Review of IPG1 Greenhouse Gas Management Plan

BHP Iron Ore Pty Ltd

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Executive summary

Under the Western Australian Environmental Protection Act, “significant proposals” are to be assessed for their environmental impact by the Western Australian Environmental Protection Authority (EPA). This assessment is to include the greenhouse gas emissions impact of the proposal as part of the Environmental Impact Assessment.

The EPA requires that project proponents develop a Greenhouse Gas Environmental Management Plan (GHG EMP) which outlines the forecast of emissions over the life of the proposal and how greenhouse gas emissions will be mitigated through the adoption of best practice technology and the use of carbon offsets.

The Yarnima Power Station Stage 4 expansion proposal (the Proposal) is subject to the EPA requirements. BHP Iron Ore engaged KPMG to review the GHG EMP for the Proposal. The scope of the review covered:

- Alignment of the emissions reduction measures set out in the GHG EMP, with industry best practice (a requirement of the EPA Guidelines for preparing a GHG EMP)
- The forecast for Scope 1, 2 and 3 emissions and the overall emissions intensity of the Proposal
- Integrity of the carbon offsets strategy for the Proposal.

Best Practice

KPMG compared the emissions reduction initiatives outlined in the GHG EMP with our understanding of best practice in electricity generation. It was acknowledged that the Proposal is part of BHP’s integrated iron ore operation in the Pilbara, and that the initiatives in the Proposal were subject to the wider decarbonisation strategy of BHP. The following initiatives in the GHG EMP were consistent with best practice emissions reduction:

- BHP has identified that electrification of mining vehicles and other equipment in combination with decarbonising its power supplies offers the best prospects for significant decarbonisation. BHP is progressing efforts to electrify its operations and introducing renewable energy into its grid.
- The Proposal increases the gas fired capacity in the BHP Iron Ore Inland Power Grid, which is efficient, has a low emissions intensity and importantly has the necessary operational flexibility to enable both the integration of renewable energy into the BHP Iron Ore Inland Power Grid as well as the electrification of mining operations.
- BHP is in consultation with other stakeholders in the Pilbara including governments and other mining companies, to decarbonise and expand the capacity of the Pilbara electricity grid.

Under recent amendments to the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule, the Proposal as part of the Yarnima Power Station facility, is required to transition to zero net scope 1 greenhouse gas emissions by 2050.

Emissions Forecasts

KPMG assessed the calculations, assumptions and factors supporting the forecasts of Scope 1, 2 and 3 emissions in the GHG EMP, for consistency with the National Greenhouse and Energy Reporting (Measurement) Determination and the Greenhouse Gas Protocol. KPMG benchmarked BHP’s emissions reporting for the Proposal against its peers and international industry standards, and determined that the coverage of Scope 1, 2 and 3 emissions sources is consistent with peers and used accepted methodologies.

Offsets

KPMG assessed whether carbon offsets that satisfy integrity principles are likely to be reasonably practicable and available as and when required by the Proposal. The type of carbon offsets being considered for use by the Proposal which satisfy the integrity principles are considered to be reasonably practicable. Further, the number of carbon offsets that may conservatively be required prior to FY2030 is modest relative to what is projected to be available in the market.

Whilst there is a risk of the Safeguard compliance offsets market becoming tight during the FY24 to FY30 period, securing the relatively small volume of carbon offsets that may be required for the Proposal does not appear to be a material risk. However, post FY2030 the carbon offsets that may be conservatively required for the Proposal could become material. To account for this possible procurement risk, BHP is considering procurement options which reduce reliance on securing carbon offsets from the spot market in a compliance period.

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Disclaimers

This report has been prepared as outlined with BHP Iron Ore Pty Ltd in the Scope Section of the engagement contract dated 14 June 2023. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently no opinions or conclusions intended to convey assurance have been expressed.

A reference to the term "review" contained in this report refers to the scope of review required under the Western Australian EPA guidance on environmental factors and as outlined in the "Expert review" section of the Introduction of this document. Similarly, a reference to "best practice" contained in this report refers to the context of the term as it is applied in the Western Australian EPA guidance on environmental factors and as outlined in the "Best practice measures" section of the Introduction of this document.

No warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by, BHP Iron Ore Pty Ltd management consulted as part of the process.

KPMG have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report.

KPMG is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form.

This report is solely for the purpose set out in the Scope Section and for BHP Iron Ore Pty Ltd's information and is not to be used for any purpose not contemplated in the engagement contract or to be distributed to any third party without KPMG's prior written consent.

This report has been prepared at the request of BHP Iron Ore Pty Ltd in accordance with the terms of KPMGs engagement contract dated 14 June 2023. Other than our responsibility to BHP Iron Ore Pty Ltd, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

Introduction

Project description

BHPIO proposes to develop a Proposal to install Gas Reciprocating Engines (GREs) at Yarnima, delivering a maximum additional installed capacity of up to 120 MW, to support the planned electrification of BHP's iron ore operations.

The GREs are high-efficiency, low emissions-intensity generation units which will enable the BHP Iron Ore Inland Power Grid to respond rapidly to intermittency issues associated with the planned electrification of equipment and introduction of renewable energy. The installation of the GREs will also allow the diesel power generation to be phased out other than for back up and black out operations.

Western Australian EPA guidance on environmental factors

Under Part IV of the Western Australian Environmental Protection Act 1986 (the EP Act), "significant proposals" are assessed for their environmental impact by the Western Australian Environmental Protection Authority (EPA) as part of the project approval process. A "significant proposal" is one that is defined as having a "significant impact on the environment" and includes expansions of existing operations.

The Western Australian Government has acknowledged the impact of greenhouse gas emissions on the environment as a result of global warming. Under Section 15 of the EP Act which requires the EPA to act to "protect the environment" and to "to prevent, control and abate pollution and environmental harm", an assessment of the greenhouse gas impacts of a new proposal is required as part of the overall Environmental Impact Assessment ('EIA'). The EPA has published Guidelines outlining how this is to be carried out (WA Environmental Protection Authority 2023).

The Guidelines apply to a proposal where the Scope 1 or Scope 2 emissions are reasonably likely to exceed 100,000 tCO_2-e on an annual basis.

The Guidelines require proposal proponents to develop and submit:

(i) An estimate (forecast) of annual Scope 1, 2 and 3 emissions over the lifecycle of the project, disaggregated by emissions source (e.g., rail operations, mining); and the emissions intensity per production unit; and

(ii) A Greenhouse Gas Environmental Management Plan (GHG EMP) outlining how they will mitigate the GHG impact of the proposal through the implementation of best practice technology.

Estimate of emissions

For the estimate of emissions over the lifecycle of the project, the EPA requires:

- Credible estimates of annual and total Scope 1, 2 and 3 emissions over the expected life of the proposal (including the maximum emissions).
- This should include estimates based on throughput at maximum nameplate/nominal capacity, annual average operational design capacity (including applicable rates and assumptions), actual expected operational throughput (if significantly different from the nameplate or design capacity), and history of actual emissions (for proposals already in the operations phase).
- Scope 1 emissions estimates must include all emissions caused as a direct result of the proposal, including emissions associated with the clearing of vegetation and loss of sequestration potential.
- A breakdown of GHG emissions by source over the life of a proposal inclusive of, but not limited to, stationary energy, fugitives, transport, and emissions associated with changes to land use.
- Projected emissions intensity (emissions per unit of production) for the proposal and international benchmarking against other comparable projects, best practice, industry standards and/or milestones and sector pathways, benchmarks and/or milestones.

Greenhouse Gas Environmental Management Plan (GHG EMP)

The GHG EMP should outline:

- A summary of emission estimates.

- A clear pathway for reducing scope 1 and/or scope 2 emissions over the life of the Proposal. This should usually be consistent with, or exceed, the EPA's minimum expectations for emissions reductions.
- Transparent emission estimates and clear targets for commitments for short term reductions, and targets for medium to long term reductions (noting a minimum expectation of 5-year targets).
- Strategies that demonstrate how best practice measures have been adopted to avoid or reduce a proposal's scope 1 emissions at commencement, and throughout the life of the proposal.
- Strategies that demonstrate reasonably practicable measures and alternatives have been considered to avoid or reduce scope 2 emissions at commencement, and throughout the life of the proposal.
- Show that consideration has been given to reducing scope 3 emissions (where reasonably practicable) throughout the life of the proposal through regular reviews.
- Justification for the emissions baseline used and the alternative approaches that were considered for calculating baselines (including an explanation why these were not adopted).
- A demonstrated commitment to continuous improvement to ensure emissions reductions over the life of the project. This should include a consideration of measures to improve performance or setting targets for emissions intensity improvement over time.
- Implementation of a GHG emissions offset package to offset residual emissions for unavoidable scope 1 and 2 emission sources, to achieve proposed commitments and targets. In some cases, it may also be reasonably practicable to offset all residual scope 1 and 2 emissions.
- Whether there are other legal and policy instruments that can regulate GHG emissions from the proposal to meet the EPA's objectives.
- Demonstrate how the scope 1, 2 and 3 emissions from project operation beyond 2050 is consistent with a global low-carbon transition to net zero by 2050 scenario.

Expert review

The GHG EMP should usually be accompanied by:

- An expert review that has been undertaken to demonstrate how best practice measures have been adopted. The EPA usually requires independent expert review of best practice measures.
- An expert review undertaken of whether offsets that satisfy integrity principles are likely to be reasonably practicable and available at the time of proposed future surrender.
- Any reviews that demonstrate that the Proposal is consistent with, or outperforming, relevant sector pathways and, benchmarks and/or milestones.
- A summary of whether scope 2 emissions are subject to emissions reduction regulation.
- A summary of where scope 3 emissions will be emitted (domestic or international) and whether they are or are reasonably likely to be subject to similar emissions reduction regulation as scope 1 or 2 emissions.

Best practice measures

The EPA's expectations for "best practice measures" include:

- Avoiding or minimising emissions through best practice design.
- Avoiding or minimising emissions through demonstration of best practice operations.
- Adoption of renewable and low emissions.
- Identification of best practice for the sector that is appropriate to the scale of the relevant proposals at the time best practice is being considered.
- Evidence that the proposed best practices are capable of achieving stated emissions reductions.
- Identification of local conditions and current circumstances of the relevant proposal that might influence the choice of technologies or procedures to mitigate GHG emissions.
- Comparison of GHG emissions and energy intensity performance metrics with comparable facilities both domestically and internationally.

Approach

Review of best practice measures

KPMG compared the emissions reduction initiatives outlined in BHP's Yarnima Power Station Stage 4 GHG EMP with our understanding of best practice measures, and the feasibility and implementation timeline of decarbonisation initiatives.

We have developed an understanding of best practice measures for emissions reduction in mining and electricity generation, from our own engagement with the sectors on decarbonisation over more than 10 years, and from reviewing authoritative reports on the status of decarbonisation in the iron and steel supply chain. A description of the references used for this report is provided in Appendix 1.

We also considered the wider decarbonisation strategy of BHP Group noting that the Yarnima Power Station Stage 4 proposal is part of an integrated iron ore and energy supply operation, and that BHP has publicly stated its own decarbonation targets and objectives.

Where required, discussions were held with BHP specialists to clarify our understanding of BHP'S GHG EMP and the plans to implement best practice design and operation.

Emissions forecast

With respect to the greenhouse gas emissions forecast, KPMG:

- Assessed the emissions sources (Scope 1, 2 and 3) coverage based on KPMG's experience of developing end-to-end carbon lifecycle assessments for different mining operations,
- Checked the calculations, assumptions and factors used for deriving Scope 1, 2 and 3 emissions, and the emissions intensity factor, and
- Assessed the approach taken by BHP to develop the emissions baseline for the proposal including key assumptions and use of methodologies (e.g., the NGER (Measurement) Determination and the Greenhouse Gas Protocol for Scope 3 emissions).

Offsets proposal

KPMG assessed what carbon offsets (carbon credit standards and schemes) would best satisfy integrity principles including:

- The carbon credit standards and schemes which BHP is more likely to rely on for compliance and voluntary purposes,
- Consideration of BHP's position with respect to perceived offsets integrity, and
- The methodologies within such carbon credit schemes that either have or are perceived to have higher levels of integrity.

The future supply availability of credits was also assessed by considering BHP's demand window for the Proposal and the likely market demand for credits of suitable integrity.

Other

Consideration was given to:

- BHP's position on the development and implementation of emissions reduction initiatives relative to its peer organisation of large-scale iron ore mining companies
- Recent amendments to the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Safeguard Rule).

Best practice measures

KPMG reviewed BHP's GHG EMP and supporting information, against each of the criteria for Best Practice measures set out in the EPA Guidelines. Sections 1, 2 and 3 outline BHP's initiatives in the Proposal for emissions minimisation in design and operation and adoption of renewable energy. Section 4 compares these initiatives with KPMG's understanding of relevant best practice for comparable operations.

Feasibility of the initiatives is discussed in section 5, and the impact of local factors in section 6. Benchmarking of the emissions intensity of the Proposal is discussed in section 7.

1. Avoiding or minimising emissions through best practice design

As outlined in the GHG EMP, BHP's decarbonisation strategy is reliant on the electrification of BHP's operations and the integration of renewable energy for power generation. Trials of Battery Electric Vehicle (BEV) haul trucks are planned to commence in 2024, with the first vehicle expected to be operational by 2028. BHP's fleet is to be progressively electrified by the mid-2030s. BHP has an additional program to replace diesel electric locomotives with battery electric technology. Electrifying the mining operations and rail will displace diesel use in mining operations but will increase the power demand on the BHP Iron Ore Inland Power Grid which is an islanded power network. Concurrently BHP is also looking to reduce the emissions intensity of its power by purchasing renewable energy for those operations that import power from the grid, and by installing behind the meter renewable energy for those operations that are off the grid. BHP's target to reach net zero GHG emissions by 2050 is thus premised on the electrification of mining equipment and rail, and an increased adoption of renewable energy for power generation.

Two key design drivers for the Proposal are: 1) to increase the capacity of the Yarnima power plant, and 2) to ensure that the Yarnima plant is capable of providing flexible but firm supply (that is to provide power as and when required), whilst reducing the emissions intensity of the power generation. The increase in power capacity is required to support increase in production and dewatering requirements as well as electrification of rail and mining operations. The need for flexible but firm supply is required to support the integration of renewable power into the BHP Iron Ore Inland Power Grid as well as to better respond to the demand variability resulting from the electrification of BHP's mining operations and rail.

The fluctuations in power demand in the BHP Iron Ore Inland Power Grid are due to the increased electrification of BHP's operations. Such variability of demand loads includes for example the requirement to support the fast charging of batteries for BEV haul trucks.

The variability of the renewable energy supply and power demand therefore needs to be managed by introducing generating capacity into the BHP Iron Ore Inland Power Grid that can quickly respond to such fluctuations.

Currently the supply capacity for the BHP Iron Ore Inland Power Grid is 164MW. The main source of the grid power is the 119MW Yarnima gas fired power station which utilises a highly efficient Combined Cycle Gas Turbine (CCGT). This power supply is further supplemented by two diesel generators: a 35 MW diesel generator at Yarnima (Yarnima Temporary Power Station or TPS) and a 10 MW diesel generator at Mining Area C.

The Proposal is looking to add up to 120 MW of gas fired power supply by installing multiple Gas Reciprocating Engines (GREs) with individual generating capacity of between 4MW and up to 15 MW.

The diesel power generation is to be phased out, other than for back up and black start operations, once the GREs are brought into service. Therefore, noting that 45 MW of diesel generation will be displaced by up to 120 MW of GREs, the Proposal is expected to increase the power supply capacity of the BHP Iron Ore Inland Power grid by up to 75 MW to a total of 239 MW.

CCGT technology is recognised as being the most efficient and least emissions intensive thermal power generation technology (UK Parliament 2015, Australian Energy Council 2020). CCGT utilises waste heat from the first stage of gas combustion, to generate steam which is used to drive a second turbine to generate additional electricity. However, such high efficiencies depend on operating CCGTs at or close to their nominal capacity. The efficiency of CCGTs decreases when they are operated below their nominal capacity (Wärtsilä 2023a, Power Engineering 2016). Furthermore, CCGTs have a minimum operating capacity before requiring to be turned off. In the case of the Yarnima CCGT, the minimum operating load is 55MW. Once CCGTs are turned off they typically require 20 to 30 minutes to restart from a cold state. CCGTs are also not designed for frequent restarts as this impacts their maintenance and reliability.

The efficiency of GREs is slightly lower than that of CCGTs, but their efficiency is not significantly impacted when they operate at below their nominal capacity. The efficiency of GREs does not materially vary with their generation capacity; smaller 4MW GRE's are approximately 1-2% less efficient than larger 10MW GRE's

(Jenbacher 2023 & Wärtsilä 2023c). GREs also have the advantage that they can be started within two minutes and are designed to tolerate frequent restarts (Wärtsilä 2023b, Power Engineering 2016). Also, whilst higher ambient temperatures reduce the efficiency of both CCGTs and GREs, GREs are impacted less than CCGTs (Wärtsilä 2023d)..

GREs therefore are a more efficient power generation option than CCGTs when electricity demand is highly variable. The operation of an 119MW CCGT and up to 120MW of GRE power allows BHP to switch the GREs on and off as demand requires. The ability to turn down or switch off GREs with little impact to their operational efficiency is a critical consideration when the BHP Iron Ore Inland Power Grid needs to support intermittent renewable energy. GREs can respond quicker to intermittency during partly cloudy days for example, than a CCGT is able to.

Whilst being a separate initiative to the Proposal, BHP is proposing to construct 500 MW of additional renewable energy generation and storage by 2030. This includes approximately 200 MW of wind powered generation, 200 MW of solar PV and 150 MW of battery storage. In the longer term, BHP plans to replace the power supplied by Yarnima and the proposal, with renewable energy.

Being an islanded grid, the BHP Iron Ore Inland Power Grid will be prone to fluctuations in both supply and demand due to the intermittent nature of renewable energy particularly in this initial phase, and the absence of a connected stabilising grid with multiple (including renewable) power sources. The proposal supports the overall objective of decarbonising the BHP Iron Ore Inland Power Grid by providing a stable source of power while the network and mining operations adjust to the increased penetration of electrified vehicles and renewable power.

The Proposal design minimises emissions as follows:

- The increase in the Yarnima power capacity supports the electrification of BHP’s rail and mining operation, helping to displace diesel use,
- The addition of up to 120 MW of gas fired power allows the phasing out of 45MW of diesel power from normal operations, which is more emission intensive,
- The gas fired power supply also enables the integration of renewable energy into the BHP Iron Ore Inland Power Grid, ultimately reducing demand for thermal power generation,
- GREs are the least emissions intensive option for meeting highly variable demand, and
- The proposal supports the wider objective of decarbonising the BHP Iron Ore Inland Power Grid by providing a stable supply of power during the transition to electric vehicles and the increased use of renewable energy.

2. Avoiding or minimising emissions through demonstration of best practice operations

In order to maximise power generation efficiency and minimise emission intensity, BHP’s proposed dispatch priority is as follows:

- Renewable energy will have first priority for dispatch with thermal power generation turned down to accommodate renewable energy when available.
- The CCGT will have second priority and, depending on demand will operate at its nominal capacity. If total network demand falls below the CCGT capacity, the CCGT supply will be turned down.
- The GREs will have third priority. GREs will be turned on when the network demand exceeds the CCGT capacity. GREs will be brought online or offline individually to balance demand as the GREs operate independently of one another providing flexibility to match demand.

Although outside of the Proposal, BHP plans to add 500 MW of additional renewable power capacity to the grid by 2030. This comprises 200 MW of wind power, 200 MW of solar PV and 150 MW of battery storage.

3. Adoption of renewable and low emissions technology

BHP’s existing CCGT at Yarnima reflects best practice design in gas-fired power generation.

Separate to the Proposal, BHP is planning to add 500MW of renewable power and storage to the BHP Iron Ore Inland Power Grid by 2030. This will comprise approximately 200 MW of wind power, 200 MW of solar PV and 150 MW of battery storage. Locations are being evaluated for prevailing weather conditions and for proximity to the existing grid and mining operations. The addition of extra capacity will need to be staged in line with the uptake of electrification in BHP’s truck and rail fleet, and the evolution of optimum charging (including fast charging) and energy management practices in the operations. The Proposal supports safe and reliable operations by providing a stable source of power that is responsive to demand fluctuations, during this period of significant transition.

BHP is a participant in the Pilbara Industry Roundtable, which is evaluating options for the interconnectivity of independent grids serving the Pilbara. A grid with a larger capacity, larger energy storage and multiple renewable energy supplies that are geographically dispersed, will be more stable and require less thermal power to back up renewable energy supplies. The Proposal may assist in stabilising a connected grid during the transition of decarbonisation in the Pilbara. The Clean Energy Finance Corporation has recently announced $3 billion in funding to support interconnectivity and renewable energy in the Pilbara.

4. Identification of best practice for the sector that is appropriate to the scale of the relevant proposals at the time best practice is being considered

KPMG has identified the switching of fuel from diesel to gas for power generation as a best practice measure applicable to the Proposal under the WA EPA Guidelines. Separate to the Proposal, BHP is also planning to add 500 MW of renewable power and storage.

These measures are also being considered by BHP's peer organisations in the Pilbara and overseas.

Examples of best practice measures being adopted in the Pilbara include:

- Newman Power Station operated by Alinta Energy: Installation of 14 gas fired GREs to add 60MW of "fast start capacity) in 2022 to support the 60MW Chichester Solar Gas Hybrid solar PV project and battery storage, and retirement of older GTs (Alinta Energy 2021, Clarke Energy 2021).
- FMG Pilbara Energy Generation's power station in the Pilbara comprising of 14 gas fired GREs with a combined capacity of 165MW (FMG 2020).
- Rio Tinto's construction of two 100MW solar farms and 200MWh of on-grid battery storage in the Pilbara due to be brought into service by 2026 (PV Magazine 2022).
- Horizon Power's construction of an 8MW gas fired modular station at Onslow complemented with a 1MW battery storage facility and a 1MW solar PV farm in 2021 (PV Magazine 2021).

Other power generation technologies with lower emissions do exist but the technologies are not yet commercial. Examples of alternative technologies considered by BHP include:

- Concentrated Solar Thermal (CST): CST systems generate solar power by using mirrors or lenses to concentrate a large area of sunlight into a receiver. A Concentrated Solar Plant (CSP) can incorporate thermal energy storage, which stores energy either in the form of sensible heat or as latent heat (for example, using molten salt), which makes CSP a dispatchable form of solar energy. The technology is still at the developmental stage with five existing projects in Australia (four in NSW and one is SA) each of a 3MW capacity or less (NREL 2023). CSIRO is also progressing a number of pilot scale CST projects (CSIRO 2022b).
- Green hydrogen (Green hydrogen is obtained by electrolysis of water using renewable energy): There are number of pilot or demonstration green hydrogen projects across Australia including for the Pilbara. Production and transport of green hydrogen economically, at scale and at commercially competitive prices is a significant challenge, and the projects are still at the assessment or feasibility phase.

  In November 2021, the Western Australian Government announced an investment of up to $117.5 million to attract Australian Government funding for Pilbara and Mid-West renewable hydrogen hubs (GoWA 2021).

  There is the potential to transport a limited volume of hydrogen via natural gas pipelines through blending. The limit to the proportion of hydrogen that can be accommodated on existing gas transmission pipelines is due to hydrogen embrittlement which compromises the structural integrity of steel pipelines.

  The Proposal can take advantage of any future introduction of hydrogen in the gas transmission system as both the Yarnima CCGT and proposed GREs can operate on a blend of natural gas and hydrogen.
- Carbon capture and storage (CCS): CCS would involve capturing the emissions from the combustion of gas and transporting the emissions to a separate location to be pumped into an underground geological reservoir. Whilst CCS technology has been in use for a number of years in the oil and gas industry, the technology is not currently commercially viable for remote facilities such as the Yarnima power station.

5. Evidence that proposed best practices are capable of achieving stated emissions reductions

BHP has an objective of reducing emissions by 30% (below 2020 levels) by 2030 and to achieve net zero by 2050. BHP Iron Ore supports these goals by focusing on emissions reduction in power generation and purchased electricity, and by undertaking projects to replace combustion of diesel in rail locomotives and mining equipment. These strategies are consistent with best practice in relation to current and emerging decarbonisation technologies for large scale iron ore mining operations.

The Clean Energy Finance Corporation and the Minerals Research Institute of Western Australia (CEFC 2022) have recently carried out a detailed review of the decarbonisation options available to the mining industry in Australia. Each technology is given a “decarbonisation score” between 0 and 10 based on decarbonisation impact, technological readiness, commercial readiness, social and environmental factors (CEFC 2022).

Solar photovoltaic (PV) and wind power stations assisted by lithium-ion battery storage technology achieve a high decarbonation score based on technological maturity, ease of implementation and a high rate of commercial uptake. Based on this assessment, decarbonisation of the BHP Iron Ore Inland Power Grid would be considered as having a low to medium risk.

The emission reductions premised in the GHG EMP are based on comparing the emissions from the Proposal which assumes that the BHP Iron Ore Inland Power Grid is supplied from the Yarnima CCGT and GREs against a baseline scenario whereby the BHP Iron Ore Inland Power Grid is supplied through power from the existing CCGT and diesel generators plus the proposed GREs. The emission reductions result from the displacement of diesel power generation. The same demand was assumed for both scenarios. On this basis the proposed emission reductions are credible and capable of being achieved.

As noted in the GHG EMP (section 3.1.3), forecasting emissions from power generation is challenging due to in part the inherent variability of load demand. Whilst the performance of the Yarnima power station may be different to what BHP is forecasting, the emission calculations undertaken by GHD for BHP include a number of conservative assumptions including a lower operating efficiency for the GREs and an assumption that some of the GREs will provide “spinning reserve” capacity. The lower GRE operating efficiency is on the basis that the GREs will not always operate at the optimal load. Spinning reserve for power generation capacity refers to maintaining power generation (in this case the GREs) on-line but unloaded. This allows a fast response to load demand to compensate for a generation or transmission outage. The assumption that the GREs are providing spinning reserve capacity results in a conservative estimation of the Yarnima power station emission intensity.

In addition, the emissions estimates do not yet include BHP's intention to install 500 MW of renewable generation and storage, which would further reduce emissions.

6. Identification of local conditions and current circumstances of the relevant proposal that might influence the choice of technologies or procedures to mitigate GHG emissions

The local conditions, current circumstances and how each affects the emissions reduction approach in the Proposal have been covered in the preceding discussion. In summary, these are:

- The requirement for the BHP Iron Ore Inland Power Grid is to provide additional firm and flexible power supply whilst minimising emissions. The proposed renewable energy plus battery storage initiatives (which are outside the scope of the Proposal), whilst emission free, are intermittent in nature and unable to securely supply power to meet operational demand at all times.
- Gas-fired power generation provides firm capacity with a lower emission intensity relative to other fossil fuels. Gas-fired generation is projected to decrease as renewable power generation and storage capacity is increased but will remain critical to ensure that power demand can always be serviced. GREs are highly efficient and flexible. By introducing GREs into the BHP Iron Ore Inland Power grid, security of supply is maintained while maximising the utilisation of installed renewable generation.
- The potential to interconnect the BHP Iron Ore Inland Power Grid with other independent power grids across the East Pilbara in future may result in a diversification of renewable energy, both in geographic and renewable energy type (solar and wind), as well as energy storage which could help reduce the dependency on thermal power.
- Due to the demand variability associated with electrification of rail and the mining operations and with the introduction of renewable energy into the BHP Iron Ore Inland Power Grid, GREs are best suited to provide dispatchable power operating at variable loads with relatively little variability in emission intensity compared to CCGTs.
- Lack of availability of green hydrogen in the region and the availability of natural gas supplies and transmission systems means that natural gas is at present the cleanest fuel of choice for power generation. However, the Proposal is able to accommodate a certain proportion of hydrogen in the fuel mix should it become available in future.
- Lack of availability of carbon capture and storage infrastructure at present in the region means that emissions associated with power production cannot as yet be captured and stored.

7. Comparison of GHG emissions and energy intensity performance metrics with comparable facilities both domestically and internationally

The emissions intensity of power stations relies on a number of factors, including:

- Power stations that feed power into a large grid tend to be more efficient as the facility can be operated closer to its nominal capacity, which is the most efficient operating point. The Yarnima power station is not grid connected.
- Ambient temperatures impact the operating performance of thermal power stations, with higher ambient temperatures resulting in an overall drop in efficiency.
- The integration and proportion of renewable energy and battery storage.
- The primary fuel used for thermal power generation. Natural gas is a less emission intensive fuel for power generation compared to coal or diesel (Our World in Data 2023).

BHP has benchmarked the emission intensity for the Proposal against other Pilbara iron ore mining operations (Table 13 of BHP's GHG EMP) based on data compiled by the Clean Energy Regulator under the National Greenhouse Gas and Energy Reporting (NGER) Act for FY2021. This information is shown in Table 1 along with the Industry Average baseline for electricity generation published in Schedule 2 of the Safeguard Mechanism Rule (*NGER Regulations (Safeguard Mechanism) Rule* 2015).

Table 1: Benchmarking Data

Power Station / Data Source	Emissions intensity (tCO_2-e per MWh)
Proposal & Historic	0.46
South Hedland	0.52
Safeguard Mechanism Industry Average (Default)	0.539
Paraburdoo	0.54
West Angelas	0.56
Yurralyi Maya	0.58
Cape Lambert	0.59
Solomon	0.61
Karratha	0.70
Newman	0.70
Port Hedland	0.75

KPMG sought additional information on the emissions intensity of gas reciprocating engines as outlined in Table 2, to further benchmark the intensity forecast in the Proposal. Refer to Appendix 1 for the data source descriptions.

Table 2: Additional Benchmarking Data

Information source	Emissions intensity (t CO_2-e per MWh)	Comment
AGL – Appendix H Greenhouse Gas Assessment (Pg 21) 2019	Reciprocating Engine 1 – 0.568 t CO_2-e/MWh Reciprocating Engine 2 – 0.580 t CO_2-e /MWh	GHG emissions factors (Scope 1 and 3) associated with natural gas <u>RE Comments:</u> Reciprocating Engines can be operated via Natural Gas or Diesel Plant operational at full electrical output 14% of year, and starts 200 times a year Scope 2 emissions are minor
US Department of Energy (USDoE 2016)	0.454 t CO_2-e /MWh	- 9.3MW GREs
EPA – FMG Pilbara Energy Power Station (WA EPA 2020)	0.464 t CO_2-e /MWh	- Heat Rate 9 GJ/MWh - 165MW station - 12MW GRE's
UK Parliament; written Q&A, Fossil Fuelled Power Stations: Carbon Emissions and Nitrogen Oxides (UK Parliament 2015)	0.497 t CO_2-e /MWh	

Legislative impacts

The Safeguard Mechanism

Under recent amendments to the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (the Safeguard Rule), facilities with annual Scope 1 emissions greater than 100,000 tonnes CO_2 must adopt a site-specific emissions intensity factor based on the middle three years (as emissions intensity) of the last five years of production (FY2018 to FY2022). This factor transitions to the Industry Average factor in the Safeguard Rule, by 2030. An annual decline rate of 4.9% is applied to this "hybrid" factor up to 2030, beyond which the decline rate is set to achieve net zero emissions by 2050.

From 1 July 2023, a facility must "make good" on emissions above its baseline by purchasing Australian Carbon Credit Units (ACCUs) or Safeguard Mechanism Credits (SMCs). Facilities that operate below their baseline can generate credits that can be banked or traded with other liable facilities.

The Proposal will form part of the existing Yarnima Power Station and will therefore be subject to the emissions reduction requirements for the Yarnima Power Station Safeguard facility under the Safeguard Rule. This will drive the Proposal to support the emissions reduction trajectory.

BHP has stated that its emissions reduction trajectory will be determined by the Safeguard Mechanism. The emissions reduction initiatives outlined in the Proposal are consistent with this objective.

Emissions forecast

This section presents the findings of the review of whether BHP has met the requirements to "Provide estimated proposal scope 1, 2 and 3 emissions, as tonnes of CO_2-e for all project phases" and "Provide trajectory of estimated proposal scope 1, 2 and 3 emissions, as tonnes of CO_2-e for all project phases."

The assessment has been split into the following elements:

1 Assessment of the emissions source's coverage,

2 Checking of calculations, assumptions and factors used for deriving Scope 1, 2 and 3 emissions and the emissions intensity factor, and

3 Assessment of the approach taken by BHP to develop the emissions baseline.

The findings for each of the above elements is presented below.

1. Assessment of the emissions sources (Scope 1, 2 and 3) coverage based on KPMG's experience of developing end-to-end carbon lifecycle assessments for different mining operations

BHPIO has estimated total project emissions of 23,861,630 t CO_2-e, averaging annual emissions of 916,601 t CO_2-e, for the life of the Proposal. Maximum total annual emissions are 942,000t CO_2-e. The figures above are sourced from Table 15 in BHP's GHG EMP. These emissions relate to the Proposal scenario in the GHG EMP where the diesel power generation in the Mining Area C and Yarnima Temporary Power Station (TPS) are displaced from normal operation in 2027 once the GREs are operational. These figures do not include Scope 3 emissions which have been calculated separately.

The following sources of emissions are included in the scope of the Proposal GHG EMP:

- Natural gas consumed for power generation from the Proposal.
- Diesel consumed for power generation, including backup and black start operations.
- Land Clearing made up of embodied emissions associated with vegetation.

Natural gas consumption

Natural gas will be the predominate fuel source for firm power over the life of the Proposal.

Diesel consumption

BHPIO has two diesel power stations, the Mining Area C and the Yarnima TPS. Under the Proposal, diesel power generation is proposed to be phased out once the GRE's become operational in 2027 with the exception of back up and black start operations.

Land Usage

BHPIO intends to clear up to 4 ha of land to support the Proposal development. BHPIO has estimated the land clearing emissions from the Western Ridge land clearing activities. Those emissions were based on FullCAM calculations. The area to be cleared for the Proposal is sufficiently small and the vegetation of the two locations are sufficiently similar to enable this approximation.

Using FullCAM to estimate emissions due to land clearing is consistent with Australia's National Greenhouse Accounts and National Carbon Accounting System (NCAS), and with estimation methods adopted by the Australian Government and the National Inventory reporting used by DCCEEW for emission inventory.

Scope 1

At a facility level, the Scope 1 emissions categories are consistent with the benchmarking research based on the emissions intensity benchmarking sources most relevant to the Yarnima Power Station from the US Department of Energy (USDoE 2016), EPA (WA EPA 2020), FMG (FMG 2020), and the UK Parliament (UK2015). Solid waste disposal and fugitive emissions have not been included, as putrescible waste is not proposed to be disposed of at the project site, and fugitive emissions are not required for reporting for this facility under NGER.

To further evaluate the Scope 1 emissions sources coverage across the life cycle of Yarnima Power Station, KPMG has benchmarked the emission sources reported by peers for comparable Pilbara-based power stations and beyond (see section 7 of Best Practice) and determined that the coverage of Scope 1 emissions sources is consistent with peers.

Scope 2

BHP has noted that there were no Scope 2 emissions associated with the Proposal project, and no Scope 2 emissions associated with these power generation projects.

Scope 3

The Scope 3 emissions associated with the Proposal are limited to upstream activities related to the production and transportation of: a) natural gas via pipeline, and b) the supply of diesel, for power generation which is consistent to similar facilities, such as FMG's Pilbara Energy Generation (PEG) Program power station as outlined under its GHG EMP.

2. Checking of calculations, assumptions and factors used for deriving Scope 1, 2 and 3 emissions, and the emissions intensity factor

Scope 1 GHG emissions estimates in this GHG EMP have been calculated in accordance with the NGER Act, with exception of land clearing emissions, for which the NGER Act does not include a calculation methodology.

The emissions for power generation have been calculated by adopting the calculation and methodology from the DCEEW's NGA factors. The total emissions are also calculated for the life of the project to 2052.

BHPIO presently operates one of the most efficient power generation facilities with one of the lowest emissions intensities in the Pilbara. BHPIO's electricity demand is increasing to sustain current operations and growth in its production thus requiring a flexible firm power generation.

KPMG performed additional benchmarking and research to confirm validity of emissions forecasting and estimates. Based on the summary of emissions calculations below, the BHPIO Yarnima Stage 4 proposal's estimates are consistent with relevant frameworks, peer GHGMP methodologies, and existing BHP projects.

Table 4: Emission Factor data

Emission Source (Unit)	Emission Scope	Yarnima Emission Factor	Source	KPMG Notes	Emissions Factor Benchmarks
Diesel (kg CO_2-e/ GJ)	Scope 1	70.2	Australian National Greenhouse Accounts Factors (dcceew.gov.au)	Confirmed emission factor is consistent with the most recent Australian National Greenhouse Accounts Factors (dcceew.gov.au).	GHG Protocol 74.1
Natural Gas (kg CO2-e/GJ)	Scope 1	51.6	Australian National Greenhouse Accounts Factors (dcceew.gov.au)	Confirmed emission factor is consistent with the most recent Australian National Greenhouse Accounts Factors (dcceew.gov.au)	GHG Protocol 48
Vegetation Land Clearing (tCO_2-e/ha)	Scope 1	19.5	ETA Peer Review FullCAM	-	FMG Iron Bridge 49.1
Diesel (kg CO_2-e/ GJ)	Scope 3	17.3	Australian National Greenhouse Accounts Factors (dcceew.gov.au)	Confirmed emission factor is consistent with the most recent Australian National Greenhouse Accounts Factors (dcceew.gov.au)	
Natural Gas (kg CO2-e/GJ)	Scope 3	4.0	Australian National Greenhouse Accounts Factors (dcceew.gov.au)	Confirmed emission factor is consistent with the most recent Australian National Greenhouse Accounts Factors (dcceew.gov.au)	

Scope 1 Emissions:

Scope 1 – Electricity Usage

BHPIO has estimated total project Scope 1 emissions of Yarnima Power Station to be 23,861,630 t CO_2-e, averaging annual emissions of 916,601 t CO_2-e, for the life of the Yarnima Power Station. Maximum annual emissions for Scope 1 are 942,000 t CO_2-e. These figures are related to the Proposal scenario in the GHG EMP and are sourced from Table 15 in BHP's GHG EMP. These figures do not include Scope 3 emissions which have been calculated separately.

BHPIO has estimated natural gas combustion emissions associated with electricity generation for the Proposal by multiplying the heat rate for corresponding load factors by the National Greenhouse Account factor for "Natural Gas" stationary combustion. The heat rate range of 9.1 GJ/MWh to 8.6 GJ/MWh was used for the CCGT operating at 46% of nominal load (55WM) and nominal load (119MW) respectively. A heat rate of 9.1 GJ/MWh for the GREs based on OEM data was used which assume the engines operate at part load.

Similarly, BHPIO has estimated diesel combustion emissions associated with electricity generation for the Proposal by multiplying the heat rate by the National Greenhouse Account factor for "Diesel oil" stationary combustion. The fuel consumption of 3.5 kWh per litre was assumed in the estimation which equates to a heating value of 10.9 GJ/KWh (assuming an HHV for diesel of 28MJ/L (University of Birmingham 2011)).

Land Usage

The Proposal development will require 4 ha of land clearing. The total Scope 1 emissions associated with land clearing is 78 t CO_2-e. An average emissions factor of 19.47 t CO_2-e/ha based on BHP's Western Ridge GHG EMP was used in the Proposal's land clearing emission estimation. The accuracy of adopting this emission intensity will depend on the characteristics of the area on the development envelope including the characteristics of the vegetation and soil. However, the limited extent of land proposed to be cleared and its proximity to the Western Ridge area means that such an approximation will not have a material impact on the overall scope 1 emissions of the Proposal.

Scope 3 – Emissions:

The scope 3 emission factors for natural gas and diesel are associated with the upstream emissions involved in supplying fuel to off-grid power stations, which covers emissions associated with the production, processing and transportation of diesel and gas (cradle to gate emissions). BHPIO has estimated these emissions using the Scope 3 emission factors for natural gas and diesel oil (for stationary combustion) using the Australian National Greenhouse Accounts Factors published by DCCEEW which are relevant for this analysis.

Emissions Intensity:

The estimated emissions intensity for the Proposal was calculated as being the forecasted Scope 1 emissions divided by the projected power demand. The emission intensity for the Proposal is expected to be similar to the Yarnima Power Station's historical emission intensity.

3. The approach taken by BHP to develop the emissions baseline for the proposal including key assumptions and use of methodologies (e.g. the NGER (Measurement) Determination and the Greenhouse Gas Protocol for Scope 3 emissions).

The emissions reporting in BHP's GHG EMP are based on NGER Act reportable activities occurring within the project's development envelope. GHG emissions estimates have been calculated in accordance with the NGER Act, aside from emissions due to land clearing, for which the NGER Act does not detail a calculation methodology. BHP has calculated land-use-change emissions using the Full Carbon Accounting Model (FullCAM), consistent with estimation methods adopted by the Australian Government and the National Inventory reporting used by DCCEEW in emission inventory reporting.

Scope 1 emissions from the proposal are to be reported annually in accordance with NGER, with the proposal covered by the NGER scheme and the Safeguard Mechanism.

Scope 3 emissions are not reportable under the NGER Act as they occur outside of the project envelope. However, certain Scope 3 emissions relating to the transportation and supply of natural gas and diesel used as fuel for power generation are discussed in the GHG EMP. BHP's Scope 3 calculations are consistent with the GHG Protocol as defined in BHP's GHG EMP and emissions calculation methodology.

Offsets proposal

This section will present the findings of the assessment of “whether the offsets that satisfy integrity principles are likely to be reasonably practicable and available at the time of proposed future surrender” as articulated in the EPA Guidelines.

The assessment has been split into the following five elements:

1 Examination of the offset integrity principles that BHP applies for offset investments,
2 Extent to which such offsets are practicable,
3 Assessment of the offset demand required to meet the stated emission reduction targets under BHP’s GHG EMP, with respect to offset type, volume and timing,
4 Market review on the availability for the required carbon offsets, and
5 Examination of the strategies considered by BHP to reduce the offset supply risk.

The findings for each of the above elements is presented below.

Proposal’s Offsets Integrity Principles

BHP has publicly set seven quality standards that it looks to apply when investing in carbon offsets (BHP 2023). These quality standards are identical to the set BHP will adopt for offset investments required to support BHP’s GHG EMP (section 3.8 of the GHG EMP).

BHP’s minimum offset quality standards include the offset integrity standards set under the Carbon Credit Act 2011 (Australian Government 2011) and the offsets integrity principles outlined in the Climate Active Carbon Neutral Standard (Climate Active 2022). Moreover, BHP’s offset integrity principles further require that carbon offset projects should not result in any social or environmental adverse impact and that offsets vintages are limited to the last five years.

BHP has also stated in section 3.8 of the GHG EMP that it would look to align its minimum sourcing standards and sourcing strategy with the outcome of the Chubb review into the integrity of ACCUs. Of note is that the Chubb review has recommended not to allow new project registrations under the then current avoided deforestation method because of additionality concerns, and instead consider the development of new methods that incentivise the maintenance of native vegetation (DCCEEW 2022). The Minister for Climate Change and Energy has subsequently revoked the avoided deforestation method on February 2023 (DCCEEW 2023b).

BHP undertakes due diligence of offset investments on a case-by-case basis, a process which includes a risk assessment of the extent to which an offset investment meets the stated minimum quality standards.

Extent to which Offsets are Practicable

The Environmental Protection Act 1986 defines “reasonably practicable” as “having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge” (GoWA 2020). Section 3.8 of BHP’s GHG EMP states that any offset units that may be required to meet emission targets for BHP’s GHG EMP are to be sourced from either internationally recognised voluntary carbon standards such as the Verified Carbon Standard and the Gold Standard, or from the ACCU scheme. The offsets from these two voluntary standards and the ACCU compliance scheme can be considered as being practicable in the sense that such carbon offset schemes are capable of delivering offsets which meet the above stated minimum quality principles and are capable of being put into practice.

Projected Offset Demand for Proposal

Section 3.8 of BHP’s GHG EMP sets out that GHG emission reductions are to be prioritised over investment in carbon offsets. However, BHP’s GHG EMP does not delineate the relative proportion of the emission reductions that are to be achieved through structural abatement versus offsets.

To review whether offsets that satisfy integrity principles are likely to be available at the time of proposed future surrender and given that there is no estimated proportion of emission reductions to be achieved through structural abatement, for the purpose of this assessment it has been assumed that all emission reductions required for the Proposal will be achieved via offsets. This is a very conservative assumption as it can be expected that by the mid-2030s a significant proportion of the emission reductions will be achieved through structural abatement.

Further, as the project will be required to comply with the Safeguard Mechanism, this assessment will assume that all offsets will be in the form of ACCUs. The basis for this assumption is as follows:

1 ACCUs are more versatile units as the offsets can be used to meet Safeguard compliance and emission reduction targets under BHP's GHG EMP, whilst offsets from voluntary carbon standards are not eligible to be used for Safeguard compliance, and

2 The Safeguard compliance requirement for this development coincide with the emission targets set out in BHP's GHG EMP as set out on Table 11 of BHP's GHG EMP.

Whilst Safeguard Mechanism Credits (SMCs) can also be used for Safeguard compliance and BHP may consider using SMCs for compliance purposes for the Yarnima Power Station NGER facility, it is unclear whether SMCs meet the requirements of the WA EPA Environmental Factor Guideline. DCCEEW notes that SMCs do not meet the additionality principle under the CFI Act and that therefore the units are not regarded as offsets (DCCEEW 2023a). The EPA Environmental Factor Guideline requires the use of domestic "offsets" under the Safeguard Mechanism which meet the offset integrity principles. Given that DCCEEW deems SMCs as not being additional or offsets, the eligibility of SMCs for use against the GHG EMP at this point is unclear.

Assuming that on a conservative basis, all emission reductions for BHP's GHG EMP (as set out in Table 11 of the GHG EMP) will be achieved via offsets, then the yearly average ACCU offset demand for BHP's GHG EMP is as **per Table 3.**

Table 3: Assumed ACCU Demand for Proposal

Compliance Period	Annual Average ACCU Demand Assumed (rounded)
FY27-FY30	220,000
FY31-FY35	420,000
FY36-FY40	570,000
FY41-FY45	730,000
FY46-FY50	880,000
FY51-FY52	940,000

Market Projections of Offsets Availability

ACCU Carbon Market Balance Through FY2030

Safeguard facilities have the option of meeting their Safeguard baselines by either reducing their emission intensities or through carbon offsets. The proportion of emission reductions achieved through structural abatement will depend on the availability of technological solutions and their relative costs to carbon offsets. To the extent that Safeguard facilities look to use offsets to meet part or all of their Safeguard baseline exceedances in a compliance year, they can either use ACCUs or SMCs.

DCCEEW has targeted a cumulative abatement of 205Mt between FY24 and FY30 for Safeguard facilities over business as usual projections through the Safeguard Mechanism reforms (DCCEEW 2023a). The 4.9% annual decline set through the Safeguard Mechanism reforms is designed to achieve this level of abatement from existing Safeguard facilities and in addition, build up a reserve emission abatement. This reserve is to factor in the uncertainty over emissions projections from Safeguard facilities as well as to allow some room for new facilities captured in the Safeguard Mechanism over the FY24 to FY30 period.

Market Demand

Research from the CBA in February 2023 (CBA 2023a) suggested that Safeguard facilities can optimistically reduce emissions by 23.4% over the FY24 and FY30 period rather than the 34.3% reduction required under the Safeguard Mechanism. This is based on a comparison of the emission reduction performance of the National Electricity Market in the period 2014 to 2021 and assessing what level of cost reduction performance can be anticipated for Safeguard facilities over the FY24 to FY30 period. The difference between emission reductions and the Safeguard abatement target would need to be made up with offsets. Under the CBA optimistic emission reduction scenario, this gap corresponds to 95 million ACCUs for the FY24 to FY30 period. The more likely Safeguard ACCU demand scenario in the CBA analysis over this period is 105 million ACCUs, with an upper demand range of 114 million ACCUs. Coupled with voluntary ACCU demand, the CBA estimates that the cumulative total ACCU demand for the FY24 and FY30 period to be between 100 to 140 million ACCUs. This demand range was recently revised to 90 to 140 million ACCUs to take into account recent changes to the Safeguard Mechanism in April 2023. CBA's ACCU demand forecast to FY30 is summarised in Table 4.

Table 4: CBA ACCU Demand Forecasts to FY30

Scenario	**February Research** (CBA 2023a)			**May Research** (CBA 2023b)
	Voluntary ACCU demand (million)	*Compliance ACCU demand (million)*	Total ACCU demand (million)	Total ACCU demand (million)
High Demand	*26*	*114*	140	140
Base Demand	*13*	*105*	117	108
Low Demand	*5*	*95*	100	90

Market Supply

The CBA February analysis projected that the ACCU supply over the FY24 and FY30 period to be between 102 and 160 million ACCUs. The ACCU supply is projected to come from new ERF projects supplying between 51 to 95 million ACCUs as well as from existing projects which have Carbon Abatement Contracts (CACs) with the Clean Energy Regulator (CER) of between 51 to 65 million ACCUs. The CBA recently revised the supply range to 51 - 95 million ACCUs. CBA's ACCU supply forecast to FY30 is summarised in Table 5.

Table 5: CBA ACCU Supply Forecast to FY30

Scenario	**February Research** (CBA 2023a)			**May Research** (CBA 2023b)
	ACCU supply from new projects (million)	*ACCU supply from Carbon Abatement Contracts (million)*	Total ACCU supply (million)	Total ACCU supply (million)
Low Supply	*51*	*51*	102	51
Base Supply	*64*	*58*	122	64
High Supply	*95*	*65*	160	95

The CBA's ACCU supply base case from the February analysis assumes that 64 million ACCUs are sourced from five ERF methodologies being plantation forestry, ecological native plantings, human induced regeneration (HIR) of native forest, soil carbon and savannah fire management. These ERF methodologies are well established in the market. CBA's supply volumes have been derived from CSIRO's Australia's carbon sequestration potential report (CSIRO 2022a). CBA has not as yet provided a breakdown of the revised supply scenarios.

The HIR method is set to expire in October 2023. This has for the moment reduced the number of projects registered under the HIR method and is thereby expected to impact ACCU issuance related to this method in the medium term (CER 2023b). The HIR method expiry impact on ACCU supply is unlikely to have been factored in CBA's supply modelling. The CER is implementing the recommendations of the Independent Review of ACCUs with respect to the HIR method (recommendation 8) which requires evidence of a causal relationship between suppression mechanisms in the baseline period and the HIR activities undertaken to remove the suppressors so that the land can regenerate to forest. The CER has noted that it expects the crediting rate under this method to accelerate over time (CER 2023b), presumably once recommendation 8 has been implemented and a replacement method has come into effect.

The ACCU supply from CACs could come from either the holders of the CACs who seek to exit their arrangements with the CER or alternatively from the CER who will hold the ACCUs from the CACs in a buffer with the intent of making them available to Safeguard facilities as part of the Safeguard cost containment measure. The variability in the ACCU supply from CACs modelled by the CBA reflects the risk that some carbon projects may fail to deliver against their contractual obligations. The Australian Government is accumulating ACCUs into a designated Commonwealth account for the Safeguard Mechanism cost containment measure. As of May 15, 2023 the Australian Government has accumulated 430,000 ACCUs into this account (CER 2023b).

Market Balance

The CBA February analysis anticipated the ACCU market to remain balanced over the FY24 to FY30 period with an equal chance of the ACCU market being either in surplus or deficit. The more recent CBA analysis suggests that the ACCU market is at risk of being in a deficit over this period as outlined in Table 6.

Table 6: CBA ACCU Market Balance Outlook to FY30

Scenario	**February Research** (CBA 2023a)				**May Research** (CBA 2023b)			
	Supply (million)	*Demand (million)*	Surplus/ Deficit (million)	Likelihood	*Supply (million)*	*Demand (million)*	Surplus/ Deficit (million)	Likelihood
High Demand – Low Supply	*102*	*140*	-38	Medium	*51*	*140*	-89	Medium
Mid Demand and Supply	*122*	*117*	4	High	*64*	*108*	-44	High
Low Demand – High Supply	*160*	*100*	60	Low	*95*	*90*	5	Low

The CBA analysis may be somewhat conservative in that it does not take into account:

1. The ACCUs that have been accumulated to date in the market and have not been retired.
   At the end of March 2023 some 24 million ACCUs have been "warehoused" by project proponents, businesses and intermediaries (CER 2023b). These include entities with exposure to Safeguard facilities which have accumulated ACCUs for future requirements, as well as traders and banks who are looking to sell the ACCUs in a rising market.
2. The impact of SMCs on ACCU demand over the FY24 to FY30 period.
   The Safeguard Mechanism reform is inherently designed to remove any "headroom" in the Safeguard baselines and for ensuring that, with the headroom removed, Safeguard facilities on average abate 34.3% of emissions by FY30. Therefore, assuming that the cost of large-scale structural abatement is mostly commercially unfeasible prior to FY30, the volume of SMCs anticipated to be generated in the market prior to FY30 can be expected to be relatively small compared to the total ACCU demand.

Comparison of Proposal Demand to Market Trading Volume

The volume of ACCUs being conservatively assumed to be required for this project is modest. The 220,000 ACCUs per annum that are assumed for the FY27 to FY30 period represents approximately 1% of the total transacted volume in 2022, representing 11 average ACCU transactions. So even on a conservative basis, the ACCU volume required for BHP's GHG EMP is modest when compared to the ACCU market size as shown in Table 7.

Table 7: ACCU Market Transaction Volume

Year	Number of Transactions	ACCU Volume Transacted	Average ACCUs per Transaction
2019	261	4,248,631	16,278
2020	266	3,908,781	14,694
2021	524	7,498,816	14,310
2022	1,189	23,281,843	19,581
Q1 2023	501	13,027,194	26,002

(Source: CER 2023a)

ACCU Carbon Market Balance Post FY2030

There is little public information with respect to the projected ACCU market position post FY30. The Safeguard Mechanism has set clear targets and cost containment provisions up to FY30, but there are fewer guiderails post FY30. This makes it difficult to make projections on the state of the ACCU market post 2030 with any confidence. There are also a number of key carbon abatement technologies which are excepted to mature post 2030. These include electrification of heavy haulage vehicles which will significantly reduce emissions and biochar and carbon capture and storage technologies which will increase supply of offsets.

The assumed conservative ACCU demand for the Proposal post FY30 as outlined in Table 3 may become a material volume of offsets relative to the potential market volume. A CMI report which examined the projected sources of ACCU supply and demand noted that the ACCU supply forecasts ranged from a pessimistic 37 million ACCUs per annum to well above 150 million ACCUs per annum (CMI 2023). Whilst BHPIO does not look to exclusively rely on carbon offsets to meet its stated GHG EMP emission targets, the Proposal's total annual emissions post FY30 represent more than 2.5% of the most pessimistic ACCU annual supply volume quoted in the CMI report.

Strategies Considered to De-risk Offset Supply for Proposal

Sourcing offsets on the spot market in a compliance period is considered a high-risk sourcing option. In its GHG EMP BHP has outlined long-term sourcing approaches for securing offsets to help reduce reliance on sourcing offsets from the spot market in a compliance year. These include long term offtake agreements and carbon insetting (or carbon project origination).

Whilst BHP has not set a target for securing a proportion of offsets ahead of a compliance year, given that the conservative estimate for ACCU requirement for BHP's GHG EMP is relatively small compared to the ACCU market size, any residual ACCU volumes that may be required to be procured through the spot market between the FY25 to FY30 period is expected to be modest.

BHP has also highlighted that it will use a portfolio approach in securing and using offsets. Moreover, BHP is looking to use offsets not only for regulatory compliance but also for meeting emission voluntary targets and goals and pursuing commercial opportunities such as marketing carbon neutral products (BHB 2023). Using a portfolio approach in sourcing and utilising offsets will reduce the risk of a supply shortfall for the Proposal.

One complication for BHP to manage is the offset vintage restriction whereby BHP looks to retire (or sell) offsets within five years from the offset registration. This places limits on how long BHP can warehouse offsets before they are used or sold. However, as BHP is adopting a portfolio approach on the use of offsets, this is unlikely to present a significant risk or limitation in accumulating offsets ahead of a compliance period.

Appendix 1 - References

The following references were used for this report:

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Carbon Market Institute (CMI), 2023, Considerations for future ACCU supply and demand, June 2023

CEFC 2022, *Technology solutions for decarbonisation: Mining in a low-emissions economy*, Clean Energy Finance Corporation with the Minerals Research Institute of Western Australia, 2022

This is the second of three extensive reports by CEFC and MRIWA into decarbonisation of Australia's mining industry. The report identifies the current and emerging technology solutions for decarbonisation, discusses the opportunities and challenges of each, and assigns a rating based on technological readiness and commercial viability. Opportunities for decarbonisation are grouped by their position in the supply chain, i.e.:

- Energy carriers (fuels) including electricity, hydrogen and biofuels
- Stationery energy generation including green hydrogen, biofuels and renewables
- Material movement including haul vehicles, crushing and conveying
- "In mine" operation including blasting, excavation and dewatering.

Alternative fuels such as green hydrogen and ammonia were categorised as having an advanced level of technological readiness but were some way off being commercially viable due to the lack of large-scale chemical manufacturing including electrolysis to produce hydrogen, and supply chain infrastructure. Biofuels to replace diesel were closer to commercial viability due to lower substitution costs than other diesel alternatives, however large-scale production of biofuels may lead to undesirable sustainability outcomes due to competition for food crops and scarce water resources.

Grid electricity supply was at a high level of commercial readiness but was dependent on the development of. battery electric vehicles for main haulage and other operations and was subject to the emissions intensity of the grid. Combined cycle gas turbines were efficient (relative to other forms of fossil-fuel power generation) when applied to supply base load electricity demand. Renewable power sources (solar PV and wind) and current lithium ion battery storage had high levels of technical and commercial readiness. Alternative battery storage technologies such as vanadium flow and compressed hydrogen, required additional development but could be "drop in" technologies to replace older style batteries in the future.

Battery and fuel cell electric vehicles faced challenges in relation to energy storage, range and charging. Both technologies were assessed as being advanced in relation to technological readiness, but well short of commercial viability at the present time. Battery electric vehicles depend for their decarbonisation impact on the emissions intensity of the grid but are not dependent on development of a green hydrogen supply infrastructure.

The uptake of renewable power, battery storage and battery electric drive trains, offer solutions to the emissions intensity of crushing, excavation, loading and dewatering. These operations typically rely on diesel power or grid electricity, or electricity generated from diesel combustion.

The report gives an overall Decarbonisation Score to the various technology options based on the potential for emissions reduction, technological and commercial readiness, and environmental and social impact. On a scale of 0 to 10, the following technologies had a rating of 7 or higher:

- Renewable power generation (solar and wind) and grid electricity
- Lithium ion (current technology) and vanadium flow (emerging technology) batteries

- Battery electric vehicles (using green power)
- Trolley assist (overhead supply of electricity. Not viable for large scale open cut mining)
- In pit crushing and conveying.

Clean Energy Regulator (CER) 2023a, *QCMR data workbook - March Quarter 2023*, Available at: https://www.cleanenergyregulator.gov.au/Infohub/Markets/quarterly-carbon-market-reports/quarterly-carbon-market-report-march-2023, 15 June 2023

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KPMG have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report.

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