Lithium Hydroxide Refinery Project

covalent LITHIUM

Greenhouse Gas Management Plan

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Covalent Lithium

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February 2021

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Defined terms

Term / Abbreviation	Defined as meaning:
CER	Clean Energy Regulator
CIF	Community Information Forums
Covalent	Covalent Lithium
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DBS	De-lithiated beta spodumene
EFG	*Environmental Factor Guideline – Greenhouse Gas Emissions* (2020).
EMP Instructions	*Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (2020)
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EV	Electric Vehicle
GEMS	Greenhouse and Energy Minimum Standards
GHG	Greenhouse gas
GHGMP	Greenhouse Gas Management Plan
GWP	Global Warming Potential
ha	Hectares
ICEV	Internal Combustion Engine Vehicle
Kt	Thousand tonnes
LiOH	Lithium Hydroxide

Term / Abbreviation	Defined as meaning:
MCCs	Motor control centres
Mt	Million tonnes
NGER Act	*National Greenhouse Energy Reporting Act 2007* (Cth)
NGER	National Greenhouse and Energy Reporting
Scope 1 emission	Direct GHG emissions released to the atmosphere onsite as a direct result of an activity, or series of onsite activities at a facility level.
Scope 2 emission	The GHG emissions released to the atmosphere offsite from the indirect consumption of an energy commodity.
Scope 3 emission	The GHG emissions other than scope 2 emissions that are generated in the wider economy. They occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facility's business.
SWIN	South West Interconnected Network
SWIS	South West Interconnected System
t CO_2e	Tonnes of carbon dioxide equivalent
t CO_2e pa	Tonnes of carbon dioxide equivalent per annum
tpa	Tonnes per annum
VSD	Variable speed drive
WA	Western Australia

1 Summary

Covalent Lithium Pty Ltd (**Covalent**) has developed this Greenhouse Gas Management Plan (**GHGMP**) for the purpose of supporting the assessment, approval and implementation of its proposed battery grade lithium hydroxide refinery in Kwinana (**Refinery**) under Part IV of the *Environmental Protection Act 1986* (WA) (**EP Act**) (**Proposal**). The Refinery is currently being assessed by the Western Australian Environmental Protection Authority (**EPA**) by way of Assessment on Referral Information.

A Part IV assessment has been required by the EPA on the basis that the predicted emissions of the Refinery will exceed the 100,000 tonne carbon dioxide equivalent (**CO_2e**) emissions threshold for Scope 1 emissions per annum as outlined in the EPA's *Environmental Factor Guideline – Greenhouse Gas Emissions* as published in April 2020 (**EFG**).

The Refinery is part of the integrated Mount Holland Lithium Project (**Project**), which consists of a spodumene mine and concentrator operation based near Southern Cross in Western Australia and the Refinery which is to be located in the Kwinana strategic Industrial Area.

The lithium hydroxide that the Refinery will produce is an integral component of renewable energy technologies, electric vehicles (**EV**) and the emerging 'clean energy' green economy. The Refinery is expected to produce 50,276 tonnes per annum of lithium hydroxide on a nominal basis, which is enough raw material to manufacture lithium-ion batteries for up to approximately 1.1 million passenger EV. Based on this assumption, the lithium hydroxide produced at the Refinery may assist in reducing global emissions by over 1,600,000 tonnes per annum of CO_2e greenhouse gases (**GHG**), this equates to a reduction of more than 80 million tonnes of CO_2e over the life of the Proposal, which is achieved through the displacement of internal combustion engine vehicles (**ICEV**). This figure is expressed on a net basis, with the Refinery itself expected to generate less than one third of these emissions saved. This potential to reduce GHG emissions is set to increase given the significant commitments provided by Covalent in this GHGMP to reduce and/or offset its emissions at the Refinery and will further increase if the State Government fulfils its stated intention to reduce the emissions intensity for grid electricity in the future.

Covalent will manage the operation of its Refinery in a manner that is consistent with the EFG, this GHGMP and Covalent's objective of ensuring it limits its CO_2e emissions to as low as reasonably practicable using commercially viable options.

The expected GHG emissions of the Refinery have already been minimised prior to construction through smart design and selection of efficient equipment and technologies. Some of the technologies chosen by Covalent are novel and have not yet been used commercially within the lithium industry, however Covalent has selected these for their potential to significantly reduce energy consumption and consequently GHG emissions. At the time of writing, Covalent's equipment selection is expected to allow the Refinery to have the lowest initial Scope 1 and Scope 2 GHG emissions intensity for a spodumene refinery in the world.

This GHGMP has been developed in accordance with the *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (2020) (**EMP Instructions**) and the EFG, in consultation with the EPA.

A brief description of the Refinery proposal is given in Table 1 below.

Table 1 – Summary

Proposal name	Lithium Hydroxide Refinery Project
Proponent name	Covalent Lithium
Purpose of GHGMP	• To support the assessment, approval and implementation of the Proposal under Part IV of the EP Act. • The Refinery is being assessed by the EPA under Part IV EP Act. Covalent expects implementation of the Proposal to be subject to the conditions of a Ministerial Statement, including in respect to GHG emissions. • This GHGMP has been developed in accordance with the EMP Instructions and the EFG. • This GHGMP has also been developed to be consistent with the requirements of the Western Australian *Government's Greenhouse Gas Emissions Policy for Major Projects* (August 2019), which is designed to guide State Government decision making for major projects that are assessed by the EPA. • To assist SQM and Wesfarmers to meet their announced intentions to significantly reduce their respective GHG emissions. Wesfarmers has announced its intention to reduce to zero its net Scope 1 and 2 emissions by 2050 and SQM has announced its intention to become carbon neutral in lithium products by 2030.
Key environmental factor/s and objectives	**Key environmental factor:** Greenhouse Gas Emissions **EPA Objective:** To reduce net GHG emissions in order to minimise the risk of environmental harm associated with climate change. **GHGMP objective:** To reduce and mitigate GHG emissions to as low as reasonably practicable.
Proposal benefits [1]	The Part IV EPA Act environmental approval of the Refinery will trigger the full funding of the Project by Wesfarmers and SQM. Proceeding with the investment will deliver the following key benefits: • The Project, in addition to allowing the reduction of at least 1,600,000 tonnes per annum of CO_2e- GHG through the manufacture of EV, is also expected to create over 1,000 jobs during construction (at peak manning) and over 350 jobs during the operational phase. • The Project, including the Refinery, will have significant economic benefits for the State of Western Australia over its multi-decade mine life and associated significant royalties payment contributions expected to be made.

[1] Covalent recognises the potential for economic information to be determined as outside the remit of the EPA's consideration, in which case Covalent acknowledges and accepts the information would not be evaluated within the EPA's assessment of Covalent's GHGMP. Notwithstanding this, the information is provided on the basis this is a public document, and high-level information relating to the economic benefits of the project will be of general public interest to some readers.

	• The Project will support global efforts to decarbonise and enable more effective utilisation of renewable energy. The Proposal delivers this benefit through the supply of battery-grade lithium hydroxide, which is an essential commodity required to produce rechargeable lithium-ion batteries. • As demonstrated through benchmarking, favourable GHG emissions intensity[2] compared to Australian and global spodumene refineries. • As the first battery-grade lithium hydroxide refinery to be assessed under the EPA's EFG, transparent and leading practice management of GHG emissions through the GHGMP.
Key provisions of the GHGMP	In this GHGMP, Covalent commits to: • reduce or offset its Scope 1 CO_2e emissions to below 100,000 tonnes of CO_2e per annum within 10 years of commencing operations at the Refinery, through continuous improvement or the purchase of carbon offsets; and • support the Western Australian State Government's aspirational target outlined in the EFG to achieve net zero Scope 1 CO_2e emissions by 2050.

Covalent will also ensure that its reporting requirements and obligations under the Commonwealth NGER Act are met.

2 Context, Scope and Rationale

The Refinery, as part of the broader Project, will have the capacity to produce 50,276 tpa of battery-grade lithium hydroxide monohydrate on a nominal basis. This product is for export into the global market and will play a significant role in assisting to reduce GHG emissions on a global scale.

While the expected emissions of the Refinery have already been minimised upfront through the design and selection of modern, efficient technologies, there will still be residual GHG emissions that are an inevitable result of the lithium hydroxide refining process.

Covalent's GHGMP demonstrates that all reasonable, practicable and commercially viable measures have been, and will continue to be, applied to minimise anticipated residual GHG emissions.

GHG emissions arising during the construction phase of the Refinery are entirely represented by Scope 1 emissions from the combustion of diesel for stationary purposes. Once the Refinery is built, operational GHG emissions will be largely attributable to the consumption of grid electricity (Scope 2 emissions) and the combustion of natural gas for steam generation and calciner firing (Scope 1 emissions).

GHG reduction measures have been identified for both the construction and operation phases of the Refinery. In summary, these include measures related to the careful selection of fuel and energy sources, plant process and technology in order to maximise energy efficiency and minimise GHG emissions. Covalent will adopt a continual improvement approach to GHG emissions reduction and look for opportunities to optimise the emissions profile of the Refinery over its life.

[2] Scope 1 and Scope 2

Through the management principles and actions outlined in section 3 of this GHGMP, Covalent commits to:

- reduce or offset its Scope 1 CO_2e emissions to below 100,000 tonnes of CO_2e per annum within 10 years of commencement of operation at the Refinery through continuous improvement or carbon offsets; and
- support the Western Australian State Government's aspirational target outlined in the EFG to achieve net zero Scope 1 CO_2e emissions by 2050.

2.1 The Green Economy

The Paris Agreement and the Intergovernmental Panel on Climate Change 1.5 Report recommends a global target of net zero emissions by 2050. This recommendation has been acknowledged by the Western Australian State Government and the EPA in the EFG. The EFG requires proponents to demonstrate their contribution towards the aspiration of net zero emissions by 2050. This GHGMP demonstrates Covalent's contribution towards the wider societal aspiration to enable this emission reduction target to be met.

It is widely recognised that lithium is an essential component required to reduce societal reliance on carbon fuel sources. Wider application and adoption of lithium-ion battery storage technology is essential to help mitigate the effects of global climate change through its ability to enable the storage of renewable energy on a large scale.

The Refinery plays an important role in the emerging global 'green economy' which seeks to support initiatives to reduce GHG emissions. The Refinery is expected to produce enough battery grade lithium hydroxide to reduce vehicle emissions globally by more than 1.6 million tonne of CO_2e per annum (which is equivalent to a reduction of more than 80 million tonne of CO_2e over the life of the Project) by displacing existing ICEV. This expected net global reduction has the potential to grow further beyond these parameters as electricity grids are expected to progressively decarbonise with take up of renewable energies.

The reduction in downstream Scope 3 emissions are an important consideration, however have been excluded in reporting the Refinery's projected emissions to align with the EFG. To that end, the availability of lithium and its application in the storage of clean energy and downstream use in transportation (e.g. EV) is essential to support Scope 3 emission reductions globally. The availability and price competitiveness of lithium are fundamental drivers required to facilitate a global change in consumer behaviour towards renewable energy and EV.

The concentration and refinement of lithium hydroxide is a necessary process in order to achieve these goals, with refining currently being the only commercially proven method of producing lithium hydroxide from spodumene on a large scale. Using current technologies, this process necessarily requires the consumption of significant volumes of energy (in the form of natural gas) in order to achieve the high temperatures required for refining. The production of some CO_2e- emissions is therefore an unavoidable part of the refining process for lithium hydroxide and, as with other green technologies such as solar panels and wind turbines, is necessary to achieve a much greater reduction in CO_2e- emissions globally.

Further, the establishment of downstream lithium hydroxide refining capacity in Australia which utilises the latest technology available will contribute to driving a lower global emissions intensity within this growing sector.

2.2 The Proposal

The broader Project is a joint venture between subsidiaries of Wesfarmers Ltd (**Wesfarmers**) and Sociedad Quimica y Minera de Chile S.A (**SQM**) which encompasses the development of the Mine and Concentrator and the Refinery (**Joint Venture**).

SQM is one of the biggest lithium producers in the world and Wesfarmers, a leading Australian listed company, has significant expertise in chemical processing within the

Wesfarmers Chemicals, Energy and Fertilisers division. Covalent is the joint venture management company responsible for the development and operation of the Project for and on behalf of the Joint Venture.

Spodumene is mined and concentrated at the Mt Holland operation, with spodumene concentrate then transported to the Refinery for conversion into high-purity, battery grade lithium hydroxide monohydrate. The Refinery will have a nominal capacity to produce 50,276 tpa of battery grade lithium hydroxide monohydrate for export to the global market.

The Mt Holland spodumene concentrate is proposed to be transported in enclosed transport containers to the Refinery in Kwinana. Following processing, the finished product (lithium hydroxide) will be stored, bagged, and then transported via truck from the Refinery to Fremantle Port for export. The loading facilities will be enclosed to prevent dust emissions.

The Refinery will process spodumene ore concentrate (containing approximately 5.5% lithium expressed as Li_2O on dry basis), via pyrometallurgical and hydrometallurgical unit operations. Further technical detail in respect of the initial concentrate processing and lithium hydroxide production stages that will be undertaken by the Refinery are described below in Table 2.

Table 2 – Technical process by area of Refinery

Area of Refinery	Description of process
Initial Concentrate Processing	
Calcination Area	The spodumene concentrate ore is received and calcined in a rotary calciner. This calcination converts the alpha-spodumene to the reactive beta-spodumene form. The calcined spodumene is cooled in a rotary cooler using cooling water and is sent to the Acid Roast Area.
Acid Roast Area	The calcined spodumene is mixed with sulfuric acid and roasted in a rotary calciner to sulphate the beta-spodumene. The sulphated spodumene is then cooled in a rotary cooler.
Leaching Area	The sulphated calcine is transferred to the Leaching Area where the sulphated spodumene leaches into the process liquor. Following the leach, the slurry is pH adjusted. The neutralised slurry is filtered. The residue solids are sent back to Mt Holland for disposal, while the filtrate is fed to the Neutralisation and Purification Area.
Neutralisation and Purification Area	The filtrate is fed to a reactor tanks to remove trace impurities such as magnesium and calcium via precipitation to inert form and additional filtration. The filter filtrate goes directly to the Ion Exchange Area.

Area of Refinery	Description of process
Ion Exchange Area	Trace impurities are removed from the filtrate using ion exchange columns. The resulting purified liquor solution is sent to the Causticisation Area.
Lithium Hydroxide Production Stage	
Causticisation Area	The solution is mixed with sodium hydroxide to convert lithium sulphate to lithium hydroxide, and sodium hydroxide to sodium sulphate. The resulting lithium hydroxide liquor is fed to the Glauber’s Salt Crystallisation Area.
Glauber’s Salt Crystallisation Area	In this area, the solution enters into a crystalliser to produce Glauber’s Salt (which is a hydrated form of sodium sulphate). The salt is then transferred to the next centrifugation stage.
Glauber’s Centrifugation Area	The Glauber´s salt is dewatered in a centrifuge, with the cake material being directed to the Sodium Sulphate Crystallisation Area, while the concentrate is separated and sent to the Crude Lithium Hydroxide Crystallisation Area.
Crude Lithium Hydroxide Crystallization Area	Lithium hydroxide monohydrate is crystallised in a crystalliser. The crystal slurry dewatered in a centrifuge, with the centrate liquor being recycled back to causticisation, while the product solids discharge is fed on a conveyor to the Pure Lithium Hydroxide Crystallisation Area.
Pure Lithium Hydroxide Crystallisation Area	Lithium hydroxide monohydrate crystals are re-precipitated using a crystalliser. The slurry is dewatered in a centrifuge, while lithium hydroxide monohydrate crystals are sent to the Lithium Hydroxide Drying Area.
Lithium Hydroxide Drying and Bagging Area	The lithium hydroxide monohydrate is dried and then later bagged. The dried solid product is conveyed in sealed systems, packaged, and stored prior to it being containerised before export.
Sodium Sulphate Crystallisation Area	The previously formed Glauber’s Salt is transferred to another crystalliser. Sodium Sulphate is produced and dewatered in a

Area of Refinery	Description of process
	centrifuge. The product is sent to the Sodium Sulphate Drying and Bagging Area.
Sodium Sulphate Drying and Bagging Area	The sodium sulphate is packaged. The dried solid product is conveyed in sealed systems, packaged, and stored prior to it being containerised before export.

Construction of the Refinery is anticipated to commence in 2021, with operations due to commence in financial year 2025.

The Refinery will be located at Lot 15 Mason Road, being Crown Land zoned for industrial land use under the City of Kwinana Town Planning Scheme (TPS) No. 2, as shown in Figure 1 below.

Figure 1 – Refinery location

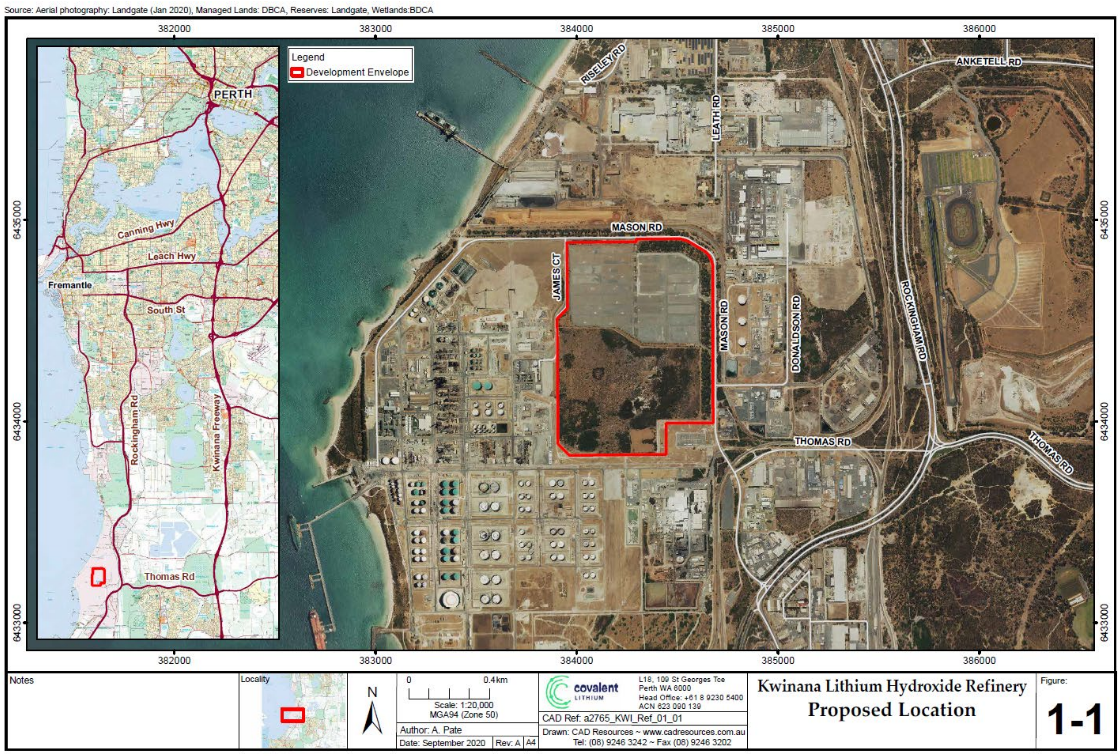


Table 3 below presents the key characteristics of the Proposal.

Table 3 – Summary of the Proposal

Element	Proposed extent
Physical elements	
Lithium refinery and associated infrastructure including: • pyrometallurgical, water leaching, separation and crystallisation processing plant; • product and secondary refinery co-product outputs drying and storage facilities; • dangerous goods storage; • containment infrastructure; and • on-site laboratory.	No clearing proposed. Clearing of no more than 11.2 ha of vegetation within a 76 ha Proposal DE.
Services corridor for the installation / connection of: • 132 kV cable; • natural gas pipeline; • water pipeline; • wastewater pipeline, and • reagent pipelines from neighbouring industries.	Clearing of no more than 11.2 ha of vegetation within the 76 ha Proposal DE.
Utilities corridor for the installation / connection of: • overhead power line; and • underground gas pipeline.	No substantive clearing will be required for the utilities corridor.
Laydown area	Disturbance of no more than 11.2 ha of vegetation within a 76 ha Proposal DE.
Treatment of refinery process wastewater (liquid effluent and water treatment salt) prior to disposal to the SDOOL.	Treatment of up to approximately 252ML pa.

2.3 Estimated GHG emissions

The concept of accounting for life cycle GHG emissions has well established methodologies. A high-level summary of the methodology used in the assessment of estimated GHG emissions associated with the Refinery is provided below:

- Various considerations accounting for GHG emissions due to process variability were applied. This need arose due to specific process requirements which are necessary to accommodate a continuous-processing scheme as well as the bespoke nature of the Refinery design.

- For Scope 1 emissions, an energy and carbon-balance of all GHG related quantities in and out of the Refinery was performed.
- For Scope 2 emissions, a power demand was established based on equipment lists and expected power requirements.
- To quantify carbon dioxide equivalents, appropriate CO_2e intensity factors have been used. These factors have been used to multiply the source quantity which is in turn applied to determine the amount of GHG produced.
- Global Warming Potential (**GWP**) index for CO_2 emissions have an assumed index value of 1.0.
- The GWP indices for all other GHGs are a number of times higher in warming potential when compared to CO_2 (e.g., nitrous oxide = 265, methane = 25). Given Covalent has selected modern generation burner control equipment which it regards as best in the lithium refining sector in terms of its fuel usage and energy efficiency, Covalent's GHG emissions analysis assumes significant amounts of nitrous oxide and/or fugitive emissions of unburnt methane do not occur.

An estimate of Scope 1 and 2 emissions for the Refinery is provided in this section.

The reduction in downstream Scope 3 emissions associated with the renewable energy applications for battery grade lithium hydroxide, as described above at 2.1, are an important benefit inherent in the Proposal. However, these reductions have been excluded from the assessment of estimated GHG emissions for the Refinery in order to align with the EFG and contemporary emissions estimation methodologies.

Covalent recognises that GHG emission estimates are likely to change over the life of the Refinery, which has informed the development of estimated GHG emission projections and the implementation of this GHGMP. These estimates will be revised during the 5-year GHGMP review.

Estimated GHG emissions for the Refinery are grouped broadly into GHG emissions associated with the 2 key phases of the Proposal, being:

1. construction; and
2. operation of the Refinery.

GHG emissions associated with each phase have then been assessed by source, which include:

- electrical power;
- natural gas and reagents;
- transportation;
- energy transformation; and
- changes to land use.

On-site renewable energy options for the Refinery were not feasible due to the constrained size of the lot. Further, renewable options could not provide power sufficient to heat the calciner to the required temperature (over 1,000 degrees C).

The estimated GHG emissions arising from the construction and operational phases are set out in the tables at 2.3.1 and 2.3.2 below.

Target emissions intensity (emissions per unit of production) for the Refinery are set out in Table 6 below. Various relevant industry benchmarks were considered in the assessment of estimated GHG emissions, these are listed in Table 7 – Benchmark CO_2e emissions intensity.

The Refinery's estimated operational GHG emissions have been assessed against its nominal capacity. The projected Refinery capacity used in the assessment of estimated GHG emissions are set out in Table 4 below.

Table 4 – Projected Refinery capacity

Projected Refinery capacity	
Project life [3]	40 years
Spodumene ore concentrate as a refinery feed intermediate	**Nominal capacity (average)** **Tonnes dry per day**
	1,049
Refinery product **Expressed in Lithium Carbonate Equivalent (LCE)**[4]	121

In summary, the outcomes of the GHG emissions assessment are:

- GHG emissions from the construction phase of the Refinery are entirely represented by Scope 1 emissions, which are associated with the combustion of diesel for stationary purposes.
- GHG emissions from the operational phase, once the Refinery is constructed, are largely attributed to the consumption of grid electricity (Scope 2 emissions) and the combustion of natural gas for steam generation and calciner firing (Scope 1 emissions).
- In relative terms, the construction phase emissions are a minor percentage of the emissions arising from the annual operation of the Refinery.
- Predicted GHG emissions from the initial annual operation of the Refinery compares favourably to relevant benchmarks.

2.3.1 Construction GHG emissions – predicted baseline

Construction GHG emissions comprise solely Scope 1 emissions from the combustion of diesel for stationary purposes.

[3] Many factors influence the life of the refinery operation, including future recovery and grade of the spodumene concentrate received.

[4] 1 tonne LCE is equivalent to 0.88 tonne Lithium hydroxide monohydrate.

Table 5 – Refinery construction GHG emissions estimates

Refinery Construction GHG emissions estimates	Cumulative t CO_2e		
	Scope 1	Scope 2	Total Scope 1 & 2
Construction activities	14,163	0[5]	14,163

The construction phase of the Refinery will occur over multiple years. Estimated GHG emissions associated with this phase are comparatively minor in the context of overall Refinery emissions estimates, representing less than 4.5% of Scope 1 and Scope 2 emissions arising from the first full year of nominal operation of the Refinery.

Regarding Scope 1 and 2 Construction emissions, it is assumed any potential for connection to an electrical network giving rise to Scope 2 emissions will simply displace predicted scope 1 emissions cited, resulting in net Scope 1 and 2 emissions from construction activities being at or below the estimate provided in this plan cited for Scope 1 alone.

While Scope 3 Construction emissions have not been shown in the table, upstream Scope 3 emissions can be expected from the construction phase. That said, Covalent considers any assessment of Scope 3 emissions to have unacceptably high levels of multiple uncertainties. On this basis, it is not appropriate to provide an estimate due to the high uncertainty mentioned.

2.3.2 Operational GHG emissions – predicted baseline

Operational GHG emissions are attributed to the consumption of grid electricity (Scope 2 emissions) and the combustion of natural gas and reagents (Scope 1 emissions). A summary of Covalent's internal target CO_2e intensity is also provided in Table 6 below.

[5] No grid power supply is expected to be available during construction. However, if grid power is supplied then Scope 2 emissions arising in the construction phase can be assumed to substitute no more than an equivalent amount of Scope 1 emissions.

Table 6 – Covalent's internal target CO_2e intensity

Refinery Operational GHG Emissions Intensity	t CO_2 per t lithium hydroxide[6]			% Reduction from benchmark reference[7]	
	Scope 1	Scope 2	Total Scope 1 & 2	International benchmark	WA benchmark
Baseline 2025 emissions[8]	≤3.2	≤3.1	≤6.3	50%	4%

Table 7 – Benchmark CO_2e emissions intensity

Covalent Refinery Scope 1 and 2 t CO_2e per t lithium hydroxide	Refinery Facility Equivalent Benchmark Processing Reference	Benchmark reference t CO_2e per t lithium hydroxide	Comments
≤6.3 [9]	*Documented WA Industry*	*6.6* [10]	*Data taken from public reference of from similar refinery*
	Estimated International	*12.7* [11]	*Data from supply chain studies. Corroborated through research.*

[6] Calculations assume established ramp up and varied availability of assets.

[7] Refer section 2.5 for discussion of the benchmarking assessment informing the stated benchmarks in Table 6.

[8] The internal GHG intensity targets proposed are intended to represent maximum expected operational GHG emissions intensity.

[9] As detailed in Table 6 above.

[10] Report for Albemarle Lithium - GHD Report - GHG Management Plan - p8.

[11] The basis for this figure considers the various sources including "The CO2 Impact of the 2020s' Battery Quality Lithium Hydroxide Supply Chain". The result was corroborated using a variety of sources including through discussions with subject matter experts and related professional networks and is considered to represent a reasonable benchmark comparison for Scope 1 and 2 emissions for a standalone refinery operating in China.

Table 8 – Refinery Scope 1, 2 and 3 nominal operational CO_2e emissions (absolute)

Refinery Nominal Operational GHG Emissions	Estimated Cumulative t CO_2e			
Annual t CO_2e	Scope 1	Scope 2	Scope 3	Total Scope 1, 2 & 3
Annual –first year of nominal operation (2025)	159,874	157,575	307,628	625,077
Cumulative t CO_2e over the life	Scope 1	Scope 2	Scope 3	Total Scope 1, 2 & 3
Total – **without** further mitigation implemented 40-year life scenario	6,394,960	6,303,000	12,305,120	25,003,080
Total – **without** further mitigation implemented 47-year life scenario	7,514,078	7,406,025	14,458,516	29,378,619
Total – **without** further mitigation implemented 50-year life scenario	7,993,712	7,878,773	15,381,411	31,253,896

As shown in Table 8 above, predicted Scope 1 and Scope 2 GHG emissions from the initial annual operation of the Refinery are estimated to be 6.3 tonne CO_2e per tonne of lithium hydroxide product. This compares favourably to the Western Australian and international benchmarks highlighted in Table 6 above.

Further, the unmitigated total cumulative emissions are proportional by the life of the project. Many factors influence the life of the refinery operation, including future recovery and grade of the spodumene concentrate received. As a long-life deposit, there is level of uncertainty in relation to the anticipated life of the refinery, and therefore three scenarios (between 40, 47 and 50 years) are shown.

A tabulated breakdown of expected 2025 GHG emissions by source is provided in Table 9 below.

Table 9 – GHG emissions by source and scope

Scope / Source	Relative breakdown	
Emissions from natural gas (Scope 1)	70.2%	112,238
Emissions from transport fuels (Scope 1)	0.1%	208
Emissions from reagents, including fugitive emissions (Scope 1)	29.7%	47,428
Total Scope 1 ***(159,874 tonne CO_2e pa)***	100%	
Power consumption (Scope 2)	100%	157,575
Total scope 2 ***(157,575 tonne CO_2e pa)***	100%	
Inorganic acids and alkalis (Scope 3)	97.9%	301,059
Filter aids (Scope 3)	0.4%	1,193
Water / water treatment reagents (Scope 3)	1.7%	5,376
Total scope 3 ***(307,628 tonne CO_2e pa)***	100%	

A high-level summary of various major utilities and reagents is provided in Table 10 below.

Table 10 – Emissions factors applied

Major utilities and reagents	Scope	Factor used	Units of measurement
Natural gas – Refinery	1	2.84	tonne CO_2e / Tonne
Transport fuel – Refinery	1	3.47	tonne CO_2e / Tonne
Reagents, including fugitive emissions	1	*0.74 to 3.103*	tonne CO_2e / Tonne
Grid supplied power	2	0.70	tonne CO_2e / MWh

Major utilities and reagents	Scope	Factor used	Units of measurement
Water / water treatment reagents	3	*1.64 to 7.0*	tonne CO_2e / tonne
Inorganic acid / alkalis	3	*0.14 to 1.12*	tonne CO_2e / Tonne
Filter aids	3	0.267	tonne CO_2e / Tonne

Note: *Ranges of factors have been provided where confidential information has been used.*

2.3.3 Alternative approach to GHG emissions

The reduction in carbon intensity within society is a key long-term measure for climate action success, and a driving factor in an investment decision to produce battery-grade lithium hydroxide via this Project. Covalent is committed to this long-term vision and recognises that, into the future a flexible regulatory approach is essential in driving ongoing innovation and improvement in best practice technologies. To help foster this, Covalent sees merit in progressive adoption of alternative regulatory approaches.

Regulation of such an alternative includes GHG performance of industries/projects on a reduction in intensity basis, rather than absolute emissions. Doing so will support industry growth whilst providing an appropriate balancing of emissions. This approach is universally applicable to all industries which support the needs of a modern society and is especially important for industries whose products result in a net reduction of emissions and directly enable decarbonisation.

Further, it is expected an approach which considers emissions intensity will lead to lower global emissions through greater investment in higher technologies and the development of lower emission facilities established within advanced economies that have good access to skilled labour, such as Australia. An approach which does not consider emissions intensity, will likely favour low emission technology facilities being built in countries other than Australia and result in higher global emissions.

Another potential concept involves allowing future projects the option to assess their GHG performance based on an agreed level of ‘cumulative’ GHG emission performance. Under this approach their cumulative Scope 1 project emissions would be agreed prior to building the facility, and the proponent would once the plant was operational then be required to perform against an ‘area under a defined trajectory line’, as opposed to performing against discrete targets. The suggested approach further incentivises early proactive adoption of abatement alternatives.

Covalent recognises the suggested alternative concepts will not be considered under the assessment of its project.

2.4 Design and engineering studies

Fundamental design principles that consider high efficiency, low energy loss, and energy recovery were applied during Covalent's design process. Covalent has identified a number of design measures which will be utilised to enable GHG emissions reduction for the construction and operation of the Refinery. Importantly, Covalent has sought to reduce GHG emissions through best practice design. Design choices have been made with regard to:

- Location of the development.
- High efficiency equipment selection.
- Process and equipment design to focus on efficiency and the reduction of energy losses.
- Careful selection of fuel and energy sources.
- Analysis of waste streams to reduce waste generation, increase recovery of energy, and enable materials to be recycled and reused.
- Use of low emissions intensity technologies.
- Layout and equipment provisions which will allow easy adoption of new technologies in the future.

Covalent will adopt a continual improvement approach to GHG emissions reduction and will seek opportunities to optimise the emissions profile of the Refinery over its lifetime. Continuous improvement is discussed in greater detail below at 4.1.

Several examples of design considerations to reduce GHG emissions across the Refinery are described below in Table 11. These represent examples of key items, noting the table does not represent an exhaustive list.

2.4.1 Abatement measure assessment process

In line with the GHG mitigation hierarchy outlined in section 3.2, Covalent has proposed the management provisions (refer section 3) based on the following rationale:

- GHG abatement opportunities adopted in this GHGMP were assessed to determine whether they were reasonable and practicable against multiple criteria including safety, technical performance, operability, emissions reduction, availability, scale, and economic return. Covalent considers that reasonable and practicable GHG abatement measures are considered 'good industry practice'.
- There is potential for substantial changes in GHG policies, markets and technology as well as infrastructure over the proposal lifetime, which may influence the reasonableness or practicability of GHG abatement measures. Given the GHGMP is considered dynamic, as part of each 5 yearly review Covalent will undertake an extensive literature search and industry review process and compare its previous performance against this information. The reviews will consider broader matters relating to policies, markets, technology and infrastructure as part of this adaptive management approach.
- Over the multi-decade period the proposal is expected to operate, various major maintenance / refit milestones will offer potential opportunities to implement further GHG abatement measures if these become practicable due to policy, market, technological, infrastructure, or other changes. The 5-yearly review of the GHGMP represents a practicable frequency to enable sufficient time to plan, design and procure and implement future abatement opportunities ahead of the major maintenance / refit milestone.
- Covalent will continuously monitor its GHG emissions to:

- Respond to resolve any exceedances or unplanned emissions as soon as reasonably practicable,
- Report in accordance with legislative requirements, and
- Measure achievements in reductions of adopted technologies.

2.4.2 Adopted greenhouse gas emission abatement opportunities

As part of the development of this management plan, Covalent conducted an extensive review of reasonable and practicable GHG emission abatement project optimisation opportunities. Those opportunities described have been adopted into the upfront design of the Refinery where they have been demonstrated to be reasonable and practicable measures to avoid or reduce the Refinery's emissions over the life of the proposal.

Table 11 provides a summary of the adopted GHG emission abatement opportunities/ measures, which are reasonable and practicable and considered to be best or leading industry practice.

The application of the GHG reduction measures during the design phase has resulted in Covalent having a noticeably lower predicted Scope 1 GHG emissions in its first year of operation relative to the current performance of benchmarks asserted.

As stated above, once the Refinery is operational, the ongoing review of performance and advancements in industry regarding reasonable and practicable GHG emission abatement opportunities will be conducted by Covalent in line with commitments and timeframes stated in this GHGMP.

Table 11 – GHG abatement opportunity adopted during design

Design consideration relevant to GHG abatement opportunity adopted	Discussion	Mitigation hierarchy	Estimated indicative CO_2e mitigated per annum	Justification
A) Location of the Refinery	The location for the Refinery in Kwinana was selected to realise **lower transport** GHG emissions. Greater mass of reagents / inputs are anticipated to be required to be transported to the Refinery in Kwinana than mass of concentrate is to be transported from the Mt Holland mine site to Kwinana. Further, it is proposed that the Refinery will be integrated with a number of existing neighbouring facilities within the Kwinana Industrial Area. Integration with existing infrastructure presents a number of efficiencies, including transport of reagents to the Refinery, when compared with other potential sites, for example Mt Holland. On this basis, **lower than otherwise transport emissions** are able to be realised with the refinery development in Kwinana. Through benchmarking studies, it was determined that it is common for established lithium hydroxide refineries within other jurisdictions to reuse de-lithiated beta spodumene (**DBS**) within neighbouring industries such as cement manufacturing. A significant opportunity exists for neighbouring industries in Kwinana to consume the DBS material, and this location advantage will reduce GHG emissions associated with the transport of DBS. It will also **reduce the emission linked to the supply of displaced materials** by the neighbour.	Reduce	1. Lower transport GHG emissions from deliveries 2. Indirect transport emissions 3. Emission linked to the supply of displaced materials Aggregate emissions mitigated **~ 2,200 tonne CO_2e pa** (Scope 3)	With the Kwinana Industrial Area being the State's premier location for manufacturing, the proposed site in Kwinana is considered the ideal location for the Refinery. The location gives rise to the various synergies described which results in indirect transport emissions connected with the Refinery being reduced and mitigated to as low as reasonably practicable.
B) Vegetation clearing and location of handling and process plant	The selected development site has been previously used for a variety of different purposes including, as a storage facility for used tyres, project laydown and storage area and a waste management site. The vast majority of the site that will be developed **is already cleared**. In regard of previous utilisation of the site, a deliberate design effort has been applied to ensure existing cleared areas are selected and optimised to **reduce unnecessary vegetation clearing**. This is regarded as good GHG design	Avoid	1. Use of existing cleared ground 2. Avoid the unnecessary vegetation clearing Aggregate emissions mitigated	Design effort applied to ensure existing cleared areas are selected and optimised results lower emission connected with the Refinery construction / presence of asset. Emissions reduced and mitigated to as low as reasonably practicable.

Design consideration relevant to GHG abatement opportunity adopted	Discussion	Mitigation hierarchy	Estimated indicative CO_2e mitigated per annum	Justification
	practice. While no quantitative GHG credit has been taken for it in GHG evaluation terms, Covalent will also ensure that at the end of life, the Refinery equipment and associated infrastructure is removed, and all necessary rehabilitation and re-vegetation processes are satisfactorily actioned.		**~ 5,400 tonne CO_2e pa** (Scope 3)	
C) Selecting low emissions, high efficiency power generation	Covalent intends to avoid installing any base load generation at the Refinery given the proximity and access to the South West Interconnected Network (SWIN). The South West Interconnected System (SWIS) has established **low emissions capacity** that leverages the State's significant natural gas supplies. Due to its scale and design, the SWIS baseload power supply is highly reliable and utilises power generation units which are much **higher in efficiency** than a smaller onsite baseload power plant solution supported by renewables. Further, in line with State Government policy the SWIS connection is **expected to increase its percentage of renewable generation**. On this basis the SWIS is expected to provide Covalent with low carbon renewable electricity while also providing a reliable baseload source of power. Covalent has performed screening studies and expects that a non-SWIS connection solution provides significant GHG benefits when compared to using an onsite baseload power supported by renewables. Commercial arrangements with a potential power supplier will be in place prior to the commencement of operations. Where it is commercially viable, a **corporate PPA** with a renewable power source may be considered by Covalent.	Reduce	1. Low emissions capacity of interconnected network 2. High efficiency of the network 3. Increases its percentage of network 4. Corporate PPA Aggregate emissions mitigated **~7,700 tonne CO_2e pa** (Scope 2)	Covalent intends to avoid installing any base load generation at the Refinery during its initial project build, given the close proximity and access to the SWIN, and the proposed connection to SWIS will, over the long term, reduce and mitigate GHG emissions to as low as reasonably practicable. This connection will allow future pathways to increasing the take up of renewables

Design consideration relevant to GHG abatement opportunity adopted	Discussion	Mitigation hierarchy	Estimated indicative CO_2e mitigated per annum	Justification

D) Design energy network to accept renewables	It is expected that the mix of generation in the SWIS will continue to move towards renewables over time. Therefore, with a grid connection, the Refinery is inherently designed to leverage the expected increase in renewable power generation in the SWIS over time.
	
	Evidence exists to support that the SWIS has been decarbonising over time, with the emission factor for consumption of purchased electricity from the SWIS reducing from 0.76 tonnes of CO_2e per MWh in 2015[12] to 0.68 tonnes of CO_2e per MWh in 2020[13]. Covalent's Scope 2 emissions assessment of its GHG intensity assumes a factor of 0.70 tonnes of CO_2e per MWh.
	
	There is scope for further significant decarbonisation in the SWIS over time. Under all possible scenarios modelled in "The Whole of System Plan 2020" prepared by the WA Energy Transformation Taskforce, and commissioned by the WA State Government[14], the overall emissions intensity of the SWIS are forecast to reduce from current levels to between 0.18 to 0.30 tonnes of CO_2e per MWh, or 55% to 75% below current levels by 2040.
		Reduce
		
		(future)
			1. Network connection is designed to accept renewables
			2. SWIS are forecast to reduce from current levels
			
			Aggregate emissions mitigated
			
			Current:
			~NIL tonne CO_2e pa
			(Scope 2)
			
			Future:
			In 2040
			If 55% reduction in grid GHG emissions intensity, then
			~87,000 tonne CO_2e pa
			
			If 75% reduction in grid GHG emissions intensity, then
			~118,000 tonne CO_2e pa
				Evidentiary references supporting discussion comments provided. References are included as footnotes below.
				
				Decarbonisation for the SWIS will result in lower future Scope 2 emissions for the Refinery. Covalent is confident this solution offers a robust means to reduce and mitigate GHG emissions to as low as reasonably practicable.

[12] National Greenhouse Accounts Factors - August 2015 (industry.gov.au).

[13] National Greenhouse Accounts Factors (industry.gov.au).

[14] Whole of System Plan_Report.pdf (www.wa.gov.au).

Design consideration relevant to GHG abatement opportunity adopted	Discussion	Mitigation hierarchy	Estimated indicative CO_2e mitigated per annum	Justification
			If up to 100% reduction in grid emissions intensity, then **157,575 tonne CO_2e pa**	
E) Choice of best available technology and equipment	Best available technology and equipment have been chosen in the Refinery design, for example: 1. The Refinery requires natural gas for heating. Most GHG Scope 1 emissions are expected from natural gas usage in the Refinery. The selection of waste heat recovery equipment in high natural gas heating applications, such as the pyrometallurgical system in the Refinery, will incorporate modern technologies with heat recovery systems. These systems represent significant upfront capital costs, as well as high ongoing operating expense due to their associated use of energy. Covalent has applied the highest degree of consideration and evaluation processes to ensure the most efficient heating solution is selected and implemented into its Refinery. 2. Appropriate upfront design effort has reduced incremental emissions through the selection of efficient natural gas burner control equipment, which Covalent regards as best in the lithium refining sector in terms of its fuel usage and energy efficiency. The modern generation burner control system is a key design feature that will reduce GHG emissions by ensuring superior process operation, stability and minimised thermal transience, thereby resulting in associated lower energy use. 3. The Refinery is expected to consume more than 20MW of electrical power, and as a result significant upfront design focus has been applied to reduce onsite electrical energy demand requirements. The choice of best	Reduce	1. Waste heat recovery equipment 2. Burner control system 3. Eco-design motor testing 4. Higher efficiency motor 5. Variable speed drive units Aggregate emissions mitigated **~ 7,900 tonne CO_2e pa** (Scope 1 and 2)	Fundamental design principles that consider best available technology and equipment that delivers high efficiency, low energy loss, and energy recovery have been applied during the Refinery design process. This has resulted in the selection of specific equipment capable of reduced GHG emissions. Covalent will purchase equipment from reputable vendors and will have in place commercial arrangements with all major equipment vendors which will help ensure strict energy consumption targets are met. Covalent's criteria for selection of technology requires that the viability of new technology selections are tested across a range of considerations. Covalent's criteria requires it to rigorously consider the whole of life costs, not only an equipment's upfront capital cost but also its ongoing running and energy

Design consideration relevant to GHG abatement opportunity adopted	Discussion	Mitigation hierarchy	Estimated indicative CO_2e mitigated per annum	Justification
	available technology has included the parameters applicable to selection of electrical motor equipment. Covalent's tenders for electrical motor equipment have specified vendors to supply modern high efficiency eco-design motors. All pump and conveyor electrical motors shall comply with high efficiency types as per the requirements of AS1359.5[15]. Prior to supply, equipment suppliers are required to undertake testing for all electric motors and obtain Greenhouse and Energy Minimum Standards (GEMS) certification for all 3-phase electric motors offered to Covalent, whether they are sourced within Australia or overseas for incorporation into the Project. 4. Higher efficiency motor selection has been actively pursued by Covalent's engineers where an offset of the higher upfront capital costs of higher efficiency motors against lower associated lifetime electrical energy usage exists. 5. Variable speed drive (VSD) units, also commonly known as variable voltage variable frequency drives, have been selected by Covalent where modulation of electrical energy demands is required. Electrical motors are typically installed and operated at a high constant speed, and the installation of VSDs specifically enables large electrical motor speeds to be easily modulated and reduced to an idling speed in instances when high motor speeds are not needed at all times of operation. The upfront capital cost of installing VSDs has been assessed and is expected to be offset by the associated lifetime energy reductions throughout the plant. On this basis an extensive number of motors within the Refinery will have VSDs installed.			costs, reliability, and efficiency. This approach ensures that despite a technology having a higher capital cost, viable technologies that carry the benefit of a lower running cost and typically lower energy use (and therefore have less GHG emissions) are prioritised in the selection process. Covalent has followed a robust design review process and various evaluations, process optimisations and reviews relating to the Refinery design have been conducted. Best available technology and equipment have been chosen in the Refinery design, for example: These examples highlight Covalent's application of a concerted design effort in the Refinery to ensure GHG emissions are reduced. As demonstrated through benchmarking, collectively these examples (and others) provide the Refinery with a significant upfront GHG benefit and achieve a solid basis to demonstrate that emissions have been reduced

[15] Rotating electrical machines - General requirements Part 5: Three-phase cage induction motors - High efficiency and minimum energy performance standards requirements.

Design consideration relevant to GHG abatement opportunity adopted	Discussion	Mitigation hierarchy	Estimated indicative CO_2e mitigated per annum	Justification
				and mitigated to as low as reasonably practicable.
F) Avoid selection of poor energy efficiency equipment and processes	1. Covalent has sought to reduce its filtration unit operations, Covalent's design had previously considered two stage primary filtration process. Through careful design this has been reduced to a single stage primary filtration process, thereby reducing the number of equipment items and their associated energy demands. 2. Covalent will install water recovery unit processes to ensure it recycles water as much as practicable, reduces its usage of fresh water and avoids unnecessary wastage of wastewater. While in this example the isolated recycling of water onsite will result in some additional Scope 1 emissions by Covalent, the reduced demand for high purity fresh water will reduce total GHG emissions in the context of the overall supply chain emissions. Offsite emissions connected with the public water utility provider, Water Corporation, utilise higher energy desalination and reverse osmosis processes in order to deliver higher water quality supply into its network. These offsite processes by the Water Corporation require considerably more electricity to achieve the equivalent amount of water supply. In net terms, GHG emission will therefore reduce through water recycling processes proposed by Covalent, as well as the broader environmental benefits associated with careful water use. 3. High wash efficiency equipment and processes have been incorporated into the design. When washing of materials can be achieved more effectively with less water, then less energy (and water) is used. This in turn results in lower total emissions.	Avoid & Reduce	1. Filtration 2. Water recovery 3. Wash efficiency Aggregate emissions mitigated **~10,900 tonne CO_2e pa** (Scope 2)	Large power consumption / intensive energy equipment are often required in processing facilities, however Covalent has sought to ensure the number of these high energy units are minimised in the Refinery design. Inefficient forms of filtration and separation equipment have been deliberately excluded from the design given poor performance will lead to higher energy demands and associated GHG emissions. Taking a more holistic view of the supply chain, as well as avoiding the selection of poor efficiency unit process and optimising efficiencies where reasonably practicable, further demonstrates GHG emissions have been reduced and mitigated by Covalent in the Refinery design

Design consideration relevant to GHG abatement opportunity adopted	Discussion	Mitigation hierarchy	Estimated indicative CO_2e mitigated per annum	Justification
G) Improving layout to reduce energy losses	Covalent has optimised its energy supply systems by designing the Refinery layout to reduce energy losses through the internal operational transport/transfer of its energy requirements. Examples include: 1. Covalent's motor control centres (MCCs) will be located near to the specific equipment motor power demand. The close proximity of the MCCs will significantly reduce electrical line resistance losses, which would otherwise result in higher electrical usage. 2. The steam generator will be located near to the steam demand to reduce heat losses to surroundings. The close proximity of the generator to the steam demand will reduce steam condensation in pipes, which would otherwise result in higher natural gas usage. 3. A range of ceramic refractory and mineral wool heat conservation insulation will be fitted to specific equipment applications to ensure valuable heat is not lost to the surroundings through the walls of pipes and vessels. The upfront capital cost of installing heat conservation insulators will be offset against the associated lifetime energy reductions this feature provides.	Avoid & Reduce	1. MCC generator located near demand 2. Steam generator located near demand 3. Heat conservation Aggregate emissions reduced **~4,100 tonne CO2e** (Scope 1 and 2)	The reduction of energy losses through the internal operational transport/transfer of its energy requirements is easily addressed during preliminary design phase. Designing out energy losses from unit process results in avoiding GHG as well as reducing emissions through improved efficiencies where reasonably practicable, this further demonstrates GHG emissions have been reduced and mitigated by Covalent in the Refinery design

Note: Aggregate total is in current terms is approximately ~38,200 tonne CO_2e annually.

2.4.3 Other abatement measures considered

As outlined in section 2.4.1, Covalent has proposed to implement numerous abatement measures which have been incorporated upfront as part of its design and process equipment selection. Given it was a key priority and formed part of the basis of design for the Refinery, the design review and selection process specifically targeted the incorporation of GHG reduction technologies that were considered technically and commercially acceptable.

An outline of other relevant potential abatement measures considered, but are not currently proposed for immediate implementation, is included below:

Table 12 – Summary of other abatement measures considered

Abatement measures considered	Comments
Various processing technologies, including the assessment of immature ones e.g. flash calcining	Covalent's project involves constructing one of the largest battery-grade lithium refineries in the world. Due to its scale, striking the balance between adopting new technologies capable of lower emissions and ensuring that immature technology is not applied is a critical success factor. By way of example, immature calcining technologies such as 'flash calcining' have the potential to consume less natural gas and consequently also potentially offer lower GHG emissions. However, such technology has not yet been demonstrated at an industrial scale in reference to the calcination of spodumene. Covalent's review process ensured various other processing technology alternatives were each systematically assessed during the preliminary design phase. Their eventual exclusion was primarily due to their poor demonstration of scale and stable operations, which in itself is likely to result in higher emissions due to transience and instability, as well as unacceptable reliability. While the level of maturity of technologies should not prevent their assessment, most immature technologies present an unacceptable level of risk to the Refinery. By contrast, the calciner technology eventually selected by Covalent is regarded as highly innovative and best-in-class modern technology (currently), incorporating sophisticated heat recovery systems which reduce fuel use, as well as superior process control automation allowing for stable operation and minimal thermal transience, thereby resulting in associated lower energy use. That said, there is a life-cycle element to consider for major equipment and the modern system selected today. The calciner equipment is expected to reach a near end-of-life condition after some 20 to 30 years of operation. Closer to the end-of-life state in its life cycle, Covalent intends to once again review all options (including some which may currently not exist) to ensure the future retrofit / replacement programmes of all major equipment items consider advancements made in technology development and their suitability for industrial scale implementation.

Abatement measures considered	Comments
Future fuels for use in Calcination and Roasting. e.g., replace natural gas with green hydrogen	Alternate green fuels to natural gas have been considered. Much interest in Hydrogen as a fuel exists and a CSIRO document published in 2018 (National Hydrogen Roadmap) provides a blueprint for the development of a hydrogen industry in Australia – refer link: 18-00314_EN_NationalHydrogenRoadmap_WEB_180823.pdf In Western Australia, the supply of green hydrogen is still very much in its infancy, and unfortunately green hydrogen is not currently readily available. For example, if hydrogen were to be supplied using existing natural gas networks, then advice received indicates transport options are not current available and requires considerable time to complete major upgrade works expected. On this basis, use of hydrogen as a fuel for use at the Kwinana refinery has been determined to be an unviable alternative for implementation at present. Unfortunately, no market supply currently exists and significant barriers to establishing a supply exist. While logistically it is not possible for Covalent to install hydrogen fired appliances as part of its upfront project design, Covalent will continue to consider such alternatives over the long term and assess their future retrofit / implementation. With Covalent’s battery-grade lithium refinery proposed to be centrally located within the core of the Kwinana industrial area, it is considered ideally situated for a green hydrogen connection, should a nearby producer be established there in the future.

Abatement measures considered	Comments
Self-generation of renewable (solar or wind) power at Kwinana	Considerable land area is required to facilitate the installation of renewables, and at present a shortage of low value unencumbered neighbouring land area exists in the vicinity of the refinery. Given the location of the Refinery in the State's premier strategic industrial area, the inflated cost of land for lease in the vicinity prohibits the installation of dedicated self-generation of power using renewables at this time. Over the long term, Covalent will continue to consider the assessment and future implementation of renewables for some aspects of the Refinery that could be powered in this manner. The viability of renewable alternatives could improve, should the availability of nearby land and its associated leasing arrangements significantly change. The proposed connection to SWIS can however provide future optionality. Over the long term, the connection can be further leveraged to maintain certainty of supply particularly if implementing renewable generation which will to help reduce and mitigate GHG emissions to as low as reasonably practicable while also maintaining high certainty of base load electrical supply.

The optimal selection and implementation timing of future abatement measures is heavily reliant on the relative performance of the various processing areas within the Refinery during operations. The future performance of the plant will be analysed by Covalent on an ongoing basis.

Subject to this, the assessment of abatement measures will be evaluated on their individual merits and implemented in a manner which prioritises abatement measures rather than offsets where possible while ensuring that Covalent's Scope 1 CO_2e reduction commitments are met.

Assumptions and uncertainties

Key assumptions and uncertainties relating to the proposed approach to managing GHG emissions are discussed below.

State of WA and Commonwealth GHG policy

- The Western Australian EPA released a draft GHG Factor Guideline in December 2019. The guideline was finalised in April 2020 (EPA, 2020).
- State and Commonwealth Government policies continue to evolve with key uncertainties remaining, which include:
    - The finalisation of the Commonwealth "Benchmark Baseline" concept for new industry projects, which will enable proponents to apply for a 'baseline' of GHG emissions (tCO_2e).
    - the State's contribution to Commonwealth targets versus other states
    - the setting of targets to 2050
    - the setting of sector specific targets for industry versus other sectors (e.g. power, transport, agriculture, buildings).

- The State of Western Australia is proposing to release a State Climate Policy and Energy Transformation Policy in 2020, the details of which (including targets) are unknown.

Market price carbon emissions

- At this current time, there is no uniformly applied (i.e. on unit of carbon emitted) market price for carbon emissions (i.e. a carbon levy) within Australia. This may change in the future, given that there was a formal national price for carbon emissions (also known as a 'carbon tax') in the past, formerly repealed in 2014).
- Covalent will assess opportunities for future capital expenditure to avoid and/or reduce net CO_2 emissions in line with its adaptive management approach.

Cost of technology for renewable energy

- The cost of renewables has changed significantly over the last 10 years, and further downward trends are expected.
- As described in Table 12, the potential exists renewable power solutions may become a viable, and as described this will be assessed in line with Covalent's adaptive management approach.

Options and viability of processing technology in relation to plant CO_2 emissions

- As described in Table 12, the selection of the most appropriate processing technology at a future point in time may differ. As outlined Covalent will use its review and assessment processes when considering the life cycle of major equipment items.
- Covalent will monitor CO_2 emissions from the whole of plant and individual equipment to assess abatement opportunities in accordance with its adaptive management approach.

Availability of similar industry GHGMP information

- No lithium hydroxide refinery is currently operational in Western Australia.
- Albemarle's Kemerton Refinery, which was under construction at the time of the benchmarking exercise, is the only modern generation refinery with a publicly available GHGMP document that could be sourced.
- A degree of uncertainty will often exist when researching information relating to the performance of third parties, particularly given the recent nature of industrial developments within the lithium refining industry.

Life of operations

- Many factors influence the life of the refinery operation, including future recovery and grade of the spodumene concentrate received has also been added. As a long-life deposit, there is level of uncertainty in relation to the precise anticipated life of the operation.

2.5 Benchmarking

2.5.1 Benchmarking assessment

Growth in the production of lithium hydroxide for use in EV represents a relatively new trend. There is limited reliable publicly available GHG emissions data from similar plants to the Refinery operating globally. As a result, it has been necessary for Covalent to undertake a range of activities to obtain reliable emissions intensity benchmarks for lithium hydroxide refineries for the purpose of this assessment.

Covalent utilised the Pilbara Minerals 2019 Annual Report and the under-construction Albemarle Kemerton Plant GHGMP (November 2018) to develop a Western Australian based benchmark for the overall supply chain. Tianqi Lithium's Kwinana based lithium hydroxide plant has not yet been commissioned and an associated GHGMP in respect to it is not publicly available. This facility has therefore not been able to be included in the scope of the industry benchmarking exercise.

At the time of the benchmarking exercise there was no publicly available operating data available to Covalent from an equivalent Australian plant source. This is because there are currently no operational lithium hydroxide refineries in Australia. To counterbalance some of the limitations presented to benchmarking due to limited publicly available data, Covalent has had regard to GHG emission data in respect of:

- major equipment items installed in refineries constructed in the above-described Australian plants; and
- published in supply chain studies data for other global refineries.
- Information sources utilised by Covalent for the purpose of the benchmarking exercise are set out in Table 13 below.

Table 13 – Summary of information gathered during benchmarking exercise

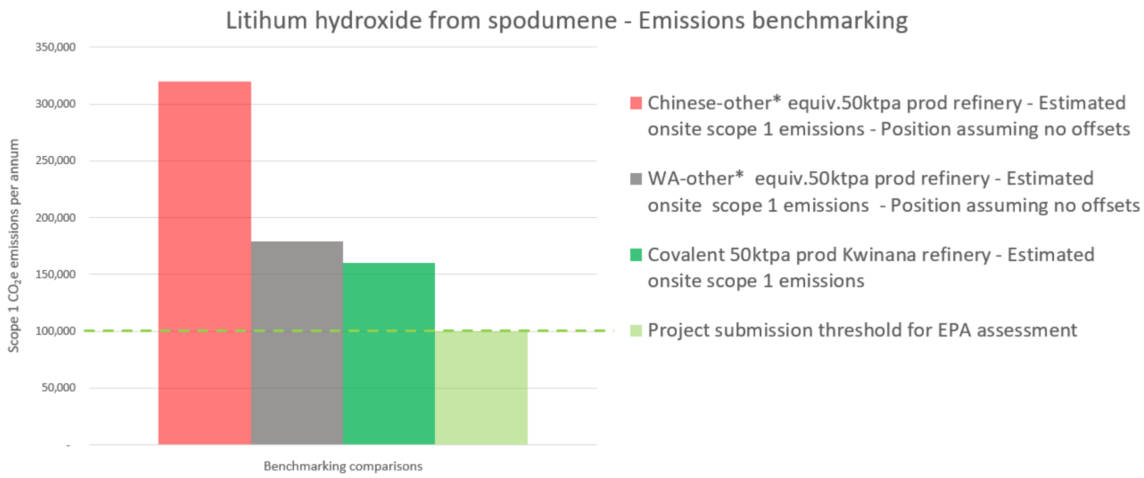
Nature of information	Sources	Comment /discussion (including limitations / uncertainties)
Available industry GHGMP information	No lithium hydroxide refinery is currently operational in Western Australia. Albemarle's Kemerton Refinery, which was under construction at the time of the benchmarking exercise, is the only modern generation refinery with a publicly available GHGMP document that could be sourced. This document was considered by Covalent in the benchmarking exercise.	Scope 1 and 2 emissions intensity from an Australian LiOH refinery was assumed to be 6.6 t CO_2e per tonne LiOH.H_2O produced. This was taken from public reporting referencing "expected emissions" from Albemarle's Kemerton refinery.[16] At this time there is no operational LiOH refinery in Australia. Scope 1 and 2 emissions intensity from fully operational international spodumene to LiOH refineries is provided below.
Study tour	More than five lithium hydroxide refineries located outside of Western Australia were visited by Covalent's technical representatives. Information collected from the study tour was considered in the benchmarking exercise.	Several overseas facilities were reviewed. An understanding of raw material efficiency, power, fuel, and transportation was gained. Assumed data was corroborated against publicly reported references. Scope 1 and 2 emissions intensity for equivalent al spodumene refinery references was to be approximately 12.7t CO_2 per tonne LiOH.H_2O produced
Lithium Ion Battery value chain studies	Value chain studies reviewed.	Several lithium-ion GHG lifecycle energy papers were reviewed. These covered battery technology ation in light vehicles. While not directly comparable to discrete GHG emissions from a standalone refinery, the supply chain studies provide a basis of considering emissions more broadly. A range of emissions

[16] The Albemarle reference cites emissions for its future WA refining only and has excluded embodied emissions from spodumene ore (i.e. its Kemerton GHGMP has reported GHG emissions as if Albemarle is a non-integrated producer of spodumene within the overall lithium hydroxide supply chain).

Nature of information	Sources	Comment /discussion (including limitations / uncertainties)
		intensities is shown below which capture GHG emissions from the recovery of the raw material (brine or spodumene) through the supply chain to LiOH production. These papers reported[17]:: From Brine / South American refining[18] = 5.0 - 7.4 t CO_2e per tonne $LiOH.H_2O$ Spodumene / Chinese refining = 14.8 - 15.1t CO_2e per tonne $LiOH.H_2O$ Calculated: Spodumene / Australian refining = 14.8 - 15.1t CO_2e per tonne $LiOH.H_2O$

Notwithstanding the Refinery's projected 2025 GHG emission are expected to be the lowest emissions intensity for any like refinery in the world, Covalent is committed to ensuring that it continues to proactively limit its CO_2e emissions to as low as practicable, using available commercially viable options. Covalent is committed to its long-term vision for the Refinery and recognises that a flexible approach is essential to drive innovation and continuous improvement in best practice technologies. Figure 2 below highlights the initial Scope 1 emissions from the Refinery relative to current benchmarks.

Figure 2 – Lithium hydroxide from spodumene – Emissions benchmarking



In summary, the benchmarking exercise has provided Covalent with insight and understanding of other developments, and how development plans for the Refinery can be further optimised. Covalent was able to contrast its development plans in the scope of the Refinery against others, allowing a range of design considerations (as discussed above at 0) to be optimised including but not limited to:

[17] "The CO2 Impact of the 2020s Battery Quality Lithium Hydroxide Supply Chain" Alex Grant, David Deak, Robert Pell, (January 2020); "Life Cycle of Lithium - Life Cycle Assessment of Lithium", Sustainable Lithium 2020.

[18] Due to favourable climate, geography and landforms, viable easy to access long life lithium brine deposits exist within South America. Australia does not have such deposits available, however does have access to commercially viable hard rock spodumene resources. Brine is therefore currently not a possible raw material in the Australian market.

- the location of the refinery;
- layout of units;
- selection of equipment;
- understanding the differences in processes selected; and
- opportunities to reduce losses.

2.6 GHG management objective and the Covalent approach

Covalent supports the Western Australian State Government's aspiration to achieve net zero emissions by 2050. It is Covalent's primary objective under the GHGMP to reduce and mitigate GHG emissions to as low as reasonably practicable over the lifetime of the Refinery.

Covalent has committed to reducing its Scope 1 emissions from the Refinery to below 100,000 tonne CO_2e per annum within 10 years of operation. This target will be achieved proactively through initial design considerations and continuous improvement over the life of the Proposal, with any further necessary emission reduction to be achieved through carbon offsets (if required). Covalent will implement a robust and transparent reporting process with respect to the Refinery's GHG performance.

To achieve its primary objective, Covalent has adopted four key management principles for the GHGMP which will be applied in implementing the Proposal:

1. Voluntarily apply firm GHG emissions targets over the first 10 years of operation of the Refinery and reduce its Scope 1 CO_2e emissions to below 100,000 tonne CO_2e per annum within 10 years of operation through continuous improvement or the purchase of carbon offsets.
2. To support the Western Australian Government's aspiration to achieve net zero Scope 1 emissions by 2050, apply five yearly targets intended to also achieve net zero Scope 1 CO_2e emissions by 2050.
3. Conduct five-yearly performance and industry reviews, and 10 year forward projections.
4. Review and update the GHGMP on a five-yearly basis to embed the outcomes of reviews and continuous improvement to reduce the Refinery's emissions intensity.

Table 14 below provides a summary of Covalent's internal targets for reducing its nominal annual CO_2e emissions.

Table 14 – Refinery Scope 1 nominal operational CO_2e emissions

Refinery Nominal Operational GHG Emissions	Estimated Scope 1 t CO_2e [19]	
Annual t CO_2e	**Scope 1**	**% change from 1st year**
Annual – 1st year of nominal operation (2025)	159,874	NA
Annual - 5th year of nominal operation (2030)	129,937	-19%
Annual - 10th year of nominal operation (2035)	<100,000	-38%
Annual - 15th year of nominal operation (2040)	66,667	-58%
Annual - 20th year of nominal operation (2045)	33,333	-79%
Annual - 25th year of nominal operation (2050)	0	-100%

***Note**: Post 2050 through to the end of life of the asset (estimated though to end of life), Scope 1 emissions will remain at zero.*

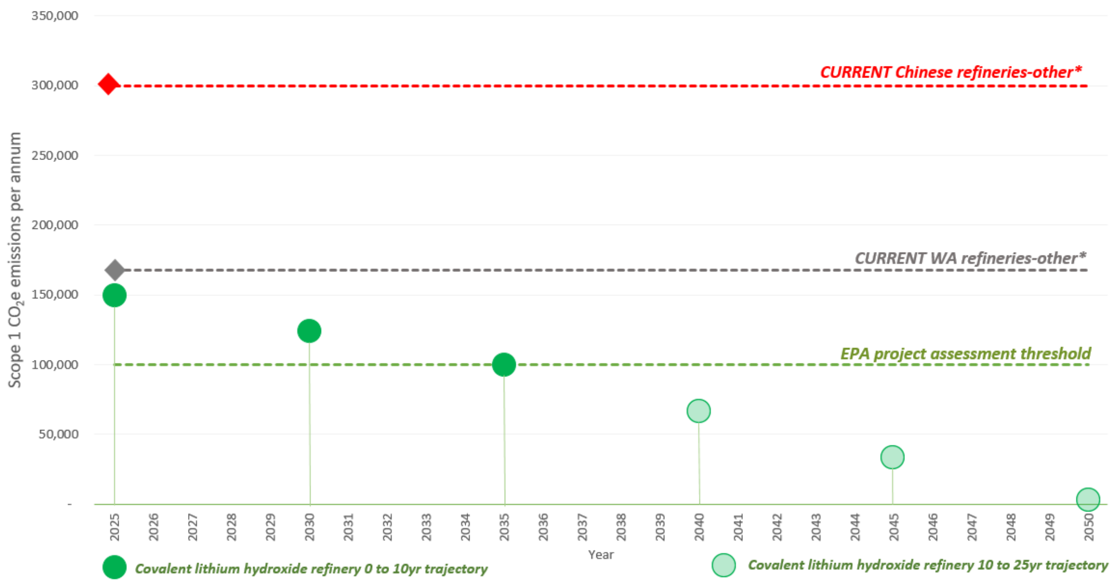
Cumulative t CO_2e over the life	Scope 1
Total – **without** further mitigation implemented (excluding downstream benefits) 40-year life scenario	6,394,960
Total – **without** further mitigation implemented (excluding downstream benefits) 47-year life scenario	7,514,078
Total – **without** further mitigation implemented (excluding downstream benefits) 50-year life scenario	7,993,712
Total – **with** further mitigations implemented (excluding downstream benefits) All life scenarios beyond the year 2050 are identical	2,129,308

[19] The downstream benefits of lithium are excluded from these es

The requirement to provide total cumulative CO_2e emissions over the full potential life has in turn led to various scenarios being applied due to the level of uncertainty described. Further, given Scope 1 emissions reduce to nil by 2050 (i.e., within 25 years from commencement in 2025), if the refinery continued to operate beyond 25 years i.e., between 40 to 50years, then the Scope 1 emissions from the Proposal **would not change** because the aspirational target of nil occurs in 2050 (earlier than end of life).

Figure 3 below illustrates anticipated GHG emission reduction trajectory for the Refinery as compared with other refineries, this reduction trajectory is supported by Covalent's management principles.

Figure 3 – Emission reduction trajectory cases



Covalent provides the commitment to reduce emissions over the life of the Refinery in accordance with the above emission reduction (as illustrated by Figure 3). In addition, it is assumed that targets set at each five-year interval remain as maximum annual targets for the following 5 years until the subsequent target comes into effect. As mentioned, Covalent will conduct five-yearly performance and industry reviews, and in turn 10 year forward projections will be provided as an outcome of this process.

It is not possible for Covalent to predict the trajectory of GHG emissions expected from third party Chinese or other WA refineries over time, therefore the performance of these benchmarks illustrated in Figure 3 is defined as "Current" performance only and is shown as a single diamond dot with dashed line for the reasons of comparison only.

As described in section 0, Covalent is installing considerable GHG reduction features within its plant as part of the upfront design, and as illustrated in Figure 3 Covalent's emission intensity in its first year of operation is significantly lower than current Chinese operations. Currently most of the global refinery capacity exists in China and these emissions are reported to be among the most GHG intensive emissions for the industry. Therefore, from a global emissions reduction perspective, it is especially important that new modern generation refineries (that bring lithium hydroxide supply to market with significantly reduced GHG emissions) such as Covalent are supported.

3 GHG management provisions

3.1 Management principles and actions

This section outlines the management principles and actions Covalent proposes to implement to achieve the primary objective of this GHGMP. Covalent's management principles are set out in Table 15 below.

Additional information required to assess whether the proposed mitigation measures are suitable and capable of achieving the proposed reductions is provided in Table 11. Management provisions described in Table 15 and Table 16 also contain an indication of the nature and quantum of GHG reduction associated with the application of each management principle.

Table 15 – GHG management principles and actions

EPA objective: To reduce net GHG emissions in order to minimise the risk of environmental harm associated with climate change.

Objective: To reduce and mitigate GHG emissions associated with the Refinery to as low as reasonably practicable and to contribute to Western Australian GHG policy targets.

Key impacts and risks: Increase in the State's emissions contributing to climate change and the risk that climate change presents to the Western Australian environment.

Objective-based

Management principles/targets (and associated indicative quantum of estimated CO_2e mitigated per annum as a result)	**Management actions**	**Monitoring**	**Timing / frequency of actions**	**Reporting**
1 – Voluntarily apply firm GHG emissions targets over the first 10 years of operation of the Refinery and reduce its Scope-1 CO_2e emissions to below 100,000 tonne CO_2e per annum within 10 years of operation through continuous improvement or the purchase of carbon offsets. Given the application of this target, in Scope 1 terms, the quantum GHG annual reduction ascribable to this management principle is estimated as being up to **circa 60,000 tonne** CO_2e (relative to Covalent's Scope 1 GHG baseline of 159,874).	• Implement continuous improvement process to identify reduction opportunities. • Examples of actions that Covalent anticipates will be commercially viable over the first 10 years of operation of the Refinery include: – Improved process yield through the identification and implementation of refinement and optimisation projects once the plant is operational. – Optimise energy usage through analysis of high energy use areas and the identification and implementation of refinement and optimisation projects once the plant is operational. – Reduce waste and increase reuse through the identification and implementation of refinement	• Accurate monitoring of Refinery material and energy usage will occur routinely. Key parameters will be captured through facility control systems and data will be stored in a secure location for the life of the Refinery. • GHG emissions associated with relevant material and energy flows will be calculated and included in annual reporting.	At least annual review of reduction opportunities. Implementation of continuous improvement process as per section 4.1. Revised GHGMP earlier that the 5 year review, if and as required.	Annual Compliance Assessment Report. Public GHG performance report. Revise / update GHGMP.

Management principles/targets (and associated indicative quantum of estimated CO_2e mitigated per annum as a result)	**Management actions**	**Monitoring**	**Timing / frequency of actions**	**Reporting**
Importantly, if the resulting Scope 1 GHG mitigations are insufficient relative to target, Covalent will purchase the necessary offsets to meet its commitments.	and optimisation projects once the plant is operational. – Promoting and reinforcing a waste reduction and energy efficiency culture amongst its employees and contractors. – Adopting clean technologies, such as Electric Forklifts – Reuse of DBS within neighbouring industries. • Maintain a watching brief of relevant Australian and international developments and trends. • Update GHGMP to reflect any significant reduction opportunities that have been implemented. • Acquire credible carbon offsets for any Scope 1 GHG emissions in excess of commitments.			
2 – To support the Western Australian Government's aspiration to achieve net zero by 2050, apply five yearly targets intended to also achieve net zero Scope-1 CO_2e emissions by 2050. The projected reduction in emissions from 2025 to net zero by 2050 is equivalent to an average reduction of four per cent per annum.	• Implement continuous improvement process to identify reduction opportunities. • Achieve reduction of Scope 1 CO_2e emissions to below 100,000 tonne CO_2e per annum within 10 years of operation. • The specific actions to be taken to support the achievement of this target once emissions are 100,000 tonne CO_2e per annum will be determined with reference to commercially viable options at the second 5 year review and revision of the GHGMP.	• Relevant monitoring data will be collected routinely as described in management principle 1 above. • GHG emissions will be calculated and reported as described in management principle 1 above.	At least annual review of reduction opportunities. Implementation of continuous improvement process as per section 4.1. Revised GHGMP following the second 5 year review to reflect specific actions.	Annual Compliance Assessment Report. Public GHG performance report. Revise / update GHGMP.

Management principles/targets (and associated indicative quantum of estimated CO_2e mitigated per annum as a result)	**Management actions**	**Monitoring**	**Timing / frequency of actions**	**Reporting**
In Scope 1 terms, this principle is estimated as being up to **circa 6,400 tonne** CO_2e mitigated (reduced from Covalent's Scope 1 GHG baseline). Importantly, if the resulting Scope 1 GHG reductions are insufficient relative to target, Covalent will purchase the necessary offsets to meet its commitments.				
3 – Conduct five yearly performance and industry reviews and 10 year forward projections. The emission reduction due to this principle relies on proactive reviews identifying opportunities. The average quantum reduction required is described in item 2 above.	• The scope of the review will be to: – Assess the GHG performance of the Refinery and broader industry. – Establish GHG emissions forward projections and reduction targets. • Outcomes of the review are to be included a revised GHGMP.	• Relevant monitoring data will be collected routinely as described in management principle 1 above. • Extensive literature search and industry review processes will be conducted. The information gathered will serve as input to a robust systematic assessment process, used to identify potential reduction opportunities for management approval. All information, literature and review findings gathered will be stored in a secure database for the life of the Refinery.	The first by 5 years from the date of commencement of operations and subsequent reviews every 5 years thereafter.	Revise / update GHGMP.

Management principles/targets (and associated indicative quantum of estimated CO_2e mitigated per annum as a result)	Management actions	Monitoring	Timing / frequency of actions	Reporting
4 – Conduct five yearly review and updates of GHGMP. This principle is aligned with average quantum reduction in emissions described in items 2 and 3.	Update GHGMP to reflect outcomes of 5 year review and any other aspects requiring revision. Update GHGMP to reflect any significant reduction opportunities that have been implemented.	• GHG emission reduction opportunities will be systematically identified. Necessary updates will be made to the GHGMP, with the intention of ensuring the management principles are met. • The revised update to the GHGMP will show actual progress to date against proposed trajectory, as well as provide a forecast new trajectory.	The first by 5 years from the date of commencement of operations and subsequent updates every 5 years thereafter. GHGMP revisions may occur earlier, if and as required.	Revise / update GHGMP.

3.1.1 Management principle 1

Covalent has used a number of key strategies in design of the Refinery and, though a process of continual improvement, will implement others during the operational phase to avoid, reduce and offset (if required) the Refinery's Scope 1 emissions to below 100,000 tonne CO_2e per annum within 10 years of operation.

Covalent has and will continue to apply the hierarchy of the mitigations as set out in Figure 4 in section 3.2 below. The aim of Covalent's mitigation measure methodology is to identify and apply all reasonable, practicable and commercially viable measures at each step of the mitigation hierarchy.

A more detailed account of GHG reduction initiatives which have been adopted and incorporated into the design of the plant is included in Table 11. A summary of currently identified strategies which provide an example of both design decisions and future continuous improvement and adaptive management is provided below.

Table 16 – Key strategies (examples)

Strategy	Description
Equipment location and selection during design	During its project development phase Covalent has carefully considered opportunities to influence and improve GHG design. The initial opportunities are summarised in Table 11. The optimal location of equipment and selection has occurred. This has been the subject of value optimisation bid evaluation and design review processes which have engaged various reputable consultancy and subject matter expert resources.
Improved process yield	Brownfield projects seeking to increase yield will significantly reduce GHG emission intensity. Various projects are planned once the Refinery is operational. These include the further refinement and optimisation of raw material and energy usage of equipment within the major process areas including, but not limited to; calcination, milling, roasting, leaching, filtration, ion exchange, crystallisation, drying and packaging. Covalent is internally incentivised to ensure process yield is continuously improved for the life of the project.
Reduced energy inputs	Brownfield projects seeking to optimise energy usage will significantly reduce GHG emission intensity. Various projects are planned once the plant is operational. These include the further refinement and optimisation of high energy use utility equipment (eg cooling, water treatment, boilers, compressors and other ancillary equipment). Again, Covalent is internally incentivised to ensure energy intensity inputs are continuously reduced for the life of the project.
Improved reuse of co-products	Covalent initially assumes its refinery DBS will be returned to the Mt Holland mine rather than the alternative to have it instead go to a metropolitan land fill facility. This additional transport back to the mine is disadvantageous in terms of offsite GHG emissions from the Refinery.

Strategy	Description
	Through Covalent's benchmarking studies it was determined that it is common for established lithium hydroxide refineries within other jurisdictions to reuse DBS within neighbouring industries. These neighbouring industries that consume the DBS material, see it a convenient local feed input and agree favourable terms with the lithium hydroxide refineries in exchange for secure supply access arrangements. Covalent is committed to establishing a practicable and commercially viable long term reuse option for DBS within the Kwinana / Perth metropolitan area. Covalent is also internally incentivised to ensure a viable market for this coproduct is established within the first 5 years of operation.
Reduced energy through improved use of waste	Brownfield projects seeking to reduce waste and increase reuse will significantly reduce GHG emission intensity. Various projects will be undertaken once the Refinery is operational. One such example is in respect to waste water. Waste water processing at the Refinery represents an energy burden. Various opportunities to optimise the re-use of the various grades of process water have been taken up. Reusing water decreases the total waste water generated and essentially also reducing the energy burden associated with it. Operational perseverance and the development of experience will be important factors in Covalent's successful waste minimisation strategy.
Promote GHG minimisation within its social networks and communities	To reinforce and promote the reduction in waste, Covalent will incorporate energy reduction and materials recycling programs with its employees as well as have it as a requirement of the contractors that it uses. In order to further reinforce and promote the use of clean energy, Covalent intends purchase Electric Forklifts for use at its Kwinana refinery and install a charging station. Covalent will naturally expand its take up of clean technologies over time.

In aggregate, these design decisions, future continuous improvement, adaptive management strategies and the use of offsets are required to reduce net emissions from the Project. The application of clear targets, together with firm management principles, will result in Covalent's Scope 1 emissions reducing from its nominal baseline – refer Table 14. In general terms and as an indicative average, emissions will be progressively mitigated by approximately four per cent per annum, which aligns with a net zero 2050 outcome - refer Table 11.

Covalent will pursue reductions in GHG emissions principally through continuous improvements in the Refinery operations in the immediate future. Offsets will only be considered if Covalent reaches the point of diminishing returns and further reductions in GHG emissions through continuous improvement will be difficult to achieve.

If Covalent is not able to achieve its Scope1 GHG emission reduction commitments, it will acquire carbon offsets that meet contemporary Australian acceptability standards. This may include Australian and international offsets. Covalent will continue to offset any GHG emissions in excess of 100,000 tonne CO_2e per annum for the life of the Refinery, while also continuing to pursue opportunities for improvement that arise over time. Further details on Covalent's approach to carbon offsets is set out in section 3.2.2 below.

3.1.2 Management principle 2

Covalent is committed to a long-term vision of GHG emissions reductions over the life of the Refinery and recognises that a flexible approach is important in driving ongoing innovation and improvement in best practice technologies in the long term. Specific actions to be taken to support the achievement of net zero Scope 1 CO_2e emissions by 2050 will be determined with reference to commercially viable options at the second 5 year review. Those actions will then be embedded in a revised GHGMP.

Covalent is focused on utilising a sustainable business model applying the mitigation hierarchy but that remains flexible. This includes continuing to identify opportunities for improvement in performance of the Refinery and carbon offsets as needed at any time.

3.1.3 Management principles 3 and 4

Covalent intends to strive towards becoming an Australian leader within the battery grade lithium hydroxide production space and will consider all measures needed to improve performance for GHG emissions intensity improvement over time. The purpose of the 5 year review is to closely interrogate:

- the GHG emission performance of the Refinery;
- the performance of the Refinery relative to the broader industry performance and any relevant trends in this regard; and
- Covalent's implementation of this GHGMP.

In line with the routine processes described, GHG emissions associated with relevant material and energy flows will be calculated and reported by Covalent, and performance will continue to be closely monitored on an ongoing basis.

As part of each 5 yearly review, Covalent will undertake an extensive literature search and industry review process and compare its previous performance against this information. All information gathered will serve as input to a robust systematic assessment process, which will be used to identify potential reduction opportunities for management approval.

Necessary updates will be made to the GHGMP to reflect GHG emission reduction measures that are implemented, with the intention of ensuring the management principles are met.

The process will provide an opportunity to assess the success of Covalent's continuous improvement process, identify any other commercially viable opportunities for reducing GHG emissions and take account of developments in relevant law, policy and practice.

Covalent will also undertake 10 year GHG emissions forward projections at this time and consider the Scope 1 CO_2e emissions targets contained in this GHGMP. Once Covalent has achieved its first milestone of reducing emissions to below 100,000 tonne CO_2e per annum, further targets will be set during the review to support the achievement of net zero Scope 1 CO_2e emissions by 2050.

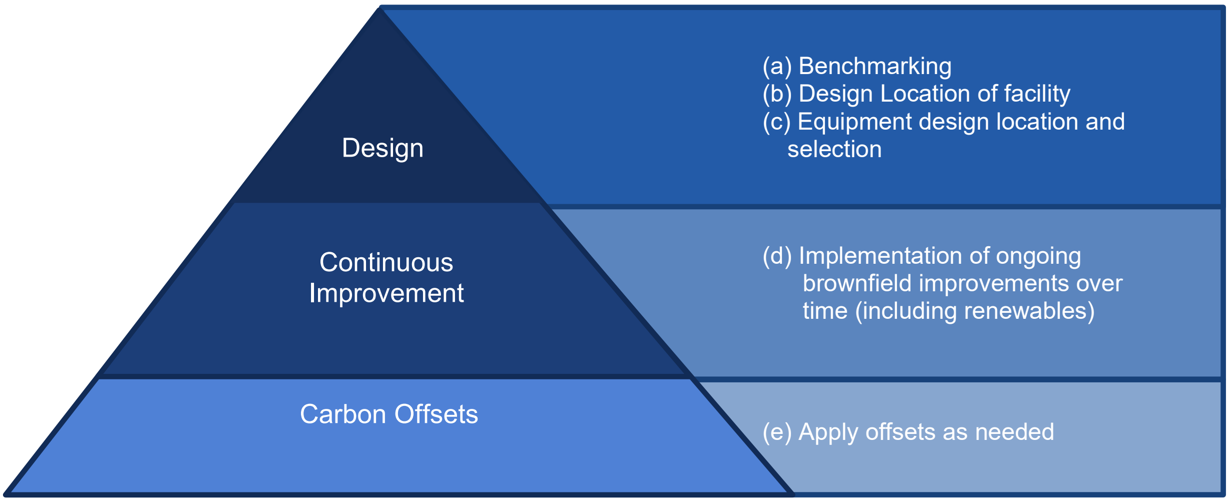
The key outcomes of the review will be embedded in a revised GHGMP. The update will show actual GHG reduction progress made to date against proposed trajectory. It will also provide a forecast new trajectory based on the latest information available at the time.

The GHGMP may also be revised outside of the 5 year review process, on an as needs basis. Further details on revision of the GHGMP are set out in section 4.2 below.

3.2 Application of the mitigation hierarchy

Covalent's development of management principles and actions, as described above at 3.1, is guided by the mitigation hierarchy and is consistent with the EFG. The mitigation hierarchy has been applied in this GHGMP to avoid, reduce and mitigate emissions across the lifetime of the Refinery in order to achieve the primary objective of the GHGMP. Covalent will apply the mitigation hierarchy to the Refinery as set out in Figure 4 below. Underpinning Covalent's mitigation methodology is the principle that all reasonable, practicable and commercially viable measures are to be applied at each step of the mitigation hierarchy in order to achieve the primary objective of this GHGMP, being GHG emission reduction and mitigation.

Figure 4 – GHG Mitigation Measure Hierarchy



An overview of the mitigation measures, as applied across the life of the Refinery, is described at a high level as follows:

Design:

Reducing GHG emissions through best practice design, including:

(1) comparing emissions and energy intensity performance metrics with equivalent facilities and ensuring emissions and energy intensity are minimised at the design stage;

(2) targeting high efficiency equipment selection, reduction of energy losses through improved design, reduction in the generation of waste streams, increased recovery of energy, and recycle and reuse of materials;

(3) targeting low emissions intensity performance through the adoption of low emissions technologies; and

(4) reducing emissions intensities through the layout and equipment provisions that allow easy future adoption of renewables and other technologies.

Continuous improvement:

Planning to reduce emissions over the life of the Refinery through continuous improvement processes and the consideration of commercially viable measures that may improve performance for emissions intensity over time.

Carbon offsets:

Offsetting GHG emissions through the implementation of a GHG emissions offset package for some or all residual emissions.

3.2.2 Carbon offsets

Carbon offsets are relevant to the Refinery and are expected to play a role as a mitigation measure in this GHGMP. Carbon offsetting will, however, only be contemplated after exhausting mitigation measures aimed at avoiding and reducing GHG emission. Carbon offsets sits at the lowest level of the hierarchy applied by Covalent. If Covalent's GHG emissions targets are not met through continuous improvement, then offsets will be applied to address the deficit. Covalent will acquire carbon offsets that meet contemporary Australian acceptability standards. This may include Australian and international offsets.

Where required, Covalent will acquire and apply acceptable offsets which may include credible international offsets in accordance with the Western Australian Government's Greenhouse Gas Emissions Policy for Major Projects.

Acceptable offsets units may include GHG Emissions issued under one of the following schemes:

a) Australian Carbon Credit Units issued under the Carbon Credits (Carbon Farming Initiative) Act 2011 (Cth);

b) Verified Emission Reductions issued under the Gold Standard programme;

c) Verified Carbon Units issued under the Verified Carbon Standard programme; or

d) Other offset units that the Minister has notified Covalent in writing meet integrity principles and are based on clear, enforceable and accountable methods.

3.3 Reporting

3.3.1 NGER Act scheme

The GHG emissions reporting framework for the Refinery is largely guided by the National Greenhouse and Energy Reporting (**NGER**) scheme. Under the *National Greenhouse Energy Reporting Act 2007* (Cth) (**NGER Act**), corporations that exceed the corporate and facility thresholds for emissions, energy production or energy consumption are required to report annually to the Clean Energy Regulator (**CER**). The current reporting thresholds for facilities and corporate groups is outlined in Table 17 below.

Table 17 – Current facility and corporate group reporting annual thresholds[20]

Threshold type	Facility threshold	Corporate group threshold
Scope 1 and Scope 2 emissions	>25,000 t CO_2e	>50,000 t CO_2e
Production of energy	>100 TJ	>200 TJ
Consumption of energy	>100 TJ	>200 TJ

Scope 1 emissions associated with the operation of the Refinery will be above the threshold for facility and corporate level reporting of 25,000 tonne CO_2e and 50,000 tonne CO_2e respectively under the NGER Act. When in operation the Refinery will be above the facility and corporate reporting threshold for energy consumption. On this basis, Covalent is required to register as a controlling corporation under the NGER Act and report annually.

Reporting under the NGER Act will be required from the first year of lithium hydroxide production at the Refinery onwards. While construction emissions are given cumulatively, in practice construction will occur over a number of years. Scope 1 emissions for construction is not anticipated to exceed the NGER scheme annual reporting threshold.

Annual Scope 1 emissions arising from the operation of the Refinery are estimated to be above the NGER Emissions Reduction Fund Safeguard Mechanism benchmark threshold of 100,000 tonne CO_2e, for at least the first 10 years of operation. Covalent is required to apply for a baseline to be set by the CER prior to its Scope 1 emissions exceeding the threshold. This is expected before its facilities are operational. The safeguard mechanism requires facilities whose net emissions exceed the safeguard threshold to keep emissions at or below the baseline set for that facility.

3.3.2 Summary plan and progress statement

Covalent intends to provide a GHGMP summary plan and progress statement which is publicly available, updated each time the GHGMP is revised, and each time a five yearly report is submitted.

The summary plan would outline non-confidential key information from the GHGMP (and relevant reports to that time), in an accessible form which can be easily reviewed by third parties for transparency.

The summary plan would allow third parties to compare the Covalent's plan against other proposals, and against relative contributions to the achievement of EPA objectives for the State.

Without precluding other intended needs being met, the summary plan will have a focus on Scope 1 emissions and include:

- a graphical comparison of emission reduction commitments in the GHGMP with 'actual' emissions for compliance periods,
- proposal performance against benchmarking for comparable facilities,
- emissions intensity,

[20] http://www.cleanenergyregulator.gov.au/NGER/Reporting-cycle/Assess-your-obligations/Reporting-thresholds

- a summary of emission reduction measures undertaken by the proponent, and
- a clear statement as to whether interim targets have been achieved.

3.3.3 Additional reporting

Broadly, GHG measurement and reporting undertaken by Covalent will consider the Refinery's associated GHG emissions, energy production or energy consumption. Tracking carbon inputs/outputs and energy efficiency will be key performance metrics within Covalent's daily and monthly performance reports. While from a systems perspective these requirements will be embedded in Covalent's environmental management system and routine production management reporting protocols, Covalent is itself internally incentivised to ensure at an operational level its carbon and energy intensity inputs are reduced as far as is reasonably practicable to do so.

Covalent will include the following information in the Annual Compliance Assessment Report for the Refinery:

- facility-level GHG emissions;
- emissions intensity (emissions per unit of product) achieved in practice; and
- measures implemented to reduce, mitigate and offset GHG emissions.

Covalent also intends to participate in other voluntarily public reporting to the wider community of its GHGMP progress. This will occur through Community Information Forums (**CIF**) typically used to ensure the community is kept informed on a range of topical matters. CIFs are open public meetings where reputable existing industrial business that operate within Kwinana present, and are periodically arranged and chaired by the Kwinana Industries Council, of which Covalent is a full member. This additional public reporting will be aligned with annual assessment reporting requirements as well as public five-year reporting[21] as set out in Article 4 of the Paris Agreement.

Covalent will ensure that:

- its reporting requirements and obligations under the Commonwealth NGER Act are met.
- its GHGMP is updated if there is a change to the proposal which means there is a material risk that emissions reduction targets will not be achieved.
- its GHG performance will be periodically audited and reviewed, and verification of these audits will be made publicly available as well as referenced within its GHGMP as part of its ongoing 5-yearly review / update process. For commercial reasons, any information regarded as sensitive or confidential will not be made publicly available.

4 Continuous improvement, adaptive management and GHGMP review

An adaptive management approach has been adopted by Covalent in this GHGMP. Developments in knowledge, technology, markets, policy and law are anticipated across the lifetime of the Refinery. This landscape of change presents a number of uncertainties and unknowns, the adaptive approach to management of the GHGMP affords Covalent the inherent ability to remain responsive, flexible and able to embrace opportunity for improvement. Measures adopted by Covalent, including continuous improvement and ongoing review of this GHGMP, that form the basis of the adaptive management approach are described below. Examples of what continuous improvement may look like in practice,

[21] Commencing five years after operation.

once operation of the Refinery has commenced, are described in Table 16 for Management principle 1 above.

4.1 Continuous improvement and adaptive management

Covalent is committed to reducing GHG emissions over the lifetime of the Refinery through ongoing continuous improvement processes. The primary objective of this GHGMP is to reduce and mitigate GHG emissions to as low as reasonably practicable. This approach maximises the long-term sustainability of the business without subsidy, encourages ongoing improvement and investment over time to reduce GHG emissions and waste energy, while minimising risk to the Western Australian environment associated with climate change.

Covalent has undertaken a number of upfront activities to ensure it proactively (and deliberately) minimises its emissions footprint prior to construction as part of initial engineering design and project decision making. This deliberate action has resulted in the Refinery's predicted 2025 baseline performance being exceptionally low by global standards. Because of the implementation of upfront design effort, Covalent is reliant on the incremental benefits of continuous improvement principles and will proactively pursue this strategy as a means to reduce its GHG emissions (as well as reduce its need to purchase carbon offsets which would otherwise be needed to meet its commitments). In doing so Covalent will adopt an adaptive management approach.

Covalent is committed to its plans to reduce emissions over the life of the Refinery through its ongoing continuous improvement processes.

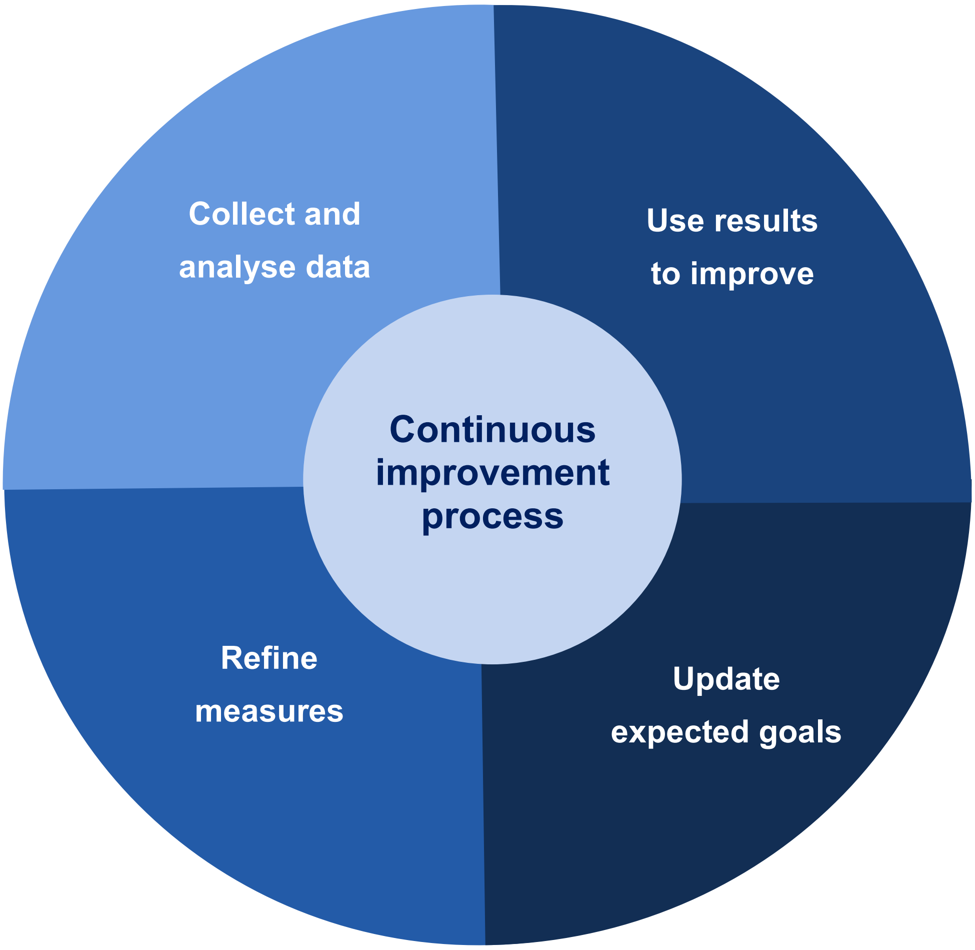
Covalent intends to strive towards becoming an Australian industry leader within the GHG emission reduction space and will consider all measures needed to improve performance for emissions intensity improvement over time. A number of future brownfield projects have already been identified implementation at a later date as part of Covalent's continuous improvement approach. To illustrate the consideration of continuous improvement in GHG emissions, several examples are described in Table 16 for Management principle 1 above.

Once the plant is commissioned, Covalent's engineering team will review the performance of the plant and identify and prioritise GHG performance areas on an ongoing basis – areas identified for development will be addressed as part of Covalent's continuous improvement plans. Mechanisms for assessing priorities, and changes thereof, will be built into Covalent's continuous improvement plan, this ensures flexibility and adaptability is maintained in Covalent's approach. To that end, the continuous improvement plan will be a 'live working plan' which will be under constant review to ensure its adaptive management remains highly dynamic and agile.

As illustrated below, Covalent will follow a four-step continuous improvement process, which operates in an ongoing cyclical fashion, to achieve GHG emission reduction. Covalent will:

1. collect and analyse its monitoring data;
2. use its results to identify improvements opportunities;
3. update its internal expectations to reflect its intended goal to continuously improve; and
4. refine measures as ongoing improvements are realised.

Figure 5 – Covalent's continuous improvement process



4.2 GHG Management Plan review

Covalent will formally review this GHGMP on a five yearly basis during the lifetime of the Refinery, to embed the outcomes of reviews and continuous improvements to reduce the Refinery's emissions intensity.

In line with the management approach adopted by Covalent, specifically the mitigation measure of continuous improvement as discussed above at 4.1, the GHGMP supports informal opportunities for review of management actions on an ongoing basis. This will allow Covalent to adapt the approach of the GHGMP and respond to new technologies as they emerge in the lifetime of the Proposal. Ultimately, this flexibility will support Covalent to achieve the primary objective of this GHGMP.

5 References

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