

Hope Downs 2 greenhouse gas environmental management plan

Expert review

Executive summary

Energetics has undertaken a review of the greenhouse gas environmental management plan (“the Plan”) prepared by Rio Tinto for their proposed Hope Downs 2 iron ore project (“the Proposal”). This review has been prepared in a manner that is consistent with the definition of an expert review, as defined in the April 2023 version of the WA Environmental Protection Agency’s (“the EPA”) 'Environmental Factor Guideline: Greenhouse Gas Emissions' (“the Guideline”) (WA Environmental Protection Authority, 2023). Per the Guideline, an expert review of the Plan should be undertaken to evaluate whether:

- best practice measures have been adopted to avoid or reduce scope 1 and 2 emissions associated with the Proposal
- offsets that satisfy integrity principles are likely to be reasonably practicable and available at the time of proposed future surrender
- the Proposal is consistent with, or outperforming, relevant sector pathways and milestones.

In undertaking our review of the Plan, Energetics has drawn on a range of publicly available sources, including peer greenhouse gas environmental management plans (GHG EMPs) and independent reports. Where relevant, we have provided our expert opinion based on our experience in developing and assessing emissions reduction, net zero and offsets strategies.

The findings of our review are summarised in Table 1:

Table 1: Summary of findings and recommendations

Guideline reference	Abridged findings	Recommendations
Best practice measures: power generation	<p>The following best practice measures were identified within the Plan: 34MW and 100MW solar PV systems and 12MWh battery storage system to be integrated into the Proponent’s “Pilbara Power Network”¹.</p> <p>The Plan does not, however, specify the estimated emissions savings at the Proposal.</p>	<p>The Plan should qualify the estimated emissions savings at the Proposal. Alternately, the Plan should provide a forecast of how the emissions intensity of the Pilbara Power Network is anticipated to decline over time.</p> <p>Timeline for update: First Ministerial Statement Annual Compliance Assessment Report (2025).</p>
Best practice measures: fleet decarbonisation	<p>The following best practice measures were identified within the Plan: supply chain engagement to support the commercialisation of zero emissions vehicles (electric haul trucks) and integration of biodiesel as a transition fuel.</p> <p>A Proposal-specific implementation timeline has not, however, been provided for either measure.</p>	<p>The Plan should include a Proposal-specific implementation timeline for both zero emissions vehicles and biodiesel.</p> <p>Timeline for update: First Ministerial Statement Annual Compliance Assessment Report (2025).</p>

¹ As the Proposal will be connected to this network, Energetics have assumed that any measures implemented at the network level will result in direct emissions reductions at the Proposal. Energetics have not assessed this best practice measure from a capacity perspective.

Guideline reference	Abridged findings	Recommendations
Best practice measures: materials handling	<p>The following <i>potential</i> best practice measure was identified within the Plan: adoption of road trains in lieu of conventional haul trucks for Hope Downs 2.</p> <p>The Plan does not, however, provide a clear strategy to decarbonise this class of vehicle (recommended to demonstrate best practice).</p>	<p>The Plan should include a strategy for decarbonising the road train fleet in line with commercially available technologies.</p> <p>Timeline for update: First Ministerial Statement Annual Compliance Assessment Report (2025).</p>
Best practice measures: energy efficiency (fleet)	The following best practice measures were identified within the Plan: engine upgrades for existing haul trucks to improve efficiency and procurement of new energy-efficient haul trucks and dig units.	None
Best practice measures: energy efficiency (general)	The following best practice measure was identified within the Plan: mains powered water supply bores.	None
Offset integrity	The Plan indicates that where offsets are required, only ACCUs will be surrendered, which is in compliance with the EPA requirements.	None
Offset availability	There is sufficient recognition in the Plan that a multi-pronged approach may be required in securing sufficient offsets to manage supply risks, including increased purchasing as well as through offtake arrangements and direct investment.	<p>The Plan should commit to providing targets and timelines associated with Rio Tinto's risk mitigation strategies, in particular, the development of nature-based solutions.</p> <p>Timeline for update: First Ministerial Statement Annual Compliance Assessment Report (2025).</p>
Pathways and milestones	The targets presented within the Plan suggest that the Proposal will meet relevant sector pathways and milestones.	None

Based on these findings, it is our conclusion that, subject to the adoption of recommendations outlined in Table 1, the Plan demonstrates that the environmental objective of the Guideline will be met and provides a clear and credible plan for meeting the EPA's minimum expectations for emissions reductions.

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1.0 Background

1.1 Context

Greenhouse gas environmental management plans (GHG EMPs) are required by the Western Australian Environmental Protection Authority (“the EPA”) for projects considered to be “reasonably likely” to have GHG emissions in excess of 100,000 tonnes CO₂-e of scope 1 or 2 emissions in any year (WA Environmental Protection Authority, 2023).

GHG EMPs are required to be developed in accordance with the EPA’s ‘Environmental Factor Guideline: Greenhouse Gas Emissions’ (“the Guideline”) (WA Environmental Protection Authority, 2023). Per the Guideline, an expert review of the Plan should be undertaken to evaluate whether:

- best practice measures have been adopted to avoid or reduce scope 1 and 2 emissions associated with the Proposal
- offsets that satisfy integrity principles are likely to be reasonably practicable and available at the time of proposed future surrender
- the Proposal is consistent with, or outperforming, relevant sector pathways and milestones.

Energetics has been engaged by Rio Tinto to undertake the expert reviews described above for the GHG EMP (“the Plan”) prepared by Rio Tinto for their proposed Hope Downs 2 iron ore project (“the Proposal”).

1.2 Overview of the Proposal

The Proposal comprises the development of two new iron ore deposits: Hope Downs 2 and Bedded Hilltop. The new deposits are located approximately 80km north-west of Newman, WA and will be “open cut above water table pits”.

It is understood that the Proposal will be limited to the development of the above mentioned deposits (including direct supporting infrastructure such as water supply systems) and “linear infrastructure” to transport ore between the new deposits and existing processing facilities at Hope Downs 1. The Proposal will utilise existing infrastructure located at Hope Downs 1, including materials processing infrastructure, train load out facilities and administrative and maintenance buildings.

The Proposal will be connected to the Proponent’s existing “Pilbara Power Network”.

1.3 Statement of independence

Energetics takes seriously our obligation to act with integrity and our commitment to managing real and perceived conflicts of interest to the standard incumbent upon similar professional services providers in Australia. As such, we specifically acknowledge the need for independence in this particular assignment, namely, the review of a GHG EMP for referral to the EPA.

2.0 Approach

2.1 Scope of review

Energetics has undertaken our review in a manner that is consistent with the definition of an 'expert review', as defined in the Guideline.

Per the Guideline, an expert review of the Plan should be undertaken to evaluate whether:

- best practice measures have been adopted to avoid or reduce scope 1 and 2 emissions associated with the Proposal
- offsets that satisfy integrity principles are likely to be reasonably practicable and available at the time of proposed future surrender
- the Proposal is consistent with, or outperforming, relevant sector pathways and milestones.

As such, while we have reviewed the Plan in its entirety from a context-setting perspective, the primary focus of our review is on the sections of the Plan relating to the scope outlined above.

2.2 Specific interpretations

In preparing this review, Energetics has taken the following interpretation of the intent of the Guideline:

- The EPA, as part of their process to assess a proposal, are seeking to understand the specific contribution the Proposal will have on the state's GHG emissions and, by consequence, what measures will be implemented under a GHG EMP to reduce or avoid those emissions.
- Notwithstanding the interpretation above, Energetics acknowledges that larger organisations frequently take a portfolio-wide approach to emissions abatement. We have considered portfolio-level initiatives in this report where the Plan clearly demonstrates how such initiatives could achieve emissions reductions for the Proposal.
- GHG EMPs should be comprehensive, providing all information necessary to demonstrate that objectives and requirements of the Guideline have been met. As such, Energetics has not considered any reports, assessments or studies undertaken by Rio Tinto that are not referenced and detailed within the Plan.

2.3 Methodology

Review of best practice measures

Energetics has reviewed publicly available GHG EMPs for iron ore proposals in Western Australia alongside government and industry reports focussed on decarbonisation within the mining sector. This research has been used to establish the definitions of best practice that have been used to benchmark the measures included in the Proposal.

Based on our research, a detailed summary of which is presented in Appendix A, abatement measures have been grouped into five broad categories: power generation, fleet² decarbonisation, optimisation of materials handling, energy efficiency (fleet) and energy efficiency (other). For each category, we have established minimum criteria for demonstrating best practice (refer Table 2).

Table 2: Minimum criteria for demonstrating compliance – best practice measures

Guideline reference	Category	Minimum criteria for demonstrating best practice
Best practice measures	Power generation	<ul style="list-style-type: none"> Electricity supply to Proposal should include large-scale (>10MW)³ renewable generation. Battery energy storage systems (BESS) systems should be considered for implementation as a minimum.
	Fleet decarbonisation	<ul style="list-style-type: none"> Clear evidence of engagement with supply chain to fast-track zero emissions vehicles. High-level narrative of expected timelines for implementation of zero emissions vehicles.
	Optimisation of materials handling	<ul style="list-style-type: none"> There should be clear evidence that alternate haul methods (conveyors, trolley-assist systems or other novel technologies) have been considered and/or implemented to optimise materials handling.
	Energy efficiency (fleet)	<ul style="list-style-type: none"> There should be clear evidence that measures have been considered and implemented to improve the fuel efficiency of the proposed diesel fleet.
	Energy efficiency (other)	<ul style="list-style-type: none"> There should be clear evidence that measures have been considered and implemented to improve the efficiency of non-fleet equipment and infrastructure.
	All categories	<ul style="list-style-type: none"> Best practice measures should be: <ul style="list-style-type: none"> specific linked to reduction or avoidance of emissions associated with the Proposal quantified.

Review of offsets strategy

In reviewing the offsets strategy in accordance with the requirements under the Guideline, Energetics considers two key elements within the GHG EMP, namely compliance with the 'offset integrity principles' and reasonable consideration of 'offset availability'. Table 3 outlines our approach in undertaking our expert review with respect to offsets, including specific elements within each criteria.

² The term "fleet" has been used throughout this report to refer to load and haul equipment. As such, it excludes light vehicles on site which would be included under "energy efficiency (other)".

³ Systems identified in peer GHG EMPs ranged from 30MW – 100MW.

Table 3: Minimum criteria for demonstrating compliance – carbon offsets

Guideline reference	Guideline requirements	Minimum criteria for demonstrating compliance
Offset integrity principles	<ul style="list-style-type: none"> • Offset selection for the purposes of the GHG EMP needs to consider 'offset integrity principles'. • Integrity principles under the Commonwealth Carbon Credits (Carbon Farming Initiative) (CFI) Act 2011 as well as the principles under the Climate Active Carbon Neutral Standard for Organisations, Commonwealth of Australia, 2022 can be used by way of guidance/reference in addressing this requirement (WA Environmental Protection Authority, 2023). • Domestic offsets under the Safeguard Mechanism, namely Australian Carbon Credit Units (ACCU) are deemed acceptable. • Voluntary offsets can be used to manage any residual emissions as long as they are consistent with offset integrity principles. • Whilst the Guideline does not prescribe specific voluntary offset types, given the Guideline's reference to Climate Active, the following international offsets could be considered as being eligible: <ul style="list-style-type: none"> ○ Certified Emissions Reductions (CERs) ○ Removal Units (RMUs) ○ Verified Emissions Reductions (VERs) ○ Verified Carbon Units (VCUs). 	<ul style="list-style-type: none"> • Specification of offset type(s), including domestic (i.e. ACCUs) or voluntary/international. • Specification of offset standard/program under which offsets are issued. • Consistency of the integrity principles for the nominated standard/program(s) and with integrity standards, which the EPA has a 'due regard', such as the CFI and Climate Active (Carbon Credits (Carbon Farming Initiative) Act 2011, 2011) (Climate Active, 2022). • Approach to undertaking offset due diligence and any 'quality' thresholds (e.g. vintage, permanence and co-benefits). Although, this is not explicitly required under the Guideline, this approach is considered prudent to manage any reputational / 'greenwashing' risks arising from selection of 'poor' quality offsets.
Offset availability	<p>Provision of details on whether selected offsets are likely to be 'reasonably' available at the time they are proposed to be surrendered.</p>	<ul style="list-style-type: none"> • Acknowledgement of potential future offset supply risks. • Outlining contingency measures to mitigate supply availability risks, including consideration of: <ul style="list-style-type: none"> ○ spot markets ○ hedging strategies ○ long-term offtake agreements ○ direct project investment ○ sourcing alternative class of offsets.

Review of pathways and milestones

To evaluate performance of the Proposal in this element of the Guideline, Energetics has undertaken a review of the targets and pathways established by relevant government agencies and industry bodies to identify relevant sector pathways and milestones⁴. The most relevant sector-specific milestone or pathways are currently:

- 2030 target: aligned with Safeguard Mechanism obligations
- 2050: net-zero: aligned with Federal commitments.

These pathways / milestones have been compared to any pathways and milestones identified within the Plan to determine whether the Plan is “consistent with, or outperforming those pathways”.

A detailed summary of the research findings is presented in Appendix A.

⁴ We have assumed that the pathways and milestones referenced in the Guideline refer to the iron ore mining industry.

3.0 Review of GHG EMP

3.1 Findings – best practice measures

Energetics has reviewed the measures proposed in the Plan against the criteria identified in Table 2. Our findings are detailed in Table 4.

Table 4: Review of the measures proposed in the Plan

Item	Category of best practice measure	Findings
1	Power generation	<p>The Plan provides clear evidence of how best practice measures are being adopted within the Pilbara Power Network (which is understood to supply all power to the Proposal). Measures adopted include:</p> <ul style="list-style-type: none"> • 12MWh battery energy storage system (BESS) (under construction) • 34MW solar PV system (under construction) and 100MW solar PV system (construction to commence 2024) • Commencement of a wind monitoring program to inform viability of wind generation in the Pilbara Power Network. <p>Implementation timeframes and expected emissions savings have been confirmed, at a portfolio (i.e. "Pilbara wide") level, for all measures.</p> <p>The Plan should specify the estimated emissions savings <i>at the Proposal</i> or provide a forecast of how the emissions intensity of the Pilbara Power Network is anticipated to decline over time. This will provide surety that the proposed renewable energy systems have sufficient capacity to guarantee emissions savings over the life of the Proposal. This information should be provided by no later than the First Ministerial Statement Annual Compliance Assessment Report (2025).</p>
2	Fleet decarbonisation	<p>The Plan provides evidence that the proponent is engaging with their supply chain to:</p> <ul style="list-style-type: none"> • support the commercialisation of zero emissions vehicles (electric haul trucks), including target dates for near-term trials, and • support the integration of biodiesel as a transition fuel with formal trials underway at an international Rio Tinto operation. <p>A high-level narrative of expected timelines for implementation has been confirmed at a portfolio (i.e. "Pilbara wide") level, including near-term trials.</p> <p>The Plan should specify the indicative implementation timeframes for these measures <i>at the Proposal</i>. This information should be provided by no later than the First Ministerial Statement Annual Compliance Assessment Report (2025).</p>
3	Optimisation of materials handling	<p>The Plan outlines the following <i>potential</i> best practice measure targeting the optimisation of materials handling:</p> <ul style="list-style-type: none"> • Road trains (in lieu of conventional haul trucks) to transport ore between Hope Downs 2 and the existing processing plant at Hope Downs 1.

Item	Category of best practice measure	Findings
		<p>Expected emissions savings and implementation timelines have been presented for this measure.</p> <p>While the emissions savings associated with this measure are significant, the Plan does not provide a clear strategy to decarbonise this class of vehicle. The Plan should include a strategy for decarbonising the road train fleet in line with commercially available technologies. This information should be provided by no later than the First Ministerial Statement Annual Compliance Assessment Report (2025).</p> <p>In addition to road trains, the Plan indicates that a 'mine plan optimisation process' is underway to reduce haul distances, minimise material rehandling and optimise haul truck movements (refer to 'mine design' in Table 3-8 of the Plan). Insufficient evidence is presented to demonstrate that this measure represents best practice, however. In order to demonstrate best practice, a list of Proposal-specific design decisions / measures should be provided, including the estimated emissions savings.</p>
4	Energy efficiency (fleet)	<p>The Plan references several measures aimed at improving the fuel efficiency of the proposed diesel fleet. Of the measures referenced, the following are considered to be best practice:</p> <ul style="list-style-type: none"> • Engine upgrades for existing haul fleet to improve efficiency • Procurement of fuel-efficient haul trucks • Procurement of fuel-efficient dig-units <p>Emissions savings have been quantified for these measures and implementation timeframes have been defined.</p> <p>The Plan states that "a number of opportunities exist and are under investigation" to reduce fleet emissions (refer to 'energy efficiency' in Table 3-8 of the Plan). Insufficient evidence is presented to demonstrate that these opportunities represent best practice however. Given the magnitude of emissions from fleet, and in order to demonstrate best practice, a list of Proposal-specific measures should be provided, including the estimated emissions savings.</p>
5	Energy efficiency (other)	<p>The Plan includes several measures targeting energy efficiency (other). Of the measures referenced, the following are considered to be best practice:</p> <ul style="list-style-type: none"> • Mains powered water supply bores <p>Emissions savings have been quantified for this measure and implementation timeframes have been defined.</p> <p>The Plan references two other measures targeting non-grid connected water supply bores, namely: 'variable speed generators (VSG) for water supply bores' and 'diesel generator plus battery powered bores'. A review of recent case studies suggests, however, that solar powered bore pumps represent best practice for remote bore systems (refer Table 7). As such, diesel-only water supply systems would not be considered best practice.</p> <p>In addition to the measures above, the Plan states that non-processing infrastructure and the 'construction camp' will be required to meet the Proponent's internal energy efficiency standards (refer to 'NPI and construction camp building designs' in Table 3-11 of the Plan).</p> <p>Although a range of potential best practice measures are outlined in the Plan (including LED lighting, high-efficiency HVAC systems and building passive design), insufficient evidence is presented to demonstrate best practice. In order to demonstrate best practice, a list of Proposal-specific measures should be provided, including the estimated emissions savings.</p>

3.2 Findings – offsets

Energetics have evaluated the offsets strategy described in the Plan against the Guideline and specific elements identified in Table 3, with findings detailed in Table 5.

Energetics notes that whilst the Plan applies the mitigation hierarchy, it indicates that the utilisation of offsets will be required to achieve emissions reductions targets.

Table 5: Review of GHG EMP offsets strategy

Item	Element of offsets strategy	Findings
6	Offset integrity	<p>The Plan outlines that, where offsets are required, ACCUs will be the preferred offset type. Further, Energetics notes that the Plan has been explicit in naming land based ACCUs (Environmental Planting, Savanna Burning and Human Induced Regeneration), which will be developed and/or sourced. Further, the Plan recognises the sunsetting of Human Induced Regeneration offsets and contemplates the future use of ACCUs from the Integrated Farm method instead (from Q4 2023).</p> <p>The use of ACCUs for future compliance is aligned with the Guideline's offset integrity requirements (i.e., as set out in the Commonwealth Carbon Credits (Carbon Farming Initiative) Act 2011). Further, the Plan does not include ACCU types (such as Avoided Deforestation), which are being phased out of Australia's Emissions Reduction Fund and unlikely to be deemed eligible under the Guideline (Clean Energy Regulator, 2023).</p> <p>The Plan has emphasised the use of 'high quality' offsets and does outline Rio Tinto's position to ensure its internal quality principles and assessment criteria (e.g., co-benefits, additionality and permanence) are aligned with International Carbon Reduction and Offset Alliance (ICROA).</p> <p>Although, not strictly required by the EPA, the Plan mentions Rio Tinto's 'vintage' criteria for offsets to be generated from 2018 onwards. This aligns with Climate Active's current requirement for all units to have a vintage year later than 2012 (Climate Active, 2023).</p> <p>The Plan could be enhanced by elaborating on due diligence activities conducted by Rio Tinto, such as ground-truthing, to ensure the sourcing of credible offsets. This is deemed important in light of the current market scrutiny, particularly in relation to international/voluntary market offsets.</p>
7	Offset availability	<p>There is recognition in the Plan that a multi-pronged approach may be required in securing sufficient offsets and to avoid offset shortfalls.</p> <p>The Plan clearly outlines multiple procurement models to manage supply risks, including direct investment in nature-based solutions, co-investment and long-term offtake arrangements. Further, Energetics notes that the Plan also identifies a ramp up in commercial activity to secure offsets.</p> <p>The Plan would benefit from some indication on targets and timelines associated with the development of nature-based solutions at or near Rio Tinto sites.</p>

3.3 Findings – pathways and milestones

Table 6 outlines key findings from the review of pathways and milestones in the Plan.

Table 6: Review of GHG EMP pathways and milestones

Item	Sector-specific pathway / milestone	Finding
8	Findings on whether the Plan is consistent with the relevant sector-specific pathways and milestones	The emissions reduction targets presented in the Plan (50% reduction by 2030, net zero by 2050) exceed the relevant sector pathways and milestones, as established in our research (refer Section 2.3 and Appendix A). Table 4-1 of the Plan outlines the approach to achieving compliance with the requirements of the Safeguard Mechanism.

3.4 Conclusion

The Plan outlines a wide range of measures to reduce emissions associated with the Proposal. Of the measures outlined, the following are considered to be best practice:

- Power generation: 12MWh battery energy storage system (BESS) and two large-scale solar PV systems (34MW and 100MW) to be integrated into the Proponent’s “Pilbara Power Network”
- Fleet decarbonisation: supply chain engagement to support the commercialisation of zero emissions vehicles (electric haul trucks) and integration of biodiesel as a transition fuel
- Energy efficiency (fleet): engine upgrades for existing haul trucks to improve efficiency and procurement of new high-efficiency haul trucks and dig units
- Energy efficiency (other): mains powered water supply bores.

The following recommendations should be incorporated into the Plan by no later than the first Ministerial Statement Annual Compliance Assessment Report (2025):

- BESS and solar PV projects: The Plan should quantify the estimated emissions savings at the Proposal or provide a forecast of how the emissions intensity of the Pilbara Power Network is anticipated to decline over time.
- “Zero emissions haul truck fleet” and “biofuels for Heavy Mining Equipment”: The Plan should specify a Proposal-specific implementation timeline for both measures.
- “Use of road trains instead of haul trucks”: The Plan should include a strategy for decarbonising the road train fleet in line with commercially available technologies.

Regarding the use and selection of carbon offsets, the Plan is clear about its approach for ensuring offset integrity by opting to only use ACCUs, which by definition are compliant with the Guideline’s offset integrity requirements (i.e., as set out in the Commonwealth Carbon Credits (Carbon Farming Initiative) Act 2011) and the principles in the Climate Active Carbon Neutral Standard for Organisations (Climate Active, 2022).

In terms of offset availability, there is sufficient recognition in the Plan that a multi-pronged approach may be required in securing sufficient offsets to manage supply risks. The Plan would benefit from some indication on targets and timelines associated with the development of nature-based solutions at or near Rio Tinto sites.

The targets presented within the Plan suggest that the Proposal will meet relevant sector pathways and milestones.

Appendix A: Research findings

Best practice measures

Energetics has reviewed publicly available GHG EMPs for iron ore proposals in Western Australia to identify the measures that have been implemented, considered, or planned at comparable mine site operations and which, by consequence, are considered to represent best practice. The following GHG EMPs were included in our research:

- FMG Iron Bridge – North Star Magnetite Project (July 2022) (FMG Iron Bridge, 2022)
- Roy Hill Iron Ore Mine – Revised Proposal (November 2020) (Roy Hill, 2020)
- Rio Tinto – Greater Paraburdoo Iron Ore Hub (April 2022) (Rio Tinto, 2022)
- Atlas Iron – McPhee Creek (April 2022) (Atlas, 2022)
- BHP – Newman Hub (Western Ridge) (January 2023) (BHP, 2023).

In addition to the GHG EMPs mentioned above, Energetics reviewed a range of other sources to assist in supporting the conclusions drawn from the GHG EMPs. These included:

- government and industry reports focussed on decarbonisation of the mining sector
- case studies of measures adopted at other mining operations.

Table 7 provides a summary of our research findings.

Table 7: Summary of research findings – best practice measures for avoiding or reducing emissions in iron ore mining operations

Category	Elements of best practice from peer GHG EMPs	Conclusions from independent reports	Case studies
Power generation	<ul style="list-style-type: none"> Power supplies include approved, large-scale⁵ renewable power generation. Implementation schedules provided (Rio Tinto, 2022; FMG Iron Bridge, 2022; Roy Hill, 2020). Battery energy storage systems (BESS) considered or implemented with indicative implementation timeframes stated (Rio Tinto, 2022; FMG Iron Bridge, 2022). Emissions abatement quantified in all cases (Rio Tinto, 2022; FMG Iron Bridge, 2022; Roy Hill, 2020) (BHP, 2023). Measures linked to reduction or avoidance of emissions at proposal level (Rio Tinto, 2022; FMG Iron Bridge, 2022; Roy Hill, 2020) (BHP, 2023). 	<ul style="list-style-type: none"> Renewable power generation systems (wind and solar PV) considered commercially and technically ready (Roy Hill, 2020). Electro-chemical battery storage systems considered commercially and technically ready (Roy Hill, 2020). 	<ul style="list-style-type: none"> Sandfire Resources – DeGrussa Copper Mine (WA): 10.6MW solar PV power plant, completed 2016 (DeGrussa Solar Project Pty Ltd, 2022). Gold Fields – Agnew, Granny Smith and Gruyere gold mines (WA): total of 18MW wind, 25MW solar PV and 19MW BESS implemented across operations, completed 2020-2022 (Government of Western Australia - Department of Mines, Industry Regulation and Safety, 2022).
Fleet decarbonisation	<ul style="list-style-type: none"> Active engagement with original equipment manufacturers (OEMs) to fast-track commercialisation of zero emissions vehicles (Rio Tinto, 2022) (BHP, 2023). High-level narrative of when diesel vehicles will be displaced at the proposal and estimated abatement provided (Rio Tinto, 2022) (BHP, 2023). Measures linked to reduction or avoidance of emissions at proposal level (Rio Tinto, 2022) (BHP, 2023). 	<ul style="list-style-type: none"> Zero-emissions vehicles have not achieved technical or commercial readiness. Significant work is being undertaken with expected displacement of diesel vehicles over the next 10 years (Trove Research and University College London, 2021). 	<ul style="list-style-type: none"> Anglo American Platinum – Mogalakwena platinum mine (South Africa): trial of 300t zero-emissions haul truck (hydrogen fuel cells and batteries). Over 1,200 hrs of operation since May 2022 (First Mode, 2023).

⁵ Systems identified ranged from 30MW to 100MW

Category	Elements of best practice from peer GHG EMPs	Conclusions from independent reports	Case studies
Optimisation of materials handling	<ul style="list-style-type: none"> • Feasibility studies into the use of conveyors as a means of displacing diesel fleet vehicles (FMG Iron Bridge, 2022) (Roy Hill, 2020) (BHP, 2023). • Feasibility studies into the use of trolley-assist systems as a means of displacing diesel fleet vehicles (Roy Hill, 2020) (BHP, 2023). • Measures linked to reduction or avoidance of emissions at proposal level (FMG Iron Bridge, 2022) (BHP, 2023). 	<ul style="list-style-type: none"> • “Conveyor belt systems have been shown to be significantly more energy efficient in transporting materials than haul trucks, using about 20% of the energy required by heavy-duty trucks” (Rio Tinto, 2022) • Trolley-assist systems considered technically and commercially ready (Roy Hill, 2020). 	<ul style="list-style-type: none"> • Boliden Kevitsa mine (Sweden): 13 x 227t haul trucks converted to operate partially with trolley assist; trial commenced in 2022 • Copper Mountain Mining Corporation (Canada): One kilometre trolley-assist haul ramp and seven pantograph-equipped Komatsu 830E-5 electric haul trucks adopted (Moore, n.d.).
Energy efficiency (fleet)	<ul style="list-style-type: none"> • Several measures considered and implemented to improve the efficiency of diesel vehicles (including fuel additives, lightweight truck trays and vehicle engine tuning) (Roy Hill, 2020). • Implementation timeframes and estimated abatement specified (Roy Hill, 2020). • Descriptions of measures are specific and detailed (Roy Hill, 2020). • Measures linked to reduction or avoidance of emissions at proposal level (Roy Hill, 2020). 	<ul style="list-style-type: none"> • A wide range of potential measures identified, including the use of biodiesel (Rocky Mountain Institute), payload management, driver training, optimising mine design and the use of lightweight truck trays (Department of Foreign Affairs and Trade, 2016). 	<ul style="list-style-type: none"> • FMG Chichester operations (WA): diesel savings in excess of 350kL/yr associated with modelling and optimisation of haul road design (Department of Foreign Affairs and Trade, 2016). • Remote Energy’s ‘Eco-Drive’ APU system maintains operation of air conditioner and critical systems, allowing for the shutdown of haul truck engines when stationary (Remote Energy, n.d.).
Energy efficiency (general)	<ul style="list-style-type: none"> • Several measures considered and implemented to reduce scope 2 emissions associated with ancillary systems and site infrastructure, including LED lighting selection, smart lighting controls (daylight sensors, motion detection, timers), solar powered lighting towers and the use of variable speed drives (Rio Tinto, 2022). • No examples of energy efficiency measures were identified to reduce scope 2 emissions associated with processing plant. 	<ul style="list-style-type: none"> • Wide range of potential measures available to improve energy efficiency across mining operations. Measures identified include: improvements to site buildings (optimisation of HVAC systems, improved building thermal characteristics), lighting design improvements (installation of LED lighting, smart lighting controls), optimisation of dewatering systems, improvements to mobile lighting controls and optimisation of processing circuits. 	<ul style="list-style-type: none"> • RTIO – Hope Downs 4 (WA): trial of a UON-supplied solar powered dewatering system with diesel power for backup only (UON, 2023) • Northern Star – WA mine site: solar powered bore pump for remote dewatering (98kW solar, 104kWh BESS) (UON, 2023) • Our research identified a wide array of solar lighting towers suitable for mining applications

Category	Elements of best practice from peer GHG EMPs	Conclusions from independent reports	Case studies
			(PR Power, n.d.; Blue Diamond Machinery, n.d.).

Based on our research, abatement measures have been grouped into five broad categories: power generation, fleet decarbonisation, optimisation of materials handling, energy efficiency (fleet) and energy efficiency (other). For each category, we have established minimum criteria for demonstrating best practice (refer Table 8). In establishing these criteria, Energetics have avoided being overly prescriptive, noting that specific measures which are suitable for one mining operation may not be suitable for implementation at another mining operation.

Table 8: Minimum criteria for demonstrating compliance – best practice measures

Category	Minimum criteria for demonstrating best practice
Power generation	<ul style="list-style-type: none"> Electricity supply to proposal should include large-scale⁶ renewable generation. Battery energy storage systems (BESS) systems should be considered for implementation as a minimum.
Fleet decarbonisation	<ul style="list-style-type: none"> Clear evidence of engagement with supply chain to fast-track zero emissions vehicles. High-level narrative of expected timelines for implementation of zero emissions vehicles.
Optimisation of materials handling	<ul style="list-style-type: none"> There should be clear evidence that alternate haul methods (conveyors, trolley-assist systems or alternate novel technologies) have been considered and/or implemented to optimise materials handling. As this project is considering using a novel approach to materials handling in the form of road trains, best practice would be substantive evidence that they will be decarbonising the road train fleet in line with commercially available technologies.
Energy efficiency (fleet)	<ul style="list-style-type: none"> There should be clear evidence that measures have been considered and implemented to improve the fuel efficiency of the diesel fleet proposed.
Energy efficiency (general) ⁷	<ul style="list-style-type: none"> There should be clear evidence that measures have been considered and implemented to improve the efficiency of non-fleet equipment and infrastructure (excluding processing plant).

⁶ Systems identified in peer GHG EMPs ranged from 30MW – 100MW.

⁷ Note that no examples of energy efficiency measures were identified to reduce scope 2 emissions associated with processing plant.

Category	Minimum criteria for demonstrating best practice
All categories	<ul style="list-style-type: none"> • Best practice measures should be: <ul style="list-style-type: none"> ○ specific ○ linked to reduction or avoidance of emissions at the proposal ○ quantified.

Pathways and milestones

Table 9 below outlines all of the domestic and global sector-specific pathways and milestones identified which are relevant to the Plan.

Table 9: Pathways and milestones relevant to iron ore mining

Pathway/milestone reviewed	Targets	
Australian Government targets	Interim target of 43% reduction by 2030 and net zero by 2050 (Department of Climate Change, Energy, the Environment and Water, 2023).	Australia's interim target was legislated in September 2022. The primary mechanism for achieving this target is the Safeguard Mechanism which was reformed in early 2023 and commenced on 1 July 2023. The reformed legislation imposes linear annual baseline reductions and requires facilities to achieve industry average emissions intensity by FY30. The exact decline rate will vary depending on an organisation's individual circumstances (e.g. financial performance, whether the organisation is an emissions-intensive trade-exposed entity) ⁸ .
Western Australian Government targets	Net zero by 2050 ⁹ (Department of Water and Environmental Regulation, 2022).	The Western Australian Climate Policy, issued in 2020 confirms the government's commitment to "adapting to climate change and working with all sectors of the economy to achieve net zero greenhouse gas emissions". No interim emissions target (applicable to Western Australian industry) has been announced by the State Government ¹⁰ .
Minerals Council of Australia	Net zero by 2050 (Minerals Council of Australia, 2021).	The Minerals Council of Australia has "confirmed the industry's ambition to achieve net zero emissions by 2050". No commitment to an interim target has been declared.

⁸ Under the reformed Safeguard Mechanism, the decline rate varies between a minimum of 1% and a maximum of 4.9%.

⁹ No interim target announced, however development of sectoral emissions reduction strategies expected to be completed in 2023 (Department of Climate Change, Energy, the Environment and Water, 2023)

¹⁰ The state government has commenced a project to "develop sectoral emissions reduction strategies". This work is expected to be completed in late 2023.

Pathway/milestone reviewed	Targets	
International Council for Mining and Metals (ICMM)	Net zero by 2050 (International Council on Mining & Metals, 2021)	The ICMM note "we collectively commit as members of the International Council on Mining and Metals (ICMM) to a goal of net zero Scope 1 and 2 greenhouse gas (GHG) emissions by 2050 or sooner in line with the ambitions of the Paris Agreement."

Based on the findings in Table 9, the most relevant sector-specific milestone or pathway is currently:

- 2030 target: aligned with Safeguard Mechanism obligations
- 2050: net-zero aligned with Australian Federal commitments.

Appendix B: References

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