The relevant listed EPO is primarily the Paris Agreement. The UK Climate Change Act 2008 (as amended) is included to provide context at a country level, supported (as shown in the response to Item 6) by the other instruments listed in section 6.2.21 (Equinor, 2025).

33 ITEM 33

"Paragraphs 6.4.22 and 6.4.23 discuss the Climate Change Committee's advice[18] on the demand for oil and gas under UK future carbon budgets concluding in paragraph 6.5.6.3 that the UKCS production is within the future demand under Carbon Budget 7 and therefore that the consequence is low. The further information does not represent accurately the reference to the CCC's document, as this document is providing advice on the level of Carbon Budget 7 to achieve Net Zero Greenhouse Gas emissions by 2050. The CCC's modelling for a CB7 "*Balanced Pathway*" is done at the sectoral level and does not constitute endorsement of specific projects. Please provide an update to accurately represent the information referenced in the context of emissions rather than focusing on demand."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the points raised to consider the information in the CCC's Seventh Carbon Budget and to clarify the contextualisation of the significance is based on emissions.

The CCC's Seventh Carbon Budget (CCC, 2025b) analysis provides systems-level emissions pathways to achieve Net Zero, rather than endorsing specific projects or levels of hydrocarbon production. The CCC's advice constitutes the UK's official "net zero-consistent" pathway and is a benchmark for UK climate policy and carbon budgets. Equinor (2025) paragraphs 6.4.22 and 6.4.23 reference the CCC's analysis as high-level contextual information on the UK's emissions trajectory.

Assumptions within the CCC's modelling are made (informed by NSTA data) that relate to UK oil and gas production which is showing a continued but declining trend. Production information is presented in Equinor (2025) to provide context on the broader transition of the UK energy system. CCC (2025b) cites that *"Fossil fuel supply emissions will be declining over time (even without new policy in the sector) due to shrinking North Sea oil and gas production and reducing demand from the electrification of transport, buildings, and industry."*

As explained in Item 6, Rosebank Development's downstream Scope 3 emissions are not directly accounted for within the UK carbon budget, however the CCC's analysis remains relevant as contextual information to support the assessment of significance (Item 15). In this context, it is recognised that achievement of the CCC's Balanced Pathway[10]is determined by economy-wide emissions reductions rather than the contributions of individual projects. Emissions reduction in the UK to date have been achieved via the phase out of coal and the increase in renewable electricity generation: achieving future targets requires emissions reduction in sectors including surface transport, buildings, industry, and agriculture (CCC, 2025b).

---

[10] An emissions reduction pathway from 2025 to Net Zero by 2050. The pathway is in line with UK legislated carbon budgets and stated NDCs. The Balanced Pathway achieves the recommended Seventh Carbon Budget via domestic action.

As outlined in Table 14 of the assessment in Equinor (2025), the assessment of significance contextualises emissions from the Rosebank Development (at the UK level) in relation to wider UK policy framework and emissions reduction objectives. Per Item 6, the Rosebank Development is aligned with UK government climate policies and strategies e.g. the North Sea Transition Deal and the North Sea Futures Plan, contributing to contextualisation for the overall evaluation of significance.

To clarify, the assessment of significance is based on emissions (refer to Item 15), however, demand provides additional context for the assessment.

34 ITEM 34

> "Paragraphs 6.5.3 and 6.5.7 provide conclusions on the assessment of likely significant effects. It is stated in these paragraphs that where Paris alignment is not achieved that emissions from any project including Rosebank could have a significant effect on climate. It is subsequently concluded under a Paris aligned pathway, that the effect of Rosebank's scope 3 emissions is not significant. Please provide an update giving further consideration to the likelihood of the presented pathways in support of the assessment, we noted that there are multiple pathways with no likelihood attached, as such any of the outcomes are possible. Further, in light of point 30, consideration that all hydrocarbons are combusted must be included."

The comment is noted and has been taken into account in the review of the assessment. The response below has been prepared to address the points raised relating to the likelihood of the presented pathways and the consideration that all hydrocarbons are combusted.

As detailed in the response to Item 5 and further clarified in Items 20 and 31, the presented pathways do not have a likelihood attached to them. It is clarified that the "likelihood" term in the evaluation of significance is defined in paragraph 6.2.1 of Equinor (2025), i.e. *The impact of the Rosebank Development's Downstream Scope 3 Emissions on the climate is considered "likely" as GHG emissions from any project will contribute to climate change.* It is further noted that:

- No probabilities are assigned to pathways because they are scenario-based and exploratory (not predictive). Given the range of uncertainties associated with any single pathway (Item 19), the assessment considers a range of plausible futures to test and contextualise the conclusion of no-significance.
- Paris-aligned pathways are policy-relevant benchmarks to test consistency with internationally agreed climate objectives (and are not a prediction of future outcomes).
- Realisation or exceedance of the Paris Agreement temperature goals will occur independently of the Rosebank Development. Attainment is determined by co-ordinated system-wide transitions across all sectors and geographies (IPCC, 2023a).

As confirmed in the response to Item 16, the assessment assumed that all hydrocarbon produced from the Rosebank Development is combusted (paragraph 5.3.4; Equinor, 2025).

The conclusions of the assessment in Equinor (2025) remain unchanged following this clarification on the consideration of the use of multiple emissions pathways (with no associated likelihood) and the clarification on the consideration of scenarios that included non-combustion of some produced hydrocarbons (refer to Item 30).

35 ITEM 35

> "In the Glossary Section the following needs to be addressed:
>
> Global Carbon Budget; please clarify the reference of the definition, for example, is it as calculated and referenced in the IPCC reports or another source?
>
> IMPs - please reference where this definition came from - for example is it from AR6 WGIII? (Mitigation pathways or scenarios are called different things in different reports e.g. RCP's are in AR5).
>
> IPCC Scenarios (SSP-RCP) please be clearer about where this comes from as this relates to IMPs - which IPCC report does this come from?"

The comment is noted and has been taken into account in the review of the assessment. The response below identifies the sources for the definitions in the Glossary section of Equinor (2025) listed by OPRED and explains the interface between these definitions.

- The definition of the Global Carbon Budget is taken from Global Carbon Budget (2025).
- IMPs were developed for AR6 and are presented in the WGIII report Chapter 3 (IPCC, 2022).
- The SSP and RCP scenarios form the basis of the climate projections assessed in IPCC (2021) AR6 Working Group I Report. SSPs and RCPs are combined into a joint SSP-RCP framework, which pairs a socioeconomic pathway (SSP) with a climate forcing outcome (RCP), allowing exploration of how different societal choices lead to different climate outcomes.

PART 2: UPDATED ASSESSMENT OF THE PROJECT DOCUMENT

36 ITEM 36

Paragraph 4.3.2 Seabed Fauna 4.3.2.2.2.3 Cold water corals. Please summarise the evidence used to support reaching the conclusion that there were no coral gardens present in the survey area. It could be beneficial to summarise the re-examined survey sites in a table, alongside all the coral species identified that contribute to the taxa listed in the Henry and Roberts (2014a)[19] UK technical definition for coral gardens against the assessment criteria for each location.

[19] Henry, L.A. & Roberts, J.M., (2014a), Developing an interim technical definition for Coral Gardens specific for UK waters and its subsequent application to verify suspected records, JNCC Report No. 507, JNCC, Peterborough, ISSN 0963-8091. Developing an interim technical definition for Coral Gardens specific for UK waters and its subsequent application to verify suspected records | JNCC Resource Hub

In December 2022, DNV (2022) carried out an assessment of the video and photographic data from the April 2022 survey and re-evaluated the data against the criteria cited in Henry and Roberts (2014a) working definition of coral gardens. A summary of the DNV (2022) assessment with regard to the Henry and Roberts (2014a) requirements under the three "Density" criteria is as follows:

- **Density - Coral garden taxa need to be dominant. This can be determined by comparing the mean density of coral garden taxa (not including reef forming corals) to the density of other habitat forming species.**

  DNV concluded that coral garden taxa (*Gersemia*) were not found to be dominant compared to other macrofaunal species identified during the survey. Information on the occurrence of *Gersemia* in the stations surveyed in 2022 is provided in Table 14 (DNV, 2022).

- **Assemblage - Coral garden taxa need to characterise the community.**

  The *Gersemia*/pycnogonida (sea spiders that feed on *Gersemia*) species assemblage that have been identified at the deeper stations at the Rosebank Development contribute to the definition of the megafauna communities at those deeper stations and thus could in that respect be considered to fulfil the criteria "coral garden species characterise the community". However, these deeper stations had in general very low abundances of megafauna and the communities would therefore not be described as characterised by coral garden taxa. Table 14 details occurrence of *Gersemia* and pycnogonids in the stations surveyed in 2022 (DNV, 2022).

- **At least one, non-reef forming coral taxon needs to be at least 'Frequent' on the SACFOR scale.**

  A classification of density (DNV, 2022) is provided for each station using the Superabundant (S), Abundant (A), Common (C), Frequent (F), Occasional (O), Rare (R) (SACFOR) scale. This has been presented in Table 14, and shows densities at all stations to be in the lower half of the scale.

On the basis of the above review of criteria, DNV (2022) concluded from the survey data that the Henry and Roberts (2014a) requirements under the "Density" criteria were not met for coral garden classification in any location surveyed. In only 3 stations were "frequent" coral garden taxa identified (ENV06, ENV08 and ENV11; Figure 4-5, from the Rosebank Development ES (Equinor 2022)), and in these three stations not all the remaining Henry and Roberts (2014a) density-related criteria were met. Considering that survey data did not pass the "Density" criteria filter (i.e. the first step in the Henry and Roberts (2014a) criteria), further assessments related to the "Biotope" and "Ecological function" criteria were not considered.

Table 14: General overview of fauna composition at different environmental stations from the visual survey in 2022. Coral species included in Henry and Roberts (2014a) are underlined.

SACFOR scale: 1: Rare; 2: occasional; 3: Frequent; 4: Common; 5: Abundant; 6: Superabundant, with (-) indicating absence. Source DNV (2022).

Sampling Station	Depth (m)	Fauna Description	Dominating Species	*Gersemia* in the SACFOR Scale	Deep-sea Sponge Aggregations
ENV25	126	Individual poor but relatively heterogenous macrofauna.	Sea potato (*Echinocardium*) and the sea urchin *Gracilechinus acutus* and sea star *Porania pulvillus*.	(-)	No
ENV28	127	Relatively species and individual poor.	Squat lobsters (*Munida*).	(-)	No
ENV26	133	Individual poor but relatively heterogenous macrofauna.	Hermit crabs (*Pagurus*) and *Ditrupa arietina*.	(-)	No
ENV24	140	Relatively species rich, heterogenous over the area as substrate changed.	Hermit crabs (*Pagurus*) and tube forming polychaeta *Ditrupa arietina*, *Filograna*, *Hydroides*.	(-)	No
ENV23	165	Moderate density of species and individuals, heterogenous over the area as substrate changed.	Hermit crabs (*Pagurus*).	(-)	No
ENV22a_214	191	Few species and individuals registered.	Seastar (*Ceramaster granularis*).	(-)	No

Sampling Station	Depth (m)	Fauna Description	Dominating Species	*Gersemia* in the SACFOR Scale	Deep-sea Sponge Aggregations
ENV21	251	Few species and individuals registered.	Ophiuroids, cup coral (*Caryophyllia smithii*).	(-)	No
ENV20a_212	352	Moderate number of species.	Squat lobsters (*Munida*), sea potatoes (*Echinocardium*) and the sea urchin *Cidaris cidaris*.	(-)	No
ENV19	425	Small patches of hardbottom sponges – scattered.	Squat lobsters (*Munida*), sea urchin *Cidaris cidaris*.	(-)	No
ENV18	493	Patches of hardbottom sponges – «high» and «common», falling into Oslo Paris Convention (OSPAR) habitat Deep-sea sponge aggregation. Scattered occurrences of hardbottom sponges between the patches of higher density.	Hardbottom sponge species in genus *Axinella*, *Phakellia*, *Mycale*. soft coral *Gersemia*.	2	OSPAR habitat Deep-sea sponge aggregation
ENV17a_207	523	Relatively uniform distribution of hardbottom sponges falling into density category «common». OSPAR habitat Deep-sea sponge aggregation. Relatively species rich.	Hardbottom sponge species in genus *Axinella*, *Phakellia*.	1	OSPAR habitat Deep-sea sponge aggregation

Sampling Station	Depth (m)	Fauna Description	Dominating Species	*Gersemia* in the SACFOR Scale	Deep-sea Sponge Aggregations
ENV27	556	Scattered to no occurrences of hard-bottom sponges.	Sabellid polychaetes, hard-bottom sponge species in genus *Axinella*, *Phakellia*.	1	No
ENV16	615	Smaller patches of hard-bottom sponges – scattered.	Seastars (*Ceramaster granularis*, *Gracilechinus acutus*) and ophiuroids.	1	No
ENV15	689	Scattered to patchy occurrences of the soft coral Gersemia and pycnogonids.	Sea feathers *Antedon/ Bathycrinus*. Soft coral Gersemia spp. and pycnogonids e.g. *Colossendeis proboscidea*.	2	No
ENV14	779	Small rock outcrop. Scattered to patchy occurrences of the soft coral *Gersemia* and pycnogonids.	Sponge *Chondrocladia gigantea*, soft coral *Gersemia*.	2	No
ENV13	920	Scattered to patchy occurrences of the soft coral *Gersemia* and pycnogonids.	Giant club sponge *Chondrolcladia gigantea*, soft coral *Gersemia* spp., crinoid *Poliometra prolixa*.	1	No
ENV12a_202	991	Single registrations of the soft coral *Gersemia*.	*Soft coral Gersemia*, crinoid *Bathycrinus*.	2	No

Sampling Station	Depth (m)	Fauna Description	Dominating Species	*Gersemia* in the SACFOR Scale	Deep-sea Sponge Aggregations
ENV07	1077	Single registrations of the soft coral *Gersemia* and scattered occurrences of single crinoids.	*Soft coral Gersemia*, *Colossendeis proboscidea*, crinoid *Poliometra prolixa*.	1	No
ENV06	1090	Patchy occurrences of the soft coral *Gersemia* and pycnogonids.	Anemones (Cerianthiidae), soft coral *Gersemia* and pycnogonida.	3	No
ENV11	1095	Single registrations of the soft coral *Gersemia*.	Bryozoa on rocks, Anemones (Cerianthiidae), soft coral *Gersemia* and pycnogonida.	3	No
ENV05	1098	Single registrations of the soft coral *Gersemia*.	Polychaeta sabellids, tube forming, Anemones (Cerianthiidae), soft coral *Gersemia* and pycnogonida.	2	No
ENV29_314	1099	Patchy occurrences of the soft coral *Gersemia* and pycnogonids.	Anemones (Cerianthiidae), soft coral *Gersemia* and green spoonworm *Bonellia viridis*.	2	No
ENV09	1100	Single registrations of the soft coral *Gersemia* and scattered occurrences of single crinoids.	Soft coral *Gersemia* and pycnogonida.	1	No
ENV01	1101	Single registrations of the soft coral *Gersemia*.	Polychaeta sabellids, tube forming anemones (Cerianthiidae), soft coral *Gersemia* and pycnogonida.	2	No

Sampling Station	Depth (m)	Fauna Description	Dominating Species	*Gersemia* in the SACFOR Scale	Deep-sea Sponge Aggregations
ENV04	1102	Single registrations of the soft coral *Gersemia* and scattered occurrences of single crinoids.	*Soft coral Gersemia*, Cerianthiidae, Crangonidae indet.	2	No
ENV10	1102	Single registrations of the soft coral *Gersemia*.	Anemones (Cerianthiidae), ***Gersemia*** and pycnogonida.	2	No
ENV02	1103	Single registrations of the soft coral *Gersemia* and scattered occurrences of single crinoids.	*Soft coral Gersemia*, *Colossendeis proboscidea*, crinoid *Poliometra prolixa*.	2	No
ENV03	1105	Single registrations of the soft coral *Gersemia* and scattered occurrences of single crinoids.	*Soft coral Gersemia*, *Colossendeis proboscidea*, crinoid *Poliometra prolixa*.	2	No
ENV08	1110	Single registrations of the soft coral *Gersemia* and scattered occurrences of single crinoids.	Anemones (Cerianthiidae), soft coral *Gersemia* and pycnogonida.	3	No

37 ITEM 37

Paragraph 6.4.2 Potential Seabed and Habitat Impacts, including on Protected Sites. The assessment of sponge aggregations within the surveyed area presented needs to be explained. A clearer understanding of the potential presence of any habitats that can be classified as sponge aggregations is required in order to evidence the conclusion reached. Please provide:

-a summary of the depth in metres of all sampling stations used in the environmental survey.

-the outcome of the review of the Henry and Roberts 2014(b) criteria for sponge density classification. This could be provided in a table format to improve clarity.

The depth in metres of all sampling stations in the site-specific environmental survey carried out in 2022, and the outcome of the review of the Henry and Roberts 2014(b) criteria, are presented in Table 14 in Item 36 above.

Section 4.3.2.2.2 "Deep-sea sponge aggregations" of the Rosebank Development ES (Equinor, 2022) included an assessment of sponge aggregations to support the assessment presented in Section 6.4.2 of Equinor (2025). That assessment was undertaken in line with the Henry and Roberts (2014b) criteria, which covers:

- Density:
  - Raw measurements of abundance/density that equal or exceed densities of OSPAR (2010), so that which are generally between 0.5 and 24 sponges/m^2.
  - Assessments of occurrence categorised as at least 'frequent' according to the Marine Nature Conservation Review's SACFOR scale of abundance, and using the multivariate similarity of percentages (SIMPER) metric to determine that sponges were truly characteristic of an assemblage.
- Habitat:
  - Habitat type characterised by one or a set of large (>5 cm diameter) sponge species that may or may not dominate the community biomass (OSPAR, 2010). In assessing this, a sponge record passes the habitat criteria if it could be determined that the assemblage could not be described as anything other than a potential deep-sea sponge aggregation i.e. not falling into any other habitat forming fauna types such as *Desmophyllum* coral reefs.
- Ecological function:
  - The criteria proposed by Henry and Roberts (2014b) could not be confirmed with appropriate confidence as the somewhat increased megafaunal richness observed at the two stations (ENV18 and ENV17a-207; see Table 14) was likely associated with both the increased abundance of sponges and increased heterogeneity in general due to the relative proportion of rocky substrate and increased number of niches supporting other fauna.

In line with these criteria, as shown in Table 14 in Item 36 above and Section 4.3.2.2.2 "Deep-sea sponge aggregations" of the Rosebank Development ES (Equinor, 2022), deep sea sponge aggregations were recorded at only two of the survey stations. Since the assessment of sponge aggregations was taken in line with best practice criteria for determining presence and quality of such habitat, and noting that even where present densities of sponges were generally low to moderate and aggregations were generally spread over smaller areas (DNV, 2022), the Rosebank Development ES (Equinor, 2022) conclusion that the consequence of effects was assessed as low and that there will be no significant impact on the seabed is considered to remain valid.

38 ITEM 38

Please provide the potential total cumulative effects on the seabed (in square kilometres (km^2) from the permanent infrastructure that has been installed since the designation of the FSSB NCMPA This should include the effect from current Rosebank operations and the potential impact from proposed Rosebank operations, in addition to the impact from other approved projects e.g. existing infrastructure from other oil and gas operators (out with the FSSB NCMPA and within). In addition, please include the potential impact upon the FSSB NCMPA as a % of the total area of the NCMPA in addition to the area of impact in km^2.

An estimate of the seabed footprint of all permanent infrastructure that has been installed within the FSSB NCMPA has been made using available data from the NSTA, and this is presented in Table 15. This covers permanent infrastructure (e.g. pipelines, wellheads, rock and manifolds) installed since the designation of the FSSB NCMPA; if the date of installation was not clear in the NSTA database, the infrastructure was included within the assessment in order to represent a worst case figure. The total area of potential impact is estimated to be approximately 1.89 km^2, representing approximately 0.035% of the total area of the FSSB NCMPA.

Table 15: Cumulative effects on the seabed from permanent infrastructure in the FSSB NCMPA.

Activity	Calculated Approximate Impact (m^2)	Calculated Approximate Impact (km^2)
Permanent infrastructure related to non-Adura operations	1,717,415	1.72
Permanent infrastructure related to the Rosebank Development (as per latest Environmental Assessment Justification submitted to OPRED)	174,000	0.17
Total permanent infrastructure	**1,891,415**	**1.89**
Approximate % of FSSB NCMPA on which permanent infrastructure has been installed since designation (protected area = 5,278 km^2)		**0.035%**

Note: The figure used to assess potential impact from Rosebank activities within the Rosebank Development ES (Equinor, 2022) was a worst-case estimate of 0.61km^2. This figure has been reduced to the 0.17km^2 (as per Table 15) through detailed engineering and installation planning, as would be expected to occur post-ES submission.

39 ITEM 39

Paragraph 3.4.5 Mud Selection and Cuttings Discharge. There appear to be discrepancies between the amount of drill cuttings proposed for discharge assessed in the ES and the latest Screening Direction applications submitted to OPRED. For example, drill cuttings discussed in the ES for phase 1 wells such as Dynamically Positioned 1 (DP1) indicate a total of 948 tonnes with no contingency, whereas the latest screening direction applications indicate, for well DP1, a potential quantity of 1,339 tonnes (with no contingency) and 1,890 tonnes including a contingency. Please clarify.

Table 3-6 in Section 3.4.5 of the Rosebank Development ES (Equinor, 2022) provides an estimate of the cuttings generated from each well. The DP1 well was estimated to result in a total of 944 te of cuttings (Table 16) (note the number in the question above of 948 is believed to be a typing error and it should be 944 in line with this). Since the ES was submitted, Screening Direction applications have been submitted for three of the development wells; DP1, DP3 and CP2. These Screening Direction applications include updated estimates for quantities of drill cuttings, as would be expected to occur as project design matures. A comparison of the cuttings quantities in the Rosebank Development ES (Equinor, 2022) with the quantities in the Screening Direction applications (DRA/1178, DRA/1102 and DRA/1159) is summarised in Table 16.

Table 16: Comparison of the potential cuttings proposed for discharge as estimated for wells DP1, DP3 and CP2.

Well Section	Cuttings (te)					
	DP3		DP1		CP2	
	ES	DRA/1178	ES	DRA/1102	ES	DRA/1159
42(36)″	191	186	191	186	191	186
26″	382	643	382	602	386	792
17 ½″	420	538	326	476	452	443
12 ¼″	82	144	41	64	104	192
Contingency sidetrack	-	(682)[11]	-	(540)	-	(635)
8 ½″	82	105	4	11	87	104
Contingency sidetrack	-	(105)	-	(11)	-	(104)
Total	**1,157**	**1,616 (2,403)**	**944**	**1,339 (1,890)**	**1,220**	**1717 (2,456)**

The discrepancies between the amount of drill cuttings estimated for discharge in the Rosebank Development ES and the Screening Direction applications for the Rosebank Development wells submitted to date are as a result of changes to well design and differences in the cuttings estimation methodology. This is explained further below:

A. Well Section Lengths

Following refinement of the well design, the proposed section lengths for the 26″ section, 17 ½″ section, 12 ¼″ section and 8 ½″ section have been amended, resulting in a subsequent increase in the quantity of cuttings. This is presented in Table 17.

[11] *Number in bracket signify this contingency cuttings volumes.*

Table 17: Comparison of drill section lengths between the Rosebank Development ES and Screening Direction applications.

Well Section	Section Length (metres)					
	DP3		DP1		CP2	
	ES	DRA/1178	ES	DRA/1102	ES	DRA/1159
42(36)"	90	84	90	84	90	84
26"	478	555	478	520	484	684
17 ½"	1162	1111	901	984	1251	915
12 ¼"	461	664	230	293	588	882
8 ½"	949	1000	51	106	1012	995
Total	**3,140**	**3,414**	**1,750**	**1,987**	**3,428**	**3,560**

For all production wells, the 36" and 26" sections will be drilled riserless, and the cuttings and sweeps from these sections plus small amounts of cement returned from setting the 30" conductor and 20" casing in place will be discharged at the seabed. All subsequent sections will be drilled with a marine riser in place which means that the cuttings and drilling fluids are circulated back to the Mobile Offshore Drilling Unit (MODU). The 17 ½" and 12 ¼" sections will be drilled with water based mud (WBM), and the cuttings and drilling fluids passed over shale shakers where the fluids will be recovered for re-use and the cuttings and any remaining drilling fluids on cuttings discharged overboard at the sea surface.

The 8 ½" section will now be drilled with low toxicity oil-based mud (LTOBM), with cuttings for this section recovered and returned to shore.

B. Addition of Washout Factor

A washout factor is included in the cuttings volumes in the Screening Direction applications, but was not included in the Rosebank Development ES (Equinor, 2022). Washout is the term used to describe the situation where the hole diameter becomes larger than the diameter of the drill bit. This may occur as a result of rock stresses, fractures, and when drilling through softer and/or unconsolidated rock formations (e.g. shales) and generates more rock cuttings from erosion and collapse of the wellbore. The following washout factors are added to the well sections: 30% to the 36" and 26"; 20% to the 17 ½", and 10% to the 12 ¼" and 8 ½" well sections. Including the contingency for additional cuttings generated from washout conditions increases the estimate of mass of cuttings in the Screening Direction applications compared to the Rosebank Development ES. The 30% washout factor applied to the 26" section is the main reason for the increase in cuttings quantities between the Rosebank Development ES (Equinor, 2022) and the Screening Direction applications.

C. Cuttings density factor

The volume of cuttings (in m^3) is converted to mass (tonnes) by multiplying by a density factor (tonnes/m^3). In the Rosebank Development ES (Equinor, 2022), the density factor used to convert cuttings volumes to a mass value was approximately 2.4 tonnes/m^3. In the Screening Direction applications, an alternative, albeit also typically used, factor of approximately 2.6 tonnes/m^3 was selected. The application of a higher density factor to a specified volume of cuttings increases the estimated mass of those cuttings. Therefore, the higher density factor used in the Screening Direction applications results in a higher estimate of mass of cuttings compared to the Rosebank Development ES (Equinor, 2022).

D. Inclusion of Sidetrack Contingency

The Screening Direction applications for the Phase I wells include a contingency option for drilling a sidetrack involving potential redrill of the 17 ½", 12 ¼" and 8 ½" well sections. In this contingency case, additional cuttings from redrilling the 17 ½" and 12 ¼ " well sections operations are discharged to sea. It is estimated, as a worst case, that drilling a sidetrack could potentially double the quantity of cuttings generated from these sections.

Summary

Subsections A-D above explains the differences between the cuttings estimates within the Rosebank Development ES (Equinor, 2022) and the subsequent Screening Direction applications as submitted.

40 ITEM 40

Please also clarify whether the original conclusion presented in the ES of the potential environmental impacts associated with the proposed discharge of drill cuttings remains or needs to be amended. If the latter, please provide an update.

To address this item, we provide our response as follows:

- Summary of the modelling presented in the Rosebank Development ES (Equinor, 2022).
- Summary of what is presented in the permits.
- Is the impact assessment presented in the Rosebank Development ES (Equinor, 2022) still relevant?

Summary of the Modelling Presented in the Rosebank Development ES (Equinor, 2022)

Modelling of the discharge from a theoretical worst-case 4-well drilling programme was conducted for the Rosebank Development ES (Equinor, 2022) using the ParTrack module within “Stiftelsen for industriell og teknisk forskning” (SINTEF)’s Dose-Related Risk and Effect Assessment Model (DREAM) (included in Marine Environmental Modelling Workbench (MEMW) version 12.1.0). The mass of cuttings and muds estimated for a typical production well (DP3 was referenced in the Rosebank Development ES; Equinor, 2022) were used to derive quantities of total drilling discharges at a single location occurring at the same time for the model. The modelling was carried out for a two well per template scenario to emulate the maximum number of wells per template for the Phase 1 production wells and a worst-case 4 well (maximum) per template scenario (Table 18).

Table 18: Well parameters and tonnages for drilling discharges modelled in the Rosebank Development ES (Equinor, 2022; single well).

Single Well	42"	26"	Total	17 ½"	12 ¼"	8 ½"	Total
Mud / fluids	Seawater and sweeps			WBM drilling fluids			
Cuttings (te)	191	382	573	420	82	82	584
Drilling Fluid (te)[12]	675	1,460	2,135	3,567	1,387	2,367	7,321
Fate + cuttings	Discharged at seabed			Discharged at sea surface			

The single well quantities in the Rosebank Development ES (Equinor, 2022) were multiplied to generate the 2-well and 4-well quantities (in tonnes) which were input to the model used to support the assessment (summarised in Table 19).

Table 19: Quantities of cuttings and drilling fluids discharged to seabed and at sea surface at the same location at the same time in the 2-well template and 4-well template modelled scenarios.

Modelled Quantities from the ES	Discharged at Seabed (te)		Discharged at Sea Surface (te)	
	Cuttings te	Drilling Fluid[13] te	Cuttings te	Drilling Fluid[2] te
Two well template	1,146	4,270	1,168	14,642
Four well template	2,292	8,540	2,336	29,284

Cuttings are the predominant component of the particulate discharges that arise from drilling a well and the main contributor to seabed impact. WBM additives are mainly water soluble and risk assessed in the chemical permit application. The quantities and particle size of weighting agents, such as barite and bentonite, are very low/small compared to cuttings and are not included in Table 18 and Table 19, but they were assessed within the modelling presented in the Rosebank Development ES (Equinor, 2022). Discharges of barite and bentonite have been further risk assessed in the relevant chemical permit applications made to OPRED.

[12] *Total mass of drilling fluid includes added substances and water*

[13] *Ibid.*

Summary of What is Presented in the Permits

The input parameters to the modelling (Table 18) carried for the Rosebank Development ES (Equinor, 2022) can be compared with the cuttings estimated to be generated from the proposed well programme (Table 19). Phase 1 of the planned development is for a maximum of two wells per template with a maximum of three per template in Phase 2. The inclusion of a third and fourth well in the modelling allows for sufficient mud/cuttings volume to accommodate the revised volumes anticipated for each template following the detailed well planning. A comparison of the quantities of cuttings estimated for these wells in the Screening Direction Applications with the modelled quantities in the Rosebank Development ES (Equinor, 2022) is summarised in Table 20. The estimated quantity of cuttings generated from drilling a sidetrack is included in brackets.

Note: In the Screening Direction applications, the 8 ½" well section is drilled with LTOBM and all cuttings from this section and LTOBM drilling fluids are skipped and shipped to shore for treatment and disposal.

Table 20: Comparison of Template D wells with the modelled scenarios.

Estimated Cuttings Quantities (tonnes)	Discharged at Seabed (tonnes) (36" and 26")	Discharged at Sea Surface (tonnes) (17 ½", 12 ¼")	Total Discharged at Template (tonnes)
DP1	788	540 (+ 540 contingency)	1,328 (1,868)
DP3	829	682 (+ 682 contingency)	1,511 (2,193)
DP1 + DP3	1,617	1,222 (+ 1,222 contingency)	2,839 (4,061)
Modelled 2 well template scenario	1,146	1,168	2,314
Modelled 4 well template scenario	2,292	2,336	4,628

Is the Impact Assessment Presented in the Rosebank Development ES (Equinor, 2022) Still Relevant?

The estimated quantities of cuttings in the 2 well scenario modelled in the Rosebank Development ES (Equinor, 2022) are slightly lower than the combined estimates for cuttings included in the Screening Direction applications for DP1 and DP3 (excluding the sidetrack contingency) due to the updated calculations as described above in the response to Item 39 (Subsections A to D).

The estimate of total cuttings discharged to sea from DP1 and DP3 – including cuttings from the contingency sidetracks (4,061 tonnes) – is less than quantity of cuttings from the 4 well per template scenario assessed in the Rosebank Development ES (4,628 tonnes; Equinor, 2022). The modelling inputs in the Rosebank Development ES (Equinor, 2022) are therefore considered to be representative of the high case estimate for cuttings discharged at a single template during Phase 1 drilling operations.

Therefore, the potential environmental impacts associated with the discharge of drill cuttings as described and assessed in the Rosebank Development ES (Equinor, 2022) are considered representative of the potential impacts of cuttings discharged at a single template location during the Phase I drilling campaign and the conclusions presented in the Rosebank Development ES (Equinor, 2022) remain valid.

41 ITEM 41

Paragraph 9.1 Atmospherics and Climate – Introduction. Table 9.1 List of the planned activities at the Development contributing to atmospheric emissions. Detail the methane emissions associated with tanker loading, as described in Table 9.1 of the ES and how the methane emissions could be minimised.

Methane emissions from tanker loading are primarily a function of the shuttle tanker cargo tank conditions, physical and chemical characteristics of the previous cargo, method of unloading the previous cargo and blanketing conditions maintained en route from previous offload. Secondly, they are a function of the physical and chemical characteristics of the new cargo being loaded from the Floating Production Storage and Offloading Vessel (FPSO), and the method of loading from the FPSO.

Estimating methane emissions from tanker loading (as noted in Table 9.1 of the Rosebank Development ES; Equinor, 2022) is challenging because the emissions are highly dependent on the composition of the vapour space of the shuttle tanker cargo tanks that is displaced to atmosphere during loading, and because there are limited studies where this is robustly measured. To account for these challenges and variability in assessing emissions, three different publicly available methodologies have been used here to estimate life of field (LOF) methane emissions. These are outlined below:

- 1) EEMS: Using the emissions factor provided in the UK Environmental and Emissions Monitoring System (EEMS), the total methane emissions for the life of field would be approximately 1000 teCH_4;
- 2) Environment Protection Agency (EPA): Using a second approach, EPA AP-42 Section 5.2 (AP-42 Section 5.2: Transportation And Marketing Of Petroleum Liquids), the tanker loading emissions would be estimated as 5,075 tonnes of organics over the life of field. This method recommends taking 15% of the total organics as methane and ethane, which is approximately 760 tonnes in total. Using this methodology estimates LOF methane emissions of less than 760 teCH_4 when the ethane portion is removed from the total as this is not applicable to this assessment.
- 3) RSC: A recent study by Purvis *et al.* (2026) published by the Royal Society of Chemistry (RSC) using unmanned aerial vehicle (UAV) and aircraft to measure methane emissions during loading gives a further comparison. Using the low and high case recorded methane emissions from the study, LOF methane emissions estimates have been calculated as approximately 1,400 and 3,000 teCH_4 respectively. This assumes venting for 12 hours during each tanker loading operation and that the rate from the study is consistent throughout the whole venting operation.

Table 21: Summary of methane emission estimates.

Methodology	Methane Estimate for LOF (te)	Methane Emissions as CO_2e (te) (IPPC AR5 methodology[14]F)
1. EEMS	1000	28,000
2. EPA	<760	<21,280
3. RSC	1,400-3,000	39,200-84,000

Table 21 shows that the total for LOF methane emissions from cargo tank loading would represent between a minimum of <760 and a maximum of 84,000 tonnes CO_2e. The worst-case estimate of 84,000 te CO_2e equates to approximately 2% of the total LOF CO_2e emissions. Given the small magnitude of the methane emissions it would not change the conclusions of the assessment of operational activities.

Adura is a member of Oil and Gas Methane Partnership 2.0 (OGMP 2.0) which demonstrates a commitment to reducing and managing methane emissions. Minimisation of methane emissions from tanker operations could be achieved via:

- Prioritising the selection of shuttle tankers with Volatile Organic Compound (VOC) recovery systems for charter to the Rosebank Development where these are available from the market. Crude lifting from the Rosebank Development will be done by Equinor. There will be a Crude Offtake Agreement between Adura and Ithaca SP E&P Ltd, which will be operated by Equinor for the Rosebank Development. Equinor will provide tankers from their term charter pool. Equinor select shuttle tankers following their process TR2380 – Minimum Technical and Operational Requirements for Shuttle Tankers. TR2380 states: 'Unless otherwise specified, Offshore Loading Shuttle Tankers shall be equipped with a VOC recovery system as per agreement with the VOC Industry Cooperation (VOCIC).'
- Implementation of protocols with shuttle tanker operators during offshore loading to minimise cargo tank venting on the tanker. Protocols will be developed jointly with Altera and shuttle tanker operators as operations begin.

[14] *Methane (CH_4) has a 100-year global warming potential (GWP) of approximately 28 times that of CO_2*

42 ITEM 42

Paragraph 9.3.6 Quantification of Emissions during Production Operations. The ES presents the estimated scope 1 emissions from production operations in Table 9.5 based on the normal operation of equipment. As no information has been presented about the calculations behind the figures presented in this table, it is assumed that the basis for these emissions calculations is the load from 2 turbines out of 4 operation. However, OPRED has been made aware that the normal installation demand and installation peak load demand is in the region of 28.9 Megawatts Electric (Mwe) and 31.7 Mwe, respectively with turbines operating in a 3 out of 4 configuration. Therefore, the estimated emissions calculated and presented in Table 9.5 in the ES may need to be updated. Please clarify and present accordingly:

a) The normal installation load and peak load;

b) The operational configure of the turbines to satisfy the normal and peak loads (e.g. 3 out of 4 operation);

c) Include a copy of the spreadsheet discussed in Footnote 42 of the ES to assist in understanding the inputs to the calculation of point a above and explain how this leads to the operational philosophy of the turbines.

d) An update to the scope 1 emissions presented in Table 9.5 of the ES where required or an explanation as to why no change is required.

A. The Normal Installation Load and Peak Load

Normal installation load demand and installation peak load demands are 28.9 MWe (Megawatts Electric) and 31.7 MWe and are presented in Table 4-2 of the Petrojarl Rosebank FPSO Best Available Technique (BAT) Assessment document 217505C-003-RT-6200-0001/1 issued in support of Altera's Pollution Prevention and Control (PPC) application. Loads are forecast in the event that all operational equipment is online.

Load demands presented in the Altera BAT Assessment are taken from the facility Electrical Load List – 0D204-ABB-E-82-LA-000002_P04. This load list represents power demands based on the maximum power rating of the equipment. The Rosebank Development ES (Equinor, 2022) used the same load list data but taken from an earlier project stage. There are two key differences between the Rosebank Development ES (Equinor, 2022) and Altera's more recent BAT assessment:

- The Rosebank Development ES (Equinor, 2022) uses power loads based on process simulation rather than equipment sizing and therefore is based on expected power demand linked to the production profile rather than equipment sizing (as was used in the Altera BAT assessment). Power demands used for the Rosebank Development ES (Equinor, 2022) therefore change through time.
- The Rosebank Development ES (Equinor, 2022) represents yearly average annual power demand and therefore has periods of plant downtime linked to the production profile. This will reduce the average annual process power demand from the facility. The PPC application does not account for equipment uptime.

Table 22 below summarises the different cases, with explanation of terms used in Table 22 provided as follows:

- PPC column: this shows the data presented by Altera with the PPC permit (Petrojarl Rosebank FPSO Best Available Technique (BAT) Assessment document 217505C-003-RT-6200-0001/2 Table 4-2).
- Base Case – Max: this column shows the maximum case taken from the inputs to the Rosebank Development ES (Equinor, 2022) calculation assuming all peak process loads occur simultaneously. This is not representative of expected operations as peak water injection, produced water handling, gas export and gas lift will not occur simultaneously.

- Base Case – 2033 simulation: 2033 is the maximum power demand year from the Rosebank Development ES (Equinor, 2022) input data. This represents maximum simulated demand during that year combined with a tanker offload.
- Production Efficiency (PE) Adjusted – 2033 simulation: data in this column is adjusted for production efficiency aligned with the production profile and reflecting the number of planned offloads during the year.

It is concluded that the input data to the Rosebank Development ES (Equinor, 2022) and the PPC application are aligned; overall maximum demand used within the Rosebank Development ES (Equinor, 2022) is 29 kilowatts (kW; 0.1%) greater than that represented by the PPC application. The differences between the demands are due to the Rosebank Development ES (Equinor, 2022) presenting annual averages aligned with the production profiles rather than maxima.

Table 22: Summary of cases (base case max, base case 2033 simulation and PE adjusted – 2033 simulation).

Equipment Description	PPC (kW)	Base Case – Max (kW)	Base Case – 2033 Simulation (kW)	PE Adjusted – 2033 Simulation (kW)
Base Load (including thrusters)	8,063	8,767	8,767	8,767
Water Injection Pump	5,095	4,012	4,012	3,868
1st Stage High Pressure (HP) Compression	4,254	4,315	4,189	4,040
Ancillary Process Equipment and Contingency	3,118	1,061	1,196	1,153
2nd Stage HP Compression	2,579	2,724	2,654	2,560
3rd Stage HP Gas Export Compression	1,420	1,650	1,276	1,230
Sea Water Lift Pump	1,240	1,239	1,239	1,195
Seawater Feed Pump	1,191	1,189	1,189	1,147
3rd Stage HP Gas Lift Compressor	819	1,977	926	893
Low Pressure (LP) Compressor	374	388	366	353
Low-Low Pressure Compressor	277	328	282	272
Seawater Injection Transfer Pump	204	208	205	197
Cooling Medium Circulation Pump	192	223	223	215
Produced Water Injection Transfer Pump	153	225	89	86

Equipment Description	PPC (kW)	Base Case – Max (kW)	Base Case – 2033 Simulation (kW)	PE Adjusted – 2033 Simulation (kW)
Offloading	2,731	3,433	3,433	301
Total	**31,709**	**31,738**	**30,046**	**26,278**
Delta to PPC Case	N/A	+29	-1,692	-3,769

B. The Operational Configuration of the Turbines to Satisfy the Normal and Peak Loads (e.g. 3 out of 4 Operation)

The following statement is contained in Section 3.7.8.1 of the Rosebank Development ES (Equinor, 2022): *"As can be seen in Figure 3-20 A the estimated load during both normal production and production plus offloading modes, will allow power generation to be supplied from two turbines. If the power demand whilst operating with two turbines is deemed as being too high, then the philosophy will be to utilise a third turbine. The fourth turbine is only there as a backup for maintenance and will not be operated under normal operations."*

An update to this is provided as follows:

– Figure 3-20 of Equinor (2025) does not represent the power loads used for the emissions quantification work done for the Rosebank Development ES (Equinor, 2022) – see discussion below in response to Item 43.
– Normal and peak power loads for the Rosebank FPSO will be achieved operating three turbines. This is the expected operating mode for the life of the Rosebank Development. During periods of production curtailment the production optimisation opportunity will be taken to reduce the number of turbines online.
– The emissions modelling work undertaken for the Rosebank Development ES (Equinor, 2022) was based on three turbine operation for almost every year.
– Later in field life (2042 and beyond) the modelling supports two turbine operation. This is consistent with declining power demand as compressor loads decrease however it is conservatively assumed that three turbines will remain operational.
– The fourth turbine is still only there as a backup for maintenance and will not be operated under normal operations.

C. Include a Copy of the Spreadsheet Discussed in Footnote 42 of the ES to Assist in Understanding the Inputs to the Calculation of Point A Above and Explain How this Leads to the Operational Philosophy of the Turbines.

A copy of the spreadsheet is included as an attachment to this response. Outputs from this spreadsheet are contained in Appendix 4 as a reference view of the content of the spreadsheet, but they are not designed to be read in isolation from the spreadsheet.

D. An update to the Scope 1 Emissions Presented in Table 9.5 of the ES Where Required or an Explanation as to Why No Change is Required.

Table 9-5 of the Rosebank Development ES (Equinor, 2022) has been reviewed in line with most recent estimates of fuel gas, flare and diesel.

Fuel Gas: Table 9-5 shows the estimated CO_2 emissions from fuel gas to be 3,999,782 tonnes. This has been recalculated based on the information as provided as part of the Altera PPC permit with identified efficiencies and using the most up to date data:

- Including power demand three turbine usage every year.
- Updated turbine modelling to align with Altera PPC permit – efficiency and fuel composition (ES used a more conservative turbine efficiency than PPC).

The updated CO_2 from fuel gas use has been calculated at 3,902,365 tonnes which equates to a reduction of 2.4% from the figure as presented in the Rosebank Development ES (Equinor, 2022).

Flare: Assumptions for volume of flare rates remain as described within the Rosebank Development ES (Equinor, 2022). It should be noted however that whilst the total estimated volume of flare has not changed the emissions factor used has been updated to a Rosebank Development specific fuel gas density of 0.181kg/Sm^3 (Kilograms per Standard Cubic Meter) as opposed to a default flare gas density from the Inventory of Carbon and Energy database (0.68kg/Sm^3). This has resulted in an increase to the overall estimates from 81,956 tonnes CO_2 as presented in the ES to 98,467 tonnes CO_2.

Diesel: Assumption for diesel use has not changed since the ES was submitted and therefore the numbers as presented in the ES remain valid.

Summary: A summary of changes made to life of field CO_2 emissions from fuel and flare (diesel not included as this is the same as presented in the ES) based on the information provided above is presented in Table 23. This shows that the current estimate for CO_2 emissions for life of field are comparable with those presented in Table 9-5 in the Rosebank Development ES (Equinor, 2022), and given the revised estimates are slightly lower the conclusions presented in the Rosebank Development ES (Equinor, 2022) remain valid and therefore the table does not need to be updated at this time.

Table 23: Summary of changes to CO_2 estimates for fuel gas and flare since submission of the Rosebank Development ES (Equinor, 2022).

Emission Source	LOF CO_2 (te) emissions Table 9-5 in the ES	LOF CO_2 (te) emissions based on revised calculations	Difference (te) (+/-)
Fuel gas	3,999,782	3,902,365	-97,417
Flare gas	81,956	98,467	+16,511
Total	4,081,738	4,000,832	-80,906

43 ITEM 43

Paragraph 3.7.8.1 Power Generation. Figure 3.20 Estimated energy requirement for the range of services on the FPSO at Rosebank, A for life of field and B comparative for a typical year. To provide further clarification and calculations behind Fig. 3.20, please submit a review and explanation of the potential electrical load by setting out the contributing items >0.5 MWe of equipment in a table.

A summary of cases (base case max, base case 2033 simulation and PE adjusted – 2033 simulation) containing all the continuing items >0.5MWe is shown in Table 22 within response to Item 42:

- Figure 3-20A as presented in the Rosebank Development ES (Equinor, 2022) came from earlier Phase 1 work rather than the work used for the Rosebank Development ES (Equinor, 2022) emissions calculation i.e. the calculations presented in the ES were correct but the accompanying figure was outdated.
- Figure 3-20A did not include a 15% contingency which was also used for the emissions calculation power demand.

A revised figure is shown below that aligns with the Rosebank Development ES (Equinor, 2022) calculations and with the information presented within Table 22 in response to Item 42. All equipment >0.5 MWe is represented in that table and in Figure 8.

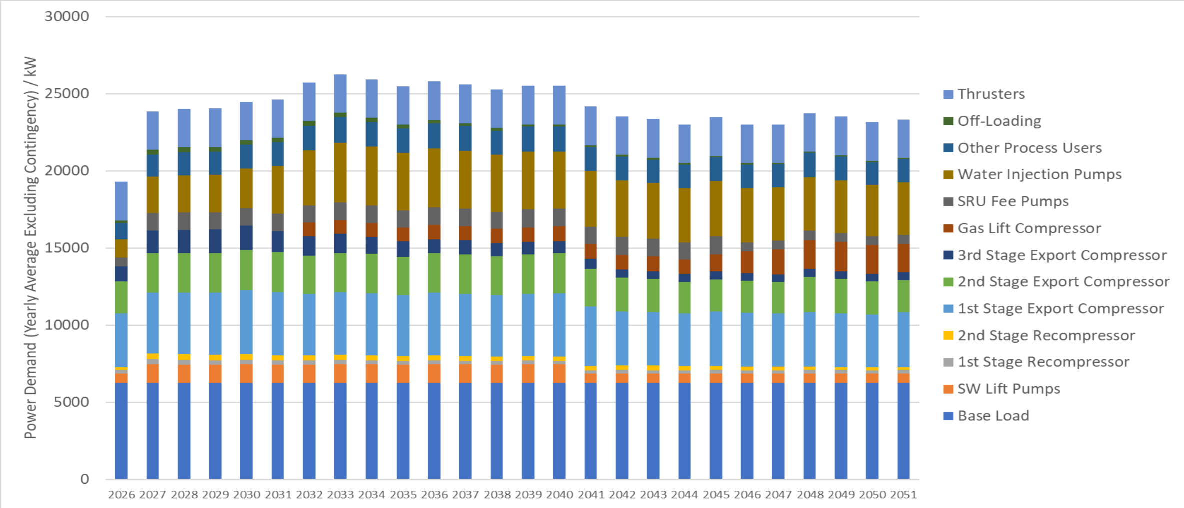


Figure 8: Estimated energy requirements updated to align with the final Rosebank Development ES (Equinor, 2022) calculations.

44 ITEM 44

Paragraph 9.3.8 Carbon Intensity of Production. The ES states that, “The intensity for the Development in the base case, defined as efficient gas turbines and optimised operations, is estimated to be approximately 12 kg CO_2/(barrels of oil equivalent) boe.” In clarifying the above points, please re-visit and state whether the estimated carbon intensity of production of 12 kg CO_2e/boe stated needs to be revised and provide any updates accordingly.

The carbon intensity for the Rosebank Development has been reviewed in line with the most recent information and calculations presented herein. As the emissions as presented herein remain consistent with those used for the Rosebank Development ES (Equinor, 2022), the carbon intensity as presented in the Rosebank Development ES (Equinor, 2022), of 12kg CO_2e/boe, remains valid.

45 ITEM 45

Assessment of the likely significant effects of the project on the environment resulting from vulnerability of the project to climate change. The original ES submission under paragraph 4.2.4 and 4.6 assesses the metocean conditions in the project area. Please clarify if this information is up to date and whether the metocean conditions discussed in these sections of the ES includes the likely evolution of metocean conditions (wind and wave heights) that pose a risk to the development and may result in an accidental event in an increased risk of hydrocarbon spills over the lifetime of the project.

The metocean conditions for the Rosebank Development were described following the principles outlined in "Norsk Sokkels Konkurranseposisjon" (NORSOK) standard N-003:2017. According to NORSOK (section 6.1.2), for permanent facilities with a planned service life of more than 50 years (a category for which the Rosebank Development qualifies), climate change shall be accounted for by increasing the extreme significant wave heights and extreme wind speed (10,000 year return period events) by 4% to account for this effect 50 years ahead. As the Rosebank Development has a design life of 25 years there has been no adjustment to account for climate change.

Rosebank Development metocean design conditions were independently verified by DNV (2025), with Section 3.2 of the DNV (2025) report stating:

"In its recent assessment report, Intergovernmental Panel for Climate Change (IPCC) states that there is medium confidence that mean wind speeds will decrease in Northern Europe beyond the middle of the century. Moreover, a slightly increased frequency and amplitude of extratropical cyclones, strong winds and extratropical storms are projected for northern Europe by the middle of the century and beyond, for global warming levels of 2°C or higher. The report from Working Group 1 (WG1) further states that it is medium confidence that future changes in maximum wind speeds will be small, although changes in the location of storm tracks could lead to substantial changes in local extreme wind speeds. Output from Coupled Model Intercomparison Project Phase (CMIP) 5 models suggests that that the number of extratropical cyclones (ETC) associated with extreme winds will significantly decrease in the mid- and high latitudes of the Northern Hemisphere in winter, with the projected decrease being larger over the Atlantic. In summary, according to IPCC, the observed intensity of extreme winds is becoming less severe in the low to mid-latitudes, while becoming more severe in high latitudes poleward of 60 degrees (low confidence). Projected changes in the frequency and intensity of extreme winds are associated with projected changes in the frequency and intensity of tropical cyclones (TCs) and ETCs (medium confidence). A more recent review based on CMIP6 suggests that mean wind speeds is expected to reduce while extreme conditions might intensify. A recent review reports projections of wave climate in the North Atlantic suggests that mean wave heights may decrease by up to 10%, with regional variability and uncertainty in changes in the extremes."

The datasets used to inform the basis of design and the DNV (2025) independent review are as described in Table 24 and Table 25.

Table 24: Datasets used in statistical analysis for wind.

Analysis	Time Period
Equinor Metocean Design Basis	01.01.1958 – 31.12.2019
DNV Independent Verification	01.01.1958 – 31.12.2022

Table 25: Datasets used in statistical analysis for waves.

Analysis	Time Period
Equinor Metocean Design Basis	01.01.1958 – 31.12.2019
DNV Independent Verification	01.01.1958 – 25.06.2023

As per the basis of design and further DNV (2025) review, the metocean design basis for the Rosebank Development is suitable for design purposes, and so the metocean conditions discussed in paragraph 4.2.4 and 4.6 of the Rosebank Development ES (Equinor, 2022) are up to date and include the likely evolution of metocean conditions (wind and wave heights) that pose a risk to the Rosebank Development. As such, the assessment in the Rosebank Development ES (Equinor, 2022) which is based on this information is considered to remain valid.

PART 3: RESPONSE TO REQUIREMENT #3

Parts 1 and 2 of this response document address items relating to the environmental impact of the Rosebank Development. In addition to answering the specific questions in Part 3 of the March 2026 Regulation 12(1) Request, which are addressed later in this section, Adura is taking the opportunity to outline a number of additional matters to reflect developments since the Rosebank Development September 2025 submission, including the formation of Adura and the publication of the North Sea Future Plan by the UK Government.

3.0 INTRODUCTION TO ADURA

Since the Rosebank Development submission of September 2025, Shell and Equinor combined the majority of their UK offshore oil and gas operations to form Adura on 1st December 2025.

Headquartered in Aberdeen and owned by Shell U.K. Limited (50%) and Equinor UK Limited (50%), Adura brings together two strong portfolios and combined expertise.

Adura employs approximately 1,100 employees and has interests in ten North Sea producing oil and gas assets (Figure 9): Buzzard, Clair, Gannet, Mariner, Nelson, Penguins, Pierce, Schiehallion, Shearwater, and Victory, and two projects in execution: Rosebank and Jackdaw.

The Rosebank Development is a Joint Venture between Adura (80%) and Ithaca SP E&P Limited (20%), a subsidiary of Ithaca Energy PLC, one of the largest independent oil and gas companies in the UKCS by reserves and resources.

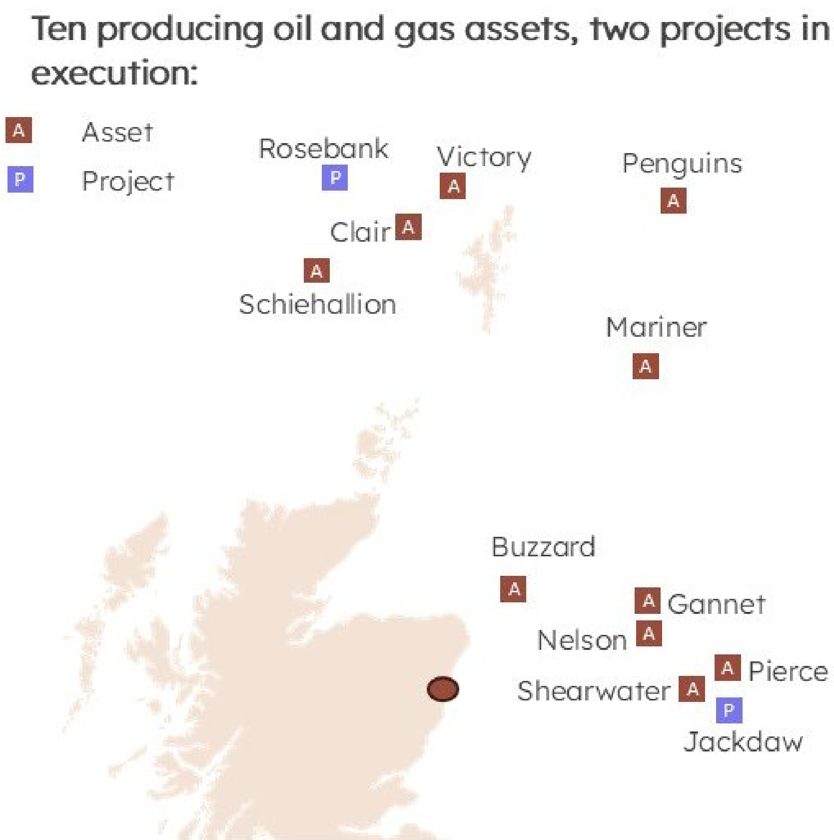


Figure 9: Adura portfolio assets and projects.

3.1 BALANCE OF ADVANTAGE

The purpose of this section is to support the Secretary of State in taking a decision by presenting information relevant to the balance of advantage, in accordance with the Supplementary Guidance for assessing downstream Scope 3 emissions. This information is in addition to the contents of the previous submission Further Information Part 3 – Relevant Information to the Project' provided by Rosebank to OPRED in September 2025 (Equinor, 2025).

The Supplementary Guidance (DESNZ, 2025a) states:

"When reaching a decision as to whether agreement should be given to the grant of consent the Secretary of State will consider the environmental effects of the project (as required by the Offshore EIA Regulations) and will form a view of the overall balance of advantage between any potential significant effects on the environment and wider benefits to the interests of the nation and any other relevant factors in proceeding with the project."

The Supplementary Guidance indicates factors which may be considered as part of the "balance of advantage" test. In accordance with the guidance this Part 3 of the response provides further information on the Government's energy and environmental objectives and the socio-economic and other advantages of the Rosebank Development proceeding.

3.1.1 ALIGNMENT WITH UK POLICY OBJECTIVES

The Supplementary Guidance makes reference to an '*assessment of the extent to which the project aligns with the Government's stated objectives for the future of the North Sea'* (DESNZ, 2025a). Throughout the development phase of the Rosebank Development, Equinor, and now Adura, have acted as responsible operators, ensuring consistency with UK Government policy.

Shortly after the publication of the Supplementary Guidance and September 2025 submission from Equinor, UK Government policy evolved, most notably with the publication of the North Sea Future Plan (DESNZ, 2025b) ('the NSFP'). The NSFP sets out clear objectives:

- ***Overarching objective:*** *to foster an internationally-leading offshore clean energy industry, which ensures good, long term jobs, growth and investment in communities across the North Sea, in tandem with a sustainable transition in oil and gas – boosting the country's economy and energy security, in line with our climate obligations.*

- ***Supporting objective 1:*** *to ensure our oil and gas workers and supply chain can take advantage of the opportunities of our clean energy transition, creating a global blueprint for a transition which supports prosperity, jobs, growth, communities and energy security.*

- ***Supporting objective 2****: to take a globally standard-setting, 1.5°C and climate science aligned approach to future oil and gas production."*

It is clear from these objectives that the UK Government's focus is to deliver an orderly and fair transition, whilst recognising the need to support employment, growth and investment in the North Sea. The UK Government, and independent bodies such as the Climate Change Committee in their 7th Carbon Budget, have also acknowledged the demand for oil and gas up to and beyond 2050 (Climate Change Committee, 2025).

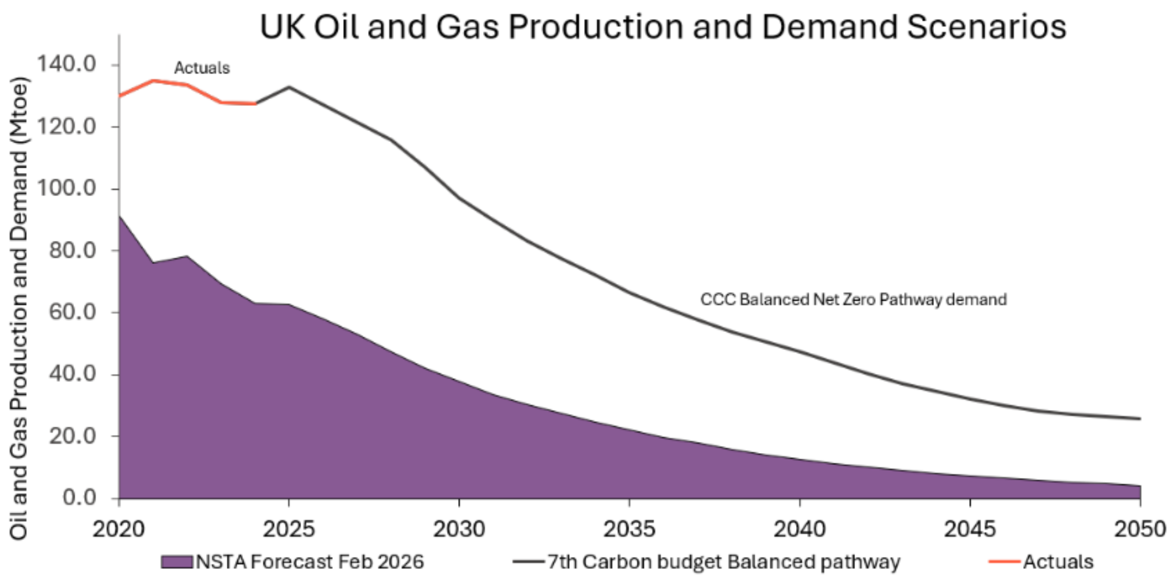


Figure 10: UK oil and gas production and demand scenarios.

Source: Adura (NSTA, 2025 and CCC, 2025)

Figure 10 provides a visual representation of the 7th Carbon Budget's Balanced Net Zero Pathway demand alongside the NSTA's forecast for UKCS oil and gas production. The UK has been a net importer of oil and gas since 2004/05, so the supply deficit between 2020 and 2025 (the 'actuals') is in line with the longer-term historical trend (UK Parliament 2018). However, as explored throughout this section, closing the demand gap with domestic production can be lower emissions intensive than alternatives and the most economically beneficial option to the UK. The profile of oil production in the UK is complicated, as addressed in greater detail in Section 3.1.2, but UKCS oil represents a significant contribution to the European oil market providing stable economic activity both sides of the Channel (DUKES, DESNZ, 2025c).

The Rosebank Development is recognised as an existing field in the UKCS Offshore Activity portal (NSTA, website) and is expected to operate for more than 20 years, providing supply to meet residual demand in partnership with European refineries. This position is consistent with the NSFP, which states *'continued oil and gas production from existing fields will support a smoother transition and retain the skilled workforce we need in the UK as we ramp up cleaner technologies'* (DESNZ, 2025b), without fettering the Government's executive decision-making authority for any future developments to be considered on a case-by-case basis.

Further to the energy policy objectives set out in the NSFP, the Government's Autumn 2024 Budget set fiscal policy relevant to North Sea developments. In the Autumn 2024 Budget, the UK Government increased the Energy Profits Levy (EPL) from 35% to 38%, bringing the headline tax rate up to 78%. The Chancellor also extended the EPL sunset clause to 31 March 2030 and removed the 29% investment allowance. However, by maintaining the first year 100% allowance and the decarbonisation allowance (reduced to 66%), this provided an indication to the market that further investment was desirable.

In confirming the changes during the Autumn 2024 Budget speech, the Chancellor of the Exchequer stated *"The levy will now expire in March 2030, and we will remove the 29% investment allowance. To ensure that the oil and gas industry can protect jobs and support our energy security, we will maintain the 100% first-year allowances, and the decarbonisation allowances, too."* (UK Parliament, 2024).

In 2026, UK energy security was once again brought to the fore as a result of the war in the Middle East and the prolonged closure of the Strait of Hormuz, highlighting the importance of producing the UK's domestic resources. In response to this global event, the Chancellor noted in her 2026 Spring Statement, "*Tomorrow I will meet with North Sea industry leaders, to discuss the implications that they face, and work with them to manage this uncertain period*" with a clear intention to stimulate investment in UK resources in response to global instability.

The Rosebank Development supports this commitment toward investment, jobs and energy security, subsequently returning significant revenue to the Government under the current fiscal regime and subsequent Oil and Gas Price Mechanism (OGPM).

3.1.2 SIGNIFICANCE OF DOMESTIC PRODUCTION

The Supplementary Guidance states that the Secretary of State may consider "*the severity, extent, understanding and duration of the significant effects, the Government's overall energy and environmental objectives*". Parts 1 and 2 of this document have provided a detailed response to the items relating to the environmental impact of the Rosebank Development.

As highlighted by Figure 10 and the NSFP, the question is not whether the UK will need fossil fuels to meet its energy needs, but where will those fossil fuels come from.

In the previous submission to OPRED, *Response to Requirement #3 (Provision of relevant information for the Secretary of State to consider when reaching a decision on whether or not to agree to the grant of consent) of the Regulation 12(1) Notice dated 21 July 2025* (Equinor, 2025), a citation was provided for the NSTA's Emissions Monitoring Report for 2025. The NSTA report shows that production emissions from the UK's offshore oil and gas industry decreased by 34% between 2018 and 2024. On oil specifically this report states that UK produced oil is estimated to be 7kgCO_2e/boe lower emitting than the global average at 26kgCO_2e/boe and 33kgCO_2e/boe, respectively (NSTA, 2025). The report also notes the significant progress the industry has made to decarbonise, surpassing the North Sea Transition Deal 2027 target with 2 years to spare and around a third of emissions cut since 2018.

The life of field emissions for Rosebank Phase 1 and Phase 2 is currently estimated at 12 kgCO_2e/boe[PM6.1], (Wood Mackenzie, 2024) significantly below both the UKCS average of 26 kgCO_2e/boe and the global average of 33 kgCO_2e/boe (NSTA, 2025). Adura has committed to investment in support of emissions reductions related to the production of UKCS oil and the Government's Net-Zero GHG emissions reduction target. The NSTA's OGA Plan requires that relevant projects must be electrification ready from day one, and NTSA's Development and Production Consent Guidance requires pre-investment in facility design to allow connection to future low carbon power and other emission reduction opportunities. The Rosebank FPSO has been designed to be electrification ready from day one of production.

The flow of molecules from UKCS extraction is not only relevant to upstream operations. It is well documented that UKCS produced oil is exported for processing abroad. 86% of the exported crude goes to Europe, primarily to the North West with The Netherlands as the primary recipient, amounting to a critical supply pipeline (Wood Mackenzie, 2025) (DUKES, DESNZ, 2025c). The UK subsequently benefits from the European refineries' products in the form of fuels such as petrol and aviation fuel, which otherwise aren't met by UK production (DUKES, DESNZ, 2025c). This alignment serves to benefit both UK and European energy security and economic activity.

The number of active refineries in the UK peaked in the 1970's at 18. By 2013, this fell to 7, and the recent closures of Grangemouth and Lindsey has left 4 active refineries in the UK (UK Parliament, 2025). A similar downward trend can be seen in the crude produced by UK refineries, with a peak 50.9 million tonnes of oil processed in 1999 reduced to 4.67 million tonnes in 2025 (DUKES, DESNZ, 2025c). This capacity reduction cannot be attributed to a single issue but rather the cumulative build-up of commercial and policy pressures, which has ultimately resulted in the UK's high-quality, light and sweet crude oil no longer being suitable for processing at scale domestically. Despite this, the crude oil set to be produced at Rosebank would meet the American Petroleum Institute (API) and sulphur requirements and could be processed by any of the four UK refineries, subject to market availability.

Rosebank crude would be sold on a global market, however this is consistent with the existing market for UKCS crude which we have seen is primarily traded within Europe (DUKES, DESNZ, 2025c). To meet demand for petroleum products across Europe a commercial relationship has developed over decades. This now forms a part of a much broader UK-EU energy policy alignment, evidenced through recent summits on the transition, such as the UK-EU Summit in 2025 and North Seas Energy Cooperation. Whilst the world undergoes its energy transition, these arrangements become the means to provide security of supply and wider energy security benefits, as explicitly discussed by the UK and The Netherlands in 2022 (FCDO, 2022).

Figure 11, below, shows the product flows for UKCS crude and refined oil products as they relate to UK demand and export. This highlights the limited flow of UKCS oil through UK refineries at present. The total volume of UKCS crude produced in 2024, 517,000 bbl/d (Figure 11 WoodMac Sankey diagram), falling significantly below the volumes of refined product required to meet existing demand and clarifying the importance of the relationship between the UK and Europe to operate efficiently and effectively.

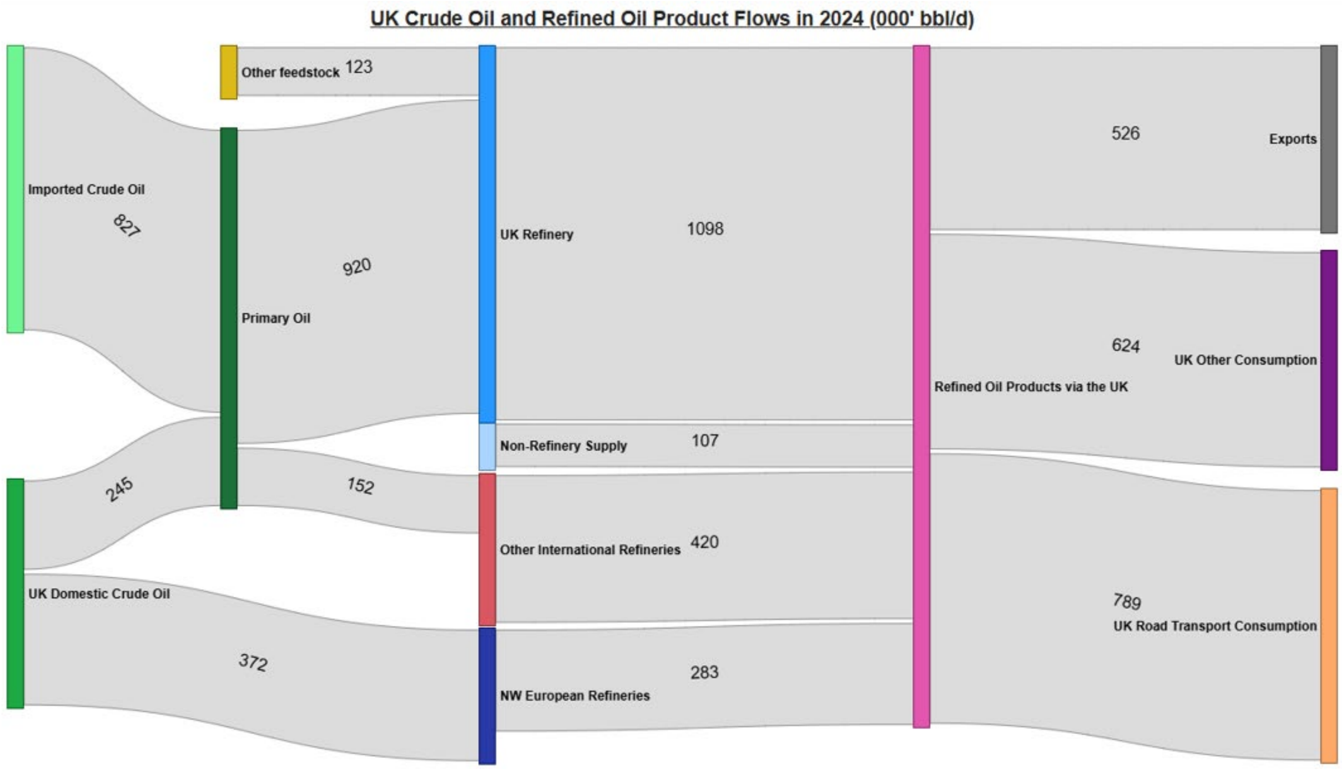


Figure 11: WoodMac Sankey diagram of flows of UK domestic crude oil and refined products.

The Rosebank Development is projected to contribute ~8% of the UK's crude oil from first production (2026/27) until 2030, and ~10% throughout the 2030s. In addition to crude oil, the Rosebank Development will also produce natural gas, which would amount to ~4% of UK domestic gas production supply (Adura). Combined with its re-purposed electrification-ready FPSO and utilisation of existing infrastructure (gas pipeline to St Fergus), the Rosebank Development could become a valuable contribution to this relationship, providing an economic, secure, relatively low emission supply of crude oil for processing and use across the UK and Europe, while also noting that the Rosebank FPSO has been designed to be electrification-ready. Alongside the advantages of the network, there are significant economic benefits to the UK, specifically, which are explored further in 3.1.3.

3.1.3 ROSEBANK AND ADURA'S SOCIO–ECONOMIC CONTRIBUTION

Rosebank Economic Contribution

As evidenced throughout the Part 3 response, Rosebank has provided and can continue to provide a significant economic contribution to the UK. This is consistent with the Supplementary Guidance, which states that *the potential economic and other advantages of the project proceeding* will be considered by the Secretary of State.

Important for the UK, this economic contribution is not confined to Aberdeen. The economic effects of the Rosebank Development can be felt across the UK, through direct, indirect and induced expenditure shown in response to item 47B. To summarise, Rosebank:

- In addition to the economic contribution made through direct taxation, would provide £5.8 bn of investment into the UK economy and a total GVA of £24.3bn, with an average £0.8bn per annum.
- Will support supply chain companies across the UK including Aberdeen, Lerwick, Shetland, Dunfermline, Hartlepool, and Newcastle (see response to Item 49).
- Has contributed over 2600 direct, indirect, and induced jobs, and will average 581 UK-based jobs over the lifetime of the asset directly supporting >8,000 years of full-time equivalent (FTE) employment in the UK (see response to Item 46).
- Could contribute ~10% of UKCS oil production and ~4% of domestic natural gas production (Adura).

Adura Portfolio Economic Contribution

Rosebank sits within a wider portfolio (see 'Introduction to Adura'). Alongside Adura's other development project, Jackdaw, Rosebank could form a significant part of Adura's community offer which has seen direct investment in skills and communities across Scotland. Taken together both the Rosebank and Jackdaw projects would make a combined contribution of ~10% of UK gas supply and £28.7 billion GVA to the UK over the anticipated production periods of each field, in addition to significant direct tax contributions.

Adura is committed to investment within the communities that support its operations. Adura works closely with community leaders to consider the social, economic, and environmental impact of existing and planned activities, as well as the most locally beneficial social investments. The scale of Adura's subsequent contribution comes down to the cumulative success of the portfolio rather than any individual asset. Therefore, the commencement of operations at Rosebank, and Jackdaw, could provide the means to sustain this contribution for a longer duration. To date, these social investments include:

- Sponsoring the Aberdeen Science Centre to make science accessible to everyone, nurturing the next generation of innovators.
- Sponsorship of the River Dee Trust to deliver the educational fund, and transport and lunch fund which provide support to schools, organisations, and individuals, as well as funding physical restoration of the Culter catchment area, the second largest sub-catchment of the River Dee.

- Involvement in the Highlands and Islands Enterprise Science Skills Academy, specifically through sponsorship of the Newton Room in Shetland, a STEM classroom intended to make learning accessible in remote areas.
- Collaborating with local partners to deliver activities and projects tailored to local priorities – such as sponsorship of Our Union Street[15].

Adura's Skills and Development Programs

The pipeline of work which Rosebank is providing, and will continue to provide, will help the UKCS remain a competitive draw for our skilled workforce and creates additional incentive for the next generation, whilst an employment market for new technologies matures.

Adura actively supports the development of the workforce at all stages of their career. Adura is also engaged in the development of apprentices and the diversification of the workforce, through:

- Sponsorship of the APTUS Scheme, managed by OPITO, providing for unique onshore and offshore work experiences for apprentices by combining classroom learning with hands on training. Adura has 21 apprentices in the active pipeline. The next opportunity to pledge will be in Q3 2026.
- Support for STEM initiatives near the Adura offices and operations, in partnership with leading education and skills organisations.

In 2026, Adura became the lead industry partner of the Aberdeen Energy Transition Skills Hub, the largest skills hub in Scotland. Shell UK initially committed £1.8 million to support the establishment and initial operation of the Hub, with Adura now building on this strong foundation and taking forward the remaining £1.1 million of Shell UK's original sponsorship (Shell, 2023) (Adura, 2026a).

The hub is the anchor project of the city's Energy Transition Zone. It brings together state of the art facilities including:

- A welding academy, already tripling North East Scotland College's (NESCol) previous training capacity.
- An advanced manufacturing zone.
- Future technology digital training suites used for innovation, renewables and modern engineering skills.

The hub aims to support 1,000 people into jobs in its first five years. As of March 2026, it has already provided 150 training places in welding, trebling NESCol's previous training capacity. With further expansion planned for 2026/27, this could rise to four times the pre-hub capacity (Adura, 2026b).

Adura also supports the Girls in Energy programme which encourages this under-represented group to consider careers in energy, including in renewables. Over 1,800 young women have completed the Girls in Energy programme since 2010.

In 2026, the Aberdeen Energy Transition Skills Hub and the Girls in Energy programme has provided:

- 150 welding training places (with plan to quadruple capacity from 2027).
- >130 students regularly using the advanced manufacturing, innovation, renewables and flexible workshop spaces.
- 284 participants in the Girls in Energy programme.
- 25 competitors in the Ocean Winds Virtual Welding Challenge.

---

[15] About - Our Union Street

Further detail on this has been provided in response to Item 46.

3.2 CONCLUSION

In summary the purpose of this section is to support the Secretary of State in taking a decision by presenting information relevant to the balance of advantage, in accordance with the Supplementary Guidance for assessing downstream Scope 3 emissions.

Parts 1 and 2 relate to the environmental impacts of the Rosebank Development. Part 3 provides responses to questions on the socio-economic benefits which could flow from Rosebank, as well as related updates relevant to this since the submission of the Environmental Statement (Equinor, 2022). Section 3.1.2 looked deeper into UKCS production and the long-established market with Europe which contributes to the security of supply on both sides of the Channel. The relative carbon intensity of UKCS oil and investment in Rosebank decarbonisation make the Development a desirable supplier of crude oil, relative to other global suppliers, whilst continuing to support the established UK-European market. Gas from Rosebank, which is expected to make up 4% of UK gas supply (Adura), will also be exported via Shetland and will ultimately end up in the UK grid at St Fergus, contributing to the UK's energy security.

The development of Rosebank directly contributes significant socio-economic benefits to the UK over the life of the field, as shown in 3.1.3 and the subsequent items in this document. Rosebank has provided over 2600 jobs and could support £24.3bn contribution to GVA, alongside UK supply chain utilisation. In addition as part of Adura's future portfolio, Rosebank will enable Adura to continue to provide substantial community benefits. Rosebank also remains consistent with UK Government policy – first with the North Sea Transition Deal and now the North Sea Future Plan and the UK Government's current fiscal framework which maintain support for investment in the North Sea during the transition.

To conclude the information presented demonstrates that Rosebank supports the UK's objectives, supporting the well established market with Europe to deliver greater energy security, economic growth and producing crude oil with lower average intensity emissions than alternative sources of supply.

46 ITEM 46

46. Section 3 'Good, Long-Term Jobs' (pages 6 & 7) provides information on job creation/retention (including on the supply chain and man-years of full-time work). Please provide:

a. Detail of the methodology used to reach the figures in paragraphs 3.2 and 3.3.
b. An annual profile of jobs generated during construction and operation, broken down by direct, indirect and induced, detailing the methodology.
c. Any uncertainty analysis of jobs generated (i.e. high/low sensitivities)
d. The underlying figures, or updated figures where relevant, to Figure 1 in this report published on Equinor's website estimating the number of UK based full-time Rosebank employees from 2022 to 2054.
e. If available, a breakdown of the types of job roles created by the Rosebank project, with estimated salaries & any other relevant metric of quality. For example, engineers, technicians, welders.
f. The number of apprentices trained, if any, as a direct result of the project.
g. Information on any specific provisions to train and upskill workers (both for work on the project itself and for the transition to green technologies in the North Sea).

46.1 ITEM 46A

Employment Methodology

For the employment analysis, as seen in the referenced paragraphs, the direct jobs were taken from the supply chain analysis conducted by Wood Mackenzie. Type I industry specific employment multipliers were used to obtain the combined direct and indirect employment, and Type II multipliers were applied to obtain the direct, indirect, and induced employment.

The employment multipliers were sourced from the Scottish Government's Analytical Tables. These have been selected given the concentration of employment in Scotland, despite there being employment seen across the UK.

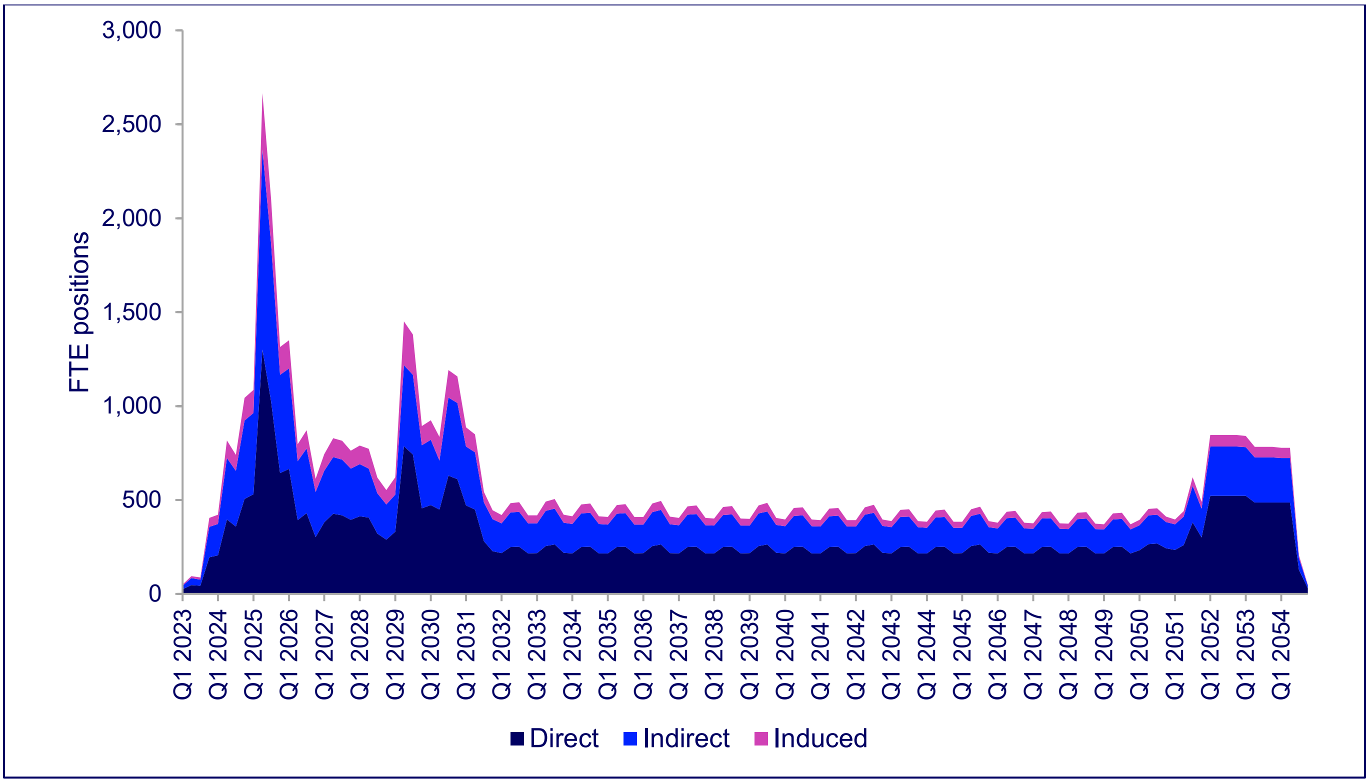
46.2 ITEM 46B

Figure 12 sets out the actual and forecast direct, indirect and induced employment for Rosebank over its lifetime. The Rosebank Development has provided >2600 direct, indirect, and induced jobs at its peak in the development cycle, it is forecast to contribute an annual average of 580 UK-based jobs over the anticipated life of the field.

Methodology

For the employment analysis, the direct jobs were taken from the supply chain analysis. Type I industry specific employment multipliers were used to obtain the combined direct and indirect employment, and Type II multipliers were applied to obtain the direct, indirect, and induced employment.

The employment multipliers were sourced from the Scottish Government's Analytical Tables. These have been selected given the concentration of employment in Scotland, despite there being employment seen across the UK.



Source: Adura/ Wood Mackenzie Rosebank Socio Economic Impact Analysis

Figure 12: Rosebank Development employment profile by year.

46.3 ITEM 46C

High/low sensitivities were not included in this analysis for the following reasons:

Direct Employment: Given that most of the development scope has already been completed and the associated costs incurred, there is a high degree of confidence in the employment figures used for the development phase of the model. For the operational phase, staffing levels on platforms and vessels are relatively rigid in nature, with minimum operating requirements and finite bed space capacity acting as practical constraints on employment variability. This limits the extent to which a meaningful high/low sensitivity range could be applied.

Indirect and Induced Multipliers: The Scottish Government multipliers applied in this study do not incorporate high/low sensitivity variants, and as such, this was not reflected in the Wood Mackenzie report.

46.4 ITEM 46D

Table 26 provides the latest breakdown of the average jobs forecast to be created by Rosebank by category of employment.

Table 26: Average direct, indirect and induced UK-based full-time equivalent jobs created/supported by the Rosebank Development.

Category	2023-2054 Average
UK Direct - Oil & gas extraction, metal ores & other	268
UK Direct - Mining Support	31
UK Direct - Electrical equipment	17
UK Direct – Total	**316**
UK Indirect	205
UK Induced	59
Total UK	**580**

Source: Adura/ Wood Mackenzie Rosebank Socio Economic Impact Analysis

46.5 ITEM 46E

Table 27 provides a breakdown of jobs as they apply to development only and then to development and operations combined. The number of 'development only' roles indicates why employment numbers seen in response to 46b peaked during development, but as we move into operations we expect still to see an average of 580 UK-based jobs over the lifetime of the asset.

Table 27: Types of direct jobs created/supported by the Rosebank Development.

Development Only		Development and Operations	
Thermal Insulators	Cementer	HVAC Technician	Helicopter Pilot
Instrument Pipefitters	Wireline Engineer	Process Technician	Helicopter Ground Crew
Pipefitters	Wireline Operator	Electrical Technician	Crane Operator
Riggers	Medic	Process Engineer	Inspectors
Design Engineer	Stewards	Mechanical Engineer	Reservoir Engineer
Project Support	Company Representative	Electrical Engineer	Environmental Scientist
Roustabouts	Pipelay Vessel Captain	Instrument Technician	Painters/ Blasters
Roughneck	Pipelay Vessel Crew	Project Manager	Marine Supervisor
Derrickman	Onshore Waste Processing Operator	Commercial Manager	Marine Mechanical technician
Assistant Driller	Rig Mechanic	Geologist	Marine Operator
Driller	Drilling Engineer	Geophysicist	Deck Crew
Tool Pusher	Completions Engineer	OSV Captain	Scaffolder
Offshore Installation Manager	Cost Engineer	OSV Crew	Lab Technician
Rig Electrician	Buyer	HSE officer	DSV Captain
Mudlogger	Planner	Camp Boss	DSV Crew
Data Analyst	Project Engineer	Catering/Cleaning Stewards	Subsea Engineer

Development Only		Development and Operations	
M/LWD Engineer	Commissioning Lead	Logistics Coordinator	ROV Pilot
Directional Driller	Mud Engineer	Radio Operator	Offshore Doctor/Medic

Salaries

Offshore Energies UK has collaborated with employment specialists, employers and trade unions to produce reports and agreements, available on their website, outlining salaries and other compensation for workers in the energy sector.

- Average basic salary for an offshore oil and gas worker at technician level is £69,695 and at craft level is £64,796, according to the Energy Services Agreement published on the OEUK website. This is based on 161 days worked plus 28 days of holidays. This does not include overtime or other allowances (OEUK, 2025).
- Entry-level roles can range between £43,200 and £61,530 based on the same working days and holidays annually (OEUK, 2025).
- Senior technical and managerial roles can exceed £100,000–£150,000 annually (OEUK, 2025a).
- **Non-Monetary Benefits** often include comprehensive training programs, health and safety certifications, and career development opportunities. The shift patterns combined with an annual leave entitlement of 28+ days provide opportunities for long breaks from work and more time off than within other sectors (OEUK, 2025a).

According to Offshore Energies UK in their Workforce Insight 2025, '*the Oil & gas sector has well-defined pay agreements and mature frameworks that have contributed to higher salaries and better job security*' for technical and craft roles.

46.6 ITEM 46F

In total, there are currently 54 apprentices across contractors who are working on the Rosebank Development, a breakdown by supplier for which can be found in Table 28. More broadly, Adura's funding contributes to the development of apprentices through both direct programme participation and broader industry initiatives detailed in Section 3.1.3.

Table 28: Apprentice involvement in the Rosebank Development.

Supplier	Apprentices involved
TechnipFMC	48
Baker Hughes	5
Halliburton	1

Source: Adura Suppliers

46.7 ITEM 46G

Adura has a highly skilled, future-ready workforce as explored in 3.1.3. Employees receive comprehensive on-the-job training that meets immediate operational needs and builds capability, as well as supporting long term career progression. Adura is creating a resilient and adaptable workforce equipped to meet the demands of today's energy system while preparing them for evolving roles in the energy sector.

Rosebank will generate employment and support the development of skills critical to the low carbon sector i.e. wind, hydrogen and CCS, for roles such as:

Welders, pipefitters, inspectors, platers, development engineers, reservoir engineers, geoscience engineers, riggers, crane operators, scaffolders, electrical technicians, mechanical technicians, instrument technicians, maintenance engineers and technicians, marine engineers, environmental scientists, and a variety of offshore engineers, operators and technicians.

47 ITEM 47

47. Section 4 'Growth and Investment in Communities' (page 8) provides information on the Gross Value Added (GVA) of the project and figures on the investment created (including an estimate of investment in the UK economy). Please provide:

a. Detail of the methodology used to reach the figures in paragraph 4.1 and 4.2 (including the GVA figures in paragraph 4.2).
b. An annual profile of GVA generated over the Rosebank project's lifetime, broken down by direct, indirect and induced.
c. Any uncertainty analysis of GVA generated (i.e. high/low sensitivities)
d. Annual profile of investment and cost figures over the Rosebank project's lifetime, e.g. operating expenses (OpEx), capital expenditure (CapEx) and decommissioning, with breakdown of investment/costs and any relevant investment in local communities (e.g. port infrastructure etc).
e. We note the direct investment figure on page 8 is stated as £8.5bn, whereas in this report published on Equinor's website (page 7) it is £8.1bn. Please confirm which is the correct figure and/or explain the differences between these.

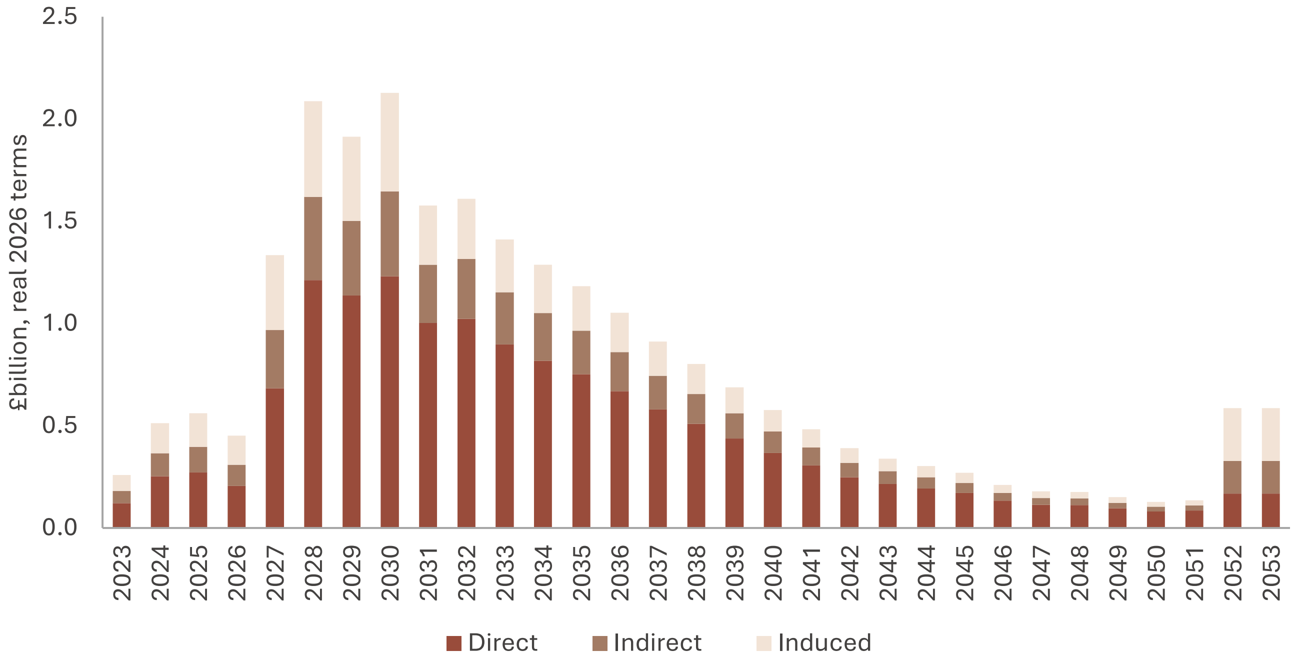
47.1 ITEM 47A

A field cash flow model was created for the Rosebank field, the outputs from which were used in an input-output model, developed by Wood Mackenzie, to evaluate the gross value added (GVA) of the development on the economy. Direct GVA was calculated by summing the CAPEX and field revenues (net of OPEX). Type I industry specific GVA multipliers were then applied to obtain the combined direct and indirect GVA. The same process was followed using Type II GVA multipliers to obtain the combined direct, indirect, and induced GVA.

The GVA multipliers were sourced from the Office for National Statistics (ONS) Analytical Tables.

47.2 ITEM 47B

Across the life of the field, Rosebank is expected to generate an average GVA of £0.8 billion per year and reaching a total GVA of £24.3 billion with direct, indirect and induced contributing £14.3 billion, £4.7 billion and £5.3 billion respectively. During peak activity – between 2028 and 2030 when Phase One of the field is onstream and the development of Phase Two is planned – the annual GVA would be approximately £2 billion equivalent to around 0.8% of Scottish GDP. Figure 13 sets out the annual profile of Rosebank GVA by year and category.



Source: Adura/ Wood Mackenzie Rosebank Socio Economic Impact Analysis

Figure 13: Rosebank Development GVA profile by category.

47.3 ITEM 47C

High/low sensitivities were not included in this analysis for the following reasons:

Multipliers: The ONS multipliers applied in this study do not incorporate high/low sensitivity variants, and as such, this was not reflected in the Wood Mackenzie report.

Price Sensitivities: Price sensitivities were deliberately excluded to present a single conservative view of GVA. Wood Mackenzie's base price deck was used throughout to ensure that the economic contribution of the Rosebank Development was not overstated.

Capital Costs: Given that much of the development scope has been completed, and the associated costs have been incurred at the time of writing the report, there is a high degree of confidence in the CAPEX figures underpinning the model. As a result, the scope for meaningful cost sensitivity analysis was considered limited.

47.4 ITEM 47D

As is consistent with other major infrastructure projects, Figure 14 shows the significant CAPEX investment made during Rosebank's development phase, peaking at £0.95bn. Whilst a steady OPEX cost over £100-150 million per annum will follow during when the Rosebank Development is operational. Decommissioning costs have been estimated at £262 million in 2052 and 2053 and are included in the below chart as CAPEX spend.

Figure 15 goes on to provide a further breakdown of the activity comprised within the CAPEX and OPEX spend.

[redacted]

Source: Adura and Wood Mackenzie

Figure 14: Rosebank Development CAPEX and OPEX profile. (REDACTED)

[redacted]

Source: Adura and Wood Mackenzie

Figure 15: Rosebank Development CAPEX and OPEX breakdown. (REDACTED)

47.5 ITEM 47E

The difference in figures comes from the different versions of the socio-economic analysis conducted by WoodMac. £8.5 billion was the figure in 2024 report, £8.1 billion came from the 2023 WoodMac report. The report was refreshed in 2026 to support this response and the figure is now £8.7 billion.

48 ITEM 48

48. Paragraph 2.4 states: “Rosebank also supports future energy flexibility through its Floating Production, Storage and Offloading vessel (FPSO) design and aligns with the UK Government’s strategy to maintain domestic production to preserve critical infrastructure, skills, and supply chain capacity for the energy transition.” Please provide detail on how the FPSO design supports future energy flexibility.

After Phase 1 & 2, there will be five spare production well slots to allow for further phases of drilling if required on Rosebank.

The FPSO will provide flexibility for the area, with the capability to act as a hub for the development of existing discoveries.

<u>FPSO Specifications (Altera, Website)</u>

- **Oil capacity – 70,000 bbl/d**
    - Expected to have spare capacity from the early to mid-2030s (Equinor, 2025).
- **Gas capacity – 66 mmscf/d**
    - Spare capacity throughout the life of Rosebank with significant spare capacity from the mid to late 2030s.
- **Riser capacity – 14 slots**
    - Two will be used for production.
    - Four will be used for water injection, gas lift, gas export and the umbilical.
    - Three slots are not in use.
    - Five spare slots remain for future tiebacks/expansions.
    - Tie-ins to spare riser slots will not require the vessel to be taken off station allowing continuous operations.
- **Well Slots – Phase 1 & 2 installs three 4-slot templates**
    - 5 spare well slots available on the initial templates.
- **Subsea Control System – designed to handle 24 wells**
    - Capacity to handle 17 more wells after phase 1 & 2.

Gas export pipeline will be installed with an extra tie in point for future gas opportunities.

49 ITEM 49

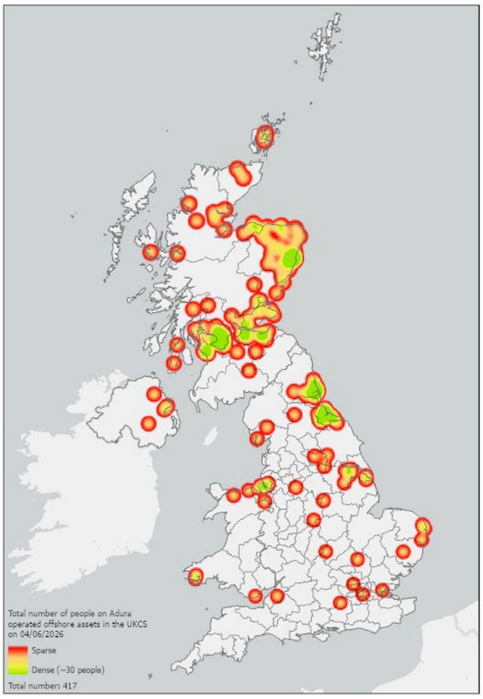
49. We anticipate that information within the Supply Chain Action Plan (SCAP) and the Standard Economic Template (SET) may be relevant to considering the information provided in relation to job creation/retention, the supply chain and contribution to economic growth – please provide these if so. Please also provide, if not included in the SCAP or SET, any other information relevant to considering these effects or which might put those effects in context, such as:

a. the geographic location of supply chain jobs linked to the project;
b. the percentage UK content of the supply chain linked to the project;
c. an overview of tier 1 suppliers linked to the project (such as the names of companies, an indication of what they were supplying, approximate contract value and geographic location of those suppliers).

The SCAP and SET have not been provided owing to their commercial confidentiality. The following responses provide the information requested and the relevant sources.

49.1 ITEM 49A

Figure 16 provides a heatmap snapshot of the home locations of the current workforce across all Adura's offshore locations on 3 June 2026 which can be used as a proxy for the distribution of the workforce on Rosebank. Further detail cannot be provided due to the sensitivity of the data.



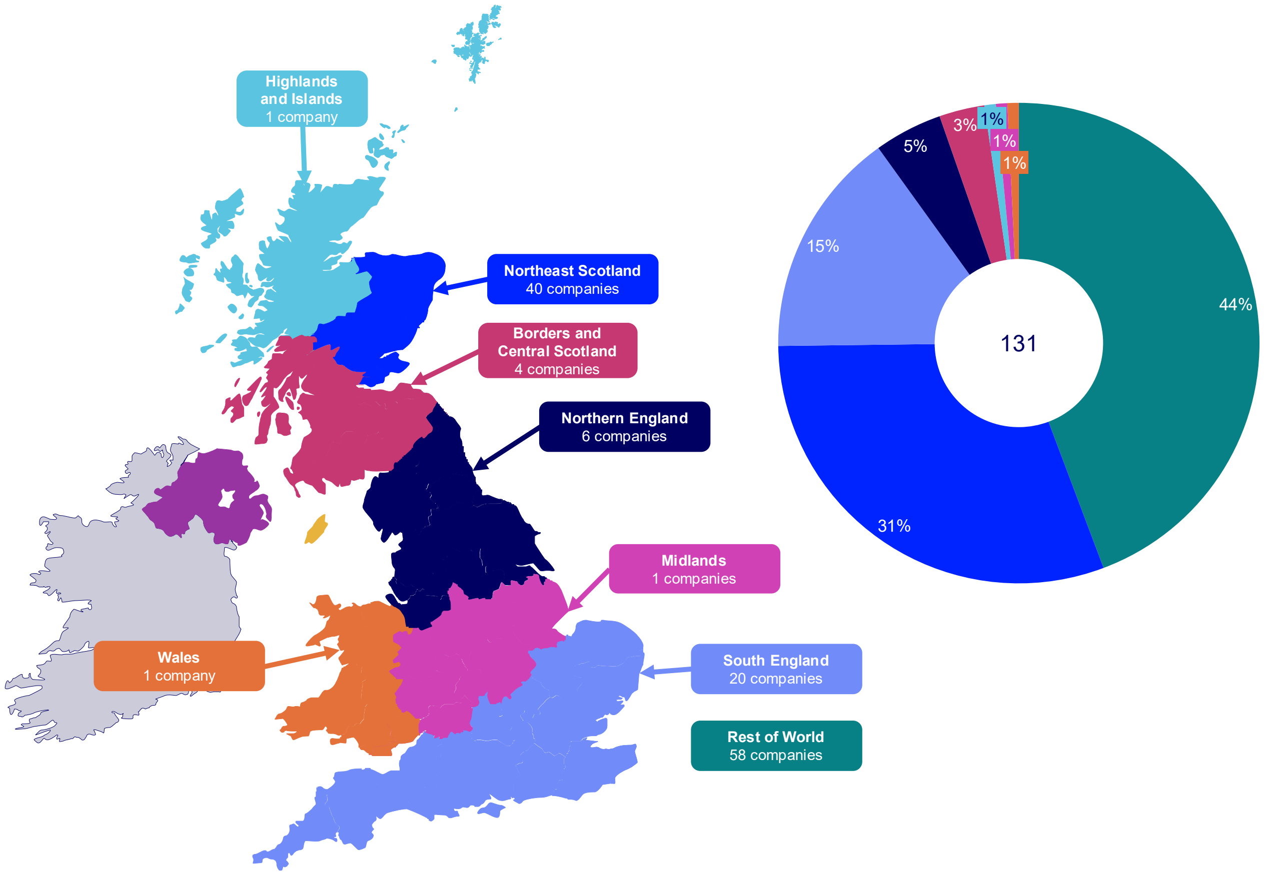
Source: Adura/ Wood Mackenzie

Figure 16: Heat map of workforce primary residence across Adura assets.

Rosebank will utilise 73 UK-based supply chain businesses with a total 131 businesses linked to the Development. The domestic supply chain can be found across the UK, consistent with the home addresses of Figure 16 and detailed in Figure 17.

Some specific activity is detailed below:

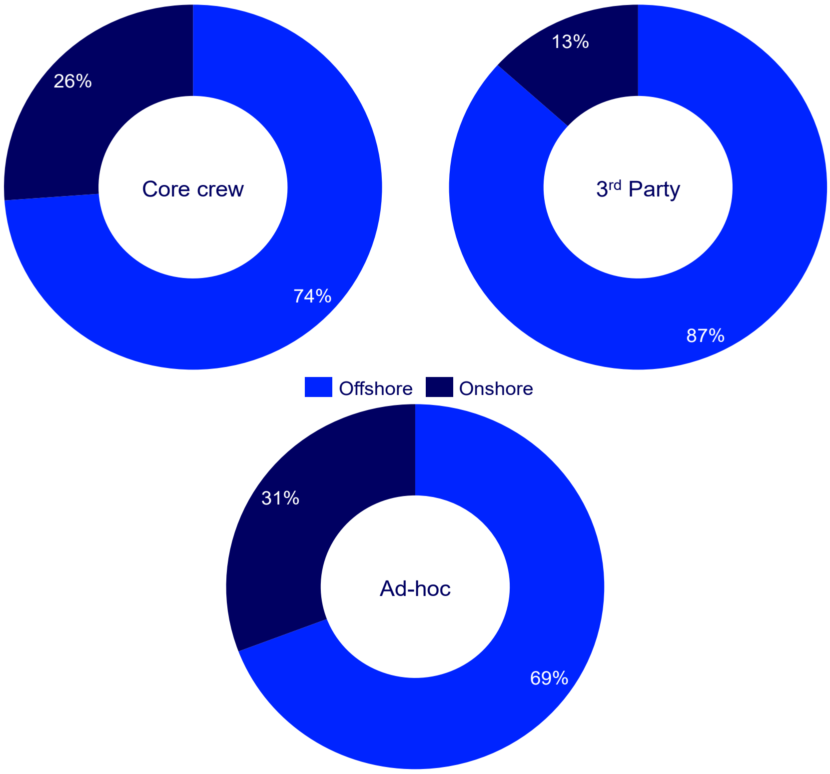
- Project management and engineering – Aberdeen.
- Marine and logistics support – Lerwick, Shetland.
- Christmas trees – Dunfermline.
- Pipeline fabrication, welding and spooling – Evanton, Cromarty Firth.
- Pipeline coating – Hartlepool.
- Flexibles manufacture – Newcastle.



Source: Adura/ Wood Mackenzie

Figure 17: Map and chart of supply chain company locations.

Figure 18 shows the geographical location of the roles. This shows a majority taking place offshore, whilst there remains a significant number onshore across the core crew, third party, and ad-hoc roles.



Source: Adura/ Wood Mackenzie

Figure 18: Supply chain job locations.

49.2 ITEM 49B

Please refer to page 5 the summary section of “Response to Requirement #3 (Provision of relevant information for the Secretary of State to consider when reaching a decision on whether or not to agree to the grant of consent) of the Regulation 12(1) Notice dated 21 July 2025” for the number at the time of submission.

In the 2026 refresh of the analysis (Wood Mackenzie, 2026) the figures are as follows:

- 69% of jobs over the field’s life are based in the UK.
- 67% of the £8.7 billion goes into the UK economy.

Analysis of the supply chain was conducted by Wood Mackenzie with an overview of key phases of construction and operation, and the direct employment relating to this. The figures above are considering the direct contribution to the Rosebank Development.

49.3 ITEM 49C

Table 29 lists the primary suppliers for Rosebank alongside the key product or service they are providing. Note that whilst values have been made available in the table, the suppliers have requested that this information remains confidential for commercial reasons.

Table 29: Tier 1 Supply Chain companies. Note: Suppliers have requested values are kept confidential as the values are commercially sensitive. (REDACTED)

Company	Product/Service	Contract value (£million)	Location
[redacted]	Helicopter Services	[redacted]	[redacted]
[redacted]	Vessels (ERRV)	[redacted]	[redacted]
[redacted]	Vessel (Supply)	[redacted]	[redacted]
[redacted]	Vessel (Supply)	[redacted]	[redacted]
[redacted]	Vessel (Supply)	[redacted]	[redacted]
[redacted]	Shorebase Services	[redacted]	[redacted]
[redacted]	Chemicals	[redacted]	[redacted]
[redacted]	Integrated Drilling & Wells Services	[redacted]	[redacted]
[redacted]	Integrated Drilling & Wells Services	[redacted]	[redacted]
[redacted]	Downhole Monitoring	[redacted]	[redacted]
[redacted]	Integrated Drilling & Wells Services	[redacted]	[redacted]
[redacted]	OCTG	[redacted]	[redacted]
[redacted]	Marine Drilling unit and Services	[redacted]	[redacted]
[redacted]	Operations & Maintenance Services	[redacted]	[redacted]
[redacted]	FPSO Bareboat Charter	[redacted]	[redacted]
[redacted]	FPSO-FEED	[redacted]	[redacted]
[redacted]	Fibre Optic Cable Installation	[redacted]	[redacted]
[redacted]	SURF iEPCI	[redacted]	[redacted]

50 ITEM 50

50. Should the project impact on other infrastructure, Adura may wish to provide information on those aspects – for example should the project extend the life of, or better utilise, any existing infrastructure; or support the managed decommissioning of legacy infrastructure. This could include, if applicable, the extent to which the project could become part of a 'low carbon' hub by sharing infrastructure with offshore wind, hydrogen or CCS projects, or could de-risk future opportunities such as a carbon storage, hydrogen or offshore wind project or 'low carbon' hub.

The Rosebank Development was designed intentionally to make the most of existing infrastructure, for example through the use of an existing gas pipeline to take gas from Rosebank to St Fergus and the re-purposing of an existing FPSO (Figure 19). Adura has also invested in ensuring the FPSO is electrification ready in support of Government Net Zero GHG emissions reduction policy. ". St Fergus Gas Terminal is not an Adura asset, however it is a critical part of the value chain for the UK and further indicates how Rosebank can utilise existing assets to maximise economic output of and energy supply to the UK.

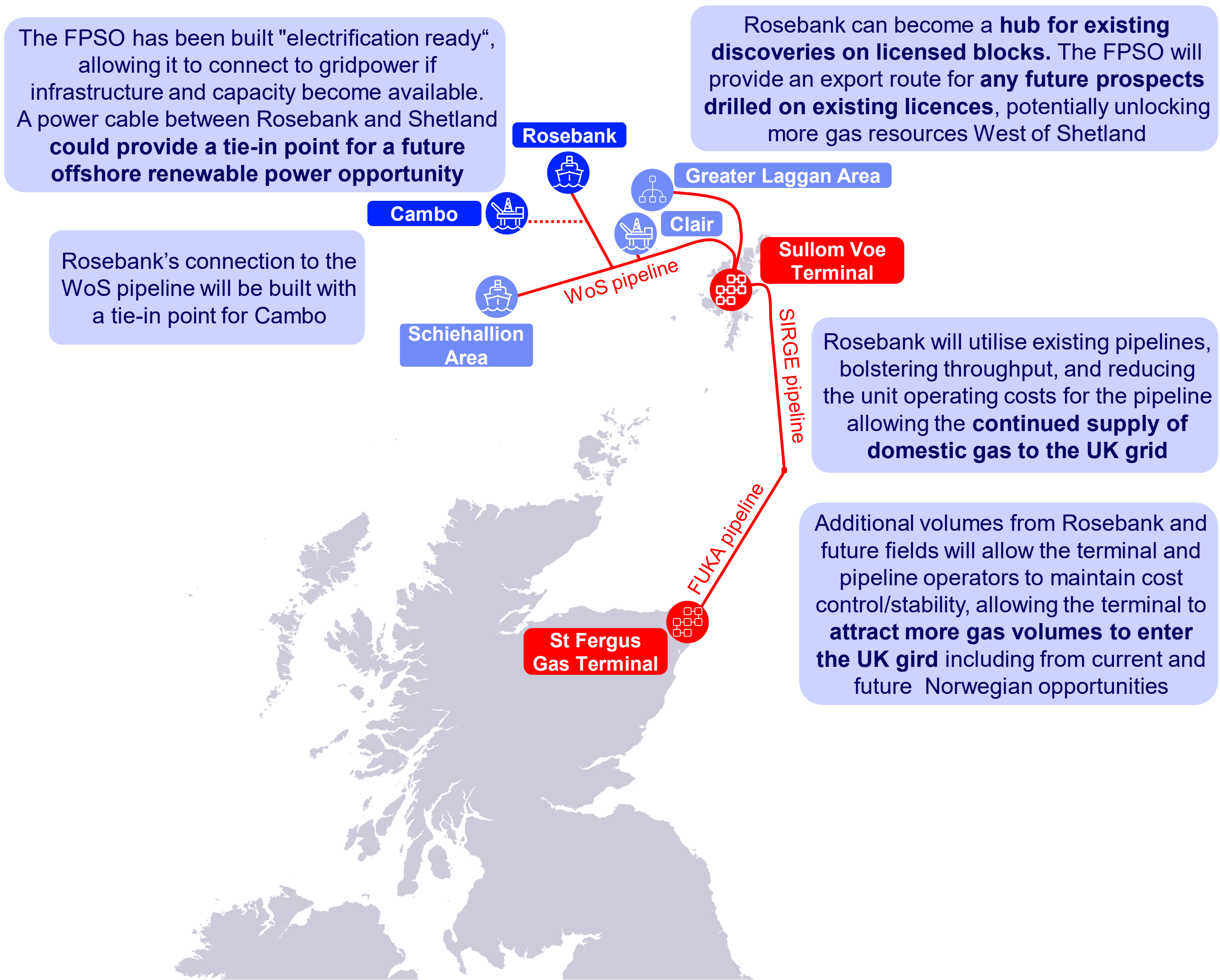


Figure 19: Rosebank Development and supported infrastructure.

51 ITEM 51

51. Please provide the Wood Mackenzie reports referenced on pages 5, 6, 8 & 10: a. Wood Mackenzie, 'Rosebank – Social Economic Impact Analysis' (15 July 2024) b. Wood Mackenzie, 'Rosebank Development Social Economic Impact Study – Refresh' (December 2023)

51.1 ITEM 51A

The Wood Mackenzie Report, '*Rosebank – Social Economic Impact Analysis*' (15 July 2024), has been attached to this response.

51.2 ITEM 51B

The Wood Mackenzie Report, '*Rosebank Development Social Economic Impact Study – Refresh* (December 2023), has been attached to this response.

In addition to the earlier reports, the Wood Mackenzie analysis was refreshed in June 2026 to support this response and will be provided alongside it. This updated report also includes a summary of the key metrics, highlighting how they have changed across the different versions.

REFERENCES

Adura (2026a). Adura. (2026). Webpage: People and Communities. Available online at: https://adura.com/people-communities/.

Adura (2026b). Adura. (2026). Press Release: Adura on Board as Lead Industry Partner of Transformational Energy Transition Skills hub. Available online at: https://adura.com/adura-on-board-as-lead-industry-partner-of-transformational-energy-transition-skills-hub/.

Altera (Website). Altera. Webpage: Petrojarl, Rosebank. Available online at: https://alterainfra.com/vessels/petrojarl-rosebank.

CCC (2025). Climate Change Committee. (2025). The seventh carbon budget: Advice for the UK government. Available online at: https://www.theccc.org.uk/wp-content/uploads/2025/02/The-Seventh-Carbon-Budget.pdf.

CCC (2025a). *Progress in adapting to climate change: 2025 report to Parliament*. Available online at: https://www.theccc.org.uk/publication/progress-in-adapting-to-climate-change-2025/ [Accessed: 17/04/2026].

CCC (2025b). The Seventh Carbon Budget – Advice for the UK Government (The Seventh Carbon Budget - Climate Change Committee). Available online at: https://www.theccc.org.uk/publication/the-seventh-carbon-budget/ [Accessed: 26/05/2026].

Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2025). Latest Kennaook / Cape Grim greenhouse gas data. Available online at: https://www.csiro.au/en/research/natural-environment/atmosphere/Latest-greenhouse-gas-data [Accessed 19/06/206].

Department for Energy Security and Net Zero (DESNZ) (2021). Net Zero Strategy: Build Back Greener. Available online at: https://www.gov.uk/government/publications/net-zero-strategy [Accessed: 26/05/2026].

DESNZ (2022). British energy security strategy. Available online at: https://www.gov.uk/government/publications/british-energy-security-strategy [Accessed: 26/05/2026].

DESNZ (2023a). Carbon Budget Delivery Plan. Available online at: https://www.gov.uk/government/publications/carbon-budget-delivery-plan/carbon-budget-delivery-plan [Accessed: 03/06/2026].

DESNZ (2023b). Powering Up Britain: Net Zero Growth Plan. Available online at: https://www.gov.uk/government/publications/powering-up-britain/powering-up-britain-net-zero-growth-plan [Accessed: 26/05/2026].

DESNZ (2024). Clean Power 2030 Action Plan. Available online at: https://www.gov.uk/government/publications/clean-power-2030-action-plan [Accessed: 26/05/2026].

DESNZ (2025a). Department for Energy Security and Net Zero. (2025). Environmental Impact Assessment (EIA) – Assessing effects of downstream scope 3 emissions on climate: Supplementary Guidance. https://assets.publishing.service.gov.uk/media/6853fa3d1203c00468ba2b15/Supplementary_guidance_-_Effects_of_Scope_3_Emissions.pdf

DESNZ (2025b). Department for Energy Security and Net Zero. (2025). North Sea Future Plan. Available online at: https://assets.publishing.service.gov.uk/media/6926dede345e31ab14ecf507/north-sea-future-plan-government-response.pdf.

DESNZ (2025c). Digest of UK Energy Statistics. Available online at: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2025

DESNZ (2025d). Carbon budget and growth delivery plan. Available online at: https://www.gov.uk/government/publications/carbon-budget-and-growth-delivery-plan [Accessed: 03/06/2026].

DESNZ and Department of Business, Energy and Industrial Strategy (BEIS) (2021). North Sea Transition Deal. Available online at: https://www.gov.uk/government/publications/north-sea-transition-deal [Accessed: 26/05/2026].

DESNZ and BEIS (2023). Independent Review of Net Zero. Available online at: https://www.gov.uk/government/publications/review-of-net-zero [Accessed: 26/05/2026].

DESNZ and NSTA (2025). North Sea Future Plan for fair, managed and prosperous transition. Available online at: https://www.gov.uk/government/news/north-sea-future-plan-for-fair-managed-and-prosperous-transition [Accessed: 12/06/2026].

DNV (2022). Rosebank EIA Survey. Habitat assessment report, Rosebank Gas Export Pipeline Route.

DNV (2025). Rosebank Metocean Independent Verification.

Edelenbosch, O. Y., Hof, A. F., van den Berg, M., de Boer, H. S., Chen, H.-H., Daioglou, V., Dekker, M. M., Doelman, J. C., den Elzen, M. G. J., Harmsen, M., Mikropoulos, S., van Sluisveld, M. A. E., Stehfest, E., Tagomori, I. S., van Zeist, W.-J., & van Vuuren, D. P. (2024). Reducing sectoral hard-to-abate emissions to limit reliance on carbon dioxide removal. *Nature Climate Change*, **14**, 715–722.

Equinor (2022). Rosebank. Environmental Statement. ES/2022/001. Available online at https://assets.publishing.service.gov.uk/media/62f62fec8fa8f50b4de7f743/Rosebank_Environmental_Statement_-_Final_for_Submission_To_OPRED_Equinor_3rd_August_2022.pdf [Accessed: 25/06/2026].

Equinor (2025). Rosebank. Response to Requirement #1 (An assessment of the effects of downstream scope 3 emissions from the above project on climate) of the Regulation 12(1) Notice dated 21 July 2025. Available online at: https://assets.publishing.service.gov.uk/media/68ef61fd82670806f9d5e0a9/Rosebank_Reg_12__1__Assessment_of_Scope_3_Emissions__OPRED_131025__errors_corrected.pdf [Accessed: 15/04/2026].

FCDO (2022). Foreign, Commonwealth & Development Office. UK-Netherlands Strategic Dialogue 2022. Available online at: https://www.gov.uk/government/publications/uk-netherlands-strategic-dialogue-2022-joint-statement-on-foreign-development-and-security-bilateral-cooperation.

Forster, P.M., Smith, C., Walsh, T., *et al.*, (2025). Indicators of Global Climate Change 2024: annual update of key indicators of the state of the climate system and human influence. *Earth System Science Data Discussions*, **2025**, 1-72. Available online at: https://essd.copernicus.org/articles/17/2641/2025/ [Accessed: 17/04/2026].

Forster, P.M., Walsh, T., Smith, C., *et al.* (2026). Indicators of Global Climate Change 2025: annual update of key indicators of the state of the climate system and human influence. *Earth System Science Data Discussions*, (pre-print) 1-72. Available online at: https://essd.copernicus.org/preprints/essd-2026-287/essd-2026-287.pdf[Accessed: 27/05/2026].

Friedlingstein, P., O'Sullivan, M., Jones, M. W., *et al.* (2026). Global Carbon Budget 2025. *Earth System Science Data, **18**,* 3211-3288. Available online at: https://essd.copernicus.org/articles/18/3211/2026/essd-18-3211-2026.pdf [Accessed: 26/05/2026].

Gillett, N.P. (2024). Halving of the uncertainty in projected warming over the past decade. *npj Climate and Atmospheric Science*, **7**, Article number: 146 (2024).

Global Carbon Budget (2024). Global Carbon Budget. Available online at: https://globalcarbonbudget.org [Accessed: 03/06/2026].

Global Carbon Budget (2025). Global Carbon Budget. Available online at: https://globalcarbonbudget.org/gcb-2025/the-global-carbon-budget-faqs-2025/ [Accessed: 03/06/2026].

Henry L-A, Roberts JM (2014a). Developing an interim technical definition for coral gardens specific for UK waters and its subsequent application to verify suspected records. JNCC Report No. 507. Available online at: https://data.jncc.gov.uk/data/72060f25-76ff-454a-b980-4afc8de4c490/JNCC-Report-507-FINAL-WEB.pdf [Accessed: 13/04/2026].

Henry L-A, Roberts JM (2014b). Applying the OSPAR habitat definition of deep-sea sponge aggregations to verify suspected records of the habitat in UK waters. JNCC Report No. 508. Available online at: https://data.jncc.gov.uk/data/788783fe-0c27-4faf-9fc3-6b1b1ad3bf78/JNCC-Report-508-FINAL-WEB.pdf [Accessed: 13/04/2026].

IEA (2023). The Oil and Gas Industry in Net Zero Transitions (The Oil and Gas Industry in Net Zero Transitions – Analysis - IEA).

IEA (2024). World Energy Outlook 2024. Available online at: https://www.iea.org/reports/world-energy-outlook-2024 [Accessed: 03/06/2026].

IEA (2025a). World Energy Outlook 2025. Available online at: https://iea.blob.core.windows.net/assets/9753df19-0a71-422a-b725-012c555763b3/WorldEnergyOutlook2025.pdf [Accessed: 26/05/2026].

IEA (2025b). Global Energy and Climate Model. Available online at: https://www.iea.org/reports/global-energy-and-climate-model [Accessed: 29/05/2026].

IEA (2025c). The Implications of Oil and Gas Field Decline Rates. Available online at: https://www.iea.org/reports/the-implications-of-oil-and-gas-field-decline-rates [Accessed: 29/05/2026].

IEMA (2020). *Demystifying Cumulative Effects. Thought pieces from UK practice.* Impact Assessment Outlook Journal Volume 7: July 2020. Available online at https://www.isepglobal.org/content/impact-assessment-outlook-journal-volume-7-demystifying-cumulative-effects-july-2020/ [Accessed: 26/05/2026].

IEMA (2022). *Institute of Environmental Management & Assessment (IEMA) Guide: Assessing Greenhouse Gas Emissions and Evaluating their Significance.* 2nd Edition. [Blake, J., Dearing, T., Dinnage, C., Griffiths, R., Leggatt, K., Marsland, E., Panting-Skeet, M., Parsons, J., Peacock, T., Peet, J., Tasker, A., Vergoulas, A., and Wright, J.]. Available online at: https://www.iema.net/media/xmgpoopk/2022_iema_greenhouse_gas_guidance_eia.pdf [Accessed: 26/05/2026].

International Institute for Sustainable Development (IISD) (2022). Navigating Energy Transitions: Mapping the Road to 1.5°C. Available online at: https://www.iisd.org/publications/report/navigating-energy-transitions [Accessed 05/06/2026].

IPCC (2018). Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Available online at ipcc.ch/site/assets/uploads/sites/2/2022/06/SR15_Full_Report_HR.pdf.

IPCC (2021). Climate Change 2021: The Physical Science Basis. Summary for Policymakers. Available online at: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_Stand_Alone.pdf [Accessed: 20/04/2026].

IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

IPCC (2023a). Sections In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115. doi: 10.59327/IPCC/AR6-9789291691647.001.

IPCC (2023b). Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001.

IPCC (2024). What is the IPCC? Available online at: https://www.ipcc.ch/site/assets/uploads/2024/04/IPCCFactSheet_WhatisIPCC.pdf [Accessed 11/06/2026].

ISEP (2026). Assessing Greenhouse Gas Emissions and Evaluating their Significance Edition 2.1, April 2026 with Supplementary Guidance.

Jacobson, A. R., *et al.* (2023). *CarbonTracker CT2022.* NOAA Global Monitoring Laboratory. https://doi.org/10.25925/Z1GJ-3254.

Lamboll, R.D., Nicholls, Z.R., Smith, C.J., Kikstra, J.S., Byers, E. and Rogelj, J. (2023). Assessing the size and uncertainty of remaining carbon budgets. *Nature Climate Change*, ***13*(12)**, 1360-1367.

Lan, X., Nisbet, E. G., Dlugokencky, E. J., & Michel, S. E. (2021). *What do we know about the global methane budget? Results from four decades of atmospheric CH_4 observations and the way forward.* Philosophical Transactions of the Royal Society A, 379: 20200440. https://doi.org/10.1098/rsta.2020.0440.

Lindsey, R. (2025). *Climate Change: Atmospheric Carbon Dioxide.* Climate.gov. Available online at: https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide.

Marine Scotland (2015). Scotland's National Marine Plan: A Single Framework for Managing Our Seas. Available online at: https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2015/03/scotlands-national-marine-plan/documents/00475466-pdf/00475466-pdf/govscot%3Adocument/00475466.pdf [Accessed: 26/05/2026].

Met Office (2026a). *Tracking the Changing Climate with Earth Observations.* Available online at: https://climate.metoffice.cloud.

Muttitt, G., Green, F., and Pye, S. (2025). The Climate Implications of New Oil and Gas Fields in the UK—An Overview of the Evidence, June 2025, UCL Policy Lab, UCL Energy Institute, and UCL Department of Political Science Available online at: https://www.ucl.ac.uk/policy-lab/sites/policy_lab/files/report-climate_implications_pages_online.pdf [Accessed: 26/05/2026].

NSTA (2025). North Sea Transition Authority (NSTA). (2025). Emissions Monitoring Report: Emissions Monitoring Report 2025.

NSTA (Portal). North Sea Transition Authority. Webpage: UKCS Offshore Activity. Available online at: https://experience.arcgis.com/experience/de29b515976048018c4b65ad2c1b026d.

OEUK (2025). Offshore Energies UK (OEUK). (2025). Energy Services Agreement. Available online at: https://oeuk.org.uk/industry-support/energy-services-agreement.

OEUK (2025a). Offshore Energies UK (OEUK). (2025). Pay Comparison Report.

OPRED (2021). The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 – A Guide. Available online at: https://assets.publishing.service.gov.uk/media/60f961e68fa8f50429f0e6d1/The_Offshore_Oil_and_Gas_Exploration__Production__Unloading_and_Storage__Environmental_Impact_Assessment__Regulations_2020_-_A_Guide__July_2021.pdf [Accessed: 26/05/2026].

OPRED (2026). Notice Under Regulation 12(1) Rosebank Field. Available online at: https://assets.publishing.service.gov.uk/media/69c6a22c43217762153609e8/12_1__FINAL_for_issue_27_March_2026_Redacted.pdf [Accessed: 12/04/2026].

OSPAR (2010). Background Document for deep-sea sponge aggregations. Available online at: https://qsr2010.ospar.org/media/assessments/Species/P00485_deep_sea_sponge_aggregations.pdf [Accessed: 13/04/2026].

Planning Inspectorate (2025). Nationally Significant Infrastructure Projects: Advice on Cumulative Effects Assessment. Available online at: https://www.gov.uk/guidance/nationally-significant-infrastructure-projects-advice-on-cumulative-effects-assessment [Accessed: 04/05/2026]

Purvis, R.M., Burton, R., Allen, G., Dawson, K., Drysdale, W.S., France, J., Hopkins, J.R., Lee, J.D., Lewis, A.C., Mobbs, S., Moore, T.C., Thistlethwaite, G. and Young, S. (2026). Methane emission from shuttle tankers during standard operations on an oil platform during oil loading. Environmental Science: Processes & Impacts. Royal Society of Chemistry. 28, 1134-1143

Rystad Energy (2022). UCube Browser v. 2.3.2. Available online at: https://www.rystadenergy.com/services/ upstream-solution.

SEI, Climate Analytics, E3G, IISD, UNEP. (2023). Phasing Down or Phasing Up? Top Fossil Fuel Producers Plan Even More Extraction Despite Climate Promises: Production Gap Report 2023. doi: ttps://doi.org/10.51414/sei2023.050 [Accessed: 26/05/2026].

SEI, Climate Analytics and IISD (2025). The Production Gap Report 2025. Stockholm Environment Institute, Climate Analytics, and International Institute for Sustainable Development. 2025 Report - Production Gap. Available online at: https://www.iisd.org/publications/report/production-gap-2025 [Accessed: 26/05/2026].

Shell (2023). Energy Transition Zone. (2023). Press Release: Aberdeen's New Energy Transition Skills Hub Set to Open in 2024 as Millions in Funding Secures New Skills and Jobs. https://etzltd.com/news/aberdeens-new-energy-transition-skills-hub-set-to-open-in-2024-as-millions-in-funding-secures-new-skills-and-jobs

Trout, K., Muttitt, G., Lafleur, D., Van de Graaf, T., Mendelevitch, R., Mei, L. and Meinshausen, M. (2022) *Existing fossil extraction would warm the world beyond 1.5 °C. Environ. Res. Lett.* **17** 064010 doi 10.1088/1748-9326/ac6228 (https://doi.org/10.1088/1748-9326/ac6228).

UK Parliament (2018). United Kingdom Parliament Briefings. (2018). Briefing Paper: Energy imports and exports. https://researchbriefings.files.parliament.uk/documents/SN04046/SN04046.pdf.

UK Parliament (2024). United Kingdom Parliament Hansard. (2024). Hansard: Financial Statement and Budget Report, Column 821. Available online at: https://hansard.parliament.uk/commons/2024-10-30/debates/11809FC2-3FF8-4B3A-9C78-4A56268F0D5E/FinancialStatementAndBudgetReport#:%7E:text=Next%2C%20we%20are,decarbonisation%20allowances%2C%20too.

UK Parliament (2025). The future of the oil refining sector, House of Commons Library, Debate Pack CDP-2025-0235. Available online at: https://commonslibrary.parliament.uk/research-briefings/cdp-2025-0235/ [Accessed 19/06/2026].

United Nations Climate Change (UNCC) (2021). Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its third session, held in Glasgow from 31 October to 13 November 2021l. Available online at: https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf [Accessed: 26/05/2026].

United Nations Environment Programme (UNEP) (2025). Emissions Gap Report 2025. Available online at : https://www.unep.org/resources/emissions-gap-report-2025 [Accessed 09/06/2026].

Venmans and Carr (2024). *Literature-informed likelihoods of future emissions and temperatures*. Climate Risk Management 44. doi: Available online at: https://doi.org/10.1016/j.crm.2024.100605.

WMO (2026). State of the Global Climate 2025. Available online at: https://library.wmo.int/viewer/69807/download?file=WMO-1391-2025_en.pdf&type=pdf&navigator=1 [Accessed: 20/04/2026].

Wood Mackenzie (2024). Rosebank – Social Economic Impact Analysis: Summary. Attached.

Wood Mackenzie (2025). The UK's critical role in Europe's integrated oil system. Available online at: https://www.woodmac.com/news/opinion/uk-critical-role-in-europe-integrated-oil-system.

Wood Mackenzie (2026). Rosebank – Social Economic Impact Analysis: 2026 Refresh and Comparison Report.

APPENDIX 1 BASELINE ENVIRONMENT DETAILED INFORMATION

Item 1 requests further detail on 1) reasonable future estimate of GHG emissions affecting climate over the lifetime of the project, 2) the current state of the climate and the environment and 3) future predictions for the state of the climate and environment over the lifetime of the project. These points are addressed in this Appendix.

Appendix 1 provides a high-level summary of relevant scientific literature relating to the current state of the environment. This has been prepared by Adura by drawing on a range of respected, publicly available scientific sources. This summarises and paraphrases information from those sources and does not express the views or opinions of Adura, or Ithaca. While efforts have been made to reflect the content of the underlying sources accurately, the summaries necessarily involve simplification and are not intended to constitute an exhaustive description of every aspect of that source. Readers should refer to the original sources for the full analysis.

The baseline presented within the assessment of effects of downstream Scope 3 emissions (Section 3.3; Equinor, 2025) discusses the future climate scenarios of the IPCC AR6 (IPCC, 2023a). The consideration of the IPCC (2023) AR6 future climate scenarios is in line with the Supplementary Guidance which states: "*OPRED considers that an assessment of Scope 3 emissions in relation to the current state of climate and global emissions-reduction pathways (IPCC, 2023b) is more likely to support a reasoned conclusion on significance".*

The Supplementary Guidance advises that a "*reasonable future estimate of global GHG emissions affecting the climate over the lifetime of the project, reflecting the expected trajectory of climate conditions and the environment"* should be considered as part of the determination of the baseline scenario. OPRED (2026) have requested that further information should be included in the baseline of the assessment of effects of downstream Scope 3 emissions to address this requirement, including "*the likely trajectory of emissions and associated climate effects across the life of the field"* where emissions pathways associated with IPCC AR6 future climate scenarios are used, including but not limited to Current Policies (CurPol)/ModAct pathways (i.e. warming categories C6 and C7 and SSP2-4.5 and SSP3-7.0).

The assessment of effects of downstream Scope 3 emissions (Equinor, 2025) considers projected future GHG emissions in 2030, 2040 and 2050 across the C1 (SSP1-1.9), C3 (SSP1-2.6), C6 (SSP2-4.5) and C7 (SSP3-7.0) future climate scenarios from IPCC AR6 (Table 15 in Equinor, 2025). It is acknowledged that these future emissions projections are not detailed within the baseline section of Equinor (2025). Nevertheless, these projections are considered within the evaluation of significance (Section 6; Equinor, 2025) and therefore this specific requirement of the DESNZ (2025a) Supplementary Guidance is considered to be addressed.

The use of a range of future climate scenarios to encompass various levels of future GHG emissions is considered to reflect best practice and recognises the uncertainty in future climate conditions and GHG emissions. The emissions pathways, which represent the quantitative emissions projections associated with the IPCC AR6 future climate scenarios, are not predictions or forecasts. They are conditional on the realisation of a range of highly uncertain assumptions associated with human choice and are not assigned a relative probability or likelihood. Therefore, it is appropriate to assess the Scope 3 emissions of the Rosebank Development against a range of plausible future scenarios, rather than the arbitrary selection of a single plausible future scenario which may or may not be achieved. Several recent studies have attempted to provide more certainty on the potential range of future emissions pathways.

For example, Gillett (2024) reviewed the uncertainties in future emissions and climate response in light of progress on climate policy and climate science. Gillett (2024) identified that the range of plausible future emissions pathways can be reasonably narrowed to between SSP1-1.9 and SSP2-4.5 (i.e. C1 – C6 warming categories). Similar findings were also reported by Venmans and Carr (2024) who identified RCP 2.6 to 4.5 as being a representative range of current and announced climate pledges. This range of future emissions pathways is incorporated into the assessment of effects of downstream Scope 3 emissions, noting that the range of projected emissions level is still uncertain (projected emissions for SSP2-4.5 is approximately six times higher than SSP1-1.9 in 2050 (median of 52 gigatonnes carbon dioxide equivalent ($GtCO_2e$) vs 8 $GtCO_2e$) (IPCC, 2023b).

GLOBAL SURFACE TEMPERATURE

The Met Office reports that over the past century, global temperatures have risen significantly, largely due to increased GHG emissions. Currently, the Earth's average surface temperature is approximately 1.1°C higher than pre-industrial levels (see Figure 20) (Met Office, 2026a). Temperature data collected worldwide indicate this warming trend.

Figure 20 illustrates the correlation between atmospheric CO_2 levels and the global mean temperature (Met Office, 2026a). This relationship highlights temperature as a key climate indicator. According to the WMO, recent years have been among the warmest on record; notably, 2024 was the warmest year to date, with an estimated global near-surface temperature about 1.55°C ± 0.13°C above the 1850–1900 baseline (WMO, 2025).

According to the IPCC (IPCC, 2023) "*global net anthropogenic GHG emissions were 59 Gt CO_2eq (+/- 6.6 Gt CO_2eq) in 2019*", with "*the largest share and growth in gross GHG emissions occurring in CO_2 from fossil fuels combustion and industrial processes, followed by methane*". Furthermore, the IPCC (IPCC, 2023) state that "*in 2019, approximately 79% of global GHG emissions came from the sectors of energy, industry, transport and buildings together and 22% from agriculture, forestry and other land use*".

More recently updated GHG emission estimates indicate that total global GHG emissions were 55.4 $GtCO_2$eq (+/- 5.1 $GtCO_2$) in 2023, of which CO_2 emissions from fossil fuel combustion and industry contributed 37.8 $GtCO_2$eq (+/- 3.0 $GtCO_2$) (Forster *et. al*, 2025).

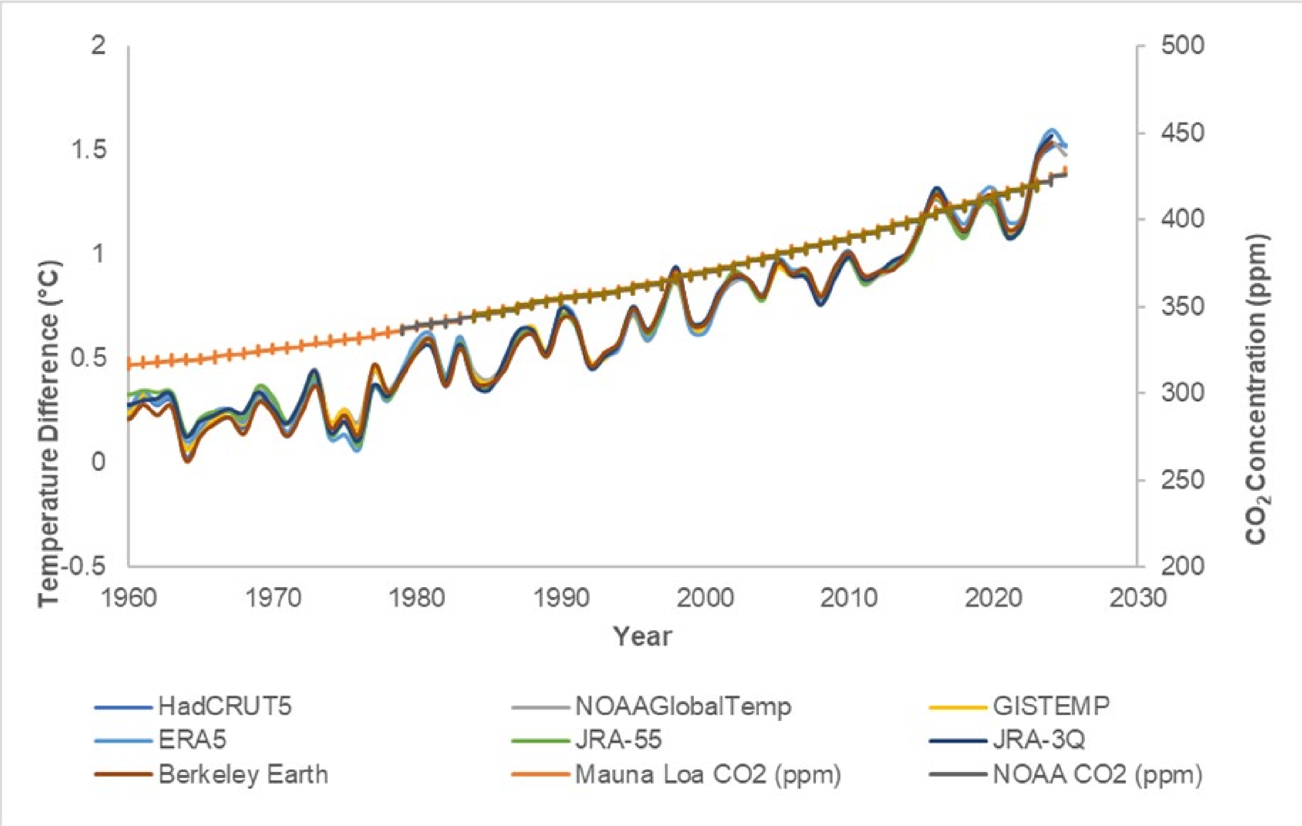


Figure 20: Correlation between carbon dioxide concentrations in the atmosphere and annual global mean temperature difference from pre-industrial conditions [Extrapolated (Met Office, 2026a)].

The Emissions Database for Global Atmospheric Research (EDGAR) provides country by country estimates of GHG emissions (excluding land use, land use change, and forestry) from 1990 to 2024 (EDGAR, 2025). EDGAR estimates that total global GHG emissions during this period have risen by 65%. Furthermore, EDGAR provides estimates of country by country fossil fuel based CO_2 emissions from 1990 to 2024. During this period, global fossil fuel-based CO_2 emissions have risen by 75%.

The Intergovernmental Panel on Climate Change (IPCC) AR6 (IPCC, 2023) states a "*near-linear relationship between cumulative CO_2 emissions and global temperature rise.*" and that *"Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO_2) and the Greenhouse Gases occur in the coming decades."* (IPCC, 2021).

EXTREME WEATHER AND CLIMATE EVENTS

An extreme weather event is defined by the IPCC as "*an event that is rare at a particular place and time of year*" and an extreme climate event is defined as "*a pattern of extreme weather that persists for some time, such as a season*" (IPCC, 2021).

According to the IPCC, "*Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones and, in particular, their attribution to human influence, has strengthened since [the fifth IPCC Assessment Report 2014] AR5*" (IPCC, 2021).

Current observations reported by the IPCC of global temperature extremes, heavy precipitation and droughts are presented in further detail below and summarised in Figure 21. Table 31 summarises information obtained from IPCC of the projected increases in frequency and intensity increase of these extreme weather events relative to the 1850-1900 baseline.

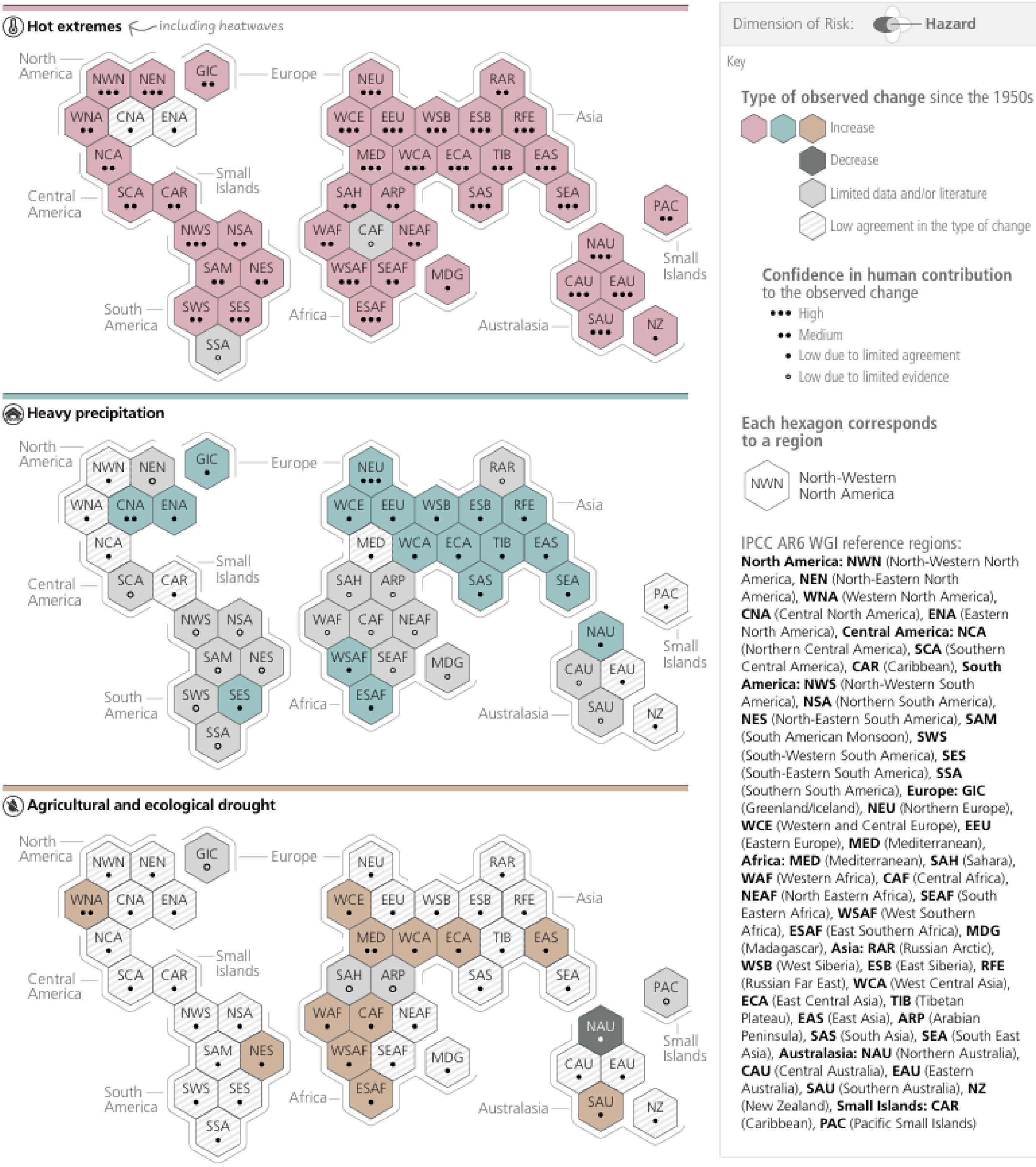


Figure 21: Summary of globally observed changes since the 1950s in temperature extremes (including heatwaves), heavy precipitation and drought, and the confidence level in the role of human influence to the observed changes (IPCC, 2023).

Temperature Extremes

According to the IPCC, since 1950 there has been an increase in frequency and intensity of global hot extremes and a decrease of cold extremes. Heatwaves have also become more intense, longer lasting, and more frequent worldwide. These trends are likely evident across Europe, Asia, Australia, and North America, with moderate to high confidence in Africa and South America. Notably, land-based minimum temperatures have increased around 3 times more than global surface temperatures since the 1960s, particularly in the Arctic (IPCC, 2021).

Heavy Precipitation

The IPCC notes that heavy precipitation events have increased in frequency and intensity across most global land regions. Since 1950, the annual maximum precipitation occurring over a day and 5-day periods has likely increased in more regions than it has decreased. At the continental scale, heavy precipitation has likely intensified across North America, Europe, and Asia. However, there remains very low confidence in observed changes in extreme precipitation occurring over shorter periods (i.e. less than a day) due to limited data and a small number of relevant studies (IPCC, 2021).

Droughts

Droughts are defined by the IPCC as extended periods of significantly reduced moisture, often affecting large regions, in which limited water availability results in adverse impacts on natural systems and economic sectors (IPCC, 2021). The four common types of drought types are: meteorological drought, agricultural drought, ecological drought and hydrological drought. These are defined further by the Met Office in Table 30.

Global observations noted by IPCC show that droughts have become more widespread and impactful in recent decades. While drought trends vary by region and drought type, there is strong evidence that agricultural and ecological droughts have increased globally from the 1950s onwards (IPCC, 2021).

Table 30: Definitions of common drought types (Met Office, 2026b).

Drought Type	Definition
Meteorological	A period of below average precipitation for a region, lasting from weeks to months or longer.
Agricultural	Occurs when reduced rainfall and higher temperatures lower soil moisture, limiting water availability for crops and/or natural vegetation.
Ecological	Develops when prolonged soil moisture deficits and heat causes stress or damage to ecosystems such as forests, wetlands and greenlands.
Hydrological	Occurs when persistent lack of rainfall reduces water availability in rivers, lakes, reservoirs and groundwater, impacting water supply.

According to Sergio *et. al*, globally there is no clear long term trend in meteorological drought based on global precipitation records, with observed changes limited to a few regions rather than representing a global pattern (Sergio *et. al*, 2022). Sergio *et. al* further state that increases in temperature have raised atmospheric evaporative demand, causing soils, vegetation, rivers, and reservoirs to dry out more rapidly. This has led to more severe and longer-lasting agricultural and ecological droughts, even in some regions where rainfall has not declined significantly. This drying effect has been the strongest in warm seasons and is particularly noticeable in mid-latitude and subtropical regions (Sergio *et. al*, 2022).

According to IPCC, drought indices that incorporate temperature-driven evaporation e.g. (Standardised Precipitation-Evapotranspiration Index (SPEI)) indicate slightly greater increases in drought frequency and severity over recent decades than precipitation-only indices (e.g. Standardised Precipitation Index

(SPI)), particularly in regions experiencing drying such as Western and Southern Africa, the Mediterranean, and East Asia. This is consistent with observed declines in soil moisture. Figure 22 shows observed worldwide trends in drought and precipitation indices from 1951-2016 (IPCC, 2021).

Rodell & Li report that satellite observations over the past two decades also confirm that extreme dry events are occurring more frequently and with greater intensity. These datasets show an increase in both the duration and spatial extent of droughts across multiple continents, linked closely to global warming (Rodell & Li, 2023).

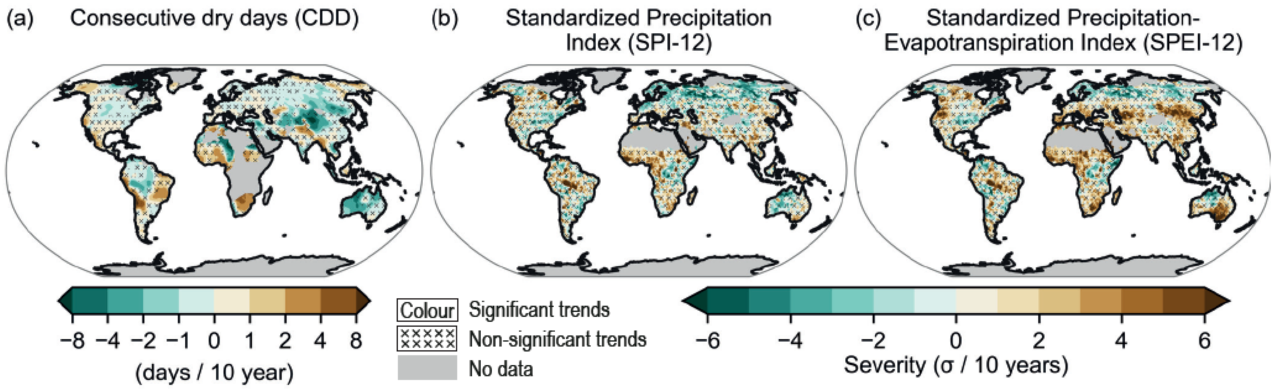


Figure 22: Observed linear trend for (a) consecutive dry days (CDD) during 1960–2018, (b) SPI and (c) SPEI during 1951-2016 (IPCC, 2021).

According to the IPCC, overall current global observations indicate that droughts are becoming more intense, longer-lasting, and more damaging, particularly for agriculture and ecosystems. As stated by the IPCC in AR6 (IPCC, 2023), *"human influence has contributed to increases in agricultural and ecological droughts in the dry season in some regions due to increases in evapotranspiration. The increases in evapotranspiration have been driven by increases in atmospheric evaporative demand induced by increased temperature, decreased relative humidity and increased net radiation over affected land areas."*

Table 31 summarises the IPPC projected increase in frequency and intensity of hot temperature extremes, heavy precipitation and agricultural and ecological droughts under 1.5°C, 2°C and 4°C warming scenarios (IPCC, 2021a).

Table 31: Projected changes in the intensity and frequency of hot temperature extremes over land, extreme precipitation over land, and agricultural and ecological droughts in drying regions (IPCC, 2021).

	1850-1900 Baseline*	Current Observations (1°C)	Future Global Temperature Increase		
			1.5°C	2°C	4°C
Hot temperature extremes over land**					
Frequency per 10 years	Once	Now likely occurs 2.8 times (1.8 – 3.2)	Will likely occur 4.1 times (2.8 – 4.7)	Will likely occur 5.6 times (3.8 – 6.0)	Will likely occur 9.4 times (8.3 – 9.6)
Intensity Increase	-	+1.2°C warmer	+1.9°C warmer	+2.6°C warmer	+5.1°C warmer

	1850-1900 Baseline*	Current Observations (1°C)	Future Global Temperature Increase		
			1.5°C	2°C	4°C
Frequency per 50 years	Once	Now likely occurs 4.8 times (2.3 – 6.4)	Will likely occur 8.6 times (4.3 – 10.7)	Will likely occur 13.9 times (6.9 – 16.6)	Will likely occur 39.2 times (27.0 – 41.4)
Intensity Increase	-	+1.2°C warmer	+2.0°C warmer	+2.7°C warmer	+5.3°C warmer
Heavy precipitation over land* **					
Frequency per 10 years	Once	Now likely occurs 1.3 times (1.2 – 1.4)	Will likely occur 1.5 times (1.4 – 1.7)	Will likely occur 1.7 times (1.6 – 2.0)	Will likely occur 2.7 times (2.3 – 3.6)
Intensity Increase	-	+6.7% wetter	+10.5% wetter	+14.0% wetter	+30.2% wetter
Agricultural & ecological droughts in drying regions******					
Frequency per 10 years	Once	Now likely occurs 1.7 times (0.7 – 4.1)	Now likely occurs 2.0 times (1.0 – 5.1)	Now likely occurs 2.4 times (1.3 – 5.8)	Now likely occurs 4.1 times (1.7 – 7.2)
Intensity Increase	-	+0.3 standard deviations drier	+0.5 standard deviations drier	+0.6 standard deviations drier	+1.0 standard deviations drier

*Projected changes are shown at global warming levels of 1°C, 1.5°C, 2°C, and 4°C and are relative to a baseline of 1850–1900 which represents a climate without human influence.

**Hot temperature extremes are defined as the daily maximum temperatures over land that were exceeded on average once in a decade (10-year event) or once in 50 years (50-year event) during the 1850–1900 baseline.

***Extreme precipitation events are defined as the daily precipitation amount over land that was exceeded on average once in a decade during the 1850–1900 baseline.

****Agricultural and ecological drought events are defined as the annual average of total column soil moisture below the 10th percentile of the 1850–1900 baseline. Intensity changes are expressed as fractions of standard deviation of annual soil moisture.

GLOBAL MEAN SEA LEVEL

According to the IPPC, global mean sea level rose by approximately 0.16 m (0.12 - 0.21 m) between 1902 and 2015. The rate of sea level rise has increased significantly in recent decades, reaching 3.6 mm per year (3.1 – 4.1 mm per year) between 2006–2015. This is approximately 2.5 times higher than the mean rate of 1.4 mm per year (0.8 – 2.0 mm per year) observed during 1901–1990 (IPCC, 2021).

WMO reports that between 2015 to 2025, the mean rate of sea level rise was approximately 4.75 ± 0.3 mm per year (WMO, 2026). In recent years, satellite observations show that global mean sea level rose rapidly by around 5mm during 2023 and 2024, driven by a strong El Niño that ended in early 2024. Sea level remained similarly high in 2025 as conditions shifted toward a weak La Niña, resulting in a smaller annual rise than the previous period. By the end of 2025, global mean sea level was approximately 11 cm higher than in 1993. Figure 23 shows the change in global mean sea level from the start of satellite records in 1993 to 2025 (WMO, 2026).

According to the IPCC recent sea level rise is primarily driven by mass loss from glaciers and ice sheets at a rate of 1.8 mm per year (1.7 – 1.9 mm per year) during 2006–2015 and this exceeds the contribution from thermal expansion of ocean water over the same period at a rate of 1.4 mm per year (1.1 – 1.7 mm per year). According to the IPCC, ice loss from the Greenland and Antarctic ice sheets has increased substantially, contributing to an acceleration in sea level rise (IPCC, 2021).

According to the WMO, while sea level has increased across nearly all oceans since 1993, the fastest rises have occurred in parts of the Pacific, particularly the tropical and south-western regions, whereas slower rises have been observed in the eastern Pacific, southern Indian Ocean, and parts of the North Atlantic (WMO, 2026).

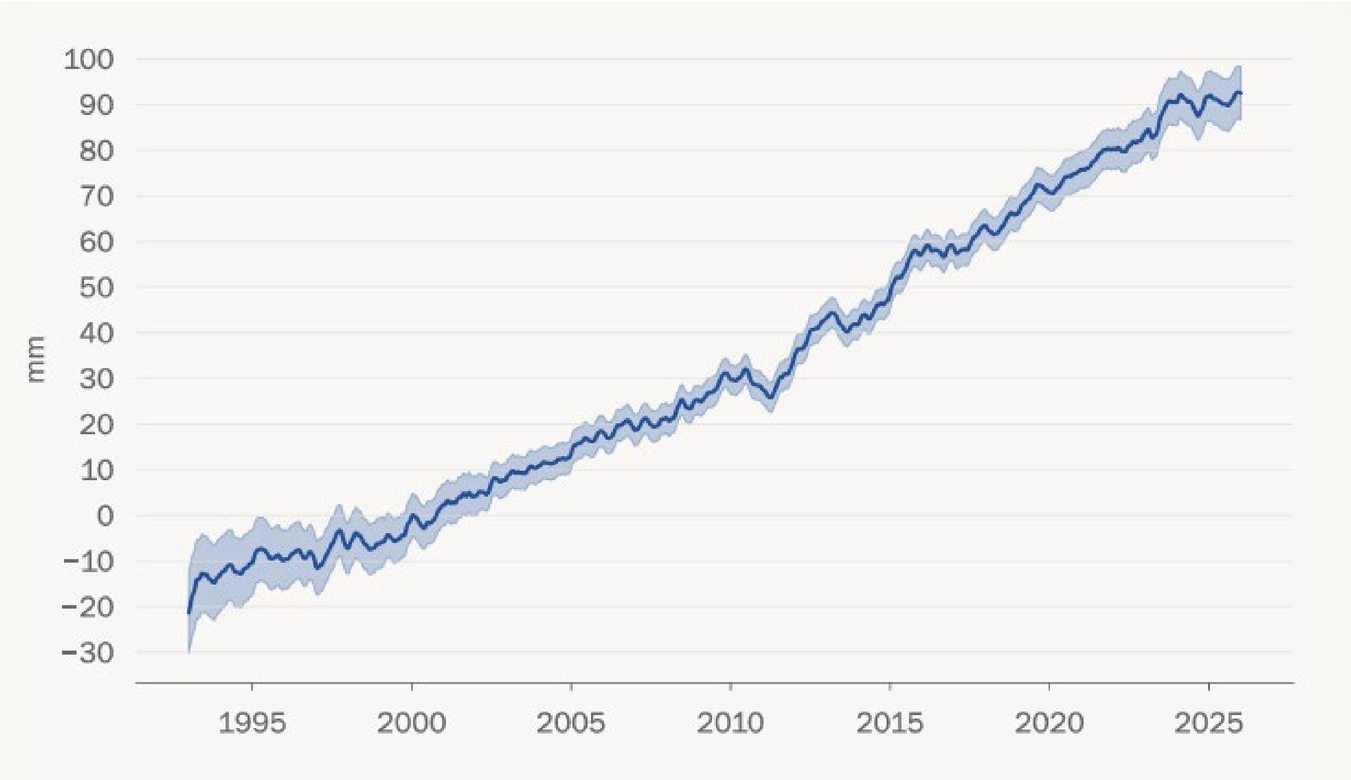


Figure 23: Global mean sea level change (change from January 1993 in mm) shown for 1993–2025 (with the seasonal cycle removed from the data and uncertainty represented by the shaded area) (WMO, 2026).

According to the IPCC's Special Report on the Ocean and Cryosphere in a Changing Climate (IPCC, 2019), "*the dominant cause of global mean sea level rise since 1970 is anthropogenic forcing*". Ice sheet mass loss has intensified, with Antarctic ice mass loss tripling and Greenland ice mass loss doubling in the most recent decade compared to the previous one. The IPCC concludes this ongoing acceleration represents a key risk for long-term coastal impacts (IPCC, 2019).

CRYOSPHERE CHANGES

The IPCC's Special Report on the Ocean and Cryosphere in a Changing Climate (IPCC, 2019) highlights that, *"Over the last decades, global warming has led to widespread shrinking of the cryosphere, with mass loss from ice sheets and glaciers, reductions in snow cover and Arctic sea ice extent and thickness, and increased permafrost temperature."* The IPCC also reports that between 2006 and 2015:

- The Greenland Ice Sheet lost ice at an average rate of 278 ± 11 Gt per year (equivalent to 0.77 ± 0.03 mm per year of global sea level rise), mainly from surface melting.
- The Antarctic Ice Sheet lost ice mass at an average rate of 155 ± 19 Gt per year (0.43 ± 0.05 mm per year), largely driven by the rapid thinning and retreat of major glaciers flowing out of the West Antarctic Ice Sheet.
- Glaciers outside of Greenland and Antarctica have lost ice mass at an average rate of 220 ± 30 Gt per year (equivalent to 0.61 ± 0.08 mm per year sea level rise) (IPCC, 2019).

The IPCC also reports that since the 1980s, permafrost has warmed to record levels, with warming of up to 2–3°C observed at depths of approximately 10–20 m in some locations compared with temperatures recorded 30 years ago. Further reporting by the IPCC states that the rate of permafrost temperature increase was around 0.29°C ± 0.12°C between 2007 to 2016 across polar and high mountain regions worldwide. According to the IPCC, an estimated 1460-1600 Gt organic carbon is stored in arctic and boreal permafrost, almost double the amount of carbon currently in the atmosphere. While there is some evidence that thawing permafrost may be increasing CH_4 and CO_2 emissions, scientific agreement on this is limited. The IPCC reports that thawing permafrost, combined with retreating glaciers, has also reduced the stability of slopes in many high-mountain regions (IPCC, 2019).

The IPCC reports that between 1979 and 2018, Arctic sea ice declined during all months throughout the year, with sea ice reductions in September being around 12.8 ± 2.3% per decade. Additionally, the IPCC reports that Arctic sea ice has thinned, with much older ice disappearing. According to the IPCC, these losses have amplified warming in the Arctic to more than twice the global average. In contrast, Antarctic sea ice shows no clear long term trend due to strong regional differences (IPCC, 2019).

WMO reports that in 2025, both Arctic and Antarctic sea-ice extents remained below their respective 1991–2020 averages throughout the year, as shown in Figure 24. WMO further reports that Arctic sea ice recorded one of the lowest annual average extents since 1979, at 10.10 ± 0.33 million km^2 (approximately 0.9 million km^2 below the long-term mean). WMO noted that Antarctic sea ice also remained notably low, with the 2025 annual average ranking as the third lowest on record, at 10.81 ± 0.26 million km^2, exceeded only by the unusually low extents observed in 2023 and 2024 (WMO, 2026).

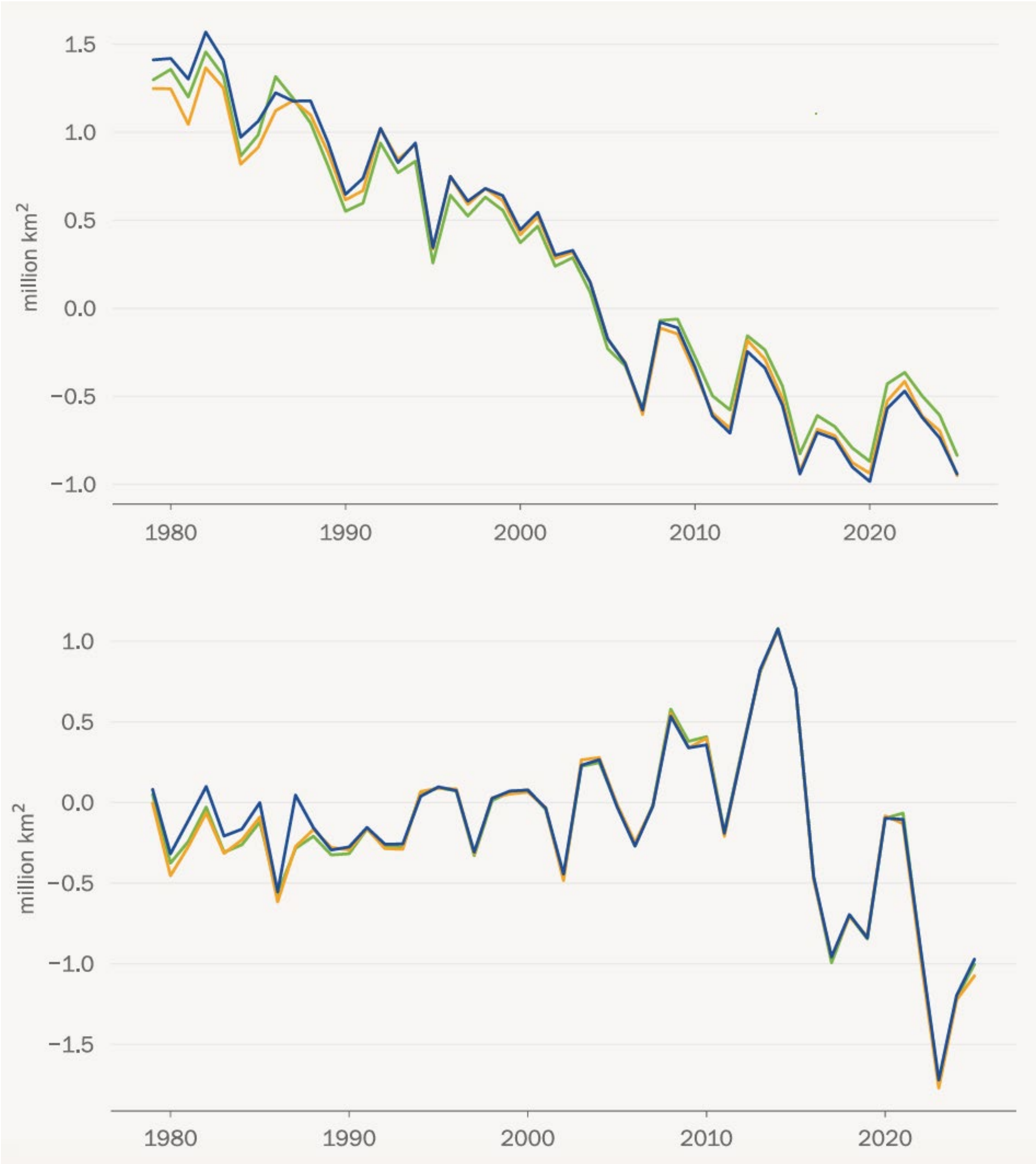


Figure 24: Annual Arctic (upper panel) and Antarctic (lower panel) sea-ice extent anomalies in millions of square kilometres from 1979-2025 (relative to the 1991–2020 average). Data sets from 3 sources are shown: the USA National Snow and Ice Data Center (NSIDC), Japan Aerospace Exploration Agency (JAXA) and OSI SAF (WMO, 2026).

OCEANIC CHANGES

OCEANIC WARMING

Ocean Surface Temperatures

The IPCC reports that the ocean surface has warmed significantly since pre-industrial times. The IPCC further reports that, compared to the late 1800s (1850–1900), the average ocean surface temperature has increased by around 0.88°C (0.68°C – 1.01°C) in 2011-2020. The IPCC considers that most of this warming, around 0.6°C (0.44°C - 0.74°C) has occurred since 1980, showing that ocean warming has accelerated in recent decades (IPCC, 2021).

Figure 25, using data from the Met Office, shows the change in global average sea-surface temperature from 1850 to 2025, expressed as a difference relative to the 1981-2010 average (with values below 0°C indicating cooler conditions and values above 0°C indicator warmer conditions than the reference period). A long-term increase in global sea-surface temperatures is reported by the Met Office, with especially rapid warming since the late 20th century. This trend is visible in both independent datasets (HadSST4 and ERSSTv5) shown in Figure 25, reinforcing the conclusion of the Met Office that the world's oceans are warming over time (Met Office, 2026a).

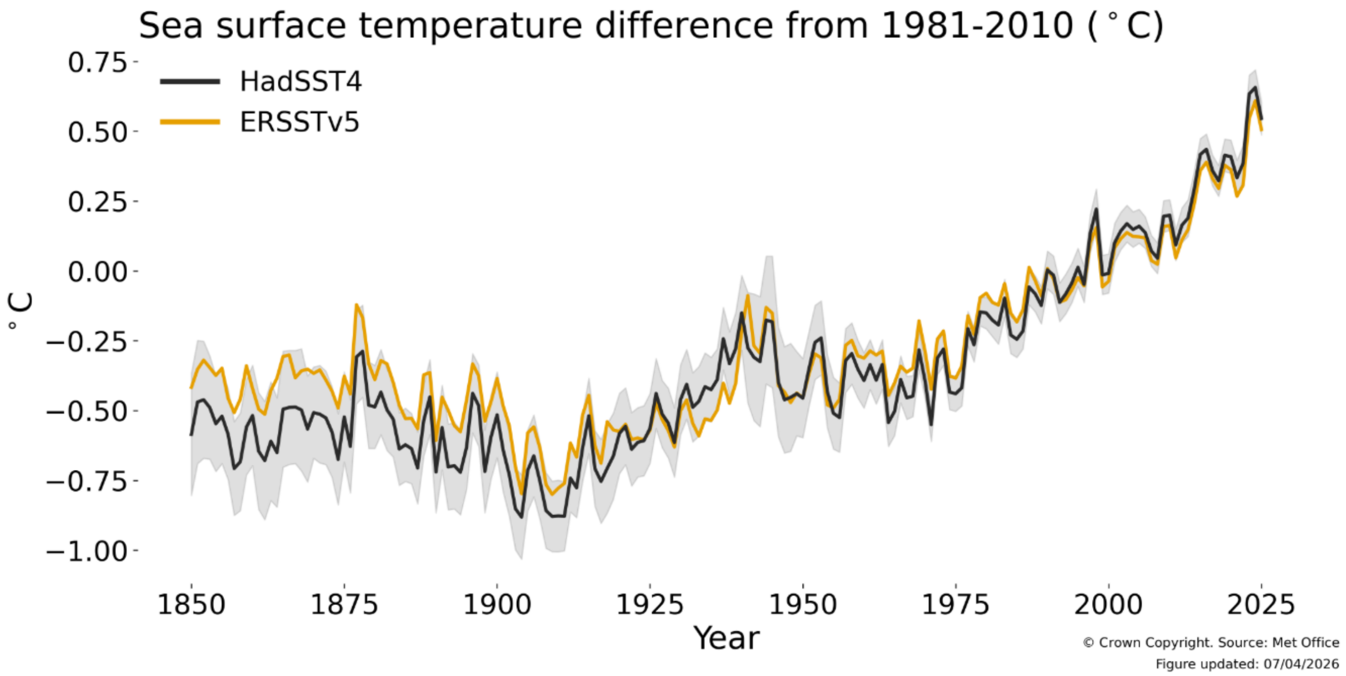


Figure 25: Annual global mean sea-surface temperature difference from 1850 to 2025 relative to the 1981-2010 average (Met Office, 2026a).

Ocean Heat Content

Annual ocean heat content from 1960-2025, from the WMO, is shown in Figure 26. According to the WMO, in 2025 global ocean heat content in the upper 2,000 m of the ocean reached a new record since observations began in the 1960s, surpassing the previous record set in 2024 by 24 ± 16 ZJ. The WMO also reports that the rate of ocean warming increased to 11.0–12.2 ZJ per year over 2005–2025, more than double the 1960–2005 rate of 3.05–3.91 ZJ per year (WMO, 2026).

Observations show that global ocean heat content has increased steadily since the 1970s, with the rate predominantly driven by human influence (IPCC, 2021). WMO reports global ocean heat content rose by an average of 5.8 ± 0.5 ZJ per year across the ocean basin between 1971 and 2025. Over the same period, the deep ocean (2,000–6,000 m) also warmed, at a rate of 1 ± 0.2 ZJ per year (WMO, 2026).

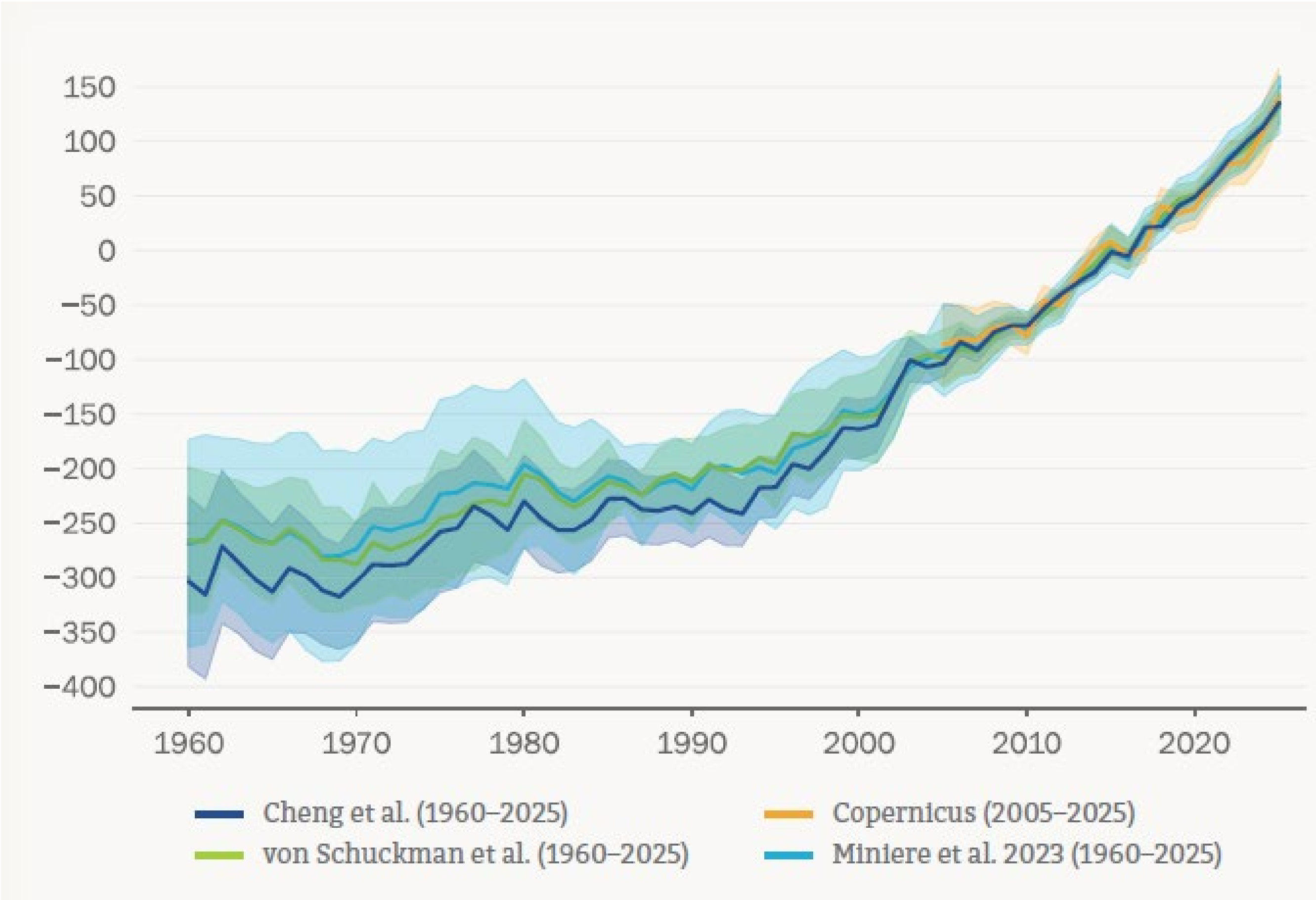


Figure 26: Annual global ocean heat content (zettajoules (ZJ) down to 2,000 m depth for the period 1960–2025. One ZJ is the equivalent of 10^{21} Joules. The shaded area represents the uncertainty (WMO, 2026).

The IPCC reports that marine heatwaves have become more frequent, longer, and more intense, since the 1980s. During the 1982-2016 reference period, their global frequency doubled, the average number of marine heatwave days per year increased from approximately 2.5 to 5 days, and their intensity rose by around 0.15°C. According to the IPCC, marine heatwaves are projected to increase several-fold this century, particularly in tropical oceans and the Arctic (IPCC, 2019).

At the same time, the IPCC considers that the upper ocean has become more stratified due to surface warming and freshening, reducing mixing with deeper waters. This stratification is expected to continue increasing throughout the 21st century, with important effects on ocean circulation and ecosystems (IPCC, 2019).

Marine Heat Waves

Marine heatwaves refer to extreme ocean temperature events (i.e. localised anomalies of higher sea temperature). Capotondi *et al.,* (2024) summarise the recent marine heat waves, explore the drivers of these events and their potential impacts. One of the most recent and prominent marine heat wave event was experienced in the boreal summer of 2023, where a widespread ocean warming event occurred and records for global monthly-mean sea surface temperatures were exceeded. Several other marine heatwave events have occurred in recent decades as shown on Figure 27. Research into the impacts of marine heat waves is still evolving, however, they may have profound impacts on ecosystems and reduce update in ocean carbon sink (Cornes *et al.,* 2025; Müller *et al.,* 2025).

Cornes *et al.* (2025) report that for the 17-year period between 2000 to 2016, there were 3.8 more marine heatwaves relative to the earlier 17-year period between 1982 to 1998 (Cornes *et al.,* 2025). Moreover, Cornes *et al.* (2025) also report that higher latitudes are disproportionately affected and experience more frequent marine heat wave events.

Climate models have predicted increases in the frequency, intensity, duration and spatial extent of marine heat waves (Capotondi *et al.,* 2024; Cornes *et al.,* 2025).

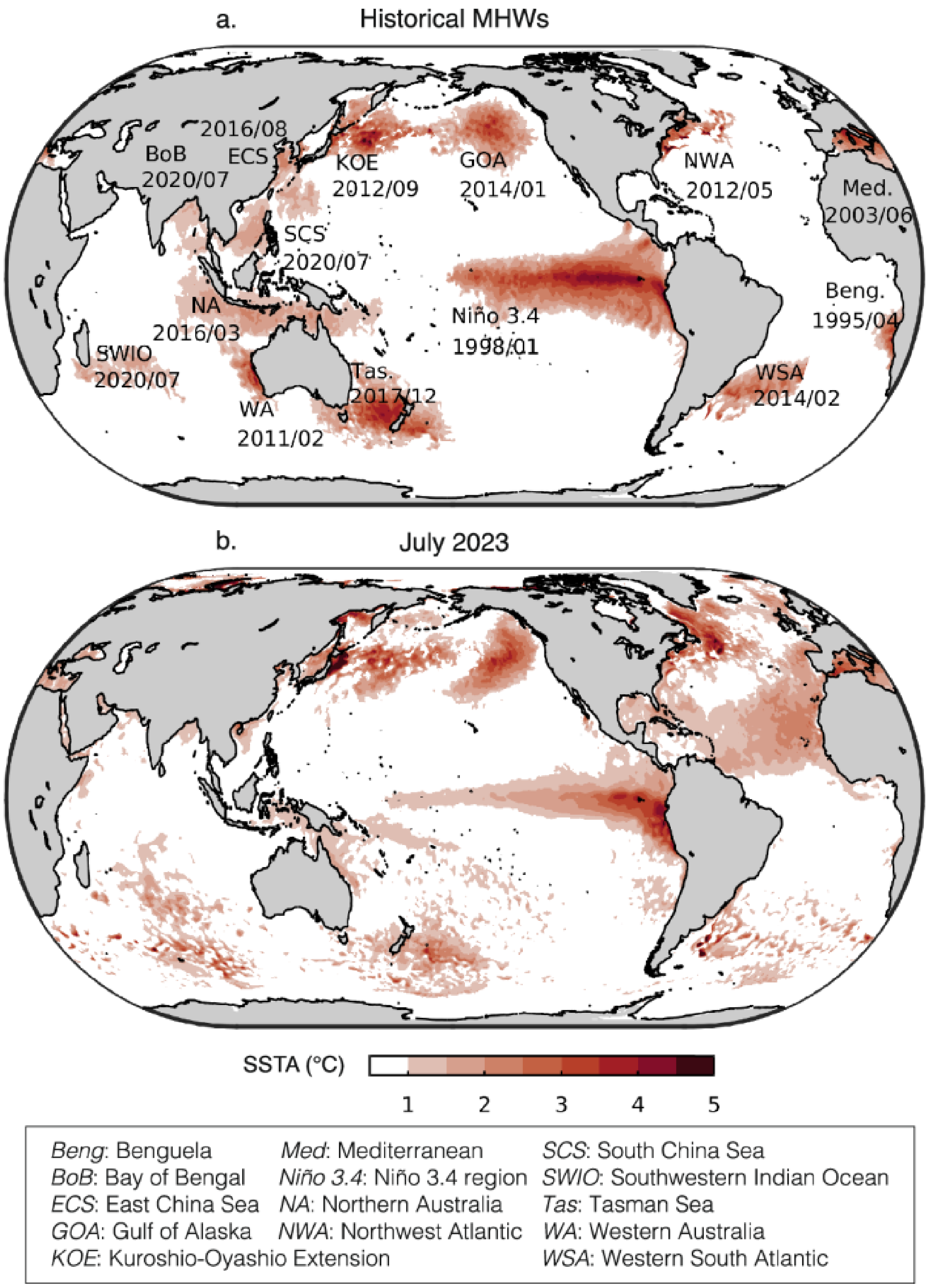


Figure 27 Historical marine heat waves (Capotondi *et al.*, 2024).

OCEANIC ACIDIFICATION

The physical–chemical process by which the ocean absorbs CO_2 is often called the air–sea CO_2 exchange and carbonate chemistry system, which involves a sequence of linked physical and chemical steps.

Atmospheric CO_2 diffuses across the air–sea interface into surface seawater, with the rate of uptake controlled by factors including:

- The CO_2 partial pressure gradient between air and surface ocean.
- Wind speed and turbulence.
- Sea temperature (with colder waters absorbing more CO_2).

When atmospheric CO_2 concentrations exceed those in surface waters, net transfer occurs into the ocean.

Once dissolved in seawater, CO_2 reacts with water to form carbonic acid, which subsequently dissociates. This process reduces the concentration of carbonate (CO_3^{2-}) ions while increasing bicarbonate (HCO_3^-) and hydrogen (H^+) ion concentrations. The resulting shift in carbonate chemistry toward a less alkaline state is commonly referred to as ocean acidification (IPCC, 2023).

According to the IPCC, since the 1980s the ocean has absorbed an estimated 20-30% of anthropogenic CO_2 emissions, leading to increased ocean acidification. As a result, surface ocean pH has fallen by around 0.017 – 0.027 pH units per decade since the late 1980s, as shown by the WMO in Figure 28. For over 95% of the ocean's surface, the drop in pH is now outside the range of normal, natural fluctuations and, according to the IPCC, is likely to have been caused by human driven activities (IPCC, 2019).

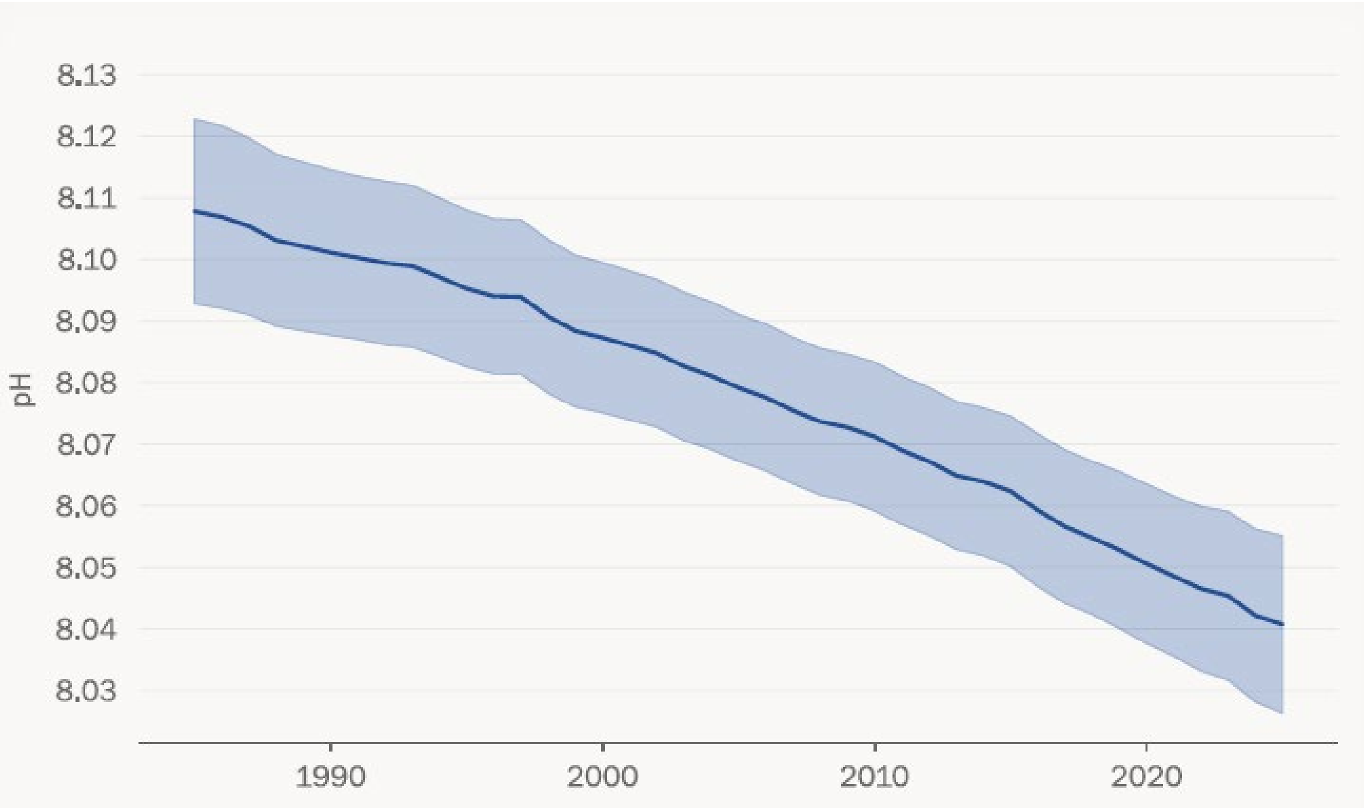


Figure 28: Annual global mean surface ocean pH from 1985 to 2025. The dark line represents the central estimate, while the shaded area indicates the uncertainty range (WMO, 2026).

The WMO reports that regional patterns in surface ocean pH change are uneven. The strongest declines in surface pH have been observed by the WMO in the Indian Ocean, Southern Ocean, eastern equatorial

Pacific, northern tropical Pacific, and parts of the Atlantic Ocean. Collectively, these regions represent approximately 47% of the sampled global ocean and, according to the WMO, exhibit rates of surface ocean acidification that exceed the global mean (WMO, 2026).

CARBON SEQUESTRATION CAPACITY

Carbon sequestration via natural processes occurs through forests, grasslands, wetlands and oceans that absorb CO_2 from the atmosphere (Fu and Xu, 2023). These are referred to as carbon sinks.

Friedlingstein *et al.* (2026) estimated that cumulated since 1850, the terrestrial carbon sink absorbed 24% of the total anthropogenic emissions, with two thirds taken up by terrestrial ecosystems since 1959. Since 1850, the ocean sink has removed 27% of total anthropogenic emissions with 70% of the total taken up since 1959.

In the past decade, the ocean and land carbon sink absorbed 29% and 21% of the total CO_2. Friedlingstein *et al.* (2026) report that climate change and climate variability have reduced land and ocean sinks by 25% and 7.1%, respectively. The partitioning of CO_2 emissions between ocean and land sinks is shown in Figure 29.

The increase of the ocean sink is driven by the increased atmospheric CO_2 concentration. The effect of climate change is causing a weakening in the ocean sink's capacity to continue to sequester CO_2.

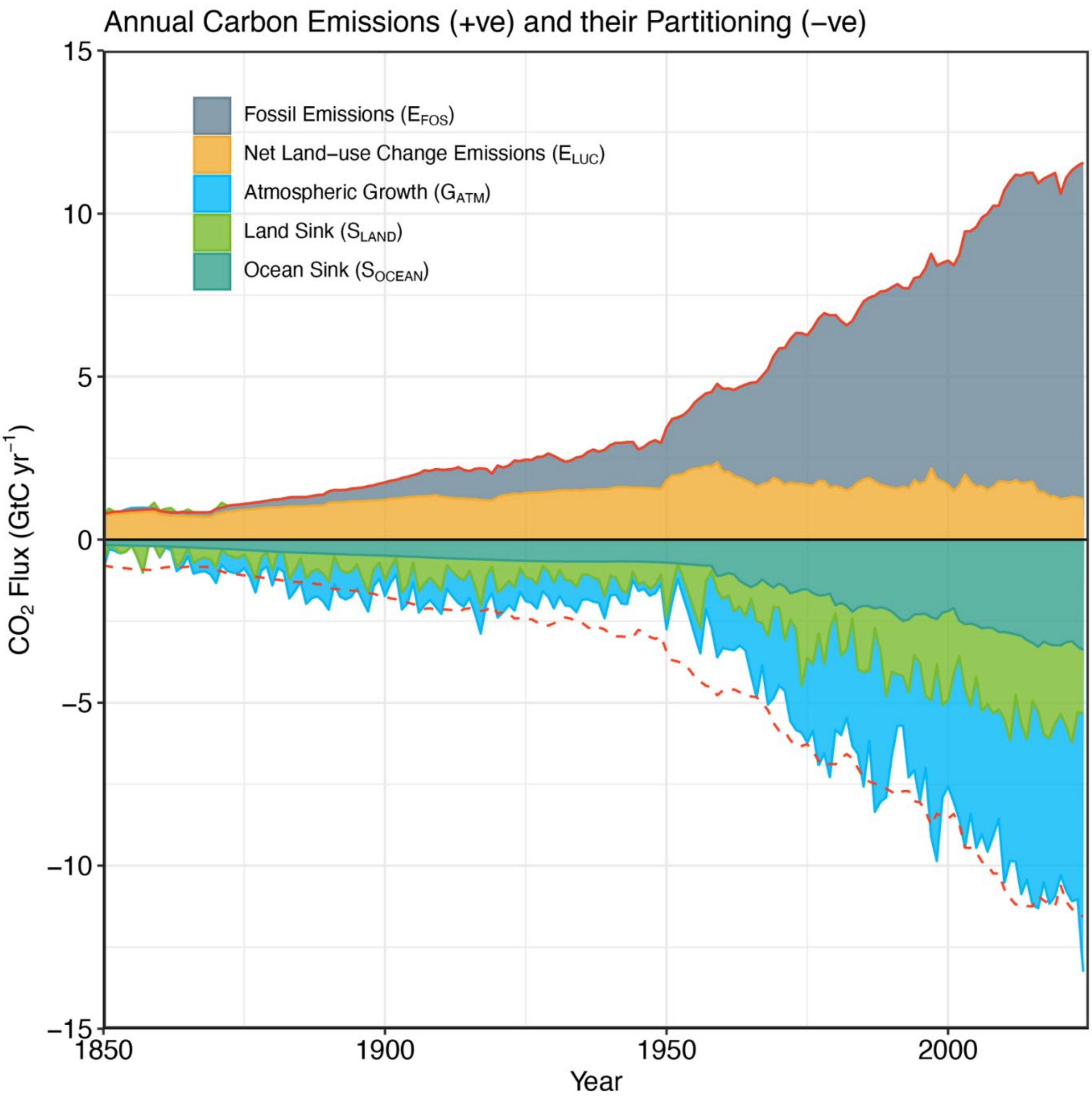


Figure 29: Combined components of the global carbon budget. The partitioning of the fossil CO_2 emissions in land sinks and ocean sinks are shown in green (Friedlingstein *et al.,* 2026). The partitioning is based on nearly independent estimates from observations (for G_{ATM}) and from process model ensembles constrained by data (for S_{OCEAN} and S_{LAND}) and does not exactly add up to the sum of the emissions, resulting in a budget imbalance (B_{IM}) which is represented by the difference between the bottom red line (mirroring total emissions) and the sum of carbon fluxes in the ocean, land, and atmosphere reservoirs.

BIODIVERSITY

Biodiversity is the variety of life on Earth and the natural systems that support it. It is essential as it underpins the fundamental biological and ecological processes that sustain life. Biodiversity is the essential foundation and regulator that enables ecosystem services, supporting clean air and water, food production, climate regulation, pollination, disease control, and other critical processes essential to human survival and wellbeing.

According to the WWF, habitat loss and fragmentation are the leading causes in all global regions of biodiversity decline, driven primarily by the conversion of natural ecosystems such as forests, wetlands, and grasslands into agricultural land, urban areas, and infrastructure. According to the WWF, this is followed by pressures from overexploitation, invasive species, and disease. Additional threats include climate change, which is most frequently highlighted by the WWF in Latin America and the Caribbean, and pollution, which is particularly prominent in North America and the Asia-Pacific region (WWF, 2024).

According to the IPCC, a diverse ecosystem is more resilient to environmental changes like climate change. However, climate change has caused widespread and detectable changes across marine, terrestrial and freshwater ecosystems worldwide. Figure 30 shows the confidence levels of the IPCC associated with climate change impacts on changes to ecosystem structure, species range shifts and changes in seasonal timing in terrestrial, freshwater and ocean ecosystems globally (IPCC, 2022).

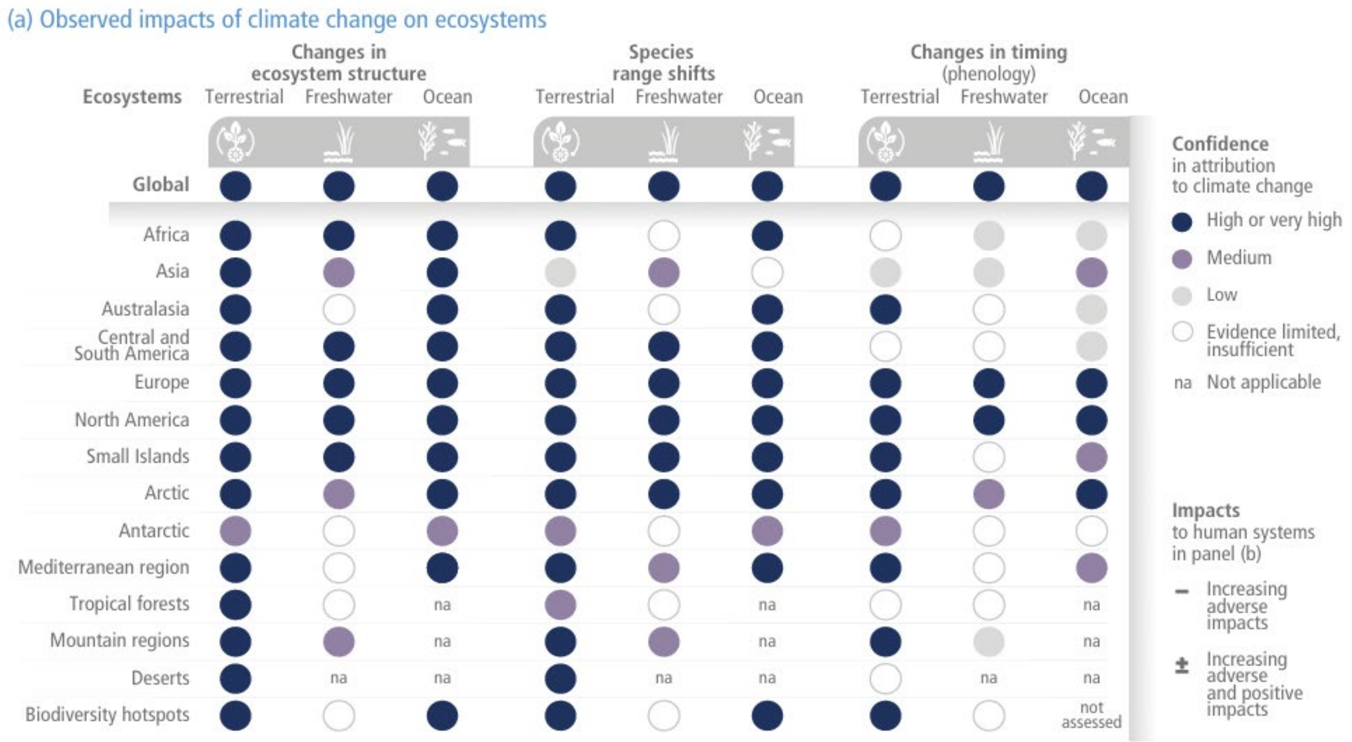


Figure 30: Observed global and regional impacts on ecosystems (IPCC, 2022).

According to the IPCC, these impacts have occurred earlier than previously projected, and over broader geographic areas with more severe consequences. As stated by the IPCC, many organisms show biological responses such as altered physiology, growth rates, population size, geographic range shifts, and changes in seasonal timing. These responses are often insufficient to keep pace with the rapid rate of recent climate change. As an example and as stated by IPCC, Figure 31 illustrates the observed shifts in the latitudinal geographic ranges of different marine species from 1955 to 2015 and shows a decline in marine species richness around the equator and in the Arctic (IPCC, 2022).

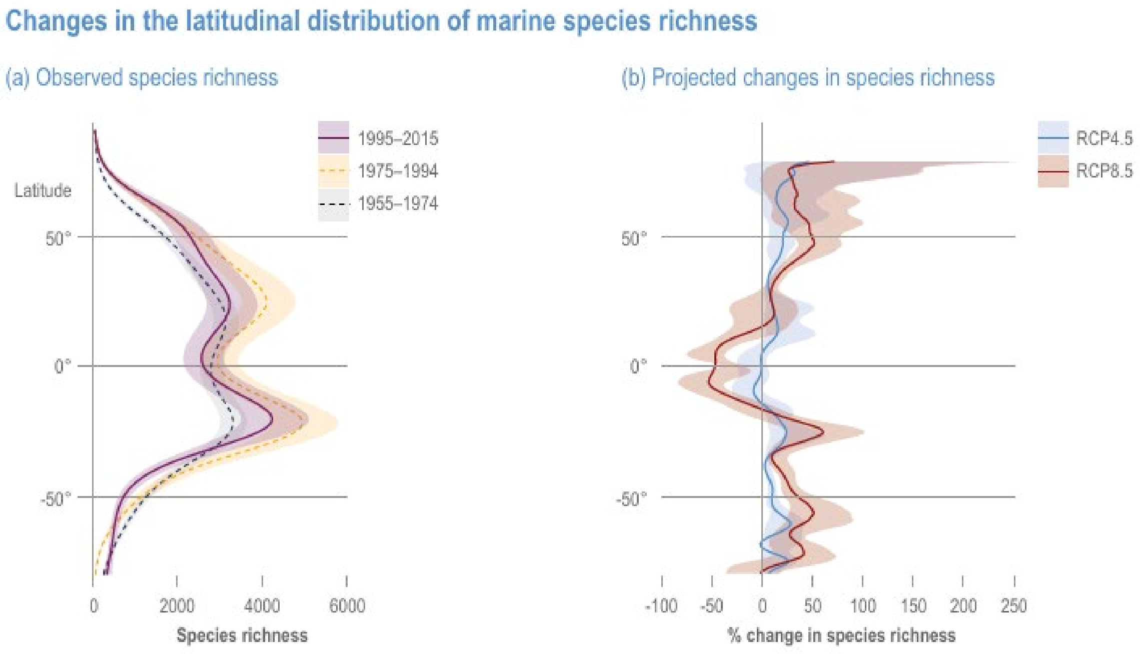


Figure 31: Changes in the latitudinal distribution of observed marine species richness (based on 48,661 marine species) for three historical periods (1955-1974, 1975-1994, 1995-2015) (IPCC, 2022).

As a result, climate change has driven local species losses and increased the prevalence of disease. In some cases, these pressures have contributed to climate driven extinctions (IPCC, 2022).

In addition, ecosystems are being structurally reorganised, alongside intensified wildfire activity and increases in burned area, with climate change driving an estimated 15.8% increase in global burned area between 2003 and 2019 (Burton, 2024). The capacity of ecosystems to deliver key services, such as food production, water regulation, and climate buffering, has declined.

"The Living Planet Index (LPI) [tracks] recent changes in nature from 1970 to the present by tracking the size of animal populations and how they are changing and is an early warning indicator of increasing extinction risk and the potential loss of ecosystem function and resilience", as shown in Figure 32 (WWF, 2024).

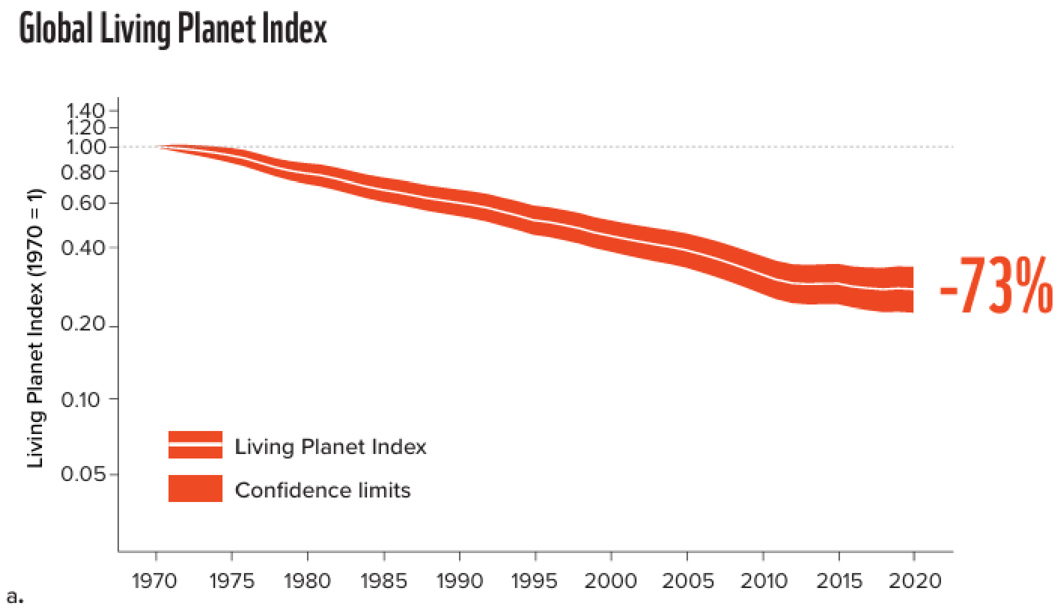


Figure 32: The global Living Planet Index (1970 to 2020) based on 34,836 monitored populations representing 5,495 vertebrate species. The index is shown by the white line, with shaded areas illustrating statistical uncertainty (WWF, 2024).

Figure 33 shows the steepest declines have occurred in freshwater ecosystems (85%), followed by terrestrial (69%) and marine systems (56%) (WWF, 2024). These trends reflect changes in population abundance rather than absolute species extinctions, but they signal ecosystem stress according to WWF.

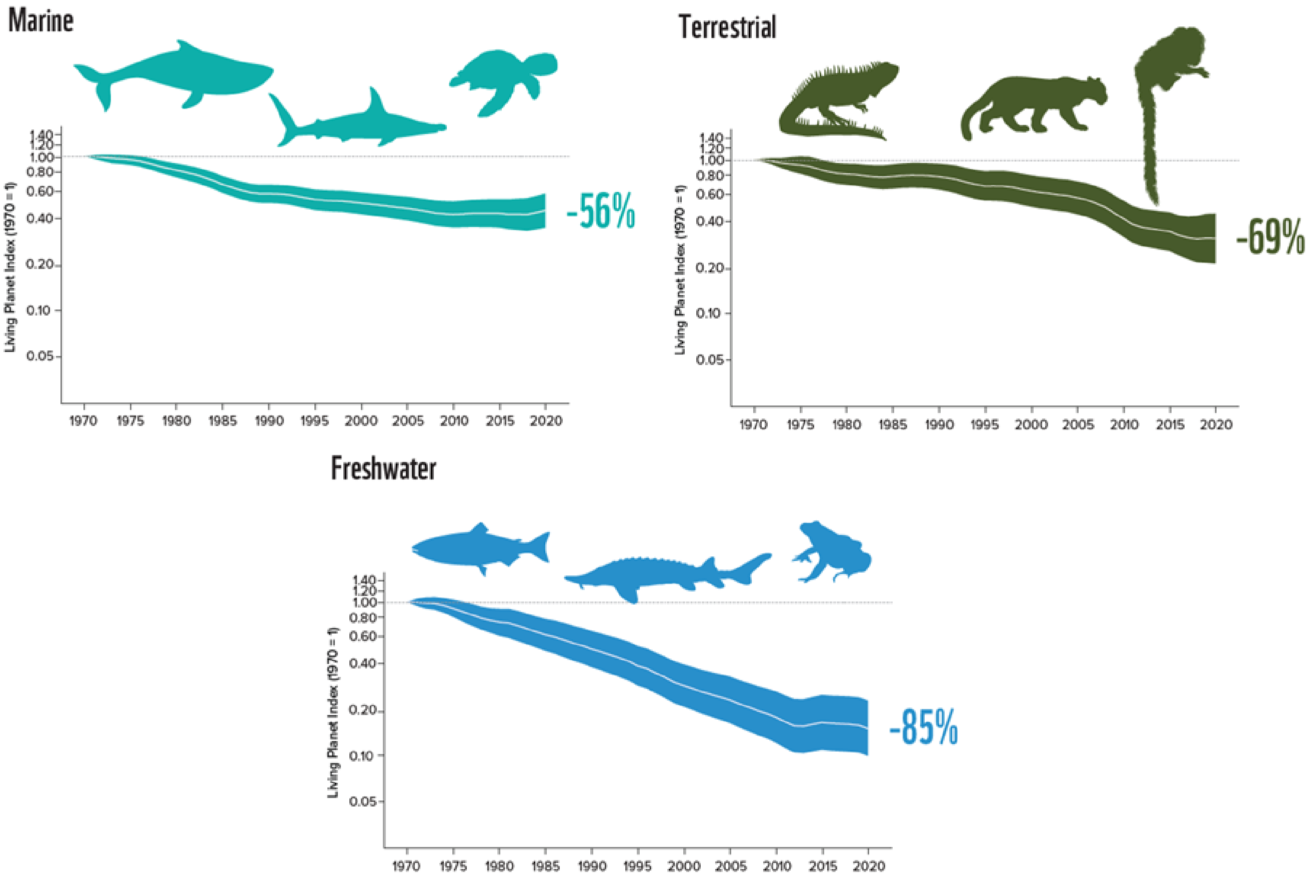


Figure 33: The Living Planet Index trends by ecosystem type (1970-2020), incorporating data from 16,909 populations of 1,816 marine species, 11,318 populations of 2,519 terrestrial species and 6,609 populations of 1,472 freshwater species (WWF 2024).

Coral Reefs

Coral reefs are a key example of highly biodiverse ecosystems, supporting around 25% of all marine species while occupying just 0.2% of the ocean (IPCC, 2019). However, according to the IPCC, coral reefs are currently undergoing rapid global biodiversity loss, with mass coral bleaching primarily driven by ocean warming and further exacerbated by ocean acidification. (IPCC, 2022).

The ongoing fourth global coral bleaching event (January 2023 - present), as reported by NOAA and shown in Figure 34, has affected the majority of the world's reefs. According to NOAA, approximately 84.4% of the world's coral reefs have experienced bleaching level heat stress, with mass bleaching documented in at least 83 countries and territories, making this the largest global bleaching event to date. The previous record was set during the third global coral bleaching event (2014–2017), which affected 68.2% of the world's reef area, with earlier events in 1998 and 2010 (NOAA, 2025).

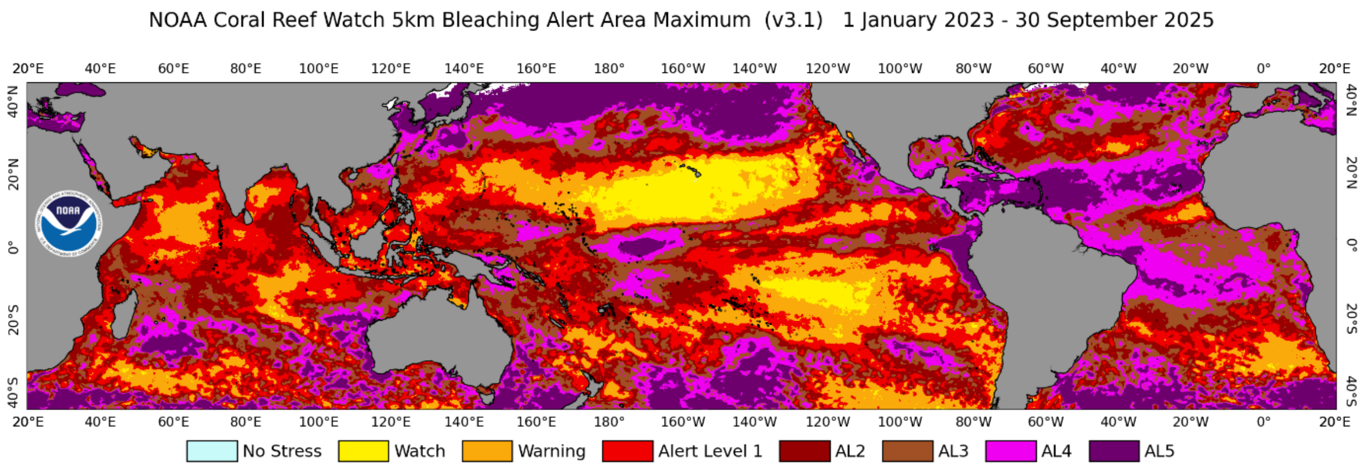


Figure 34: NOAA Coral Reef Watch's 5 km Bleaching Alert Area Maximum product (January 2023–September 2025) showing the highest accumulated heat stress experienced by coral reefs globally, with darker colours indicating conditions capable of causing reef wide bleaching and severe coral loss (NOAA, 2025).

As live coral declines, the complex habitats that sustain diverse fish, invertebrates, and microbial communities are lost, leading to reductions in species richness, shifts in community composition, and diminished ecosystem functioning. Repeated bleaching, combined with ocean acidification, overfishing, and pollution, is reducing reef resilience and increasing the risk of local extinctions.

POPULATION AND HUMAN HEALTH

According to the IPCC, climate-related health risks are increasing, affecting physical health, nutrition, longevity, and mental well-being, while also placing increasing pressure on healthcare systems (IPCC, 2022).

Figure 35 from the IPCC summarises the observed global and regional impacts of climate change on human systems, highlighting the levels of confidence associated with these impacts and indicating whether they are increasing adverse and/or positive outcomes. Figure 35 also focuses on impacts related to water scarcity and food production, human health and well-being, and cities, settlements, and infrastructure (IPCC, 2022).

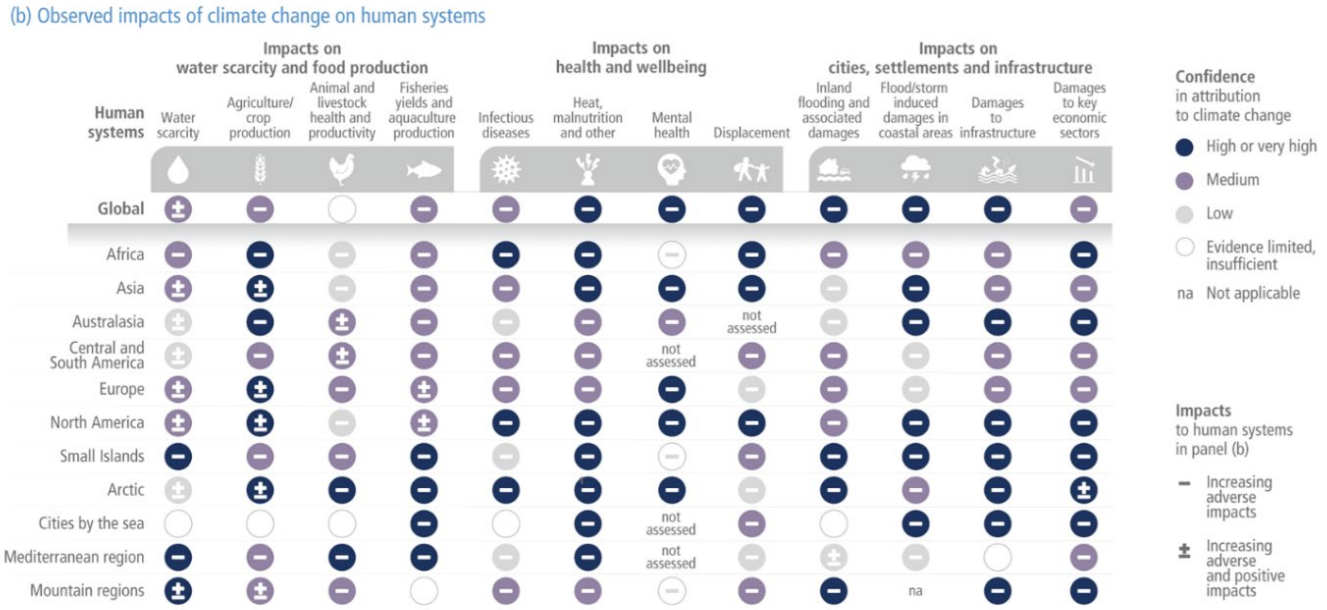


Figure 35: Observed global and regional impacts of climate change on human systems (IPCC, 2022).

Climate-Sensitive Diseases and Health Outcomes

Although malaria cases have declined globally due to improvements in healthcare and socioeconomic conditions, warming temperatures have contributed to the disease spreading to higher altitudes. Observed changes in temperature, rainfall, humidity, and human mobility are also strongly associated with increases in dengue worldwide, chikungunya across multiple regions, and tick-borne diseases such as Lyme disease in North America and Europe. Higher temperatures, heavy rainfall, and flooding have been linked to increased incidence of diarrhoeal diseases, including cholera, other gastrointestinal infections, and food-borne illnesses, while flooding events have also disrupted public health services and increased exposure to water- and vector-borne diseases.

In addition, the IPCC reports that climate extremes such as wildfires, storms and floods are associated with elevated risks of respiratory infections and higher rates of adverse mental health outcomes in affected populations (IPCC, 2022).

Heat-Related Health Impacts

Heat is becoming a growing health risk due to expanding urban areas, more frequent and intense high-temperature events, and aging populations. Over the past two decades, the number of working hours lost because of heat has increased considerably, and some regions are already experiencing heat levels that reduce people's ability to work safely and effectively.

Some recent heatwave-related health impacts can be partly attributed to climate change; however, other factors including age, pre-existing health conditions, housing quality, socioeconomic status, and the capacity of public health systems also play an important role. Extreme heat events have also negatively affected mental health, well-being, cognitive performance, and can increase irritability and aggression. According to the IPCC, evidence indicates a consistent association between elevated temperatures and adverse mental health outcomes. (IPCC, 2022).

Food and Nutrition Security

According to the IPCC, observed climate variability and change have been associated with increased food insecurity in many regions, particularly in low- and middle-income countries. These conditions have been linked to multiple forms of malnutrition, including undernutrition and obesity. The IPCC reports that climate change affects all four aspects of food security: availability, stability, access, and utilisation. Impacts extend beyond insufficient calorie intake to include poor diet quality and diet-related chronic diseases (IPCC, 2022).

The IPCC reports that globally the scale of malnutrition remains severe: more than 690 million people are undernourished, 144 million children are stunted (chronic undernutrition), 47 million are wasted (acute undernutrition), and over 2 billion people suffer from micronutrient deficiencies. The IPCC further reports that in 2019 135 million people across 55 countries experienced acute hunger requiring urgent assistance (IPCC, 2022).

The IPCC considers that climate change contributes to malnutrition by reducing crop yields, increasing food price volatility, disrupting food supply chains, and limiting access to nutrient-dense foods. The IPCC reports that studies across multiple global regions show that higher temperatures are associated with reduced dietary diversity, while areas exposed to higher precipitation tends to improve diet diversity (IPCC, 2022).

At the same time, the IPCC further reports that climate change is also linked to rising rates of obesity, particularly in low- and middle-income countries. Its reported that heat exposure can reduce physical activity, increase reliance on processed and calorie-dense foods, and raise the cost of fresh produce. As a result, according to the IPCC, food insecurity increasingly coexists with obesity and diet-related chronic diseases, including diabetes and cardiovascular disease. The IPCC reports that globally 38.3 million children under five are overweight, 2.1 billion adults are overweight or obese, and diabetes prevalence has nearly doubled over the past 30 years (IPCC, 2022).

According to the IPCC, populations exposed to extreme weather events such as droughts, floods, and storms have experienced reduced access to sufficient and nutritious food, contributing to higher risks of malnutrition and illness (IPCC, 2022).

MATERIAL ASSETS, CULTURAL HERITAGE AND THE LANDSCAPE

MATERIAL ASSETS

Material assets, including buildings, infrastructure, and other physical resources, are increasingly affected by climate change and wider environmental pressures. Many assets were designed for past climatic conditions and are therefore vulnerable to more frequent and intense extreme weather events such as flooding, heatwaves, storms, and coastal erosion. Rising temperatures can accelerate material degradation and reduce the performance and lifespan of buildings and infrastructure, while flooding and erosion can cause direct damage, disruption, or loss of assets (IPCC, 2022).

These physical risks to material assets do not occur in isolation but interact with broader socio-economic conditions. Rising global temperatures, increasing frequency and intensity of extreme weather events, and long-term environmental degradation are interacting with existing socio economic vulnerabilities such as inequality, population growth, urbanisation, and resource dependence. These interactions are amplifying risks to livelihoods, food and water security, public health, infrastructure, and economic stability, with disproportionate impacts on the poorest populations, particularly in low-income countries and climate-sensitive regions (IPCC, 2022).

Economic losses from climate change result from negative impacts on key inputs, including reduced crop yields, reduced water availability, and decreased outdoor work productivity due to heat stress. The largest losses occur in sectors that are directly exposed to climate conditions, such as agriculture, forestry, fisheries, energy, and tourism, with impacts varying by region (IPCC, 2022).

Energy and Industrial Water Use

According to the IPCC, water availability is a critical determinant of the performance, reliability, and longevity of energy sector material assets, particularly hydropower and thermoelectric power plants, which together account for 94.7% of global electricity generation in 2019 (IPCC, 2022). Climate change is already undermining these assets through altered precipitation patterns, reduced river flows, rising water temperatures, and an increasing frequency of extreme events such as droughts, floods, and storms. These pressures reduce power plant efficiency, constrain cooling systems, accelerate wear and degradation of infrastructure, and can cause direct physical damage to generation facilities, transmission networks, and associated assets. At the same time, rising ambient temperatures increase electricity demand for cooling, placing further stress on existing energy infrastructure (IPCC, 2022).

Hydropower assets are particularly sensitive to changes in water availability and flow regimes. Evidence from multiple regions shows that droughts and altered runoff patterns have significantly reduced hydropower output, lowering utilisation rates and reducing the economic value of installed infrastructure (IPCC, 2022).

Thermoelectric power generation infrastructure is more consistently affected by water scarcity and elevated temperatures. Insufficient cooling water availability during droughts and heatwaves leads to widespread reductions in operational capacity, forced shutdowns and long term efficiency losses. On a global scale, drought years during the 1981–2010 period led to an average 3.8% reduction in thermoelectric power output compared to long term average values (IPCC, 2022). According to the IPCC, these impacts increase operating costs, shorten asset lifespans, and expose energy systems to heightened risks of disruption and reduced energy security (IPCC, 2022).

Overall, there is high confidence that climate change has already reduced the performance and utilisation of hydroelectric and thermoelectric energy assets globally, primarily due to drought, altered river flows, and rising water temperatures (IPCC, 2022).

Extreme Weather and Climate Events

Extreme weather and climate related events have led to growing losses through damage to material assets, including buildings, transport networks, utilities, and other critical infrastructure, as well as through disruption of supply chains and essential services (IPCC, 2022). Damage to these physical assets increases recovery and rebuilding costs, reduces asset lifespans, and undermines the reliability of economic and social systems. Consequently, these impacts caused by extreme weather and climate events have slowed economic growth, particularly in developing countries, and have disproportionately affected vulnerable populations and livelihoods (IPCC, 2022).

According to the IPCC, economic losses from climate related disasters continue to rise, placing increasing pressure on public finances, insurance systems, and long term development pathways, while climate risks remain insufficiently integrated into investment, planning, and adaptation decisions (IPCC, 2022). According to the OECD, severe climate disasters reduce regional GDP by up to 2.2%, with long lasting losses of around 1.7% persisting for at least 5 years after an event (OECD, 2025). Material asset damage is particularly evident in highly exposed regions and sectors.

Food and Natural Resource Production Systems

Climate change is increasingly affecting the material assets that underpin food and natural resource production systems, including agricultural land and soils, irrigation and drainage infrastructure, forestry and fisheries assets, storage facilities, and processing equipment. Damage to, or reduced performance of, these assets is limiting the capacity of agriculture, forestry, fisheries, and aquaculture to meet growing demand from an increasing human population, while also driving economic losses through lower productivity, asset degradation, repair and replacement costs, and operational disruptions across these sectors (IPCC, 2022). Over the past 50 years, human-driven warming has slowed improvements in agricultural productivity, particularly in mid- and low-latitude regions. Trends in agricultural total factor productivity (TFP), defined as the ratio of aggregate agricultural outputs (crops and livestock) to aggregate inputs (land, labour, fertiliser, machinery, etc.), show that although global TFP increased between 1961 and 2015, long term climate change substantially constrained this growth. Specifically, climate trends reduced global TFP growth by an estimated cumulative 21% over the 55-year period compared with a counterfactual scenario without climate change (IPCC, 2022). According to Ortix-Bobea *et al.*, the negative impacts were more pronounced in Africa, Latin America, and the Caribbean, where reductions in TFP growth of approximately 26–34% were observed (Ortiz-Bobea *et al.*, 2021).

According to the IPCC, rising temperatures have also degraded crop and grassland quality and increased annual variability in harvests. Figure 36 from the IPCC presents the increase in food production loss events since the 1960s experienced by aquaculture, fisheries, livestock and crops. According to the IPCC, the observed direction of impact and confidence in attribution from climate change to crop yield productivity across four major crop types globally: maize, rice, soybean and wheat, with predominately negative impacts (IPCC, 2022).

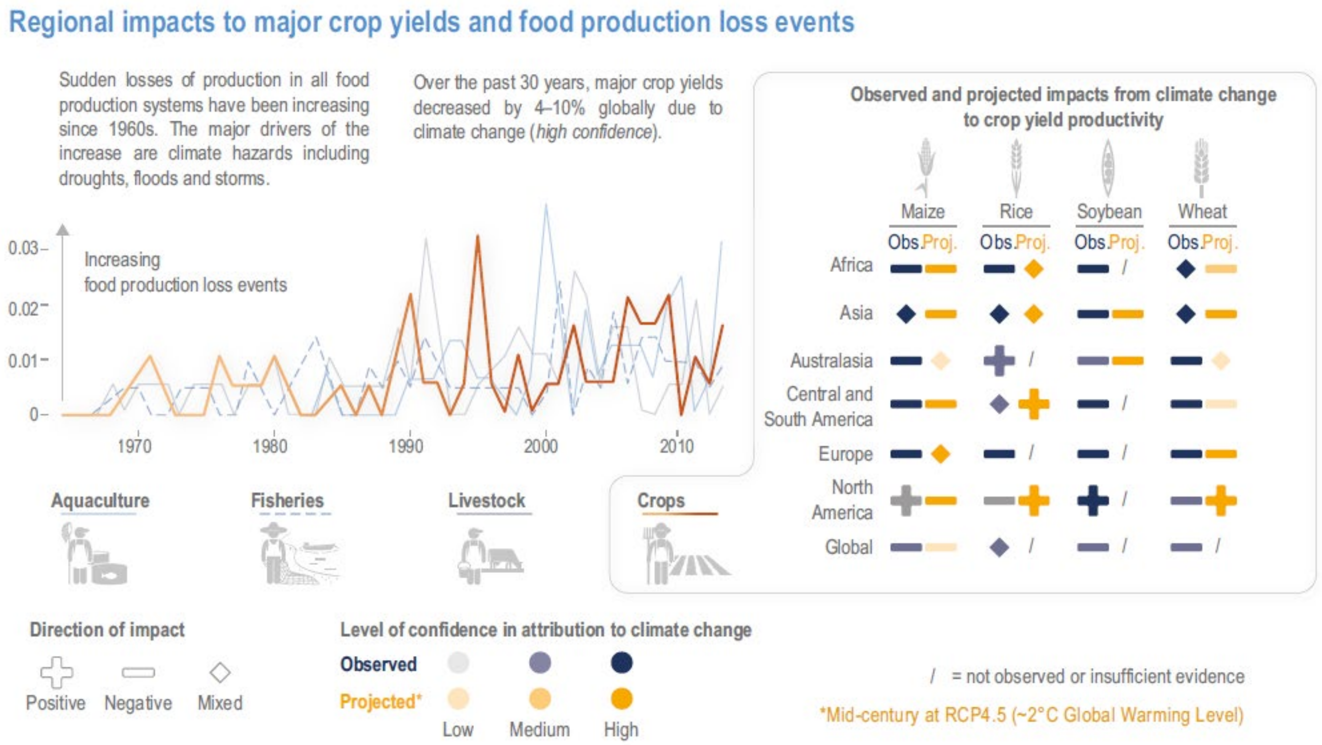


Figure 36: Food production loss events affecting aquaculture, fisheries, livestock and crops (left panel) and regional impacts on crop yield productivity (right panel) (IPCC, 2022).

The IPCC reports that in marine and freshwater systems, warming waters and ocean acidification have already had measurable negative effects on farmed aquatic species. In wild fish populations, sustainable yields have decreased by 4.1% between 1930 and 2010 due to ocean warming (IPCC, 2022).

Figure 37 presents the global frequency of food production loss events between 1961 and 2013 across crops, fisheries, livestock, and aquaculture (IPCC, 2022).

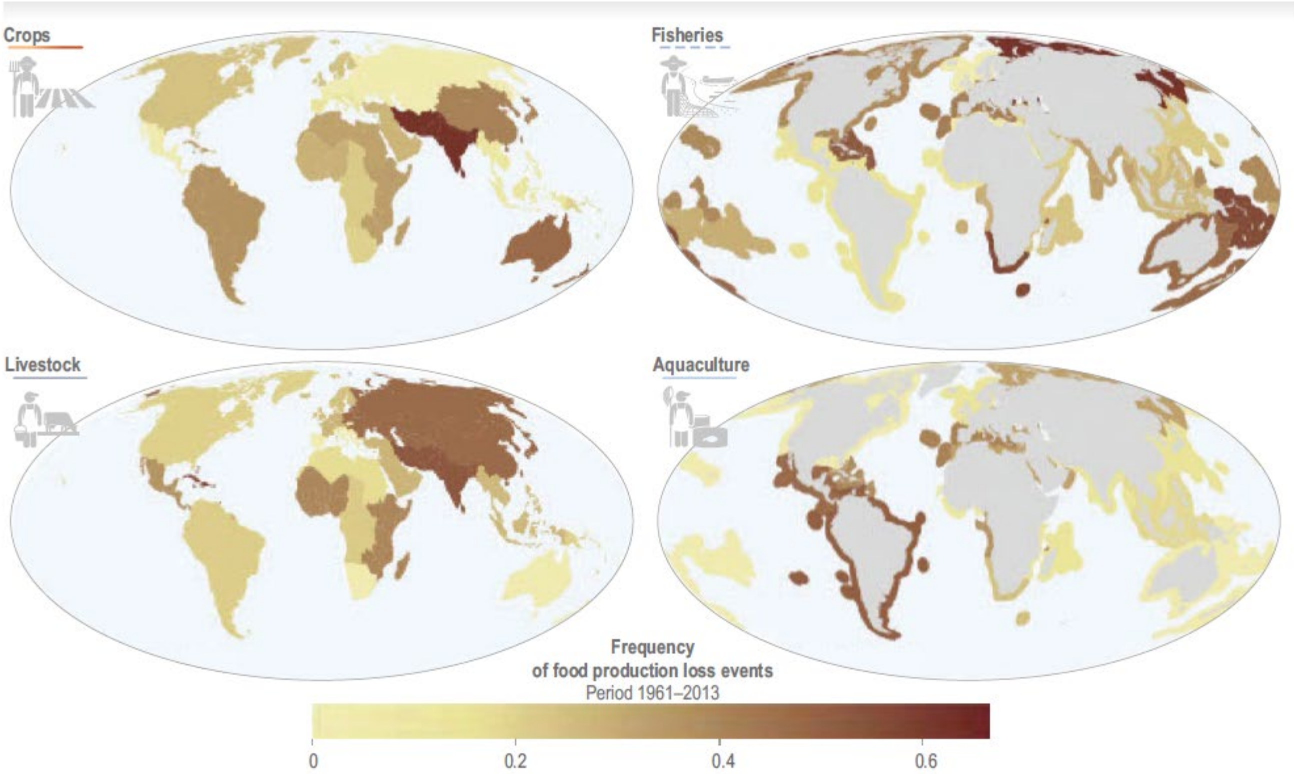


Figure 37: Frequency of food production loss events from 1961 to 2013 for crops, fisheries, livestock, and aquaculture (IPCC, 2022).

According to the IPCC, extreme weather and climate events, such as droughts, floods, wildfires, and marine heatwaves, reduce food production and raise food prices, putting food security, nutrition, and livelihoods at risk. Figure 38 below shows that the frequency of climate-related food production loss events has increased globally over recent decades, including a rise in large-scale losses exceeding 20 million tonnes (IPCC, 2022).

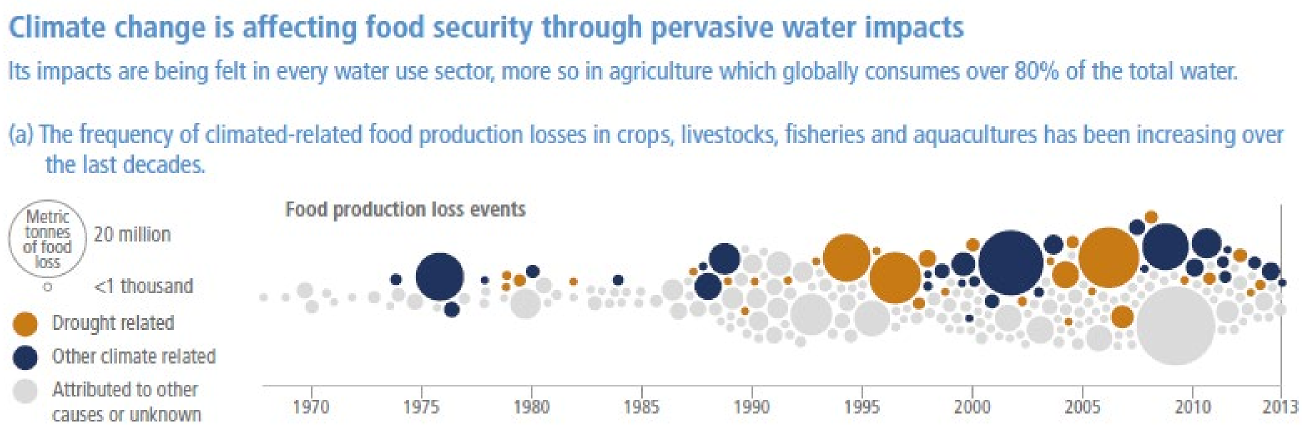


Figure 38: Frequency of climate-related food production losses in crops, livestock, fisheries and aquacultures (IPCC, 2022).

In Europe, according to the IPCC, the impacts of extreme heat and drought have increased in severity over the past 50 years. These events have caused significant economic losses across livestock, forests and crop systems, including repeated reductions in wheat production in 2012, 2016 and 2018. Heat and drought have also damaged forests, leading to reduced timber production and sales (IPCC, 2022).

The IPCC reports that marine heatwaves have resulted in major losses in fisheries and aquaculture, including well-documented events along the west coast of North America (2013–2016) and the east coast of Australia (2015–2016, 2016–2017, and 2020) (IPCC, 2022).

CULTURAL HERITAGE

Cultural heritage is increasingly recognised as vulnerable to environmental change and climate-related pressures, particularly where heritage assets are closely connected to natural processes, landscapes and long-established patterns of settlement (UNESCO, n.d.). Rising temperatures, sea-level rise, coastal erosion, flooding, wildfires and changes in soil moisture are contributing to the deterioration or loss of tangible cultural heritage (physical products of human creativity such as historic buildings, archaeological sites and cultural landscapes) and intangible cultural heritage (living traditions including practices, expressions, knowledge and skills passed down through generations) (European Parliamentary Research Service, 2024; IPCC, 2022). These risks are often exacerbated by the age and design of historic structures, which were not developed to withstand current or projected climate conditions (European Parliamentary Research Service, 2024; Historic England, 2026), and by the concentration of heritage assets in environmentally sensitive locations such as coastal and riverside areas (IPCC, 2022).

While the physical impacts of climate change on the environment are increasingly well documented, the effects on cultural heritage are less consistently monitored (IPCC, 2022).

Traditional farming practices are an example of cultural traditions that are being affected by environmental change. Indigenous and small-scale farmers often rely on local knowledge and farming methods that promote biodiversity, maintain soil health, and use natural pest control. These approaches support the cultivation of a diverse range of crops, increasing genetic diversity and helping crops withstand climate-related stresses (IPCC, 2022). However, most agricultural research, funding and support are focused on a small number of major crop species, with limited research and innovation directed towards smaller or “minor” crops. As a result, many Indigenous and small-scale farmers are shifting away from diverse cropping systems towards a narrower range of major crops. This trend can reduce the resilience of food systems, making them more vulnerable to pests, disease, and drought, and can also lead to the loss of Indigenous and local knowledge. (IPCC, 2022).

THE LANDSCAPE

Globally, the landscape is undergoing rapid and interconnected change as climate change and other environmental pressures intensify and interact. Rising temperatures, shifting precipitation patterns, sea-level rise, and more frequent and severe extreme weather events are altering terrestrial, freshwater, coastal, and marine environments, accelerating the degradation of natural systems and the transformation of human-managed landscapes (IPCC, 2021; IPCC, 2023).

River Landscapes and Connectivity

Global analysis of river flows shows spatially complex patterns, with reduced flows in regions such as the Mediterranean, southern Australia, and northeastern Brazil, and increased flows in northern Europe. More than half of global rivers currently experience periodic drying, reducing river connectivity and altering river corridor landscapes (IPCC, 2022).

According to the IPCC, in high-latitude and high-altitude streams, shrinking glaciers, reduced snow cover, earlier snowmelt and altered precipitation patterns are increasing flow intermittency, resulting in streams drying up more often. This is changing source stream landscapes, reducing their reliability as permanent features and affecting how water moves through downstream landscapes (IPCC, 2022).

Lake Landscapes

Changes to the global water cycle is altering how water is stored in lakes, leading to lake levels rising, falling, or remaining stable depending on local conditions. Although it is difficult to attribute changes at individual lakes directly to climate change, consistent patterns observed across large regions and over long time periods provide stronger evidence of a climate change influence. There is also growing evidence that climate change is leading to the loss of small, temporary ponds, which collectively cover a greater global area than permanent lakes. This is resulting in a widespread but often overlooked, simplification of freshwater landscapes (IPCC, 2022). In mountain regions, according to the IPCC, lakes fed by melting glaciers are increasing in size as glaciers retreat. On the Tibetan Plateau, higher water storage is linked to glacier melt, thawing permafrost, and changes in rainfall and runoff. These processes are reshaping high-altitude landscapes by forming new lakes, changing drainage patterns, and increasing the risk of landscape instability (IPCC, 2022).

CURRENT UK CLIMATE

The increasing impacts of climate change are evident across a range of indicators (CCC, 2025). For example since 1901, the sea level around the UK has risen by about 19.5 cm, with two-thirds of this rise happening in the last three decades (Kendon *et al.*, 2025). Table 32 details changes in selected climate indicators (2015-2024) when compared to one of two baselines, namely 1961 – 1990 and 1991 - 2020.

Table 32 Selected UK climate change indicators (Kendon *et al.,* 2025).

Climate indicator	2015-2024 in comparison to		2015–2024
	1961-1990 Baseline	1991-2020 Baseline	
Temperature	0.41°C warmer; Double number of days with temperature anomalies exceeding 5°C from baseline	1.24°C warmer	2024 included the UK's second warmest February, warmest May, fifth warmest December, fifth warmest winter and warmest spring on record.
Near-coast sea-surface temperature	0.9°C warmer	0.3°C warmer	Five of the 10 warmest years have occurred between 2015 – 2024.
Rainfall	10% wetter	2% wetter	2024 was the UK's 13th wettest year in the series from 1836.
Extremes and significant weather	N/A	N/A	Increasing magnitude and frequency of extremes e.g. temperature.

Marine heatwaves have increased in frequency by an average of 3.8 events per year around the British isles between the periods of 1982-1998 and 2000-2016 (Cornes *et al.,* 2025). Larger increases occurred to the north of the UK, where an increase of up to six additional events were experienced on average in the 2000-2016 baseline compared to 1982-1998 (Cornes *et al.,* 2025).

The North Atlantic Ocean contains more anthropogenic CO_2 than any other ocean basin. Within the shelf seas around the UK, the seawater chemistry is more variable in space and time, where seas have shown large variability in increases in absorption of CO_2. There is a strong seasonal signal in the Celtic Sea, Irish Sea and northern North Sea, where CO_2 is captured during the spring and summer months, whereas in the autumn and winter, the CO_2 is mixed through the water as the stratification of the water column breaks down. The exceptions are the southern bight of the North Sea and eastern English Channel, where thermally-driven increases in occur in summer which is primarily retained throughout the year since the water column in this relatively shallow and does not stratify (Findlay *et al., 2025*).

REFERENCES

Burton, C., *et al.* (2024). *Global burned area increasingly explained by climate change.* Nature Climate Change. Available online at: https://www.nature.com/articles/s41558-024-02140-w.

Capotondi, A., Rodrigues, R.R., Sen Gupta, A., Benthuysen, J.A., Deser, C., Frölicher, T.L., Lovenduski, N.S., Amaya, D.J., Le Grix, N., Xu, T. and Hermes, J. (2024). *A global overview of marine heatwaves in a changing climate. Communications Earth & Environment*, *5*(1), p.701.

Climate Change Committee (2025). *The Seventh Carbon Budget – Advice for the UK Government.* Available online at: https://www.theccc.org.uk/publication/the-seventh-carbon-budget/ [Accessed: 17/06/2026].

Cornes, R.C., Tinker, J., Hermanson, L., Oltmanns, M., Hunter, W.R., Lloyd-Hartley, H., Kent, E.C., Rabe, B. and Renshaw, R. (2023). *Climate change impacts on temperature around the UK and Ireland.* MCCIP Sci. Rev, 18, pp.1-18.

EDGAR (2025). *GHG emissions of all world countries.* Available online at: https://edgar.jrc.ec.europa.eu/report_2025.

Findlay, H.S., Artioli, Y., Greenwood, N., Hartman, S., Flohr, A., Leon, P., Stiasny, M. and Cronin, M. (2025). *Ocean acidification around the UK and Ireland.* MCCIP Science Review 2025.

Forster, P. M., *et al.* (2025). *Indicators of Global Climate Change 2024.* Available online at: https://essd.copernicus.org/articles/17/2641/2025/.

Friedlingstein, P., O'Sullivan, M., Jones, M. W., *et al.*, (2026). *Global Carbon Budget 2025. Earth System Science Data,* 18 pp.3211-3288. Available online at: https://essd.copernicus.org/articles/18/3211/2026/essd-18-3211-2026.pdf [Accessed: 17/06/2026].

Fu, C. and Xu, M. (2023). *Achieving carbon neutrality through ecological carbon sinks: A systems perspective.* Green Carbon, 1(1), pp.43-46.

IPCC (2019). *Special Report on the Ocean and Cryosphere in a Changing Climate.* Available online at: https://www.ipcc.ch/srocc/.

IPCC (2021). *Climate Change 2021 – The Physical Science Basis.* Available online at: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FullReport.pdf.

IPCC (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability.* Available online at: https://www.ipcc.ch/report/ar6/wg2/.

IPCC (2023). *Climate Change 2023 Synthesis Report.* Available online at: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf.

IPCC (2019a). *Summary for policymakers.* In *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (pp. 3–35). Available online at: https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/.

IPCC (2019b). *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate.* Cambridge University Press. Available online at: https://www.ipcc.ch/srocc/.

IPCC (2021a). *Summary for policymakers.* In *Climate Change 2021: The Physical Science Basis (Working Group I contribution to the Sixth Assessment Report).* IPCC. Available online at: https://www.ipcc.ch/report/ar6/wg1/chapter/summary-for-policymakers/.

IPCC (2021b). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Available online at: https://www.ipcc.ch/report/ar6/wg1/.

IPCC (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* IPCC. Available online at: https://www.ipcc.ch/report/ar6/wg2/.

IPCC (2023). *Sections.* In *Climate Change 2023: Synthesis Report (Contribution of Working Groups I, II and III to the Sixth Assessment Report)* (pp. 35–115). Available online at: IPCC. https://www.ipcc.ch/report/ar6/syr/.

Jacobson, A. R., *et al.* (2023). *CarbonTracker CT2022.* NOAA Global Monitoring Laboratory. Available online at: https://doi.org/10.25925/Z1GJ-3254.

Kendon, M., Doherty, A., Hollis, D., Carlisle, E., Packman, S., Jevrejeva, S., Matthews, A., Williams, J., Garfoth, J. and Sparks, T., 2025. State of the UK Climate in 2024. International Journal of Climatology. Available online at: https://doi.org/10.1002/joc.70010.

Lan, X., Thoning, K. W., & Dlugokencky, E. J. (2026). *Trends in globally-averaged CH_4, N_2O, and SF_6 determined from NOAA Global Monitoring Laboratory measurements. Version 2026-03.* Available online at: https://doi.org/10.15138/P8XG-AA10.

Lan, X., Nisbet, E. G., Dlugokencky, E. J., & Michel, S. E. (2021). *What do we know about the global methane budget? Results from four decades of atmospheric CH_4 observations and the way forward.* Philosophical Transactions of the Royal Society A, 379: 20200440. Available online at: https://doi.org/10.1098/rsta.2020.0440.

Lindsey, R. (2025). *Climate Change: Atmospheric Carbon Dioxide.* Climate.gov. Available online at: https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide.

Met Office (2026a). *Tracking the Changing Climate with Earth Observations.* Available online at: https://climate.metoffice.cloud.

Met Office (2026b). *UK and Global Extreme Events – Drought.* Available online at: https://www.metoffice.gov.uk/research/climate/understanding-climate/uk-and-global-extreme-events-drought.

Müller, J.D., Gruber, N., Schneuwly, A., Bakker, D.C., Gehlen, M., Gregor, L., Hauck, J., Landschützer, P. and McKinley, G.A. (2025) *Unexpected decline in the ocean carbon sink under record-high sea surface temperatures in 2023.* Nat. Clim. Change 15, 978–985.

Munich RE (2026). *Climate change presses on: Devastating wildfires and intense thunderstorms exacerbate losses for insurers.* Available online at: https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2026/natural-disaster-figures-2025.html.

National Geographic (2019). *First mammal species recognized as extinct due to climate change.* Available online at: https://www.nationalgeographic.com/science/article/first-mammal-extinct-climate-change-bramble-cay-melomys.

NOAA (2025). *NOAA Coral Reef Watch Current Global Bleaching: Status Update & Data Submission.* Available online at: https://coralreefwatch.noaa.gov/satellite/research/coral_bleaching_report.php.

OECD (2025). *The macroeconomic implications of extreme weather events.* Available online at: https://www.oecd.org/en/publications/the-macroeconomic-implications-of-extreme-weather-events_5e24a2d8-en.html.

Ortiz-Bobea, A., Ault, T. R., Carrillo, C. M., Chambers, R. G., & Lobell, D. B. (2021). *Anthropogenic climate change has slowed global agricultural productivity growth.* Nature Climate Change, 11(4), 306–312. Available online at: https://doi.org/10.1038/s41558-021-01000-1.

Rodell, M., & Li, B. (2023). *Changing intensity of hydroclimatic extreme events revealed by GRACE and GRACE-FO.* Available online at: https://www.nature.com/articles/s44221-023-00040-5.

Sergio M. Vicente-Serrano *et al.* (2022). Global Drought Trends and Future Projections. Available online at: https://royalsocietypublishing.org/rsta/article/380/2238/20210285/58216/Global-drought-trends-and-future-projectionsGlobal.

Vicente-Serrano, S. M., *et al.* (2022). *Global drought trends and future projections.* Philosophical Transactions of the Royal Society A, 380(2238).

WMO (2025). *Global Annual to Decadal Climate Update 2025.* Available online at: https://hadleyserver.metoffice.gov.uk/wmolc/WMO_GADCU_2025-2029.pdf.

WMO (2026). *State of the Global Climate 2025.* Available online at: https://library.wmo.int/records/item/69807-state-of-the-global-climate-2025.

WWF (2024). *Living Planet Report 2024.* Available online at: https://www.wwf.org.uk/sites/default/files/2024-10/living-planet-report-2024.pdf.

APPENDIX 2 FUTURE BASELINE DETAILED INFORMATION

Appendix 2 provides a high-level summary of relevant scientific literature relating to the projected state of the environment under lower-, intermediate- and higher-warming futures across key environmental receptors. This has been prepared by Adura by drawing on a range of respected, publicly available scientific sources. This Appendix summarises and paraphrases information from those sources and does not express the views or opinions of Adura, or Ithaca. While efforts have been made to reflect the content of the underlying sources accurately, the summaries necessarily involve simplification and are not intended to constitute an exhaustive description of every aspect of that source. Readers should refer to the original sources for the full analysis.

The graphics, charts and tables presented are drawn from the following IPCC publications: IPCC (2019a), IPCC (2019b), IPCC (2021a), IPCC (2021b), IPCC (2022a), IPCC (2022b) and IPCC (2023).

GLOBAL SURFACE TEMPERATURE

Across every emissions pathway assessed by the IPCC, global average surface temperatures are projected by the IPCC to keep rising until at least the middle of the century, as shown in Figure 39. Without substantial and rapid cuts to CO_2 and other GHG emissions in the coming decades, warming levels of 1.5°C and 2°C are projected by the IPCC to be surpassed at some point during the 21st century.

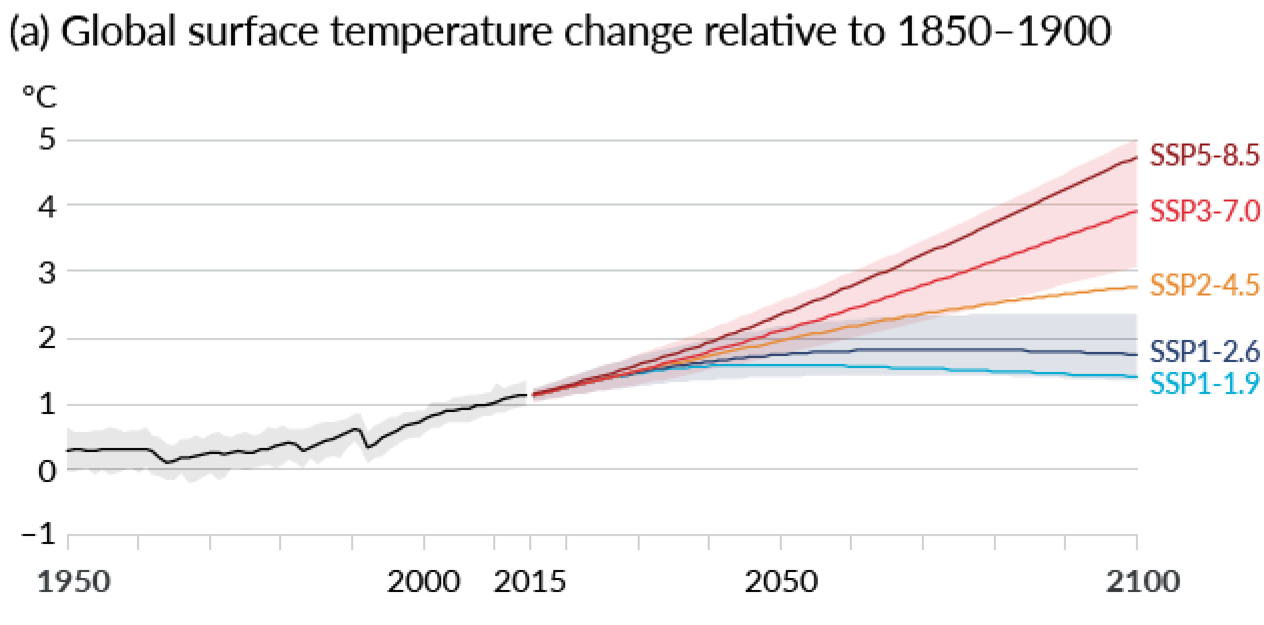


Figure 39: Global surface temperature change projections (relative to pre-industrial 1850-1900 baseline) (IPCC, 2021b).

The IPCC projected global surface temperatures for three periods (2021-2040, 2041-2060 and 2081-2100) which are reported in Table 33. According to the IPCC, relative to the 1850–1900 baseline, mean global surface temperatures during 2081–2100 are very likely to increase by between:

- 1.0°C and 1.8°C under the very low GHG emissions pathway (SSP1-1.9).
- 2.1°C to 3.5°C under the intermediate GHG emissions pathway (SSP2-4.5).
- 3.3°C to 5.7°C under the very high GHG emissions pathway (SSP5-8.5).

Table 33: Projected changes in global surface temperature (relative to the 1850-1900 baseline) for selected 20-year periods across the five illustrative emissions scenarios (IPCC, 2021a).

Scenario	Near Term (2021-2040)		Mid Term (2041-2060)		Long Term (2081-2100)	
	Best Estimate	Very Likely Range (°C)	Best Estimate	Very Likely Range (°C)	Best Estimate	Very Likely Range (°C)
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

EXTREME WEATHER AND CLIMATE EVENTS

Figure 40 shows illustrative IPCC projections how, as global temperatures rise, extreme weather and climate events are projected by the IPCC to become more widespread, more intense, and affect more regions of the world. Table 34 summarises the IPPC projected increase in frequency and intensity of hot temperature extremes, heavy precipitation and agricultural and ecological droughts under 1.5°C, 2°C and 4°C warming scenarios (IPCC, 2021a).

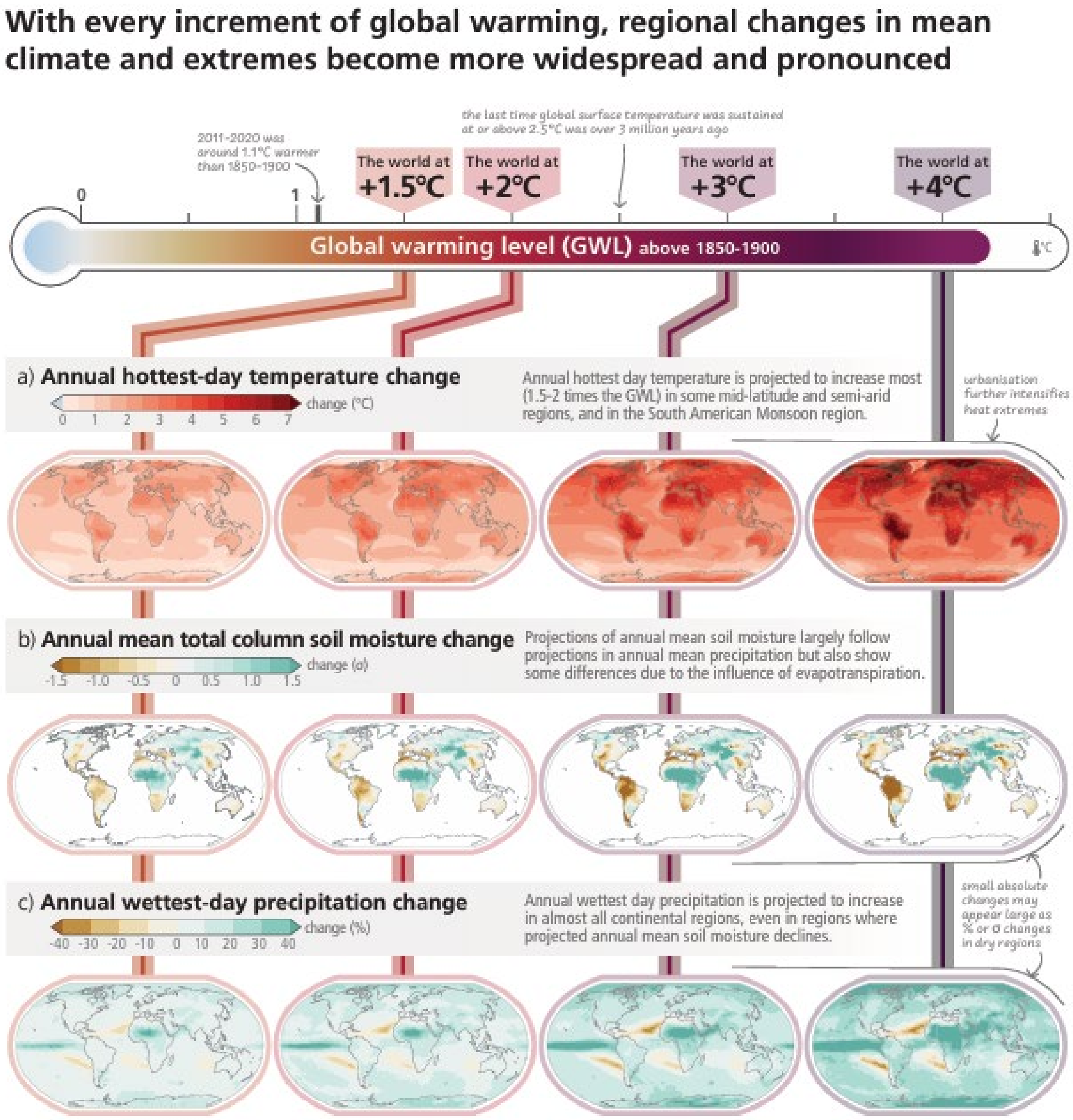


Figure 40: Projected global changes relative to the 1850–1900 baseline at warming levels of 1.5°C, 2°C, 3°C and 4°C, showing changes in (a) annual hottest-day temperature change, (b) annual mean total column soil moisture change, and (c) annual wettest-day precipitation change (IPCC, 2023).

Table 34: Projected changes in the intensity and frequency of hot temperature extremes over land, extreme precipitation over land, and agricultural and ecological droughts in drying regions (IPCC, 2021a).

	1850-1900 Baseline*	Current Observations (1°C)	Future Global Temperature Increase		
			1.5°C	2°C	4°C
Hot temperature extremes over land**					
Frequency per 10 years	Once	Now likely occurs 2.8 times (1.8 – 3.2)	Will likely occur 4.1 times (2.8 – 4.7)	Will likely occur 5.6 times (3.8 – 6.0)	Will likely occur 9.4 times (8.3 – 9.6)
Intensity Increase	-	+1.2°C warmer	+1.9°C warmer	+2.6°C warmer	+5.1°C warmer
Frequency per 50 years	Once	Now likely occurs 4.8 times (2.3 – 6.4)	Will likely occur 8.6 times (4.3 – 10.7)	Will likely occur 13.9 times (6.9 – 16.6)	Will likely occur 39.2 times (27.0 – 41.4)
Intensity Increase	-	+1.2°C warmer	+2.0°C warmer	+2.7°C warmer	+5.3°C warmer
Heavy precipitation over land***					
Frequency per 10 years	Once	Now likely occurs 1.3 times (1.2 – 1.4)	Will likely occur 1.5 times (1.4 – 1.7)	Will likely occur 1.7 times (1.6 – 2.0)	Will likely occur 2.7 times (2.3 – 3.6)
Intensity Increase	-	+6.7% wetter	+10.5% wetter	+14.0% wetter	+30.2% wetter
Agricultural & ecological droughts in drying regions****					
Frequency per 10 years	Once	Now likely occurs 1.7 times (0.7 – 4.1)	Now likely occurs 2.0 times (1.0 – 5.1)	Now likely occurs 2.4 times (1.3 – 5.8)	Now likely occurs 4.1 times (1.7 – 7.2)
Intensity Increase	-	+0.3 standard deviations drier	+0.5 standard deviations drier	+0.6 standard deviations drier	+1.0 standard deviations drier

*Projected changes are shown at global warming levels of 1°C, 1.5°C, 2°C, and 4°C and are relative to a baseline of 1850–1900 which represents a climate without human influence.

**Hot temperature extremes are defined as the daily maximum temperatures over land that were exceeded on average once in a decade (10-year event) or once in 50 years (50-year event) during the 1850–1900 baseline.

***Extreme precipitation events are defined as the daily precipitation amount over land that was exceeded on average once in a decade during the 1850–1900 baseline.

****Agricultural and ecological drought events are defined as the annual average of total column soil moisture below the 10th percentile of the 1850–1900 baseline. Intensity changes are expressed as fractions of standard deviation of annual soil moisture.

GLOBAL MEAN SEA LEVEL

Figure 41 shows how sea level rise is projected by the IPCC to continue, and how the projected speed and total amount of rise depends on future GHG emissions.

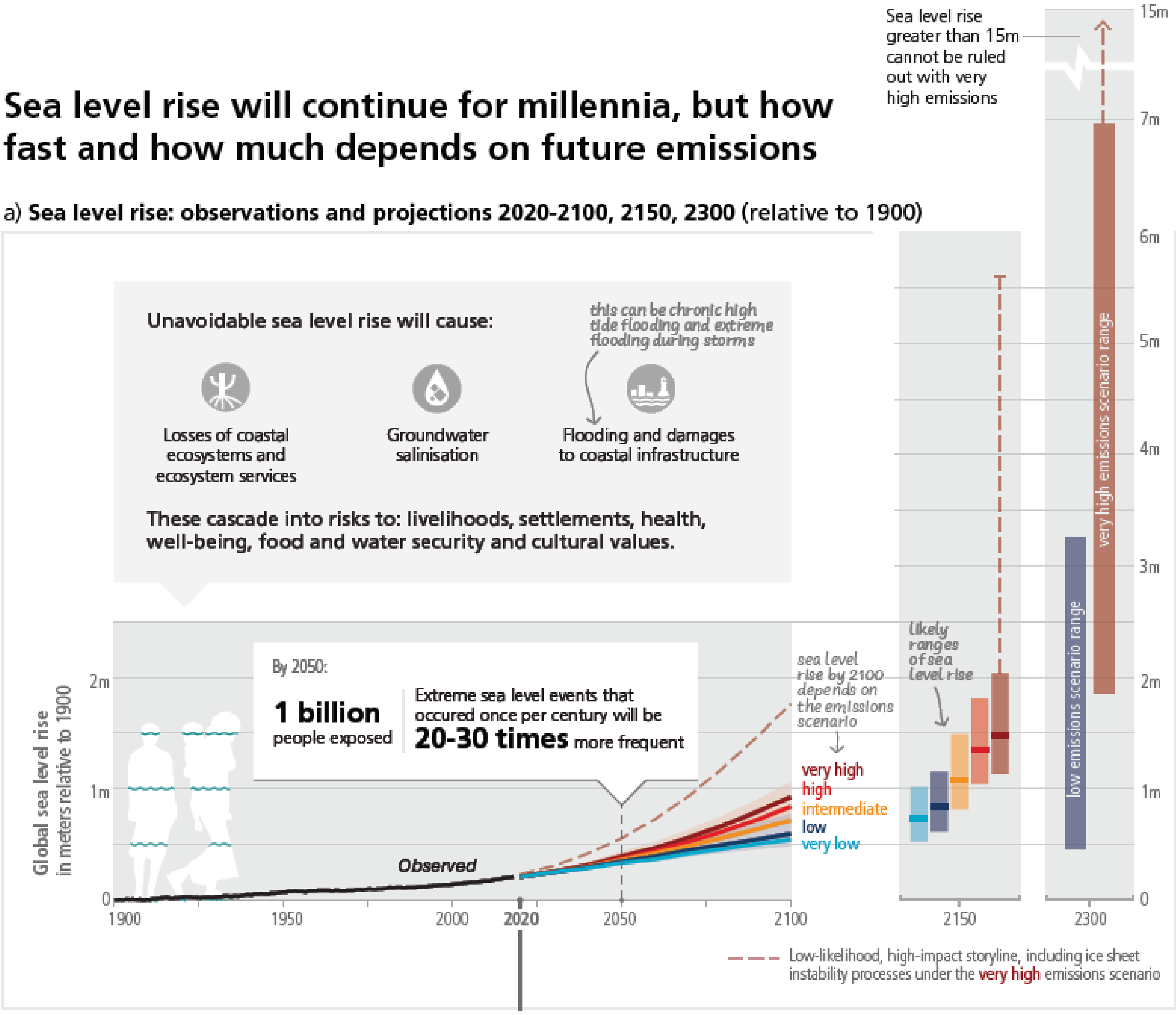


Figure 41: Projected global sea level rise under different emissions scenarios. (IPCC, 2023).

CARBON SEQUESTRATION CAPACITY

Figure 42 shows how the Earth's land and ocean carbon sinks are projected by the IPCC to absorb a smaller proportion of CO_2 emissions as total emissions increase, leaving more CO_2 accumulating in the atmosphere by 2100 under higher-emissions scenarios. In the lower emissions scenarios, most emitted CO_2 is projected to be absorbed by land and ocean sinks, while in the higher emissions scenarios, more than half of emitted CO_2 is projected to remain in the atmosphere (IPCC, 2021a).

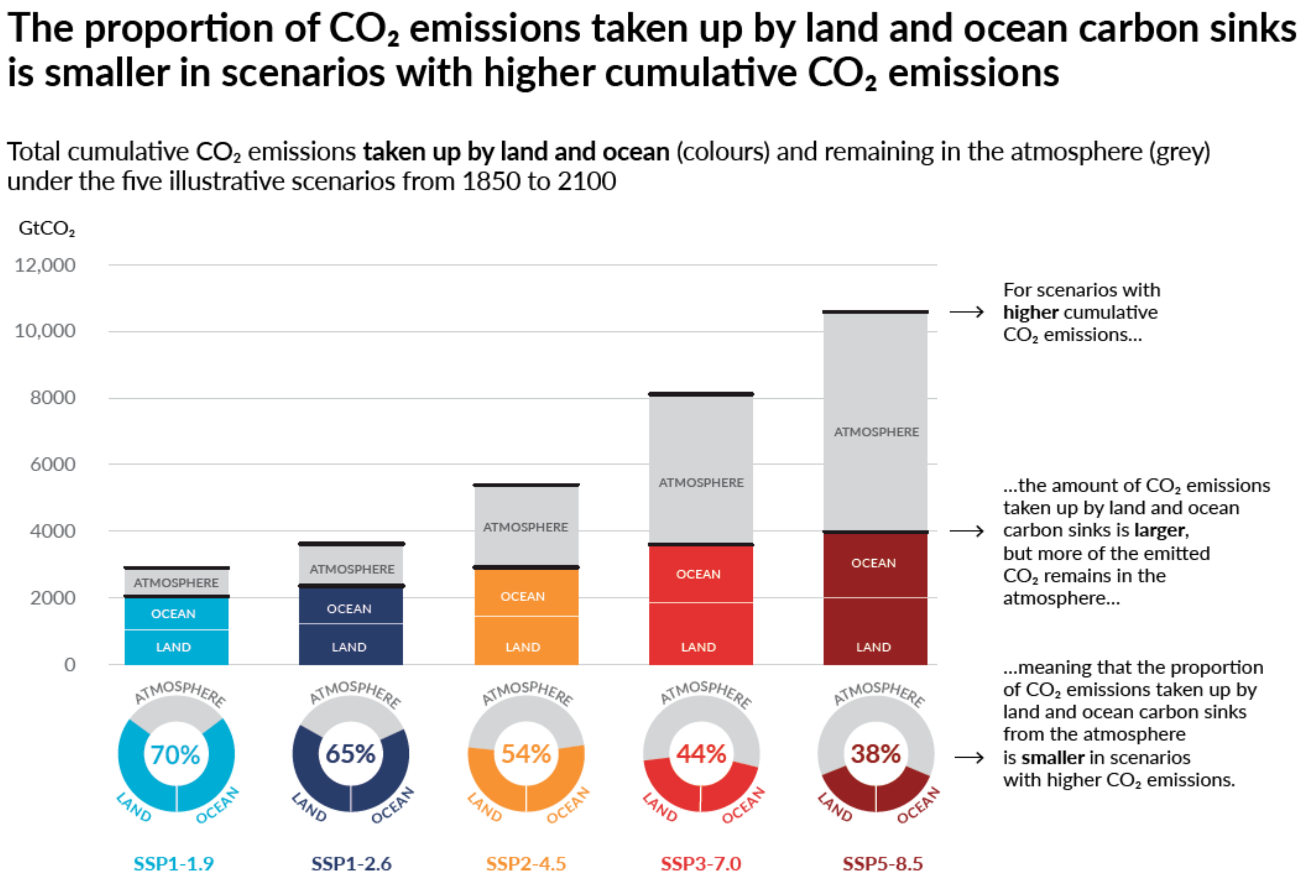


Figure 42: Cumulative anthropogenic CO_2 emissions taken up by land and ocean sinks by 2100 under the five SSPs. (IPCC, 2021a).

CRYOSPHERE CHANGES

SEA ICE

The Arctic is projected by the IPCC to become virtually sea ice free in September at least once before 2050 under all five illustrative scenarios considered (as shown in Figure 43), with higher levels of warming leading to more frequent occurrences. By contrast, there is low confidence by IPCC in projections of Antarctic Sea-ice decline.

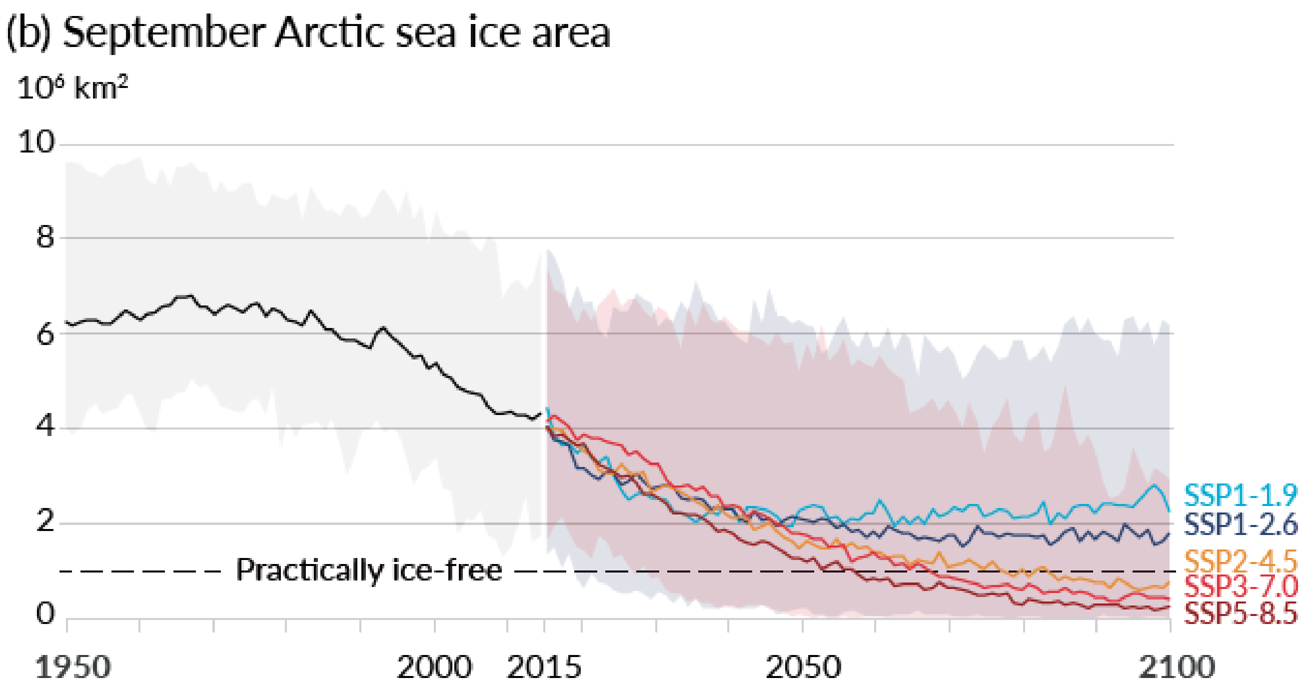


Figure 43: Projected changes in September Arctic sea-ice area under different future emissions pathways (IPCC, 2021a).

GLACIERS

As shown in Figure 44, glaciers are projected by the IPCC to continue to lose mass under all emissions scenarios for several decades, even if global temperatures stabilise, due to delayed response.

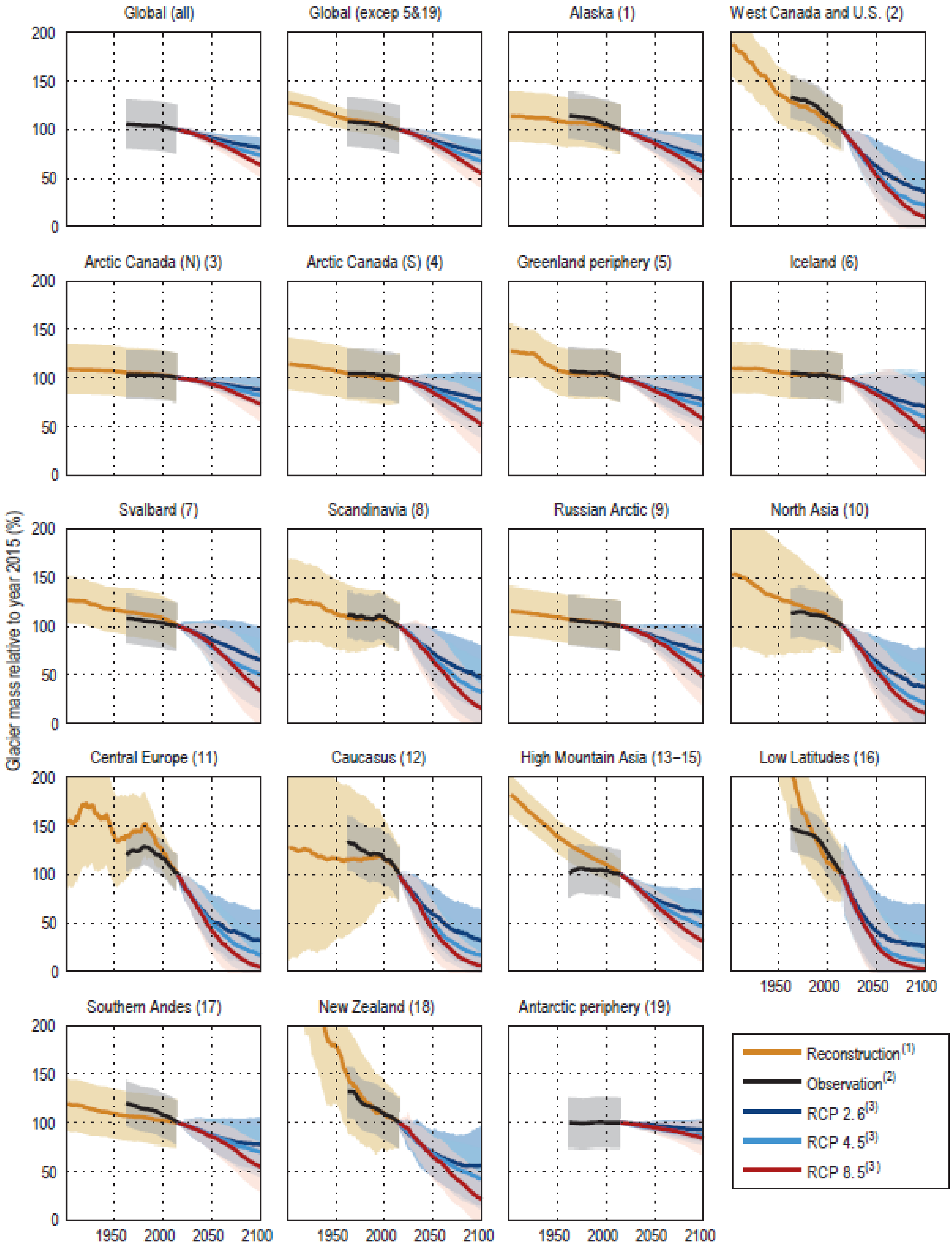


Figure 44: Projected global and regional glacier mass changes under different emissions scenarios (IPCC, 2021b). The shading shows the uncertainty envelope around the central estimate, derived from the spread of multiple climate model simulations (IPCC, 2021b).

OCEANIC CHANGES

At least 83% of the global ocean surface is projected by the IPCC to warm over the 21st century. Warming is projected by the IPCC to continue until at least 2300, even under low emissions scenarios, due to slow deep-ocean circulation. Figure 45 displays the probability ratio of marine heatwaves (i.e. how much more likely marine heatwaves are compared with pre-industrial conditions) under two IPCC emissions scenarios for 1985-2014 and 2081-2100.

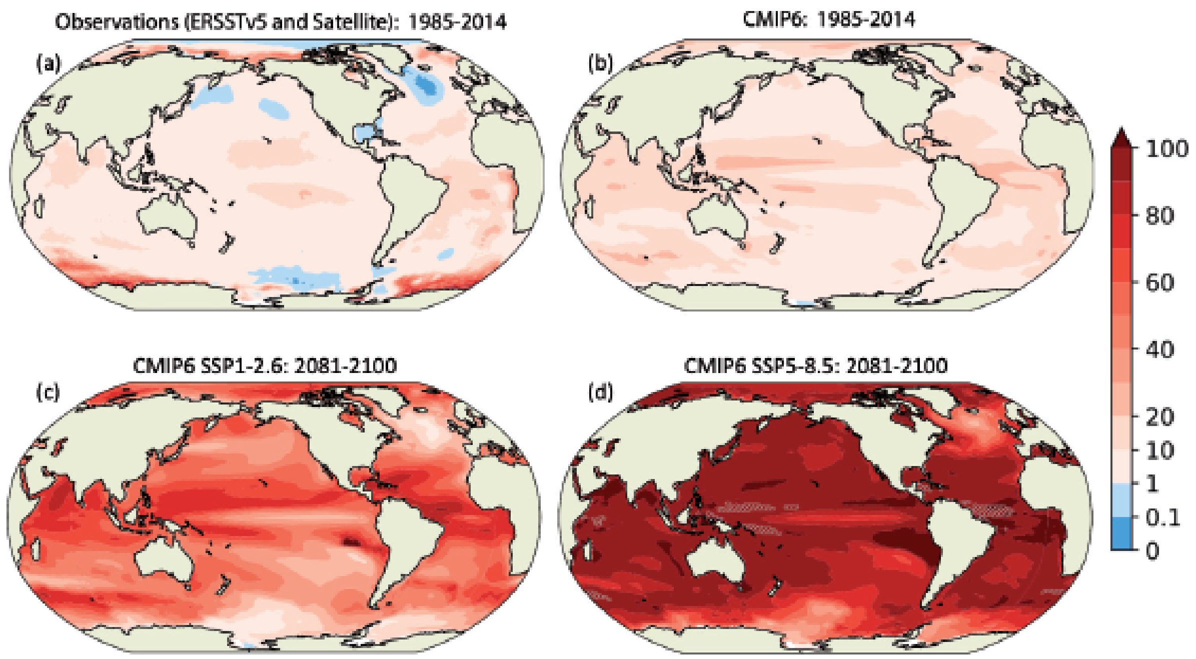


Figure 45: The probability ratio of marine heatwaves under low and high emissions scenarios for the 1985-2014 and 2081-2100, relative to pre-industrial conditions (IPCC, 2021b).

BIODIVERSITY

Figure 46 shows the percentage loss of terrestrial and freshwater biodiversity projected by IPCC at global warming levels of 1.5°C, 2°C, 3°C and 4°C, relative to the pre-industrial period.

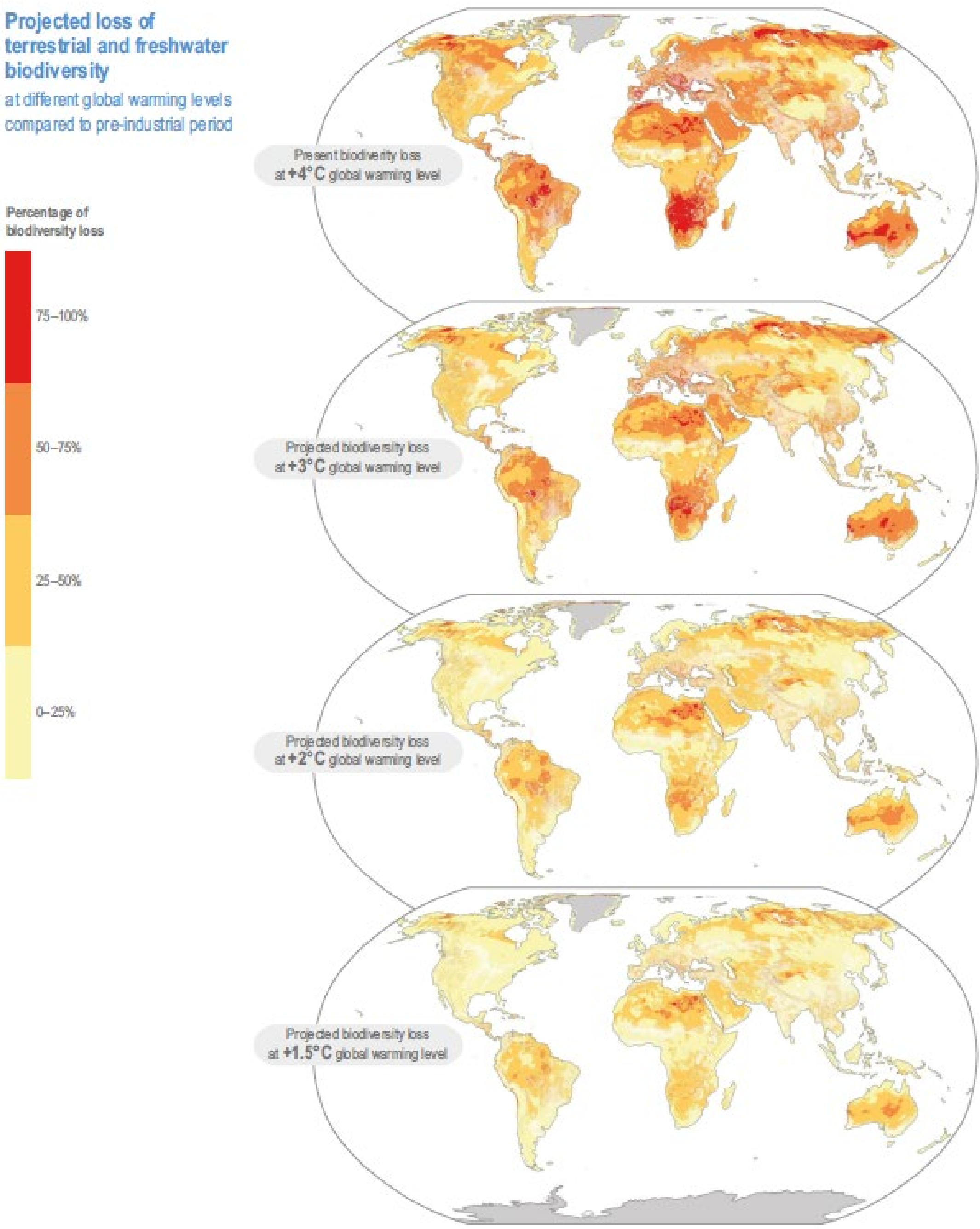


Figure 46: Projected loss of terrestrial and freshwater biodiversity at global warming levels of 1.5°C, 2°C, 3°C and 4°C (IPCC, 2022a).

Figure 47 illustrates how the impacts of climate change on natural and human systems are projected by the IPCC to become more severe and more widespread as global temperatures increase, assuming no additional adaptation measures are taken. Panel (a) shows the IPCC projected increase in biodiversity loss as global temperatures increase. Panel (b) illustrates the IPCC projected number of days per year with dangerous heat-humidity conditions affecting human health. Panel (c) presents the IPCC projected changes in food production, including impacts on maize yields and fisheries, under higher warming levels.

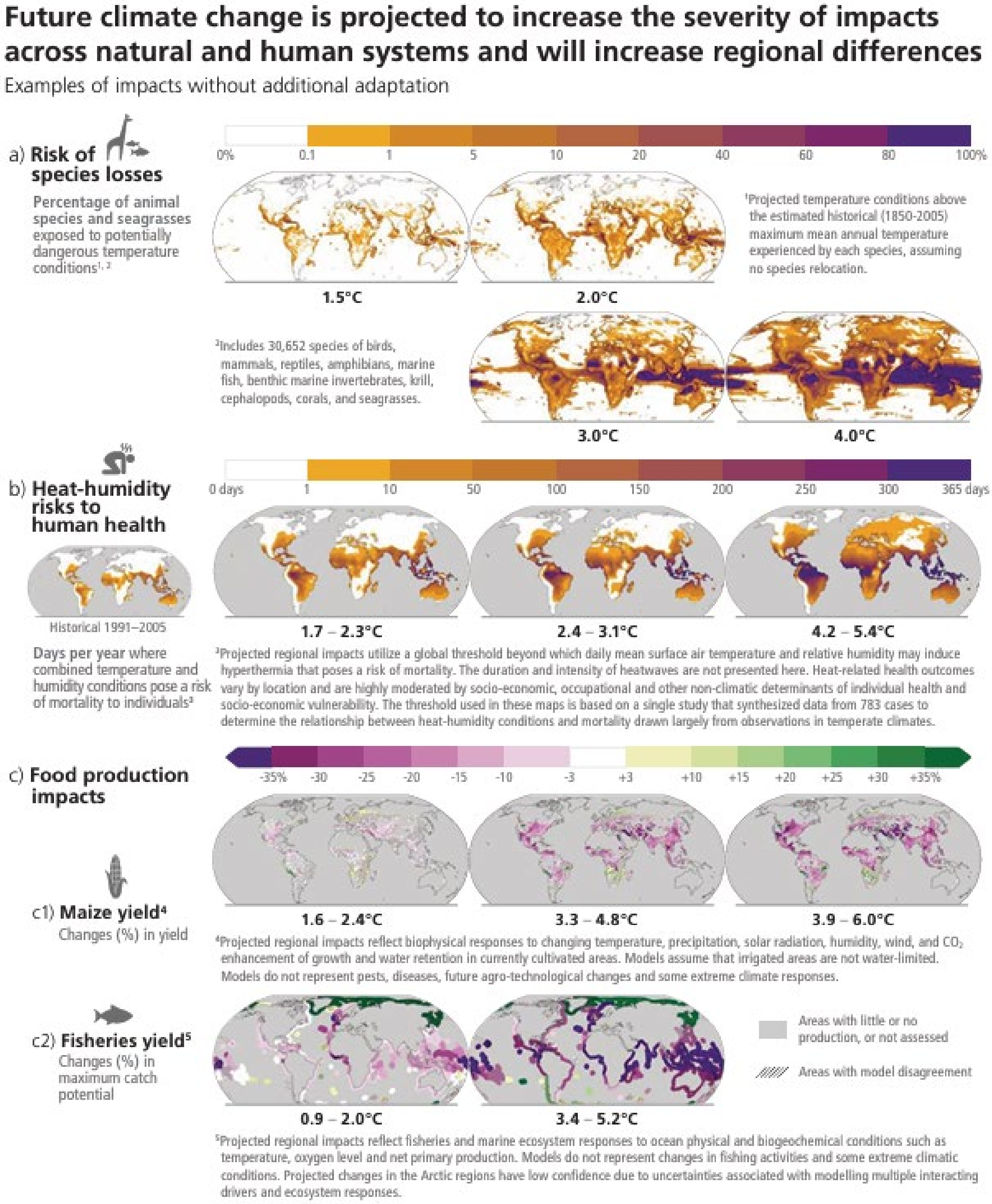


Figure 47: Projected impacts of climate change on natural and human systems at increasing levels of global warming, showing changes relative to historical conditions and assuming no additional adaptation. Panel (a) shows the risks of species loss due to exposure to higher temperature conditions, panel (b) shows the heat-humidity risks to human health, including increases in days with dangerous conditions, and panel (c) shows the impacts on food production, including changes in maize yields and marine fisheries productivity, at global warming levels of approximately 1.5°C, 2°C, 3°C and 4°C above pre-industrial levels (IPCC, 2023).

POPULATION AND HUMAN HEALTH

CLIMATE–SENSITIVE DISEASES

Figure 48 shows the IPCC projected changes in the potential abundance of Aedes aegypti (the primary vector of Dengue fever, Zika virus, Chikungunya, Yellow fever) under low and high emissions scenarios for 2090-2099 (related to a 1987-2016 baseline). The red regions on the map indicate areas where abundance is projected by the IPCC to increase, while the blue regions indicate areas where abundance is projected by the IPCC to decrease.

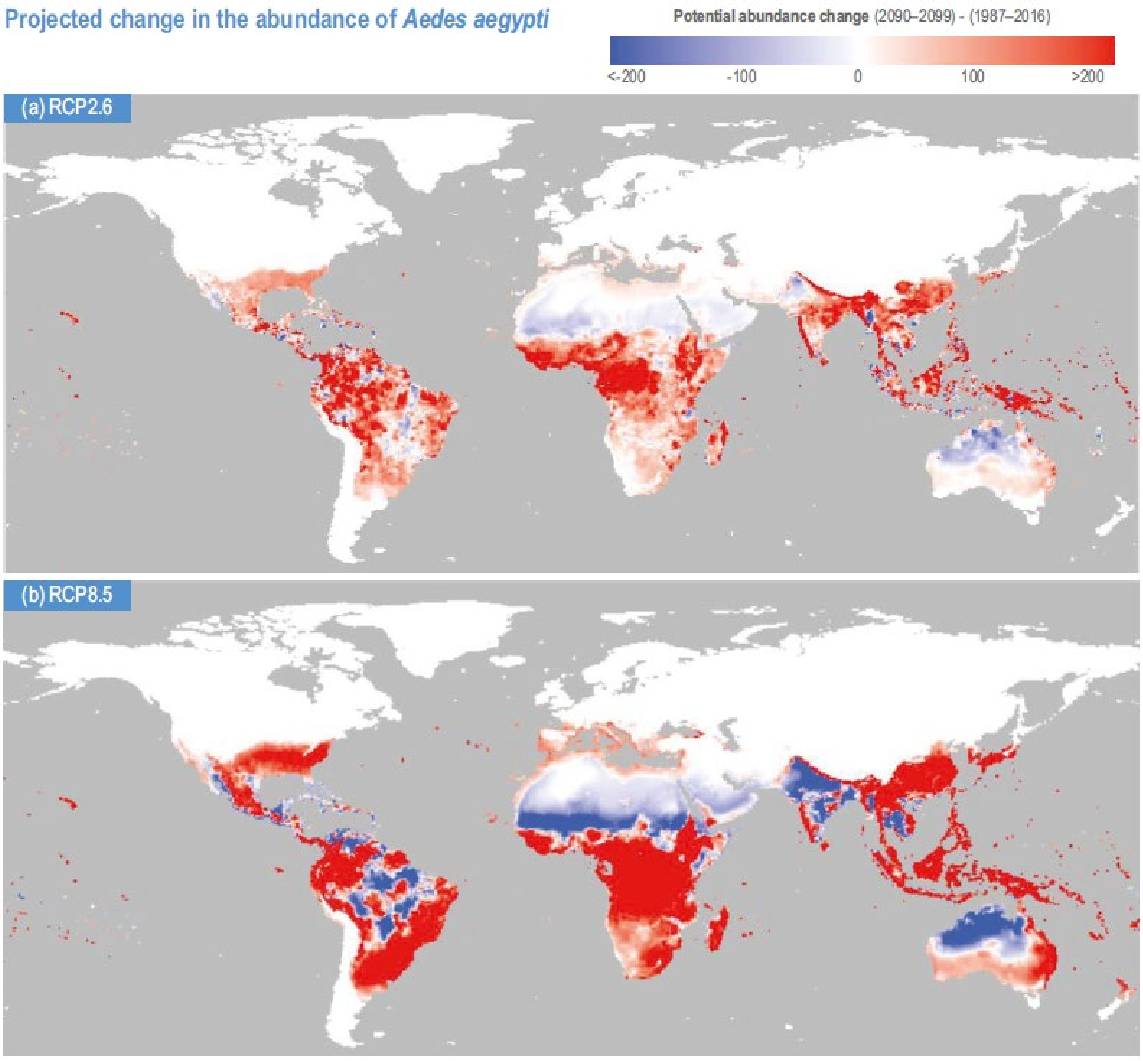


Figure 48: Projected changes in the potential abundance of Aedes aegypti (the primary vector of Dengue fever, Zika virus, Chikungunya, Yellow fever) under low and high emissions scenarios for 2090-2099 (related to 1987-2016) (IPCC, 2022a).

MATERIAL ASSETS, CULTURAL HERITAGE AND THE LANDSCAPE

MATERIAL ASSETS

Water Scarcity

Figure 49 describes the level of policy effort needed, according to the IPCC, to address water scarcity by 2050, based on both IPCC projected water stress (using the Water Scarcity Index, WSI) and the uncertainty in those IPCC projections drawing on five climate models, three hydrological models and three future SSPs. Policy challenges are classified by the IPCC as low (monitoring and review), medium (moderate changes to water systems), or high (major, transformative changes). According to the IPCC, low challenges occur where projected water scarcity remains low (WSI < 0.4) and uncertainty is stable; medium challenges occur where either projected water scarcity remains low but uncertainty increases, or water scarcity increases (WSI > 0.4) with stable uncertainty; and high challenges occur where both projected water scarcity and uncertainty increase. Areas shown in white represent locations projected by the IPCC to have very low water scarcity (WSI < 0.1) or very low water demand (IPCC, 2022).

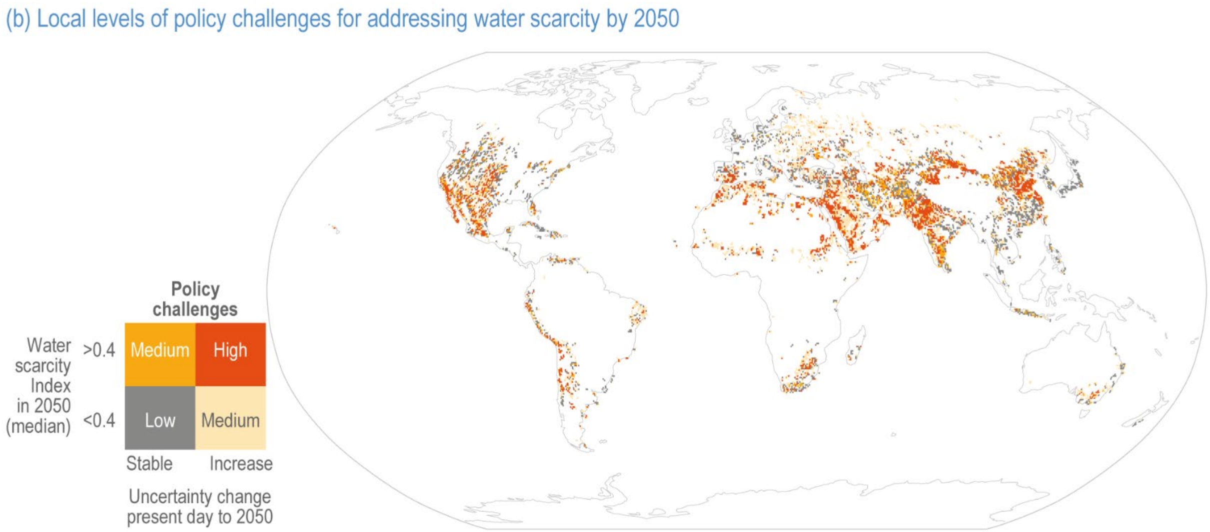


Figure 49: Level of policy effort needed to address water scarcity by 2050, based on both the expected level of water stress (using the Water Scarcity Index, WSI) and their level of uncertainty. The projections combine five climate models, three global hydrological models and three SSPs (IPCC, 2022).

Key Infrastructure Risks

Figure 50 presents examples of key regional risks and impacts projected by IPCC, along with their associated confidence levels, under warming scenarios of up to 4°C. According to the IPCC, examples relevant to material assets project the increasing risk of coastal flooding to infrastructure in Europe with rising global temperatures, and the growing costs and damages affecting key infrastructure in the Arctic (IPCC, 2022).

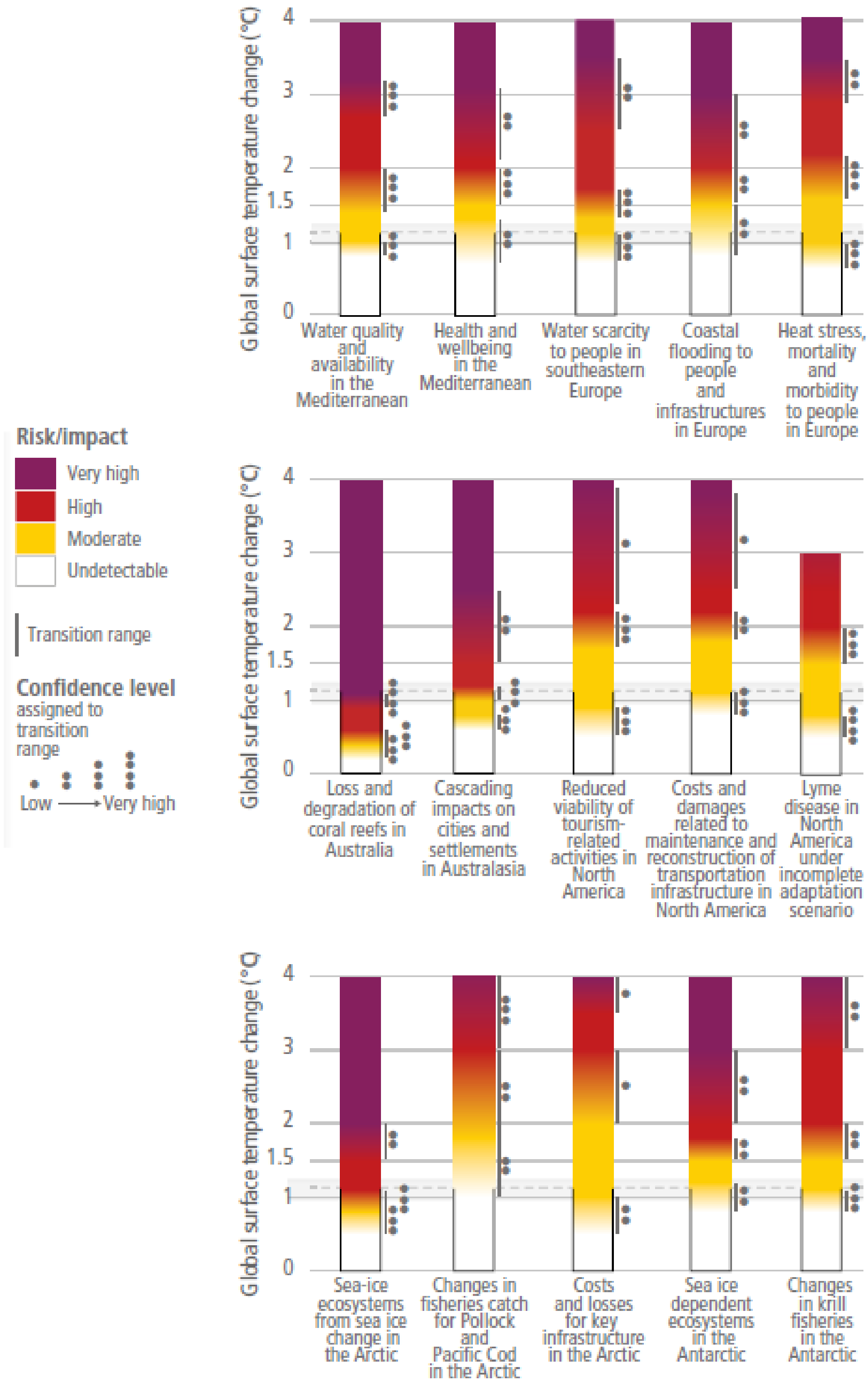


Figure 50: Examples of regional key risks/impacts and their associated confidence levels under warming scenarios up to 4°C (IPCC, 2022).

Agriculture

Figure 51 shows where wheat production is projected by the IPCC to increase or decrease globally, and how total global wheat production is projected by the IPCC to change through the 21st century, relative to a historical baseline (1983-2013).

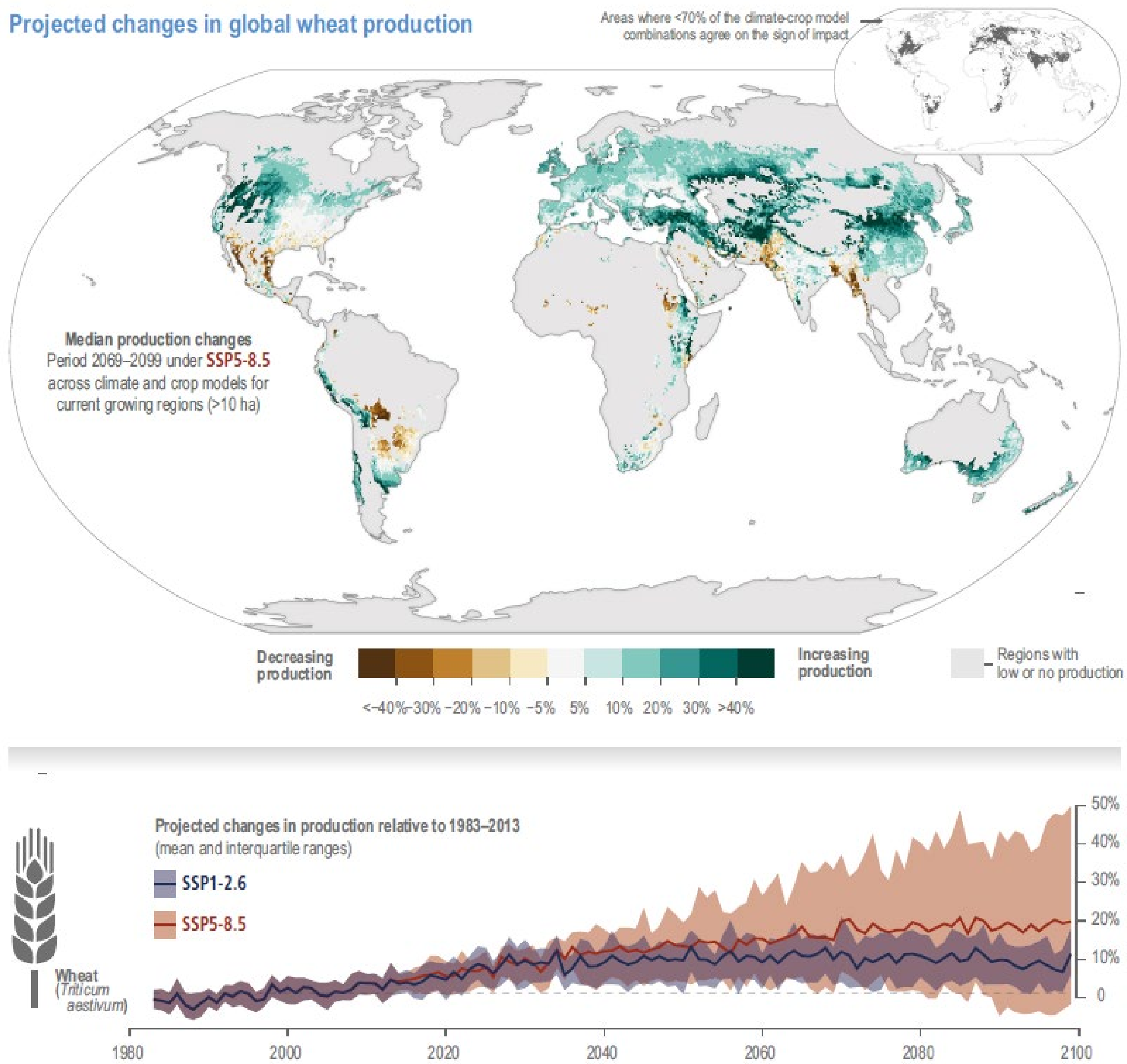


Figure 51: Projected changes in global wheat production. The upper panel shows projected production changes for 2069-2099 under a high emissions scenario, while the lower panel shows the projected changes for a low and high emissions scenario relative to a 1983-2013 baseline (IPCC, 2022a).

Figure 52 illustrates the IPCC projected number of days per year when cattle are exposed to extreme heat stress, relating to a combination of high temperature and humidity under different emissions scenarios. According to the IPCC, extreme heat stress conditions could reduce animal welfare, productivity, fertility, and survival.

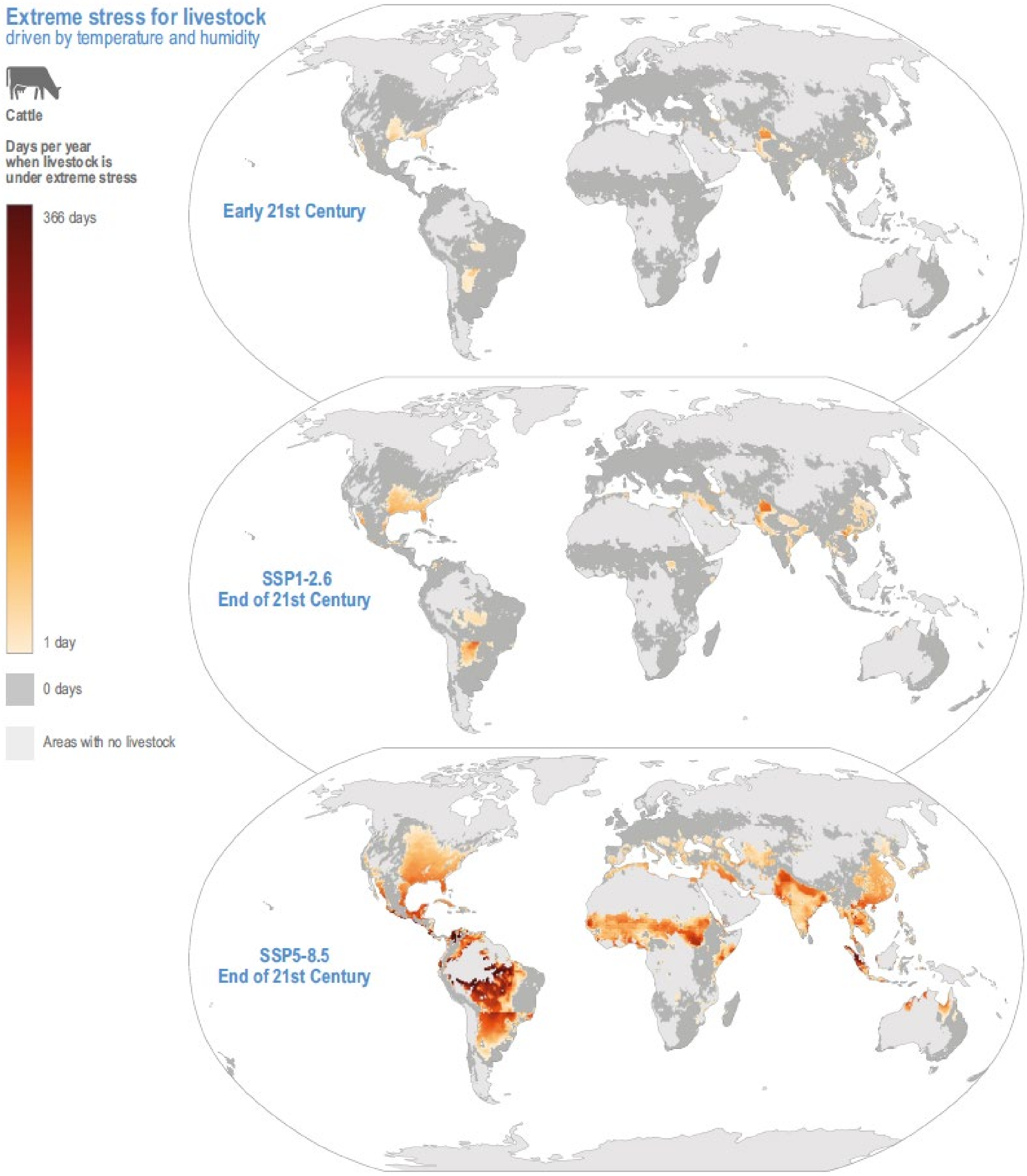


Figure 52: Projected changes in extreme heat stress for livestock (cattle) related to increasing temperature and humidity under a low emissions scenario and a high emissions scenario (IPCC, 2022a).

Productivity

Figure 53 illustrates how rising temperature and humidity are projected by the IPCC to reduce human physical work capacity for outdoor labour, particularly under higher future warming scenarios.

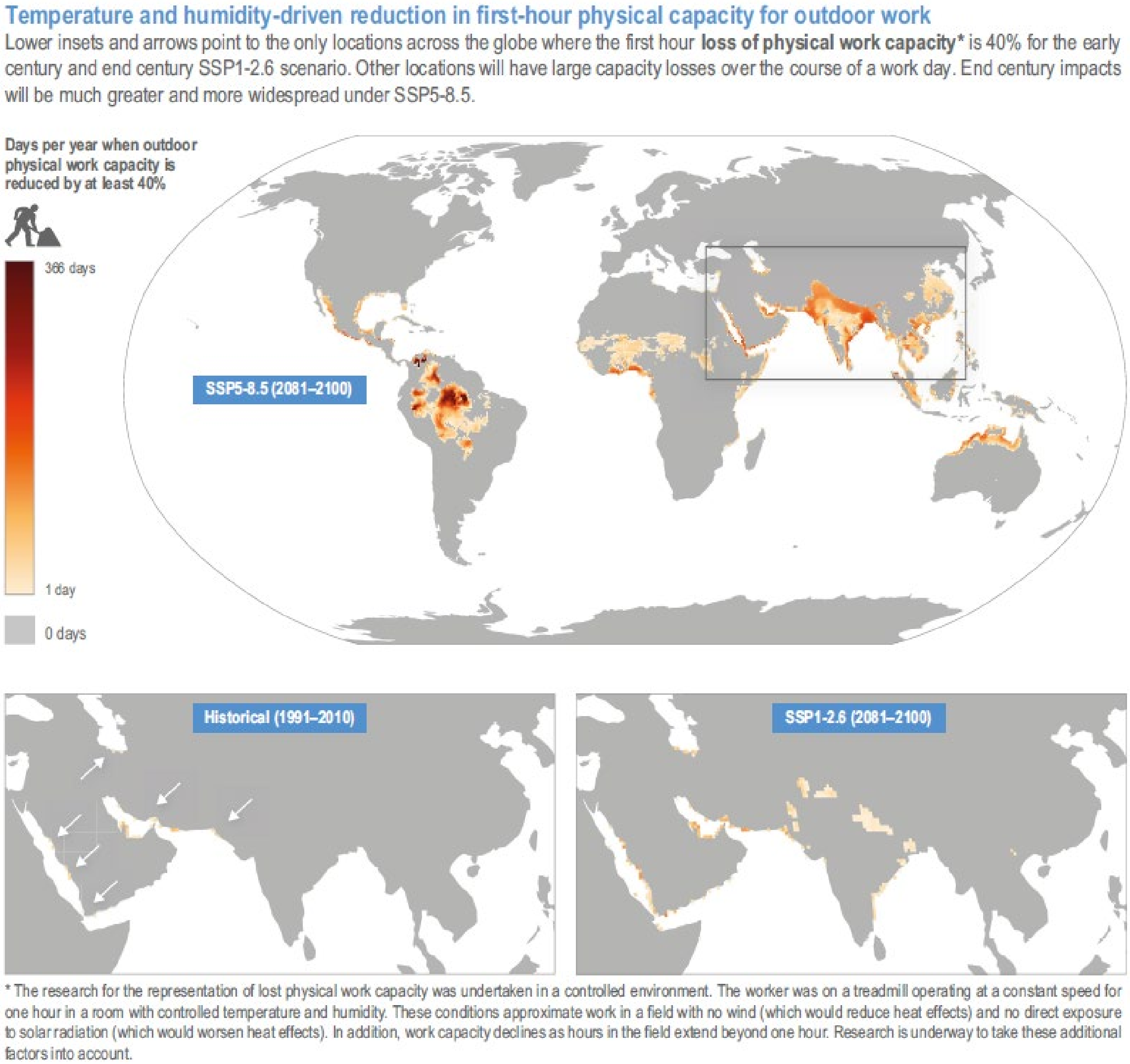


Figure 53: Temperature and humidity-driven reduction in physical work capacity for humans working outdoors for a low emissions scenario and a high emissions scenario (relative to a 1991-2010 baseline) (IPCC, 2022a).

CULTURAL HERITAGE

Projecting changes to cultural heritage is inherently challenging due to its intangible, place-specific, and context-dependent nature, which is difficult to quantify or model (Richards and Brimblecombe, 2025). In addition, there is a general lack of consistent, long term data on cultural heritage and their vulnerability, further limiting the ability to make robust predictions (Crowley *et al.*, 2022). Figure 54 presents water-related adaptation responses, including current benefits, co-benefits with mitigation, potential negative effects, and their future effectiveness and remaining risks projected by the IPCC under different levels of global warming. As shown in Figure 54, according to the IPCC there is low confidence in evidence on Indigenous knowledge and local knowledge based adaptations on water-related adaptation responses.

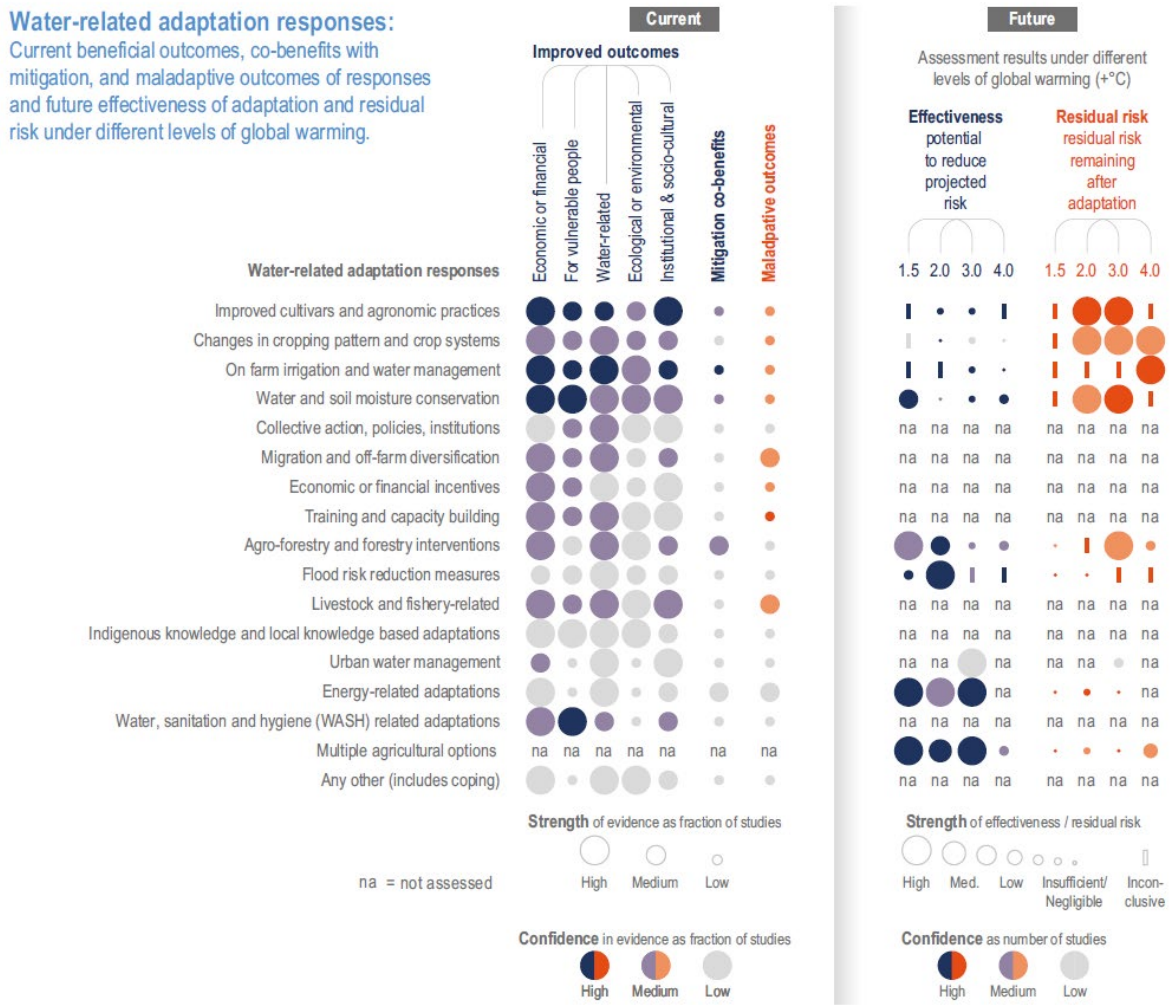


Figure 54: Water-related adaptation responses, including current benefits, co-benefits with mitigation, potential negative effects, and their future effectiveness and remaining risks under different levels of global warming (IPCC, 2022).

Sea-level rise and related coastal hazards are projected by the IPCC to pose increasing climate risks to African heritage over the coming decades. Figure 55 illustrates the coastal cultural and natural heritage sites across Africa that are projected by the IPCC to be at risk from sea-level rise and erosion by 2100 under a high emissions scenario (IPCC, 2022).

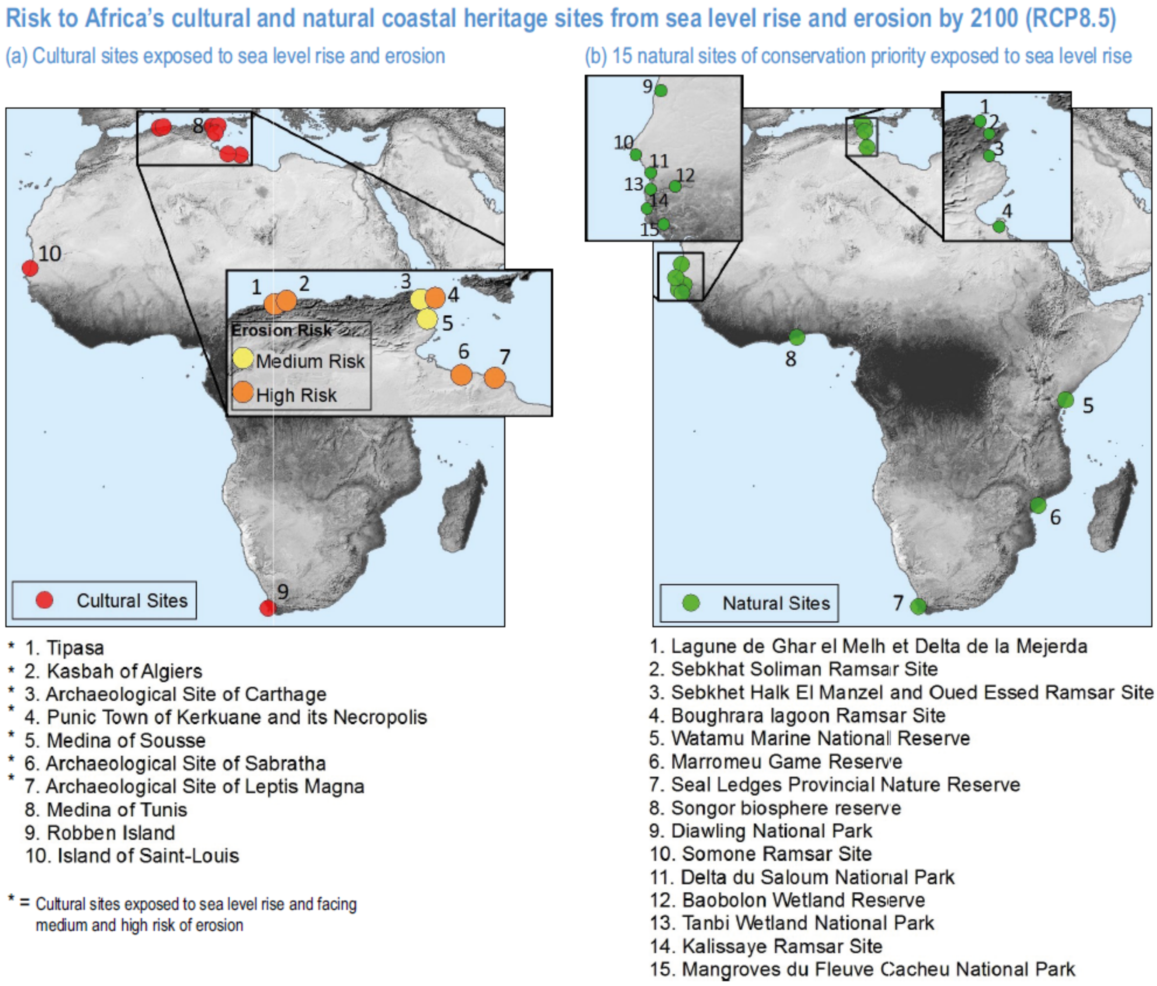


Figure 55: Risk to Africa's cultural and natural coastal heritage sites from sea level rise and erosion by 2100 under a high emissions scenario (RCP8.5) (IPCC, 2022).

Figure 56 illustrates the IPCC projected increase in risk to World Cultural Heritage sites across the Mediterranean from flooding and erosion associated with sea-level rise by 2100 under a high emissions scenario.

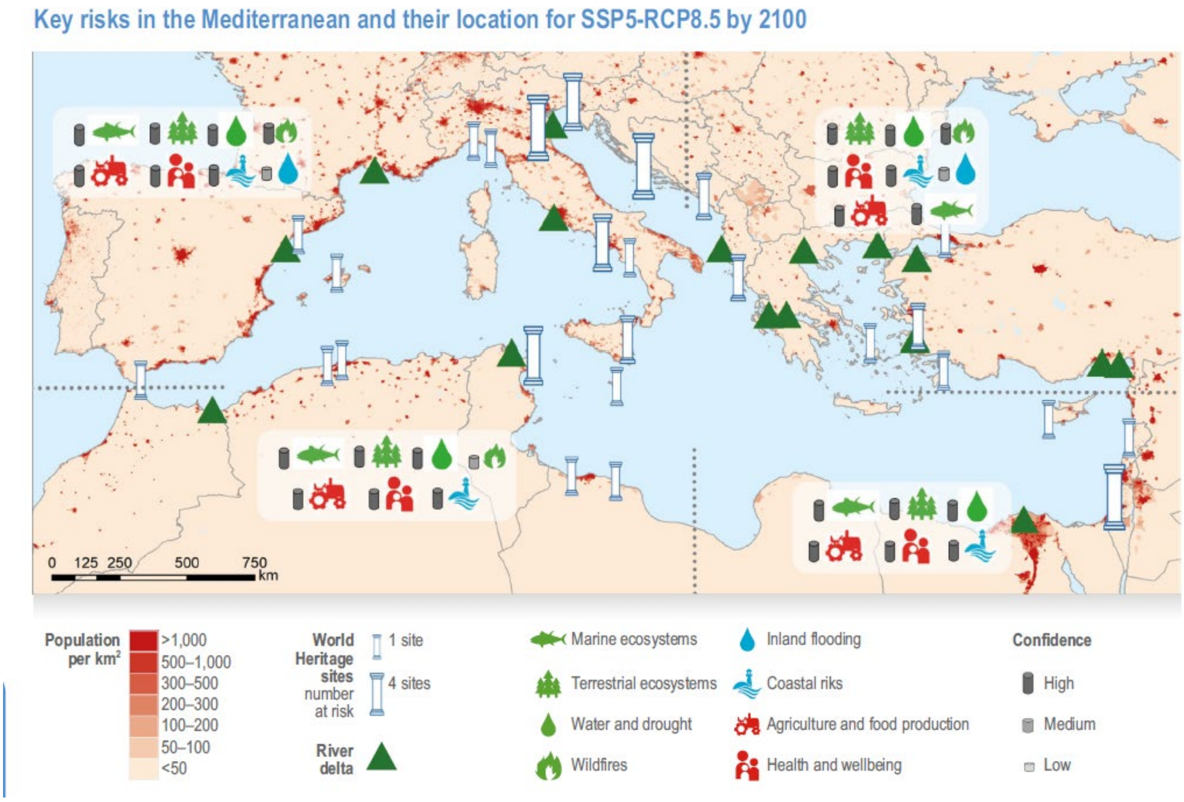


Figure 56: Key risks in the Mediterranean and their location across the Mediterranean region under a high emissions scenario (SSP5-RCP8.5) by 2100 (IPCC, 2022).

THE LANDSCAPE

Figure 57 presents the spatial distribution of current and future Northern Hemisphere lakes that, according to the IPCC, may experience intermittent winter ice cover under climate warming, with light grey areas indicating current conditions and coloured areas showing IPCC projected future changes. The figure indicates that lakes, which currently experience intermittent winter ice cover are projected by the IPCC to see a progressive reduction in ice cover duration as global temperatures increase from 2°C to 3.2°C, 4.5°C and 8°C above the 1970–2010 baseline. Under higher warming scenarios, the extent and duration of lake ice cover are projected by the IPCC to decline further, with some locations projected to lose seasonal ice cover entirely.

Figure 58 shows the IPCC forecasted changes in river ice duration across the Northern Hemisphere under the RCP4.5 scenario, approximately equivalent to a 2°C increase, for the period 2080-2100 compared with 2009-2029. The black reference lines indicate, according to the IPCC, ice duration during the period of 2009-2029, while blue shading indicates increases in ice duration, and grey areas represent land where rivers cannot be observed using the available data. The figure shows that, according to the IPCC, ice duration for rivers is expected to decline across much of the Northern Hemisphere, with the largest changes occurring in areas where rivers currently experience seasonal ice cover. In these regions, the ice season is projected by the IPCC to become shorter in the future, with deeper pink-to-red shading showing greater decreases in ice duration, compared with the baseline period, showing a projected broad reduction in the persistence of river ice under warming conditions. Overall, the figure demonstrates a widespread spatial reduction in river ice duration projected by the IPCC under a moderate warming scenario, consistent with a warming-driven decline in seasonal ice cover (IPPC, 2022).

Overall, both figures show a pattern of decreasing ice cover in lakes and rivers respectively under warming conditions, with greater reductions associated with higher temperature increases."

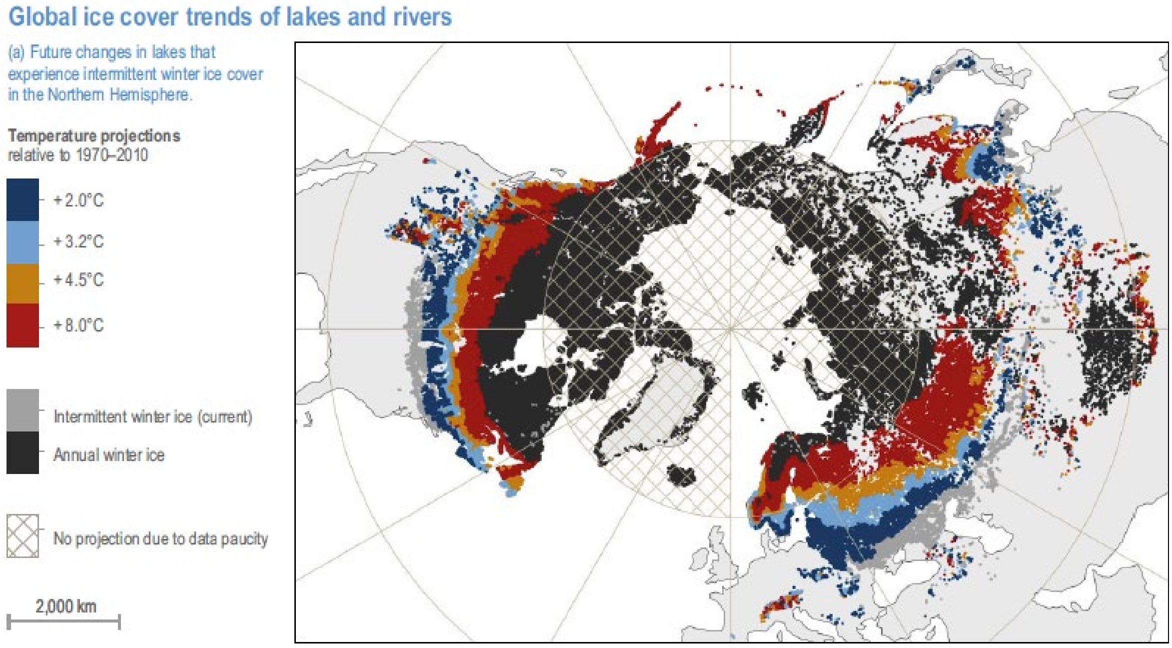


Figure 57: Projected changes in lakes that experience intermittent winter ice cover in the Northern Hemisphere under warming scenarios of 2°C, 3.2°C, 4.5°C and 8°C relative to a 1970-2010 baseline (IPCC, 2022).

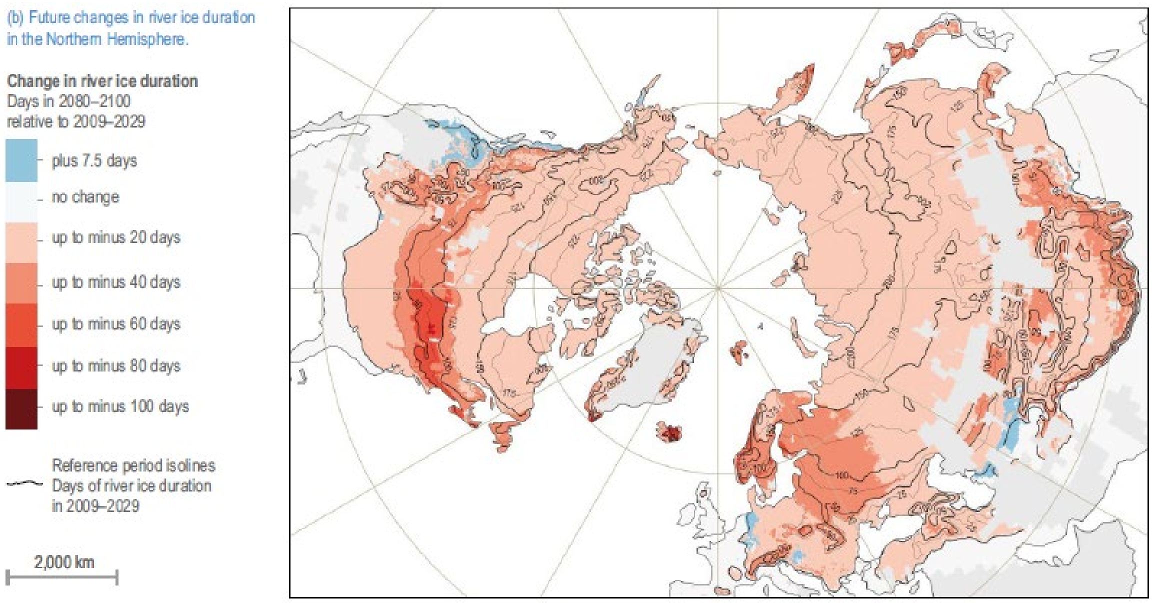


Figure 58: Projected changes in river ice duration across the Northern Hemisphere under the RCP4.5 scenario (around 2°C increase) for 2080–2100, compared to 2009–2029. White areas show rivers with no ice in the baseline period (zero days). Reference lines indicate ice duration during 2009–2029. Colours show changes in ice duration (in days), with blue indicating increases. Grey areas represent land where rivers cannot be observed using available data (IPCC, 2022).

FUTURE UK CLIMATE

Climate change is projected to continue over decades (CCC, 2025). Sea level rise projections for the UK are slightly lower than global mean sea level rise in all scenarios assessed. Sea level rise varies by location according to regional and local conditions. By 2060, sea levels are projected to rise by 19 – 40 cm under SSP1-2.6 and 22 – 44 cm under SSP2-4.5 in England, and 6 – 27cm and 8 – 30 cm in Scotland (Horsburgh *et al.,* 2020). Future projections of storminess, affecting wind and wave heights, are still uncertain due to sensitivity of climate models, therefore it is anticipated that natural variability of wind and wave heights will dominate throughout the next few decades (Bricheno *et al.,* 2025). As a result of human-induced climate change, extreme weather events such as severe winter storms may cross over the UK more frequently (Bricheno *et al.,* 2025).

Oceans absorb atmospheric CO_2, leading to declines in pH (increasing acidity). It is projected that ocean acidification will continue to occur, with the average continental shelf seawater pH continue to decline to 2050 (available data up to 2050). Under SSP2-4.5, pH in the greater North Sea shelf water will decrease at a mean rate of -0.0027 per year until 2050, which is 10% more rapid than at the surface (Findlay *et al.,* 2025).

Sea temperatures are continuing to warm around the UK, with average sea surface temperatures (SST) predicted to continue to warm until the end of the century. It is anticipated that this will be greatest across the North Sea. The increase in SST due to climate change is projected to cause a large increase in the rate of marine heat waves, where under RCP8.5, UK waters are projected to be in marine heatwave conditions for most of the year (Cornes *et al.,* 2025).

The weather related changes currently being experienced in the UK and projected to continue over decades can cause risks to people and infrastructure. The risk of pests, diseases and invasive species, in combination with extreme weather events may affect agriculture and food availability. Agricultural land may increasingly be at risk of flooding, and/or droughts (CCC, 2025). Rising sea temperatures are causing shifts in the distribution of fish and shellfish species around the UK, with declines in cold-water species and increases in warm-water species. Climate change effects in the UK pose a high risk to fishing fleets and coastal regions due to stock sensitivity and low catch diversity (Pinnegar *et al.,* 2023). Human health in the UK may also be affected due to the increased severity and frequency of extreme weather events, increasing strain on water resources, reducing air quality, and increasing risk of new infectious diseases (UK Government, 2023).

Cultural heritage assets located in coastal zones may be affected: without adaptation responses, enhanced rates of erosion and increased risk of flooding may result in loss of assets. Submerged sites will be more adversely affected by changes in ocean pH and circulation patterns (Davies *et al.*, 2023). Similarly, sea level rise and coastal erosion enhances risks to ports and coastal infrastructure. Increased frequency of extreme weather events and storms will affect coastal communities and the operation of ports, marine infrastructure and transport infrastructure (Coyle *et al.*, 2023).

REFERENCES

Bricheno, L.M., Woolf, D., Valiente, N.G., Makrygianni, N., Chowdhury, P. and Timmermans, B. (2025). Climate change impacts on storms and waves relevant to the UK and Ireland. MCCIP Science Review 2025. Available online at: https://www.mccip.org.uk/sites/default/files/2025-04/Storms%20and%20waves_update_May%202025.pdf [Accessed 17/06/2026].

Climate Change Committee (2025). *The Seventh Carbon Budget – Advice for the UK Government*. Available online at: https://www.theccc.org.uk/publication/the-seventh-carbon-budget/ [Accessed: 17/06/2026].

Cornes, R.C., Tinker, J., Hermanson, L., Oltmanns, M., Hunter, W.R., Lloyd-Hartley, H., Kent, E.C., Rabe, B. and Renshaw, R. (2023). *Climate change impacts on temperature around the UK and Ireland.* MCCIP Sci. Rev, 18, pp.1-18.

Cornes, R.C., Tinker, J., Hermanson, L., Oltmanns, M., Hunter, W.R., Lloyd-Hartley, H., Kent, E.C., Rabe, B. and Renshaw, R. (2023). *Climate change impacts on temperature around the UK and Ireland.* MCCIP Sci. Rev, 18, pp.1-18.

Coyle, J., Roberts, H., Amies, J.D., Hodge, K.R., Brooke, J., Dix, J., Clare, M. and Brooks, A.J. (2023). *Impacts of climate change on transport and infrastructure relevant to the coastal and marine environment around the UK and Ireland*. Available online at: https://www.mccip.org.uk/sites/default/files/2023-12/Impacts%20of%20Climate%20Change%20on%20Transport%20and%20Infrastructure.pdf [Accessed 17/06/2026].

Davies, M.H., Dunlop, C., Firth, A., Jay, H. and Whitewright, J. (2023). *Impacts of climate change on cultural heritage in the UK and Ireland*. Available online at: https://www.mccip.org.uk/sites/default/files/2023-09/Impacts%20of%20Climate%20Change%20on%20Cultural%20Heritage%20in%20the%20UK%20and%20Ireland_1.pdf [Accessed 17/06/2026].

Findlay, H.S., Artioli, Y., Greenwood, N., Hartman, S., Flohr, A., León, P., Stiasny, M. and Cronin, M. (2025). *Ocean acidification around the UK and Ireland: Evidence update February 2025*. Available online at: https://www.mccip.org.uk/sites/default/files/2025-02/Ocean%20Acidification_update%20Feb%202025.pdf [Accessed 17/06/2026].

Horsburgh, K., Rennie, A. and Palmer, M. (2020). *Impacts of climate change on sea-level rise relevant to the coastal and marine environment around the UK*. Available online at: https://www.mccip.org.uk/sites/default/files/2021-07/06_sea_level_rise_2020.pdf [Accessed 17/04/2026].

IPCC (2019a). *Summary for policymakers.* In *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (pp. 3–35). https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/.

IPCC (2019b). *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate.* Cambridge University Press. https://www.ipcc.ch/srocc/.

IPCC (2021a). *Summary for policymakers.* In *Climate Change 2021: The Physical Science Basis (Working Group I contribution to the Sixth Assessment Report).* IPCC. https://www.ipcc.ch/report/ar6/wg1/chapter/summary-for-policymakers/.

IPCC (2021b). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* https://www.ipcc.ch/report/ar6/wg1/.

IPCC (2022a). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* IPCC. https://www.ipcc.ch/report/ar6/wg2/.

IPCC (2022b). *Summary for policymakers.* In *Climate Change 2022: Impacts, Adaptation and Vulnerability (Working Group II contribution to the Sixth Assessment Report).* IPCC. https://www.ipcc.ch/report/ar6/wg2/chapter/summary-for-policymakers/.

IPCC (2023). *Climate Change 2023 Synthesis Report.* https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf.

Pinnegar, J.K., Garrett, A., Wouters, J., Kelly, R., Stiasny, M.H. and Marshall, C.T. (2023). *Climate change impacts on commercial and recreational fisheries relevant to the UK and Ireland*. Available online at: https://www.mccip.org.uk/sites/default/files/2023-10/Impacts%20on%20Commercial%20and%20Recreational%20Fisheries%20Relevant%20to%20the%20UK%20and%20Ireland.pdf [Accessed 17/06/2026].

UK Government (2023). *Health effects of climate change in the UK: State of the evidence 2023 (HECC overview report)*. Available online at: https://assets.publishing.service.gov.uk/media/659ff6a93308d200131fbe78/HECC-report-2023-overview.pdf [Accessed 17/06/2026].

APPENDIX 3 ITEM 19

Table 35: Characteristics, Assumptions and Limitations for the Future Scenarios and Emissions Pathways Considered in Equinor (2025)

Description	Purpose	Method for Projecting Future Emissions from Existing and Approved Projects	Key Scenario Characteristics and Assumptions	Uncertainties/Limitations
AR6 scenarios, including IMPs				
AR6 scenarios represent plausible futures for the 'human-environment' system, which vary based on set assumptions on socio-economic conditions and emission mitigation strategies (including in relation to energy systems). For the IPCC (2021) Working Group I Report five Shared Socio-economic Pathways, SSPs) were used to assess climate outcomes. SSPs are defined as baseline socio-economic narratives or storylines used to frame climate futures; they vary across population, income, inequality, technological change, trade, and lifestyle patterns, rather than prescribing a single emissions outcome (IPCC, 2019). For the IPCC (2022) Working Group III Report, a large ensemble of future scenarios were collated from modelling frameworks or studies in existing literature ('the AR6 database'). Each scenario was categorised in accordance with their likelihood of exceeding projected global warming levels (i.e. warming category, C1-C8), climate policies, population, GDP, energy (e.g. fossil fuel use by 2100) and cumulative emissions (refer to the Key Scenario Characteristics and Assumptions column for further information). The AR6 database include the five SSPs used for the Working Group I Report but cover a wider set of scenarios that are more varied in terms of assumptions and outcomes (IPCC, 2022). IPCC (2022) also assess seven Illustrative Pathways (IPs), two reference scenarios (Current Policies (CurPol) – climate policies as per 2020 with only gradual strengthening and Moderate Action (ModAct) – Nationally Determined Contributions (NDCs) as formulated in 2020 with some further strengthening) and five Illustrative Mitigation Pathways (IMPs) have been used to explore the implications of different societal choices and possible climate policy	Scenario driven mitigation pathways which evaluate climate impacts and improve analytical framing by employing standardised models integrating socioeconomic data. This approach contributes to the assessment of the feasibility and implications of different ambition levels. The scenarios are used to support understanding of possible climate outcomes, impacts and risks, and mitigation futures.	The AR6 scenarios emission projections are typically presented as a median and interquartile. This is due to the spread of individual modelling scenario outcomes across each scenario group. Each AR6 scenario projection is derived from thousands of individual modelling scenarios (which were then grouped based on key characteristics and assumptions).	The key assumptions for SSPs include: - The socio-economic drivers are exogenous narrative pathways used to generate emissions baselines (Ministry for the Environment, New Zealand, 2024a) and IAMs link these drivers to energy demand, emissions, and mitigation outcomes (IPCC, 2023b). - Baseline scenarios typically assume no additional climate policies beyond those already in place, allowing comparison with stronger mitigation scenarios (IPCC, 2023a). Emission scenarios grouped into categories (C1–C8) based on their likelihood of exceeding global warming levels (e.g. 1.5°C, 2°C, >3°C) derived from modelled emissions pathways and Integrated Assessment Modelling (IAM) results (IPCC, 2024). The key assumptions include: - The categories group emission scenarios based on the level of global warming they achieve by 2100, ranging from pathways consistent with limiting warming to around 1.5°C (C1) to those with much higher temperature increases (IPCC, 2024). - Many of the lower-temperature pathways assume rapid reductions in emissions increasing use of carbon dioxide removal technologies (IPCC, 2023b). - Categories aggregate heterogeneous pathways into single groups, masking differences in underlying assumptions or policy choices and intra-category variability (IPCC, 2023c; IIASA, 2022). The energy system is a key defining feature of the IMPs. Key characteristics ('storylines') for each scenario relevant to oil and gas emissions includes (IPCC, 2022; Achakulwisut *et al.*, 2023): - IMP-Neg (Illustrative Mitigation Pathways - Net Negative Emissions; consistent with limiting warming to 1.5°C (>50%) after a high overshoot)	General AR6 scenarios: – Large uncertainty in projections across AR6 scenario database and IMPs, each scenario is associated with range of highly uncertain assumptions about behaviour, technology (e.g. deployment of Carbon Dioxide Removal (CDR) and CCS) and investment. Scenarios are not assigned a probability. – Future scenarios are projections (i.e. plausible futures) and not predictions or forecasts. Scenarios and projections are contingent on assumptions being realised. The SSPs are narrative frameworks, not forecasts; used in models to explore a range of plausible futures rather than assign probabilities (IPCC, 2019). – Does not represent up to date global oil and gas production (historic and forecast) or climate models / modelling frameworks published after 2021. – Projections are based on a 2020 base-year (i.e. CurPol and ModAct reference scenarios are based on climate policies and NDCs, as per 2020). – Scenario database contains a vast amount of data from heterogenous sources, so the comparability of the data is less straightforward (Cointe, 2024). – IMPs are representative scenarios within each warming category (IPCC, 2022). – Projections are typically presented as median values and interquartile ranges. There are limitations to using the median values as the AR6 database does not represent a

Description	Purpose	Method for Projecting Future Emissions from Existing and Approved Projects	Key Scenario Characteristics and Assumptions	Uncertainties/Limitations
futures. These IPs can be aligned to Shared Socio-Economic Pathways (SSPs) but cover wider and more varied set of assumptions, providing a greater insight into how different mitigation strategies could achieve Paris Agreement temperature goals (IPCC, 2022). Representative quantitative projections were selected for each IP from the AR6 database (based on the scenario characteristics).			○ Reliance on carbon dioxide removal to compensate fossil fuel emissions ○ In 2050, oil supply is 25% lower than 2020 levels; gas supply is 22% lower than 2020 levels. - IMP-GS (Illustrative Mitigation Pathways - Gradual Strengthening; consistent with limiting warming to 2°C (>67%)) ○ As per IMP-Neg, with delay. ○ In 2050, oil supply is 40% lower than 2020 levels; gas supply is 66% lower than 2020 levels. - IMP-Ren (Illustrative Mitigation Pathways - Renewables; consistent with limiting warming to 1.5°C (>50%) with no or limited overshoot) ○ Emphasis on renewables expansion and electrification. ○ In 2050, oil supply is 77% lower than 2020 levels; gas supply is 78% lower than 2020 levels. - IMP-LD (Illustrative Mitigation Pathways - Low Demand; consistent with limiting warming to 1.5°C (>50%) with no or limited overshoot) ○ Strong emphasis on lowering energy demand while meeting energy needs, rapid technological advancements and transport shifts. ○ In 2050, oil supply is 90% lower than 2020 levels; gas supply is 85% lower than 2020 levels. - IMP-SP (consistent with limiting warming to 1.5°C (>50%) with no or limited overshoot) ○ Lower energy demand while meeting energy demands, expansion of renewable energy. ○ In 2050, oil supply is 51% lower than 2020 levels; gas supply is 68% lower than 2020 levels. IPCC (2022) and Achakulwisut *et al.* (2023) also reports the following (without specific reference to IPs): - For scenarios consistent with limiting warming to 1.5°C ○ Natural gas use declines by 21-62% in 2050, relative to 2020 levels. Natural	statistical sample (Achakulwisut *et al.*, 2023). – The energy system component of IMPs should not be considered in isolation from other mitigation strategies (e.g. innovation, land use and lifestyle) (IPCC, 2022). – Oil and gas supply and demand is primarily generated by IAMs which are simplified representations of complex systems and do not represent market behaviour or responses to geopolitical shocks well (Asefi-Najafabady *et al., 2020).* – Not all variables are consistently reported across the AR6 model-scenarios. – IAMs do not reflect the risk of failure of the technologies or measures on which they rely (Achakulwisut *et al.,* 2023). – Structural differences across IAMs (e.g. sector coverage, technology representation) reduce comparability (Kistra *et al.*, 2022). – IAMs typically do not separate energy and non-energy uses of fossil fuels (Achakulwisut *et al.,* 2023). – Wide range of possible outcomes due to uncertain socio-economic development, technological change, and policy responses across pathways (Piarini *et al.*, 2024; Nicholls *et al.,* 2022). – Uncertainty is structural: the SSPs encode different futures for socioeconomic development rather than probabilistic forecasts. The main uncertainty lies in future demographic, economic, institutional, and technological trajectories (IPCC, 2019). – The SSPs do not determine climate outcomes on their own; actual warming depends on the emissions

Description	Purpose	Method for Projecting Future Emissions from Existing and Approved Projects	Key Scenario Characteristics and Assumptions	Uncertainties/Limitations
			gas remains part of energy systems through to 2050. o Oil use declines by 30-78% in 2050, relative to 2020 levels. There are some scenarios with higher cumulative oil supply associated with demand for transportation and non-energy use. - For scenarios consistent with limiting warming to 2°C o Natural gas use declines by -14%-36% in 2050, relative to 2020 levels. o Oil use declines by 14%-45% in 2050, relative to 2020 levels. **CurPol and ModAct** are intended to show the effect of gradual policy strengthening versus stronger action, rather than represent a single policy forecast (IPCC, 2023d). They are used as reference cases to compare current-policy outcomes with stronger mitigation cases (IPCC, 2023f). Both reflect near- to medium-term policy real-world policy decisions and commitments rather than scenarios that are deliberately constructed to achieve a specific outcome or targets (IPCC, 2023b). They assume that policies are implemented as planned, which may not reflect real-world delays or failures. (IPCC, 2023c). Key characteristics for the **CurPol and ModAct** reference scenarios include (IPCC, 2022; Achakulwisut *et al.,* 2023): - CurPol (consistent with limiting warming to 4°C (>50%)) o Fossil fuels remain important and are locked in. o Assumes continuation of existing implemented policies by the end of 2020 (≈ policy baseline) (IPCC, 2023a; IPCC, 2023g). - ModAct (consistent with limiting warming to 3°C (>50%)) o Moving away from coal, some lock-in in fossil fuel investments, growth in renewables. o Assumes moderate strengthening of policies, often aligned with NDCs or	pathway paired with the socioeconomic storyline (IPCC, 2023e). - Wide uncertainty in socioeconomic drivers (GDP growth 2.7–4.1%/yr; population ~8.5–9.7bn by 2050) (IPCC, 2023a). - The speed and cost of technological innovation, such as clean energy deployment, are uncertain and vary across scenarios. (IPCC, 2023b). - Even if emissions pathways are known, there remains uncertainty in how the climate system will respond, meaning similar SSPs can lead to different temperature outcomes. (IPCC, 2024; Kikstra *et al.,* 2022). - Different models use different methods and assumptions, which means results for the same SSP can vary significantly depending on the model used (IPCC, 2023b). - SSPs rely on integrated assessment models and simplified representations of complex socio-economic systems.to explore different futures (Ministry for the Environment, New Zealand, 2024a). - Limited representation of feedback from climate impacts to socioeconomic development (one-directional framework) (IPCC, 2024). - Human factors such as behaviour change, lifestyle shifts, and political dynamics are simplified or only partially represented in the models. (IPCC, 2023b). C1-C8 emissions scenario categories: - There is high uncertainty about whether carbon dioxide removal technologies can be deployed at

Description	Purpose	Method for Projecting Future Emissions from Existing and Approved Projects	Key Scenario Characteristics and Assumptions	Uncertainties/Limitations
			incremental mitigation efforts (partial implementation of climate goals) inferred from AR6 comparisons (IPCC, 2023c).	the scale and speed assumed in many scenarios (IPCC, 2023b). – Climate system uncertainty (e.g., transient climate response i.e. how sensitive temperatures are to emissions) affect how pathways map to warming levels (IPCC, 2024). – Many scenarios rely heavily on large-scale carbon dioxide removal technologies, which are not yet proven at the required scale in the real world (IPCC, 2023b). – Categories aggregate heterogeneous pathways into single groups, masking differences in underlying assumptions or policy choices and intra-category variability (IPCC, 2023c; IIASA, 2022). – Differences in how models represent sectors (such as agriculture or industry) require harmonisation, which introduces simplifications (IPCC, 2023b). CurPol and ModAct scenarios: – Projections are based on a 2020 base-year (i.e. CurPol and ModAct reference scenarios are based on climate policies and NDCs). – Uncertainty is driven by how quickly current policies tighten, whether announced measures/policies are implemented, whether pledges are translated into enforceable measures and how sectoral transitions unfold (IPCC, 2023d). – These scenarios typically lead to a wide range of emission outcomes (e.g., ~2.2–3.5°C median warming for policy-based pathways), reflecting uncertainty in policy

Description	Purpose	Method for Projecting Future Emissions from Existing and Approved Projects	Key Scenario Characteristics and Assumptions	Uncertainties/Limitations
				ambition and effectiveness (IPCC, 2023c). – Political, economic and social changes (such as elections or economic crises) are not captured in baseline policy continuation assumptions and could significantly alter policy trajectories (Re IPCC, 2023b). – These pathways do not represent what would be required to meet international climate goals such as limiting warming to 1.5°C, so they are not suitable for assessing Paris-aligned futures. (IPCC, 2023a).
IEA STEPS/APS/NZE				
Scenarios derived from the IEA's Global Energy and Climate (GEC) model. Each scenario is defined as follows: • CPS – Current Policies. • STEPS – Stated Policies. • APS – Announced Pledges. • NZE – Net Zero Emissions. Contrary to the scenarios within IPCC (2023h) AR6 and SEI *et al.* (2025) Production Gap Report (see below), the scenarios in IEA (2024) do not represent an ensemble of multiple modelling scenarios and are derived from the IEA's GEC Model, a bottom-up modelling framework which uses macroeconomic drivers, socio-economic inputs and policies to design and calculate a range of future energy scenarios. Macroeconomic drivers, such as economic activity and population are generally kept constant across all scenarios, with other factors that drive fossil fuel production and consumption (e.g. fossil fuel prices, energy demand, policies) varying between scenarios. Since Equinor (2025), the IEA (2025b) World Energy Outlook 2025 has been released	Scenario-driven approach to examine future energy trends. To explore the impact of policies and targets (for STEPs and APS) on energy systems (from a defined set of starting conditions). To explore pathways for the energy sector to achieve emission goals (e.g. NZE scenario).	The GEC model projects CO_2 emissions from fuel combustion and industrial processes associated with the projected energy demand / consumption for each scenario. The GEC model derives energy demand / consumption by modelling iterative interactions between energy supply and demand and determining equilibrium price that balances energy supply and demand. **Supply module** Oil supply is modelled at the country level using an asset-based approach, incorporating: • Historical production rates. • Production profiles and estimated decline rates. • Review of upstream, planned and announced upstream projects, using information gathered for the IEA Medium-Term Oil Market Report (covers period up to 2030). • Decision modes of industry to develop new reserves. • Economic assumptions and financial risks (including to capture	– CPS (*excluded from IEA, 2024*): • Includes only policies already enacted into law, excluding announced intentions (IEA, 2025c). • No new long-lead time oil and gas projects required. – STEPS (IEA, 2024): • Based on current stated and announced policies (including planned policies), reflecting today's policy trajectory already implemented or credibly announced, but excludes aspirational targets (IEA, 2025d). • Represents the "direction of travel" under today's policy settings and market conditions. • Assumes incremental energy transition, not structural transformation. • Oil demand peaks around 2030 and gradually declines. • Gas demand continues to grow until 2036 and then plateaus. • There is an ongoing need for new oil and gas supply.	– Scenarios are exploratory and not predictions. Scenarios and projections are contingent on assumptions being realised (IEA, 2025b). – The scenarios depend heavily on assumptions about policy implementation, especially in APS and NZE. For example, the scenarios assume stated pledges become implemented policies and that current policies are strengthened. There is uncertainty about how countries will update their climate commitments (NDCs) in future policy cycles (post-2025). (IEA, 2025a). – Policy delivery risk (gap between announcements and implementation central in APS) (IEA, 2025a). – Future technology costs and adoption rates (such as renewables, hydrogen, or carbon capture) remain uncertain (IEA, 2024). – Large uncertainty in projections associated with range of highly

Description	Purpose	Method for Projecting Future Emissions from Existing and Approved Projects	Key Scenario Characteristics and Assumptions	Uncertainties/Limitations
which updates the scenario of the IEA (2024) World Energy Outlook 2024 (source for Table 17 of the assessment, Equinor (2025)). IEA (2025b) does not include the APS scenario, includes a new Current Policies Scenario (CPS) and the NZE scenario is no longer a limited-overshoot scenario, as warming peaks above 1.6 °C and exceeds 1.5°C for several decades before returning below 1.5°C by 2100. The APS scenario was excluded from IEA (2025b), pending updated NDC clarity. The formal base year for the GEC Model outputs for the IEA (2025b) World Energy Outlook 2025 is 2023, however, 2024 estimates for energy production and demand are used, where available (IEA, 2025e).		'attractiveness' of investment in oil and natural gas fields). • Values of remaining technically recoverable resources (based on the United States Geological Survey, USGS) to define the upper bound of resource availability but do not constrain production in policy-driven scenarios. Natural gas production is modelled in a similar approach to oil, however, it is assumed that natural gas is primarily traded regionally. The model accounts for declines in oil and natural gas fields, derived from the UCube database of Rystad Energy. Decline rates and post-peak production profiles for oil and gas assets are informed by asset-level databases such as Rystad Energy's UCube, supplemented by expert judgement and quality assurance processes undertaken by the IEA. The UCube database is refined to include individual oil and natural gas assets only if >50% of historical data points are of high confidence level or > 66% are medium confidence level and only if assets have <4% speculative data with no missing values. Assets with company-level data only were also excluded. **Demand and transformation module** Demand is based on projections for energy consumption across key sectors, including industry, transport, buildings under the which take account of technological advances and technology costs (factoring in fossil fuel prices, end-use prices and CO_2 prices). Electricity and heat production is calculated to determine fuel consumption and associated CO_2 emissions. **Equilibrium price** The final energy demand / consumption is derived by determining the equilibrium price the balances supply and demand. The GEC model prioritises projects based on their profitability (net present value) and applies real-world constraints for each	– APS (*excluded from IEA, 2025*): • Assumes full and timely implementation of announced pledges (e.g., NDCs, net-zero targets) (IEA, 2025a). • Assumes full implementation of all announced pledges (NDCs + net-zero) (IEA, 2025a). – NZE: • A normative pathway assuming rapid global decarbonisation, net-zero CO_2 by 2050, and strong policy + technology deployment (IEA, 2023). • No probabilities are assigned to pathways pathway designed to achieve net zero emissions by 2050. • Oil and gas demand rapidly declines to 2050. • No new long-lead time oil and gas projects required.	uncertain assumptions about behaviour, technology (e.g. CCS) and investment. – Energy demand projections depend on uncertain factors such as economic growth and electrification trends (IEA, 2024). – Focussed on energy system and does not capture economy-wide feedback (e.g. labour markets, inflation). – Some emerging technologies or behavioural changes may not be fully represented due to modelling constraints (IEA, 2024). – NZE scenario is associated with temporary overshoot of 1.5 °C (IEA, 2025b). – Considering alignment of emissions with STEPS / APS / NZE scenarios alone ignores range of other plausible climate-energy futures. – The modelling focuses primarily on the energy system and does not fully capture broader socioeconomic dynamics compared to IPCC frameworks (IEA, 2024). – The GEC model relies on estimates of the remaining technically recoverable resources, rather than the (often more widely quoted) numbers for proven reserves. Resource estimates are subject to a considerable degree of uncertainty, as well as the distinction in the analysis between conventional and unconventional resource types. – Increased uncertainty in policy ambition tracking without APS benchmark scenario. Discontinuity reduces comparability across editions (IEA, 2025a,b). • Reflects dependence on evolving policy datasets rather than stable

Description	Purpose	Method for Projecting Future Emissions from Existing and Approved Projects	Key Scenario Characteristics and Assumptions	Uncertainties/Limitations
		country, such as operating costs, development timelines for new developments, and operating costs. Where demand cannot be met, this indicates prices should increase and the model is re-run.		methodological framework (IEA, 2025b).
SEI Production Gap Report				

Analysis of future fossil fuel production plans of twenty countries and compares these volumes to the projected levels of future fossil fuel production estimates in climate models consistent with keeping the Paris Agreement's temperature goal within reach.
 	
The report includes median oil and gas production and associated emission projections for a refined set of scenarios from the AR6 database for the C1 and C2 warming categories. The report also includes the IEA STEPs and APS scenarios from the IEA World Energy Outlook 2022 (IEA, 2022) and an additional Government Plans and Projections (GPP) pathway.
 	
Since Equinor (2025), the SEI *et al.* (2025) Production Gap Report was published. The 2025 report includes updated profiles for fossil fuel production plans and uses the IEA STEPS and APS scenario modelling, reflecting the outputs from the IEA World Energy Outlook 2024 (IEA, 2024).
	Tracks alignment of planned fossil fuel production with production levels consistent with maintaining warming levels below 1.5°C or 2°C and the implications of this 'production gap'.	The SEI *et al.* (2025) Production Gap Report presents median oil and gas production and use projections for scenarios consistent with limiting warming to below 1.5 ℃ and 2 ℃. The projections are derived from modelling scenarios included within the IPCC (2023h) AR6 scenario ensemble (C1 and C3 warming categories) with several exclusions / refinements (SEI *et al.*, 2023):
		• Scenarios relying on bioenergy combined with carbon capture (BECCS) to remove 5 $GtCO_2$ per year by 2050 were excluded.
		• Scenarios relying on afforestation/reforestation to remove 3.6 $GtCO_2$ per year by 2050 were excluded.
		• Scenarios with carbon capture and storage of 8.6 $GtCO_2$/yr were excluded.
		• Scenarios that feature delayed climate action were excluded.
		• Only scenarios compatible with reaching net zero GHG emissions by 2100 were included.
		
		The GPP pathway is derived from a review of 19 major producing country plans and projections. The future global projections are calculated by aggregating production levels of the 19 major producing countries based on their predicted share of global fossil fuel production for the STEPs scenario of IEA (2024). Extraction-based emissions are based on the method presented in Davis *et al.* (2011) and assumes a portion is put towards non-energy uses.
			• GPP Pathway:
			  ◦ Oil production peaks in 2030 and plateaus, production from Saudi Arabia, Brazil and US makes the highest contributions.
			  ◦ Gas production increases to 2050 (49% above 2020 levels).
			
			The key characteristics of the STEPS scenario are not repeated here and are discussed for IEA (2025b) above. Similarly, the key characteristics the AR6 scenarios, used for the projections for pathways compatible with maintaining warming levels below 1.5°C or 2°C are described above and also not repeated here.
				• Lack of standardised reporting of fossil fuel production across countries. For some countries and fuels, government plans and projections end before 2050. To extrapolate all countries' projections to 2050, this analysis uses the percentage change for a given country and specific fossil fuel (oil, gas, and coal) as modelled under the IEA's STEPS. This scenario reflects existing policies as of 2022; thus, this is likely a conservative extrapolation approach, given that estimated global production under the GPP pathway is higher than under the STEPS.
				• Uncertainties and limitations for the scenarios derived from AR6 scenarios and IEA (2024) are described above.

Description	Purpose	Method for Projecting Future Emissions from Existing and Approved Projects	Key Scenario Characteristics and Assumptions	Uncertainties/Limitations
		The methodology for the IEA GEC Model, used for the projections of the STEPS scenario are not repeated here and are discussed for IEA (2025b) above.		

REFERENCES

Achakulwisut, P., Erickson, P., Guivarch, C., Schaeffer, R., Brutschin, E. and Pye, S. (2023). Global fossil fuel reduction pathways under different climate mitigation strategies and ambitions. *Nature Communications*, **14(1)**, 5425.

Asefi-Najafabady, S., Villegas-Ortiz, L. and Morgan, J. (2021). The failure of Integrated Assessment Models as a response to 'climate emergency'and ecological breakdown: the Emperor has no clothes. *Globalizations*, *18*(7), pp.1178-1188.

Cointe, B. (2024). The AR6 Scenario Explorer and the history of IPCC Scenarios Databases: evolutions and challenges for transparency, pluralism and policy-relevance. *npj Climate Action*, *3*(1), p.3.

Davis, S.J., Peters, G.P. and Caldeira, K. (2011). The supply chain of CO_2 emissions. Proceedings of the National Academy of Sciences, 108(45), 18554-18559.

Equinor (2025). Rosebank. Response to Requirement #1 (An assessment of the effects of downstream scope 3 emissions from the above project on climate) of the Regulation 12(1) Notice dated 21 July 2025. Available online at: https://assets.publishing.service.gov.uk/media/68ef61fd82670806f9d5e0a9/Rosebank_Reg_12__1__Assessment_of_Scope_3_Emissions__OPRED_131025__errors_corrected.pdf [Accessed 05/06/2026].

IEA (2022). World Energy Outlook 2022. Available online at: https://www.iea.org/reports/world-energy-outlook-2022 [Accessed 05/06/2026].

IEA (2023). Net Zero Emissions. Available online at: https://www.iea.org/topics/net-zero-emissions [Accessed 16/06/2026].

IEA (2024). World Energy Outlook 2024. Available online at: https://www.iea.org/reports/world-energy-outlook-2024 [Accessed 16/06/2026].

IEA (2025a). Announced Pledges Scenario (APS). Available online at: https://www.iea.org/reports/global-energy-and-climate-model/announced-pledges-scenario-aps [Accessed 16/06/2026].

IEA (2025b). World Energy Outlook 2025. Available online at: https://www.iea.org/reports/world-energy-outlook-2025 [Accessed 16/06/2026].

IEA (2025c). Current Policies Scenario (CPS). Available online at: https://www.iea.org/reports/global-energy-and-climate-model/current-policies-scenario-cps [Accessed 16/06/2026].

IEA (2025d). Stated Policies Scenario (STEPS). Available online at: https://www.iea.org/reports/global-energy-and-climate-model/stated-policies-scenario-steps [Accessed 16/06/2026].

IEA (2025e). Global Energy and Climate Model. Available online at: https://www.iea.org/reports/global-energy-and-climate-model [Accessed 05/06/2026].

IIASA (2022). AR6 Scenario Explorer and Database. Available online at: https://iiasa.ac.at/models-tools-data/ar6-scenario-explorer-and-database [Accessed 16/06/2026].

IPCC (2019). Summary for Policymakers. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Available online at:

https://www.ipcc.ch/site/assets/uploads/2019/11/02_Summary-for-Policymakers_SPM.pdf [Accessed 16/06/2026].

IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report. Cambridge University Press.

IPCC (2023a). AR6 Working Group III Chapter 3. Available online at: https://www.ipcc.ch/report/ar6/wg3/chapter/chapter-3/ [Accessed 16/06/2026].

IPCC (2023b). AR6 Working Group III Annex III. Available online at: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Annex-III.pdf [Accessed 16/06/2026].

IPCC (2023c). Figure SPM.5. In: Summary for Policymakers. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Available online at: https://www.ipcc.ch/report/ar6/wg3/figures/summary-for-policymakers/figure-spm-5/ [Accessed 16/06/2026].

IPCC (2023d). Figure 3.5. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Available online at: https://www.ipcc.ch/report/ar6/wg3/figures/chapter-3/figure-3-5 [Accessed 16/06/2026].

IPCC (2023e). AR6 WG I Chapter 4. Available online at: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter04.pdf [Accessed 16/06/2026].

IPCC (2023f). Figure 11.12. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Available online at: https://www.ipcc.ch/report/ar6/wg3/figures/chapter-11/figure-11-12 [Accessed 16/06/2026].

IPCC (2023g). Figure SPM.5. In: Summary for Policymakers. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Available online at: https://www.ipcc.ch/report/ar6/wg3/figures/summary-for-policymakers/figure-spm-5/ [Accessed 16/06/2026].

IPCC (2023h). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report. IPCC, Geneva.

IPCC (2024). AR6 Synthesis Report LR Cross-Section Box.2, Figure 1 (a): Schematic of the AR6 framework for assessing future greenhouse gas emissions, climate change, risks, impacts, and mitigation, NASA Socioeconomic Data and Applications Center (SEDAC). Available online at: https://ipcc-browser.ipcc-data.org/browser/dataset/8438/0 [Accessed 16/06/2026].

Kikstra, J.S., Nicholls, Z.R., Smith, C.J., Lewis, J., Lamboll, R.D., Byers, E., Sandstad, M., Meinshausen, M., Gidden, M.J., Rogelj, J. and Kriegler, E. (2022). A multi-model assessment of climate scenario frameworks. Geoscientific Model Development, 15, 9075–9095. Available online at: https://gmd.copernicus.org/articles/15/9075/2022/gmd-15-9075-2022.html [Accessed 16/06/2026].

Ministry for the Environment, New Zealand (2024a). Intergovernmental Panel on Climate Change SSP-RCP scenarios. Available online at: https://environment.govt.nz/what-you-can-do/climate-scenarios-toolkit/climate-scenarios-list/ipccs-ssp-rcp-scenarios/ [Accessed 16/06/2026].

Ministry for the Environment, New Zealand (2024b). International Energy Agency Scenarios. Available online at: https://environment.govt.nz/what-you-can-do/climate-scenarios-toolkit/climate-scenarios-list/international-energy-agency-scenarios/ [Accessed 16/06/2026].

Nicholls, Z., Meinshausen, M., van der Wijst, K., Kikstra, J., Byers, E., Riahi, R., van Vuure, D., and Kriegler, E. (2022). Data for Figure Box SPM.1 - Summary for Policymakers of the Working Group III Contribution to the IPCC Sixth Assessment Report. Available online at: https://ipcc-browser.ipcc-data.org/browser/dataset?id=4134 [Accessed 16/06/2026].

Pirani, A., Fuglestvedt, J.S., Byers, E., O'Neill, B., Riahi, K., Lee, J.Y., Marotzke, J., Rose, S.K., Schaeffer, R. and Tebaldi, C. (2024). Scenarios in IPCC assessments: lessons from AR6 and opportunities for AR7. *npj Climate Action*, *3*(1), p.1.

SEI, Climate Analytics, E3G, IISD, UNEP (2023). Production Gap Report 2023: Phasing Down or Phasing Up?

SEI, Climate Analytics and IISD (2025). The Production Gap Report 2025. Available online at: https://www.iisd.org/publications/report/production-gap-2025 [Accessed 05/06/2026].

APPENDIX 4 ITEM 42

The following screenshots replicate the relevant tabs of the spreadsheet referenced in Item 42. They are provided to show the type of information included in the spreadsheets; for the full detail available in the sheets, see the spreadsheet itself.

Spreadsheet tab: Emissions – Turbine & Flare

Summary

Year	Turbine	Flare	
	CO2 / year	CO2 / year	
2026	37,661	18,300	
2027	155,192	20,568	
2028	154,841	4,502	
2029	153,239	4,241	
2030	157,214	3,775	
2031	156,672	3,953	
2032	159,771	4,486	
2033	163,912	4,252	
2034	161,644	3,907	
2035	158,831	3,551	
2036	163,037	3,199	
2037	160,760	2,846	
2038	158,444	2,592	
2039	161,937	2,360	
2040	161,266	2,119	
2041	154,758	1,957	
2042	155,029	1,770	
2043	153,127	1,601	
2044	151,483	1,466	
2045	154,404	1,330	
2046	152,998	1,221	
2047	149,972	1,093	
2048	155,328	1,006	
2049	154,165	942	
2050	151,747	876	
2051	104,931	554	
Total	**3,902,365**	**98,467**	
Table 9-5	**3,999,782**	**81,956**	**From ES/2022/001**

Spreadsheet tab: Emissions Calc – Turbine

No Power from Shore																											
Power from Shore	kW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil production																											
	Unit	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**
Oil production	Sm^3/d	[redacted]																									
Oil production	bbl/d	[redacted]																									
Gas Export	kSm^3/d	[redacted]																									
Gas Export in Barrel of Oil Equivalent	BOE/d	[redacted]																									
Total production of Barrel of Oil Equivalent	BOE/d	[redacted]																									
Offloading El.consumption (avg)				capacity offloading	650000	bbl																					
Offloading el.consumption (incl additional thruster & aux.)	kW	3433		capacity offloading	103350	Sm3																					
Offloading flowrate	m3/hr	4500		duration	23	hours	(1 day with ramping up and down)																				
Specific Offloading el.consumption	kJ/m3 oil	2746																									
Number of offloading days	days/year	6	32	35	33	30	31	33	32	29	26	24	21	19	17	16	15	13	12	11	10	10	9	8	8	7	7
El. Consumption (exl. heat)																											
Process Power Demand	kW	10235	14634	14959	15207	15266	15621	16909	16997	16889	16677	16556	16565	16481	16292	16481	15351	14360	14354	14354	14213	14334	14021	14235	14581	14530	14091
Normal Thruster load	kW	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
Knarr Base load (non modified loads)	kW	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267	6267
New E-House loads	kW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Allowance (5% process power demand)	kW	512	732	748	760	763	781	845	850	844	834	828	828	824	815	824	768	718	718	718	711	717	701	712	729	726	705
El. consumption (Normal)	kW	19513	24132	24473	24734	24796	25169	26521	26613	26500	26277	26150	26159	26071	25873	26072	24885	23844	23838	23838	23691	23817	23488	23714	24076	24023	23562
El. consumption - Normal & Offloading	kW	22946	27565	27906	28166	28229	28601	29953	30046	29933	29710	29583	29592	29504	29306	29505	28318	27277	27271	27271	27123	27250	26921	27146	27509	27455	26995
El. consumption - Production Shutdown	kW	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767
Gas Turbine (without offloading)																											
Gas Turbine - Rated El.power	kW	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055	14055
Gas Turbine - No in operation	#	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Gas Turbine - max loading (max 90% & min 51%)	%	69.4%	57.2%	58.0%	58.7%	58.8%	59.7%	62.9%	63.1%	62.8%	62.3%	62.0%	62.0%	61.8%	61.4%	61.8%	59.0%	56.6%	56.5%	56.5%	56.2%	56.5%	55.7%	56.2%	57.1%	57.0%	55.9%
Gas Turbine - Net efficiency	%	29.7%	27.3%	27.5%	27.6%	27.6%	27.8%	28.5%	28.5%	28.4%	28.3%	28.3%	28.3%	28.2%	28.1%	28.2%	27.7%	27.1%	27.1%	27.1%	27.0%	27.1%	26.9%	27.1%	27.2%	27.2%	27.0%
Gas Turbines- Net Output (total)	kW	19513	24132	24473	24734	24796	25169	26521	26613	26500	26277	26150	26159	26071	25873	26072	24885	23844	23838	23838	23691	23817	23488	23714	24076	24023	23562
Power Unavailable	kW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Turbine (with offloading)																											
Gas Turbine - Rated El.power	kW	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693
Gas Turbine - No in operation	#	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Gas Turbine - max loading (max 90% & min 51%)	%	55.9%	67.1%	67.9%	68.6%	68.7%	69.6%	72.9%	73.1%	72.9%	72.3%	72.0%	72.0%	71.8%	71.3%	71.8%	68.9%	66.4%	66.4%	66.4%	66.0%	66.3%	65.5%	66.1%	67.0%	66.8%	65.7%
Gas Turbine - Net efficiency	%	27.0%	29.3%	29.4%	29.5%	29.6%	29.7%	30.3%	30.3%	30.3%	30.2%	30.1%	30.1%	30.1%	30.0%	30.1%	29.6%	29.1%	29.1%	29.1%	29.1%	29.1%	29.0%	29.1%	29.2%	29.2%	29.0%
Gas Turbines- Net Output (total)	kW	22946	27565	27906	28166	28229	28601	29953	30046	29933	29710	29583	29592	29504	29306	29505	28318	27277	27271	27271	27123	27250	26921	27146	27509	27455	26995
Power Unavailable	kW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas Turbine (no production) - assuming fuel gas																											
Gas Turbine - Rated El.power	kW	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693	13693
Gas Turbine - No in operation	#	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gas Turbine - max loading (max 90% & min 51%)	%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%	64.0%
Gas Turbine - Net efficiency	%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%	28.7%
Gas Turbines- Net Output (total)	kW	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767
Power Unavailable	kW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FUEL (without offloading)																											
LHV mass basis (stream 4504)	kJ/kg	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784
LHV volume basis	kJ/Sm3	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842
Fuel consumption - Normal	kg/hr	4851	6529	6579	6617	6626	6681	6877	6891	6874	6842	6824	6825	6812	6783	6812	6639	6486	6486	6486	6464	6482	6434	6467	6521	6513	6445
Fuel consumption - Normal	Sm3/hr	5940	7994	8055	8102	8113	8180	8421	8437	8417	8378	8355	8357	8341	8306	8341	8129	7942	7941	7941	7915	7937	7878	7919	7984	7974	7891
FUEL (with offloading)																											
LHV mass basis (stream 4504)	kJ/kg	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784
LHV volume basis	kJ/Sm3	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842
Fuel consumption - Normal & Offloading	kg/hr	6277	6951	7001	7038	7047	7102	7299	7312	7296	7263	7245	7246	7233	7204	7233	7060	6909	6908	6908	6887	6905	6858	6890	6943	6935	6868
Fuel consumption - Normal & Offloading	Sm3/hr	7686	8511	8572	8618	8629	8696	8937	8954	8933	8893	8871	8872	8857	8821	8857	8645	8460	8459	8459	8433	8455	8397	8437	8501	8492	8410
FUEL (production offline) - assuming fuel gas for fuel																											
LHV mass basis (stream 4504)	kJ/kg	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784	48784
LHV volume basis	kJ/Sm3	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842	39842
Fuel consumption - Production Offline	kg/hr	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256	2256
Fuel consumption - Production Offline	Sm3/hr	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762	2762
CO2 Emission (without offloading)																											
CO2 emission from gas turbines - Normal	tonnes/day	326	439	442	445	445	449	462	463	462	460	459	459	458	456	458	446	436	436	436	434	436	432	435	438	438	433
CO2 Emission (with offloading)																											
CO2 emission from gas turbines - Normal & Offloading	tonnes/day	422	467	470	473	474	477	491	491	490	488	487	487	486	484	486	475	464	464	464	463	464	461	463	467	466	462
CO2 Emission (no production) - assuming fuel gas for power																											
CO2 emission from gas turbines - No Production	tonnes/day	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152
Uptime	%	96.4%	96.3%	95.1%	93.8%	96.2%	95.1%	93.9%	96.4%	95.4%	94.2%	96.7%	95.7%	94.5%	97.0%	96.0%	94.8%	97.2%	96.0%	94.8%	97.2%	96.0%	94.9%	97.5%	96.2%	94.9%	97.5%
Uptime	days/year	114	352	348	342	351	347	344	352	348	344	354	349	345	354	351	346	355	351	347	355	351	346	357	351	346	242
Offline Time	days/year	4	13	18	23	14	18	22	13	17	21	12	16	20	11	15	19	10	14	19	10	14	19	9	14	19	5
Yearly fuel gas consumption	BOE	103580	426833	425867	421464	432395	430906	439427	450816	444578	436843	448412	442147	435778	445386	443540	425642	426387	421156	416632	424667	420800	412478	427209	424009	417360	288598
Yearly gas export	BOE	[redacted]																									
Annual production of barrel oil equivalent	BOE/year	[redacted]																									
Annual CO2 emission - Normal & Offloading (Average) (incl. uptime)	tonnes/year	37661	155192	154841	153239	157214	156672	159771	163912	161644	158831	163037	160760	158444	161937	161266	154758	155029	153127	151483	154404	152998	149972	155328	154165	151747	104931
CO2 footprint from gas turbines - Normal & Offloading (Average)	kg CO2 /BOE	29	7	6	7	7	7	7	7	8	8	10	11	12	13	15	15	17	18	20	22	24	26	29	31	33	24
CO2 Emission (original case)																											
Annual CO2 emission - Normal & Offloading (Average) (incl. uptime)	tonnes/year	38586	138737	138937	159462	163569	162922	165866	170141	167797	164910	169293	166916	164522	168182	167440	160943	136857	135106	133586	135952	134817	131846	136619	135883	133640	92342
Check Diesel Generation																											
Diesel Density	tonnes/Sm3	0.855		Note - check added to calculation to confirm sufficient diesel has been included for power generation purposes to cover periods when production offline and fuel gas is not being used for power generation (i.e. during a facility maintenance shutdown																							
Annual Usage	kSm3/year	3,947		or following a production trip).																							
	tonnes/year	3,375		Turbine efficiency taken from Solar performance prediction (PJ5-04-R-80-DS-01002-001).																							
Diesel LHV	MJ/kg	43		Offline Time = Annual days - Uptime Days.																							
Turbine Efficiency		0.283		Offline time accounts for planned shutdowns and unplanned production outages. Calculation shows power generation capability from diesel well in excess of demand from diesel																							
Annual Power Output	MJ	40,827,783																									
	MWh	11,341																									
El. consumption (Normal)	kW	19513	24132	24473	24734	24796	25169	26521	26613	26500	26277	26150	26159	26071	25873	26072	24885	23844	23838	23838	23691	23817	23488	23714	24076	24023	23562
El. consumption (Base Load & Thruster)	kW	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767	8767
Hours Diesel Generation (Base Load & Thruster)	hours	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294	1294
Days Diesel Generation (Base Load & Thruster)	days	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54
Excess Diesel Days	days	50	41	36	31	40	36	32	41	37	33	42	38	34	43	39	35	44	39	35	44	39	35	45	40	35	49
Deficit Diesel Days	days	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accumulated Oil production	kBOE	[redacted]																									
Accumulated CO2 emission	tonnes	[redacted]																									
CO2 emission per barrel oil equivalent	kg CO2 /BOE	[redacted]																									
Field Start date		05/09/2026	(included to give uptime days for first and last year of production)																								
Field End date		05/09/2051																									
Number of production days in first year		118																									
Number of days in year		365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	365	366	365	365	247

Emissions Calculation - Flare

Days / Year	Year	Start date	End date	Produced Gas Sm3/sd	Flared Gas kSm3	Flaring Tonnes CO2	Flared Gas / Produced Gas	Flare Gas Tonnes/day	Comment
	Commissioning - Non reservoir gas flared (WOSPS)				2,449	5,602			Aligned with non-reservoir gas in short term flare consent estimate
118	1	05/09/2026	01/01/2027	[redacted]	5,551	12,698	[redacted]	38.43	Short term flare consent estimate plus margin
365	2	01/01/2027	01/01/2028	[redacted]	8,991	20,568	[redacted]	20.13	Higher flare in year 1 due to expected production trips
366	3	01/01/2028	01/01/2029	[redacted]	1,968	4,502	[redacted]	4.39	Annual estimate 0.35% produced gas per year
365	4	01/01/2029	01/01/2030	[redacted]	1,854	4,241	[redacted]	4.15	
365	5	01/01/2030	01/01/2031	[redacted]	1,650	3,775	[redacted]	3.69	
365	6	01/01/2031	01/01/2032	[redacted]	1,728	3,953	[redacted]	3.87	
366	7	01/01/2032	01/01/2033	[redacted]	1,961	4,486	[redacted]	4.38	
365	8	01/01/2033	01/01/2034	[redacted]	1,859	4,252	[redacted]	4.16	
365	9	01/01/2034	01/01/2035	[redacted]	1,708	3,907	[redacted]	3.82	
365	10	01/01/2035	01/01/2036	[redacted]	1,552	3,551	[redacted]	3.47	
366	11	01/01/2036	01/01/2037	[redacted]	1,399	3,199	[redacted]	3.12	
365	12	01/01/2037	01/01/2038	[redacted]	1,244	2,846	[redacted]	2.78	
365	13	01/01/2038	01/01/2039	[redacted]	1,133	2,592	[redacted]	2.54	
365	14	01/01/2039	01/01/2040	[redacted]	1,032	2,360	[redacted]	2.31	
366	15	01/01/2040	01/01/2041	[redacted]	926	2,119	[redacted]	2.07	
365	16	01/01/2041	01/01/2042	[redacted]	856	1,957	[redacted]	1.91	
365	17	01/01/2042	01/01/2043	[redacted]	774	1,770	[redacted]	1.73	
365	18	01/01/2043	01/01/2044	[redacted]	700	1,601	[redacted]	1.57	
366	19	01/01/2044	01/01/2045	[redacted]	641	1,466	[redacted]	1.43	
365	20	01/01/2045	01/01/2046	[redacted]	582	1,330	[redacted]	1.30	
365	21	01/01/2046	01/01/2047	[redacted]	534	1,221	[redacted]	1.19	
365	22	01/01/2047	01/01/2048	[redacted]	478	1,093	[redacted]	1.07	
366	23	01/01/2048	01/01/2049	[redacted]	440	1,006	[redacted]	0.98	
365	24	01/01/2049	01/01/2050	[redacted]	412	942	[redacted]	0.92	
365	25	01/01/2050	01/01/2051	[redacted]	383	876	[redacted]	0.86	
247	26	01/01/2051	05/09/2051	[redacted]	242	554	[redacted]	0.80	
Total					**43,044**	**98,467**			

Note - Flaring activity level aligned with FDP and original ES flare volume. Emissions factor corrected.