Appendix F
Greenhouse gas assessment

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Clarence Colliery - Modification 11

Greenhouse gas assessment

Prepared for Centennial Coal Company Pty Limited

December 2025

Clarence Colliery - Modification 11

Greenhouse gas assessment

Centennial Coal Company Pty Limited

E250102 RP4

December 2025

Version	Date	Prepared by	Reviewed by	Comments
1	18 November 2025	Paul Boulter	Francine Manansala	Draft report
2	16 December 2025	Paul Boulter Francine Manansala	Francine Manansala	Revised draft following comments from Centennial
3	18 December 2025	Paul Boulter Francine Manansala	Francine Manansala	Final report

Approved by

Francine Manansala
Senior Associate – Air Quality and Climate
18 December 2025

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Executive summary

ES1 Overview

Clarence Colliery is an underground coal mining operation in the Western Coalfield of New South Wales, approximately 10 kilometres east of Lithgow. Clarence Colliery is seeking a modification (Mod 11) to development consent DA 504-00 under section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Mod 11 would extend the life of mining at Clarence from 31 December 2026 for a further five years until 31 December 2031.

No further changes are proposed to operations approved under DA 504-00. This includes no changes to mining methods, annual coal extraction rates, coal processing and handling activities, surface infrastructure and hours of operation, workforce numbers, or product transportation by rail and road.

This report presents a greenhouse gas (GHG) assessment for Mod 11, which has been compiled in accordance with the *NSW Guide for Large Emitters*. The assessment included estimates of scope 1, scope 2 and 3 emissions for continued operation at the mine to 31 December 2031 with the proposed modification. Both planned operational throughput and maximum capacity scenarios were considered.

ES2 GHG emission estimates

For the planned operational throughput case, the scope 1 and scope 2 emissions for Mod 11 would peak at around 44.0 kt CO_2-e/year in 2027-28. There were three financial years in which the *NSW EPA Guide for Large Emitters*' threshold of 25,000 t CO_2-e/year was exceeded, and therefore the Mod 11 was considered to be a large emitter. The aggregated scope 1 and scope 2 emissions over the life of Mod 11 would be 156 kt CO_2-e. The average scope 1 emission intensity over the life of Mod 11 would be 0.0046 tonnes of CO_2-e per tonne of ROM coal, which is an order of magnitude below the industry average value in the Safeguard Mechanism. The largest contributors to scope 1 and scope 2 emissions over the life of Mod 11 would be purchased electricity (68% of the total) and fugitive sources (29% of the total).

The scope 3 emissions for Mod 11 would be much larger than the scope 1 and scope 2 emissions. Scope 3 emissions would peak at around 3,900 kt CO_2-e/year in 2028-29. The combustion of product coal would account for approximately 98% of the total scope 3 emissions over the life of Mod 11.

ES3 Mitigation measures

Various mitigation measures are inherent to operation at coal mines (e.g. mine planning, vehicle maintenance), and these were effectively included as 'planned' measures for the purpose of calculating GHG emissions. To restrict fugitive releases of methane and carbon dioxide following mine area closure, all mine entities (drifts and shafts) will be sealed and the mine areas will be allowed to flood naturally. Mitigation of GHG emissions will continue to be conducted in accordance with Centennial Coal Company Limited's *Air Quality and Greenhouse Gas Management Plan – Western Region* (Centennial 2024).

In addition, Centennial is committed to a number of additional measures, including the installation of energy-efficient technology where feasible, and engagement in projects related to the reduction of GHG emissions, innovations and technologies.

With respect to scope 3 emissions, Centennial will continue to sell coal to countries that have Nationally Determined Contributions (NDCs) under the Paris Agreement (or have followed international standards recognised by the United Nations Framework Convention on Climate Change (UNFCCC) and published their own NDCs document in support of the Paris Agreement).

The effects of the planned and additional mitigation measures on GHG emissions have not been quantified, given that they are dependent on the outcomes of further investigations.

ES4 Comparison with NSW emissions

Scope 1 emissions for Mod 11 were compared with those in NSW. Mod 11 would represent less than 0.02% of state-wide emissions in the NSW current policy case.

Scope 1 emission-reduction goals have been determined for Mod 11 for consistency with the NSW emissions trajectory. These emission reductions varied from year to year, with a maximum of 2,008 t CO_2-e/year in 2029-30.

ES5 Climate change considerations

Climate considerations as they relate to local climate impacts and scope 3 emissions are addressed in Appendix D.

The main findings of the study were that around the Clarence Colliery, in the near future scenario, temperatures are projected to increase, annual rainfall is projected to decrease, and the FFDI is projected to increase. The contribution of Mod 11 to global GHG emissions is 0.01% and the scope 3 emissions for Mod 11 would represent 99% of all GHG emissions from Mod 11.

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1 Introduction

1.1 Background

Clarence Colliery is an underground coal mine in the Western Coalfields of New South Wales (NSW). Clarence Colliery is located in the Lithgow local government area (LGA), approximately 10 kilometres (km) east of Lithgow (Figure 1.1). Clarence has been in operation since 1979. It is operated by Clarence Colliery Pty Limited, which is a subsidiary of Centennial Coal Company Limited (Centennial).

The Clarence Colliery holding boundary (Figure 1.2) is the existing development consent boundary applicable to development consent DA 504-00 (see below).

Clarence Colliery is seeking a modification (Mod 11) to DA 504-00 under section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This report presents a greenhouse gas (GHG) assessment for Mod 11, which has been compiled in accordance with the *NSW Guide for Large Emitters* (NSW EPA 2025a).

1.2 Mod 11 summary

1.2.1 Existing approval

Clarence Colliery operates under three separate development consents:

- IRM.GE.76 – an interim development consent issued in 1976 by Blaxland Shire Council (now Lithgow City Council (LCC)) for the construction of surface facilities
- DA 174/93 – a development consent issued in 1994 by LCC for the extension of underground coal mining, surface reject emplacement areas (REAs) and water management and ancillary structures
- DA 504-00 – development consent issued in 2005 by the NSW Department of Infrastructure, Planning and Natural Resources (now the NSW Department of Planning, Housing and Infrastructure (DPHI)) to expand into Mining Lease (ML) 1583.

Clarence Colliery is approved to extract up to 3 million tonnes per annum (Mtpa) of coal until 31 December 2026. Clarence Colliery produces high quality, low ash thermal coal for both domestic and export customers.

1.2.2 Proposed modification

Clarence Colliery is seeking a modification (Mod 11) to modify the following conditions in Schedule 2 of DA 504-00:

- Condition 5 to extend the life of mining from 31 December 2026 for a further five years to 31 December 2031.
- Condition 7AA to align the transport of coal by road with the proposed extension of the life of mining, thus allowing for the transport of up to 300,000 tonnes (t) of coal by road until 31 December 2031.

No changes are proposed to operations approved under DA 504-00. This includes no changes to:

- mining methods
- annual coal extraction rates
- coal processing and handling activities
- surface infrastructure and hours of operation

- workforce numbers
- product transportation by rail and road.

The proposed modification does not require any additional surface disturbance activities beyond those currently assessed and approved to be disturbed.

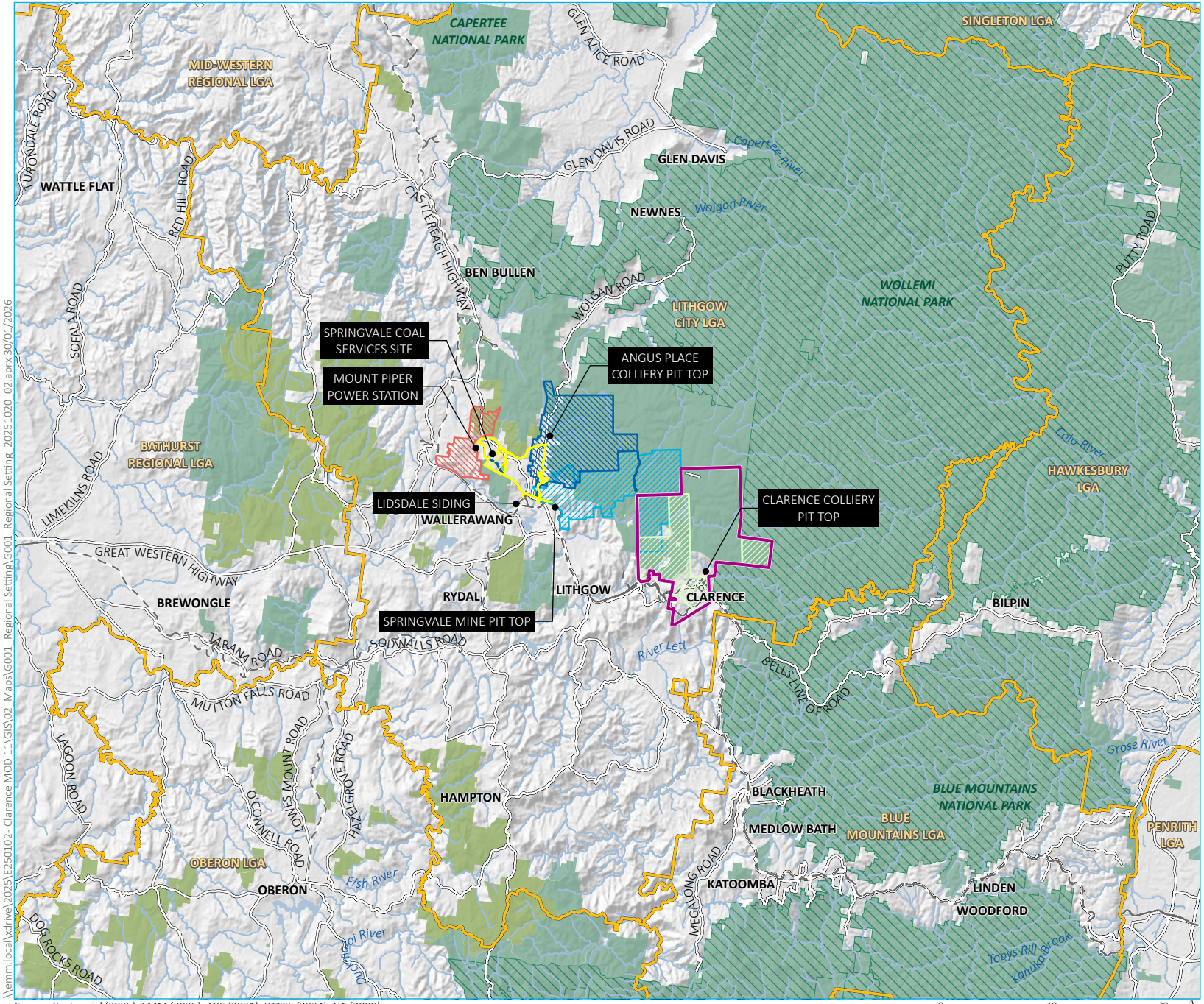
1.3 Purpose of this report

This GHG assessment has been compiled by EMM Consulting Pty Limited (EMM) to support the application for Mod 11. The *NSW Guide for Large Emitters* (NSW EPA 2025a) defines the criteria for identifying whether a given project is a large emitter of GHGs. Based on these criteria, EMM concluded that Mod 11 would be a large emitter (see Section 3.1.2).

1.4 Report structure

The remainder of this report is structured as follows:

- Chapter 2 outlines the key legislation and policy relating to GHGs.
- Chapter 3 describes the GHG assessment method and results for Mod 11, following the steps in the *NSW Guide for Large Emitters*.
- Chapter 4 provides the summary and conclusions of the GHG assessment.



KEY

- Clarence Colliery Holdings Area
- DA504-00 consent boundary
- Angus Place
- Ivanhoe
- Springvale
- Western Coal Services

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody
- Greater Blue Mountains World Heritage Area
- NPWS reserve
- State forest
- Local government area

Source: Centennial (2025); EMM (2025); ABS (2021); DCSSS (2024); GA (2009)

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Regional context

Clarence Colliery- Modification 11
Greenhouse Gas Assessment
Figure 1.1

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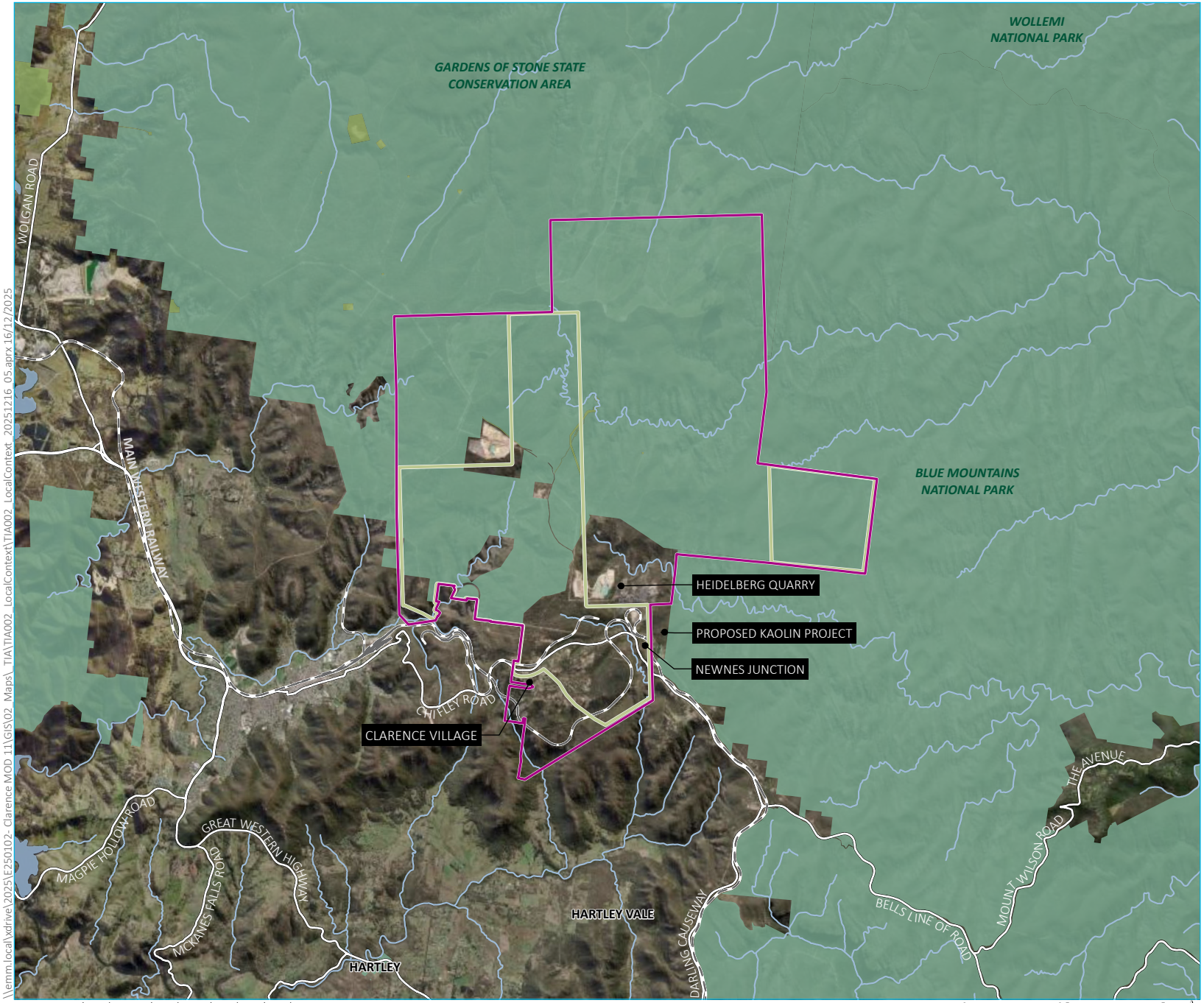

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Source: EMM (2025); DCSSS (2024); ESRI (2025); GA (2009)

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GDA2020 MGA Zone 56

N

Local context

Clarence Colliery- Modification 11
Greenhouse Gas Assessment
Figure 1.2

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2 Legislative and policy context

This chapter of the report introduces the main GHGs that are the focus of legislation and policy, and the concept of emission scopes. The chapter also summarises the legislative and policy context as it relates to the assessment, mitigation and reporting of GHG emissions. The chapter includes the international context, the Australian context and the NSW context.

2.1 Greenhouse gases and emission scopes

2.1.1 Greenhouse gases

When sunlight strikes the earth's surface, some of it is emitted back toward space as infrared radiation (heat). The term 'greenhouse gases' refers to gases that absorb this infrared radiation and trap its heat in the atmosphere. This process, referred to as 'the greenhouse effect' is a significant contributor to global warming and climate change.

The GHGs addressed under the Commonwealth *National Greenhouse and Energy Reporting Act 2007* (NGER Act – see Section 2.3.2) are summarised in Table 2.1. The most important gases in relation to coal mining are usually carbon dioxide (CO_2) and methane (CH_4). Coal mines are a minor source of nitrous oxide (N_2O) and sulfur hexafluoride (SF_6).

Table 2.1 Greenhouse gases and characteristics

Greenhouse gas	Characteristics	Global warming potential (GWP)[a]	Atmospheric lifetime (years)[a]
Carbon dioxide (CO_2)	The most abundant GHG in the atmosphere. At coal mines CO_2 is primarily released during fuel combustion.	1	N/A[b]
Methane (CH_4)	Released from coal seams during mining, and from post-mining activities (e.g. coal stockpiles), as well as fuel combustion.	28	12
Nitrous oxide (N_2O)	Released during fuel combustion at coal mines.	265	121
Sulfur hexafluoride (SF_6)	Used as an insulator in electrical switchgear at coal mines.	23,500	3,200
Hydrofluorocarbons (HFCs)	Commonly used as refrigerant gases in cooling systems. Coal mines are a not a significant source.	Dependent on HFC type	Dependent on HFC type
Perfluorocarbons (PFCs)	Used in a range of applications including solvents and insulators. Coal mines are a not a significant source.	Dependent on PFC type	Dependent on PFC type

Notes:

(a) From Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5).

(b) No single atmospheric lifetime can be given for CO_2 because it moves throughout the earth system at differing rates.

Given that the various GHGs have different global warming potentials (GWPs), it is convenient to express emissions using a common unit. For this purpose, the term 'carbon dioxide equivalent' (CO_2-e) has been defined. For any mass and type of GHG, CO_2-e signifies the mass of CO_2 which would have the equivalent global warming impact. CO_2-e emissions are calculated based on the GWPs of specific gases adopted by the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol. In this assessment, GHG emissions are presented in terms of CO_2-e.

2.1.2 Emission scopes

For accounting and reporting purposes, GHG emissions are referred to as 'direct' or 'indirect', and defined according to three 'scopes' (1, 2 and 3). Examples of scope 1, 2 and 3 emissions are provided in Figure 2.1. The purpose of differentiating between the emission scopes is to avoid the potential for double counting, where two or more organisations assume responsibility for the same emissions.

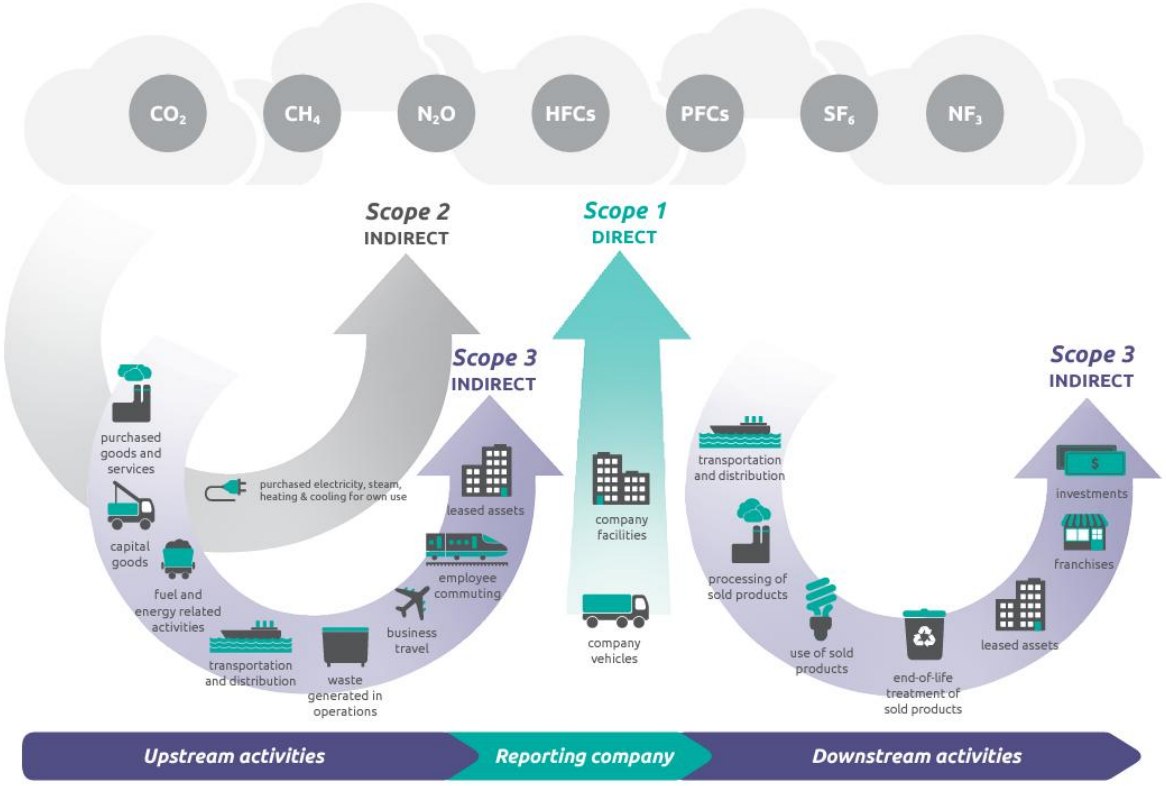

Figure 2.1 Overview of GHG emission scopes (WRI & WBCSD 2013)

The three scopes are defined as follows:

- Scope 1 relates to direct emissions from sources within the boundary of a given organisation (or project), and as a result of the organisation's activities. Scope 1 emissions are determined for the point of release (on-site). They include, but are not limited to, emissions from solid and liquid fuel combustion, fugitive emissions of CH_4, and leaks of SF_6.

- Scope 2 relates to indirect emissions associated with the purchase of electricity, steam, heat or cooling at a site. Scope 2 emissions are physically generated outside an organisation's boundaries, such as through the burning of fuel (e.g. coal, natural gas) at an external power station in the case of electricity, but they are included in an organisation's emissions as they are a result of its energy use.

- Scope 3 relates to all other indirect emissions (i.e. other than scope 2) which occur outside the boundary of an organisation but as a result of actions by the organisation and are generated in the wider economy. Scope 3 emissions may occur upstream, such as during the extraction and production of fossil fuels, or downstream, such as from the transport of an organisation's product to customers.

This GHG assessment is mainly concerned with scope 1 and scope 2 emissions, as defined under the NGER Act, but it also considers scope 3 emissions, as defined within Australia's National Greenhouse Accounts for facility reporting (DCCEEW 2025a).

2.2 International context

2.2.1 Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science in relation to climate change. The IPCC prepares comprehensive assessment reports about the state of scientific, technical and socio-economic knowledge on climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place. The first assessment report of the IPCC served as the basis for negotiating the UNFCCC. The IPCC released its Sixth Assessment Report (AR6) in 2022/2023. The IPCC also produces a variety of guidance documents and recommendation methodologies for compiling GHG emission inventories.

2.2.2 United Nations Framework Convention on Climate Change

The UNFCCC entered into force in March 2004 and provides the basis for concerted international action to mitigate climate change and to adapt to its impacts. With 198 Parties, the UNFCCC has nearly universal membership. The Conference of the Parties to the Convention (COP) is used to advance the implementation of the UNFCCC.

The objective of the UNFCCC is to stabilise GHG emissions 'at a level that would prevent dangerous anthropogenic interference with the climate system'. It states that 'such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner'[1].

2.2.3 Paris Agreement

The Paris Agreement, which the Australian Government has signed, is a legally binding international treaty on climate change. It was adopted by the (then) 196 Parties to the UNFCCC at the 21st United Nations Climate Change Conference (COP21) in Paris, France in December 2015, and entered into force in November 2016. Its overarching goal is to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. Under the Paris Agreement, all parties are required to put forward GHG emission-reduction targets through Nationally Determined Contributions (NDCs) and are required to report on national emissions, with a review of targets every five years from 2020.

2.3 Australian context

2.3.1 Climate Change Act 2022

The Commonwealth *Climate Change Act 2022* (CC Act) provides the legislative framework for implementing Australia's net-zero commitments under the Paris Agreement and sets out Australia's GHG emission-reduction targets. Australia has committed to reducing its GHG emissions by 43% below 2005 levels by 2030 and achieving net-zero emissions by 2050. The CC Act also introduced a requirement for an annual climate change statement to parliament, supported by independent advice from the Climate Change Authority (CCA).

[1] https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change

2.3.2 The National Greenhouse and Energy Reporting Act and Scheme

The NGER Act, administered by the Commonwealth Government, establishes a national framework (the NGER Scheme) for corporations to report GHG emissions, energy consumption and energy production. The framework covers the measurement, reporting and verification of GHG emissions.

Companies that exceed the NGER Scheme thresholds[2] of 25,000 t CO_2-e per year for a facility, or 50,000 t CO_2-e per year for a corporation, are required to register and report annually on their scope 1 and scope 2 emissions to the Clean Energy Regulator (CER).

Clarence does not currently report GHG emissions under the NGER Scheme, as it does not exceed the facility thresholds stated above.

The NGER Act is underpinned by the Commonwealth *National Greenhouse and Energy Reporting Regulations 2008* and the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (the Measurement Determination). The Measurement Determination provides methods, criteria and measurement standards for calculating GHG emissions and energy data. It covers scope 1 and scope 2 emissions, energy production and consumption. It identifies several calculation methodologies to account for GHGs from specific sources relevant to coal mining, based primarily on the National Greenhouse Accounts (NGA) Factors.

2.3.3 The Safeguard Mechanism

The NGER Act also provides a framework for Australia's highest emitting facilities to manage and report on their GHG emissions. This framework is the Safeguard Mechanism[3], which was first legislated in 2014 and has been in place since 2016. Reforms to the Safeguard Mechanism took effect in 2023, to ensure that the facilities it covers will contribute to meeting Australia's GHG emission-reduction targets.

In general terms, the Safeguard Mechanism applies to facilities[4] with scope 1 emissions[5] of more than 100,000 t CO_2-e per year, known as Safeguard facilities. It sets legislated limits, known as baselines, on the GHG emissions of these facilities. These baselines decrease on a trajectory that is consistent with achieving Australia's GHG emission-reduction targets of 43% below 2005 levels by 2030, and net zero by 2050. The baselines will decrease at 4.9% per year from 2023 to 2030, followed by 3.285% per year thereafter.

If a Safeguard facility exceeds its baseline, then it must take actions to reduce its emissions, such as surrendering Australian Carbon Credit Units (ACCUs) or Safeguard Mechanism Credits (SMCs) equal to the excess emissions. Facilities that have emissions below their baselines may apply to receive SMCs.

In 2023-24 there were 219 Safeguard facilities. These facilities produced 31% of Australia's GHG emissions in that year (CER 2025).

Clarence Colliery is not a Safeguard facility.

2.4 NSW context

The overarching NSW Government legislation and policy documents on GHG emissions and climate that are broadly relevant to this study are summarised in Table 2.2.

The NSW Government policy on coal mining, which is also relevant to the study, is summarised in Table 2.3.

2 The thresholds are also stated in terms of energy production/consumption.

3 https://www.dcceew.gov.au/climate-change/emissions-reporting/national-greenhouse-energy-reporting-scheme/safeguard-mechanism

4 Grid-connected electricity generators are treated separately.

5 The threshold applies to actual (gross) emissions from a facility, and does not consider any offset or displaced emissions.

Table 2.2 NSW Government legislation and policy on GHG emissions and climate

Title	Description	Reference
NSW *Climate Change (Net Zero Future) Act 2023* (the Net Zero Future Act)	Establishes guiding principles for action to address climate change that consider the impacts, opportunities and need for action in NSW. Legislates NSW target reductions in GHG emissions of 50% of 2005 levels by 2030, 70% of 2005 levels by 2035, and net zero emissions by 2050. Sets an objective for NSW to be more resilient to a changing climate. Establishes an independent, expert Net Zero Commission to monitor, review, report on and advise on progress towards the targets.	-
NSW Climate Change Policy Framework	Sets out the NSW Government's long-term goals of achieving net-zero emissions by 2050, and making NSW more resilient and better adapted to a changing climate.	NSW OEH (2016)
Net Zero Plan Stage1: 2020–2030 (the Net Zero Plan)	Foundation for NSW's action on climate change. It outlines the NSW Government's plan to grow the economy, create jobs and reduce emissions leading up to 2030.	NSW DPIE (2020)
Net Zero Plan Stage 1: 2020–2030 Implementation Update *Net Zero Plan Implementation Update 2022*	These provide updates on the key achievements of NSW Government under the Net Zero Plan, and commit NSW to reducing emissions by 50% below 2005 levels by 2030, and 70% below 2005 levels by 2035.	NSW DPIE (2021a) NSW OECC (2022)
NSW Climate Change Adaptation Strategy	Sets out the NSW Government's strategic approach for managing the impacts of climate change on the State.	NSW Government (2022)
NSW Waste and Sustainable Materials Strategy 2041	Sets out how NSW will transition to a circular economy over the next 20 years, including key reforms for reducing GHG emissions from materials (embedded carbon) and the waste sector.	NSW DPIE (2021b)
NSW Guide for Large Emitters	This defines the GHG assessment requirements for new projects and modifications to existing facilities that are likely to have 'large' emissions.	NSW EPA (2025a)

Table 2.3 NSW Government policy on coal mining

Title	Description	Reference
Strategic Statement on Coal Exploration and Mining in NSW	Sets out the NSW Government approach to the global transition to a low-carbon future, consistent with Australia's ambition under the Paris Agreement, and how it is managing the impacts for coal-reliant communities. The Statement recognises that "Ending or reducing NSW thermal coal exports while there is still strong global demand would likely have little or no impact on global carbon emissions".	NSW Government (2020)

The EPA is the primary environmental regulator for NSW. Although it has historically regulated some GHGs, the EPA has traditionally focussed on the local and regional impacts of projects and developments on health and the environment. It has recently expanded its focus to more explicitly regulate the causes and consequences of climate change in NSW. The EPA policy documents that are relevant to this study are summarised in Table 2.4.

Table 2.4 Key NSW EPA legislation and policy on GHG emissions and climate

Title	Description	Reference
Protection of the Environment Administration Act 1991	Outlines the EPA's statutory objectives and duty to address climate change. Section 6 of the Act outlines the EPA's statutory objectives to protect the environment and human health. The key elements are: • to protect, restore and enhance the quality of the environment in NSW, having regard to the need to maintain ecologically sustainable development • to reduce the risks to human health and prevent the degradation of the environment, including by taking action in relation to climate change. Section 9 of the Act imposes a statutory duty on the EPA to develop environmental quality objectives, guidelines and policies to ensure environment protection. This includes protection of the environment from climate change.	-
Protection of the Environment Operations Act 1997 (POEO Act)	Sets out EPA's statutory powers and regulatory tools, including environment protection licensing. Schedule 1 of the Act sets out the types of activities that need a licence. The EPA is required to consider its statutory objectives (above) when exercising its licensing functions.	-
Climate Change Policy	Supports and builds upon NSW Government's climate change policies and initiatives. The main purpose is to address: • the EPA's statutory objectives to protect, restore and enhance the quality of the environment in NSW, and to reduce the risks to human health and prevent the degradation of the environment • the EPA's statutory duty to develop environmental quality objectives, guidelines and policies to ensure environment protection from climate change.	NSW EPA (2023a)
Climate Change Action Plan 2023–26	Designed to deliver the Climate Change Policy. The Action Plan sets out: • the specific actions the EPA will take over the three years that it covers • the regulatory action the EPA will consider over the medium to longer term, where an increased regulatory response may be required to support the NSW Government's climate change commitments and policies, including achieving net-zero emissions in NSW by 2050.	NSW EPA (2023b)
Strategic Plan 2024–29	Describes how the EPA will deliver stewardship for the environment to protect, restore and enhance the environment and human health. It sets out commitments to effective regulation and a focus on high quality environmental outcomes across all of EPA's work. The plan details objectives and outcomes for three key areas: • caring for country • driving action on climate change • enabling a safe circular economy.	NSW EPA (2024)
Waste Delivery Plan	Outlines the actions the EPA take to reduce the harmful impact of waste and drive behaviours that create a circular economy. The Waste Delivery Plan includes actions to reduce carbon emissions and building the resilience of the waste sector to climate change.	NSW EPA (2021)

3 GHG emissions assessment

3.1 Overview

The GHG assessment has been compiled in accordance with the *NSW Guide for Large Emitters* (NSW EPA 2025). This firstly involved categorising Mod 11, identifying whether it would be a large emitter, and then following the required assessment steps.

3.1.1 Categorisation of Mod 11

The *NSW Guide for Large Emitters* distinguishes between two categories of project:

1. new proposals that are likely to have large emissions
2. proposed modifications to existing licensed premises that are likely to have large *additional* GHG emissions.

Mod 11 has been assessed as a proposed modification.

3.1.2 Large emitter status

The assessment requirements of the *NSW Guide for Large Emitters* apply to a given project if it is identified as a large emitter. NSW EPA considers a project to have large emissions if it meets three criteria. The application of these criteria to Mod 11 is shown in Table 3.1. The third criterion requires the definition of assessment scenarios and the calculation of GHG emissions. The assessment scenarios followed on from the categorisation of Mod 11, and are defined in Section 3.2.4.

The results of the supporting GHG calculations for Mod 11 are presented in Section 3.3.3i. The threshold for large emitters of 25,000 t CO_2-e was projected to be exceeded in some years of operation, and therefore Mod 11 was determined to be a large emitter.

Table 3.1 NSW EPA criteria for identifying large emitters

Criterion	Applicability to Mod 11
Does the project require development assessments and approvals under the EP&A Act?	Yes
Does the project involve one or more scheduled activities under Schedule 1 of the POEO Act and/or will be carried out at an existing licensed premises?	Yes
Is the project likely to emit (within the GHG assessment boundary) 25,000 t or more of scope 1 and 2 emissions (CO_2-e) in any financial year during the operational life of the project? [(a)]	Yes (see summary of emission calculations in Section 3.3.3)

Note:

(a) For a modification, the threshold refers to an additional 25,000 t or more of scope 1 and 2 emissions in any financial year when the modification project becomes operational, over and above emissions from the existing licensed premises. The 25,000 t CO_2-e threshold applies to operational emissions only.

3.1.3 Assessment steps

As Mod 11 has been identified as a large emitter, the GHG assessment followed the eight distinct steps in the *NSW Guide for Large Emitters*, as summarised below.

- **Step 1**: Describe the assessment boundary and scenarios
  - This involves describing the GHG assessment boundary established for the project, the project stages, the project timeframe and the scenarios included.
- **Step 2**: Characterise and prioritise sources of GHG emissions
  - This involves calculating annual emissions for all sources of scope 1, 2 and 3 emissions, and prioritising the sources for mitigation.

Notes

The *NSW Guide for Large Emitters* provides guidance on the calculation of GHG emissions at step 4. However, the prioritisation of emissions in step 2 actually requires emissions to be calculated earlier. Therefore, in this report it has been assumed that step 2 involves estimating emissions excluding planned mitigation (as discussed in section 4.2 of the of the *NSW Guide for Large Emitters*), and step 4 involves a *recalculation* of emissions following the identification of mitigation measures.

The *NSW Guide for Large Emitters* notes that in this step emissions may initially be estimated excluding mitigation. However, in the case of a coal mine there are a number of 'inherent' measures that are considered to represent best practice, such as minimising the length of haul routes, payload management and consideration of energy efficiency during procurement. These measures are commonly implemented as best practice in the mining sector, and have therefore been reflected (although not quantified explicitly in terms of their effects) at this step. A counterfactual case (i.e. without these measures) has not been considered, partly because it would not occur in practice, and partly because it could not be reliably characterised.

- **Step 3**: Select measures to avoid and reduce emissions
  - This step involves the identification and characterisation of mitigation measures, taking into account the EPA's mitigation hierarchy.
- **Step 4**: Estimate emissions with mitigation measures
  - This step involves recalculating emissions, considering any emissions avoidance and mitigation measures that will be implemented.
- **Step 5**: Emission benchmarking and goal setting
  - This step involves establishing emission-reduction goals for Mod 11 for scope 1 and scope 2 emissions, considering regulatory obligations (e.g. Safeguard Mechanism) and proposed mitigation. The goals should include efforts to reduce emissions leading towards net zero by 2050, and must consider the NSW emission-reduction targets.
- **Step 6**: Offsets strategy
  - This step involves describing any carbon offset strategies to address residual emissions that cannot be avoided or reduced.

- **Step 7**: Independent expert review
    - Projects with scope 1 and 2 emissions exceeding 100,000 t CO_2-e per year at any time over the operational life require mitigation assessments to be verified by an independent expert reviewer. This threshold would not be exceeded by Mod 11 (see Section 3.3.3), and therefore an independent review was not commissioned.
- **Step 8**: GHG assessment report
    - This step involves the production of a GHG assessment report (i.e. this report). The report broadly follows the structure and content described in Appendix C of the *NSW Guide for Large Emitters*.

The application of these steps is described in more detail below.

3.2 Step 1: Assessment boundary

Step 1 in the *NSW EPA Guide for Large Emitters* involves defining the following for a given project:

- the emission sources
- the stages
- the timeframe
- the emission scenarios to be assessed.

These aspects are addressed below.

3.2.1 Emission sources

In this report, the GHG assessment boundary for Mod 11 has been treated *conceptually* in terms of emission sources, as shown in Figure 3.1. The figure shows the emission sources that were included, and those that were potentially relevant but excluded (the reasons for exclusion are explained later in this section).

The emission sources that were included in the assessment represented the most significant sources associated with Mod 11.

For scope 1 emissions, the sources included were:

- on-site diesel consumption ('stationary' equipment, including rehabilitation)
- on-site diesel consumption (transport)
- on-site LPG consumption
- on-site consumption of oils
- on-site consumption of greases
- SF_6 leakage
- fugitive emissions from ventilation shafts.

For scope 2 emissions, the relevant source was the purchase of grid electricity for on-site use.

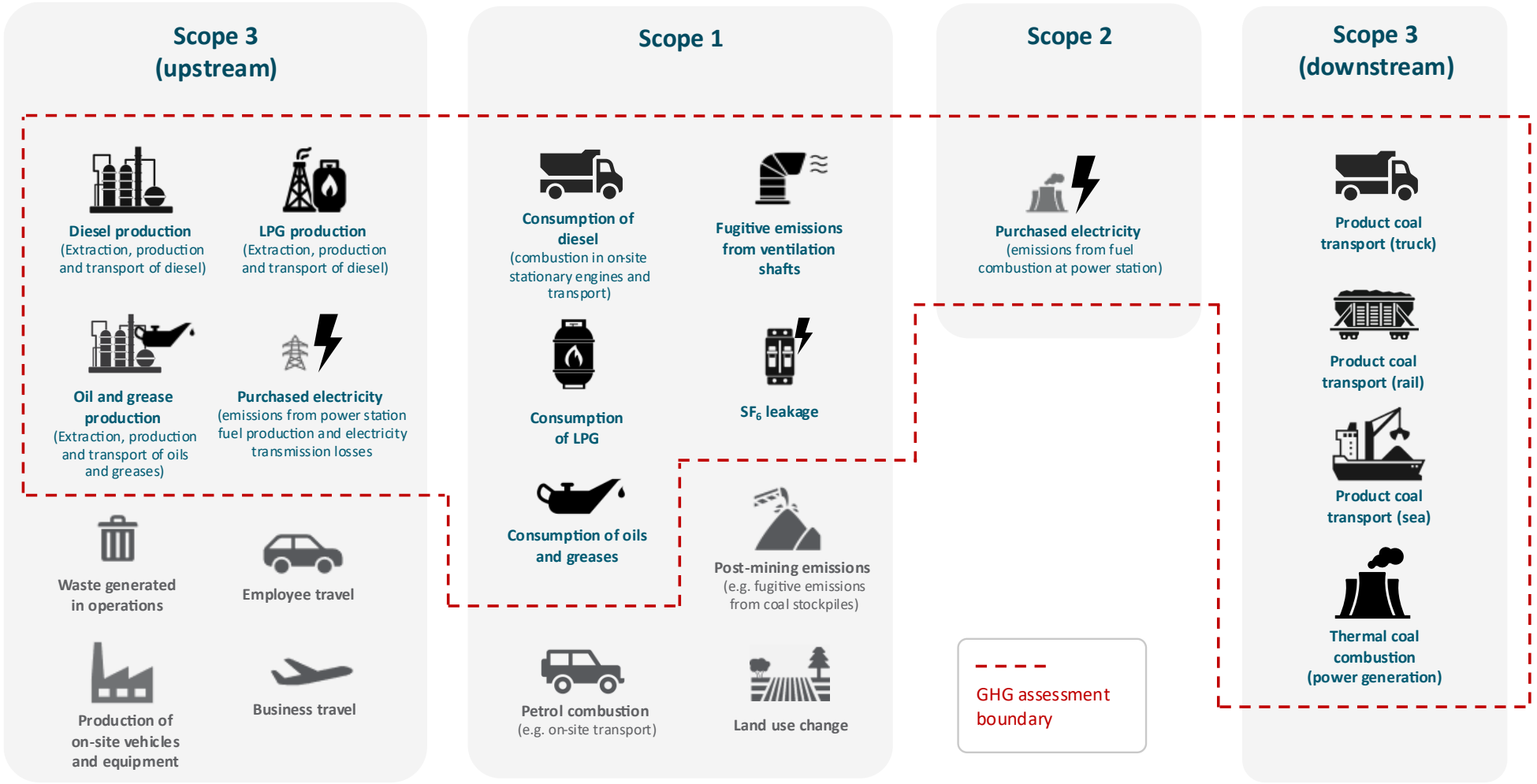

Figure 3.1 **GHG assessment boundary and emission sources**

For upstream scope 3 emissions, the sources included were:

- the extraction, production and transport of the diesel consumed on-site
- the extraction, production and transport of the LPG consumed on-site
- the extraction, production and transport of the oils and greases consumed on-site
- the purchase of grid electricity for on-site use. Here, scope 3 emissions are indirect emissions from the extraction, production and transport of the fuel burned during electricity generation, and the indirect emissions attributable to the electricity lost in delivery in the transmission and distribution network.

For downstream scope 3 emissions, the sources included were:

- the transport of product coal by road from Clarence to the local power stations (Mt Piper and Vales Point)
- the transport of product coal by rail from Clarence to the Port of Newcastle
- the transport of product coal by sea from the Port of Newcastle to overseas markets; for the purpose of the GHG calculation, these markets were assumed to be in Japan
- coal combustion (for power generation).

Several potential GHG sources were excluded from the assessment. Where a particular source was excluded from the assessment, this was either because it was not relevant, activity data for it were not readily available, or its emissions were unlikely to be material (i.e. they would have been too low over the life of Mod 11 to materially change the outcomes of the assessment or influence decision-making). The excluded sources were:

- Scope 1:
  - consumption of liquid fuels other than diesel (e.g. petrol)
  - post-mining emissions (e.g. fugitive releases from stockpiles and coal processing)
  - land use change.
- Scope 3 (upstream):
  - consumption of liquid fuels other than diesel (e.g. petrol)
  - manufacture of mine vehicles and equipment
  - employee travel
  - business travel
  - waste generated during operation.

3.2.2 IPCC nomenclature

The *NSW EPA Guide for Large Emitters* also requires emission sources to be categorised according to IPCC sectors and sub-sectors, as applied in Australia's national emission projections. For this assessment, all scope 1 emission sources are categorised as follows:

- IPCC sector = stationary energy (excluding electricity generation)
- IPCC sub-sector = mining

3.2.3 Project stages and timeframe

The *NSW Guide for Large Emitters* states that the GHG assessment must consider all relevant stages of the project (as appropriate), such as construction, operation, decommissioning, closure and post-closure. For Mod 11, only the operational phase was considered to be relevant (including the use of fossil fuels during progressive mine rehabilitation). As Mod 11 is a continuation of mining, there would be no construction activities.

The GHG assessment covers the financial years from 2026-27 to 2031-32 (six years). Financial years are considered as 1 July to 30 June the following year. Current mining operations are approved until 31 December 2026 and therefore, the emissions for Mod 11 in the financial year 2026-27 only cover a six-month period. Similarly, the extension for Mod 11 would end on 31 December 2031, and so the emissions for Mod 11 in the financial year 2031-32 also only cover a six-month period.

3.2.4 Emissions scenarios

Step 1 of the *NSW Guide for Large Emitters* also requires the definition of emission scenarios. Given that Mod 11 would involve a modification to an existing operation, scope 1, scope 2 and scope 3 emissions were calculated for the scenarios in Table 3.2. In accordance with *NSW Guide for Large Emitters*, the GHG assessment applies to Scenario 3 (the 'project only' scenario for Mod 11).

Table 3.2 Emission scenarios

NSW EPA terminology		Terminology in GHG assessment	
		Scenario no.	Scenario description
Business-as-usual (BAU)	Represents the emissions that are expected to occur without the proposed project.	1	Represents the emissions from Clarence as currently approved (i.e. to 31 December 2026).
Modified business	Represents the emissions associated with existing operations and including the proposed project as designed.	2	Represents emissions from Clarence with Mod 11.
Project only	Represents emissions for the project only, in the context of total facility emissions. **NB**: This scenario determines whether a project is a large emitter.	3	Represents emissions from Mod 11 only. Determined as emissions in Scenario 2 minus emissions in Scenario 1.

The *NSW Guide for Large Emitters* also requires scope 1 and scope 2 emissions to be estimated based on both planned operational throughput and maximum capacity. For the purposes of this report, the steps in the NSW Guide for Large Emitters have been followed based on the planned operational throughput.

3.3 Step 2: Calculation of GHG emissions and prioritisation (as designed)

Step 2 in the *NSW EPA Guide for Large Emitters* involves calculating gross GHG emissions for the project as designed, and then prioritising emission sources for mitigation.

3.3.1 Calculation approach

The GHGs that were relevant to the assessment were CO_2, CH_4, N_2O and SF_6.

Details of the GHG emission calculation methodology for Mod 11 are provided in Appendix A. Emissions in Scenario 3 were calculated as the difference between those in Scenario 2 and those in Scenario 1. The supporting activity data (e.g. coal extraction and transport, fuel consumption, electricity consumption) for the scenarios are given in Appendix B. The estimation of GHG emissions for Mod 11 was based primarily on the *National Greenhouse Accounts Factors* (NGAF) *Workbook* (DCCEW 2025a).

3.3.2 Planned mitigation

i Scope 1 emission sources

With respect to on-site fuel consumption, various mitigation measures are inherent to operation at coal mines, and are systematically implemented as best practice. For Mod 11, these measures would include:

- Mine planning:
  - optimisation of haul routes for surface activities, such as reject emplacement
  - optimisation of ramp gradients for surface activities, such as reject emplacement
  - payload management and loading equipment productivity.
- Mine vehicles and equipment:
  - procurement of energy-efficient vehicles and equipment for surface activities, such as light vehicles
  - scheduling so that equipment use and vehicle operation are optimised
  - minimising engine idling
  - ensuring that all equipment is serviced and maintained according to manufacturers' specifications.

These measures were effectively included as 'planned' measures for the purpose of calculating GHG emissions. The emission reductions of these measures have not been quantified separately, as there is no counterfactual case of deliberately inefficient mine operation.

To restrict fugitive releases of CH_4 and CO_2 following completed mining areas, any related mine entries (drafts and shafts) will be sealed, and the mine areas will be allowed to flood naturally. Post-closure fugitive emissions were therefore assumed to be zero.

ii Scope 2 emission sources

In relation to scope 2 emissions, the main measure would be optimisation of coal processing operations and electrical mining equipment.

The GHG emission calculations took into account the anticipated decarbonisation of the NSW electricity grid (i.e. emissions from the purchase of grid electricity will decrease as the NSW grid decarbonises).

3.3.3 GHG emission estimates – planned operational throughput

The results of the GHG emission calculations for Scenario 3 are summarised in the following sections. A breakdown of the emission results by scenario, year and emission source is provided in Appendix C. For ease of presentation, the results for individual gases are not included.

The estimated emissions are likely to be conservative, as the calculations do not reflect potential measures for emissions reduction which may become practicable and feasible in the future, such as fleet electrification or alternative fuels.

i Scope 1 and scope 2 emissions

The scope 1 and scope 2 emissions in Scenario 3 (the incremental increase for Mod 11), and in each financial year of the Mod 11 life, are given in Table 3.3. The average annual and total emissions for the Mod 11 life are also provided. Figure 3.2 compares the combined scope and scope 2 emissions with the threshold of 25,000 t CO_2-e/year in the *NSW Guide for Large Emitters*.

Table 3.3 Annual scope 1 and scope 2 emissions (Scenario 3)

Financial year	GHG emissions (kt CO_2-e/year)		
	Scope 1	Scope 2	Scope 1 + scope 2
2026-27	3.1	24.9	28.0
2027-28	11.0	33.0	44.0
2028-29	11.1	23.0	34.1
2029-30	11.1	10.7	21.8
2030-31	11.2	8.8	20.0
2031-32	3.1	4.5	7.6
Average (kt CO_2-e/year)	**8.4**	**17.5**	**25.9**
Total (kt CO_2-e)	**50.6**	**105.0**	**155.6**

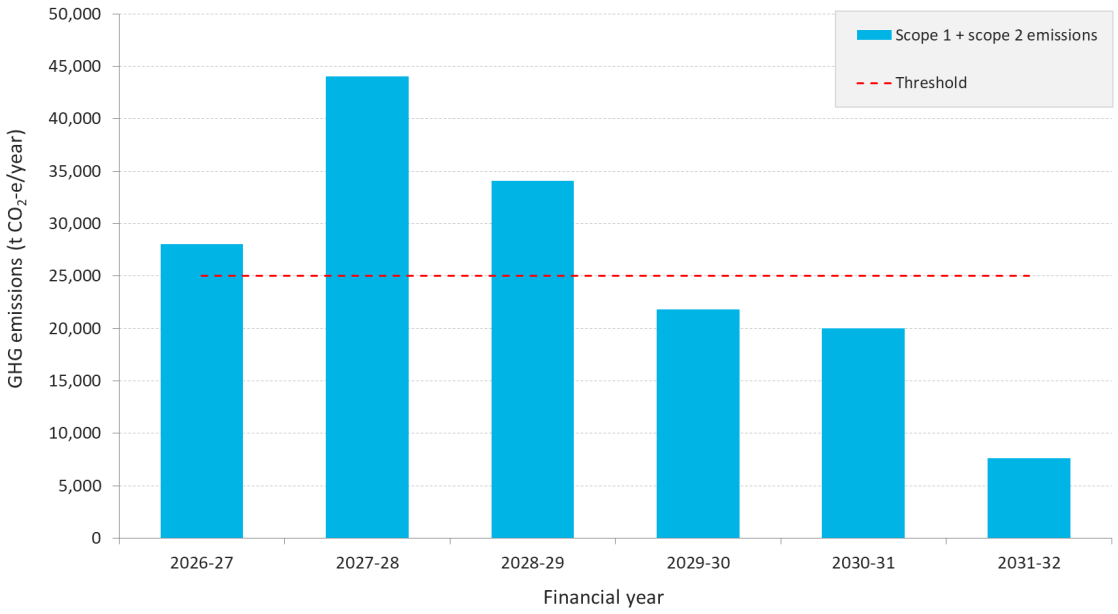

Figure 3.2 Annual scope 1 and scope 2 emissions (Scenario 3, planned operational throughput)

Emissions were above the threshold in three years of operation (2026-27, 2027-28 and 2028-29). The scope 1 and scope 2 emissions for Mod 11 would peak at 44.0 kt CO_2-e/year in 2027-28. The average annual scope 1 and scope 2 emission rate would be 25.9 kt CO_2-e/year, and the aggregated emissions over the Mod 11 life would be 156 kt CO_2-e.

The *NSW Guide for Large Emitters* also requires the calculation of scope 1 and scope 2 emissions intensity per unit of production or activity for the primary scheduled activity under Schedule 1 of the POEO Act. Production variables are also stated the *Safeguard Mechanism: Prescribed production variables and default emissions intensities* (DCCEEW 2024). For underground coal mines, the production variable is ROM coal, and the emission intensity is stated as tonnes of CO_2-e per tonne of ROM coal.

The annual emission intensities for Scenario 3 are given in Table 3.4. The average scope 1 emission intensity over the life of Mod 11 would be 0.0046 tonnes of CO_2-e per tonne of ROM coal. This is an order of magnitude below the industry average emission intensity in the Safeguard Mechanism (0.0653 tonnes of CO_2-e per tonne of ROM coal), and slightly below the best practice benchmark for *new* facilities (0.00592 tonnes of CO_2-e per tonne of ROM coal). Whilst the latter metric is presented as 'best-practice', no data are disclosed by the Australian Government to allow the underlying emission minimisation practices to be examined.

Table 3.4 Annual emission intensity (Scenario 3)

Financial year	Emission intensity (t CO_2-e / t ROM coal)	
	Scope 1	Scope 2
2026-27	0.0029	0.0232
2027-28	0.0059	0.0176
2028-29	0.0054	0.0111
2029-30	0.0053	0.0051
2030-31	0.0053	0.0042

Financial year	Emission intensity (t CO_2-e / t ROM coal)	
	Scope 1	Scope 2
2031-32	0.0028	0.0042
Average	**0.0046**	**0.0109**

ii Scope 3 emissions

The scope 3 emissions in Scenario 3, and in each financial year of Mod 11, are given in Table 3.5 and Figure 3.3. The scope 3 emissions would be much larger than the scope 1 and scope 2 emissions, and would represent 99% of all emissions. Scope 3 emissions would be directly proportional to coal production, and would peak at around 3,900 kt CO_2-e/year in 2028-29. The aggregated scope 3 emission over the life of Mod 11 is anticipated to be around 16,500 kt CO_2-e.

Table 3.5 Annual scope 3 emissions (Scenario 3, planned operational throughput)

Financial year	GHG emissions (kt CO_2-e/year)
2026-27	1,355
2027-28	3,652
2028-29	3,872
2029-30	2,777
2030-31	3,245
2031-32	1,586
Average (kt CO_2-e/year)	**2,748**
Total (kt CO_2-e)	**16,487**

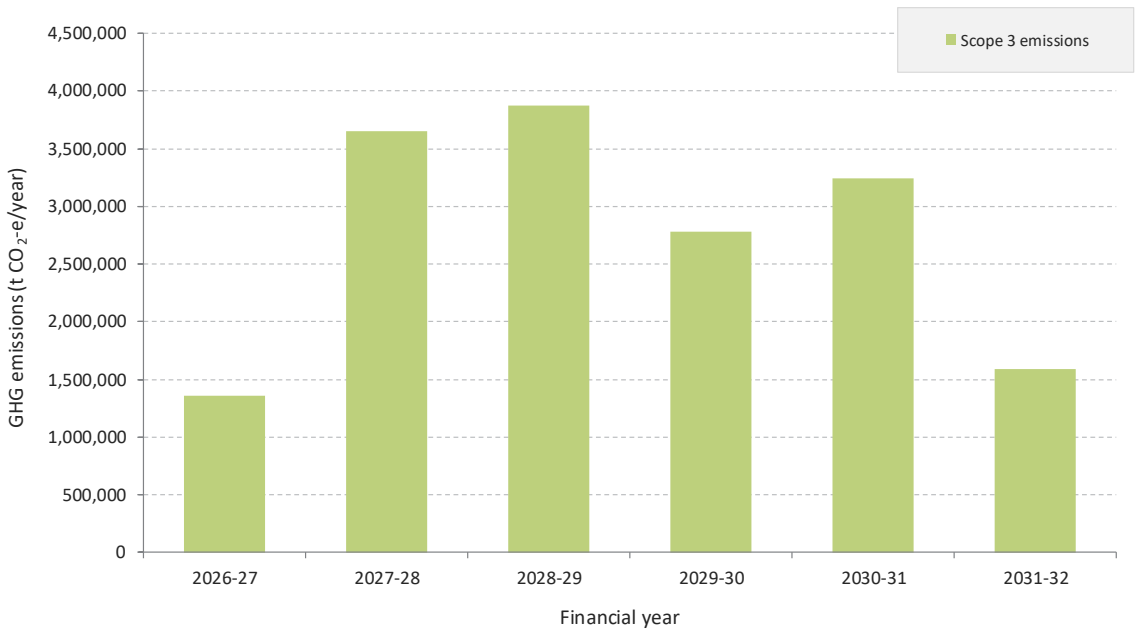

Figure 3.3 Annual scope 3 emissions (Scenario 3, planned operational throughput)

3.3.4 GHG emission estimates - maximum capacity

For the maximum capacity case, the scope 1, 2 and 3 emissions in Scenario 3 are given in Table 3.6. The combined scope 1 and scope 2 emissions for Mod 11 would peak at around 67 kt CO_2-e/year in 2027-28. The average annual scope 1 and scope 2 emission rate would be 37 kt CO_2-e/year, and the aggregated emissions over the Mod 11 life would be 223 kt CO_2-e. Scope 3 emissions would peak at around 4,800 kt CO_2-e/year, with an aggregated emission over the life of Mod 11 of around 24,000 kt CO_2-e. Depending on the year, the combined scope 1 and scope 2 emissions in the maximum capacity scenario were 37-54% higher than those in the planned operational throughput scenario.

Table 3.6 Annual scope 1, scope 2 and scope 3 emissions (Scenario 3, maximum capacity)

Financial year	GHG emissions (kt CO_2-e/year)			
	Scope 1	Scope 2	Scope 1 + scope 2	Scope 3
2026-27	4.2	34.7	38.9	2,418
2027-28	15.0	52.8	67.8	4,835
2028-29	15.0	33.3	48.3	4,834
2029-30	15.0	15.3	30.3	4,834
2030-31	15.0	12.5	27.5	4,832
2031-32	4.2	6.3	10.5	2,417
Average (kt CO_2-e/year)	**11.4**	**25.8**	**37.2**	**4,028**
Total (kt CO_2-e)	**68.3**	**154.9**	**223.2**	**24,169**

3.3.5 Prioritisation of emission sources

i Scope 1 and scope 2 emissions

The contributions of the different sources to annual scope 1 and scope 2 emissions in Scenario 3 are shown in Figure 3.4. The largest contributors to emissions would be electricity consumption (purchased from the grid) and fugitive sources. The reductions in emissions after 2027-28 would be due to the impacts of decarbonisation of the electricity grid.

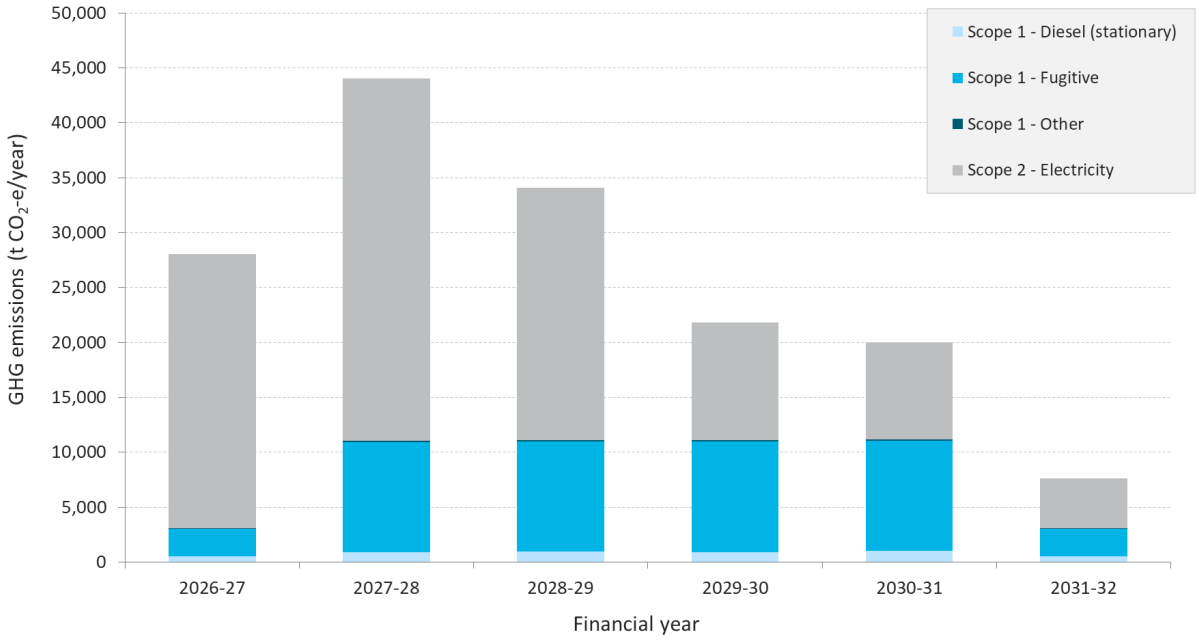

Figure 3.4 Contributions to scope 1 and scope 2 emissions (Scenario 3)

In Table 3.7, the sources of scope 1 and scope 2 emissions in Scenario 3 are ranked according to their contribution to emissions over the life of Mod 11. On this basis, electricity consumption would be responsible for 68% of the total, and fugitive emissions 29%. On-site 'stationary' diesel consumption in mining equipment would account for most of the remained, with all other sources being negligible.

Table 3.7 Ranking of scope 1 and scope 2 sources based on Mod 11 life emissions (Scenario 3)

Ranking	Source	Scope	Life of mine emissions (kt CO_2-e)	Contribution (%)
1	Electricity consumption	Scope 2	105.0	67.5%
2	Fugitive emissions	Scope 1	45.2	29.0%
3	Diesel consumption (stationary)	Scope 1	4.8	3.1%
4	Oils	Scope 1	0.4	0.2%
5	Diesel consumption (transport)	Scope 1	0.3	0.2%
6	LPG consumption	Scope 1	0.0058	<0.01%
7	Greases	Scope 1	0.0019	<0.01%
8	SF_6 leakage	Scope 1	0.0008	<0.01%

ii Scope 3 emissions

The contributions of the different sources to annual scope 3 emissions in Scenario 3 are shown in Figure 3.5. Scope 3 emissions would be dominated by the combustion of coal at end user facilities.

Table 3.8 shows the ranking of sources for scope 3 emissions in Scenario 3, based emissions over the life of Mod 11. The combustion of product coal would account for approximately 98% of the total scope 3 emissions over the life of Mod 11. The transport of product coal by sea would contribute 1.4% of emissions. All other sources would be negligible.

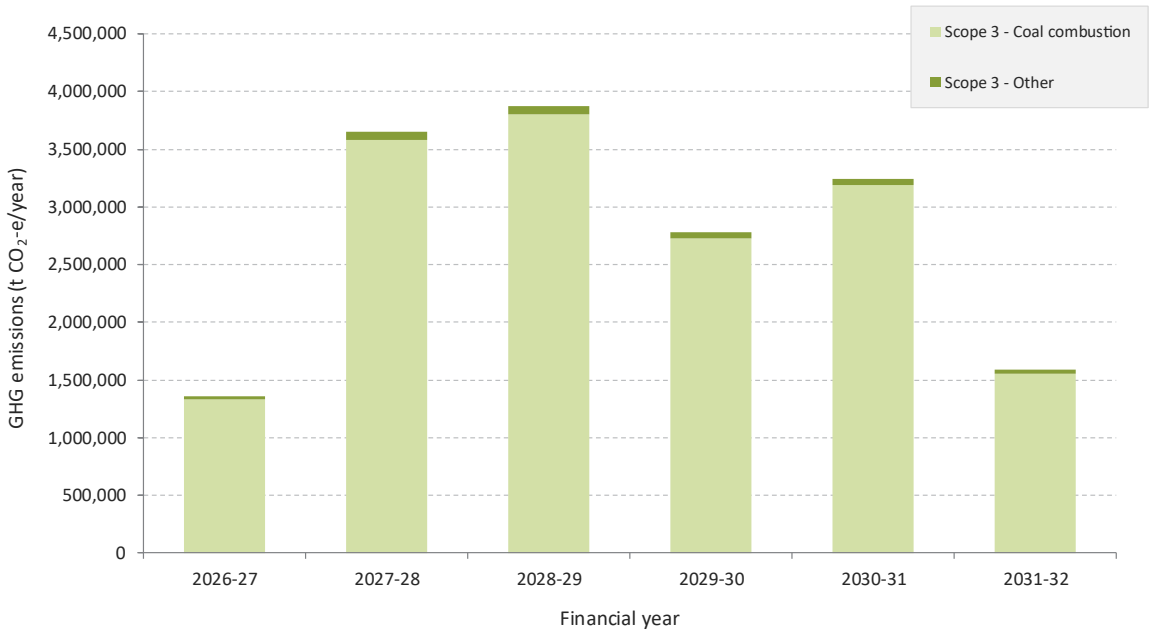

Figure 3.5 Contributions to scope 3 emissions (Scenario 3)

Table 3.8 Ranking of scope 3 sources based on Mod 11 life emissions (Scenario 3)

Ranking	Source	Scope	Life of mine emissions (kt CO_2-e)	Contribution (%)
1	Combustion of coal by end user	Scope 3 (downstream)	16,179.7	98.1%
2	Transport of coal to end user (sea)	Scope 3 (downstream)	228.7	1.4%
3	Transport of coal to end user (rail)	Scope 3 (downstream)	71.1	0.4%
4	Electricity consumption	Scope 3 (upstream)	5.2	0.03%
5	Transport of coal to end user (truck)	Scope 3 (downstream)	2.7	0.02%
6	Diesel (stationary)	Scope 3 (upstream)	1.18	<0.01%
7	Oils	Scope 3 (upstream)	0.45	<0.01%
8	Diesel (transport)	Scope 3 (upstream)	0.076	<0.01%
9	Greases	Scope 3 (upstream)	0.010	<0.01%
10	LPG	Scope 3 (upstream)	0.002	<0.01%

3.4 Step 3: Selection of mitigation measures

Step 3 of the *NSW Guide for Large Emitters* requires the selection of mitigation measures for emissions in the 'project only' scenario (Scenario 3), taking into account the EPA's mitigation hierarchy. The mitigation hierarchy places most importance on avoiding GHG emissions, followed by reduction, substitution and offsetting. Offsetting is only seen as a 'last resort' after all reasonable avoidance, reduction and substitution measures have been taken, and is only to be considered for any residual emissions.

Various mitigation measures were identified to avoid and reduce GHG emissions from Mod 11, depending on the relative practicability and feasibility of these options.

3.4.1 Scope 1 and scope 2 emissions

As outlined in Centennial's *Air Quality and Greenhouse Gas Management Plan – Western Region* (Centennial 2024), Centennial is committed to the ongoing management and reduction of GHG emissions generated by Mod 11. Centennial's Energy and Greenhouse Gas Management System monitors and reports energy usage and includes key performance indicators (KPIs) related to energy demand and GHG emissions per tonne of coal (Centennial 2024).

The planned mitigation management measures to reduce scope 1 and 2 emissions were identified in Section 3.3.2.

In addition to these, Centennial is committed to the following measures for Mod 11:

- installation of energy-efficient technology where feasible
- procurement of low-emission vehicles (e.g. electric, hybrid) for surface activities where feasible
- increasing employee training and awareness related to reducing GHG emissions
- engagement in projects related to the reduction of GHG emissions, innovations and technologies
- internal company GHG emissions and energy consumption reduction targets
- periodic review of new technologies to evaluate if these could be adopted as mitigation measures.

It is worth noting that in July 2025 NSW EPA published a *Proposed Greenhouse Gas Mitigation Guide for NSW Coal Mines* as a draft for consultation (NSW EPA 2025b). In this document, the EPA recognises that coal seams in the Western Coalfield generally have a low methane and gas content. For underground mines that are within the Western Coalfield and have GHG emissions below 100,000 t CO_2-e/year, the EPA does not have an expectation that methane emissions will be mitigated.

3.4.2 Scope 3 emissions

The majority of scope 3 emissions are due to coal combustion at end user facilities. As far as possible, Centennial will continue to sell coal to countries that have NDCs under the Paris Agreement (or have followed international standards recognised by the UNFCCC and published their own NDCs document in support of the Paris Agreement).

3.5 Step 4: Emissions with mitigation measures

The effects of the planned and additional mitigation measures on GHG emissions have not been quantified, given that they are dependent on the outcomes of further investigations.

3.6 Step 5: Emission benchmarking and goal setting

The *NSW Guide for Large Emitters* requires the GHG assessment to address the anticipated regulatory obligations for Mod 11under the Safeguard Mechanism, to consider how Mod 11 emissions compare to NSW emissions, and to set out long-term and interim GHG emission goals for a project. These requirements are addressed for Mod 11 below.

3.6.1 Safeguard Mechanism

Clarence Colliery is not a Safeguard facility. The Safeguard Mechanism is therefore not considered further in this report.

3.6.2 Comparison with NSW emissions trajectory

As noted in Table 2.2, the Net Zero Future Act sets the following legislated emissions reduction targets for NSW:

- 50% reduction in net GHG emissions from 2005 levels by 2030
- 70% reduction in net GHG emissions from 2005 levels by 2035
- Net zero GHG emissions by 2050.

These targets are largely driven by the planned closure of coal-fired power stations and the increasing integration of firmed renewable energy into the grid. The NSW targets are supported by varying emissions reductions across different sectors, rather than requiring equal reductions from every sector.

The Net Zero Future Act establishes state-wide, whole-of-government targets and guiding principles, rather than imposing direct, binding obligations on individual projects or facilities. While the Net Zero Future Act requires the NSW Government to achieve net zero emissions by 2050, and sets interim targets, it leaves the specific implementation details and sectoral requirements to be developed through future regulations and policies.

The Net Zero Emissions Dashboard ('the Dashboard') presents past and projected future net GHG emissions for NSW (NSW Government 2025). The Dashboard shows emission trends and the progress being made towards the state's emission-reduction objectives. The Dashboard provides emissions for the following cases:

- Historical **actual** emissions up to 2022.
- A future **BAU** projection up to 2050. The BAU scenario accounts for major factors impacting NSW emissions including past state policies but excludes the impact of actions under the Net Zero Plan and related NSW Government policies and programs.
- A **current policy** emission projection up to 2050. The current policy emission estimates consider:
  - current policies and programs under Stage 1 of the Net Zero Plan
  - initiatives related to reducing emissions supported by the NSW Climate Change Fund (CCF) under future stages of the Plan
  - related policies including NSW EPA Climate Change Policy and Action Plan and the Commonwealth's Safeguard Mechanism.

The future emissions from the Dashboard, and the projected annual scope 1 emissions for Mod 11 (Scenario 3), are shown in Table 3.9. Mod 11 would be a small contributor to GHG emissions in NSW. For example, it would represent less than 0.02% of state-wide emissions in the NSW current policy case.

Table 3.9 Comparison with scope 1 emissions from NSW Net Zero Emissions Dashboard

Financial year	NSW (Mt CO_2-e/year)		Mod 11 (Mt CO_2-e/year)	Mod 11 as % of NSW current policy
	BAU	Current policy		
2026-27	109.21	107.06	0.003	0.003%
2027-28	103.45	100.75	0.011	0.011%
2028-29	101.11	97.54	0.011	0.011%
2029-30	87.14	82.97	0.011	0.013%
2030-31	90.17	84.13	0.011	0.013%
2031-32	88.26	81.19	0.003	0.004%
Average (Mt CO_2-e/year)	**96.56**	**92.27**	**0.008**	-
Total (Mt CO_2-e)	**579.34**	**553.64**	**0.051**	-

3.6.3 Emission-reduction goals

Under the *NSW Guide for Large Emitters*, proponents are required to set scope 1 emission-reduction goals for a project's residual emissions. The scope 1 goals are specified in absolute terms (e.g. tonnes CO_2-e for a given year). According to NSW EPA, emission-reduction goals should include material efforts to reduce emissions leading towards net zero by 2050, and the emission trajectory should be broadly consistent with the NSW trajectory.

For a facility that is not covered by the Safeguard Mechanism, there is no guidance from NSW EPA on how to determine a trajectory that is consistent with the above requirements. Therefore, in this report, the differences between the trajectories for Mod 11 and NSW have converted to approximate emission reductions. This approach is illustrated in Figure 3.6 and Table 3.10.

Firstly, scope 1 emissions in each full year of Mod 11 were normalised to those in the first full year of operation (2027-28). Ignoring the first year (2026-27) and last year (2031-32), which only cover six-month periods, Mod 11 would have a flat emissions profile. Secondly, emissions in NSW (current policy) were also normalised to 2027-28. The difference between the two normalised values for each year was then calculated, and this was multiplied by the absolute emissions for Mod 11 in each year to give the corresponding emission reductions. These emission reductions varied from year to year, with a maximum of 2,008 t CO_2-e/year in 2029-30.

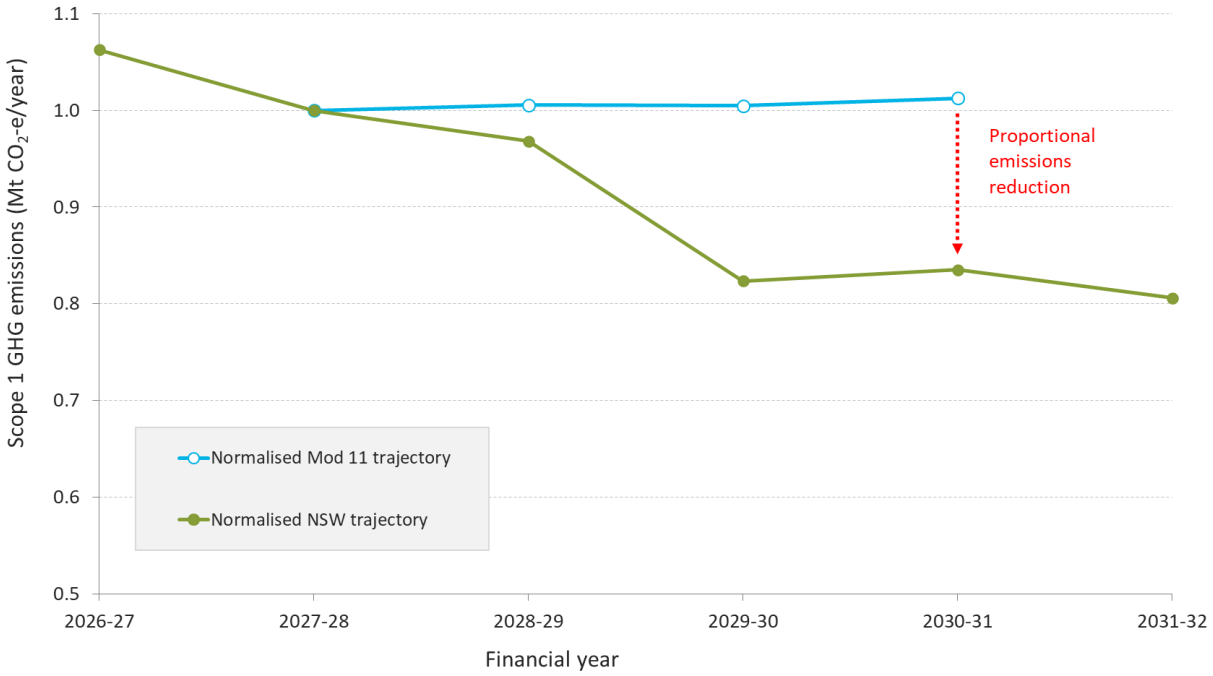

Figure 3.6 **Goal setting for Mod 11 (scope 1 emissions)**

Table 3.10 **Scope 1 emission-reduction goals for Mod 11**

Financial year	Normalised emissions			Scope 1 emissions for Mod 11 (t CO_2-e/year) [D]	Scope 1 emission reduction for Mod 11 (t CO_2-e/year) [D x C]
	NSW current policy [A]	Mod 11 [B]	Difference [C] = [B – A]		
2026-27	1.063	N/A	N/A	N/A	N/A
2027-28	1.000	1.000	0.000	11,047	0
2028-29	0.968	1.004	0.037	11,106	414
2029-30	0.824	1.004	0.181	11,096	2,008
2030-31	0.835	1.010	0.177	11,184	1,984
2031-32	0.806	N/A	N/A	N/A	N/A

3.7 Step 6: Offsets strategy

As noted earlier, Centennial is committed to the ongoing management and reduction of GHG emissions generated by Mod 11. In the short-term, Centennial anticipates that the primary approach to achieving the emission reductions in the last column of Table 3.10 will involve the use of carbon offsets. Eligible carbon offsets would meet the integrity standards set out in the Commonwealth *Carbon Credits (Carbon Farming Initiative) Act 2011*. This approach aligns with NSW EPA's expectations.

Centennial will secure offsets in a timely manner. Reflecting the NSW EPA preference for offsets from NSW-based projects, Centennial will also consider purchasing NSW-based offsets where they are available and represent a cost-effective option.

3.8 Step 7: Independent expert review

As Mod 11 would have scope 1 and scope 2 emissions below 100,000 t CO_2-e per year during its operational life, an independent expert review was not required.

3.9 Climate change considerations

3.9.1 Background

Since the publication of the *NSW Guide for large emitters*, two legal rulings have had a bearing on the considerations for GHG assessments in the state:

- Firstly, in July 2025 the Court of Appeal of the Supreme Court New South Wales declared the development consent granted by the Independent Planning Commission (IPC) to the continuation of the Mount Pleasant Coal Mine invalid[6]. The reasons for this decision included the following:
  - The IPC did not take into consideration the 'likely impacts of the development including environmental impacts on both the natural and built environments, and social and economic impacts in the locality' under section 4.15(1)(b) of the *Environmental Planning and Assessment Act 1979*. This was because it did not specifically consider the impacts of climate change in the locality of the mine (and specifically the impacts relating to scope 3 emissions). It was not enough that the IPC considered the impacts of climate change at a global level; it had to address the specific impacts on the locality.
  - The IPC failed to consider whether to impose conditions to minimise Scope 3 GHG emissions resulting from the development.
- Secondly, in November 2025 the NSW Land and Environment Court declared that the approval by the NSW Department of Planning, Housing and Infrastructure of Glencore's Modification 6 to the Ulan Coal Mine was invalid. This decision was made on the basis of the Court of Appeal's decision to reject the expansion of the Mt Pleasant Mine on the grounds that local climate impacts are a mandatory relevant consideration for greenhouse gas generating projects.

In addition, in September the NSW Net Zero Commission issue letters to DPHI and the IPC encouraging the two bodies to include consideration of various in their roles in assessing and determining applications for projects like coal mines. The following considerations are the most relevant to this assessment:

- scope 1 emissions of any proposal compared to the NSW's legislated targets
- the measures to reduce Scope 2 emissions of any proposal
- any proposal's scope 3 emissions given the capacity for such emissions to contribute to climate change and so to have an impact locally in NSW
- any proposal's adaptation measures to ensure resilience to a changing climate
- how the proposal promotes NSW's adaptation objective.

[6] Denman Aberdeen Muswellbrook Scone Healthy Environment Group Inc v MACH Energy Australia Pty Ltd [2025] NSWCA 163, https://www.caselaw.nsw.gov.au/decision/198358b0f4e9e10f2b50c718

The letters also references the Mt Pleasant decision, and highlights that scope 3 emissions are an important factor in addressing climate change locally and globally, particularly for sectors like coal mining where scope 3 emissions are a large portion of Mod 11's emissions.

3.9.2 Approach and summary

The considerations identified above – as they relate to local climate impacts and scope 3 emissions – are addressed in Appendix D.

The main findings of the study were:

- For the area around Clarence Colliery in the near future scenario, relative to the baseline period were:
  - average and maximum temperatures are projected to increase by around 0.7 to 0.8°C
  - there is projected to be an increase of less than one hot day (>35°C) per year
  - annual rainfall is projected to decrease, but there are differences between emission scenarios as well as some seasonal variation
  - the Forest Fire Damage Index (FFDI) is projected to increase slightly.
- For the Lithgow area, climate change may have potential impacts on the economy, ecosystems, water resources, infrastructure and the community. Noting the changes in climate identified above, over the timeframe of Mod 11, these impacts are likely to be relatively small.
- The proportional contribution of Mod 11 to global GHG emissions (0.01%), atmospheric GHG concentrations and anthropogenic climate change, is likely to be very minor.
- The scope 3 emissions for Mod 11 would represent 99% of all GHG emissions from Mod 11. It is beyond Centennial's control to reduce or mitigate scope 3 emissions, given they mostly occur outside Australia and are generated by third parties. Clarence Colliery will continue to export coal to countries that have NDCs under the Paris Agreement, or have followed international standards recognised by the UNFCCC.

4 Summary and conclusions

4.1 Overview

This report presents a GHG assessment for Mod 11 for Clarence, which has been compiled in accordance with the *NSW Guide for Large Emitters*. The assessment included estimates of scope 1, scope 2 and 3 emissions for continued operation at the mine to 31 December 2031 with the proposed modification. Both planned operational throughput and maximum capacity scenarios were considered.

4.2 GHG emission estimates

For the planned operational throughput case, the scope 1 and scope 2 emissions for Mod 11 would peak at around 44.0 kt CO_2-e/year in 2027-28. There were three financial years in which the *NSW EPA Guide for Large Emitters*' threshold of 25,000 t CO_2-e/year was exceeded, and therefore Mod 11 was considered to be a large emitter. The aggregated scope 1 and scope 2 emissions over the life of Mod 11 would be 156 kt CO_2-e. The average scope 1 emission intensity over the life of Mod 11 would be 0.0046 tonnes of CO_2-e per tonne of ROM coal, which is an order of magnitude below the industry average value in the Safeguard Mechanism. The largest contributors to scope 1 and scope 2 emissions over the life of Mod 11 would be purchased electricity (68% of the total) and fugitive sources (29% of the total).

The scope 3 emissions for Mod 11 would be much larger than the scope 1 and scope 2 emissions. Scope 3 emissions would peak at around 3,900 kt CO_2-e/year in 2028-29. The combustion of product coal would account for approximately 98% of the total scope 3 emissions over the life of Mod 11.

4.3 Mitigation measures

Various mitigation measures are inherent to operation at coal mines (e.g. mine planning, vehicle maintenance), and these were effectively included as 'planned' measures for the purpose of calculating GHG emissions. To restrict fugitive releases of methane and carbon dioxide following mine area closure, all mine entries and shafts will be sealed and the mine areas will be allowed to flood naturally. Mitigation of GHG emissions will continue to be conducted in accordance with Centennial's *Air Quality and Greenhouse Gas Management Plan – Western Region* (Centennial 2024).

In addition, Centennial is committed to a number of additional measures, including the installation of energy-efficient technology where feasible, and engagement in projects related to the reduction of GHG emissions, innovations and technologies.

With respect to scope 3 emissions, Centennial will continue to sell coal to countries that have NDCs under the Paris Agreement (or have followed international standards recognised by the UNFCCC and published their own NDCs document in support of the Paris Agreement).

The effects of the planned and additional mitigation measures on GHG emissions have not been quantified, given that they are dependent on the outcomes of further investigations.

4.4 Comparison with NSW emissions

Scope 1 emissions for Mod 11 were compared with those in NSW. Mod 11 would represent less than 0.02% of state-wide emissions in the NSW current policy case.

Scope 1 emission-reduction goals have been determined for Mod 11 for consistency with the NSW emissions trajectory. These emission reductions varied from year to year, with a maximum of 2,008 t CO_2-e/year in 2029-30.

4.5 Climate change considerations

Climate considerations as they relate to local climate impacts and scope 3 emissions are addressed in Appendix D.

The main findings of the study were that around the Clarence Colliery, in the near future scenario, temperatures were projected to increase, annual rainfall was projected to decrease, and the FFDI is projected to increase. The contribution of Mod 11 to global GHG emissions is 0.01% and the scope 3 emissions for Mod 11 would represent 99% of all GHG emissions from Mod 11.

Abbreviations

ACCU	Australian Carbon Credit Unit
CER	Clean Energy Regulator
CH_4	methane
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
COP	Conference of the Parties (to the UNFCCC)
DPHI	(NSW) Department of Planning, Housing and Infrastructure
EPA	(NSW) Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
GHG	greenhouse gas
GWP	global warming potential
IPCC	Intergovernmental Panel on Climate Change
Mt	million tonnes
Mtpa	million tonnes per annum
MWh	megawatt-hour
N_2O	nitrous oxide
NDC	Nationally Determined Contribution
NGA	National Greenhouse Accounts
NGER Act	*National Greenhouse and Energy Reporting Act 2007*
NSW	New South Wales
ROM	run-of-mine
SF_6	sulfur hexafluoride
SMC	Safeguard Mechanism Credit
UNFCCC	Nations Framework Convention on Climate Change

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Appendix A

GHG emission calculation methods

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A.1 Scope 1 emissions

A.1.1 Liquid fuel consumption

For each greenhouse gas *i* (CO_2, CH_4 and N_2O), annual scope 1 emissions from the on-site consumption (through combustion) of liquid fuels were estimated using the following equation:

$$E_i = \frac{Q \times EC \times EF_i}{1{,}000}$$

Equation A.1

where:

E_i = GHG emission for gas *i* (t CO_2-e/year)

Q = quantity of fuel (kL/year)

EC = energy content of fuel (GJ/kL)[7]

EF_i = emission factor for gas *i* (kg CO_2-e/GJ)[8]

The relevant activities were:

- consumption of diesel in on-site mobile and stationary plant and equipment
- consumption of diesel for on-site transport
- consumption of liquefied petroleum gas (LPG) on-site.

The energy content and scope 1 emission factors for liquid fuels are presented in Table A.1. The emission factors for mining equipment are those provided for stationary energy use in the NGAF Workbook (DCCEEW 2025a). The NGAF Workbook states 'No transport factors are provided for vehicles not registered for road use. Stationary energy factors for individual fuel types should be used in these cases'. The quantities of fuel (kL) used in the assessment are given in Appendix B.

Table A.1 Energy content and emission factors – liquid fuel consumption

Fuel	Energy content (GJ/kL)	Scope 1 emission factor (kg CO_2-e/GJ)			Reference
		CO_2	CH_4	N_2O	
Diesel (stationary)	38.6	69.9	0.1	0.2	DCCEEW (2025a) (Table 8, diesel oil)
Diesel (transport)	38.6	69.9	0.4	0.2	DCCEEW (2025a) (Table 9, Heavy duty vehicles, diesel oil, Euro III)
LPG	25.7	60.2	0.2	0.2	DCCEEW (2025a) (Table 8, LPG)

[7] GJ = gigajoules

[8] kg CO_2-e/GJ = kilograms of carbon dioxide equivalents per gigajoule

A.1.2 Oils and greases

The energy content and scope 1 emission factors for petroleum-based oils and greases are presented in Table A.1. The quantities of fuel (kL) used in the assessment are given in Appendix B.

Table A.2 Energy content and emission factors – liquid fuel consumption

Fuel	Energy content (GJ/kL)	Scope 1 emission factor (kg CO_2-e/GJ)			Reference
		CO_2	CH_4	N_2O	
Oils	38.8	13.9	0	0	DCCEEW (2025a) (Table 8, petroleum-based oils)
Greases	38.8	3.5	0	0	DCCEEW (2025a) (Table 8, petroleum-based greases)

A.1.3 Fugitive emissions

Fugitive methane emissions will be generated from mine ventilation air at Clarence Colliery.

Centennial has provided summary information based on monitoring data from the ventilation shaft at Clarence Colliery. The following information was used in the fugitive emissions calculations:

- the average flow rate was taken to be 349 m^3/s
- the average contribution of CO_2 was 0.064%
- the average contribution of CH_4 was 0%.

Centennial has confirmed that methane in the coal seam is negligible.

The volumetric flow rate of CO_2 was calculated from the information above. The following adjustment factor (from the NGER Measurement Determination) was then applied to convert gas from m^3 at standard temperature and pressure (STP) to t CO_2-e:

- CO_2 adjustment factor = 1.861×10^{-3}

A.1.4 SF_6 leakage

SF_6 leakages occur from gas-insulated switchgear and circuit breaker applications. GHG emissions from SF_6 were estimated using the following equation:

$$E = \frac{stock \times L \times GWP_{SF6} \times F_{year}}{1000}$$

Equation A.2

Where:

E	=	GHG emission	(t CO_2-e/year)
stock	=	stock of SF_6	(kg)
L	=	leakage rate of SF_6	(proportion of stock per year)
GWP_{SF6}	=	global warming potential of SF_6	
F_{year}	=	fraction of the year over which the leakage occurs	(1 = full year; 0.5 = six months)

The default leakage gas rate for SF_6 is 0.0089 per year (DCCEEW 2021). To convert the mass of SF_6 into CO_2-e, it was multiplied by the GWP of SF_6 (23,500). The SF_6 stock is given in B.1. For periods of less than a year, the SF_6 emission was adjusted accordingly.

A.2 Scope 2 emissions

Annual scope 2 GHG emissions associated with on-site electricity consumption were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EF}{1{,}000}$$

Equation A.3

where:

E_{CO2-e} = GHG emissions associated with on-site electricity consumption (t CO_2-e/year)

Q = quantity of electricity (MWh/year)[9]

EF = emission factor for electricity consumption (kg CO_2-e/MWh)

The scope 2 emission factors for electricity consumption were taken from *Australia's emissions projections 2024* (DCCEEW 2025b). These values are presented in Table A.3. The amount of electricity consumed in each year is given in Appendix B.

Table A.3 Scope 2 GHG emission factors for electricity consumption

Financial year	Emission factor (t CO_2-e/MWh)	Reference
2026-27	0.50	DCCEEW (2025b) (values for NSW/ACT in Table 42)
2027-28	0.38	
2027-29	0.24	
2029-30	0.11	
2030-31	0.09	
2031-32	0.09	

[9] MWh = megawatt hours

A.3 Scope 3 emissions (upstream)

A.3.1 Extraction, production and transport of liquid fuel

Upstream scope 3 emissions for liquid fuel consumption were calculated using Equation A.1. The energy content and scope 3 GHG emission factors for liquid fuels are presented in Table A.4. The quantities of fuel (kL) used in the assessment are given in Appendix B.

Table A.4 Energy content and scope 3 emission factors – liquid fuel consumption

Fuel	Energy content (GJ/kL)	Scope 3 emission factor (kg CO_2-e/GJ)	Reference
Diesel (stationary)	38.6	17.3	DCCEEW (2025a) (Table 8, diesel oil)
Diesel (transport)	38.6	17.3	DCCEEW (2025a) (Table 9, Heavy duty vehicles, diesel oil, Euro iii)
LPG	25.7	20.2	DCCEEW (2025a) (Table 8, LPG)

A.3.2 Extraction, production and transport of oils and greases

Upstream scope 3 emissions for oils and greases were calculated using Equation A.1. The energy content and scope 3 GHG emission factors for oils and greases are presented in Table A.4. The quantities of fuel (kL) used in the assessment are given in Appendix B.

Table A.5 Energy content and scope 3 emission factors – oils and greases

Material	Energy content (GJ/kL)	Scope 3 emission factor (kg CO_2-e/GJ)	Reference
Oils	38.8	18.0	DCCEEW (2025a) (Table 8, petroleum-based oils)
Greases	38.8	18.0	DCCEEW (2025a) (Table 8, petroleum-based greases)

A.3.3 Electricity consumption

Annual scope 3 emissions associated with on-site electricity consumption were estimated using Equation A.3, in combination with the electricity consumption values in Appendix B and the scope 3 emission factors in Table A.6. The scope 3 emission factors for electricity consumption were taken from *Australia's emissions projections 2024* (DCCEEW 2025b).

Table A.6 Scope 3 GHG emission factors for electricity consumption

Financial year	Scope 3 emission factor (t CO_2-e/MWh)	Reference
2026-27	0.02	DCCEEW (2025b) (derived from values for NSW/ACT in Tables 42 and 43)
2027-28	0.02	
2027-29	0.01	
2029-30	0.01	
2030-31	0.00	
2031-32	0.01	

A.4 Scope 3 emissions (downstream)

A.4.1 Product coal transport

Scope 3 emissions were calculated for the following transport of product coal:

- transport by road from Clarence Colliery to local power stations (Mt Piper and Vales Point)
- transport by rail from Clarence Colliery to the Port of Newcastle for export
- transport by sea from the Port of Newcastle to Japan (as the largest end user).

For road transport, diesel consumption was estimated by Centennial to be 197 kL per year. The energy content and emission factors are presented in Table A.7. Although the transport of the coal would be a scope 3 process, the scope 1 emission factors were used to represent the actual emissions associated with the processes.

Table A.7 Energy content and emission factors – diesel consumption off-site

Fuel	Energy content (GJ/kL)	Scope 1 emission factor (kg CO_2-e/GJ)			Reference
		CO_2	CH_4	N_2O	
Diesel (transport)	38.6	69.9	0.07	0.4	DCCEEW (2025a) (Table 9, Heavy duty vehicles, diesel oil, Euro IV+)

The GHG emission factors for coal transport are presented in Table A.8. Again, although the transport of the coal would be a scope 3 process, the scope 1 emission factors were used to represent the actual emissions associated with the processes. The distance by rail from Clarence to the Port of Newcastle was taken to be 300 km. For the purpose of simplicity in these calculations, it was assumed that the international transport route to Japan by sea would be 8,000 km long. The amount of product coal being transported is given in Appendix B.

Table A.8 Scope 1 emission factors – product coal transport

Transport mode	Scope 1 emission factor (kg CO_2-e/tonne-km)	Reference
Rail	0.02779	DEFRA (2024) (Freighting goods / freight train)
Sea	0.00353	DEFRA (2024) (Freighting goods / cargo ship, bulk carrier)

A.4.2 Product coal combustion

It was assumed that the product coal would be used to generate electricity in power stations, both locally and in Japan.

For each greenhouse gas *i* (CO_2, CH_4 and N_2O), annual scope 3 emissions for coal combustion were estimated using the following equation:

$$E_i = \frac{Q \times EC \times EF_i}{1{,}000}$$

Equation A.4

where:

E_i = GHG emission for gas *I* (t CO_2-e/year)

Q = quantity of coal (t/year)

EC = energy content of coal (GJ/t)[10]

EF_i = emission factor for gas *I* (kg CO_2-e/GJ)

The energy content and emission factors for coal combustion are presented in Table A.9. Although the combustion of the coal would be a scope 3 process, the scope 1 emission factors were used to represent the actual emissions associated with the processes. The quantities of coal used in the assessment are given in Appendix B.

Table A.9 Energy content and scope 1 emission factors – coal combustion

Fuel type	Energy content (GJ/t)	Scope 1 emission factor (kg CO_2-e/GJ)			Reference
		CO_2	CH_4	N_2O	
Coal	27.0	90.0	0.04	0.2	DCCEEW (2025a) (Table 4, sub-bituminous coal)

[10] GJ = gigajoules

Appendix B
Activity data

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B.1 Planned operational throughput

The activity data for planned operational throughput used in the GHG emission calculations for Mod 11 were provided by Centennial. The annual data are provided in Table B.1, and the total life values (where appropriate) are given in Table B.4.

Table B.1 Annual activity data for planned operational throughput (coal)

Financial year	ROM coal (t/year)	Product coal (t/year)	Product coal via rail to Newcastle (t/year)	Sea freight to Japan (t/year)	Product coal burnt at destination (t/year)
Scenario 1					
2026-27	1,077,152	926,351	699,202	699,202	701,306
2027-28	-	-	-	-	-
2028-29	-	-	-	-	-
2029-30	-	-	-	-	-
2030-31	-	-	-	-	-
2031-32	-	-	-	-	-
Scenario 2					
2026-27	2,154,304	1,852,701	1,398,404	1,398,404	1,402,612
2027-28	1,875,000	1,575,000	1,885,318	1,885,318	1,890,991
2028-29	2,067,000	1,674,270	2,001,432	2,001,432	2,005,443
2029-30	2,099,000	1,658,210	1,438,124	1,438,124	1,438,124
2030-31	2,123,608	1,805,067	1,679,095	1,679,095	1,680,776
2031-32	1,089,000	914,760	821,275	821,275	821,275
Scenario 3					
2026-27	1,077,152	926,351	699,202	699,202	701,306
2027-28	1,875,000	1,575,000	1,885,318	1,885,318	1,890,991
2028-29	2,067,000	1,674,270	2,001,432	2,001,432	2,005,443
2029-30	2,099,000	1,658,210	1,438,124	1,438,124	1,438,124

Financial year	ROM coal (t/year)	Product coal (t/year)	Product coal via rail to Newcastle (t/year)	Sea freight to Japan (t/year)	Product coal burnt at destination (t/year)
2030-31	2,123,608	1,805,067	1,679,095	1,679,095	1,680,776
2031-32	1,089,000	914,760	821,275	821,275	821,275

Table B.2 Annual activity data for planned operational throughput (fuel, oil and grease)

Financial year	On-site diesel use [stationary] (kL/year)	On-site diesel use [transport] (kL/year)	Diesel used to transport coal to power stations [trucks] (kL/year)	Diesel used for rehabilitation (kL/year)	LPG consumption (kL/year)	Oil consumption (kL/year)	Grease consumption (kL/year)
Scenario 1							
2026-27	177.9	12.4	98.5	12.5	0.4	70.4	1.2
2027-28	-	-	-	-	-	-	-
2028-29	-	-	-	-	-	-	-
2029-30	-	-	-	-	-	-	-
2030-31	-	-	-	-	-	-	-
2031-32	-	-	-	-	-	-	-
Scenario 2							
2026-27	355.7	24.7	197.0	25.0	0.8	140.8	2.5
2027-28	302.4	21.0	197.0	25.0	0.7	119.7	3.0
2028-29	321.5	22.3	197.0	25.0	0.7	127.2	3.3
2029-30	318.4	22.1	197.0	25.0	0.7	126.0	2.4
2030-31	346.6	24.1	197.0	50.0	0.8	137.2	2.6
2031-32	175.6	12.2	98.5	25.0	0.4	69.5	1.3

Financial year	On-site diesel use [stationary] (kL/year)	On-site diesel use [transport] (kL/year)	Diesel used to transport coal to power stations [trucks] (kL/year)	Diesel used for rehabilitation (kL/year)	LPG consumption (kL/year)	Oil consumption (kL/year)	Grease consumption (kL/year)
Scenario 3							
2026-27	177.9	12.4	98.5	12.5	0.4	70.4	1.2
2027-28	302.4	21.0	197.0	25.0	0.7	119.7	3.0
2028-29	321.5	22.3	197.0	25.0	0.7	127.2	3.3
2029-30	318.4	22.1	197.0	25.0	0.7	126.0	2.4
2030-31	346.6	24.1	197.0	25.0	0.8	137.2	2.6
2031-32	175.6	12.2	98.5	12.5	0.4	69.5	1.3

Table B.3 Annual activity data for planned operational throughput (other)

Financial year	Fugitive emissions from vent shaft (m^3/s)	CO_2 in mine vent air (%)	CH_4 in mine vent air (%)	SF_6 (kg, stock)	Electricity consumption (kWh/year)
Scenario 1					
2026-27	349.0	0.064	0	0.8	25,851,000
2027-28	-	-	-	-	-
2028-29	-	-	-	-	-
2029-30	-	-	-	-	-
2030-31	-	-	-	-	-
2031-32	-	-	-	-	-
Scenario 2					
2026-27	349.0	0.064	0	0.8	51,702,000
2027-28	349.0	0.064	0	0.8	48,750,000

Financial year	Fugitive emissions from vent shaft (m^3/s)	CO_2 in mine vent air (%)	CH_4 in mine vent air (%)	SF_6 (kg, stock)	Electricity consumption (kWh/year)
2028-29	349.0	0.064	0	0.8	49,608,000
2029-30	349.0	0.064	0	0.8	50,376,000
2030-31	349.0	0.064	0	0.8	50,966,000
2031-32	349.0	0.064	0	0.8	26,136,000
Scenario 3					
2026-27	349.0	0.064	0	0.8	25,851,000
2027-28	349.0	0.064	0	0.8	48,750,000
2028-29	349.0	0.064	0	0.8	49,608,000
2029-30	349.0	0.064	0	0.8	50,376,000
2030-31	349.0	0.064	0	0.8	50,966,000
2031-32	349.0	0.064	0	0.8	26,136,000

Table B.4 Mod 11 life activity data for planned operational throughput

Variable		Units	Total for all financial years		
			Scenario 1	Scenario 2	Scenario 3
Coal	ROM coal extracted	(t/year)	1,077,152	11,407,912	10,330,760
	Product coal	(t/year)	926,351	9,480,008	8,553,658
	Product coal via rail to Newcastle	(t/year)	699,202	9,223,649	8,524,446
	Sea freight to Japan	(t/year)	699,202	9,223,649	8,524,446
	Product coal burnt at destination	(t/year)	701,306	9,239,221	8,537,915
Fuel	On-site diesel use (stationary)	(kL/year)	177.9	1820.2	1642.3
	On-site diesel use (transport)	(kL/year)	12.4	126.4	114.0
	Diesel used to transport coal off-site via trucks	(kL/year)	98.5	1,083.5	985.0
	Diesel used for rehabilitation	(kL/year)	12.5	137.5	125.0
	LPG use	(kL/year)	0.4	4.1	3.7
Oils, greases	Oil consumption	(kL/year)	70.40	720.48	650.08
	Grease consumption	(kL/year)	1.24	15.16	13.92
Electricity	Electricity consumption	(kWh/year)	49,872,138	528,186,326	478,314,188

B.2 Maximum capacity

The activity data for maximum capacity used in the GHG emission calculations for Mod 11 were provided by Centennial. The annual data are provided in Table B.1, and the total life values (where appropriate) are given in Table B.4.

Table B.5 Annual activity data for maximum capacity (coal)

Financial year	ROM coal (t/year)	Product coal (t/year)	Product coal via rail to Newcastle (t/year)	Sea freight to Japan (t/year)	Product coal burnt at destination (t/year)
Scenario 1					
2026-27	1,500,000	1,325,000	1,325,000	1,325,000	1,250,000
2027-28	-[(a)]	-	-	-	-
2028-29	-	-	-	-	-
2029-30	-	-	-	-	-
2030-31	-	-	-	-	-
2031-32	-	-	-	-	-
Scenario 2					
2026-27	3,000,000	2,650,000	2,650,000	2,650,000	2,500,000
2027-28	3,000,000	2,650,000	2,650,000	2,650,000	2,500,000
2028-29	3,000,000	2,650,000	2,650,000	2,650,000	2,500,000
2029-30	3,000,000	2,650,000	2,650,000	2,650,000	2,500,000
2030-31	3,000,000	2,650,000	2,650,000	2,650,000	2,500,000
2031-32	1,500,000	1,325,000	1,325,000	1,325,000	1,250,000
Scenario 3					
2026-27	1,500,000	1,325,000	1,325,000	1,325,000	1,250,000
2027-28	3,000,000	2,650,000	2,650,000	2,650,000	2,500,000
2028-29	3,000,000	2,650,000	2,650,000	2,650,000	2,500,000
2029-30	3,000,000	2,650,000	2,650,000	2,650,000	2,500,000

Financial year	ROM coal (t/year)	Product coal (t/year)	Product coal via rail to Newcastle (t/year)	Sea freight to Japan (t/year)	Product coal burnt at destination (t/year)
2030-31	3,000,000	2,650,000	2,650,000	2,650,000	2,500,000
2031-32	1,500,000	1,325,000	1,325,000	1,325,000	1,250,000

Notes:

(a) '-' = not applicable.

Table B.6 Annual activity data for maximum capacity (fuel, oil and grease)

Financial year	On-site diesel use [stationary] (kL/year)	On-site diesel use [transport] (kL/year)	Diesel used to transport coal to power stations [trucks] (kL/year)	Diesel used for rehabilitation (kL/year)	LPG consumption (kL/year)	Oil consumption (kL/year)	Grease consumption (kL/year)
Scenario 1							
2026-27	288.0	20.0	161.3	12.5	0.7	114.0	2.0
2027-28	-(a)	-	-	-	-	-	-
2028-29	-	-	-	-	-	-	-
2029-30	-	-	-	-	-	-	-
2030-31	-	-	-	-	-	-	-
2031-32	-	-	-	-	-	-	-
Scenario 2							
2026-27	576.0	40.0	322.5	25.0	1.3	228.0	4.0
2027-28	576.0	40.0	322.5	25.0	1.3	228.0	4.0
2028-29	576.0	40.0	322.5	25.0	1.3	228.0	4.0
2029-30	576.0	40.0	322.5	25.0	1.3	228.0	4.0
2030-31	576.0	40.0	322.5	25.0	1.3	228.0	4.0

Financial year	On-site diesel use [stationary] (kL/year)	On-site diesel use [transport] (kL/year)	Diesel used to transport coal to power stations [trucks] (kL/year)	Diesel used for rehabilitation (kL/year)	LPG consumption (kL/year)	Oil consumption (kL/year)	Grease consumption (kL/year)
2031-32	288.0	20.0	161.3	12.5	0.7	114.0	2.0
Scenario 3							
2026-27	288.0	20.0	161.3	12.5	0.7	114.0	2.0
2027-28	576.0	40.0	322.5	25.0	1.3	228.0	4.0
2028-29	576.0	40.0	322.5	25.0	1.3	228.0	4.0
2029-30	576.0	40.0	322.5	25.0	1.3	228.0	4.0
2030-31	576.0	40.0	322.5	25.0	1.3	228.0	4.0
2031-32	288.0	20.0	161.3	12.5	0.7	114.0	2.0

Notes:

(a) '-' = not applicable

Table B.7 Annual activity data for maximum capacity (other)

Financial year	Fugitive emissions from vent shaft (m^3/s)	CO_2 in mine vent air (%)	CH_4 in mine vent air (%)	SF_6 (kg, stock)	Electricity consumption (kWh/year)
Scenario 1					
2026-27	349.0	0.064	0	0.8	69,450,000
2027-28	-	-	-	-	-
2028-29	-	-	-	-	-
2029-30	-	-	-	-	-
2030-31	-	-	-	-	-
2031-32	-	-	-	-	-

Financial year	Fugitive emissions from vent shaft (m^3/s)	CO_2 in mine vent air (%)	CH_4 in mine vent air (%)	SF_6 (kg, stock)	Electricity consumption (kWh/year)
Scenario 2					
2026-27	349.0	0.064	0	0.8	763,950,000
2027-28	349.0	0.064	0	0.8	763,950,000
2028-29	349.0	0.064	0	0.8	763,950,000
2029-30	349.0	0.064	0	0.8	763,950,000
2030-31	349.0	0.064	0	0.8	763,950,000
2031-32	349.0	0.064	0	0.8	763,950,000
Scenario 3					
2026-27	349.0	0.064	0	0.8	69,450,000
2027-28	349.0	0.064	0	0.8	138,900,000
2028-29	349.0	0.064	0	0.8	138,900,000
2029-30	349.0	0.064	0	0.8	138,900,000
2030-31	349.0	0.064	0	0.8	138,900,000
2031-32	349.0	0.064	0	0.8	69,450,000

Table B.8 Mod 11 life activity data for maximum capacity (Scenario 3, on-site only)

Variable		Units	Total for all financial years		
			Scenario 1	Scenario 2	Scenario 3
Coal	ROM coal extracted	(t/year)	1,500,000	16,500,000	15,000,000
	Product coal	(t/year)	1,325,000	14,575,000	13,250,000
	Product coal via rail to Newcastle	(t/year)	1,325,000	14,575,000	13,250,000
	Sea freight to Japan	(t/year)	1,325,000	14,575,000	13,250,000
	Product coal burnt at destination	(t/year)	1,250,000	13,750,000	12,500,000
Fuel	On-site diesel use (stationary)	(kL/year)	288.0	3,168.0	2,880.0
	On-site diesel use (transport)	(kL/year)	20.0	220.0	200.0
	Diesel used for rehabilitation	(kL/year)	12.5	137.5	125.0
	LPG use	(kL/year)	0.7	7.2	6.5
Oils, greases	Oil consumption	(kL/year)	114.0	1,254.0	1,140.0
	Grease consumption	(kL/year)	2.0	22.0	20.0
Electricity	Electricity consumption	(kWh/year)	69,450,000	763,950,000	694,500,000

Appendix C

Emissions data (planned operational throughput)

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For the three scenarios, and planned operational throughput, the emission estimates (CO_2-e) for scope 1 and scope 2 emissions (by source and by year) are given in Table C.1, Table C.2 and Table C.3.

The scope 3 emission estimates are given in Tables Table C.4, Table C.5 and Table C.6.

Table C.1 Scope 1 and scope 2 emissions by source and year (Scenario 1)

Financial year	GHG emissions by financial year (kt CO_2-e/year)[a]									
	Scope 1							Scope 2	Scope 1 total	Scope 1 + scope 2 total
	Diesel (stationary)	Diesel (transport)	LPG	Oil	Grease	SF_6 leakage	Fugitive	Electricity		
2026-27	0.52	0.03	0.00	0.04	0.00	0.00	2.51	24.94	3.10	28.03
2027-28	-[b]	-	-	-	-	-	-	-	-	-
2028-29	-	-	-	-	-	-	-	-	-	-
2029-30	-	-	-	-	-	-	-	-	-	-
2030-31	-	-	-	-	-	-	-	-	-	-
2031-32	-	-	-	-	-	-	-	-	-	-
Average (kt CO_2-e/year) [c]	0.52	0.03	0.00	0.04	0.00	0.00	2.51	24.94	3.10	28.03
Total (kt CO_2-e)	0.52	0.03	0.00	0.04	0.00	0.00	2.51	24.94	3.10	28.03

Notes:

(a) Values stated to two decimal places.
(b) '-' = not applicable.
(c) Based on non-zero years only.

Table C.2 Scope 1 and scope 2 emissions by source and year (Scenario 2)

Financial year	GHG emissions by financial year (kt CO_2-e/year)[a]									
	Scope 1							Scope 2	Scope 1 total	Scope 1 + scope 2 total
	Diesel (stationary)	Diesel (transport)	LPG	Oil	Grease	SF_6 leakage	Fugitive	Electricity		
2026-27	1.03	0.07	0.00	0.08	0.00	0.00	5.02	49.87	6.19	56.07
2027-28	0.89	0.06	0.00	0.06	0.00	0.00	10.04	32.99	11.05	44.04
2028-29	0.94	0.06	0.00	0.07	0.00	0.00	10.04	22.97	11.11	34.07
2029-30	0.93	0.06	0.00	0.07	0.00	0.00	10.04	10.69	11.10	21.79
2030-31	1.01	0.07	0.00	0.07	0.00	0.00	10.04	8.85	11.18	20.03
2031-32	0.51	0.03	0.00	0.04	0.00	0.00	5.02	4.54	5.60	10.14
Average (kt CO_2-e/year)	0.88	0.06	0.00	0.06	0.00	0.00	8.36	21.65	9.37	31.02
Total (kt CO_2-e)	5.30	0.34	0.01	0.39	0.00	0.00	50.18	129.91	56.23	186.13

Notes:

(a) Values stated to two decimal places.

Table C.3 Scope 1 and scope 2 emissions by source and year (Scenario 3)

Financial year	GHG emissions by financial year (kt CO_2-e/year)[a]									
	Scope 1							Scope 2	Scope 1 total	Scope 1 + scope 2 total
	Diesel (stationary)	Diesel (transport)	LPG	Oil	Grease	SF_6 leakage	Fugitive	Electricity		
2026-27	0.52	0.03	0.00	0.04	0.00	0.00	2.51	24.94	3.10	28.03
2027-28	0.89	0.06	0.00	0.06	0.00	0.00	10.04	32.99	11.05	44.04
2028-29	0.94	0.06	0.00	0.07	0.00	0.00	10.04	22.97	11.11	34.07
2029-30	0.93	0.06	0.00	0.07	0.00	0.00	10.04	10.69	11.10	21.79
2030-31	1.01	0.07	0.00	0.07	0.00	0.00	10.04	8.85	11.18	20.03
2031-32	0.51	0.03	0.00	0.04	0.00	0.00	2.51	4.54	3.09	7.63
Average (kt CO_2-e/year)	0.80	0.05	0.00	0.06	0.00	0.00	7.53	17.50	8.44	25.93
Total (kt CO_2-e)	4.8	0.3	0.0	0.4	0.0	0.0	45.2	105.0	50.6	155.6

Notes:

(a) Values stated to two decimal places.

Table C.4 Scope 3 emissions by source and year (Scenario 1)

Financial year	GHG emissions by financial year (kt CO_2-e/year)[a]										
	Upstream						Downstream				Scope 3 total
	Diesel (stationary)	Diesel (transport)	LPG	Oil	Grease	Electricity	Transport of coal (road)	Transport of coal (rail)	Transport of coal (sea)	Combustion of coal	
2026-27	0.13	0.01	0.00	0.05	0.00	1.00	0.27	5.83	18.76	1,329.0	1,355.0
2027-28	-[b]	-	-	-	-	-	-	-	-	-	-
2028-29	-	-	-	-	-	-	-	-	-	-	-
2029-30	-	-	-	-	-	-	-	-	-	-	-
2030-31	-	-	-	-	-	-	-	-	-	-	-
2031-32	-	-	-	-	-	-	-	-	-	-	-
Average (kt CO_2-e/year) [c]	0.13	0.01	0.00	0.05	0.00	1.00	0.27	5.83	18.76	1,329.0	1,355.0
Total (kt CO_2-e)	0.13	0.01	0.00	0.05	0.00	1.00	0.27	5.83	18.76	1,329.0	1,355.0

Notes:

(a) Values stated to two decimal places.
(b) '-' = not applicable.
(c) Based on non-zero years only.

Table C.5 Scope 3 emissions by source and year (Scenario 2)

Financial year	GHG emissions by financial year (kt CO_2-e/year)[a]										
	Upstream						Downstream				Scope 3 total
	Diesel (stationary)	Diesel (transport)	LPG	Oil	Grease	Electricity	Transport of coal (road)	Transport of coal (rail)	Transport of coal (sea)	Combustion of coal	
2026-27	0.25	0.02	0.00	0.10	0.00	1.99	0.54	11.66	37.52	2,658.0	2,710.1
2027-28	0.22	0.01	0.00	0.08	0.00	1.74	0.54	15.72	50.58	3,583.5	3,652.4
2028-29	0.23	0.01	0.00	0.09	0.00	0.96	0.54	16.69	53.69	3,800.4	3,872.6
2029-30	0.23	0.01	0.00	0.09	0.00	0.97	0.54	11.99	38.58	2,725.3	2,777.7
2030-31	0.25	0.02	0.00	0.10	0.00	0.00	0.54	14.00	45.05	3,185.1	3,245.1
2031-32	0.13	0.01	0.00	0.05	0.00	0.50	0.27	6.85	22.03	1,556.3	1,586.2
Average (kt CO_2-e/year)	0.22	0.01	0.00	0.08	0.00	1.03	0.49	12.82	41.24	2,918.1	2,974.0
Total (kt CO_2-e)	1.31	0.08	0.00	0.50	0.01	6.16	2.94	76.90	247.45	17,508.7	17,844.1

Notes:

(a) Values stated to two decimal places.

Table C.6 Scope 3 emissions by source and year (Scenario 3)

Financial year	GHG emissions by financial year (kt CO_2-e/year)										
	Upstream						Downstream				Scope 3 total
	Diesel (stationary)	Diesel (transport)	LPG	Oil	Grease	Electricity	Transport of coal (road)	Transport of coal (rail)	Transport of coal (sea)	Combustion of coal	
2026-27	0.13	0.01	0.00	0.05	0.00	1.00	0.27	5.83	18.76	1,329.0	1,355.0
2027-28	0.22	0.01	0.00	0.08	0.00	1.74	0.54	15.72	50.58	3,583.5	3,652.4
2028-29	0.23	0.01	0.00	0.09	0.00	0.96	0.54	16.69	53.69	3,800.4	3,872.6
2029-30	0.23	0.01	0.00	0.09	0.00	0.97	0.54	11.99	38.58	2,725.3	2,777.7
2030-31	0.25	0.02	0.00	0.10	0.00	0.00	0.54	14.00	45.05	3,185.1	3,245.1
2031-32	0.13	0.01	0.00	0.05	0.00	0.50	0.27	6.85	22.03	1,556.3	1,586.2
Average (kt CO_2-e/year)	0.20	0.01	0.00	0.08	0.00	0.86	0.45	11.84	38.12	2,696.6	2,748.2
Total (kt CO_2-e)	1.18	0.08	0.00	0.45	0.01	5.17	2.68	71.07	228.69	16,179.7	16,489.0

(a) Values stated to two decimal places.

Appendix D
Climate change considerations

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Clarence Colliery - Modification 11

Climate Change Considerations

Prepared for Centennial Coal Company Pty Limited

December 2025

Clarence Colliery - Modification 11

Climate Change Considerations

Centennial Coal Company Pty Limited

E250102 Climate change

December 2025

Version	Date	Prepared by	Reviewed by	Comments
1	11 December 2025	Paul Boulter	Francine Manansala	Draft
2	18 December 2025	Paul Boulter Francine Manansala	Francine Manansala	Final

Approved by

Francine Manansala
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18 December 2025

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1 Introduction

1.1 Background

Clarence Colliery is an underground coal mine in the Western Coalfields of New South Wales (NSW). Clarence Colliery is located in the Lithgow local government area (LGA), approximately 10 kilometres (km) east of Lithgow itself. It is operated by Clarence Colliery Pty Limited, which is a subsidiary of Centennial Coal Company Pty Limited (Centennial). Clarence Colliery produces high quality, low ash thermal coal for both domestic and export customers.

Clarence Colliery has been in operation since 1979. It currently operates under three separate development consents, including DA 504-00. The mine is currently approved to extract up to 3 million tonnes per annum (Mtpa) of coal until 31 December 2026.

Clarence Colliery is seeking a modification to DA504-00 (Mod 11) to modify the following conditions in Schedule 2 of DA 504-00:

- Condition 5 to extend the life of mining from 31 December 2026 for a further five years to 31 December 2031
- Condition 7AA to align the transport of coal by road with the proposed extension of the life of mining, thus allowing for the transport of up to 300,000 tonnes (t) of coal by road until 31 December 2031.

A greenhouse gas (GHG) assessment for Mod 11 has been compiled by EMM Consulting Pty Limited (EMM) (EMM 2025). The assessment was conducted in accordance with the *NSW Guide for Large Emitters* (NSW EPA 2025). In NSW, recent legal rulings and other considerations not specifically addressed by the *NSW Guide for Large Emitters* have a bearing on the content of GHG assessments. This report summarises how these have been addressed for Clarence Colliery Mod 11.

1.2 Legal decisions affecting greenhouse gas assessments

In NSW, two recent legal rulings are relevant to GHG assessments:

- Firstly, in July 2025 the Court of Appeal of the Supreme Court New South Wales declared the development consent granted by the Independent Planning Commission (IPC) to the continuation of the Mount Pleasant Coal Mine invalid[1]. The reasons for this decision included the following:
  - The IPC did not take into consideration the 'likely impacts of the development including environmental impacts on both the natural and built environments, and social and economic impacts in the locality' under section 4.15(1)(b) of the *Environmental Planning and Assessment Act 1979*. This was because it did not specifically consider the impacts of climate change in the locality of the mine (and specifically the impacts relating to scope 3 emissions). It was not enough that the IPC considered the impacts of climate change at a global level; it had to address the specific impacts on the locality.
  - The IPC failed to consider whether to impose conditions to minimise Scope 3 GHG emissions resulting from the development.

[1] Denman Aberdeen Muswellbrook Scone Healthy Environment Group Inc v MACH Energy Australia Pty Ltd [2025] NSWCA 163, https://www.caselaw.nsw.gov.au/decision/198358b0f4e9e10f2b50c718

- Secondly, in November 2025 the NSW Land and Environment Court declared that the approval by the NSW Department of Planning, Housing and Infrastructure (DPHI) of Glencore's Modification 6 to the Ulan Coal Mine was invalid. This decision was made on the basis of the Court of Appeal's decision to reject the expansion of the Mt Pleasant Mine on the grounds that local climate impacts are a mandatory relevant consideration for GHG-generating projects.

In addition, in September 2025 the NSW Net Zero Commission issued letters to DPHI and the IPC encouraging the two bodies to include consideration of various factors when assessing and determining applications for projects like coal mines. The following considerations are the most relevant to this assessment:

- scope 1 emissions of any proposal compared to the NSW's legislated targets
- the measures to reduce Scope 2 emissions of any proposal
- any proposal's scope 3 emissions given the capacity for such emissions to contribute to climate change and so to have an impact locally in NSW
- any proposal's adaptation measures to ensure resilience to a changing climate
- how the proposal promotes NSW's adaptation objective.

The letters also referenced the Mt Pleasant decision, and highlighted that scope 3 emissions are an important factor in addressing climate change locally and globally, particularly for sectors like coal mining where scope 3 emissions are a large portion of the proposal's overall emissions.

It should be noted that the terms 'local' or 'in the locality' have not been defined in the above, and are therefore open to interpretation.

1.3 Purpose of this report

This report describes how the considerations identified above – as they relate to local climate impacts and scope 3 emissions – have been addressed for Clarence Colliery Mod 11.

2 Climate change considerations for Mod 11

This section provides an assessment of the likely impacts of climate change associated with Mod 11. It provides an overview of the effects of climate change globally, nationally, and in the locality of Clarence Colliery. In addition, based on the estimated total (all scope) GHG emissions of Mod 11, it assesses how likely Mod 11 is to affect climate change within these geographies. Measures for addressing scope 3 emissions are also considered.

2.1 Climate change by geography

2.1.1 Global climate change

Climate change is a global phenomenon driven by the accumulation of GHGs in the Earth's atmosphere, primarily from the combustion of fossil fuels and land use change. The Intergovernmental Panel on Climate Change (IPCC), and the Australian and NSW Governments, have identified a range of anticipated impacts resulting from continued global warming, many of which are already observable.

The IPCC is the United Nations body for assessing the science related to climate change. The most recent comprehensive assessment report from the IPCC is AR6, published in three parts between 2021 and 2023.

The key findings on global climate impacts in AR6 (IPCC 2023) include:

- Warming observed: global surface temperature has increased by approximately 1.1 degrees Celsius (°C) above pre-industrial levels (1850–1900) as of the 2011–2020 period.
- Extreme weather events: increased frequency and intensity of heatwaves, heavy precipitation, droughts in some regions, and tropical cyclones (with regional variation).
- Water availability: increasing water scarcity due to changes in rainfall and increased evapotranspiration.
- Sea level rise: global mean sea level increased by about 0.2 metres (m) from 1901 to 2018, with accelerating trends. Further increases are virtually certain this century.
- Ecosystems and biodiversity: high risk of biodiversity loss, coral reef decline, and terrestrial and marine ecosystem disruption.
- Human health: increased risk of heat-related morbidity and mortality, food- and water-borne diseases, and mental health impacts.
- Food and water security: increasing threats to crop yields, food supply chains, and freshwater resources.

2.1.2 Climate change in Australia

At the national level, the latest CSIRO and the Bureau of Meteorology (BoM) *State of the Climate 2024* report highlights the observed and projected effects of climate change in Australia (CSIRO and BoM 2024). Its findings include:

- Warming observed: Australia's national average temperature has increased by ~1.51 ± 0.23°C since 1910, with sea surface temperature up by ~1.08°C since 1900.
- Extreme heat: an escalation in the frequency, duration, and intensity of heatwaves over both land and ocean surfaces.
- Marine heatwaves: oceans are warming faster, triggering more frequent and longer-lasting marine heatwave events.

- Fire weather: significant increases in extreme fire weather days and lengthening fire seasons across most regions.
- Heavy rainfall: while longer dry spells are emerging in cooler months across southern and eastern Australia, when heavy rainfall does occur it tends to be more intense “drier but flashier” pattern.
- Sea level rise: ongoing sea level rise is documented, particularly pronounced in the north and south-east Australian coastal regions.
- Ocean acidification: elevated atmospheric CO_2 concentrations are increasing ocean acidity, posing risks to marine ecosystems, such as the Great Barrier Reef.

In September 2025, Australia released its first comprehensive National Climate Risk Assessment (NCRA). The NCRA identifies the type and severity of physical climate risks affecting Australia and how they change under different warming scenarios. The NCRA identified 10 priority climate hazards over 11 regions in Australia:

- Riverine floods: less frequent riverine flood events and decrease in runoff. When floods do occur, they are likely to be higher due to higher event rainfall totals.
- Tropical cyclones: decrease in frequency of tropical cyclones.
- High temperatures: increase in extreme temperatures.
- Sea level rise: sea levels will continue to rise and coastal flood events will become more frequent.
- Extratropical storms: decrease in frequency in extratropical storms but convective storms producing large hail may increase in the east.
- Ocean warming and acidification: oceans are expected to become more acidic and warmer, with more frequent and longer marine heatwaves.
- Bushfires: increase risk of bushfires in forested areas and higher frequency of dangerous fire weather in southern and eastern areas.
- Drought: increase in time spent in drought.

2.1.3 Climate change in the Central West and Orana region

Clarence Colliery is located in the Lithgow LGA, in the Central West and Orana region. It is in the south-east of the region, close to the Blue Mountains and the boundary with Metropolitan Sydney.

The Central West and Orana region covers a large area of NSW (approximately 117,000 km^2). The landscape of the region is varied, characterised by vast plains, hills and ranges, rugged mountains and expansive woodlands. The Blue Mountains dominate the eastern edge of the region. In contrast, the western part of the region is characterised by fertile plains and agricultural lands.

The topography of the region results in a large range of climatic conditions and there are distinct seasonal variations in the climate. Generally, the region experiences a temperate climate. It is relatively dry on the western plains compared to the Central Tablelands. Summers are warm to hot on the western plains and cooler on the tablelands, which also experience cool to cold winters and snowfall at higher elevations. Temperatures are milder on the slopes, with summer temperatures cooler than the plains and winter conditions warmer than the tablelands. Rainfall generally decreases from the south-east to the north-west of the region, with rainfall highest in the Central Tablelands (NSW DCCEEW 2025).

Information on future climate change in the region was obtained from the *Central West and Orana Climate Change Snapshot* (NSW DCCEEW 2025). The climate projection data are taken from the NSW and Australian Regional Climate Modelling (NARCliM) project[2], and specifically NARCliM 2.0. The future simulations are for a low-emission scenario (SSP1-2.6), a medium-emission scenario (SSP2-4.5) and a high-emission scenario (SSP3-7.0), and for four distinct 20-year periods:

- an historical (baseline) period (1990 to 2009)
- a near-future period (2020 to 2039)
- a far-future period (2060 to 2079)
- a second far-future period (2080 to 2099).

For temperature and severe fire weather, and in 2090 (the average for the second far future scenario), the projected increases in the area around Lithgow are less severe than elsewhere in the region (Figure 2.1, Figure 2.2 and Figure 2.3). It should be noted that the changes in the near-future are less pronounced[3]. The projections for rainfall are more uncertain; average rainfall may remain variable. The projected reductions in rainfall are similar across the region (Figure 2.4).

[2] NARCliM is led by the NSW Government in partnership with the ACT and South Australian governments, with input from the University of New South Wales's Climate Change Research Centre (UNSW CCRC).

[3] The maps are taken from NSW DCCEEW (2025). The report only shows maps for 2090.

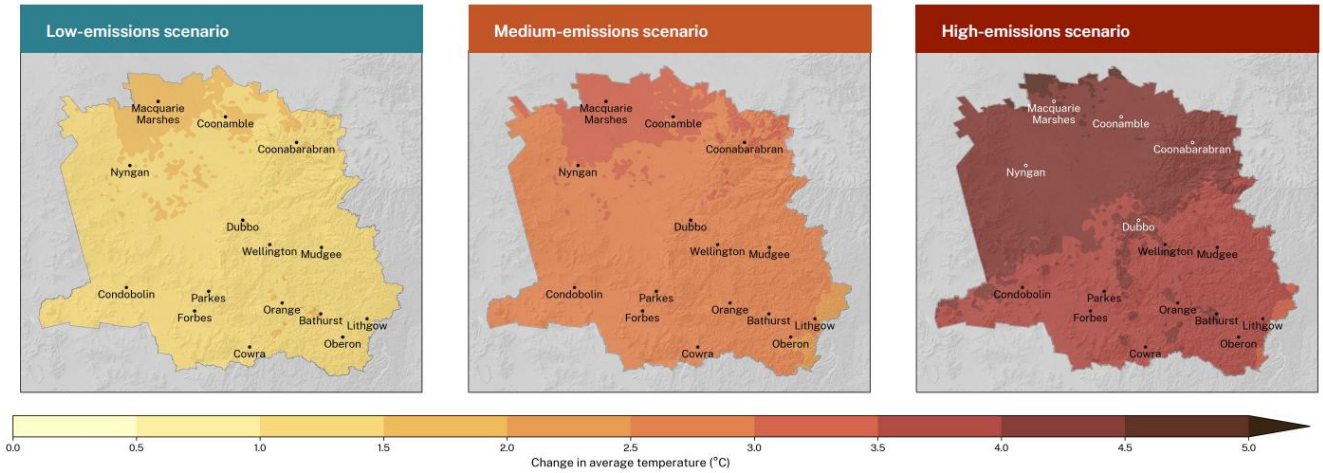

Figure 2.1 **Projected change in average temperature by 2090 for the Central West and Orana (NSW DCCEEW 2025)**

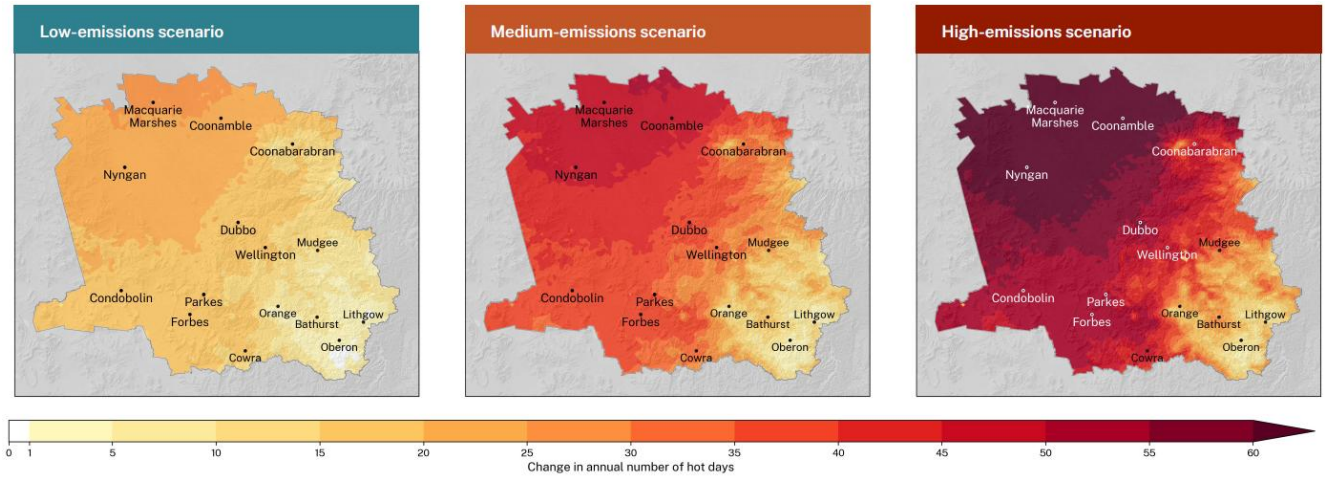

Figure 2.2 **Projected change in annual number of hot days by 2090 for the Central West and Orana (NSW DCCEEW 2025)**

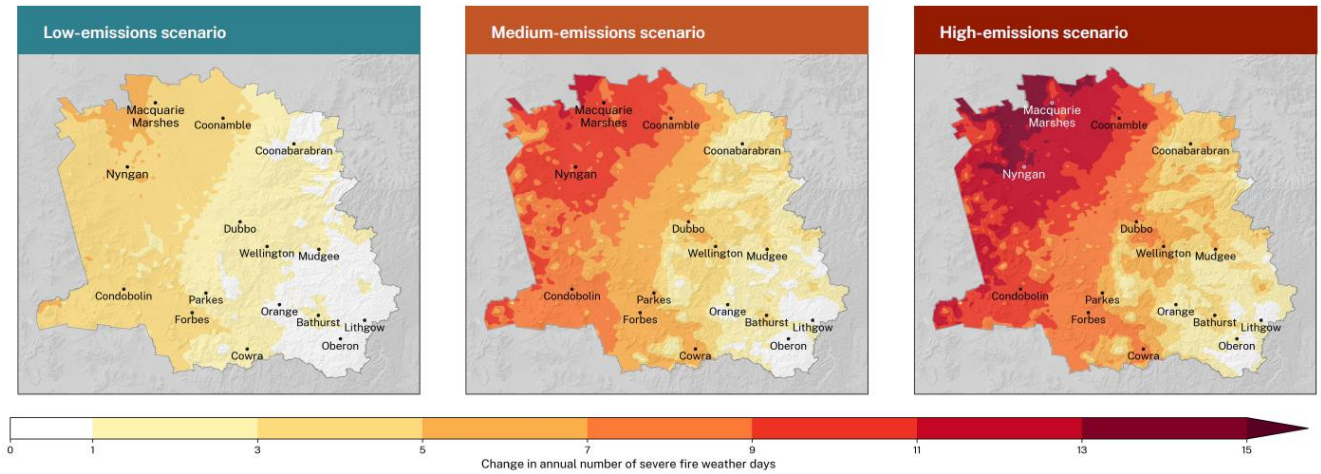

Figure 2.3 **Projected change in annual number of severe fire weather days by 2090 for the Central West and Orana (NSW DCCEEW 2025)**

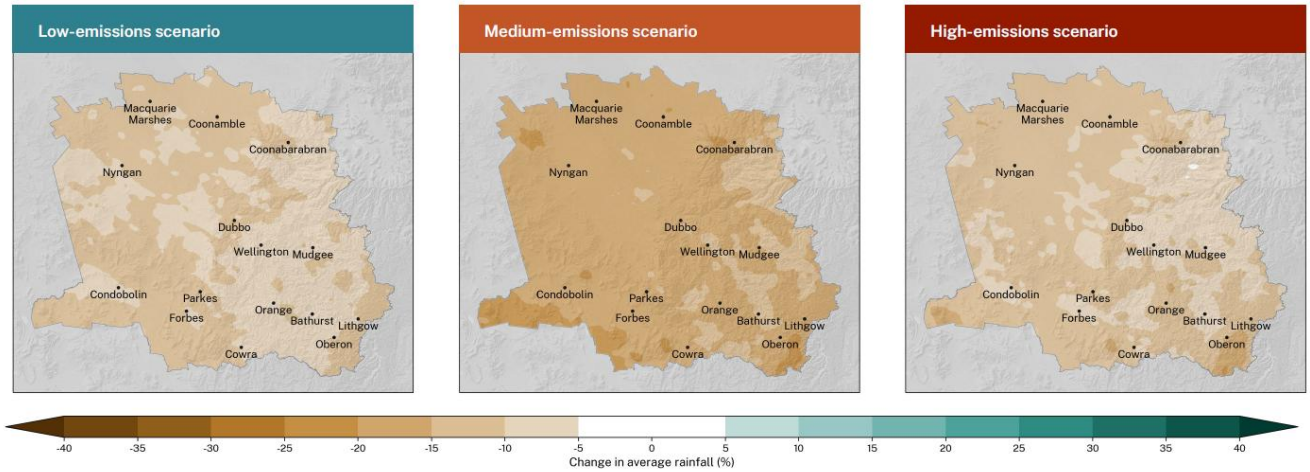

Figure 2.4 Projected change in annual rainfall by 2090 for the Central West and Orana (NSW DCCEEW 2025)

2.1.4 Climate change in the location of Clarence Colliery

Information on climate change in the vicinity of Clarence Colliery was obtained from the NSW Government's AdaptNSW website[4], and in particular the interactive map of climate parameters[5].

The interactive map provides climate projection data from the NSW and Australian Regional Climate Modelling (NARCliM) project[6], and specifically NARCliM 2.0. The climate data are provided at a 4 km grid square resolution, for the low-emission scenario (SSP1-2.6) and the high-emission scenario (SSP3-7.0), and for several future periods. The values in the interactive map are stated as changes in a given future period relative to the baseline period.

Table 2.1 provides a summary of the climate projections from the interactive map and for the 4 km grid cell containing Clarence Colliery. These are for the near-future scenario only, this being of most relevance to period covered by Clarence Colliery Mod 11. It should be noted, however, that a substantial proportion of the period between the timeframe of the baseline scenario (1990 to 2009) and the near-future scenario (2020-39) has already elapsed, and therefore at least some of the changes identified in Table 2.1 may already have occurred.

On an annual basis, average and maximum temperatures are projected to increase by around 0.7 to 0.8°C in both emissions scenarios. The increases are generally larger in summer and smaller in winter. The projections indicate that there would be an increase of less than one hot day (>35°C) per year.

Annual rainfall is projected to decrease under both the low- and high-emission scenarios, but there are differences between the scenarios as well as some seasonal variation.

Relative to the baseline period, the average annual Forest Fire Damage Index (FFDI) for both emission scenarios in this grid cell is projected to increase slightly.

4 https://www.climatechange.environment.nsw.gov.au/

5 https://www.climatechange.environment.nsw.gov.au/projections-map

6 NARCliM is led by the NSW Government in partnership with the ACT and South Australian governments, with input from the University of New South Wales's Climate Change Research Centre (UNSW CCRC).

Table 2.1 Summary of climate projections for grid cell with Clarence Colliery – near future (2020-2039), relative to baseline

Parameter / statistic	Low emissions scenario (SSP1-2.6)					High emissions scenario (SSP3-7.0)				
	Spring	Summer	Autumn	Winter	Annual	Spring	Summer	Autumn	Winter	Annual
Change in temperature										
Daily average (°C)	+0.74	+0.89	+0.69	+0.58	+0.73	+0.68	+0.87	+0.65	+0.70	+0.72
Daily maximum (°C)	+0.86	+1.00	+0.72	+0.66	+0.81	+0.75	+0.97	+0.62	+0.77	+0.78
Change in hot days										
Hot days >35°C (days)	0	+0.72	+0.03	0	+0.76	+0.01	+0.41	+0.03	0	+0.45
Change in rainfall										
Change in rainfall (%)	-11.5	-3.3	-4.7	-17.1	-8.3	+0.1	-3.4	+2.7	-21.6	-5.1
Change in FFDI[(a)]										
Change in severe fire warning days (FFDI >50)	+0.02	+0.06	0	0	+0.08	+0.01	+0.03	0	0	+0.04

Notes: The Forest Fire Danger Index (FFDI) is used in NSW to quantify fire weather. The FFDI combines observations of temperature, humidity, and wind speed with an estimate of the fuel state, with 17 stations in NSW and the ACT (DPIE 2019). FFDI values below 12 indicate low to moderate fire weather, 12-25 high, 25-49 very high, 50-74 severe, 75-99 extreme and above 100 catastrophic. Fire weather is classified as 'severe' when the FFDI is above 50, and most of the property loss from major fires in Australia has occurred when the FFDI reached this level.

2.2 Effects of climate change on local environment

Climate change will affect the Central West and Orana region, particularly through increasing temperatures. The climate projections show that temperatures are expected to keep rising, there will be more hot days and heatwaves, fire weather will increase, and rainfall patterns will change (NSW DEECCW 2025).

Potential effects of climate change on the regional and local environment are summarised in Table 2.2. The Central West and Orana region has various characteristics and potential impacts that are likely to increase its vulnerability to the predicted changes in climate. Some of these characteristics are identified in the table, with the information being taken mainly from NSW DEECCW (2025). It should be noted that:

- the potential impacts are not all directly relevant to the area around Clarence Colliery
- the longer-term changes in climate in the Lithgow area (in particular temperature and fire days) are projected to be less severe than elsewhere in the region
- some of the projected change in the near-future scenario (of most relevance to the timeframe of Mod 11) may have already occurred.

For the Lithgow area, climate change may have potential impacts on the economy, ecosystems, water resources, infrastructure and the community. Noting the changes in climate identified above, over the timeframe of Mod 11 these impacts are likely to be relatively small.

Table 2.2 Potential effects of climate change on regional and local environment

Sensitivity	Potential regional impacts (Central West and Orana)	Potential local impacts (Lithgow LGA)	Projected climate change (area around Clarence Colliery, near future scenario)
Economy	The region supports a diverse range of industries, with the highest numbers in agribusiness (agriculture, forestry and fishing), construction and specialised services (professional, scientific and technical). Agriculture may be impacted by more variable rainfall, extreme heat and increased fire risk. These changes may affect productivity, water supply, and viability of farming. More hot days may decrease the suitability of some types of agriculture in the region, such as mixed livestock-cropping. Wine production could face growing challenges from more variable and extreme rainfall patterns.	For the Lithgow LGA, health care, public administration, mining, education and retail are the dominant sectors by employment. The mining industry accounts for around one quarter of the Lithgow regional economy. Increased risk of drought could disrupt supply chains, increase unemployment, reduce water availability for business operations and reduce tourism.	Average and maximum temperatures projected to increase by around 0.7 to 0.8°C. Increase of less than one hot day per year. Annual rainfall is projected to decrease by around 5 to 8%.
Ecosystems	With rising temperatures and more extreme heat events, native ecosystems may struggle to adapt. This could lead to shifts in species distribution, stress on biodiversity, and loss of some local ecosystems. Changes in rainfall and increases in temperature could have significant impacts on wetlands across the region, including the internationally significant Macquarie Marshes.	Lithgow is near extensive bushland with numerous flora and fauna species. Eucalypt forests, heathlands and woodlands support ecological diversity, including threatened species. Fauna includes wombats, kookaburras and various bird species. The Coxs River, Farmers Creek, Wolgan River, Lake Lyell, and Lake Wallace support a wide range of aquatic life. The local ecology may be affected by an increased risk of bushfires, an earlier start to the fire season, more frequent fire-danger days, and worse fire conditions.	Increase of less than one hot day per year. FFDI is projected to increase slightly.
Water resources	Changes in rainfall and increases in temperature could have significant impacts on water supplies. There is the potential for an increased risk of significantly lower inflows to key river catchments such as the Macquarie and Castlereagh rivers. This would be likely to increase water demand, compounding water security and quality challenges.	For the Lithgow area, reduced rainfall could reduce water availability or change seasonal water cycles in the longer term. Combined with increased evaporation due to higher temperatures and more hot days, this may lead to more frequent or prolonged dry spells or droughts.	Average and maximum temperatures projected to increase by around 0.7 to 0.8°C. Annual rainfall is projected to decrease by around 5 to 8%.
Infrastructure	Infrastructure, buildings, and community services may face increasing stress. Heatwaves, fire risk, and potential water stress may affect buildings, roads and emergency services.	Infrastructure, buildings and community services may face increasing stress. Heatwaves, fire risk, and potential water stress may affect buildings, roads and emergency services.	FFDI is projected to increase slightly. Annual rainfall is projected to decrease by around 5 to 8%.
Community	Communities may be increasingly impacted by more hot days, which may cause increased heat stress for people.	Communities may be increasingly impacted by more hot days, which may cause increased heat stress for people.	Increase of less than one hot day per year.

Sources: Adapted from NSW DEECCW (2025); Bathurst Regional, Lithgow City and Oberon Councils (2024)

2.3 Contribution of Mod 11 emissions

2.3.1 Contribution to global emissions

Mod 11 is estimated to result in a total of 16.6 Mt CO_2-e of GHG emissions (between 2026–27 and 2031–32) including scope 1, 2 and 3 emissions. It will produce a maximum of 3.9 Mt CO_2-e of annual emissions in 2028–29 and an annual average of about 2.7 Mt CO_2-e.

With respect to global emissions, the maximum annual total (all scope) emissions generated by Mod 11 in 2028–29 (3.9 Mt CO_2-e) would equate to 0.01% of the global energy-related[7] CO_2 emissions of 37,800 Mt in 2024 (IEA 2025). This demonstrates that the proportional contribution of Mod 11 to atmospheric GHG concentrations and anthropogenic climate change, is likely to be very minor. However, there is no guidance on interpreting the materiality of such proportional contributions to emissions.

The climate impacts predicted to occur in the locality of Clarence Colliery, as outlined above (e.g. heatwaves, drought, bushfire conditions) are projected to occur under a range of global emissions pathways, including those in which Mod 11 does not proceed. The regional and local manifestation of these impacts will be influenced more by global emissions trajectories than by the emissions of any individual project.

2.3.2 Contribution to national and state emissions

Consideration has also been given to the contribution of Mod 11 to national and state emissions.

With respect to emissions in Australia, the maximum annual total (all scope) emissions generated by Mod 11 in 2028-29 (3.9 Mt CO_2-e) would equate to 0.9% of the national net CO_2 emissions of 437 Mt in 2025 (DCCEEW 2025). It should be recognised though, that 99% of the Mod 11 emissions (i.e. the scope 3 component) would occur outside Australia.

For NSW, the Net Zero Emissions Dashboard ('the Dashboard') presents past and projected future net GHG emissions for the state (NSW Government 2025). Further information is provided in EMM (2025). The Dashboard shows emission trends and the progress being made towards the state's emission-reduction objectives. The future emissions from the Dashboard, and the projected annual scope 1 emissions for Mod 11, are shown in Table 2.3. Emissions from Mod 11 would represent less than 0.02% of state-wide emissions in the NSW current policy case.

[7] CO_2 emissions from fuel combustion (including flaring) and industrial processes. Excludes fugitive emissions of other GHGs.

Table 2.3 Comparison with emissions from NSW Net Zero Emissions Dashboard

Financial year	NSW current policy (Mt CO_2-e/year)	Mod 11 (Mt CO_2-e/year)	Mod 11 as % of NSW current policy
2026-27	107.06	0.003	0.003%
2027-28	100.75	0.011	0.011%
2028-29	97.54	0.011	0.011%
2029-30	82.97	0.011	0.013%
2030-31	84.13	0.011	0.013%
2031-32	81.19	0.003	0.004%
Average (Mt CO_2-e/year)	**92.27**	**0.008**	-
Total (Mt CO_2-e)	**553.64**	**0.051**	-

2.4 Reducing scope 3 emissions

The scope 3 emissions for Mod 11 would be much larger than the scope 1 and scope 2 emissions, and would represent 99% of all GHG emissions from Mod 11. Scope 3 emissions would peak at around 3,900 kt CO_2-e/year in 2028-29. The aggregated scope 3 emission over the life of Mod 11 is anticipated to be around 16,500 kt CO_2-e (EMM 2025).

The great majority (98%) of scope 3 emissions are due to coal combustion for power generation at end user facilities. The majority of the product coal is exported, and for the purpose of the GHG assessment the receiving country was taken to be Japan (as the largest current end user) (EMM 2025).

It is beyond Centennial's control to reduce or mitigate scope 3 emissions, given they mostly occur outside Australia and are generated by third parties. The countries that coal has been exported to have Nationally Determined Contributions (NDCs) under the Paris Agreement, or have followed international standards recognised by the UNFCCC. It is anticipated that future export destinations for coal from Clarence Colliery will continue to follow similar patterns. However, as coal sales are market driven, export destinations may change in the future.

3 Summary of findings

The main findings of this report are summarised as follows:

- The longer-term changes in climate in the Lithgow area (in particular temperature and fire days) are projected to be less severe than elsewhere in the Central West and Orana region.
- For the area around Clarence Colliery in the near future scenario, relative to the baseline period:
  - average and maximum temperatures are projected to increase by around 0.7 to 0.8°C
  - there is projected to be an increase of less than one hot day (>35°C) per year
  - annual rainfall is projected to decrease, but there are differences between emission scenarios as well as some seasonal variation
  - the FFDI is projected to increase slightly.
- A substantial proportion of the period between the timeframe of the baseline scenario (1990–2009) and the near-future scenario (2020–39) has already elapsed, and therefore at least some of the above changes may already have occurred.
- For the Lithgow area, climate change may have potential impacts on the economy, ecosystems, water resources, infrastructure and the community. Noting the changes in climate identified above, over the timeframe of Mod 11, these impacts are likely to be relatively small.
- The proportional contribution of Mod 11 to global GHG emissions (0.01%), atmospheric GHG concentrations and anthropogenic climate change, is likely to be very minor.
- The scope 3 emissions for Mod 11 would represent 99% of all GHG emissions from Mod 11. It is beyond Centennial's control to reduce or mitigate scope 3 emissions, given they mostly occur outside Australia and are generated by third parties. Clarence Colliery will continue to export coal to countries that have NDCs under the Paris Agreement, or have followed international standards recognised by the UNFCCC.

Abbreviations

CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
DPHI	(NSW) Department of Planning, Housing and Infrastructure
EPA	(NSW) Environment Protection Authority
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
Mt	million tonnes
NDC	Nationally Determined Contribution
NSW	New South Wales
UNFCCC	United Nations Framework Convention on Climate Change

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