Appendix U

Greenhouse Gas Management Plan
Confidential Benchmarking Report
Peer Review

SIMCOA
Silicon Metal Company of Australia

Simcoa Operations Pty Ltd

Greenhouse Gas Emissions Environmental Management Plan

March 2024

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Glossary

Table 1 Table of Definitions

Term	Definition
Approved Proposal	The activities at Moora Mine and Kemerton Smelter which are described and approved under Ministerial Statement 813 (MS 813)
CER	Clean Energy Regulator (Commonwealth)
CO_2	Carbon dioxide
CO	Carbon monoxide
Climate change	A change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
ERF	Emissions Reduction Fund
ERD	Environmental Review Document
GHD	GHD Pty Ltd
GHG	A greenhouse gas (GHG) is a gas that absorbs and emits radiant energy within the thermal infrared range. Greenhouse gases can cause a warming greenhouse effect on the planet's atmosphere. The greenhouse gases that are reported under the National Greenhouse and Energy Reporting (NGER) Scheme include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6) and specified kinds of hydro fluorocarbons and perfluorocarbons.
GHG EMP	Greenhouse Gas Environmental Management Plan
Kemerton Smelter	SIMCOA's existing Smelter located in Kemerton Strategic Industrial Area (KSIA), approximately 17 km north-east of Bunbury in the South West of WA. Kemerton Smelter commenced operation in 1989 and is currently authorised to produce up to 64,000 tonnes per annum (tpa) of silicon from four submerged electric arc furnaces. Kemerton Smelter is governed by Ministerial Statement 813.
Mining Operations	GHG Emissions data is presented for Mining operations which includes the North Kiaka and Moora Mine
Moora Mine	SIMCOA's operational quartzite mine located approximately 15 km north of Moora, in the Wheatbelt of Western Australia. Moora Mine which is located on tenements M70/191, G70/91, G70/92 and G70/93, is governed under Ministerial Statement 813.
NGER Act	*National Greenhouse and Energy Reporting Act 2007* (Cth)
NGER Regulations	National Greenhouse and Energy Reporting Regulations 2008 (Cth)
NGER Rules	National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Cth)
North Kiaka DE	The North Kiaka DE is 216.42 ha, including: – Disturbance Footprint of up to 44.59 ha – Native vegetation clearing up to 17.12 ha.
The Project	The development of a new quartzite mine, North Kiaka, approximately 2 km north of Moora Mine. The proposed North Kiaka mine, is located within tenement M70/1292, and is anticipated to produce up to 130,000 tpa of lump quartz (approximately 2.34 million tonnes over the life of the mine). The Revised Proposal also includes construction of an abandonment bund for the Moora Mine pits.
The Proposal	The Proposal as referred to the EPA for assessment under s38 of the *Environmental Protection Act 1986*.
PV	Photovoltaics

Term	Definition
The Revised Proposal	The Project (North Kiaka DE) and Approved Proposal under MS 813 (Moora Mine and Kemerton Smelter).
ROM	Run of Mine
SIMCOA	SIMCOA Operations Pty Ltd
State Emissions Policy	WA Government's State Greenhouse Gas Emissions Policy for Major Projects (August 2019)
Stationary Energy Sources (emissions from)	Means the purposes for which fuel is combusted that do not involve transport energy purposes. Note: as per NGER measurement determination this is inclusive of non-road registered vehicles i.e. dozers & shovels
$tCO_{2\text{-}e}$	Tonnes of carbon dioxide equivalent
tpa	Tonnes per annum
Transport energy sources (emissions from)	Includes purposes for which fuel is combusted that consist of any of the following: (a) Transport by vehicles registered for road use; (b) Rail transport; (c) Marine navigation; and (d) Air transport
Greenhouse Gas Abatement Report: Triennial Review	Condition 9-2(3) of Ministerial Statement 813 requires Simcoa to submit a Greenhouse Gas Abatement Report: Triennial Review to the EPA. The 2020 Greenhouse Gas Abatement Report: Triennial Review was made publicly available with the Ministerial Compliance report for that year.
WA	Western Australia

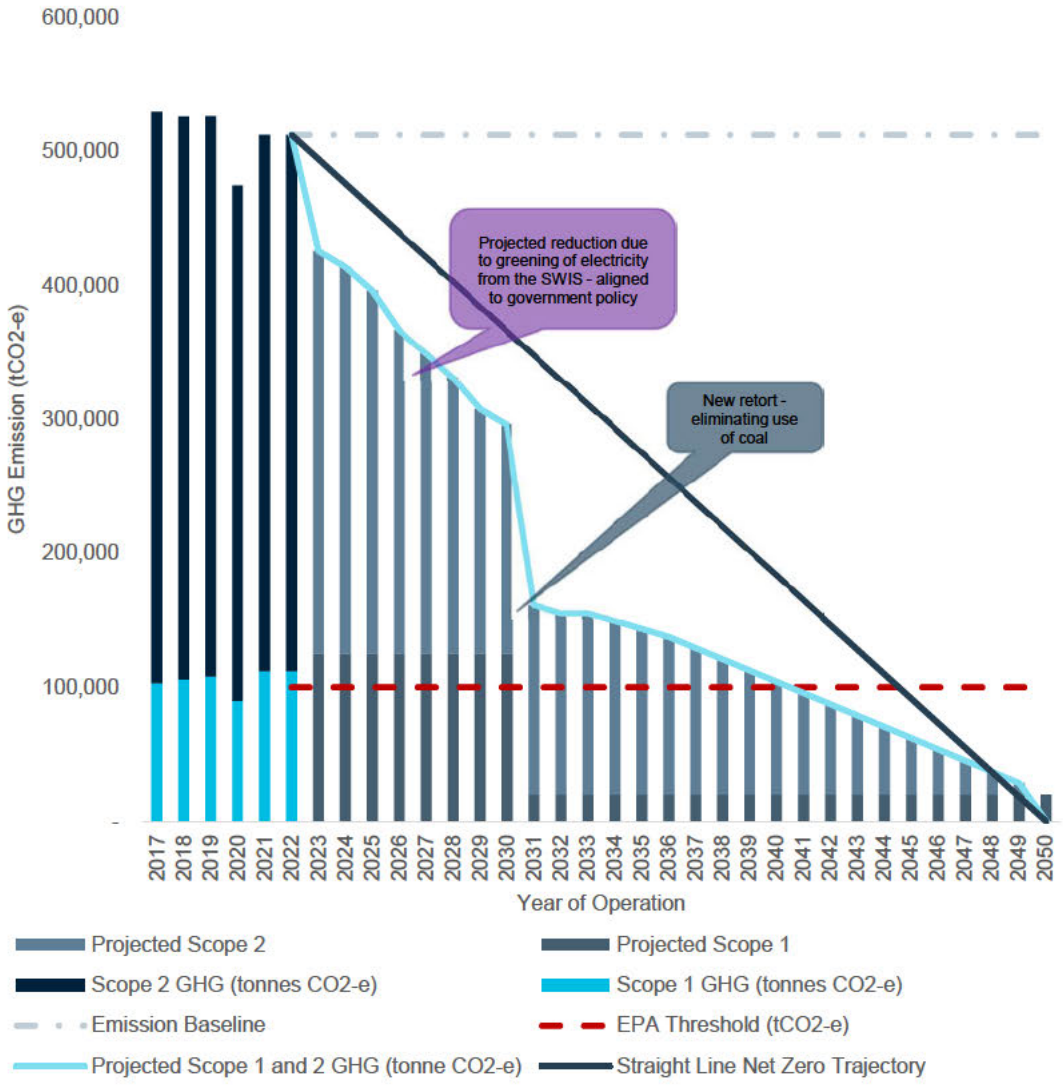
1. Executive Summary

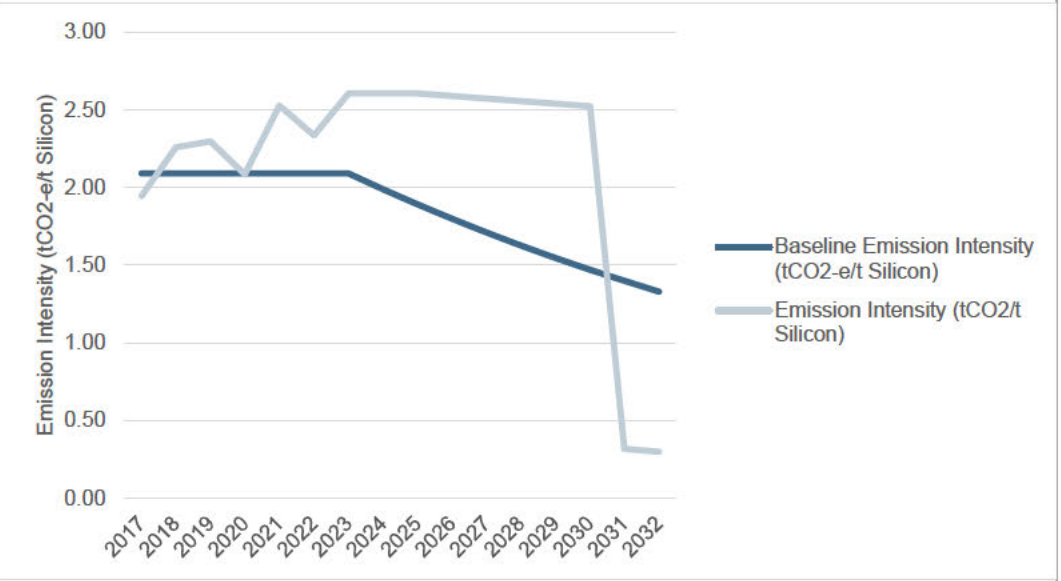
Table 2 summarises the context and purpose of the Greenhouse Gas (GHG) Environmental Management Plan (GHG EMP) for the North Kiaka mine in accordance with the Environmental Protection Authority's (EPA) environmental objectives.

Table 2 Executive summary table

<table>
<tr><td></td><td></td></tr>
<tr><td>Proposal name</td><td>North Kiaka Mine</td></tr>
<tr><td>Proponent name</td><td>Simcoa Operations Pty Ltd</td></tr>
<tr><td>Proposal description and scope</td><td>The Revised Proposal is for the development of a new quartzite mine at North Kiaka DE (the Project), approximately 15 km north of Moora, WA (Figure 3). The Project is approximately 1.5 to 2 km north northeast (NNE) of the existing Moora Quartzite Mine and is expected to generate up to 130,000 tpa of lump quartz for downstream processing at the Kemerton Silicon Smelter (Kemerton Smelter). Kemerton Smelter is located in the Kemerton Strategic Industrial Area (KSIA) 17 km north-east of Bunbury, WA.
The Project will be open-cut mine operating above the water table and has a predicted Life of Mine of 18 years based on current resource estimates.
Ore mined at the North Kiaka DE will be pre-processed (crushed and screened) using existing processing infrastructure at Moora Mine prior to transporting to Kemerton Smelter using the established network of power, water and roads at Moora Mine. The Revised Proposal also includes construction of an abandonment bund for the Moora Mine pits.</td></tr>
<tr><td>Purpose of the GHG EMP</td><td>To demonstrate the Proponent has assessed the Revised Proposal against the EPA GHG Emissions Factor Guideline and will contribute towards achieving net zero emissions by 2050 by implementing management measures for the Revised Proposal.
The original environmental approval, Ministerial Statement 813, for Kemerton Smelter and Moora mine contained conditions relating to GHE emissions under section 9-1 and 9-2. SIMCOA's Greenhouse Gas Abatement Report was submitted to the regulator in 2011. Details on SIMCOA's compliance with the conditions under 9-2 can be found in the Greenhouse Gas Abatement Report: Triennial Review as submitted to the EPA since that date.</td></tr>
<tr><td>Emissions estimates</td><td>
<table>
<tr><th>Construction emissions</th><th>Scope 1 (t CO2-e)</th><th>Scope 2 (t CO2-e)</th><th>Scope 3 (t CO2-e)</th><th>Total (t CO2-e)</th></tr>
<tr><td>Mining Operations</td><td>2,168</td><td></td><td>3,653</td><td>5,821</td></tr>
<tr><th>Annual operational emissions</th><th>Scope 1 (t CO2-e)</th><th>Scope 2 (t CO2-e)</th><th>Scope 3 (t CO2-e)</th><th>Total (t CO2-e)</th></tr>
<tr><td>Mining Operations</td><td>1,546</td><td>0</td><td>11,842</td><td>13,388</td></tr>
<tr><td>Kemerton Smelter</td><td>123,454</td><td>300,024</td><td>681,680</td><td>1,105,157</td></tr>
<tr><td>Total annual emissions[1]</td><td>125,000</td><td>300,024</td><td>693,522</td><td>1,118,546</td></tr>
<tr><th>Life of Asset emissions</th><th>Scope 1 (t CO2-e)</th><th>Scope 2 (t CO2-e)</th><th>Scope 3 (t CO2-e)</th><th>Total (t CO2-e)</th></tr>
<tr><td>Mining Operations</td><td>45,467</td><td>0</td><td>335,229</td><td>380,696</td></tr>
<tr><td>Kemerton Smelter</td><td>1,354,533</td><td>3,429,684</td><td>9,884,855</td><td>14,669,072</td></tr>
<tr><td>Total Life of Asset emissions</td><td>1,400,000</td><td>3,429,684</td><td>10,220,084</td><td>15,049,769</td></tr>
</table>
The annual and expected life of proposal emission estimates for Scope 1, 2 and 3 are presented below. This includes the construction emissions for the North Kiaka Project.</td></tr>
</table>

[1] Represents the expected emissions during the first year of operation of The Project excluding construction emissions.

Trajectory of emissions reductions	 *Figure 1 Scope 1 and 2 emission trajectory to 2050 (Executive Summary)* The projected emissions to 2050 is shown in Figure 1 outlining the key emission reduction activities that are expected to materially reduce Scope 1 and 2 emissions throughout the project lifetime. The mitigation hierarchy was applied by SIMCOA to avoid and reduce Scope 1, 2 and 3 emissions. The largest contribution to Scope 1 emissions within SIMCOA comes from the use of coal as a reductant in the smelting process at Kemerton Smelter. These emissions are expected to reduce with the installation of a new charcoal retort to avoid the use of coal, however the installation of this equipment is subject to separate environmental approvals. Scope 2 emissions are expected to reduce as the SWIS decarbonises with government policy committing to net zero by 2050. Scope 3 emissions will reduce with operations transitioning to 100% locally sourced timber instead of imported coal resulting in lower upstream transportation emissions. The product produced at the Kemerton Smelter is primarily sold to customers in Europe, the US and South-East Asia, as such a large proportion of Scope 3 emissions is subject to these country's energy mix and their decarbonisation plan. SIMCOA plans to generate Australian Carbon Credit Units (ACCUs) to offset Scope 1 emissions that can not be avoided or reduced. In the even there is a short fall of self generated ACCUs, SIMCOA will purchase them from the market.
Other statutory decision-making processes which require reduction in GHG emissions	**Safeguard Mechanism** The Safeguard Mechanism is a federal legislative framework applying to Australian emitters of Greenhouse gases emitting more than the Safeguard threshold (100,000 tons CO2-e pa), designed to keep their emissions at or below emissions baselines set by the Clean Energy Regulator. The Australian Government's Safeguard Mechanism (Crediting) Amendment Bill

	2023 passed Parliament on 30 March 2023 and takes effect from July 1, 2023. The amended legislation will apply to SIMCOA's Kemerton operations but not the North Kiaka or Moora Mine. As of the publication of this plan The Department of Climate Change, Energy, the Environment and Water (DCCEEW) is in the process of finalising amendments to the Safeguard Rule that will provide detail on how the reformed Safeguard Mechanism will be implemented. As such SIMCOA cannot currently provide trajectories under the mechanism and compare to the EPA GHG objective. It is expected, however, that all emissions reductions, key monitoring and reporting requirements under the Safeguard Mechanism will align with the requirements of this GHG EMP. SIMCOA's current baseline is based on Scope 1 emissions for the 2017/2018 financial year, 103,809 tCO2-e. SIMCOA benchmarked this performance against an emission intensity of 2.09 tCO2-e/t silicon. SIMCOA has purchased ACCUS when the emission intensity is above the baseline (e.g. 2021/22 financial year).  Figure 2 Comparison of current baseline emission intensity and projected emission intensity SIMCOA will reset the baseline based on the current Safeguard Mechanism Reform Position Paper and need to achieve 4.9% year on year reduction from the 2023/2024 financial year. SIMCOA plans to purchase ACCUS to achieve the baseline until the installation of a new charcoal retort which will achieve significant reductions below the 100,000 tCO2-e limit. This significant reduction will reduce the emission intensity baseline the current baseline as shown in Figure 2. Kemerton's Scope 2 and 3 emissions are governed by other decision-making processes requiring GHG emission reductions. **Renewable Energy Target – Emissions Intensive Trade Exposed** The Kemerton Smelter is an Emissions-intensive, trade-exposed (EITE) facility as defined under the Renewable Energy Target. This means it is trade exposed and has emissions intensive production. This in turn means the Kemerton Smelter may face higher electricity costs when compared to comparable international facilities due to the local cost pressures to reduce its emissions and be less able to manage those costs because the price of silicon is set in a global market. The EITE activity conducted at the site is the production of silicon from the reduction of silica using carbon reductant. Carbon monoxide and dioxide are produced as a gaseous waste from the process.
Key components in the GHG EMP	**Scope 1 Emission Reductions** *Avoiding Scope 1 Emissions.* SIMCOA is assessing the feasibility of an additional third charcoal retort at the Kemerton Smelter. This retort would allow the replacement of the current coal feed to the silicon furnaces with charcoal. SIMCOA intend to transition to 100% charcoal moving away from coal usage to significantly reduce Scope 1 emissions. This abatement measure is dependent on future environmental approvals being granted. *Reducing Scope 1 Emissions.* SIMCOA will additionally assess the potential of further increasing the efficiency of operation at the Kemerton Smelter facility to further reduce Scope 1 emissions over and above efficiencies pursued in the last decade, including those conducted in fulfilment of existing Ministerial Conditions.

	Offsetting Scope 1 Emissions. Where emissions cannot be avoided or reduced SIMCOA will be offset where required to meet SIMCOA's obligations under Commonwealth statutory requirements. **Scope 2 Emission Reductions** *Avoiding Scope 2 Emissions.* SIMCOA has adopted abatement opportunities during the design phase including: Substituting steel pressure rings with copper pressure rings in the silicon furnaces to achieve better electrical conductivity, resulting in greater silicon production for a given electricity consumption Using segmented shrouds in Furnace 3 that reduces the duration of shutdowns, allows better quality repairs, minimises the risk of electrode damage and provides a more rapid furnace start-up which minimises energy loses achieving electrical energy savings. Incorporating variable voltage and frequency drives to achieve electrical energy savings Some future abatement opportunities are being considered by SIMCOA, including: Incorporating furnace energy recovery and charcoal plant energy recovery to use waste heat to produce electricity which will reduce the consumption of electricity from the SWIS *Reducing Scope 2 Emissions.* The emission factor for the SWIS is projected to decrease from 0.51 tCO2-e per MWh in 2023 to 0.20 tCO2-e per MWh in 2035[2]. As a result, SIMCOA's Scope 2 emissions will significantly reduce as the emission factor for the SWIS reduces. It is further expected that the SWIS emission factor will become 0 by 2050 in line with current government policies hence, SIMCOA will have all Scope 2 emissions avoided. SIMCOA is additionally potentially able to reduce Scope 2 emissions by the following means: – Procure certified GreenPower through a GreenPower Accredited provider if commercially viable. – Enter into a green Power Purchase Agreement if commercially viable. – Install 'behind the meter' renewable generation infrastructure (e.g. installation of solar PV). *Offsetting Scope 2 Emissions.* Scope 2 offsets are not expected to be required. **Scope 3 Emission Reductions** Scope 3 emissions will reduce as SIMCOA transitions towards 100% locally sourced timber for charcoal production instead of imported coal resulting in lower upstream transportation emissions. The remaining Scope 3 emissions occur during the processing of the sold product by customers in a variety of countries in Europe, and in the US, Japan, and South East Asia. as such a large proportion of Scope 3 emissions is subject to specific countries energy mix and associated decarbonisation plans. These emissions are defined by the energy mix used in these countries and the efficiency of their operations. These emissions will be challenging to avoid or reduce due to limited alternative customers for SIMCOA and minimal influence over the way the product is processed. However, it is expected there will be worldwide reductions in the carbon intensity of individual countries energy mixes over the timeframe of this Plan.
GHG EMP reviews and reporting	SIMCOA will provide a publicly available GHG EMP summary plan and progress statement, which will be updated each time the GHG EMP is revised, including post Ministerial Conditioning, each time a five yearly report is submitted, or when any other change is made to the Revised Proposal that results in a material risk that the emissions targets will not be met. SIMCOA also conduct triennial reviews of the Greenhouse Gas Abatement Report as required under condition 9-2 (3) of Ministerial Statement 813. These are submitted to the EPA.
Proposed construction date	2024 (Anticipated date)
GHG EMP required pre-construction?	Yes ☐ No ☒
Proposed project end of life/decommissioning date	12/2042 (Anticipated date)

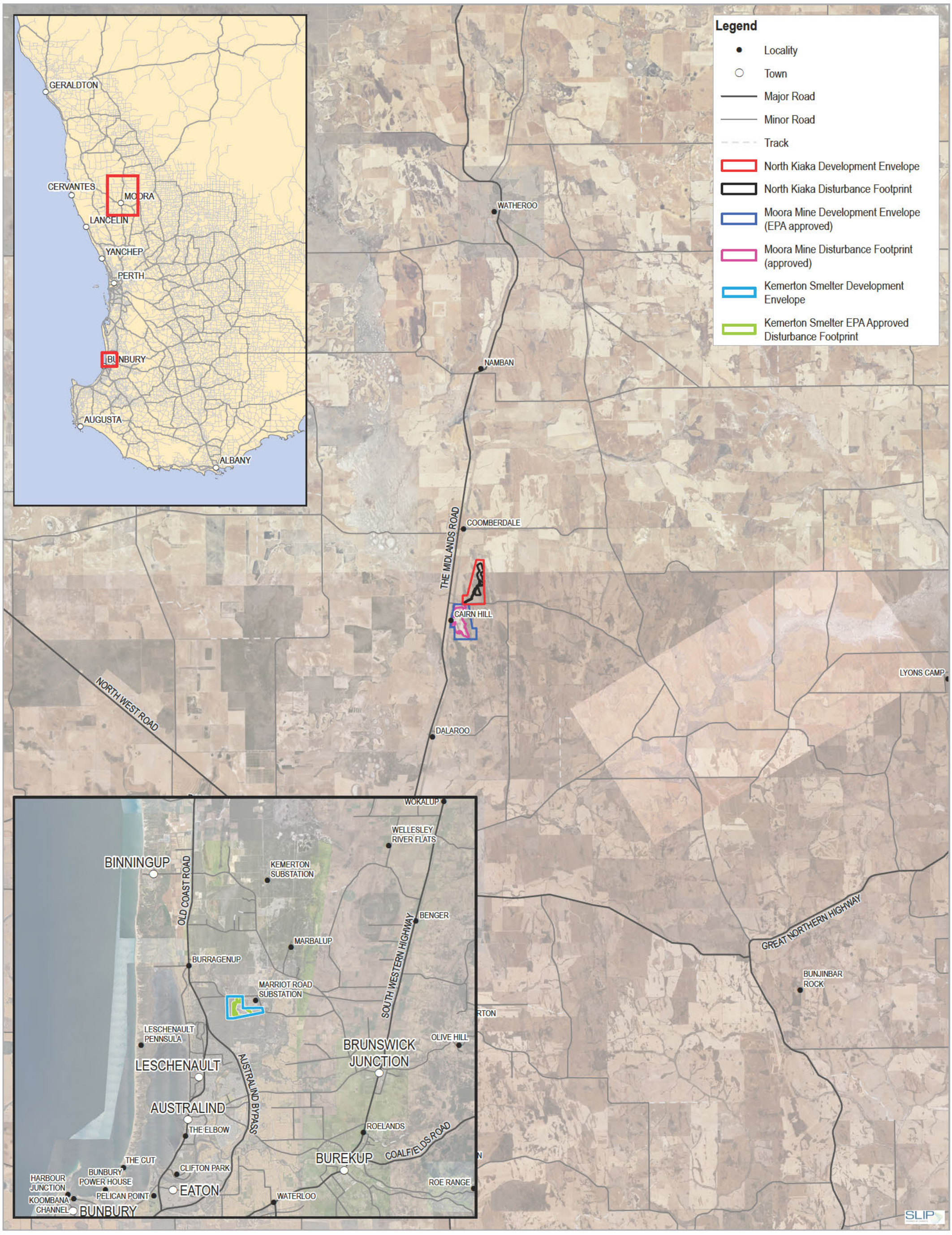
[2] Appendix C – Projected emissions factors for Australia's electricity grid in the baseline scenario, Australia's emissions projections 2022, **Australia's emissions projections 2022 (dcceew.gov.au)**

2. Context, scope and purpose

2.1 Proponent, proposal description and scope

Table 3 Summary of the Project

Project Details	
Proposal name	North Kiaka Mine
Proponent name	Simcoa Operations Pty Ltd
Project Summary	
Short Description	The Revised Proposal is for the development of a new quartzite mine at North Kiaka DE (the Project), approximately 15 km north of Moora, WA (Figure 3). The Project is approximately 1.5 to 2 km north northeast (NNE) of the existing Moora Quartzite Mine and is expected to generate up to 130,000 tpa of lump quartz for downstream processing at the Kemerton Silicon Smelter (Kemerton Smelter). Kemerton Smelter is located in the Kemerton Strategic Industrial Area (KSIA) 17 km north-east of Bunbury, WA. The Project will be open-cut mine operating above the water table and has a predicted Life of Mine of 18 years based on current resource estimates. Ore mined at the North Kiaka DE will be pre-processed (crushed and screened) using existing processing infrastructure at Moora Mine prior to transporting to Kemerton Smelter using the established network of power, water and roads at Moora Mine. The Revised Proposal also includes construction of an abandonment bund for the Moora Mine pits.
Construction and operation period	Construction phase: 1 year Operational phase: 18 years



Paper Size ISO A3

0 1 2 3 4 5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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Simcoa Operations Pty Ltd
Simcoa Environmental Approvals s40AA ERD

Project No. **12518217**
Revision No. **0**
Date **22/03/2024**

Project Location

FIGURE 3

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Data source: Simcoa: Mining Development Shape Areas is derived from client recieved 2020; Langate: Slip Imagery - April 2017 to November 2018 (accessed - 20191023), Cadastre, Road - 20180601; GA: Natmap Geodata Topo 250k Series 3. Created by: rbrown3

2.1.1 Process Description

Figure 4 provides a block flow diagram for the process of Silicon production. It shows the energy inputs for each activity in the process.

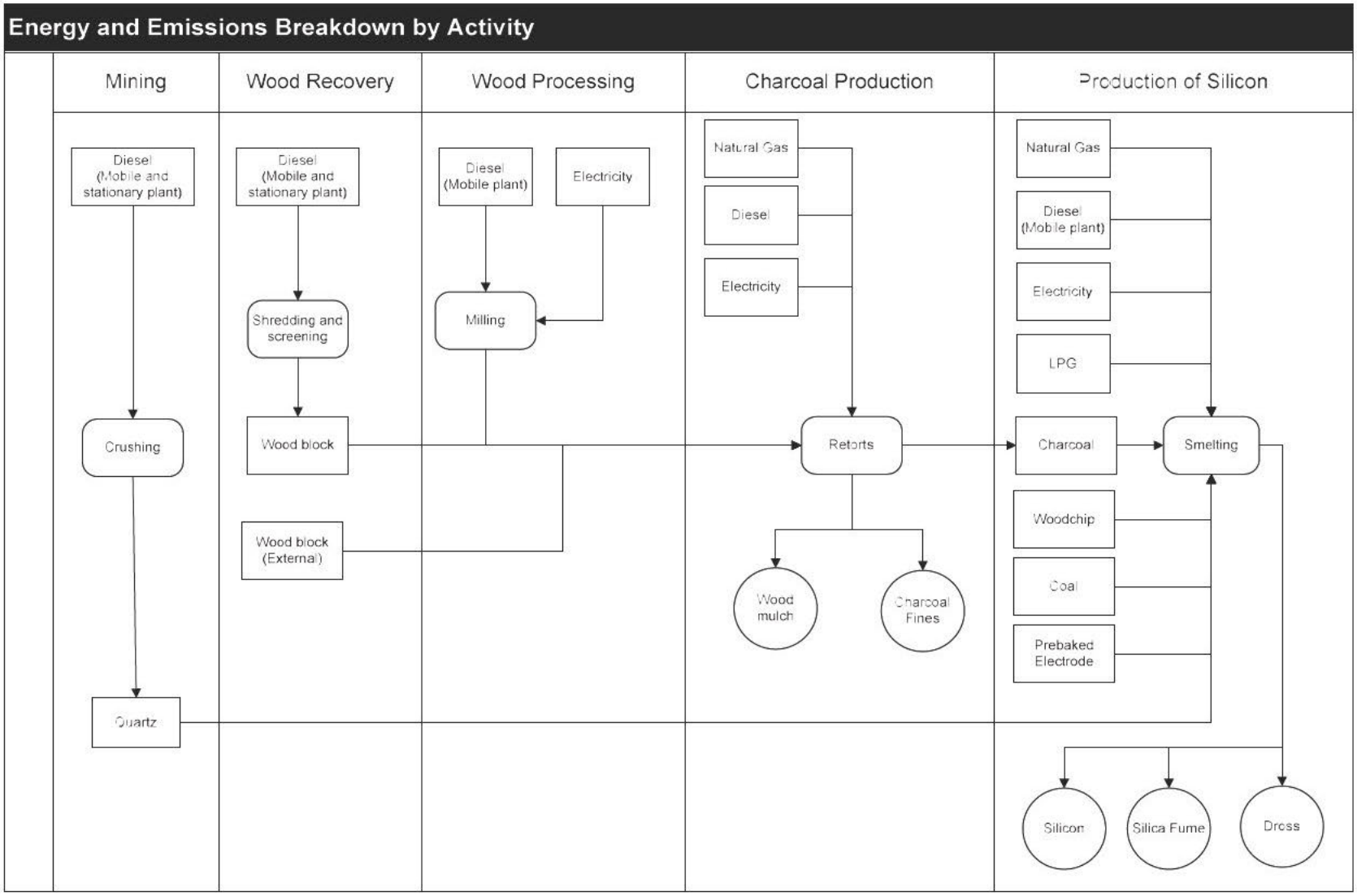

Figure 4 ***Silicon production process flow diagram***

2.2 Purpose of the GHG EMP

SIMCOA recognises that climate change represents a significant global challenge and are committed to becoming part of the solution by managing GHG emissions.

This GHG EMP has been prepared by GHD Pty Ltd (GHD) in conjunction with SIMCOA to support the assessment, approval and implementation of the Revised Proposal under Part IV of the *Environmental Protection Act 1986* (WA) (EP Act).

The purpose of the GHG EMP is to demonstrate how SIMCOA will contribute towards the State Government aspiration of net zero emissions by 2050 across Western Australia economy. SIMCOA is committed to reducing its Scope 1 and 2 operational GHG emissions for the Revised Proposal through reasonable and practicable management measures and applying an adaptive management framework to respond to current uncertainties and future developments in government policies, markets and technology.

The GHG EMP has been prepared considering the following:

- National Greenhouse and Energy Reporting Act 2007 (Cth) (NGER Act)
- National Greenhouse and Energy Reporting Regulations 2008 (Cth) (NGER Regulations) National Greenhouse and Energy Reporting (Measurement) Determination (2008)
- National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Cth) (NGER Rules)
- Greenhouse Gas Emissions Policy for Major Projects, Government of Western Australia 2019
- Climate Change in Western Australia Issues Paper, Government of Western Australia 2019
- Environmental Factor Guideline – Greenhouse Gas Emissions, EPA 2023
- Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans, EPA 2021

In preparing this GHG EMP the assessed emissions have been defined in accordance with the Australian Government NGER Act and the GHG Protocol. The NGER Act and subsidiary documentation only covers Scope 1 and 2 emissions, as such the GHG Protocol has been used to determine coverage and calculation methodology for Scope 3 emissions as per the definitions outlined in section 3.1.1.

Applying the NGER Acts covered emissions definition within this GHG EMP is seen as being consistent with the intent of the *Greenhouse Gas Environmental Factor Guideline* (EPA 2023).

2.2.1 Ministerial Statement Conditions

The current Part IV approval for the Approved Proposal, Ministerial Statement 813, for Kemerton Smelter and Moora mine, contains the following relevant conditions under section 9-1:

The proponent shall prepare and submit to the Minister for Environment, within 18 months of commencement of ground-disturbing activities, a Greenhouse Gas Abatement Report which meets the objectives set out in condition 9-2, as determined by the Minister for Environment.

And 9-2:

1) *Demonstrate that maximising energy efficiency and opportunities for future energy recovery have been given due consideration in the design of the third and fourth submerged electric arc furnaces;*
2) *Ensure that the "greenhouse gas" intensity ("greenhouse gas" per unit of silicon produced) is equivalent to, or better than, benchmarked world's best practice; and*
3) *Achieve continuous improvement in "greenhouse gas" intensity through triennial review, and if practicable, adoption of advances in technology and process management.*

2.2.1.1 Greenhouse Gas Abatement Report

SIMCOA's Greenhouse Gas Abatement Report was submitted to the regulator in 2011. Since 2011, SIMCOA has completed triannual reviews of this report in line with condition 9-2(3) of Ministerial Statement 813. These triennial reviews are submitted to the EPA.

The Triennial Review of the Greenhouse Gas Abatement Report details the following items:

- Mitigation and abatement measures (adopted and potential future opportunities)
- GHG emissions and energy profile

2.3 The Revised Proposal

SIMCOA Operations Pty Ltd (SIMCOA, the Proponent) currently operate the Kemerton Silicon Smelter and the Moora Quartzite Mine (the Approved Proposal) and is regulated under Part IV of the EP Act by means of Ministerial Statement 813 (MS 813).

SIMCOA is proposing to establish a new quartzite mine (the North Kiaka Mine) immediately north of the Moora Mine (with the mine pit located approximately 1.5 – 2 km north of Kiaka Road and the existing mine) and an abandonment bund at the existing Moora Mine. The proposed development of the North Kiaka Mine (the Project) is located within tenement M70/1292 (Figure 3). The Project is expected to generate up to 130,000 tonne per annum (tpa) of lump quartz for up to 18 years. The Kemerton Silicon Smelter, the Moora Mine and the proposed North Kiaka Mine represent the Revised Proposal.

3. GHG EMP Components

3.1 Emissions estimates

3.1.1 Emissions Scope Definitions

The NGER Act separates GHGs into Scope 1, 2 and 3 emissions. The NGER regulations define Scope 1 and 2 emissions as follows:

1. Scope 1 emissions- reg 2.23 states that a Scope 1 emission of GHG, in relation to a facility, means the release of GHG into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility. Scope 1 emissions are produced by the combustion of fuels such as diesel, and by vehicles, plant and equipment that Simcoa has operational control over. The direct combustion of these fuels is considered a Scope 1 emission.
2. Scope 2 emissions- reg 2.24 states that a Scope 2 emission of GHG, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility. These are indirect emissions as they arise from sources not owned or controlled by the person or business who consumes the electricity.
3. Scope 3 emissions- Scope 3 emissions are not defined in the NGER Regulations but comprise indirect GHG emissions other than Scope 2 emissions that are generated in the wider community and occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facilities business (Clean Energy Regulator 2018).

The types of GHG emitted and associated global warming potentials are detailed in Appendix A. Additionally, the explanation of emission sources, methodology and emission factors used in the emissions estimate are detailed in Appendix A.

The GHG EMP focuses on emissions for the Revised Proposal, which consists of:

- The North Kiaka Project (new Quartzite Mine and abandonment bund at the existing Moora Mine) construction and operational Scope 1 & 3 emissions in response to the EPA's Environmental Factor Guideline Gas Emissions (April 2023)

- The Scope 1, 2 & 3 emissions relating to the operation of SIMCOA's Kemerton Smelter
- The Scope 1 & 3 emissions relating to the operation of SIMCOA's Moora Quartzite Mine

This management plan discusses SIMCOA's capacity to reduce these emissions over the life of the Revised Proposal.

Table 4 Summary of Scope 1, 2 & 3 annual & total operational emissions life of all assets including construction emissions

Construction emissions	**Scope 1 (t CO2-e)**	**Scope 2 (t CO2-e)**	**Scope 3 (t CO2-e)**	**Total (t CO2-e)**
Mining Operations	2,168	0	3,653	5,821
Annual operational emissions	**Scope 1 (t CO2-e)**	**Scope 2 (t CO2-e)**	**Scope 3 (t CO2-e)**	**Total (t CO2-e)**
Mining Operations	1,546	0	11,842	13,388
Kemerton Smelter	123,454		681,680	1,105,157
Total annual emissions[3]	125,000	300,024	693,522	1,118,546
Life of Asset emissions	**Scope 1** (t CO2-e)	Scope 2 (t CO2-e)	Scope 3 (t CO2-e)	**Total** (t CO2-e)
Mining Operations	45,467	0	335,229	380,696
Kemerton Smelter	1,354,533	3,429,684	9,884,855	14,669,072
Total Life of Asset emissions	1,400,000	3,429,684	10,220,084	15,049,769

The annual and total operational GHG emissions and estimated construction emissions for the Revised Proposal are outlined in Table 4. These estimates are based on a nominal capacity of 48,000 tpa of Silicon produced by SIMCOA operations. This nominal capacity is expected to be maintained throughout the production lifetime of the Kemerton Smelter. The total operational emission estimate takes into account the expected GHG reductions during the lifetime of the Revised Proposal which are discussed under Sections 3.3 and 3.4. The baseline for operational emission calculations is the FY022 NGERS reporting year.

3.1.2 Scope 1 emission sources

3.1.2.1 Construction emission sources

A quantitative GHG assessment was undertaken to estimate potential emissions associated with construction activities associated with the Revised Proposal. The vast majority of these activities are restricted to the North Kiaka Mine (The Project). The assessment determined that the following are the most significant construction related Scope 1 emission sources:

a. Stationary energy sources including generation of electricity during construction (combustion of diesel)

b. Clearing vegetation (loss of initial carbon and carbon sequestration potential)

The estimated Scope 1 emissions attributable to construction activities are outlined in Table 5. The construction emissions relating to stationary energy sources and vehicle movements are presented as the total emissions for the 12-month construction period and have not been annualised. The emissions attributable to the loss of carbon sequestration potential as a result of vegetation clearing are estimated over a 50-year period.

The Scope 1 emissions relating to construction activities are not subject to any of the abatement or management provisions outlined within the GHG EMP.

[3] Represents the expected emissions during the first year of operation of The Project excluding The Projects construction emissions

Table 5 Calculation of Scope 1 construction emissions

Source	Details	tCO_{2-e}	%	Method of Calculation
Stationary energy sources	Site based, non-road registered equipment and machinery	70	3.2%	Estimated consumption of diesel and NGER measurement determination
Transport energy sources	Road registered vehicles and machinery	3	0.1%	Estimated consumption of diesel and NGER measurement determination
Clearing Vegetation	Lost carbon sequestration potential	2095.0	96.6%	Based on the total clearing area, assumed vegetation classes, estimated potential maximum biomass class and subsequent tCO_{2-e}/ha emissions factor

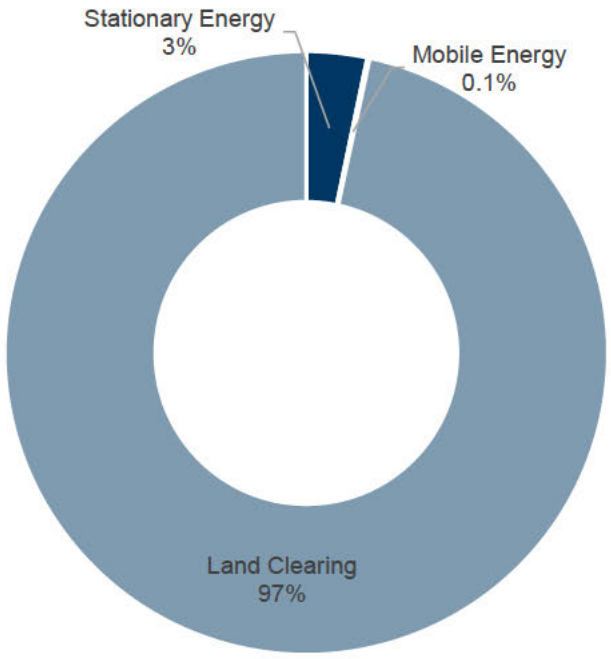

Figure 5 Breakdown of Scope 1 construction emissions

3.1.2.1.1 Stationary energy sources

Construction emissions relating to the consumption of diesel for stationary energy purposes has been estimated for the 12-month construction period based on both the duration and scale of construction activities, including bulk earthworks, physical plant construction and ancillary support services.

Emissions relating to the consumption of diesel for stationary energy purposes were estimated in accordance with the requirements of Part 2.4 Division 2.4.2 of the NGER measurement determination and include emissions from non-road registered vehicles.

3.1.2.1.2 Transport energy sources

Construction emissions relating to the consumption of diesel for transport purposes has been estimated for the 12-month construction period based on both the duration and scale of construction activities.

Emissions relating to the consumption of diesel for transport purposes were estimated in accordance with the requirements of Part 2.4 Division 2.4.2 of the NGER measurement determination and only includes emissions from road-registered light vehicles.

3.1.2.1.3 Clearing of vegetation

Construction emissions relating to the loss of potential carbon sequestration in vegetation have been estimated using the calculation methodology contained within the Transport Authorities Greenhouse Group (TAGG) Carbon Gauge tool[4]. The default quantity factors used within the Carbon Gauge tool for vegetation clearing are intended to estimate the loss of CO_2 sequestration potential through the removal of 1 hectare of the specified vegetation type and take into account carbon that exists in the vegetation at the time of clearing and carbon that could have been sequestered in the future if the vegetation was not cleared. The estimate assumes that all carbon sequestration potential in the above and below ground carbon pools is lost due to vegetation clearing.

3.1.2.2 Operational emission sources

A quantitative GHG assessment has been undertaken to estimate potential emissions associated with Project as well as the Moora Mine and Kemerton Smelter operations. The assessment determined that the following are the most significant year on year Scope 1 emission sources on site:

- Ferroalloy production

Other processes considered comparatively small and excluded from the study are considered to be:

- Vehicle movement (combustion of diesel)
- Use of oils, greases and lubricants in workshops

The processes listed below are considered to be under the operational control and responsibility of the contractors and have not been considered as a part of the Scope 1 GHG assessment:

- Delivery of goods to site and removal of wastes.

The estimated Scope 1 emissions attributable to operational activities are outlined in Table 6. The operation emissions relating to stationary energy sources and vehicle movements are presented as annual averages. The operational Scope 1 emissions reported in this GHG EMP are based on the data available in SIMCOA's annual NGER data reports submitted via the Energy and Emissions Reporting System (EERS) to the Clean Energy Regulator attesting to the accuracy of the data used in this assessment.

A large amount of the GHG emissions are related to the use of coal as a supplement to charcoal from timber as a reductant. The Kemerton Smelter contributes 97% to the overall Scope 1 operational emissions for the Revised Proposal due to the use of coal. This material source of Scope 1 emission will be the focus for developing mitigation measures for the net zero trajectory.

Table 6 Calculation of Scope 1 annual operation emissions

Source	Details	Site	tCO2-e	%	Method of Calculation
Stationary energy sources	Site based, non-road registered equipment and machinery	Mining Operations	1,502	1.2%	Estimated consumption of diesel and NGER measurement determination
		Kemerton Smelter	123,407	98.7%	
Transport energy sources	Road registered vehicles and machinery	Mining Operations	45	0.04%	Estimated consumption of diesel and NGER measurement determination
		Kemerton Smelter	46	0.04%	

[4] Energy & greenhouse - Sustainability - Environment & heritage - About us - Roads and Waterways – Transport for NSW

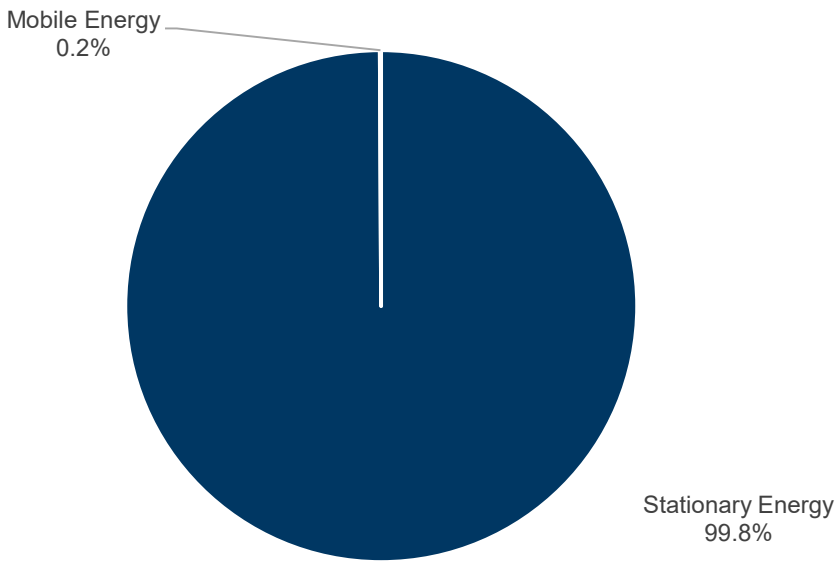

Figure 6 Breakdown of Scope 1 Operation emissions

3.1.2.2.1 Stationary energy sources

3.1.2.2.1.1 Kemerton Smelter

Operational emissions relating to the consumption of fuels (including diesel, LPG and natural gas) for stationary energy purposes at the Kemerton Smelter have been estimated for an 18-year operation period based off previous NGERs reporting and expected silicon production. Emissions relating to the use of these fuels were estimated in accordance with the requirements of Part 2.4 Division 2.4.2 of the NGER measurement determination.

3.1.2.2.1.2 Mining Operations

Operational emissions relating to the consumption of diesel for stationary energy purposes at North Kiaka Mine have been estimated for the years of operation to align with the Kemerton Smelter assumed lifetime. These emissions were estimates provided by SIMCOA based off the expectations of the mine operations. Operational emissions relating to the consumption of diesel for stationary energy purposes at Moora Mine have been combined with that for North Kiaka on the basis that operations beyond processing will cease early in the lifetime of the Project and that total production will remain the same at all times. Emissions will remain the same other than those associated with a slight increase in haul distance. Emissions relating to the consumption of diesel for stationary energy purposes were estimated in accordance with the requirements of Part 2.4 Division 2.4.2 of the NGER measurement determination.

3.1.2.2.2 Transport energy sources

3.1.2.2.2.1 Kemerton Smelter

Operational emissions relating to the consumption of diesel for mobile energy purposes for the Kemerton Smelter have been estimated for an 18 year operation period based on previous NGERs reporting data. Emissions relating to the consumption of diesel for mobile energy purposes were estimated in accordance with the requirements of Part 2.4 Division 2.4.2 of the NGER measurement determination.

3.1.2.2.2.2 Mining Operations

Operational emissions relating to the consumption of diesel for mobile energy purposes at North Kiaka Mine have been estimated for the years of operation to align with the Kemerton Smelter assumed lifetime. These emissions were estimates provided by SIMCOA based off the expectations of the mine operations. Operational emissions relating to the consumption of diesel for mobile energy purposes at Moora Mine have been combined with that for North Kiaka on the basis that operations beyond processing will cease early in the lifetime of the Project and that total production will remain the same at all times. Emissions relating to the consumption of diesel for mobile energy

purposes were estimated in accordance with the requirements of Part 2.4 Division 2.4.2 of the NGER measurement determination.

3.1.3 Scope 2 emission sources

3.1.3.1 North Kiaka construction emission sources

There are no expected Scope 2 emissions for the construction of the North Kiaka mine as there will be no electricity grid connection.

3.1.3.2 Operational emission sources

There will be no operational Scope 2 emissions for the North Kiaka Mine as there will be no electricity grid connection.

The Scope 2 emissions for SIMCOA's operations relate to the purchased electricity consumed at the Kemerton Smelter as shown in Table 7. The operation is electricity-intensive and consumes significant amount of electricity from the South West Interconnected System (SWIS). The operational Scope 2 emissions reported in this GHG EMP are based on the data available in SIMCOA's annual reports to the Clean Energy Regulator attesting to the accuracy of the data used in this assessment.

Table 7 Calculation of Scope 2 annual operation emissions

Source	Details	Site	tCO_{2-e}	%	Method of Calculation
Purchased Electricity	Electricity consumed from the SWIS	Mining Operations	0	0%	Estimated consumption of purchased electricity and NGER measurement determination
		Kemerton Smelter	300,024	100%	

3.1.4 Scope 3 emission sources

Given that Scope 3 emissions are largely outside of the direct control of SIMCOA, the available data is more limited, and a range of assumptions and estimates are required providing less robustness regarding the estimated emissions totals. As such the estimated Scope 3 emissions included in this GHG EMP are presented for the purposes of providing indicative value chain contributions only and are subject to the abatement or management provisions outlined within the GHG EMP.

3.1.4.1 North Kiaka Construction Scope 3 emissions sources

The construction related Scope 3 emissions have been estimated based on a 12-month construction period. The total estimated upstream and downstream emissions are represented for the full construction period in Table 8 and Figure 7.

Upstream emissions relating to the purchases of capital goods 83.7% of the total Scope 3 emissions and have been estimated based on the cost of construction.

Table 8 Calculation of Scope 3 North Kiaka construction emissions

Activity	GHG emissions source	tCO_{2-e}	%	Method of Calculation
Category 1 – Purchased Goods and Services	Immaterial for North Kiaka construction			
Category 2 – Capital Goods	Capital costs related to construction (including bitumen, traffic lights, dump trucks)	3,652	99.98%	GHG Protocol Qantis Tool emission factor
Category 3 - Fuel and Energy	Immaterial for North Kiaka construction			
Category 4 - Upstream Transport and Distribution	Immaterial for North Kiaka construction			

Activity	GHG emissions source	tCO_{2-e}	%	Method of Calculation
Category 5 - Waste Generated in Operations	Immaterial for North Kiaka construction			
Category 6 - Business Travel	Not applicable for North Kiaka construction			
Category 7 - Employee Commuting	Employee's commuting to and from site	1	0.02%	EPA US Emission Factor 2021
Category 8 - Upstream Leased Assets	Not applicable for North Kiaka construction			
Category 9 - Downstream Transport and Distribution	Not applicable for North Kiaka construction			
Category 10 - Processing of Sold Products	Not applicable for North Kiaka construction			
Category 11 - Use of Sold Products	Not applicable for North Kiaka construction			
Category 12 - End of life treatment of sold products	Not applicable for North Kiaka construction			
Category 13 - Downstream Leased Assets	Not applicable for North Kiaka construction			
Category 14 - Franchises	Not applicable for North Kiaka construction			
Category 15 - Investments	Not applicable for North Kiaka construction			

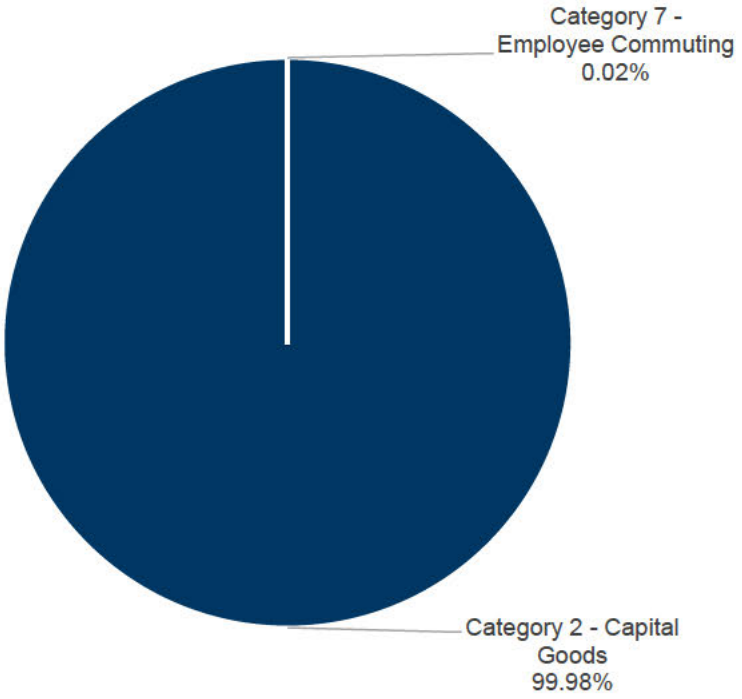

Figure 7 Breakdown of Scope 3 construction emissions

3.1.4.2 Operational Scope 3 emissions sources

Operational Scope 3 emissions have been annualised to align with the data provided for operational Scope 3 emissions shown in Table 9.

Table 9 Calculation of Scope 3 annual operational emissions

Activity Consumption	GHG emissions source	Site	Quantity (tCO2-e)	%	Method of Calculation / Emissions Factor Source
Category 1 - Purchased Goods and Services	Total spend for purchased goods	Mining Operations	3,788	0.5%	GHG Protocol Qantis Tool - Mining and Quarrying
		Kemerton Smelter	-	0.0%	
Category 2 - Capital Goods	Total spend for capital goods	Mining Operations	174	0.0%	GHG Protocol Qantis Tool - Mining and Quarrying
		Kemerton Smelter	-	0.0%	
Category 3 - Fuel and Energy	Fuel and Energy purchased for Kemerton Smelter Operation	Mining Operations	147	0.0%	NGER measurement determination
		Kemerton Smelter	24,059	3.5%	
Category 4 - Upstream Transport and Distribution	Transportation of input materials	Mining Operations	7,687	1.0%	EPA US Emission Factors 2021 and DEFRA Emission Factors 2021
		Kemerton Smelter	89,059	12.8%	
Category 5 - Waste Generated in Operations	Waste generated from smelter and mining operations	Mining Operations	11	0.0%	NGER measurement determination
		Kemerton Smelter	7,055	1.0%	
Category 6 - Business Travel	Travel and accommodation for business purposes	Mining Operations	-	0.0%	EPA US Emission Factors 2021 and DEFRA Emission Factors 2021
		Kemerton Smelter	12	0.0%	
Category 7 - Employee Commuting	Employee commute to and from site	Mining Operations	36	0.0%	EPA US Emission Factors 2021 and DEFRA Emission Factors 2021
		Kemerton Smelter	272	0.0%	
Category 8 - Upstream Leased Assets	Not Applicable for SIMCOA Operations				
Category 9 - Downstream Transport and Distribution	Not Applicable[5] for SIMCOA Operations				
Category 10 - Processing of Sold Products	Emissions related to processing of sold silicon	Mining Operations	0	0.0%	Review of literature relating Aluminum and Silicon alloy production, Photovoltaic production and the chemical industry
		Kemerton Smelter	559,340	80.7%	
Category 11 - Use of Sold Products	Immaterial for SIMCOA Operations				
Category 12 - End of life treatment of sold products	End of life treatment of silicon products	Mining Operations	0	0.0%	GHG protocol Qantis Tool - End of Life - Mixed Metals

[5] As per the GHG Protocol, all third-party transportation of materials (including downstream transportation of Silicon) is covered under Category 4 – Upstream Transport and Distribution

Activity Consumption	GHG emissions source	Site	Quantity (tCO2-e)	%	Method of Calculation / Emissions Factor Source
		Kemerton Smelter	1,882	0.3%	
Category 13 - Downstream Leased Assets	Not Applicable for SIMCOA Operations				
Category 14 - Franchises	Not Applicable for SIMCOA Operations				
Category 15 - Investments	Not Applicable for SIMCOA Operations				
Total			693,441	100%	

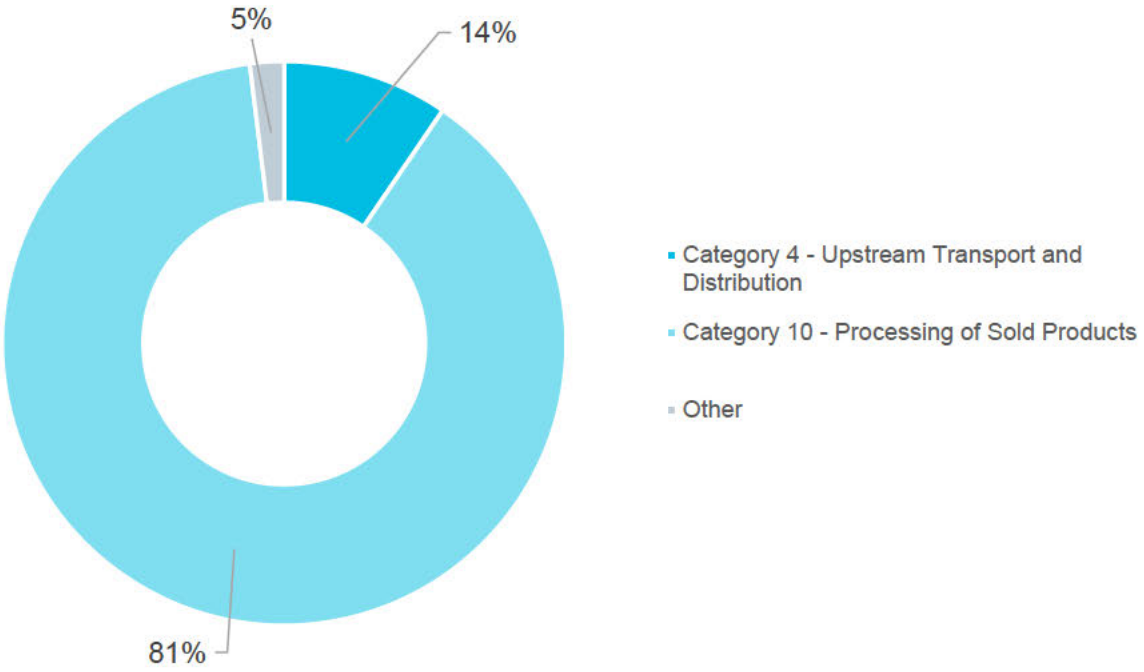

Figure 8 *Breakdown of Scope 3 operation emissions*

3.1.5 Emission Baseline

The FY2022 Scope 1, 2 and 3 emissions calculated in the Sections 3.1.2, 3.1.3 and 3.1.4 were used as the emission baseline for the trajectory in Section 3.2. This proposed emissions baseline is shown in Figure 9 alongside with historical emissions and throughputs for SIMCOA's operations.

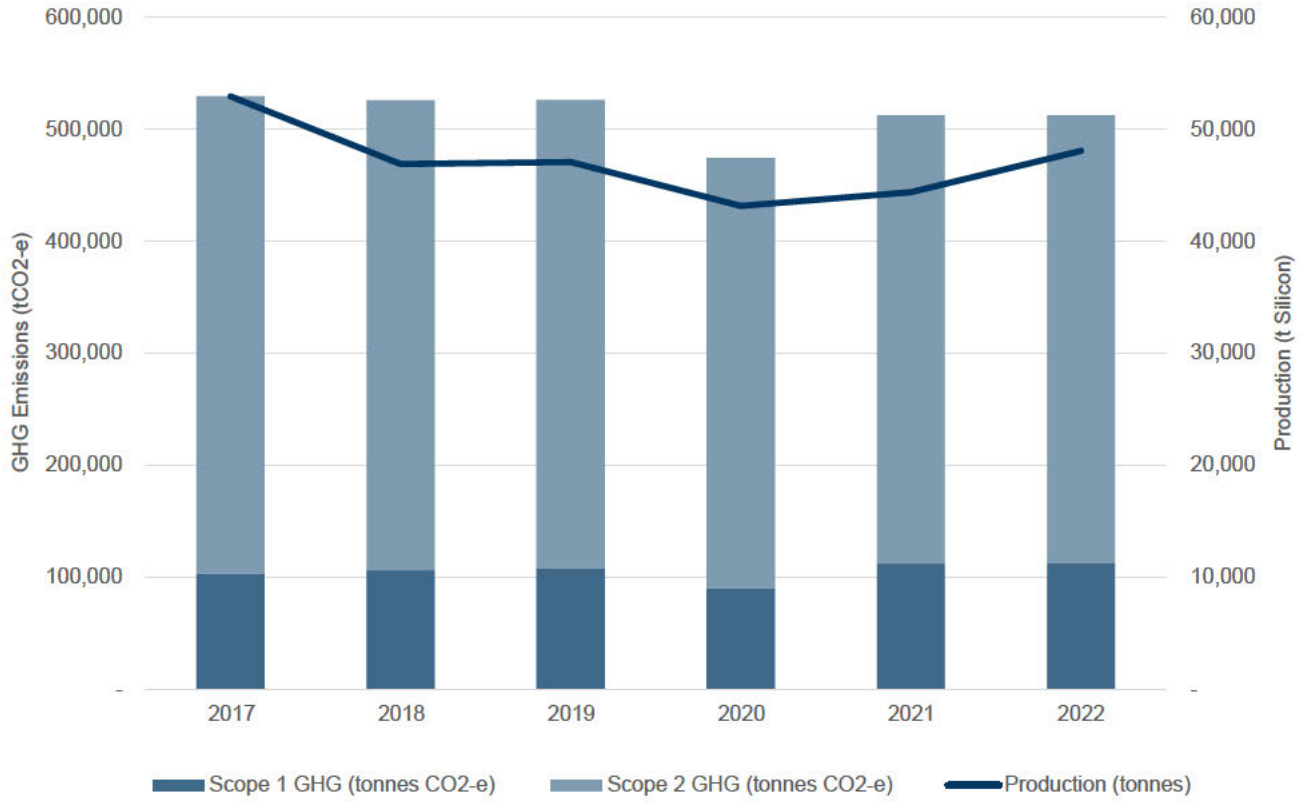

Figure 9 ***Historical emissions and throughputs for SIMCOA and proposed emission baseline used for trajectory in Section 3.2***

3.2 Trajectory of emissions reductions

A GHG emission trajectory for SIMCOA has been projected based off the current FY2022 Scope 1 and 2 operational emissions as shown in Figure 10. This trajectory includes the expected GHG reduction over time based on two key developments.

The expected decarbonisation of the SWIS as projected by the Department of Climate Change, Energy, the Environment and Water (DCCEEW)[6]. The DCCEWW provide an estimate emission factor for the SWIS from 2022 to 2030 and these were used for the projection. Additionally, the projection assumed a linear trajectory for the SWIS emission factor from 2030 to 0 by 2050 in line with current government policy. This has a significant impact to SIMCOA's Scope 1 and 2 emissions due to the electricity intensive process of silicon production.

To reduce Scope 1 emissions, SIMCOA is planning on phasing out the use of coal as a reductant in the process and increasing the use of wood to produce charcoal. This is done through implementing additional charcoal retort technology to offset the coal usage, pending the relevant environmental approvals being received. This additional retort was estimated to reduce Scope 1 emissions by approximately 90% as it offsets the majority of the coal usage. SIMCOA's investment in the retort is in line with world wide industry best practice.

[6] **Australia's emissions projections 2022 (dcceew.gov.au)**

Figure 10 shows the expected Straight-Line Net Zero Trajectory from the year 2022 to net zero by 2050. The projected emissions are expected to be under this trajectory until 2050. The remaining emissions relate to combustion of natural gas and diesel fuels which currently do not have alternatives hence, SIMCOA will plan to offset these emissions to achieve net zero by 2050. Further information on SIMCOA's Offset approach is detailed in Section 3.8.

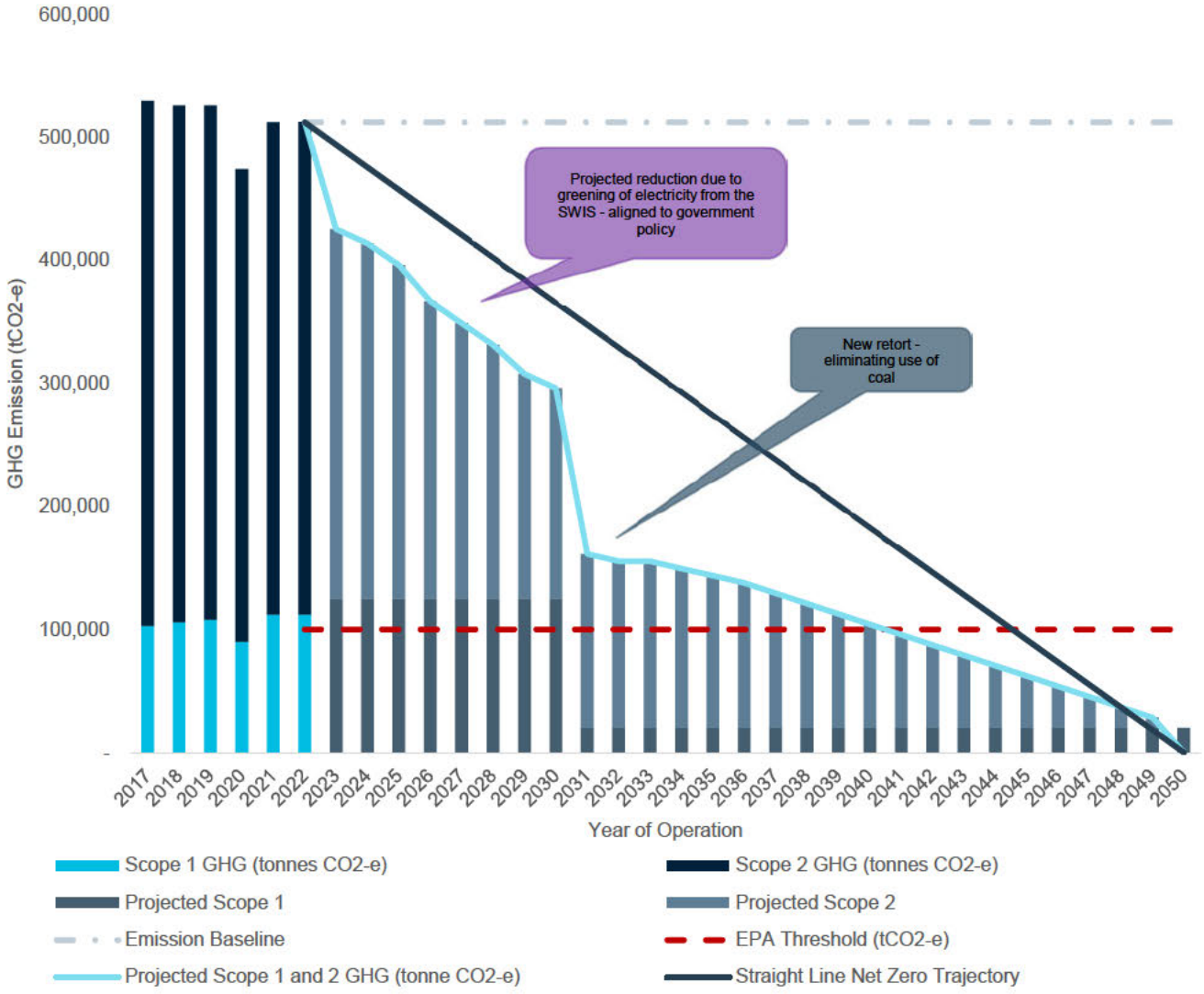

Figure 10 GHG 2050 trajectory

A Scope 3 GHG emission trajectory has been developed for SIMCOA's operations as shown in Figure 11. The material Scope 3 emissions relate to upstream transportation and the downstream processing of the product.

An emission-intensive transport activity includes the delivery of coal to the Kemerton smelter to be used as a reductant. The plan to install a new retort will eliminate the need for coal resulting in a decrease in the Scope 3 downstream transportation emissions. This has been incorporated in the trajectory with the abatement to occur in the year 2030 shown in Figure 11.

The remaining Scope 3 emissions occur during the processing of the sold product by customers. Simcoa exports 90% of the silicon metal to a range of countries and industries depending on market forces and demand for final product use. The end uses for silicon metal vary however tend to be split between three main industries:

- Metallurgical uses (i.e. aluminium alloys) (24.4%)
- Chemical uses (i.e. silicones) (57.3%)
- Polysilicon uses (i.e. solar panels) (18.3%)

The estimated end destination by region for SIMCOA's silicon product is as follows:

- 50% Asia
- 20% Europe
- 20% United States
- 10% Australia

Scope 3 emissions are defined by the energy mix used in these countries and the efficiency of their operations. The trajectory considers the current emission targets of Europe[7], the US[8], South-East Asia[9] and Australia[10], with majority of the countries in these regions having a net zero target by 2050. If these targets are met, SIMCOA's Category 10 Scope 3 emissions will be zero by FY50 as shown in the trajectory below.

These emissions will be challenging to avoid or reduce due to limited alternative customers for SIMCOA and minimal influence over the way the product is processed. However, it is expected there will be some reduction in the carbon intensity in these countries over the timeframe of this plan. SIMCOA will monitor the progress of the customer's performance against their emission targets and update the Scope 3 emission profile and trajectory.

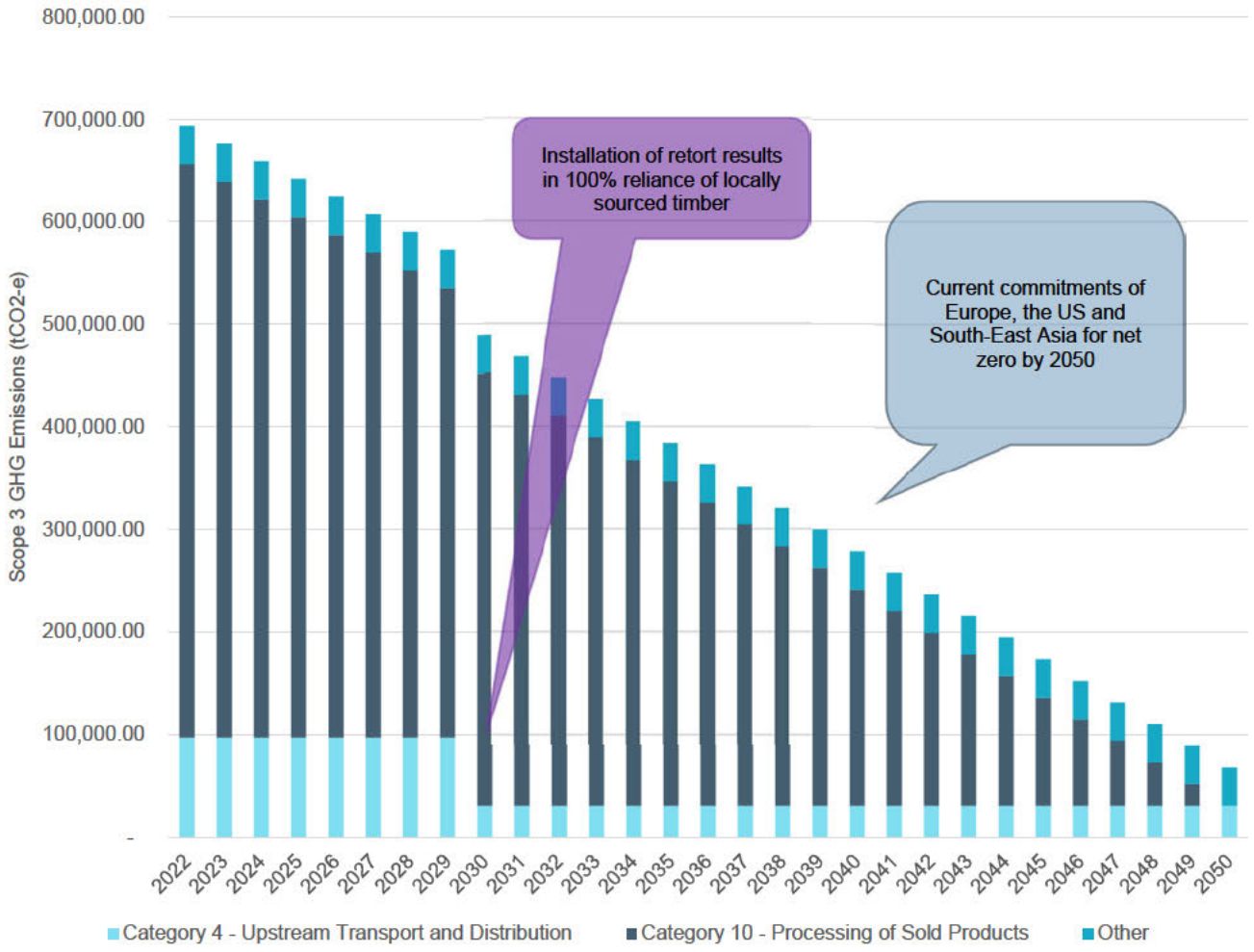

Figure 11 *Scope 3 trajectory to 2050*

[7] **Net zero targets | Climate Action Tracker**
[8] FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies | The White House
[9] Southeast Asia's Challenge of Decarbonizing While Growing Rapidly (csis.org)
[10] Australia submits new emissions target to UNFCCC - DCCEEW

3.2.1 Emission reduction targets

SIMCOA has identified a greenhouse gas emissions reduction target of net-zero operational greenhouse gas emissions by 2050, which aligns with the target for net zero emissions by 2050 identified in the Greenhouse Gas Emissions Policy for Major Projects (WA Government 2019).

Targets are based on a start date year of 2022, and should there be any substantial delays to construction of North Kiaka mine start dates, this would result in a change to the GHG EMP that would trigger an update to this document.

As detailed in Table 10, SIMCOA is committed to reducing Scope 1 and 2 operational greenhouse gas emissions by 18% every five years (relative to the previous target period target) through to 2050, with a trajectory that will enable net zero emissions to be achieved by the end of operations.

Table 10 *Projected Scope 1 and Scope 2 operational GHG emissions compared to 5-Year emission targets based on straight line trajectory to zero by 2050*

Reporting period	Projected Scope 1 (tCO_2-e/ annum)	Scope 1 5-year Targets	Projected Scope 2 (tCO_2-e/ annum)	Scope 2 5-year Targets
FY25	125,000	99,986	270,610	356,971
FY30	125,000	79,989	170,602	285,577
FY35	20,000	59,992	123,539	214,183
FY40	20,000	39,995	84,040	142,788
FY45	20,000	19,997	42,020	71,394
2050	20,000	0	0	0

The Scope 1 and 2 emission targets and projected emissions are shown in the figures below.

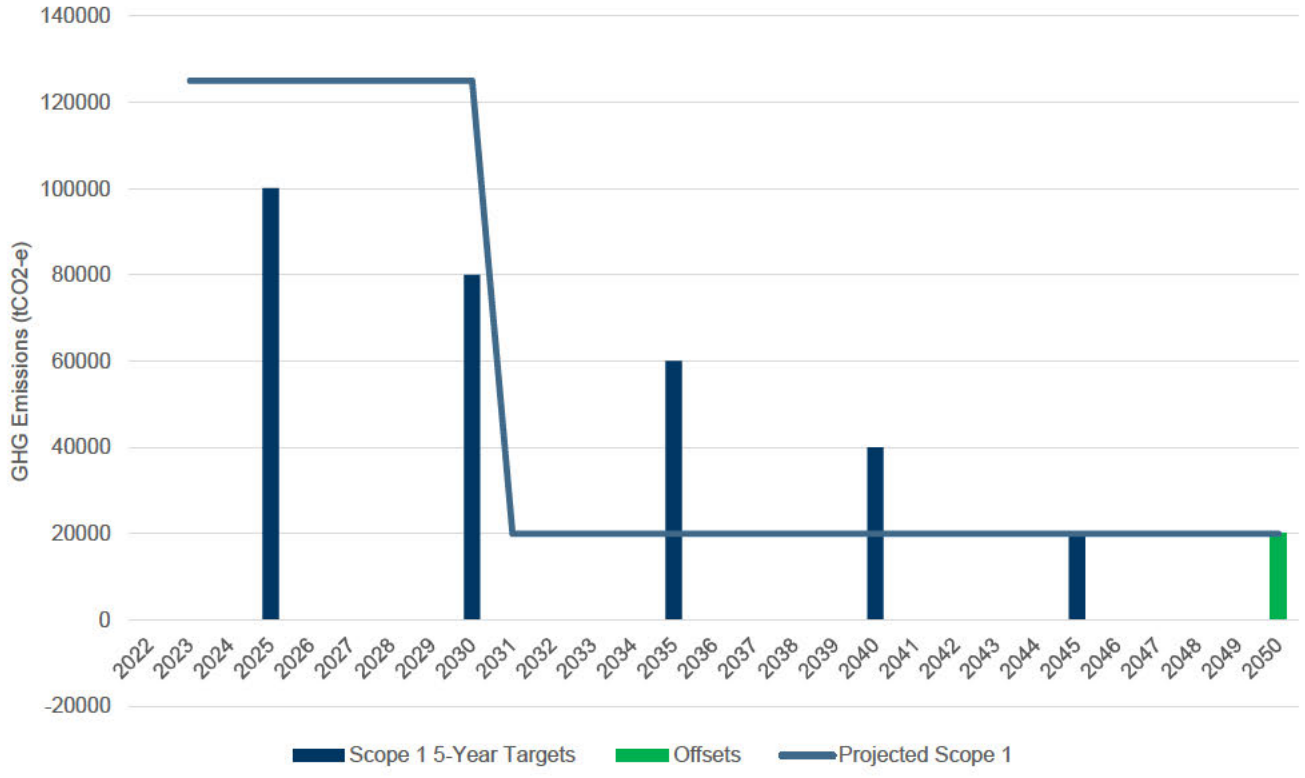

Figure 12 *Scope 1 5-Year Targets*

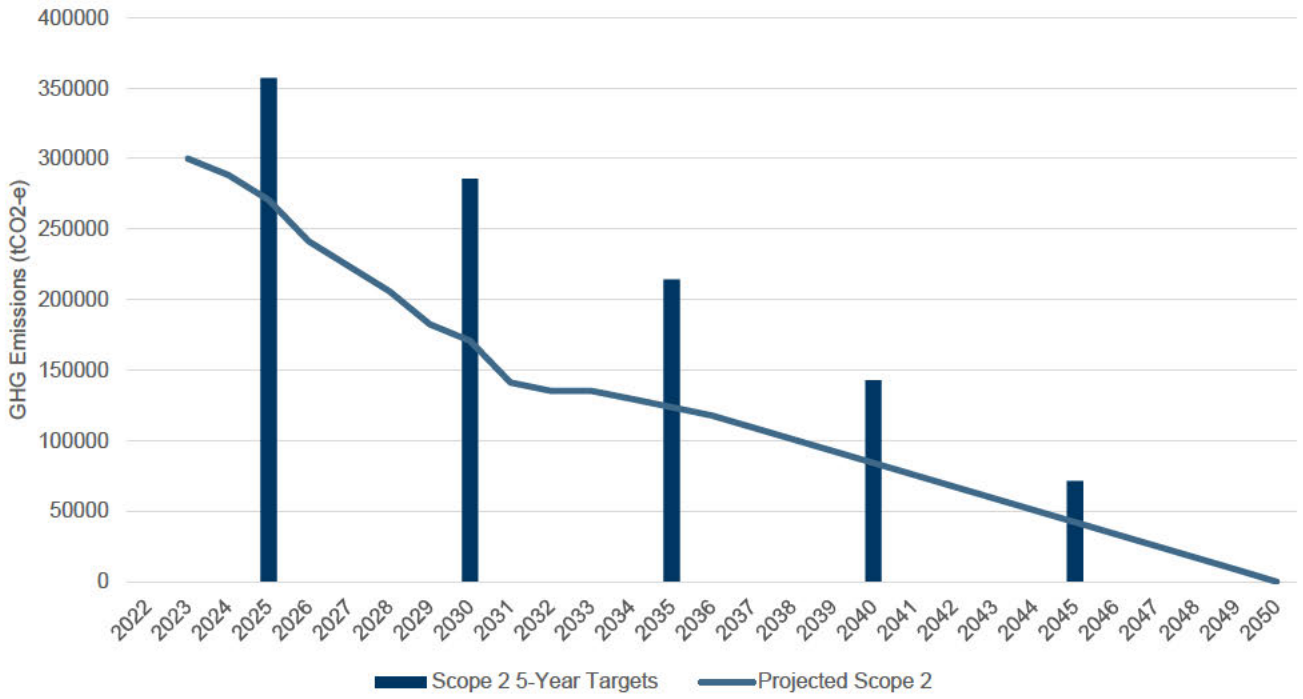

Figure 13 ***Scope 2 5-Year Targets. The Scope 2 trajectory is reliant on the State Government's target for the SWIS to be zero emissions by 2050 hence, a requirement to offset is not anticipated.***

The current approach to achieve the GHG emission reduction targets in Table 10 is as follows:

- Greening of electricity (decarbonisation of the SWIS as per current government policy)
- Increasing reliance of charcoal to minimise coal use (additional charcoal retort)
- Increasing efficiency of operation (wood drying, heat recovery)
- Relinquishment of carbon offsets.

Carbon offsets will be managed throughout the life of the Revised Proposal and the final balance of emissions versus offsets will be reviewed in the final year of operation.

Should electrification of heavy vehicles or alternative fuels such as green hydrogen become more financially available to meet the targets, these would also be considered and would therefore feature in future updates to the GHG EMP. At this stage they are cost prohibitive.

3.2.2 Mitigation Hierarchy

The mitigation hierarchy shown in Figure 14 shows the step-by-step approach taken by SIMCOA to mitigate GHG emissions. Opportunities to mitigate energy usage and GHG emissions are prioritised in terms of avoidance, reduction (e.g. efficiency improvements), replacement and lastly, through offsetting with accredited renewable energy certificates or carbon credit units.

The priority in the hierarchy and initial focus is to avoid energy consumption at the point of consumption. For SIMCOA, this may be done through focusing on electricity consumption from the Kemerton Smelter as this is the most material emission source. The next priority is to review the consumption of coal as a reductant and identify alternative materials and methods to reduce Scope 1 emissions associated with coal usage.

Once efforts have been made to avoid consumption, the focus is moved to reducing energy consumption through efficiency improvements. The process of reducing energy consumption will be on-going and efficiency opportunities will be revisited over the life of the Revised Proposals. Energy efficiency in operations at the Kemerton Smelter may be achieved through a combination of design considerations identified in the avoidance step. The potential of heat recovery and wood drying systems may assist in achieving energy efficiency and recovery to reduce SIMCOA's Scope 1 emissions.

The next step is to replace carbon/GHG intensive energy sources with renewable alternatives. This may include electrification of fleet vehicles and both the installation of 'behind the meter' renewable generation infrastructure (e.g. installation of solar PV), as well as the purchased of renewable electricity through contractual instruments or power purchase agreements (PPAs).

It is recognised that not all emissions can be avoided, particularly the emissions inherent within supply chains (Scope 3). Also, the process of silicon production requires fuel usage without current feasible alternatives hence, these residual emissions will need to be offset via the purchase and voluntary surrender of recognised accredited carbon credit units.

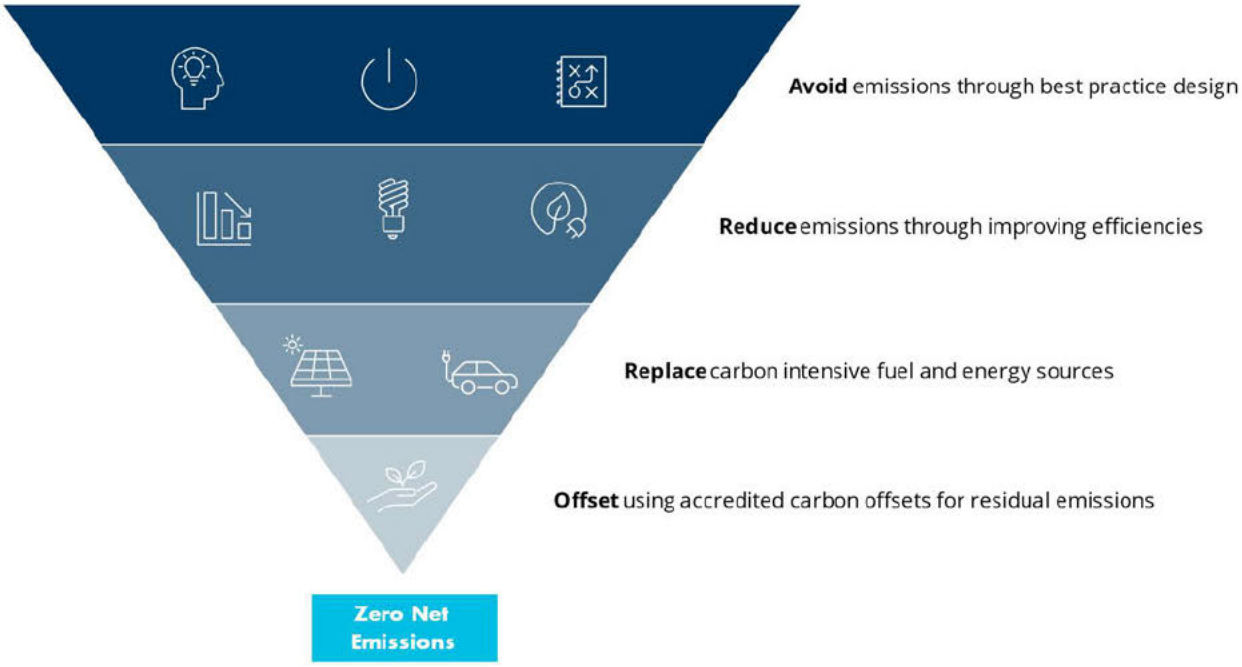

Figure 14 Mitigation hierarchy pyramid

The trajectory of emissions which will be avoided, reduced and offset to achieve net zero by 2050 is shown in Figure 15.

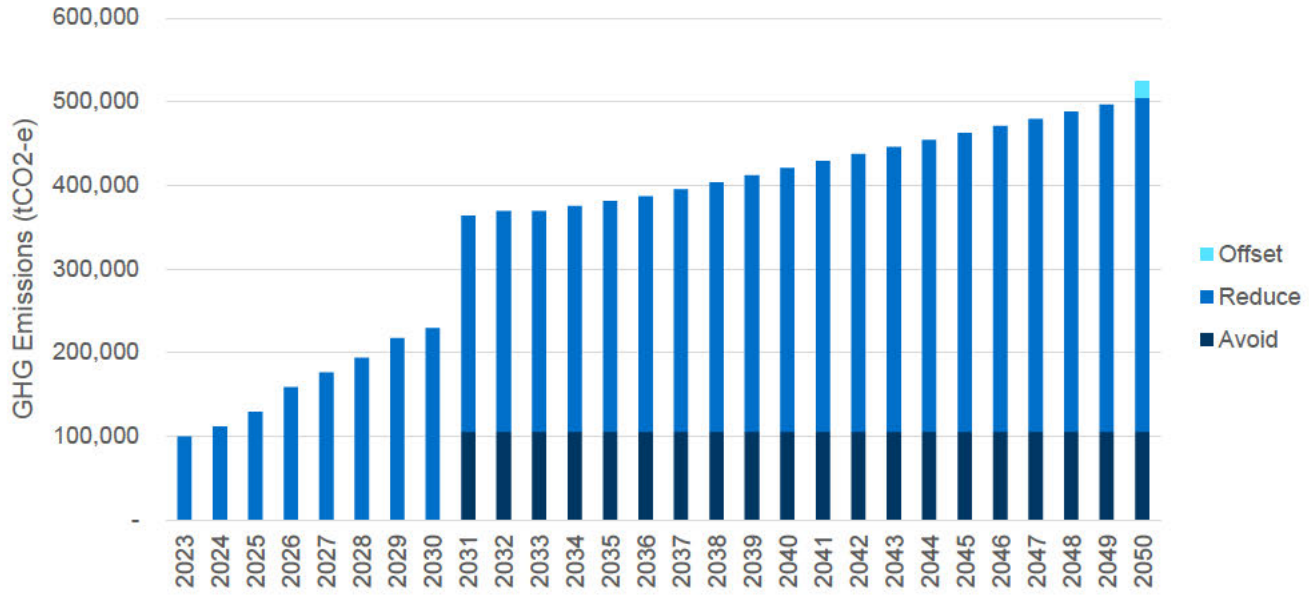

Figure 15 Trajectory of emissions which will be avoided, reduced and offset to achieve net zero by 2050

3.3 Mitigation measures adopted to avoid, reduce or offset scope 1 emissions

The material source of Scope 1 emissions is from the use of coal as a reductant at the Kemerton Smelter contributing 90% to the overall Scope 1 operational emissions. The coal is used as a reductant alongside with charcoal from timber in the process. This links to the desire for SIMCOA to avoid the use of coal in the operation and transition completely to relying on charcoal from timber sources for all reductant needs.

SIMCOA is assessing the feasibility of an additional third charcoal retort at the Kemerton Smelter. This retort would replace the coal feed with charcoal. Charcoal is more environmentally friendly relative to coal resulting in reduced emissions and use of coal. SIMCOA intend to transition towards 100% charcoal, moving away from coal usage, to reduce Scope 1 emissions. This abatement measure is dependent on environmental approvals being granted but SIMCOA is aiming to install a third retort in about 2030 as described in Section 3.2.

This transition is expected to see a 90% reduction in Scope 1 emissions due to the avoidance of using coal in the operations. This will result in the remaining 10% of Scope 1 emissions to be avoided, reduced or offset by the year 2050 to achieve net zero in line with this GHG EMP and government targets.

SIMCOA will assess the potential of increasing the efficiency of operations at the Kemerton Smelter facility to further reduce Scope 1 emissions. SIMCOA has identified potential plant improvements upgrades that will increase the efficient of the smelter operations. These improvements include, subject to their technical and financial feasibility, implementing wood drying equipment to reduce the energy required to process the reductant and to install a heat recovery system to utilise waste heat from the arc furnace operation.

The residual GHG emissions are largely related to the ongoing requirement for electrode use in the silicon furnaces. The current state of alternative technologies and processes does not allow SIMCOA to reduce or avoid these residual emissions. Hence, SIMCOA will consider available offsets for these emissions in the approach to 2050 to achieve carbon neutrality.

An estimate of the Scope 1 emissions to be avoided, reduced and offset is presented in Table 11. The quantification of the emissions saved from the proposed measures show that these measures are likely to achieve the emission reductions stated in Section 3.2.

Table 11 Estimate of Scope 1 emissions to be avoided, reduced and offset

Categories	Quantification of emissions
Avoid	105,000 tCO2-e per annum expected savings for the installation of a third charcoal retort.
Reduce	Possible energy efficiency activities are being considered but not quantified for this GHG EMP.
Offset	Refer to section 3.8

The Greenhouse Gas Abatement Report: Triennial Review, details the status of GHG Scope 1 mitigation measures which have been considered, implemented, not implemented or are under technical review, these measures are detailed in Table 12.

Table 12 Summary of Scope 1 Mitigation and Abatement Measures

Opportunity	Opportunity Description	Anticipated Emissions Reduction (tCO_2-e)	Status
Baghouse fans with variable speed drives	The Furnace 3 design incorporated variable speed drives for the baghouse fan motors, enabling the fan speed to be adjusted according to specific requirements.	2,626	Implemented
Furnace 3 energy recovery	During the design of Furnace 3, several features were included to enable the installation of an energy recovery system. Once operational, the off gas failed to reach the required high temperature for energy recovery.	0	Not Implemented

Opportunity	Opportunity Description	Anticipated Emissions Reduction (tCO_2-e)	Status
Furnace 1 and 2 energy recovery	Installation of an Organic Rankine cycle system for furnaces 1 and 2 was proposed, however this would require extended downtime for installation which is currently not feasible.	0	Not implemented
Charcoal plant energy recovery	The installation of an Organic Rankine type energy recovery system was suggested in the 2011 Greenhouse Gas Abatement Report: Triennial Review. Since this time, alternative waste heat options have been investigated	0	Not Implemented.
Briquetting of charcoal fines	Charcoal fines produced at Simcoa could be briquetted to make them suitable for use as a reductant in the furnace. These briquettes are carbon neutral and would reduce the use of coal in the furnace. In 2023, Simcoa commenced a review of opportunities for briquetting of charcoal fines. Further investigation will be undertaken in 2024.	8,700	Under Technical Review
Charcoal reductant	The 2011 report suggested Simcoa could reduce its scope 1 GHG emissions through increasing the use of charcoal in its process in place of coal reductants. An option for increasing charcoal consumption is the sourcing of charcoal from external suppliers. In 2023, Simcoa trialled a small quantity of charcoal from Brazil. The outcomes of the trial are currently being assessed and Simcoa will continue to investigate this opportunity in 2024.	Not calculated	Under Technical Review

3.3.1 Benchmarking assessment

There are no other Silicon production facilities in Australia, the benchmarking for this GHG EMP was completed by using confidential data prepared by CRU[11] comparing emission intensity for Silicon production around the world. This information is shown in confidential report included as Attachment A (not for public distribution).

3.4 Mitigation measures adopted to avoid, reduce or offset scope 2 emissions

Scope 2 emissions contribute to approximately 61% of SIMCOA's total emissions due to the electricity intensive nature of the arc furnaces required to convert the quartz to silicon product. This electricity is drawn from the SWIS, hence the emissions relate to the energy mix and emission factor for this network. The emission factor for the SWIS is projected to decrease from 0.51 $kgCO_{2\text{-}e}$ per kWh in FY23 to 0.20 $kgCO_{2\text{-}e}$ per kWh by 2035[12]. This decline in emissions is predominately related to the expected increase in uptake of renewable energy technologies. Inherently, SIMCOA's Scope 2 emissions will significantly reduce as the emission factor for the SWIS reduces. It is expected that the SWIS emission factor will become 0 by 2050 in line with current WA government policies, hence, SIMCOA will have all Scope 2 emissions avoided. SIMCOA do not anticipate the requirement for offsets for Scope 2 emissions for these reasons.

If the SWIS does not follow the expected decarbonisation trajectory and does not become net zero by 2050, SIMCOA is potentially able to reduce Scope 2 emissions through other means:

- Procure certified GreenPower through an accredited provider if financially viable.
- Enter into a green Power Purchase Agreement if financially viable.
- Install 'behind the meter' renewable generation infrastructure (e.g. installation of solar PV) if financially viable.

In terms of SIMCOA's current best-practice design approach, abatement measures were incorporated in the design of the its furnace. These measures were as follows:

- Substituting steel pressure rings with copper pressure rings to achieve better electrical conductivity resulting in greater silicon production for a given electricity consumption
- Using segmented shrouds on the third furnace that reduces duration of shutdowns, allows better quality repair, minimising risk of electrode damage and provides a more rapid furnace start-up which minimises energy loses achieving electrical energy savings.
- Incorporating variable voltage and frequency drives to achieve electrical energy savings

Further abatement measures are being explored through the following opportunities:

- Incorporating furnace energy recovery and charcoal plant energy recovery to use waste heat to produce electricity which will reduce the consumption of electricity from the SWIS
- Retrofitting the other two existing furnaces with the best-practice designs implemented for the third furnace

The Greenhouse Gas Abatement Report: Triennial Review, reports on implemented and planned GHG mitigation measures which are summarised in section 4.1.

The Greenhouse Gas Abatement Report: Triennial Review, details the status of GHG Scope 1 mitigation measures which have been considered, implemented, not implemented or are under technical review, these measures are detailed in Table 13.

[11] **https://www.crugroup.com/about-cru/**
[12] **Australia's emissions projections 2022 (dcceew.gov.au)**

Table 13 Summary of Scope 2 Mitigation and Abatement Measures

Opportunity	Opportunity Description	Anticipated Emissions Reduction (tCO_2-e)	Status
Furnace 2 copper pressure rings	Copper pressure rings have been installed on Furnace 2 resulting in an improvement in electrical efficiency.	2,781	Implemented
Furnace 2 segmented shrouds	Retrofitting segmented shrouds to reduce the duration and frequency of shutdowns to repair cooling water leaks was suggested in the 2011 report. Since that time, a single piece shroud was identified that was more reliable and should require less downtime for repair of water leaks.	Not calculated	Implemented in a modified form
Furnace 3 Segmented shrouds	The Furnace 3 design featured segmented shrouds to minimize the need for shutdowns to fix cooling water leaks, reducing both their duration and frequency.	1,083	Implemented
Furnace 3 copper pressure rings	Furnace 3 incorporated Copper pressure rings instead of the usual steel rings, enhancing electrical efficiency due to Copper's superior electrical conductivity.	2,781	Implemented

3.5 Mitigation measures adopted to reduce scope 3 emissions

The material Scope 3 emissions for the Revised Proposal are:

- Category 4: Upstream Transportation and Distribution (14%)
- Category 10: Processing of Sold Products (81%)

An emission-intensive upstream transport activity includes the delivery of coal to the Kemerton smelter to be used as a reductant. The plan to install a new retort will eliminate the need for coal resulting in a decrease in Scope 3 upstream transportation emissions. This mitigation measure should achieve approximately 30% reduction for the Category 4 Scope 3 emissions.

The downstream processing of SIMCOA's product contributes 81% to the overall Scope 3 emission profile. The processing of the product includes the manufacturing of photo-voltaic panels, aluminium and silicon alloys and use in the chemical industry. The production of photo-voltaic panels contributes 86% to this Scope 3 category. SIMCOA's product is processed in a range of countries throughout the world hence, the emissions relate to the consumption of liquid and gaseous fuels and electricity by customers in these countries. These emissions will reduce as individual countries energy mixes decarbonise and the customers of SIMCOA become more efficient and decarbonise their operations.

3.6 Other statutory decision-making processes which require reduction in GHG emissions

3.6.1 Safeguard Mechanism

The Safeguard Mechanism is a federal legislative framework, first passed in 2015, applying to Australian facilities that emit greater than 100,00 tCO2-e per year, as reported to the Clean Energy Regulator through NGER reporting obligations. The Kemerton Smelter exceeds the emissions threshold and has been a Safeguard Facility since 2016. On 30 March 2023 an amended bill was (The Australian Government's Safeguard Mechanism (Crediting) Amendment Bill 2023) passed by Parliament. This amended bill will continue to apply to SIMCOA's operations.

Initially, SIMCOA's baseline was based on Scope 1 emissions for the 2017/2018 financial year, 103,809 tCO2-e The emissions baseline was updated to use the emission intensity baseline method. The current emissions intensity baseline is 2.09 tCO2-e/t silicon. In years where SIMCOA operated above this emission intensity, SIMCOA has purchased ACCUs. For example, SIMCOA's safeguard liability in 2021/2022 financial year was 10,437 ACCUs.

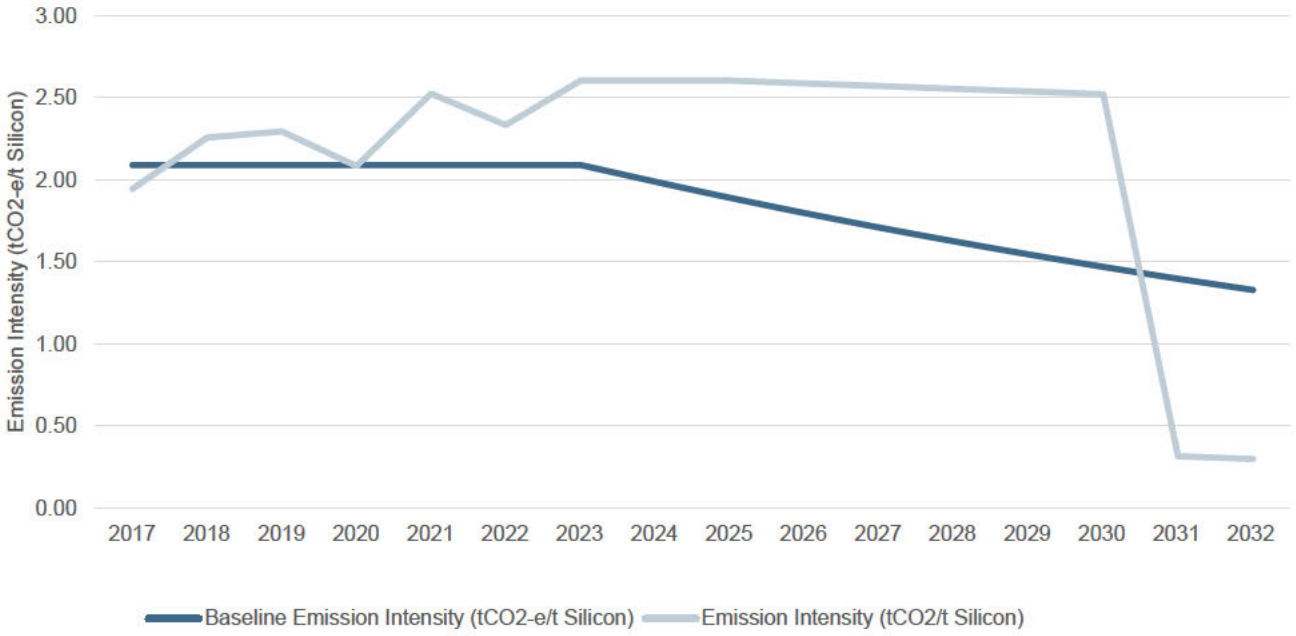

Figure 16 ***Comparison of current baseline emission intensity and projected emission intensity. Trajectory continues to 2032 to show the impact of the new retort on Scope 1 emission intensity. The baseline emission intensity considers a 4.9% year-on-year reductions from SIMCOA's emission baseline.***

Based on the Safeguard Mechanism Reform Position Paper[13], SIMCOA will have to reset the baseline intensity and submit by the 30th April 2024. From the 2023/2024 financial year onwards to 2030, there would need to be a 4.9% year on year reduction. SIMCOA will purchase ACCUs or tradable credits (SMCs) during the period leading up to the installation of the proposed charcoal retort, at which point SIMCOA will see a significant reduction below the 100,000 tCO2-e limit. This significant reduction will reduce the emission intensity as shown in Figure 16.

SIMCOA will pursue activities described in Section 3.3 to avoid and reduce Scope 1 emissions in line with the requirements of the Safeguard Mechanism. In years where SIMCOA is unable to achieve the emission requirement, SIMCOA will rely on carbon offsets to meet its statutory obligations. SIMCOA's offset approach is described in Section 3.8.

3.6.2 Renewable Energy Target – Trade Exposed

The Kemerton Smelter is an emissions-intensive, trade-exposed (EITE) facility as defined under the Renewable Energy Target. This means it is trade exposed and has emissions intensive production. This in turn means the Kemerton Smelter may face higher electricity costs when compared to comparable international facilities due to the local cost pressures to reduce its emissions and may be less able to manage those costs because the price of silicon is set in a global market. The EITE activity conducted at the site is the production of silicon from the reduction of silica using a carbon reductant. Carbon monoxide and dioxide are produced as a gaseous waste from the process. SIMCOA apply for an EITE exemption each year for the electricity consumed for the purposes of carrying out silicon production.

3.7 Consistency with other GHG reduction tools

SIMCOA do not have any public corporate emission reduction targets but rather are committed to continually reducing GHG emissions and with being one of the world's most efficient silicon producers.

There are no emission reduction targets in industry-wide commitments or sectoral pathways. SIMCOA is the only silicon producer in Australia hence, there are no peers with whom to develop emission reduction targets for the silicon industry.

[13] Department of Climate Change, Energy, the Environment and Water, 2024, Safeguard Mechanism Reforms – Position Paper. **Safeguard Mechanism Reforms (storage.googleapis.com)**

3.8 Offsets

Where net Scope 1 operational greenhouse emissions cannot be avoided or reduced through feasible measures, emissions exceeding statutory obligations will be offset through either retirement/surrender of self generated Australian Carbon Credit Units or acquisition of offsets.

SIMCOA has a preference to the use of self-generated offsets when achieving emissions targets and currently own land in the region of Moora and Yornup in WA upon which the opportunity for generating ACCUs exist.

The Yornup Aggregation Project is already underway and has been registered with the Emissions Reduction Fund under the Carbon Credits (Carbon Farming Initiative) Act 2011. This project receives credits for the first growing cycle of the trees where the trees will eventually be harvested for use in SIMCOA's retorts for charcoal production. ACCUs will be generated for a six-year period.

The planting of native vegetation on some of SIMCOA's Moora landholdings near the existing Moora Mine is still under consideration. Currently the Moora land is being leased to a third party, with the lease expiring in 2024. After the lease expires, SIMCOA has the option of revegetating the land near the Moora Mine. It is anticipated that the Moora Land Planting project would generate ACCUs for a 25 year period.

SIMCOA is committed to assessing the feasibility of other offset projects on SIMCOA owned land in accordance with approved methodologies under the Clean Energy Regulator (CER) ERF as enacted through the:

- Carbon Credits (Carbon Farming Initiative) Act 2011
- Carbon Credits (Carbon Farming Initiative) Regulations 2011
- Carbon Credits (Carbon Farming Initiative) Rule 2015

If required, SIMCOA will purchase carbon offsets with integrity (i.e. carbon offsets which are generated from clear, enforceable and accountable methods) and has a preference for local (Australian) credits. A useful definition of an offset integrity standard is provided in Section 133 (Division 3) of the Carbon Credits (Carbon Farming Initiative) Act 2011. Carbon offset standards which are considered to have an acceptable level of integrity (based on the Carbon Credits (Carbon Farming Initiative) Act 2011 definition) are provided in Table 14.

Given the duration of this GHG EMP (2023-2050) and the evolving market of offset standards and certifications, SIMCOA will request from the CEO (in writing), approval of any additional offset standards not listed in Table 14.

Table 14 Carbon offset standards

Carbon offset standard	About
Australian Standards	
Australian Carbon Credits Units (ACCUs)	ACCUs are generated from projects which are registered with the Clean Energy Regulator and follow approved methodologies. ACCUs are held in the Australian National Registry of Emissions Units and count toward Australia's International Climate (offset) commitments
Climate Active Carbon Neutral Standard (formerly the National Carbon Offset Standard)	The Climate Active Carbon Neutral Standard for Organisations (Organisation Standard) is a voluntary standard to manage greenhouse gas emissions and achieve carbon neutrality. The standard provides best-practice guidance on how to measure, reduce, offset, validate and report operational emissions data
Global Standards	

Carbon offset standard	About
Clean Development Mechanism (CDM)	Provides a global standard for carbon offsets. The CDM standard is for emission-reduction projects in developing countries which generate certified emission reduction credits. Project qualification is rigorous (public registration and issuance process) with approval given by the Designated National Authorities. The mechanism is overseen by the CDM Executive Board, answerable ultimately to the countries that have ratified the Kyoto Protocol.
Clean Development Mechanism (CDM) - Gold Standard	As per CDM, with a stronger focus on sustainable development benefits and some exclusions (i.e. forestry projects).
Gold Standard	As per CDM Gold Standard with a strong focus on environmental integrity and sustainable development. The Gold Standard is targeted towards the voluntary sector. Gold Standard is ISEAL Code Compliant. The Board of Directors provides financial oversight and strategic governance; whilst the Technical Governance Committee (an independent body composed of market specialists) ensure rigor and integrity of emission-reduction projects.
Verified Carbon Standard (VCS)	Developed and managed by Verra, the VCS standard applies to global emission-reduction projects. Credits certified under the VCS Program are called Verified Carbon Units (VCUs). VCS certification consists of a validation and verification process by an approved Validation and Verification Body (VVB).
The Climate, Community & Biodiversity (CCB) Standard	Developed and managed by Verra, the standard can be combined with VCS. The CCB standard identifies carefully designed land management projects that simultaneously address climate change, support local communities and smallholders, and conserve biodiversity. The CCB standard promotes excellence and innovation from the earliest stages of project design and development through implementation.
Sustainable Development Verified Impact Standard (SD VISta) Standard	The SD VISta Standard is a new standard from Verra that sets out rules and criteria for the design, implementation and assessment of projects that aim to deliver high-impact sustainable development benefits. Under SD VISta, projects must demonstrate to the satisfaction of a third-party assessor that they meet the SD VISta Program's rigorous rules and requirements and advance the SDGs. Once projects have been certified in the SD VISta Program, their contributions to the SDGs are listed on the program's database.

SIMCOA intend to work in partnership with a carbon service provider (or providers) that offer carbon offsets which meet integrity standards listed in Table 14 and can also deliver one or more co- benefits to:

- The environment (i.e. biodiversity, land restoration, ecosystem restoration)
- Local communities (i.e. employment)
- Aboriginal people (i.e. enhancement of Aboriginal heritage sites or places, growing Aboriginal food crops).

Australian based carbon service providers that seek to provide one or more of the co-benefits listed above include (but are not limited to):

- Green Collar

- Greening Australia
- Carbon Neutral
- Greenfleet
- Carbon Positive Australia
- Carbon Farming Foundation
- Tasman Environmental Markets.

Where available (and feasible) SIMCOA will consider forward-buying carbon offsets, to improve confidence that committed emission reduction targets (Table 10) can be met.

3.9 Projects operating beyond 2050

The projected Scope 1 and 2 emissions will be consistent with a global low-carbon transition to net zero by 2050 scenario. The mitigation measures discussed in Sections 3.3 and 3.4 will reduce Scope 1 and 2 emissions continually past 2050 and offsets will be used for the remaining emissions past 2050. The amount of offsets required may change if technology advances allow SIMCOA to reduce Scope 1 emissions further than presented in this GHG EMP.

Due to SIMCOA's wide customer base, SIMCOA's Scope 3 emissions will be difficult to reduce as SIMCOA has little influence on the way the customers process the silicon product. This will depend on the customer's emission reduction commitment as well as the relevant countries legislation on emission reduction and net zero targets.

4. Adaptive management, continuous improvement, and review of the GHG EMP

SIMCOA has in place an adaptive management approach to ensure that the Revised Proposal is future proof, through embedding a cycle of monitoring, reporting and implementing change (where required). All reasonable and practicable measures will be considered at each step of the mitigation hierarchy (avoid, reduce, offset) over the life of the Revised Proposal.

The management actions presented in this GHG EMP shall be monitored, evaluated, reviewed, and updated, as required, considering:

- Evaluation of routine emissions monitoring data
- Ensuring the implemented abatement delivers predicted emission reductions
- New and relevant data/information gained as a result of implementing this GHG EMP, or from external sources
- Effectiveness of internal processes and procedures to reduction and management of GHG emissions
- Progress against interim targets
- Changes in State or Commonwealth legislation or policy

4.1 Continuous Improvement

Since the initial 2011 Greenhouse Gas Abatement Report: Triennial Review, Simcoa has progressed a number of initiatives to improve the GHG intensity and executed a number of projects to continue reductions in GHG emissions. Projects executed since 2011 include

- Refractory lining furnace shrouds
- LED Lighting
- Upgrade of compressors
- Wood screening upgrade
- Retort process improvements
- Furnace 3 electrode conversion
- Schedule removal of furnace ledges

Current GHG improvement projects, including initiatives identified since 2011 are summarised in Table 15.

Table 15 GHG emissions intensity continuous improvement projects

Continuous improvement initiatives	Initiative description	Status
Drying of woodblock using waste heat from charcoal plant	Drying woodblock using waste heat prior to charcoal production could increase the annual charcoal production and reduce CO_2 emissions. Trials conducted by Simcoa indicate this is feasible, however not economically viable,	In late 2023, Simcoa commenced a review of opportunities for drying woodblock using recovered energy as part of a proposal for additional charcoal retort at Kemerton.
DC powered furnace to recycle fines/off spec material	Off-spec material could be recycled using low-power DC furnaces and turned into saleable product potentially reducing GHG intensity by about 2% per annum.	On hold
Installation of an Additional Charcoal Retort	The current capacity for charcoal production to reduce the need for coal reductants is insufficient. In 2023, Simcoa commence a project to install a new charcoal retort.	Seeking approvals

Continuous improvement initiatives	Initiative description	Status
Use of Solar Energy	Simcoa is conducting a trial of solar powered lights in external areas and assessing the installation of solar panels on building rooftops.	In progress
Use of Electric Loaders	Simcoa is commencing a trial of an electric loader.	In progress
Automation of Furnace Cooling Water Fan Automation	Automation of the cooling water fans on all three furnaces would reduce the number of fans required for this duty. Further work is required to determine if this initiative should be pursued.	In development
Offset Initiatives	Simcoa has commenced a program to identify opportunities for self generating offsets to assist in achieving emissions targets in accordance with approved methodologies under the Clean Energy Regulator (CER)	In progress

4.2 Management approach

The SIMCOA management approach aligns with the following objectives:

- Adhere to the State Governments' GHG Policy for Major Projects, to contribute toward the State's position to achieve net zero emissions by 2050.
- Adhere to EPA Guidance, by considering reasonable and practicable measures to avoid and reduce GHG emissions.
- Compliance with relevant State and Commonwealth GHG emission monitoring and reporting requirements, including NGER and the Safeguard Mechanism.
- Adopt an adaptive management approach to respond to current uncertainties and future developments in government policies, markets and technology.

4.3 Management provisions

This section presents the management provisions proposed by SIMCOA to fulfil the objective of the GHG Emissions Factor and the purpose of this GHG EMP (Section 2).

SIMCOA has committed to the below management provisions consistent with the rationale and approach discussed below.

Table 16 Management Provisions

Project activities: Construction of a new mine at North Kiaka and abandonment bund at the existing Moora Mine (to be incorporated in the Revised Proposal)			
EPA Objective: To reduce net GHG emissions in order to minimise the risk of environmental harm associated with climate change			
Key environmental value: Maintenance of global temperatures to within 2.0 °C above pre-industrial levels			
Key impacts and risks: Contribution to these GHG emissions causing global warming and climate change			
Management action or Environmental criteria	**Management target / Response Action**	**Monitoring (method, location and timing)**	**Reporting**
4. Establish Revised Proposal baseline emissions and maintain emissions within the baseline, to comply with Commonwealth Safeguard Mechanism	– Establish a baseline for the Revised Proposal and submit this to the Commonwealth Clean Energy Regulator (CER) – Maintain emissions below the established baseline	Annually Annually	Compliance with established baseline included in Part IV Compliance Report and published as part of annual Safeguard Mechanism data tables by the CER.

			Annual reporting in accordance with the NGER Act Annual internal reporting
5. Implement GHG monitoring and reporting in accordance with the NGER	Monitor and report on all Scope 1 & Scope 2 emissions	Annually	Annual reporting in accordance with the NGER Act Annual internal reporting
6. Review and adopt reasonable and practicable measures to avoid and reduce the Revised Proposal Scope 1 and 2 GHG emissions	Review of GHG emissions abatement opportunities register with consideration to outcomes of five yearly review and milestone developments	Annually	Annual internal reporting
7. Pursue, where reasonably practicable and financially viable, opportunities to reduce Scope 3 emissions through the life of the Proposal	Review of GHG emissions abatement opportunities and stakeholder engagement registers.	Annually	Annual internal reporting
8. Adaptive management through five yearly review of reasonable and practicable measures to reduce GHG emissions in response to developments in Commonwealth and State policies, markets, technology and regional infrastructure	– Review undertaken every five years – Review undertaken at major State and Commonwealth policy changes in GHG abatement – GHG EMP updated based on five-year review findings and policy changes	Review and assessment every five years of practicable emission reduction opportunities	Preparation of an abatement opportunities assessment report presented internally New abatement opportunities will be adopted where practicable and documented in this GHG EMP
9. Preventative maintenance to ensure that the emissions target for the Revised Proposal is achieved	– Establish a comprehensive monitoring program to facilitate assessment of plant efficiency and operating conditions – Develop procedures to address plant non- conformances	Annually Annually	Preparation of a biannual plant performance report, presented internally
10. Achieve continuous improvement in greenhouse gas intensity	– Triennial Review of the Greenhouse Gas Abatement Report	Triennially	Triennial Review of the Greenhouse Gas Abatement

SIMCOA has proposed the management provisions outlined above based on the following rationale:

- GHG abatement opportunities identified in this GHG EMP have been assessed by SIMCOA against multiple criteria including capital investment, emissions reduction, availability, scale and practicality. SIMCOA requires that adopted opportunities must offer reasonable returns on investment and are a practicable investment that ensures technical performance. SIMCOA considers that reasonable and practicable GHG abatement measures are considered.
- There is potential for substantial changes in GHG policies, markets and technology as well as regional energy infrastructure over the Revised Proposals lifetime, which may influence the practicability of GHG abatement measures. SIMCOA propose to complete periodic reviews of policies, markets, technology and infrastructure to ensure that the Revised Proposal contributes to all relevant targets in WA, industry GHG abatement measures, and adopts the most economic opportunities for GHG abatement.
- GHG emissions will be monitored and reported in accordance with legislative requirements, as well as to enable benchmarking against similar projects, and to measure achievements in reductions for adopted technologies.
- A GHG baseline will be established which will influence the intensity of GHG emissions of production from year to year.

4.4 Monitoring and corrective actions

GHG emissions will be monitored during operation. Any non-conformances to the targets outlined in Table 10 will be investigated, rectified or mitigated as soon as possible to ensure ongoing minimisation of GHG emissions. Where relevant, procedures will be amended or updated, and inductions and other workforce communication will be undertaken in a timely manner to minimise the risk of re-occurrences.

4.5 GHG Environmental Management Plan review

SIMCOA will review and evaluate the management actions outlined in this GHG EMP every five years to ensure the actions are adequately addressing the relevant key risks and meeting State and Commonwealth objectives. This GHG EMP may also be revised by SIMCOA prior to the five-year interval on an as needs basis. This may be due to the management actions not achieving the desired outcomes, monitoring identifying a variation to predicted emissions or opportunity for improvements, changes to relevant legislation, or improvements to practices to achieve a greater environmental outcome.

If and when significant changes are made to the Revised Proposal SIMCOA will update the GHG EMP for resubmission to the EPA.

SIMCOA also commits to reviewing this GHG EMP and the Abatement Opportunities Register under the following circumstances:

- Based on EPA and other stakeholder or community comments
- If a new process or activity is proposed to be introduced that has the potential to alter the emissions from the Revised Proposal above the baseline emission or is not in accordance with this GHG EMP
- Following the release of State strategies on climate change, energy transformation and State targets particularly as relevant for the industry sector.

5. Reporting

SIMCOA will provide a publicly available GHG EMP summary plan and progress statement, which will be updated each time the GHG EMP is revised, including post Ministerial Conditioning, each time a five yearly report is submitted, or when any other change is made to the Revised Proposal that results in a material risk that the emissions targets will not be met. The GHG EMP will be made publicly available on SIMCOA's website.

Within the summary SIMCOA will include:

- A graphical comparison of emissions reduction commitments in the GHG EMP with actual emissions for compliance periods
- An emissions intensity benchmarked against comparable facilities if available
- A summary of emission reduction measures undertaken by SIMCOA
- A clear statement as to whether interim targets have been achieved.

GHG emissions generated by SIMCOA's operations will be reported to the Clean Energy Regulator annually in accordance with the National Greenhouse and Energy Reporting Act 2007 (Cth) (NGER Act) and will be publicly available from the Clean Energy Regulator website.

6. Stakeholder consultation

SIMCOA has undertaken and is committed to ongoing consultation with the key stakeholders and has developed and implemented an external stakeholder consultation strategy for ongoing social engagement and community investment.

Recent engagement specifically relating to GHG emissions is presented in Table 17.

Table 17 Stakeholder engagement specifically relating to GHG emissions

Stakeholder	When	Topic/s
Western Power Board	8th March 2023	– International silicon industry context and benchmark including the impact electricity supply has on Scope 1 and 2 emissions – Cost effective greener energy supply for SIMCOA's operations
Energy providers	Financial Year 2022-2023	– New Energy Supply Agreements post 2027 – Procurement opportunities of 'green' energy and accredited LGC's from a renewable asset on the SWIS following the expiry of its two current retail contracts.
Renewable Technology experts	Financial Year 2022-2023	– Assessment of behind the meter solutions either lowering GHG emissions through energy efficiencies or renewable generation.
Customers	Financial Year 2022-2023	– SIMCOAs emissions trajectory and actions in-place to reduce emissions.

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8. GHG EMP Change Record

1. Table Changes to GHG EMP

Complexity of changes			Minor revisions ☐	Moderate revisions ☐	Major revisions ☐
Date revision submitted to EPA: DD/MM/YYYY					
Is the change proposed to be implemented under condition C3-3? If so, the proponent must provide a copy to the CEO at least 20 days before commencing implementation				Yes ☒	No ☐
Proponent's operational requirement timeframe for approval of revision Reason for Timeframe:				< One Month ☐ < Six Months ☐	> Six Months ☐ None ☒
Item no.	GHG EMP section no.	GHG EMP page no.	Summary of change (separate track changes document to be provided)	Reason for change	New or increased adverse impacts to the environment? Risk to the achievement of limits, outcomes or objectives?
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

Appendices

Appendix A

GHG Emission Data Tables

A-1-1 Global Warming potentials

Table 18 Global warming potentials

Chemical	Global Warming Potential (100-year)
CO2	1
CH4	28
N2O	265

A-1-2 Emission Summary

Construction Scope 1 and 2 emission summary:

Table 19 Summary of the construction Scope 1 and 2 emission estimate

Facility	Scope	Fuel	Amount	Units	Energy Content	Energy	CO2	CH4	N2O	CO2	Emission Factor (kg CO2-e /GJ)			Method
					GJ/unit of fuel	GJ	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	CO2	CH4	N2O	
Mining Operations (including Abandonment Bund)	1	Land Clearing	18.22	ha	-	-	-	-	-	2,095.3	115 tCO2-e/ha			1
Mining Operations	1	Diesel (stationary)	26.00	kL	38.60	1,003.60	70.15	0.10	0.20	70.45	69.90	0.10	0.20	1
Mining Operations	1	Diesel (transport)	1.00	kL	38.60	38.60	2.70	0.00	0.02	2.72	69.90	0.10	0.40	1
Mining Operations	2	Electricity	No electricity consumption during construction											

Operational Scope 1 and 2 emission summary:

Table 20 Summary of the operational scope 1 and 2 emission estimate

Facility	Scope	Total Emissions
		tCO_2-e
Kemerton Smelter	1	123,454
Kemerton Smelter	2	300,024
Mining Operations	1	1,546

A-1-3 Historical Data

Table 21 Historical data of SIMCOA's Kemerton operation

Operational Year	Nameplate Production	Production	Actual Scope 1	Scope 1 Emission Intensity	Actual Scope 2	Scope 2 Emission Intensity	Actual Scope 3[14]	Total Emission Intensity
	Tonnes	Tonnes	tCO_2-e	tCO_2-e/t Silicon	tCO_2-e	tCO_2-e/t Silicon	tCO_2-e	tCO_2-e/t Silicon
FY17	53,000	50,105	102,882	2.05	426,086	8.50	NA	10.56
FY18	53,000	52,891	105,739	2	419,640	7.93	NA	9.93
FY19	53,000	46,853	107,847	2.30	417,703	8.92	NA	11.22
FY20	53,000	47,000	89,842	1.91	383,883	8.17	NA	10.08
FY21	53,000	43,126	111,939	2.60	399,808	9.27	NA	11.87
FY22	53,000	44,329	113,234	2.55	399,807	9.02	NA	11.57

[14] Scope 3 emissions were not calculated for this period

A-1-4 Projected Emission Data

Table 22 Projected emission data

Operational Year	Nameplate Production	Projected Production	Projected Scope 1	Projected Scope 2	Total Scope 1 and 2	Projected Scope 3	Total Scope 1, 2 and 3	5 Year Targets – Scope 1	5 Year Targets – Scope 2
	Tonnes	Tonnes	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
2023	53,000	48,000	125,000	300,024	425,024	676,171	1,101,195	-	-
2024	53,000	48,000	125,000	288,258	413,258	658,901	1,072,160	-	-
2025	53,000	48,000	125,000	270,610	395,610	641,632	1,037,241	99,986	458,073
2026	53,000	48,000	125,000	241,196	366,196	624,362	990,558	99,986	458,073
2027	53,000	48,000	125,000	223,547	348,547	607,092	955,640	99,986	458,073
2028	53,000	48,000	125,000	205,899	330,899	589,823	920,722	99,986	458,073
2029	53,000	48,000	125,000	182,367	307,367	572,553	879,921	99,986	458,073
2030	53,000	48,000	125,000	170,602	295,602	489,142	784,743	79,989	366,458
2031	53,000	48,000	20,000	141,188	161,188	468,082	629,270	79,989	366,458
2032	53,000	48,000	20,000	135,305	155,305	447,023	602,328	79,989	366,458
2033	53,000	48,000	20,000	135,305	155,305	425,964	581,269	79,989	366,458
2034	53,000	48,000	20,000	129,422	149,422	404,905	554,327	79,989	366,458
2035	53,000	48,000	20,000	123,539	143,539	383,846	527,385	59,992	274,844
2036	53,000	48,000	20,000	117,656	137,656	362,787	500,443	59,992	274,844
2037	53,000	48,000	20,000	109,252	129,252	341,727	470,980	59,992	274,844
2038	53,000	48,000	20,000	100,848	120,848	320,668	441,517	59,992	274,844
2039	53,000	48,000	20,000	92,444	112,444	299,609	412,053	59,992	274,844
2040	53,000	48,000	20,000	84,040	104,040	278,550	382,590	39,995	183,229
2041	53,000	48,000	20,000	75,636	95,636	257,491	353,127	39,995	183,229
2042	53,000	48,000	20,000	67,232	87,232	236,432	323,664	39,995	183,229
2043	53,000	48,000	20,000	58,828	78,828	215,373	294,201	39,995	183,229
2044	53,000	48,000	20,000	50,424	70,424	194,313	264,738	39,995	183,229
2045	53,000	48,000	20,000	42,020	62,020	173,254	235,274	19,997	91,615

Operational Year	Nameplate Production	Projected Production	Projected Scope 1	Projected Scope 2	Total Scope 1 and 2	Projected Scope 3	Total Scope 1, 2 and 3	5 Year Targets – Scope 1	5 Year Targets – Scope 2
	Tonnes	Tonnes	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
2046	53,000	48,000	20,000	33,616	53,616	152,195	205,811	19,997	91,615
2047	53,000	48,000	20,000	25,212	45,212	131,136	176,348	19,997	91,615
2048	53,000	48,000	20,000	16,808	36,808	110,077	146,885	19,997	91,615
2049	53,000	48,000	20,000	8,404	28,404	89,018	117,422	19,997	91,615
2050	53,000	48,000	20,000	0	20,000	67,958	87,958	0	0

Appendix B

Greenhouse Gas Abatement Report: Triennial Review

SIMCOA OPERATIONS PTY LTD

2020

Greenhouse Gas Abatement Report Triennial Review 2020

November 2020

REVISION HISTORY

Revision	Date	Prepared/Reviewed	Comments
Draft	13/11/2020	Daniel Mance (Simcoa)	Draft document
Draft	13/11/2020	David Miles (Simcoa)	Reviewed
Final	13/11/2020	David Miles (Simcoa)	Endorsed Document

APPROVAL

This document is approved by:

David Miles
Vice President (Site Services and Marketing)
SIMCOA OPERATIONS PTY LTD

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Executive Summary

This report has been published as part of a triennial review of Simcoa Operations Pty Ltd (Simcoa) Greenhouse Gas (GHG) emissions from its Kemerton Silicon Smelter. This triennial review has been performed in order to satisfy condition 9-2(3) of Ministerial Statement 813.

The Kemerton smelter produces approximately 50,000 tonnes of high quality silicon annually. The silicon smelting process results in significant GHG emissions, the majority of which is a result of the large amount of electricity consumed by the 3 submerged arc furnaces operated on site, with other the major contributor being the consumption of coal as a reductant.

A report produced by Simcoa in 2011 detailed the energy efficiency design features of furnace 3 (commissioned in 2012). It also detailed potential future opportunities, set internal GHG emission key performance indicators and compared Simcoa's GHG emission intensity to global silicon producers.

The first triennial review of the report was completed in 2014, and the second in 2017. This report (2020) constitutes the third triennial review, and provides an update on the process of energy efficiency opportunities at Simcoa, as well as Simcoa's performance against internal and external benchmarks for GHG emissions.

In regard to energy efficiency opportunities, this review demonstrated that:

- All energy efficiency design features incorporated into the furnace 3 design were constructed as reported in 2011.
- Of the 7 potential future opportunities identified in 2011, 3 have been implemented. 2 others have been trialled and rejected.
- The report details 7 further opportunities identified between the 2011 report and the previous review in 2017. 4 have been implemented. 1 has been trialled but has yet to be implemented, and 2 have been rejected.
- Since the 2017 report, and additional 3 opportunities have been identified which have all been implemented

In regard to internal and external benchmarking of GHG emissions, the key findings of this report are:

- 79% of GHG emissions in 2019/20 were Scope 2 emissions as a result of the consumption of electricity
- GHG emissions intensity for the 2019/20 year was 10.6 tonnes CO2-e/tonne Si. This was below both the projected forecasts reported in 2011 for a 3-furnace operation (inclusive of the measures adopted in its design), and the reported 2013/14 emission intensity. However, it was slightly above the 2016/17 intensity.
- Total Electricity intensity for the 2019/20 year, including ancillary activity usage, was 12 MWh/tonne Si, which was in excess of the projected forecast of 11 MWh/tonne Silicon reported in 2011.
- Simcoa ranked 8th out of 25 producers for scope 1 GHG emissions intensity (tonnes CO_2-e/tonne Si). Silicon producers in Brazil have lower scope 1 intensities; however, these

smelters operate on a regime mainly consisting of carbon neutral charcoal reductants. Simcoa currently cannot source enough charcoal to operate on a similar regime.

- Simcoa's scope 1 GHG emissions intensity is 35 to 40% lower than that of silicon producers in Europe and North America.
- If Scope 2 GHG emissions intensity associated with electricity consumption is normalized for all operations by using the emission factor for Western Australian electricity production, in 2019 Simcoa ranked 8th out of 25 producers for combined scope 1 and 2 GHG emissions intensity (tonnes CO_2-e/tonne Si). Again, this is largely attributable to the extremely low scope 1 emissions of the Brazilian operations operating on charcoal reductants.
- In 2019, the project ranked 9th out of 25 producers for electrical efficiency (MWh/tonne Si).

As of this 2020 review, Simcoa is operating at, or better than the 2011 projected total GHG and electrical intensities for a 3 furnace operation.

Additionally, since July 1, 2016, Simcoa's Kemerton Smelter has been covered by the Commonwealth Government *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*. This rule effectively places a cap on the future annual net Scope 1 GHG emissions footprint of the Kemerton Smelter.

1 Purpose

In 2011, Simcoa Operations Pty Ltd produced a "Greenhouse Gas Abatement Report" in order to satisfy the requirements of Condition 9 of Ministerial Statement 813, which states:

9-1 The proponent shall prepare and submit to the Minister for Environment, within 18 months of commencement of ground-disturbing activities, a Greenhouse Gas Abatement Report which meets the objectives set out in condition 9-2, as determined by the Minister for Environment.

9-2 The objectives of the Greenhouse Gas Abatement Report required by condition 9-1 are to:

1. *Demonstrate that maximising energy efficiency and opportunities for future energy recovery have been given due consideration in the design of the third and fourth submerged electric arc furnaces;*

2. *Ensure that the "greenhouse gas" intensity ("greenhouse gas" per unit of silicon produced) is equivalent to, or better than, benchmarked world's best practice; and*

3. *Achieve continuous improvement in "greenhouse gas" intensity through triennial review, and if practicable, adoption of advances in technology and process management*

This report constitutes the third triennial review of greenhouse gas and electrical efficiency. This report also provides and update on the current status of the project.

This is the third report to provide energy and greenhouse gas emission data that includes operation of the 3rd furnace, which was commissioned in September 2012.

The results of this review, as well as a discussion of current and future energy efficiency opportunities are discussed in regular management meetings, culminating in a review meeting in October 2020. The minutes of the meeting are attached as **Appendix A**

2 The Kemerton Silicon Project

2.1 Background

Simcoa Operations Pty Ltd (Simcoa) is a wholly owned subsidiary of Shinestu Chemical Co. Ltd and operates the Kemerton Silicon Project, a fully integrated silicon metal production plant, located in Kemerton, Western Australia. The plant currently produces in excess of 48,000 tonnes of silicon per annum. The plant was commissioned in 1989 as Barrack Silicon Pty Ltd, and comprised of:

- Two submerged arc furnaces
- Baghouse
- Wood processing facilities
- Two vertical gas rinsing charcoal retorts
- Crushing and packaging facilities
- Support facilities, including administration, maintenance and laboratory.

2.2 Project Status

Construction of a 3rd submerged arc furnace and additional baghouse began in 2010 and was commissioned in September 2012. Simcoa gained environmental approval for a 4th submerged arc furnace, but has not committed to its construction as of the writing of this report.

2.3 Description of the Silicon Production Process

The production of silicon at Simcoa is carried out in submerged arc furnaces by the carbothermic reduction of silica, either as quartz or quartzite.

The reduction of quartzite to silicon is metallurgically complex but can be summarised by:

$SiO_2 + 2C \rightarrow Si + 2CO$

Most of the carbon monoxide emitted from the process reacts with oxygen gas in the atmosphere to form carbon dioxide gas.

The quartz for the silicon process is mined at Moora, north of Perth. The carbon source for the reaction is a combination of coal and charcoal. The majority of the charcoal used is produced at the site by pyrolysis of wood waste residues. The majority of the residue is sourced from wastes produced during Bauxite mining. During pyrolysis the wood is subjected to elevated temperatures in a low oxygen environment. The charcoal that Simcoa produces has very low levels of impurities and allows Simcoa to produce some of the highest purity silicon in the world. Additional charcoal and coal reductants are sourced from both domestic and overseas suppliers.

Significant electrical power is required to reduce silica to silicon. The electrical energy is transferred into the furnaces via pre-baked graphite electrodes.

A simplified process flow diagram which includes ancillary operations can be found in **Appendix B.**

2.4 Applicable Legislation

Simcoa and the silicon project are subject to a number of greenhouse gas and energy efficiency programs and initiatives.

Simcoa is required to report annually on greenhouse gas emissions, energy production and energy consumption under the *National Greenhouse and Energy Reporting (NGER) Act 2007*, and was a liable entity under the *Clean Energy Act 2011 (repealed in 2014).*

Simcoa was also a participant under the *Energy Efficiency Opportunities Act 2006* which encouraged participants to identify, evaluate, and report publicly on cost effective energy savings opportunities. This legislation was repealed in 2014, however as part of good business practice, Simcoa remains committed to actively identifying and implementing cost effective energy saving opportunities.

Since July 1, 2016, Simcoa's Kemerton Smelter has also covered been covered by the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*. Under the safeguard mechanism, covered facilities are required to keep their emissions at or below a baseline set by the Clean Energy Regulator. If facilities exceed their baseline, they must surrender Australian carbon credit units (ACCUs) to offset excess emissions. This rule effectively places a cap on the net annual Scope 1 GHG emissions footprint of the Kemerton Smelter.

3 Mitigation and Abatement Measures

The following section details the current status of GHG mitigation and abatement measures:

- Included the design of furnace 3
- Identified as future opportunities in the 2011 report
- Identified opportunities since the 2011 report

3.1 Measures adopted in Furnace 3 design

3.1.1 Furnace 3 copper pressure rings

The furnace 3 design included the use of Copper pressure rings in place of standard steel rings. This increases electrical efficiency through superior electrical conductivity. Trialling the copper rings on furnace 1 has also demonstrated that they have a lifetime in excess of 10-15 years. This is a vast improvement over the steel rings which required replacement every 18 months. This vastly reduces downtime and increases silicon production.

This feature is estimated to potentially reduce GHG emissions by 2,781 tonnes of CO_2-e per annum.

Status: Implemented

3.1.2 Segmented shrouds

The furnace 3 design included the use of segmented shrouds to reduce the duration and frequency of shutdowns to repair cooling water leaks

This feature is estimated to potentially reduce GHG emissions by 1,083 tonnes of CO_2-e per annum.

Status: Implemented

3.1.3 Baghouse fans with variable speed drives

The furnace 3 design included the use of variable speed drives on the baghouse fan motors. This feature would allow fan speed to be tailored to requirements.

This feature was estimated to potentially reduce GHG emissions by 2,626 tonnes of CO_2-e per annum.

This feature was implemented as per the design, however since commissioning of furnace 3, these fans have had to operate at a higher speed than originally planned. This has meant that the GHG savings assigned to this feature have not been fully realised for the 2013/14 period. Fume leaking from the furnace 3 hood at low fan speeds was causing an occupational hazard in the smelter building necessitating an increase in fan speed. Several modifications were recently made to the furnace hood including improving gland seals and extending the hood doors. This has reduced the amount of leakage from the hood, which in turn has allowed fans to run at lower speeds as intended in the design

Status: Implemented

3.2 Potential future abatement opportunities identified in 2011 report

3.2.1 Furnace 3 energy recovery

Furnace 3 was designed with several features to facilitate future installation of an energy recovery system, including:

- Enclosing the furnace hood to reduce off gas volumes and minimise cooling
- Designing off gas piping to enable them to be refractory lined and able to withstand high temperature off gases
- Minimising cooling by dilution air by installing a forced draught serpentine cooler

These features were all included in the design, however as of the time of publishing of this review, the installation of energy recovery equipment has not been pursued. This is mainly due to off gas temperatures not reaching the levels initially expected that would make energy recovery a viable prospect. Simcoa is currently investigating several options to increase off gas temperatures to viable levels, including improving the sealing of the furnace hood to reduce cool air ingress.

Status: Not implemented

3.2.2 Furnace 1 and 2 energy recovery

Installation of an Organic Rankine cycle system for furnace 1 and 2 was proposed in the 2011 report. Installing the required equipment would require a lengthy period of downtime, and is currently not being viewed as a realistic option at Simcoa

Status: Not implemented

3.2.3 Charcoal Plant energy recovery

An Organic Rankine style energy recovery system was also suggested for the charcoal plant in the 2011 report. There are no current plans to implement this option.

Other options for the waste heat from the charcoal plant have been investigated, including using it to dry woodblock. This option will be detailed in section 3.3.

Status: Not implemented

3.2.4 Furnace 2 copper pressure rings

The use of Copper pressure rings in place of standard steel rings increases electrical efficiency through superior electrical conductivity. Trialling the copper rings on furnace 1 has also demonstrated that they have a lifetime in excess of 10-15 years. This is a vast improvement over the steel rings which required replacement every 18 months. This vastly reduces downtime and increases silicon production.

This feature is estimated to potentially reduce GHG emissions by 2,781 tonnes of CO_2-e per annum.

Copper pressure rings were installed on Furnace 2 in mid 2014. All 3 submerged arc furnaces at Simcoa are now running copper pressure rings in place of the inefficient steel rings

Status: Implemented

3.2.5 Furnace 2 segmented shrouds

Retrofitting segmented shrouds to reduce the duration and frequency of shutdowns to repair cooling water leaks was suggested in the 2011 report. Since that time, a single piece shroud was identified that was more reliable and should require less downtime for repair of water leaks.

These shrouds were fitted on Furnace 2 in mid 2014.

Status: Implemented in a modified form

3.2.6 Briquetting of charcoal fines

The 2011 report suggested that charcoal fines produced at Simcoa could be briquetted to make them suitable for use as a reductant in the furnace. These briquettes are carbon neutral, and would reduce the use of coal in the furnace. There is also the potential to recycle silicon dust (currently a by-product) back into the process to increase production and reduce waste.

Simcoa produces approximately 2,700 tonnes of charcoal fines a year, which if briquetted could replace approximately 3,600 tonnes of coal annually, saving in excess of 8,700 tonnes of CO2-e per year.

Simcoa began production of 500 tonnes of trial briquettes in 2017, which were subsequently trialled in the furnace in 2018. Introduction of the briquettes resulted in poor furnace conditions and efficiency, likely due to a lack of briquette reactivity.

The trial was subsequently abandoned

Status: Not implemented

3.2.7 Charcoal Reductant

The 2011 report suggested Simcoa could reduce its scope 1 GHG emissions through increasing the use of charcoal in its process in place of coal reductants.

An option for increasing charcoal consumption is the sourcing of charcoal from external suppliers. A trial plan noted in the 2011 report was the purchase of 1,000 tonnes of charcoal from a South African producer. Unfortunately, this material was found to be of poor quality and was considered unviable for the Simcoa process. Simcoa subsequently located other suppliers of charcoal and used small amounts of external charcoal as reductant. However, when used in large volumes, the variable quality of this charcoal has been found to negatively impact electrical efficiency. Increased power usage, and resultant increased scope 2 emissions, negated any reduction in scope 1 emissions through use of this reductant.

There have been some recent developments in local biochar manufacturing and Simcoa is watching these developments with interest, including being actively involved in the scoping process. However, the high cost of this charcoal currently makes utilization of this source impracticable.

Status: Trialled but currently on hold

3.3 Abatement opportunities identified since 2011 report

3.3.1 Drying of woodblock using waste heat from charcoal plant

Trials have demonstrated that it is feasible to dry woodblock on site using waste heat from the retorts. Simcoa often finds it difficult to source enough dry wood to feed its retort, especially in the winter months. High moisture wood decreases charcoal production efficiency and increases the need for natural gas to maintain temperatures in the incinerator.

By drying woodblock using waste heat, Simcoa can potentially increase annual charcoal production by approximately 2000 tonnes. This would reduce annual coal usage by approximately 3,000 tonnes, saving in excess of 7000 tonnes of CO_2-e per year.

Ancillary benefits would be a reduction in diesel use by mobile equipment used to dry woodblock, and reduction in natural gas consumption in the retorts.

Work has continued on this project since the 2013/14 review, with an ongoing wood drying trial being conducted on site. The culmination of this was an extended trial in 2017, where wood was trial dried using diesel burners. This trial demonstrated that force dried wood resulted in an average increase in retort charcoal production of 5 tonnes per day.

While supporting the case of drying of wood, an economically, and emission friendly method of drying the wood has yet to be developed.

Status: In development

3.3.2 Refractory lining furnace shrouds

Simcoa performed an extended trial on one furnace which entailed the lining of the furnace shrouds with a refractory material. This reduced thermal stresses on the shrouds, minimising cracking and resultant cooling water leaks. This was subsequently rolled out across all 3 furnaces.

This modification should eliminate the need for 3 annual 12 hour shutdowns for water leak repairs for each furnace. This would result in 216 tonnes of extra silicon production annually abating approximately 1,000 tonnes of CO_2-e per year

Status: Implemented

3.3.3 DC powered furnace to recycle fines/off spec material

Every year Simcoa produces approximately 200 tonnes of off spec material and approximately 1,200 tonnes of fines. This material is not counted towards Simcoa's production figures and is sold as a by product. Technology exists in the form of low power DC furnaces that can remelt this material, and allow it to be recycled as saleable product. This could effectively reduce Simcoa's GHG intensity by approximately 2% or approximately 10,000 tonnes of CO_2-e per annum.

Since the 2017 review, there has been no further development of this proposal

Status: On hold

3.3.4 Reduction of composite electrode mantle heater setpoint

The mantle heater preheats electrode paste material to aid baking of the composite electrode. The standard setpoint of this heater was 90°C. Prior to the last review, the setpoint was lowered to 65°C as part of a trial.

This was estimated to have resulted in a saving of 1,261 MWh and 983 tonnes CO_2-e annually.

Unfortunately, the lowered set point resulted in frequent imperfections appearing in the electrodes and the trial was abandoned.

In 2020, furnace 3 was converted to pre baked electrodes (section 3.4.2). These electrodes do not utilize mantle heaters, and they were removed in the conversion process

Status: Rendered obsolete

3.3.5 LED lighting

Simcoa is currently has an ongoing program to replace its site lighting with energy saving LED's.

Since 2013, Simcoa has installed approximately 1,100 LED fittings, which is estimated to save around 700MWH and 500 tonnes CO_2-e annually .

Status: Ongoing, significantly Implemented

3.3.6 Upgrade of compressors

Prior to the 2017 review, Simcoa conducted an audit of its compressed air usage on site to evaluate the overall system efficiency and to identify opportunities of improvement.

The results revealed potential for energy savings through upgrading compressed air equipment to better match air requirements. The monitoring highlighted additional savings could be attained by installation of an improved air management system and reduction of system leaks and other inefficiencies.

The audit concluded that annual savings of 159MWh and 114 tonnes CO2-e annually were possible if its recommendations were implemented.

As a consequence of this audit, the aging compressors were replaced in 2019 with more efficient units

Status: Implemented

3.3.7 Wood screening upgrade

Simcoa routinely screens certain wood feedstocks prior to introducing them to the charcoal retorts. This is done to remove contaminants such as bark and soil, and also to reduce the volume of charcoal fines in the final product. A percentage of the fines material enters the retort cooling water system, necessitating periodic shutdowns to remove the buildup.

In 2017, Simcoa trialled and subsequently purchased a rotating trommel screen for its wood screening operations. The trommel screen has seen a doubling in product throughput compared to the gyratory screen it replaced, and has improved the overall efficiency of fines removal. This reduces diesel consumption of screening operations, as well as reduces the volume of fines entering the retort cooling system.

Replacing a gyrating screen with the trommel eliminates approximately 35KL of diesel consumption and 95 tonnes CO2-e annually.

Status: Implemented

3.4 Abatement opportunities identified since 2017 review

3.4.1 Retort Process Improvements

Simcoa does not currently possess the capacity to produce enough charcoal to completely eliminate the need for coal reductants. However, ensuring charcoal production is maximised keeps coal use as low as possible.

Since the last review in 2017, Simcoa has refined its charcoal production control system philosophy in an effort to increase annual production. This philosophy relies on increasing the stability of the process and reducing downtime.

Figure 1 Annual Charcoal Production 2013-2019

In addition, in 2017 Simcoa trialled a new method of filtration of the retort cooling water. During the production of charcoal, charcoal fines material enters the retort cooling water system. In order to maintain cooling system capacity, and prevent outbreaks of legionella, the resultant solids are removed by continuously passing the cooling system water through a filter press. Historically the filter press has been unable to remove all the fines, and this necessitated shutdown of the retorts every 3 weeks to remove the build-up of excessive solids. The 2017 trial involved increasing agitation of the sumps to better distribute solids, improving the effectiveness of the filter press. This trial was successful, and eventually completely eliminated the need to shut down for manual cleanouts of the sump.

Since these changes were implemented in 2017, annual charcoal production has increased by an average of 1,300 tonnes (Figure 1). This additional charcoal offsets the use of 2200 tonnes of coal, saving 5,400 tonnes CO2-e annually

Status: Implemented

3.4.2 Furnace 3 Electrode Conversion

During construction of Furnace 3, it was decided to utilize what are known as composite electrodes. Unlike the pre baked electrode pieces used on furnace 1 and 2, composite electrodes consist of a steel casing filled with a loose electrode paste material, with a small diameter pre baked core electrode. As the electrode is heated, the electrode paste then bakes, forming a solid electrode.

The decision to utilize this electrode system was a result of 2 main factors, namely:

- Furnace 3 utilized a larger diameter electrode than furnace 1 and 2, and there were very few electrode manufacturers that produced a suitably sized pre baked electrode. This resulted in a risk that the manufacturers may have ceased production, or made the larger electrodes too expensive to economically run the furnace.
- At the time, the composite electrode system was more economical system and would allow a lower cost per tonne of production.

After successfully running the furnace for 8 years using the composite electrode system, two things changed in the electrode supply landscape. Firstly, manufacture of large diameter pre baked electrodes became more common, and therefore the risk of interruption of supply was lessened. Secondly, the cost of the core electrodes used in the composite electrode system became prohibitively expensive.

As a consequence, it was decided to convert furnace 3 to a pre baked electrode system, a project that was completed in September 2020. Composite electrodes require an input of electrical energy to bake the electrode, something that is not required with pre baked electrodes. As such, this had a benefit in terms of electrical efficiency of the furnace.

At the time of writing of this report, there was insufficient data to accurately quantify the actual improvement in efficiency, however an improvement of 0.3 to 0.5MWH/tonne of Silicon is a reasonable estimate. This equates to a saving of between 5,200 to 8,600 MWH and 3,640 to 6,020 tonnes CO2-e annually. Actual savings will be reported in the next triennial review.

Status: Implemented

3.4.3 Scheduled removal of Furnace Ledges

Silicon production in 2019/20 was negatively impacted by higher than normal downtime due to unexpected breakdowns. This issue was exacerbated by a decline in raw material quality, namely:

- A decline in quartzite feed quality, with higher than historical contaminant levels
- A decline in coal reductant reactivity

One of the side effects of these issues is the formation of silicon carbide ledges in the furnace. These ledges consist of unreactive material that builds up on the furnace walls, greatly restricting the capacity of the furnace, reducing production and efficiency.

These ledges are difficult to remove through normal operation and therefore can impact production over an extended period. This has been evidenced by the gradual decline in furnace 1 and 2 performance since they were relined in 2013 and 2016.

After the furnace 3 electrode conversion, Simcoa had difficulties restarting efficient production due to excessive carbide formation. The decision was taken to perform a shutdown of the furnace, followed by a manual cleanout of the furnace crucible using excavator mounted rock breakers. This was successful, and allowed the removal of most of the carbide material, returning the furnace crucible to almost full capacity. Once the furnace was restarted, production volumes and efficiencies returned to expected levels.

Now that this method of removing ledges has been proven to be beneficial, it is planned that it will be performed on a scheduled basis on all three furnaces every 2 to 3 years. This should return production efficiencies back to the levels seen in 2017/18, dropping total emissions by 0.3 to 0.6 tonnes CO2-e per tonne of silicon. This equates to a saving of 15,000 to 25,000 tonnes CO2-e annually.

Status: Implemented

4 Greenhouse Gas Emissions and Energy Efficiency Profile

4.1 Performance against internal benchmarks

4.1.1 Estimation methodology

Greenhouse gas efficiency was calculated at the facility level in a manner consistent with the methodologies and factors *National Greenhouse and Energy Reporting (NGER) Act 2007* and the National Greenhouse and Energy Reporting (Measurement) Determination 2008. GHG and electrical intensities reported are for the entire Kemerton Smelter, inclusive of ancillary activities such as the charcoal retort.

4.1.2 Performance against key performance indicators

GHG emissions and Electrical Intensity Performance of the Kemerton smelter for the period 2009-2020 is shown in figure 2 through 5. Performance is compared against pre construction of Furnace 3 projections. A detailed breakdown of GHG emissions and electricity consumption can be found in **Appendix C**.

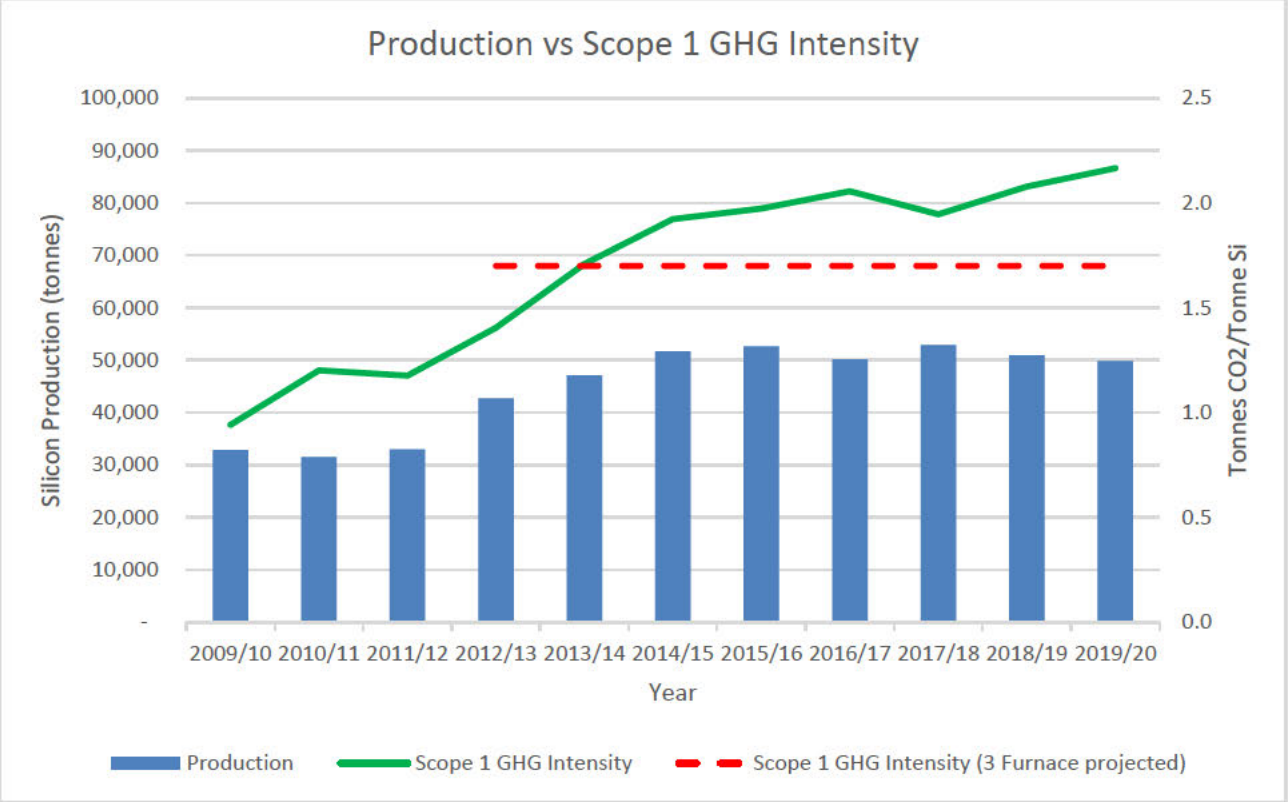


Figure 2 Production vs Scope 1 GHG Intensity

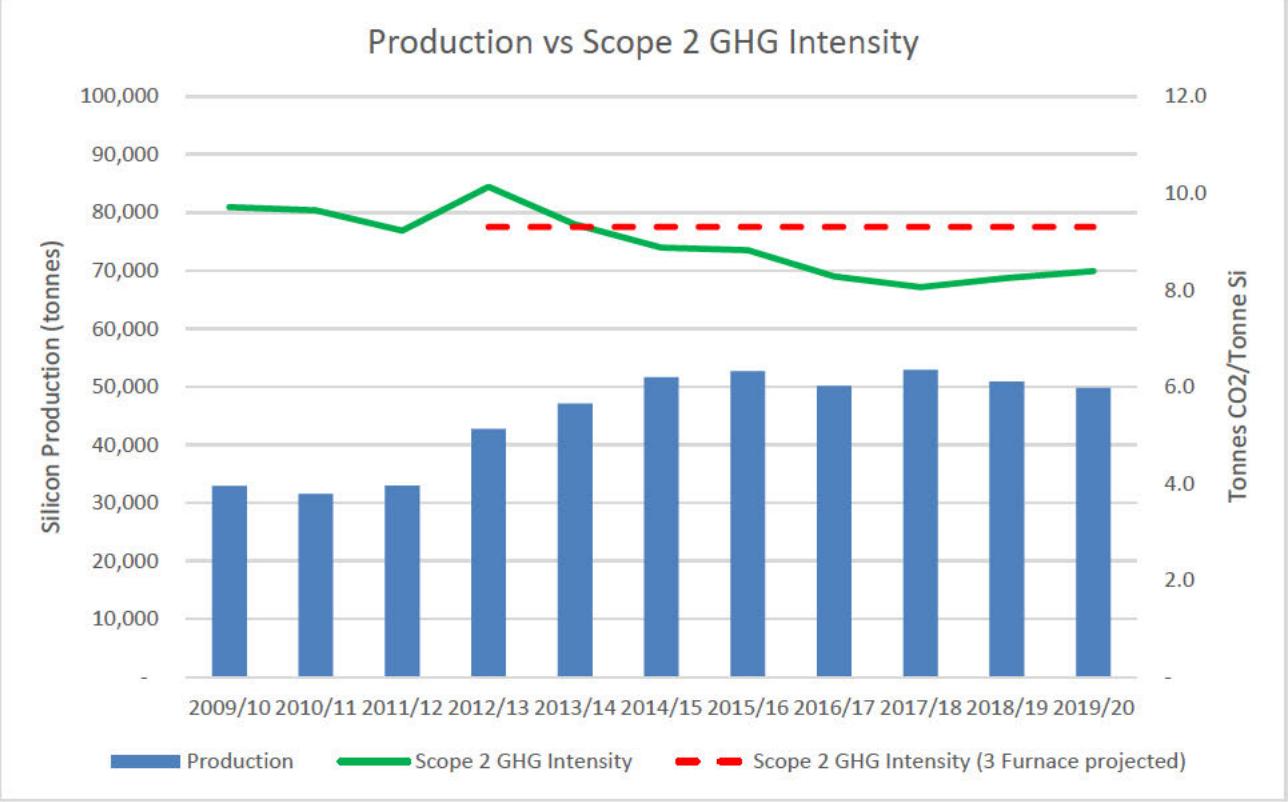


Figure 3 Production vs Scope 2 GHG Intensity

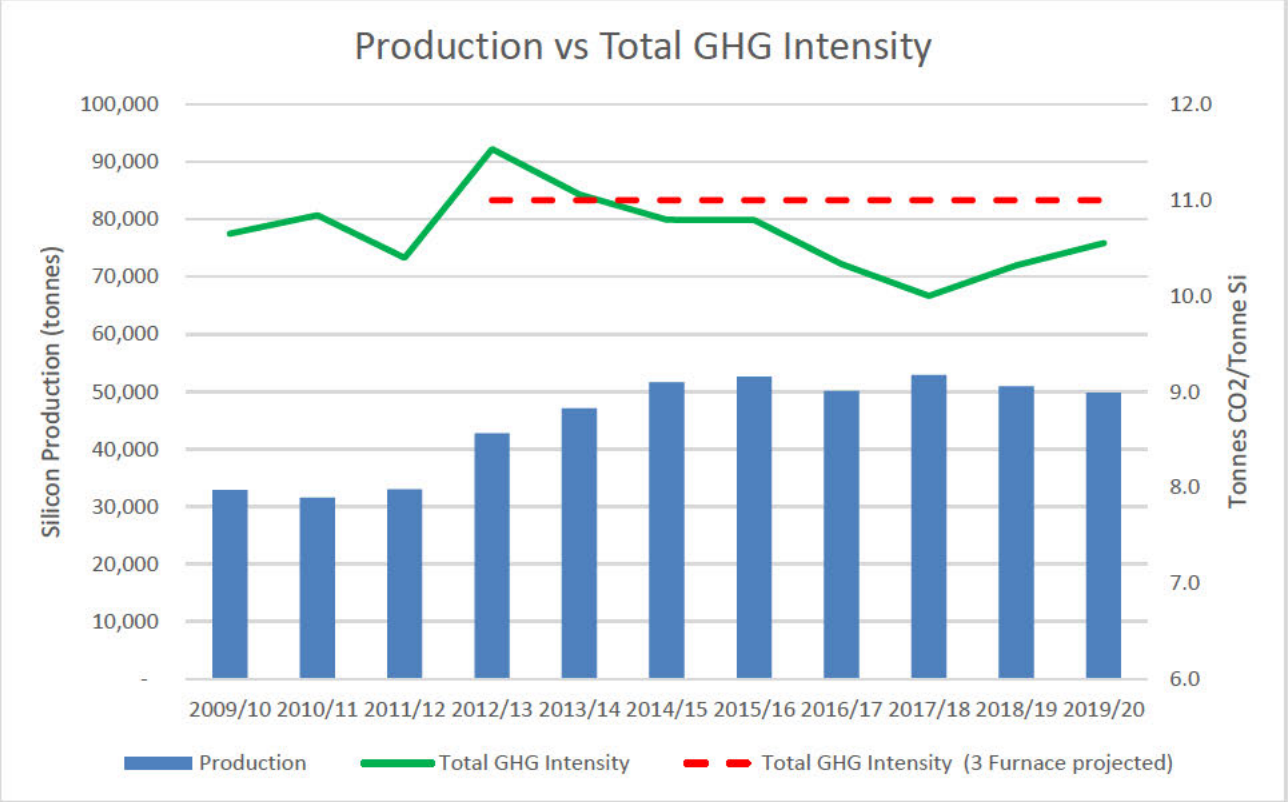


Figure 4 Production vs Total GHG Intensity

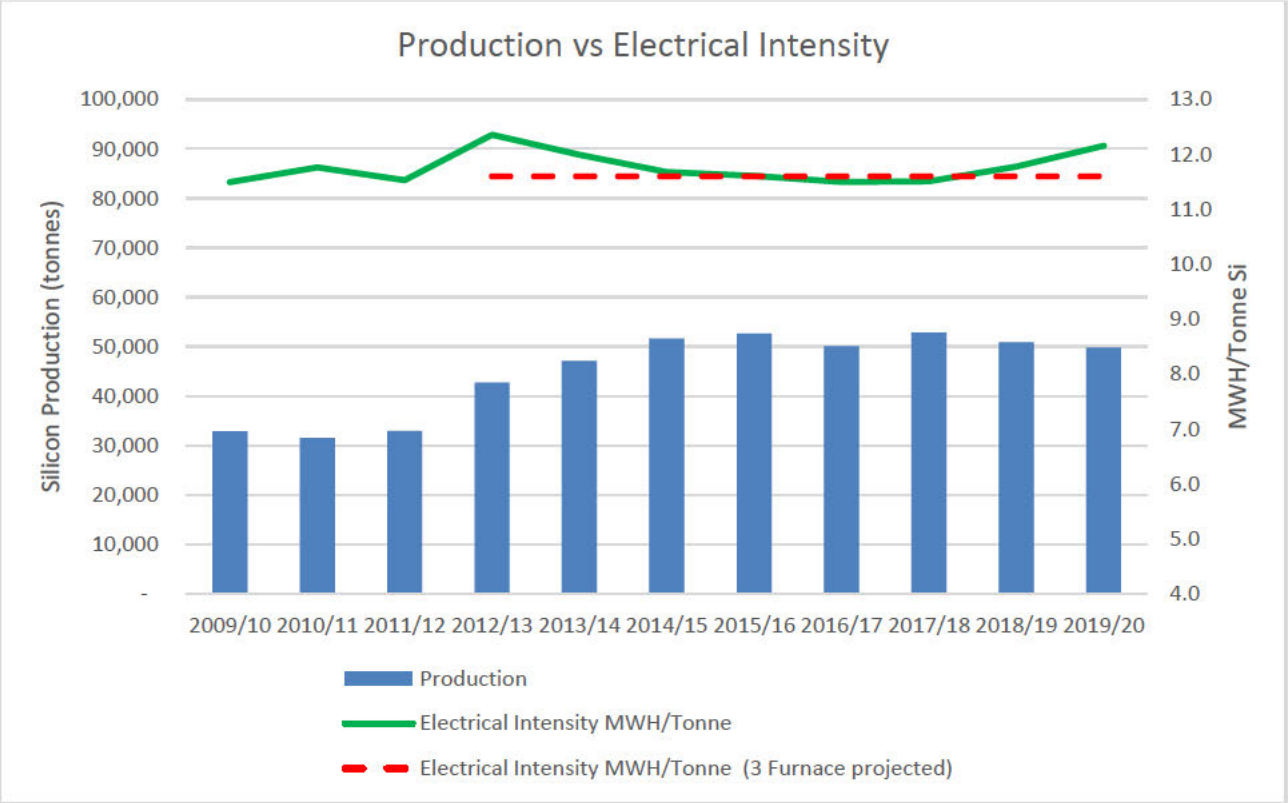


Figure 5 Production vs Electrical Intensity

4.1.2.1 2014 performance review

GHG emissions intensity for the 2013/14 year was 11 tonnes CO2-e/tonne Si, which was in line with projected forecasts reported in 2011 for a 3 furnace operation (inclusive of the measures adopted in its design). 84% of GHG emissions were Scope 2 emissions (as a result of the consumption of electricity).

Total Electricity intensity, including ancillary activity usage, was 12 MWh/tonne Si, slightly in excess of the 11.6 MWh/tonne Si projected in 2011. This slightly higher than expected electricity intensity was due to a variety of factors, most significantly:

- Since commissioning Furnace 3 in September 2012, a variety of minor issues with aspects of the furnace design were identified. Some of these issues, such as premature wear of certain components, resulted in a higher frequency and duration of downtime events than initially predicted. Stable operation has been identified as a significant factor in determining electrical efficiency. As these issues are identified and rectified, electrical efficiency should improve.
- The commissioning of Furnace 3 resulted in an increase in silicon production capacity. This was not matched by an increase in charcoal raw material production due to issues with access to raw materials and difficulty of obtaining environmental approvals. Simcoa has trialled a variety of new reductants to make up the shortfall in reductant feedstock, with varying degrees of success. Some of the trialled reductants were found to have a significantly detrimental effect on silicon production rate, and therefore also on electrical intensity. Simcoa has largely rectified these issues through its research and development programs, and therefore it is expected electrical efficiencies should improve.
- Simcoa performed several lengthy trials in the 2013/14 period in which it increased the power supplied to the furnaces in an effort to improve efficiencies. This was largely unsuccessful, with production remaining largely stable despite increased power consumption. This obviously had a detrimental effect on electrical efficiency.
- Prior to 2013, 2 of Simcoa's 3 submerged arc furnaces were in excess of 25 years old and therefore beginning to show signs of age and inefficiency. In April 2013, Simcoa refurbished one of these original furnaces. Since this furnace was reenergized, efficiencies improved. Simcoa refurbished the remaining original furnace in late 2016.

4.1.2.2 2017 performance review

GHG emissions intensity for the 2016/17 year was 10 tonnes CO2-e/tonne Si. This was below both the projected forecasts reported in 2011 for a 3-furnace operation (inclusive of the measures adopted in its design), and the reported 2013/14 emission intensity. 81% of GHG emissions were Scope 2 emissions (as a result of the consumption of electricity).

Total Electricity intensity, including ancillary activity usage, was 11.5 MWh/tonne Si, in line with the intensity originally projected in 2011 and slightly below the 12 MWh/tonne Si reported in 2013/14.

The improved GHG emission intensity and electricity intensity over previous reporting was due to a variety of factors, most significantly:

- As previously reported, since the commissioning of the 3rd furnace in 2012, Simcoa has refurbished its original 2 furnaces which had seen in excess of 25 years of service. This has

contributed to improved efficiencies in the refurbished furnaces, which has resulted in production increasing by over 6% since 2013/14.

- Continuous improvement in the availability of furnace 3 resulting in decreased downtime and improved efficiency.
- Through its research and development programs, Simcoa has refined its selection of reductant raw material. As previously reported, in the first years after the commissioning of furnace 3, Simcoa trialled a variety of reductant raw materials to fulfil the requirements of the extra furnace. Some of the trialled reductants were found to have a detrimental effect on silicon production rate and process electrical intensity (MWH/tonne Si). This was largely traced to the varying quality of external charcoal products. As shown in figure 1, a reduction in the use of external charcoal has coincided with an improvement in electrical intensity.

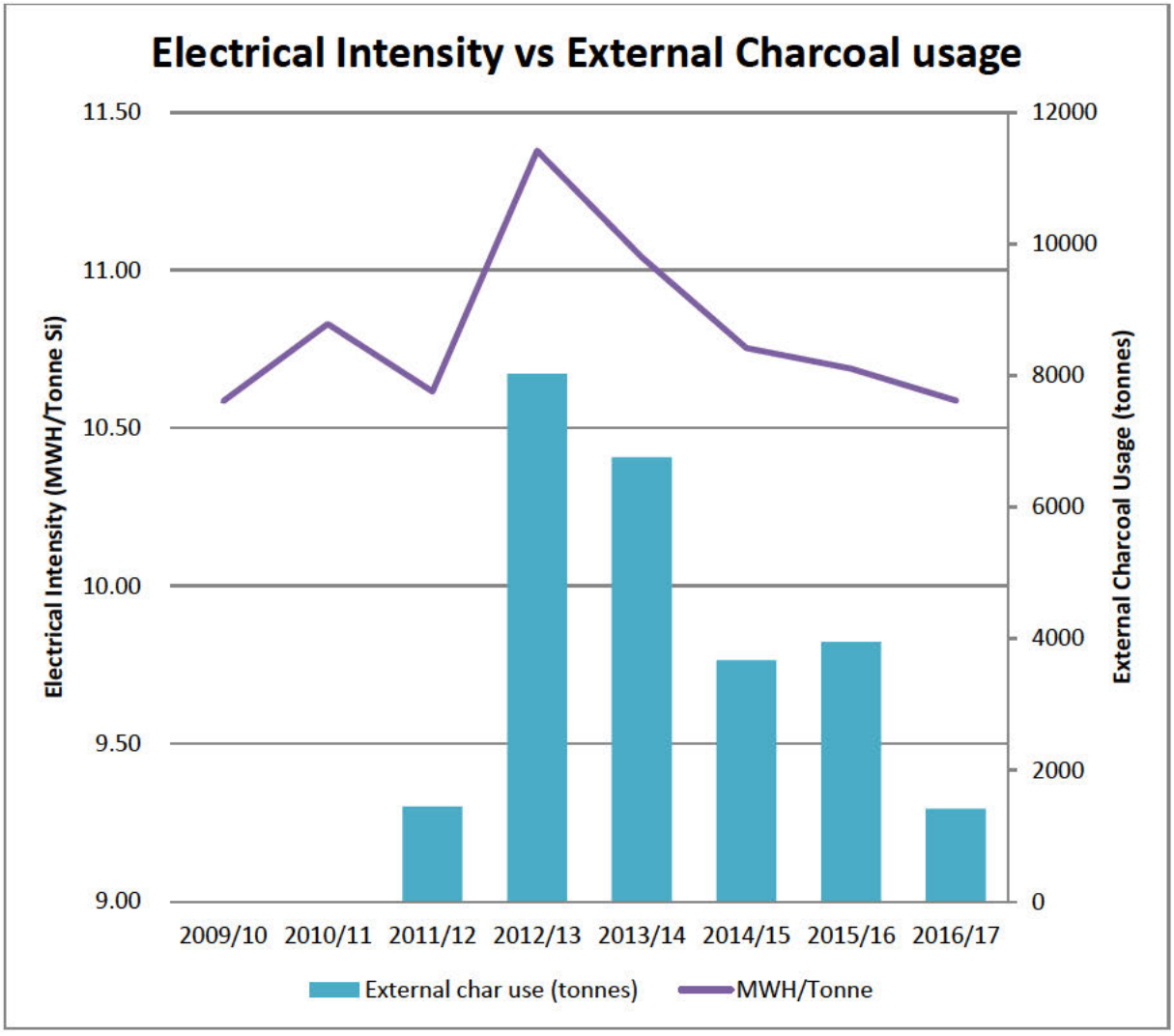


Figure 6: Electrical intensity (process only) vs External charcoal usage showing that reduced use of external charcoal has coincided with improved electrical intensity

- The emissions intensity of electricity sourced from the South West Interconnected System (SWIS), from which the Kemerton smelter is supplied, has steadily declined since the original report in 2011. In 2011, electricity delivered had a reported emission intensity of 0.80 tonnes CO2-e/MWH. By the 2014 report this had dropped to 0.78, and for the 2017 report it

dropped again to 0.72. This has subsequently reduced scope 2 emissions from the Kemerton Smelter.

4.1.2.3 2020 performance review

GHG emissions intensity for the 2019/20 year was 10.6 tonnes CO2-e/tonne Si. This was below both the projected forecasts reported in 2011 for a 3-furnace operation (inclusive of the measures adopted in its design), and the reported 2013/14 emission intensity. However, it was slightly above the 2016/17 intensity. 79% of GHG emissions were Scope 2 emissions (as a result of the consumption of electricity).

Total Electricity intensity, including ancillary activity usage, was 12.2 MWh/tonne Si, slightly above the intensity originally projected in 2011, and also the 2013/14 and 2016/17 years.

The increase in GHG emission intensity and electricity intensity since the last review was due to a variety of factors, most significantly:

- An increase in furnace downtime, mainly as a result of electrode column breakages.
- A decline in quartzite feed quality, with higher than historical contaminant levels
- A decline in coal reductant reactivity

As reported in section 3.4.3, this resulted in the formation of ledges in the furnace, which further impacted furnace efficiency.

Simcoa is aiming to recover from the issues encountered in 2019/20, both through the efficiency measures noted previously in this report, and its continual improvement philosophies.

The slight decrease in efficiencies were offset by continued decline in the emissions intensity of electricity sourced from the South West Interconnected System (SWIS), from which the Kemerton smelter is supplied. The emission intensity (tonnes CO2-e/MWH) has steadily declined since the original report in 2011. In 2011, electricity delivered had a reported emission intensity of 0.80 tonnes CO2-e/MWH. By the 2014 report this had dropped to 0.78, for the 2017 report it dropped again to 0.72, and again to 0.70 in 2020.

This has subsequently reduced scope 2 emissions from the Kemerton Smelter.

4.2 Performance against external benchmarks (update 2020)

4.2.1 Estimation methodology

The GHG emission and electrical intensity for global silicon producers was calculated using production and operations data published by CRU Analysis (CRU, 2013) (CRU, 2017) (CRU, 2020) and the default emission factors published in the 2017 edition of the National Greenhouse Account Factors (Department of the Environment, 2017). Simcoa's GHG emission and electrical intensity was based on data for the 2019/20 year.

It should be noted this methodology has some limitations, namely:

- Scope 1 and 2 GHG emissions intensity, and electrical intensity is for the direct process only (silicon production), as data for ancillary GHG emissions and electricity usage is not available for global producers.

- Scope 2 GHG emissions intensity associated with electricity consumption was normalized for all operations by using the emission factor for Western Australian electricity production. It should be noted that some producers may source electricity from systems with higher or lower emissions factors.
- Data for Chinese producers was unavailable in the 2014 report; however in 2016 and 2020, data for the largest Chinese producer (Xinjiang) has been shown for comparison purposes.

4.2.2 Performance against key performance indicators

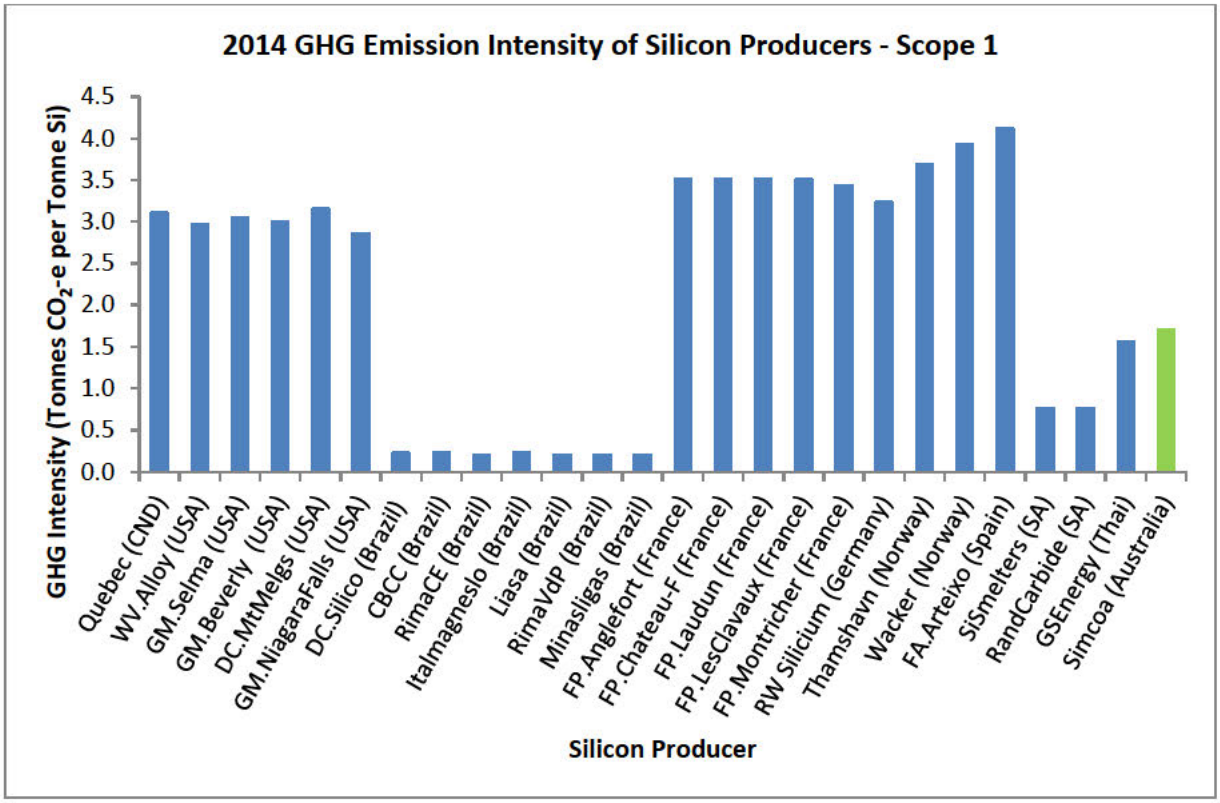
The estimated GHG emission and electrical intensity can be found in figure 7, 8 and 9.

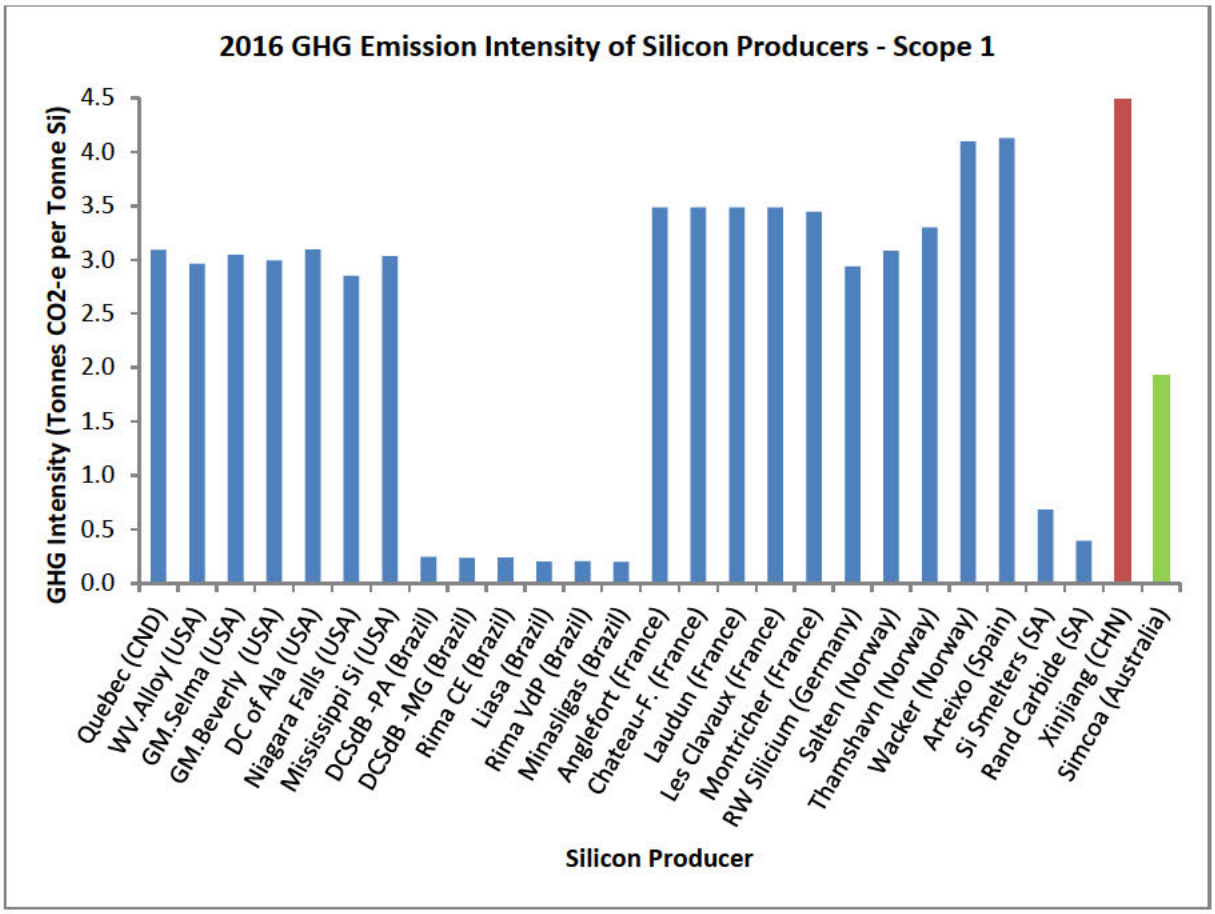
4.2.2.1 GHG emission intensity of global silicon producers - Scope 1

In 2019, Simcoa ranked 8th out of 25 producers for scope 1 GHG emissions intensity (tonnes CO_2-e/tonne Si). This was a slight improvement over its ranking of 9th in 2016. Silicon producers in Brazil, who made up 6 of the 7 smelters with the lowest scope 1 emissions, utilize high levels of carbon neutral charcoal reductants. Unfortunately Simcoa does not have access to the charcoal resources of these producers, and therefore has higher scope 1 emissions through the use of coal.

As detailed in section 3 and 3.2.7, Simcoa has attempted to increase the use of charcoal in its operations by supplementing the charcoal produced at the site with additional material from overseas producers. Unfortunately, quality control issues with this material adversely affected electrical efficiency and scope 2 intensity; negating the benefit[1]s gained in reducing scope 1 emissions.

Significantly, Simcoa's scope 1 GHG emissions intensity is 35 to 40% lower than that of producers in Europe and North America.


2014 GHG Emission Intensity of Silicon Producers - Scope 1
GHG Intensity (Tonnes CO_2-e per Tonne Si)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC.MtMelgs (USA)
GM.NiagaraFalls (USA)
DC.Silico (Brazil)
CBCC (Brazil)
RimaCE (Brazil)
Italmagneslo (Brazil)
Liasa (Brazil)
RimaVdP (Brazil)
Minasligas (Brazil)
FP.Anglefort (France)
FP.Chateau-F (France)
FP.Laudun (France)
FP.LesClavaux (France)
FP.Montricher (France)
RW Silicium (Germany)
Thamshavn (Norway)
Wacker (Norway)
FA.Arteixo (Spain)
SiSmelters (SA)
RandCarbide (SA)
GSEnergy (Thai)
Simcoa (Australia)
Silicon Producer


2016 GHG Emission Intensity of Silicon Producers - Scope 1
GHG Intensity (Tonnes CO2-e per Tonne Si)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC of Ala (USA)
Niagara Falls (USA)
Mississippi Si (USA)
DCSdB -PA (Brazil)
DCSdB -MG (Brazil)
Rima CE (Brazil)
Liasa (Brazil)
Rima VdP (Brazil)
Minasligas (Brazil)
Anglefort (France)
Chateau-F. (France)
Laudun (France)
Les Clavaux (France)
Montricher (France)
RW Silicium (Germany)
Salten (Norway)
Thamshavn (Norway)
Wacker (Norway)
Arteixo (Spain)
Si Smelters (SA)
Rand Carbide (SA)
Xinjiang (CHN)
Simcoa (Australia)
Silicon Producer

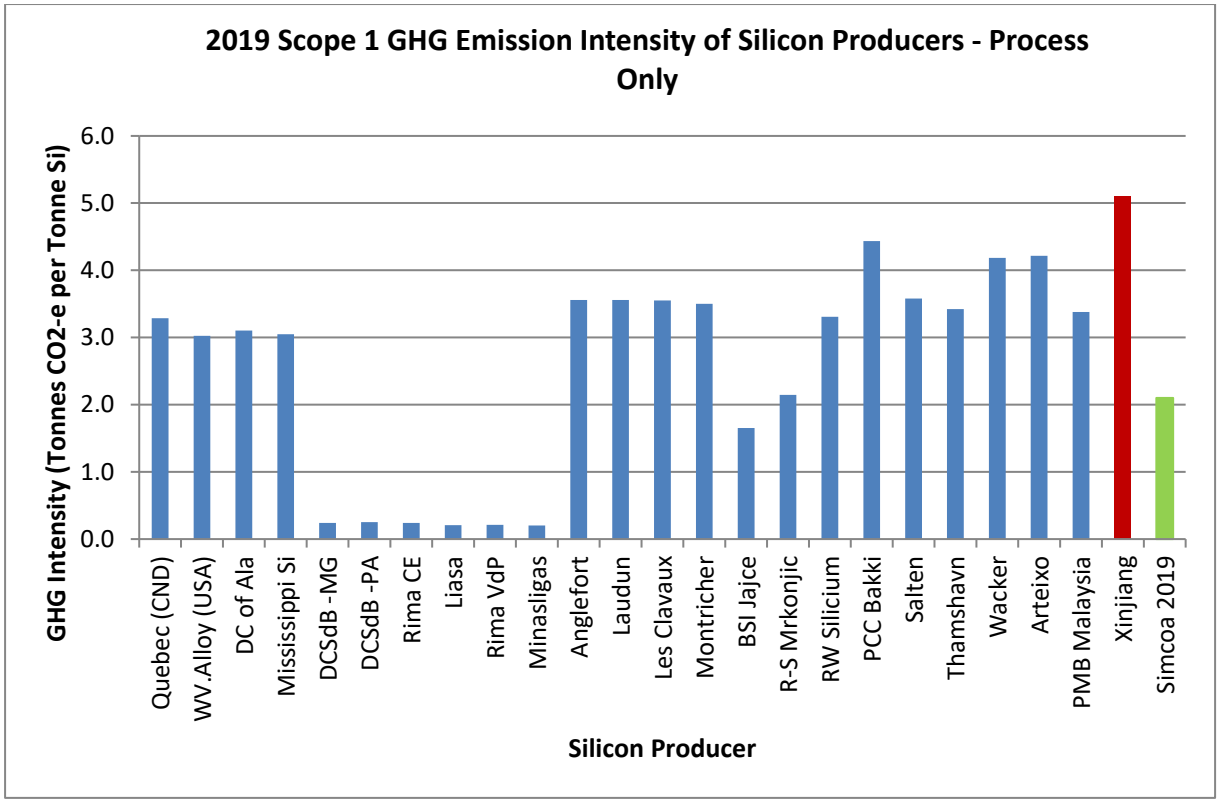
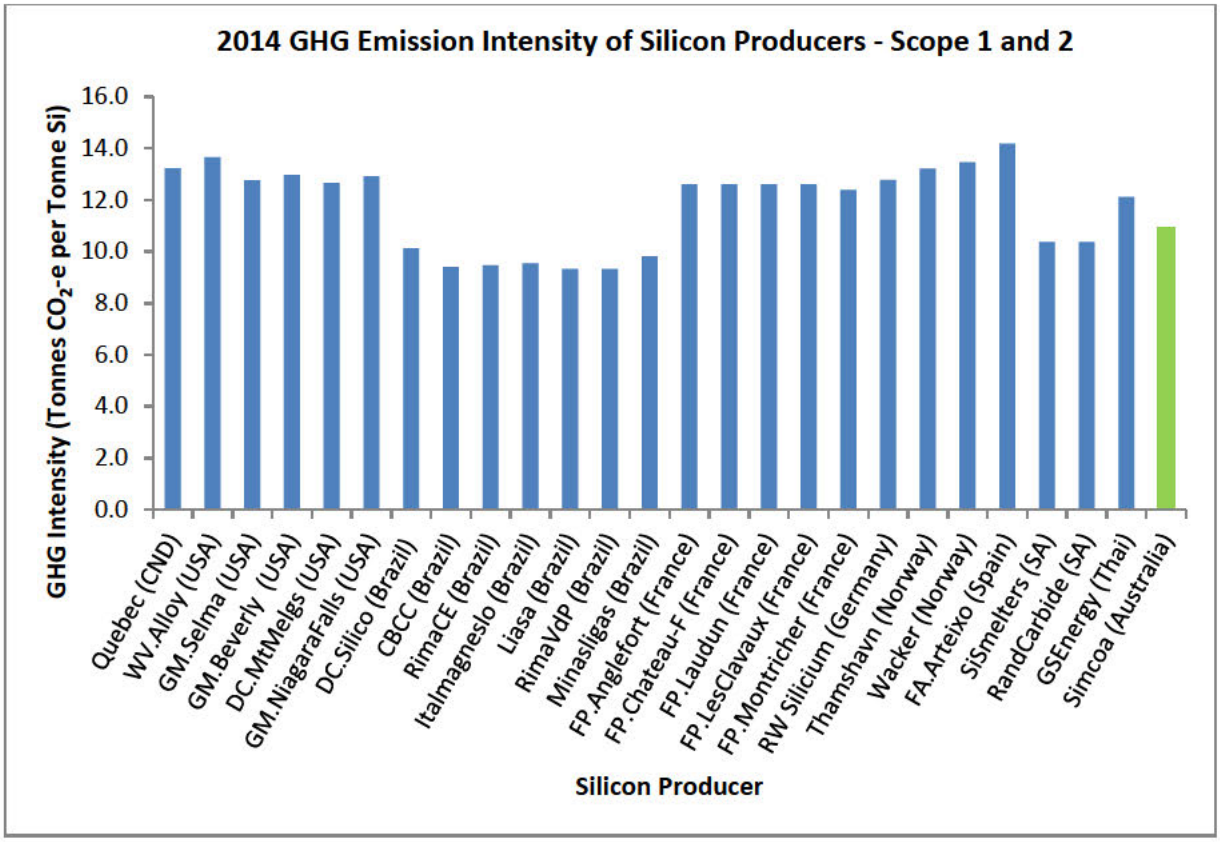


Figure 7: Scope 1 GHG intensity of global silicon producers

4.2.2.2 GHG emission intensity of global silicon producers - Scope 1 and 2

If Scope 2 GHG emissions intensity associated with electricity consumption is normalized for all operations by using the emission factor for Western Australian electricity production, the project currently ranks 8th out of 25 producers for combined scope 1 and 2 GHG emissions intensity (tonnes CO_2-e/tonne Si). This was an improvement on its ranking of 9th out of 26 in 2016. Simcoa's ranking is largely attributable to the extremely low scope 1 emissions of the Brazilian operations.


2014 GHG Emission Intensity of Silicon Producers - Scope 1 and 2
GHG Intensity (Tonnes CO_2-e per Tonne Si)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC.MtMelgs (USA)
GM.NiagaraFalls (USA)
DC.Silico (Brazil)
CBCC (Brazil)
RimaCE (Brazil)
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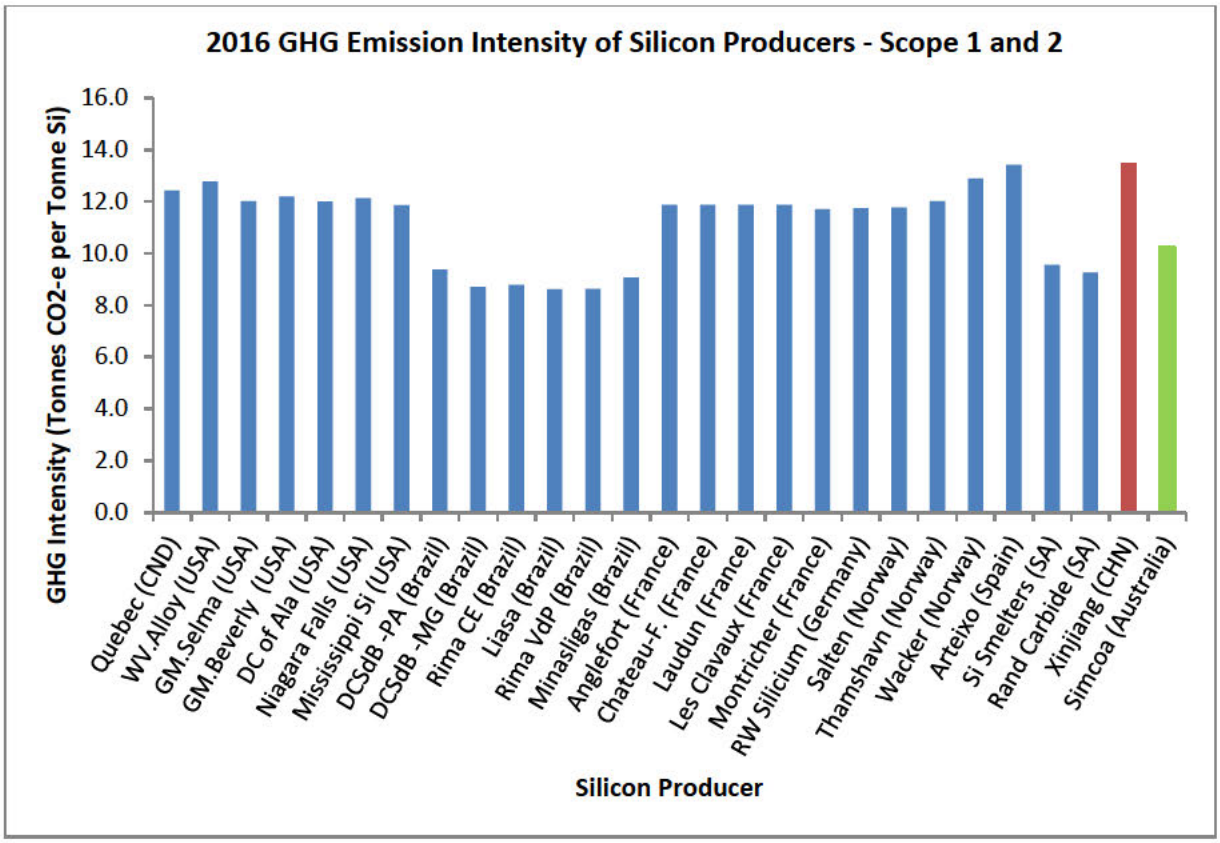
RW Silicium (Germany)
Thamshavn (Norway)
Wacker (Norway)
FA.Arteixo (Spain)
SiSmelters (SA)
RandCarbide (SA)
GSEnergy (Thai)
Simcoa (Australia)
Silicon Producer


2016 GHG Emission Intensity of Silicon Producers - Scope 1 and 2
GHG Intensity (Tonnes CO2-e per Tonne Si)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
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Si Smelters (SA)
Rand Carbide (SA)
Xinjiang (CHN)
Simcoa (Australia)
Silicon Producer

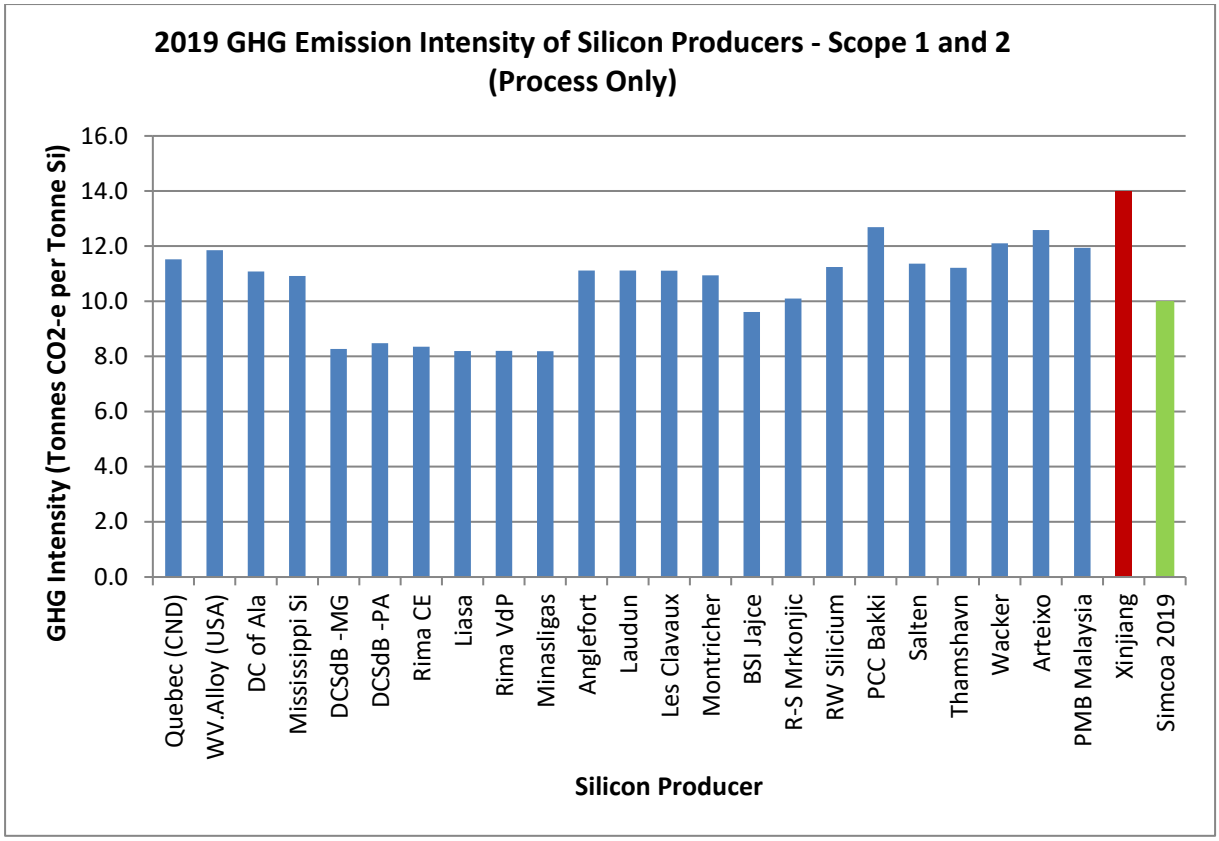
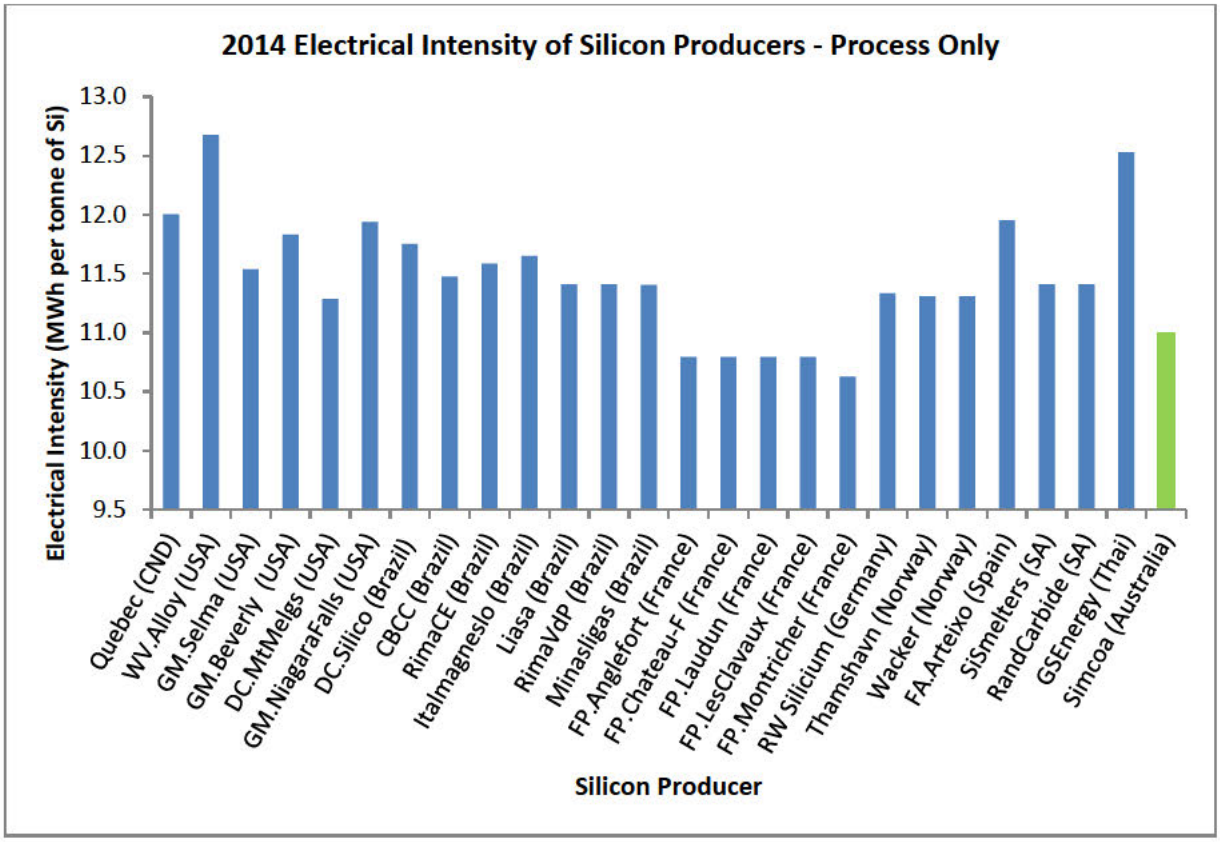


Figure 8: Scope 1 and 2 GHG intensity of global silicon producers

4.2.2.3 Process electrical intensity of global silicon producers

Electrical intensity at Simcoa declined approximately 0.3 MWh/tonne Si in 2019 compared to 2016. The project currently ranks 9th out of 25 producers for electrical efficiency (MWh/tonne Si), compared to its rating of 2nd in 2016.

Simcoa's decline in electrical efficiency, and plan to improve performance over the next 3 years is outlined in section 4.1.2.3


2014 Electrical Intensity of Silicon Producers - Process Only
Electrical Intensity (MWh per tonne of Si)
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC.MtMelgs (USA)
GM.NiagaraFalls (USA)
DC.Silico (Brazil)
CBCC (Brazil)
RimaCE (Brazil)
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Liasa (Brazil)
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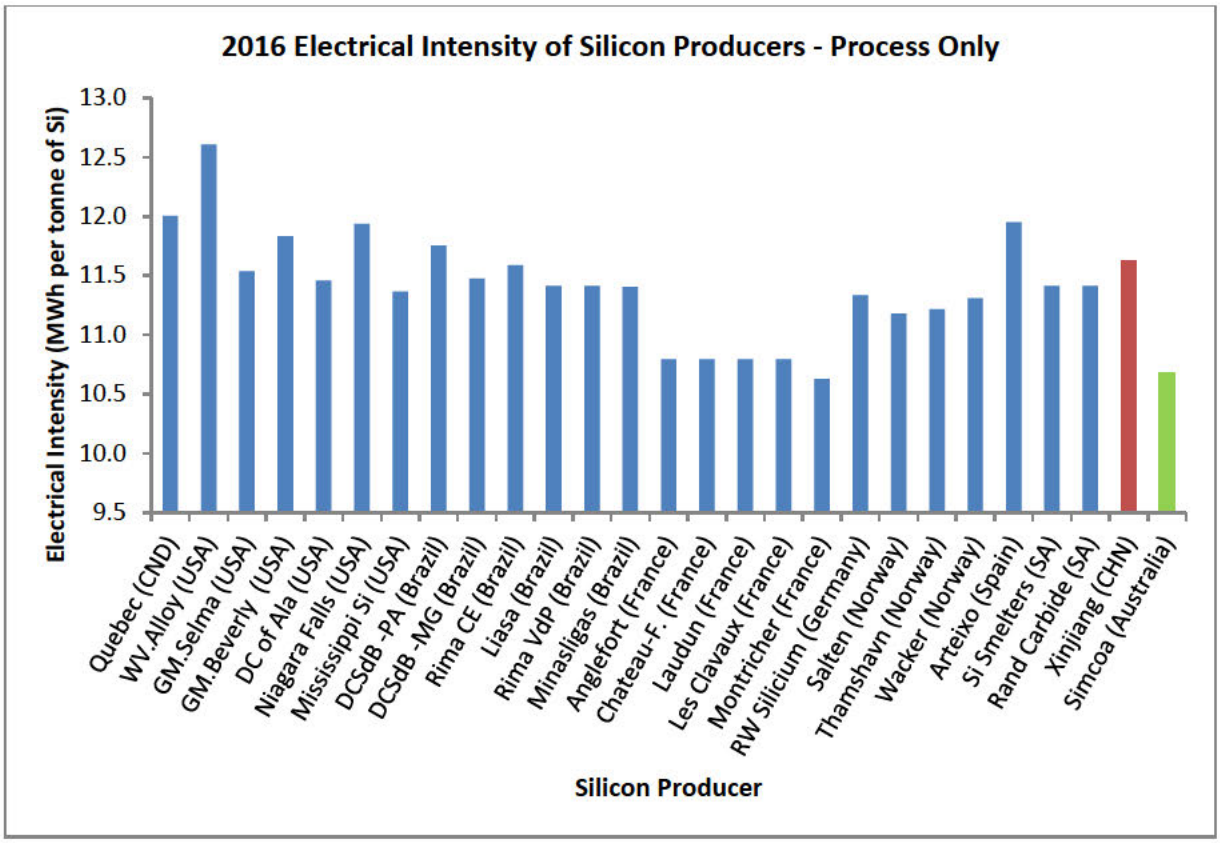
FP.LesClavaux (France)
FP.Montricher (France)
RW Silicium (Germany)
Thamshavn (Norway)
Wacker (Norway)
FA.Arteixo (Spain)
SiSmelters (SA)
RandCarbide (SA)
GSEnergy (Thai)
Simcoa (Australia)
Silicon Producer


2016 Electrical Intensity of Silicon Producers - Process Only
Electrical Intensity (MWh per tonne of Si)
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC of Ala (USA)
Niagara Falls (USA)
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DCSdB -PA (Brazil)
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Liasa (Brazil)
Rima VdP (Brazil)
Minasligas (Brazil)
Anglefort (France)
Chateau-F. (France)
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Les Clavaux (France)
Montricher (France)
RW Silicium (Germany)
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Wacker (Norway)
Arteixo (Spain)
Si Smelters (SA)
Rand Carbide (SA)
Xinjiang (CHN)
Simcoa (Australia)
Silicon Producer

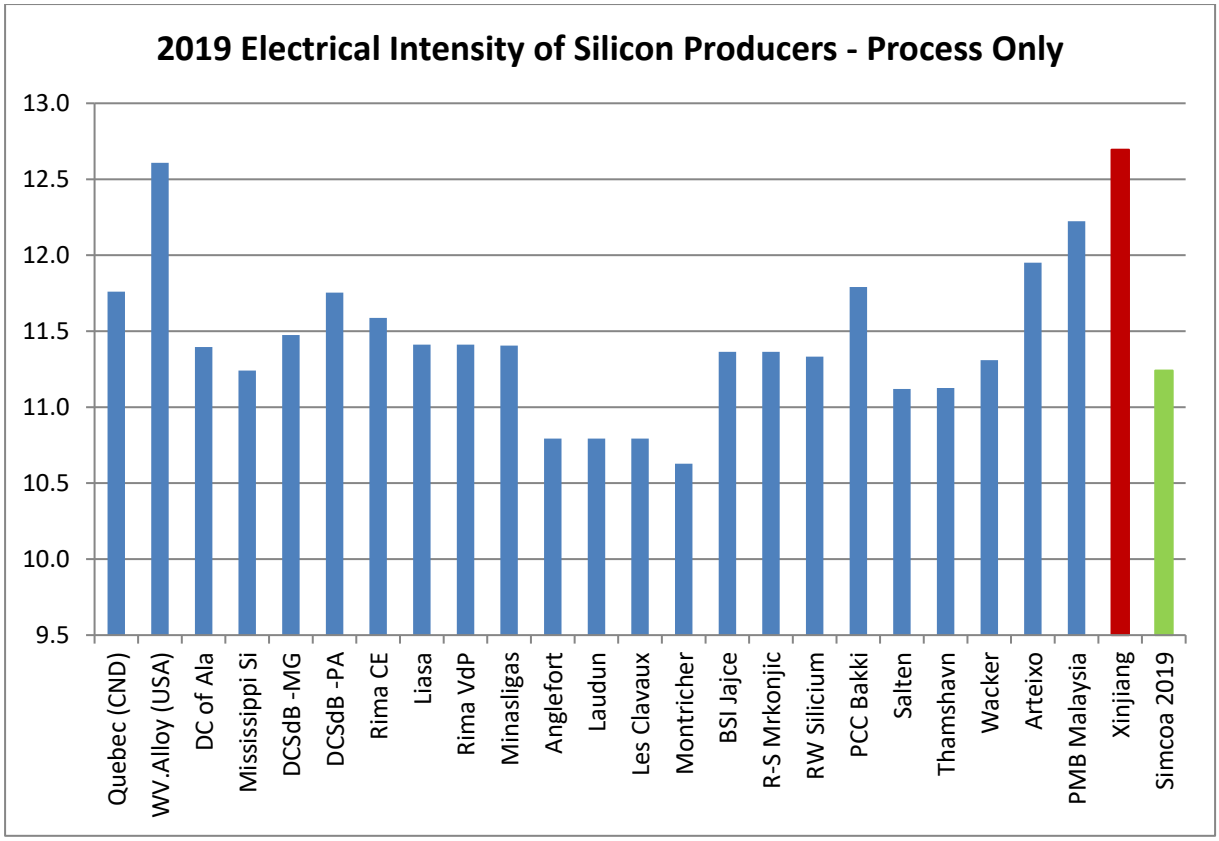

Figure 9: Electrical intensity of global silicon producers

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Appendix A: Triennial GHG abatement review meeting minutes

Greenhouse Gas Abatement Report

Triennial Review Meeting Agenda and Minutes

14 October 2020

1 Invited Attendees:

- Daniel Mance (DM) (QHSE Supervisor) Meeting Facilitator
- Drew Harris (DH) (General Manager-Production)
- David Miles (DMi) (Vice President-Site services and marketing)
- Enn Bishop (EB) (Smelter Superintendant)
- Kees Visser (KN) (Mining and Raw Material Manager)
- Terry Haines (TH) Materials Manager
- Andrew Watson (AW) (Procurement Specialist)
- Rosalie Pederick (RP) (Snr HR Business Partner)
- Shigenari Karasawa (SK) (Manager, Accounting and Finance)
- James Levy (JL) (Business Development Manager)

2 Agenda

2.1 Meeting open.

DM explains scope of meeting. Part of a requirement of condition 9-2 of Ministerial Statement 813:

9-1 The proponent shall prepare and submit to the Minister for Environment, within 18 months of commencement of ground-disturbing activities, a Greenhouse Gas Abatement Report which meets the objectives set out in condition 9-2, as determined by the Minister for Environment.

9-2 The objectives of the Greenhouse Gas Abatement Report required by condition 9-1 are to:

1. *Demonstrate that maximising energy efficiency and opportunities for future energy recovery have been given due consideration in the design of the third and fourth submerged electric arc furnaces;*

2. *Ensure that the "greenhouse gas" intensity ("greenhouse gas" per unit of silicon produced) is equivalent to, or better than, benchmarked world's best practice; and*

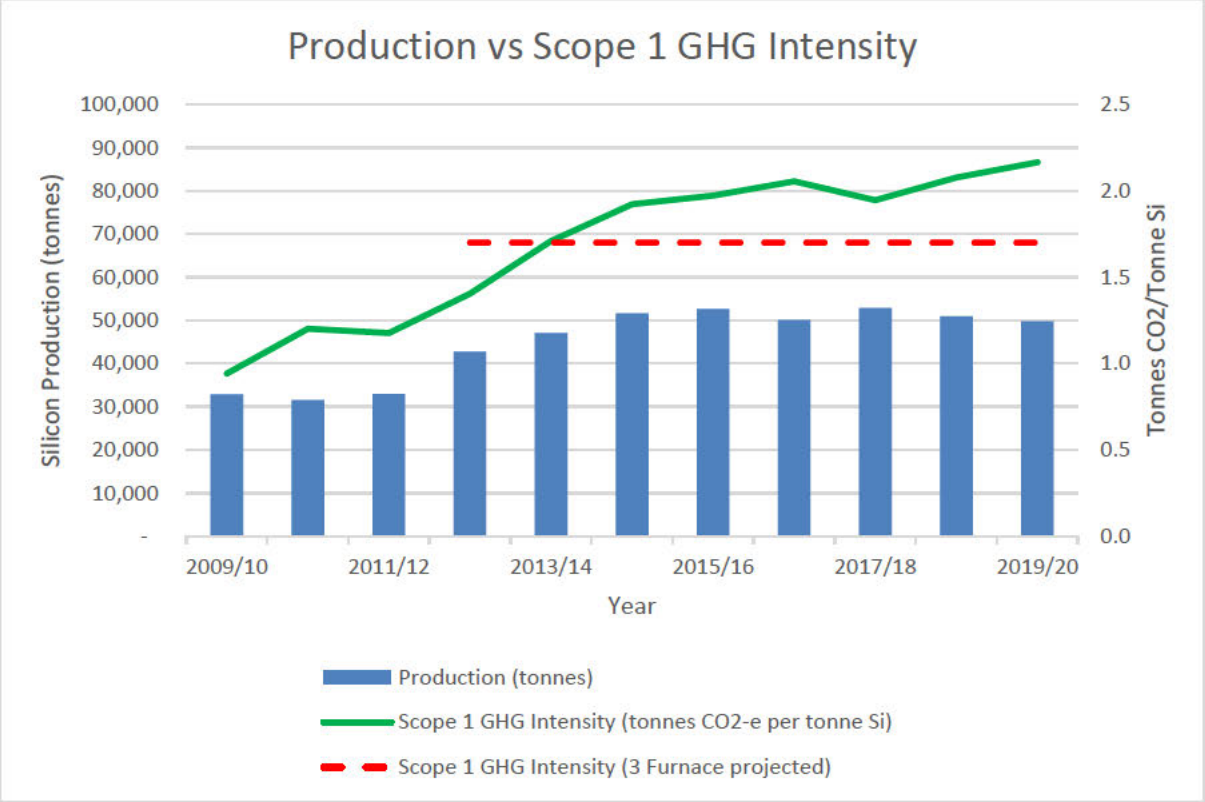
3. *Achieve continuous improvement in "greenhouse gas" intensity through triennial review, and if practicable, adoption of advances in technology and process management*

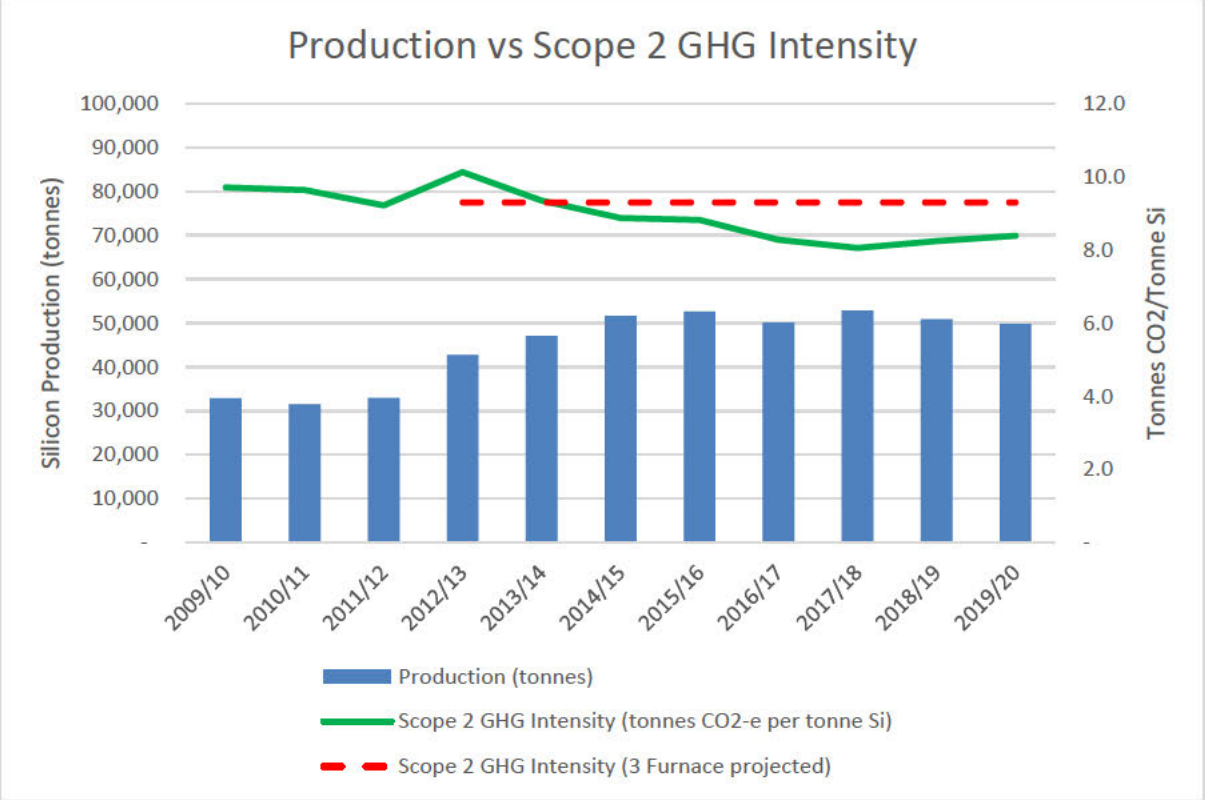
2.2 2019/20 GHG emission performance compared to GHG KPI's

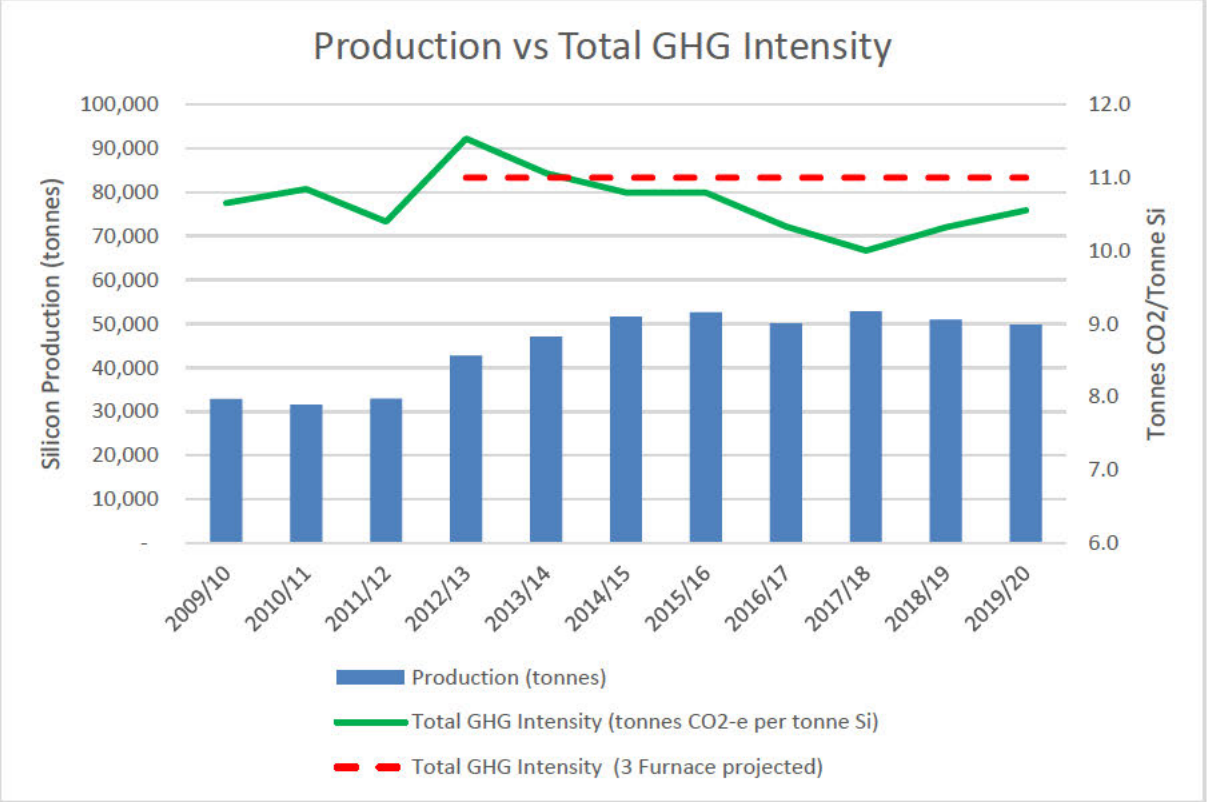
DM to present 2016/17 performance against internal and external (global silicon producer) benchmarks.

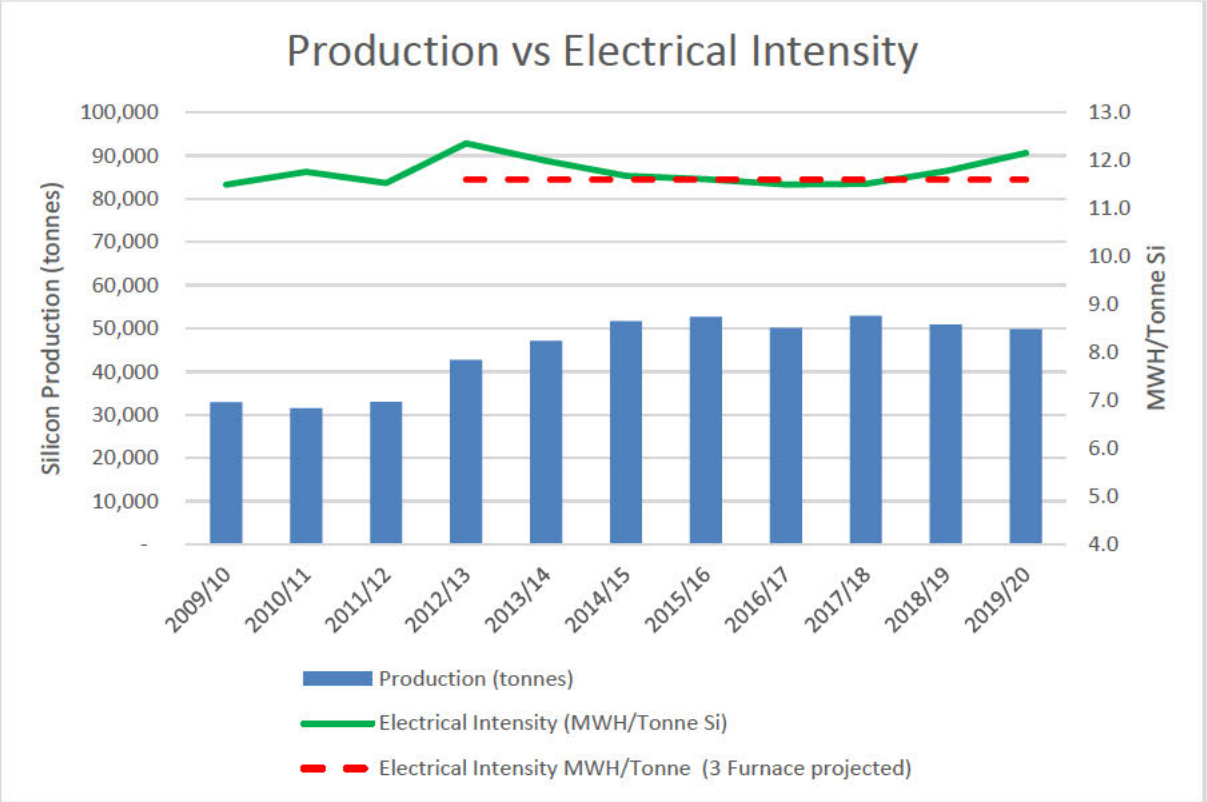
2.2.1 Internal benchmarking

GHG emissions and Electrical Intensity Performance of the Kemerton smelter for the 2009/10 through 2019/20 years are compared against Key Performance Indicators.


Production vs Scope 1 GHG Intensity
Silicon Production (tonnes)
Tonnes CO2/Tonne Si
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
-
2.5
2.0
1.5
1.0
0.5
0.0
2009/10
2011/12
2013/14
2015/16
2017/18
2019/20
Year
Production (tonnes)
Scope 1 GHG Intensity (tonnes CO2-e per tonne Si)
Scope 1 GHG Intensity (3 Furnace projected)

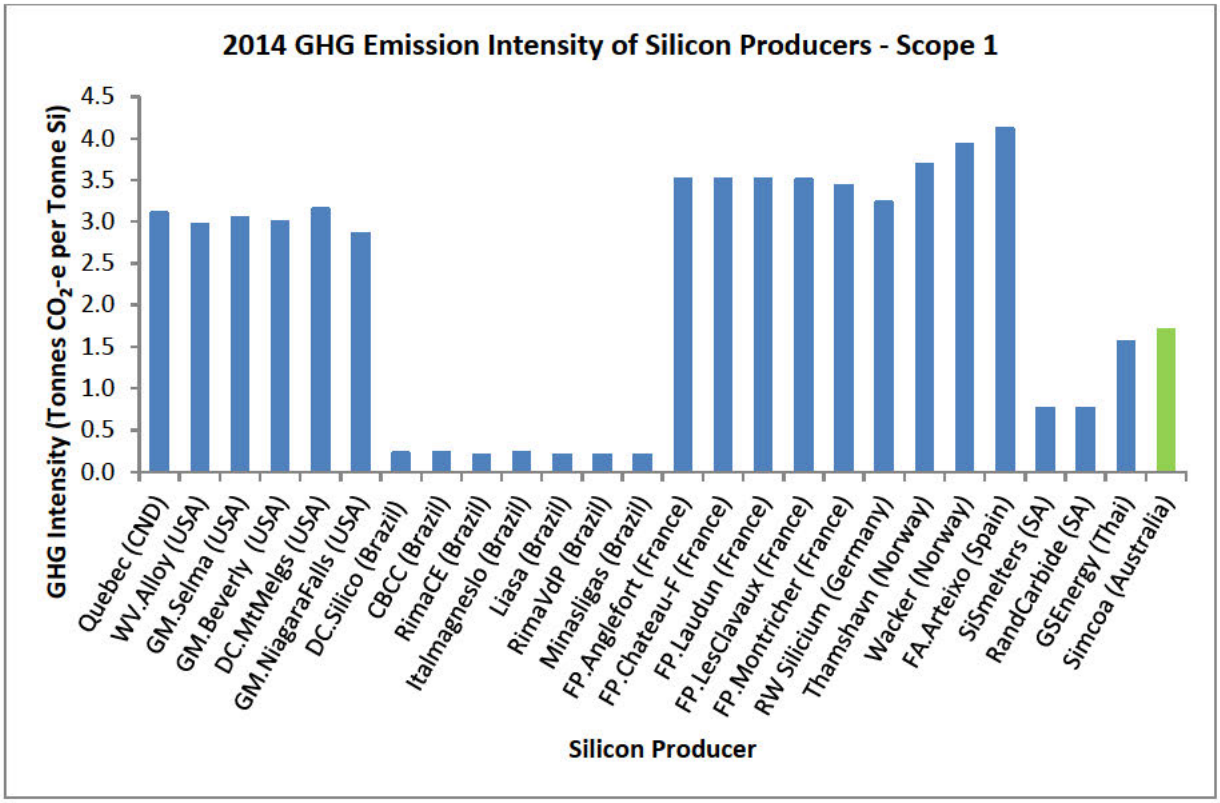

Production vs Scope 2 GHG Intensity
Silicon Production (tonnes)
Tonnes CO2/Tonne Si
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
-
12.0
10.0
8.0
6.0
4.0
2.0
-
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
2015/16
2016/17
2017/18
2018/19
2019/20
Production (tonnes)
Scope 2 GHG Intensity (tonnes CO2-e per tonne Si)
Scope 2 GHG Intensity (3 Furnace projected)

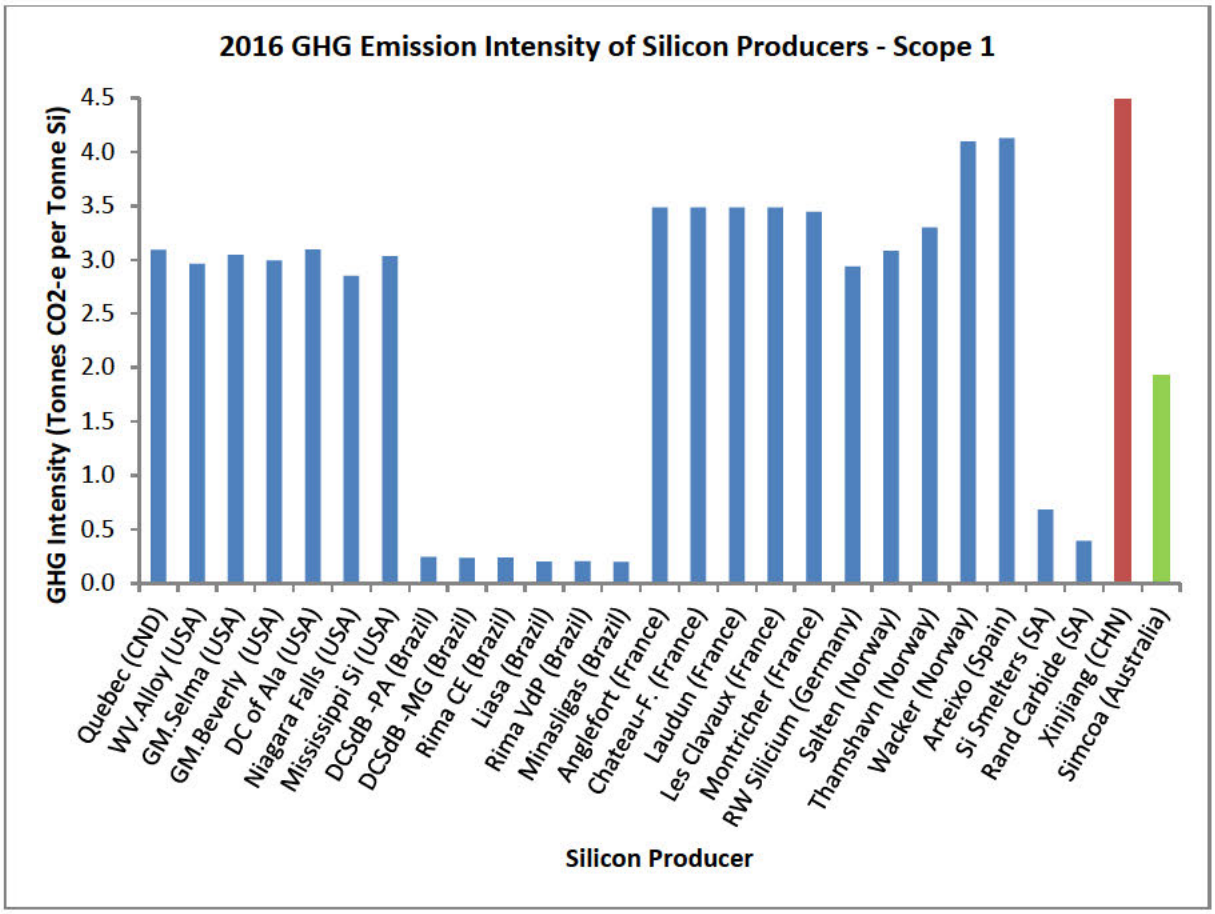


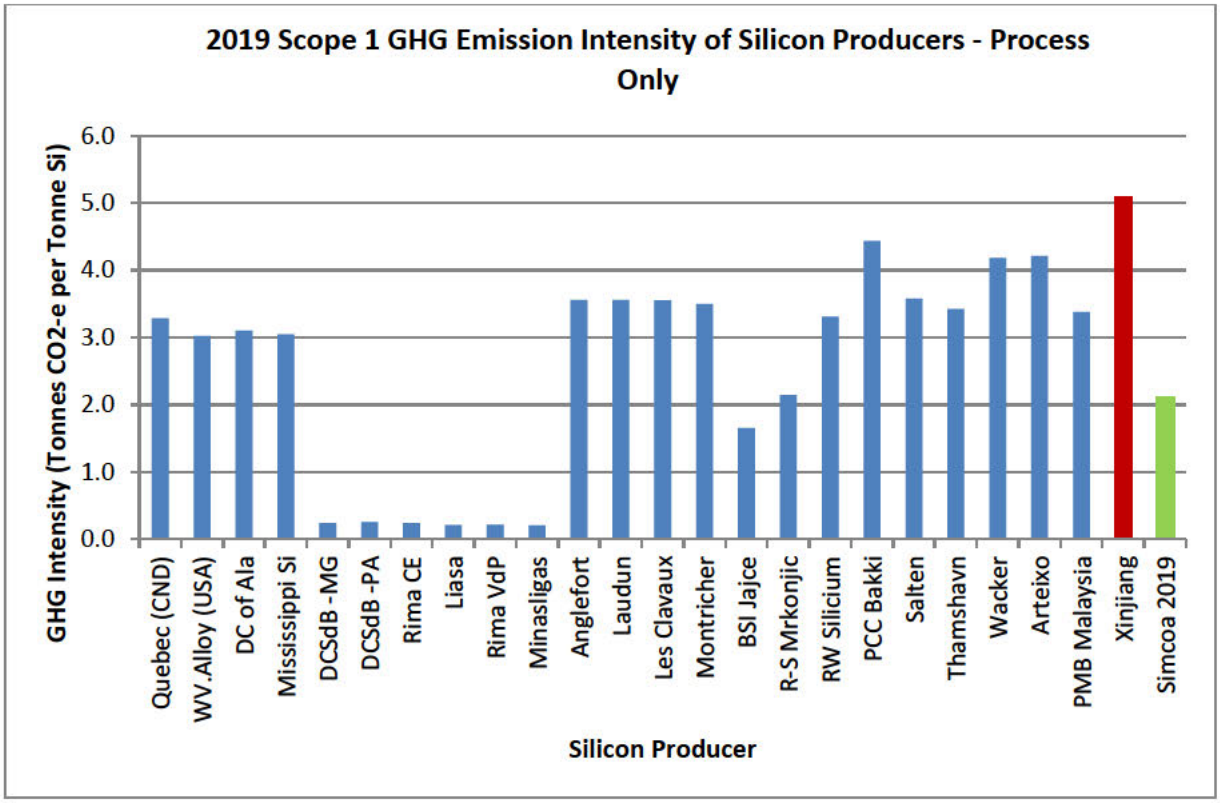


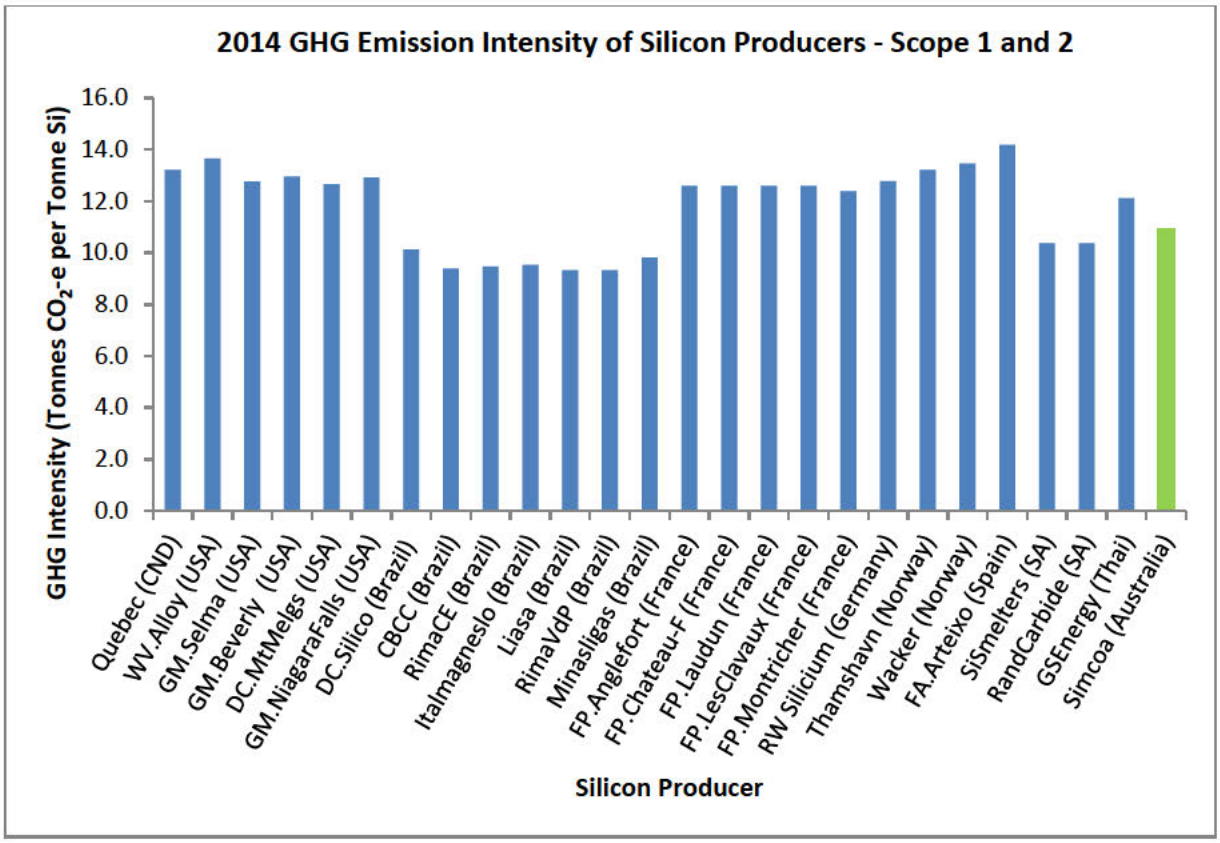
2.2.2 External benchmarking

GHG emissions and Electrical Intensity Performance of the Kemerton smelter for the 2014, 2016, 2019 years are compared against Global Producers.


2014 GHG Emission Intensity of Silicon Producers - Scope 1
GHG Intensity (Tonnes CO_2-e per Tonne Si)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC.MtMelgs (USA)
GM.NiagaraFalls (USA)
DC.Silico (Brazil)
CBCC (Brazil)
RimaCE (Brazil)
Italmagneslo (Brazil)
Liasa (Brazil)
RimaVdP (Brazil)
Minasligas (Brazil)
FP.Anglefort (France)
FP.Chateau-F (France)
FP.Laudun (France)
FP.LesClavaux (France)
FP.Montricher (France)
RW Silicium (Germany)
Thamshavn (Norway)
Wacker (Norway)
FA.Arteixo (Spain)
SiSmelters (SA)
RandCarbide (SA)
GSEnergy (Thai)
Simcoa (Australia)
Silicon Producer


2016 GHG Emission Intensity of Silicon Producers - Scope 1
GHG Intensity (Tonnes CO2-e per Tonne Si)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC of Ala (USA)
Niagara Falls (USA)
Mississippi Si (USA)
DCSdB -PA (Brazil)
DCSdB -MG (Brazil)
Rima CE (Brazil)
Liasa (Brazil)
Rima VdP (Brazil)
Minasligas (Brazil)
Anglefort (France)
Chateau-F. (France)
Laudun (France)
Les Clavaux (France)
Montricher (France)
RW Silicium (Germany)
Salten (Norway)
Thamshavn (Norway)
Wacker (Norway)
Arteixo (Spain)
Si Smelters (SA)
Rand Carbide (SA)
Xinjiang (CHN)
Simcoa (Australia)
Silicon Producer


2019 Scope 1 GHG Emission Intensity of Silicon Producers - Process Only
GHG Intensity (Tonnes CO2-e per Tonne Si)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Quebec (CND)
WV.Alloy (USA)
DC of Ala
Mississippi Si
DCSdB -MG
DCSdB -PA
Rima CE
Liasa
Rima VdP
Minasligas
Anglefort
Laudun
Les Clavaux
Montricher
BSI Jajce
R-S Mrkonjic
RW Silicium
PCC Bakki
Salten
Thamshavn
Wacker
Arteixo
PMB Malaysia
Xinjiang
Simcoa 2019
Silicon Producer


2014 GHG Emission Intensity of Silicon Producers - Scope 1 and 2
GHG Intensity (Tonnes CO_2-e per Tonne Si)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC.MtMelgs (USA)
GM.NiagaraFalls (USA)
DC.Silico (Brazil)
CBCC (Brazil)
RimaCE (Brazil)
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FP.Chateau-F (France)
FP.Laudun (France)
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RW Silicium (Germany)
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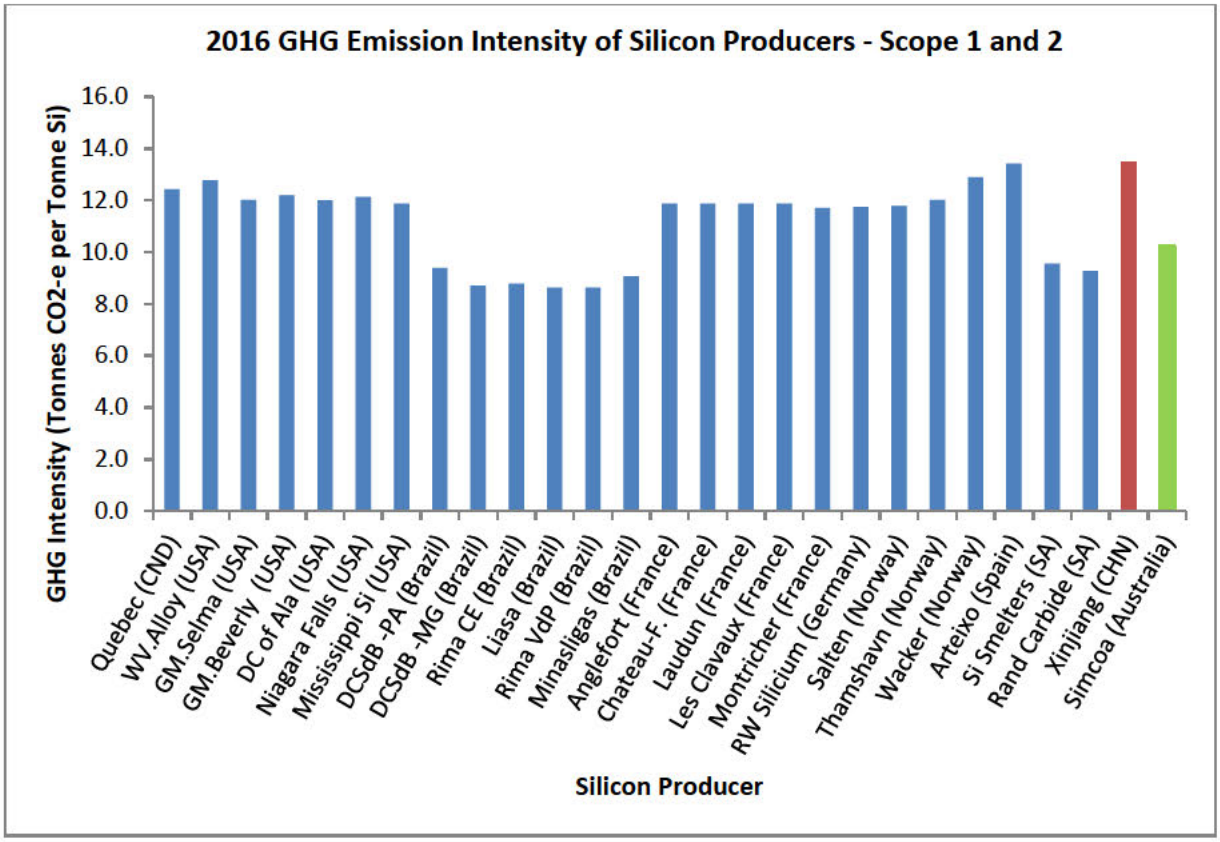
Wacker (Norway)
FA.Arteixo (Spain)
SiSmelters (SA)
RandCarbide (SA)
GSEnergy (Thai)
Simcoa (Australia)
Silicon Producer


2016 GHG Emission Intensity of Silicon Producers - Scope 1 and 2
GHG Intensity (Tonnes CO2-e per Tonne Si)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
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DCSdB -PA (Brazil)
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Rima VdP (Brazil)
Minasligas (Brazil)
Anglefort (France)
Chateau-F. (France)
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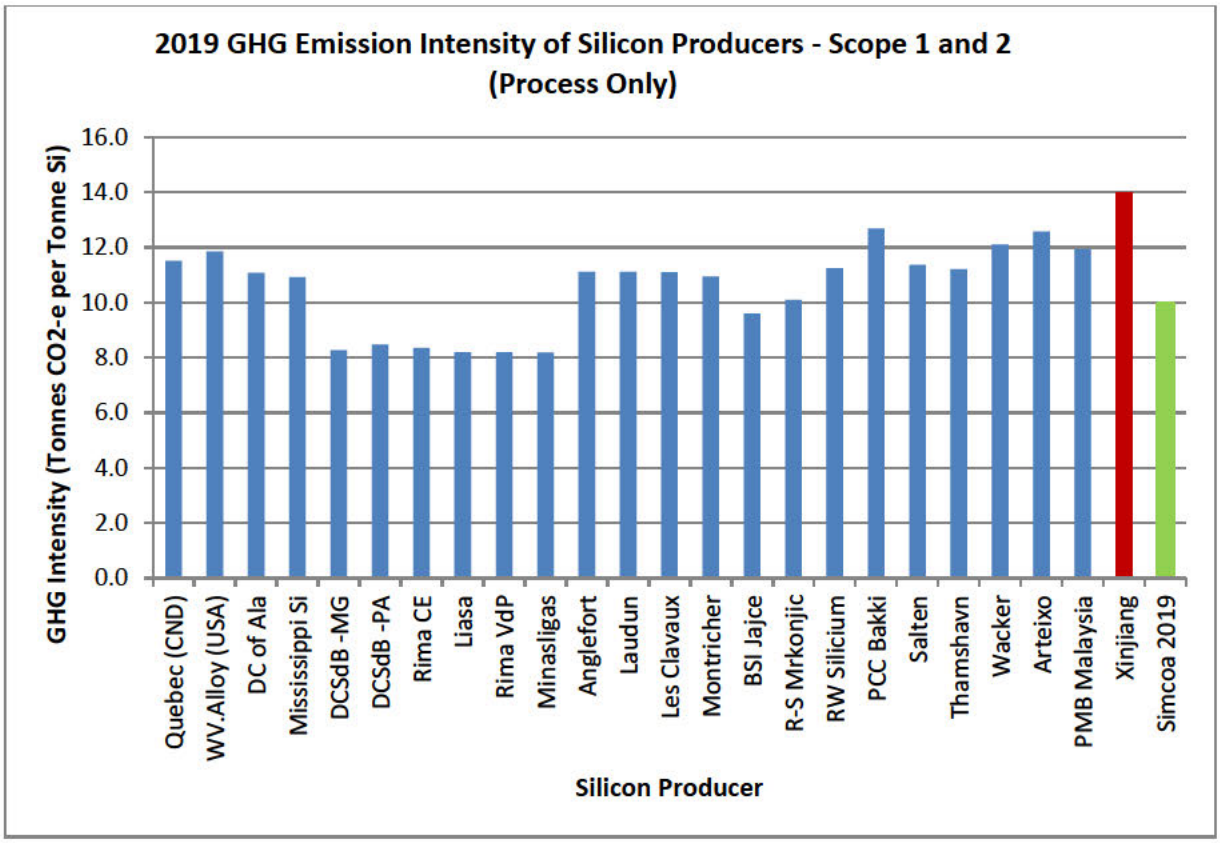
Wacker (Norway)
Arteixo (Spain)
Si Smelters (SA)
Rand Carbide (SA)
Xinjiang (CHN)
Simcoa (Australia)
Silicon Producer


2019 GHG Emission Intensity of Silicon Producers - Scope 1 and 2
(Process Only)
GHG Intensity (Tonnes CO2-e per Tonne Si)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Quebec (CND)
WV.Alloy (USA)
DC of Ala
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DCSdB -MG
DCSdB -PA
Rima CE
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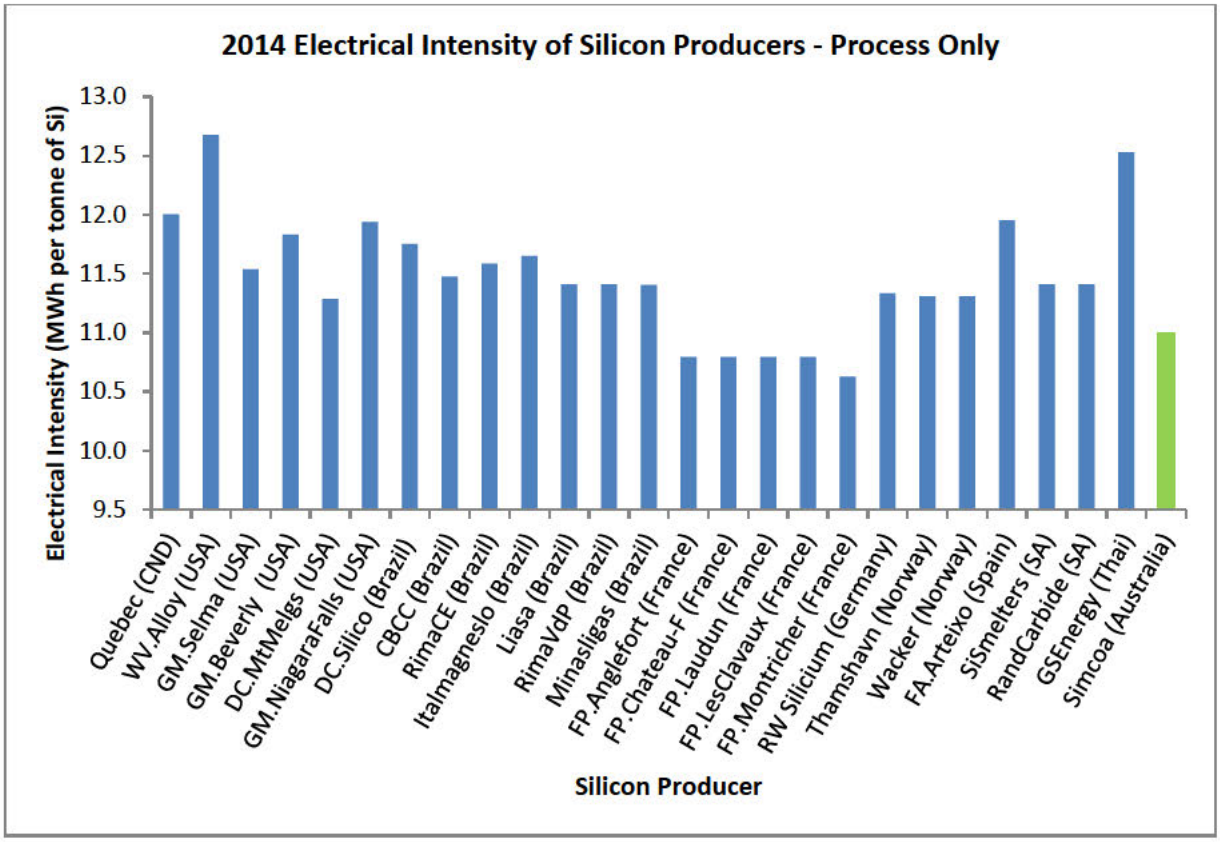
Thamshavn
Wacker
Arteixo
PMB Malaysia
Xinjiang
Simcoa 2019
Silicon Producer


2014 Electrical Intensity of Silicon Producers - Process Only
Electrical Intensity (MWh per tonne of Si)
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC.MtMelgs (USA)
GM.NiagaraFalls (USA)
DC.Silico (Brazil)
CBCC (Brazil)
RimaCE (Brazil)
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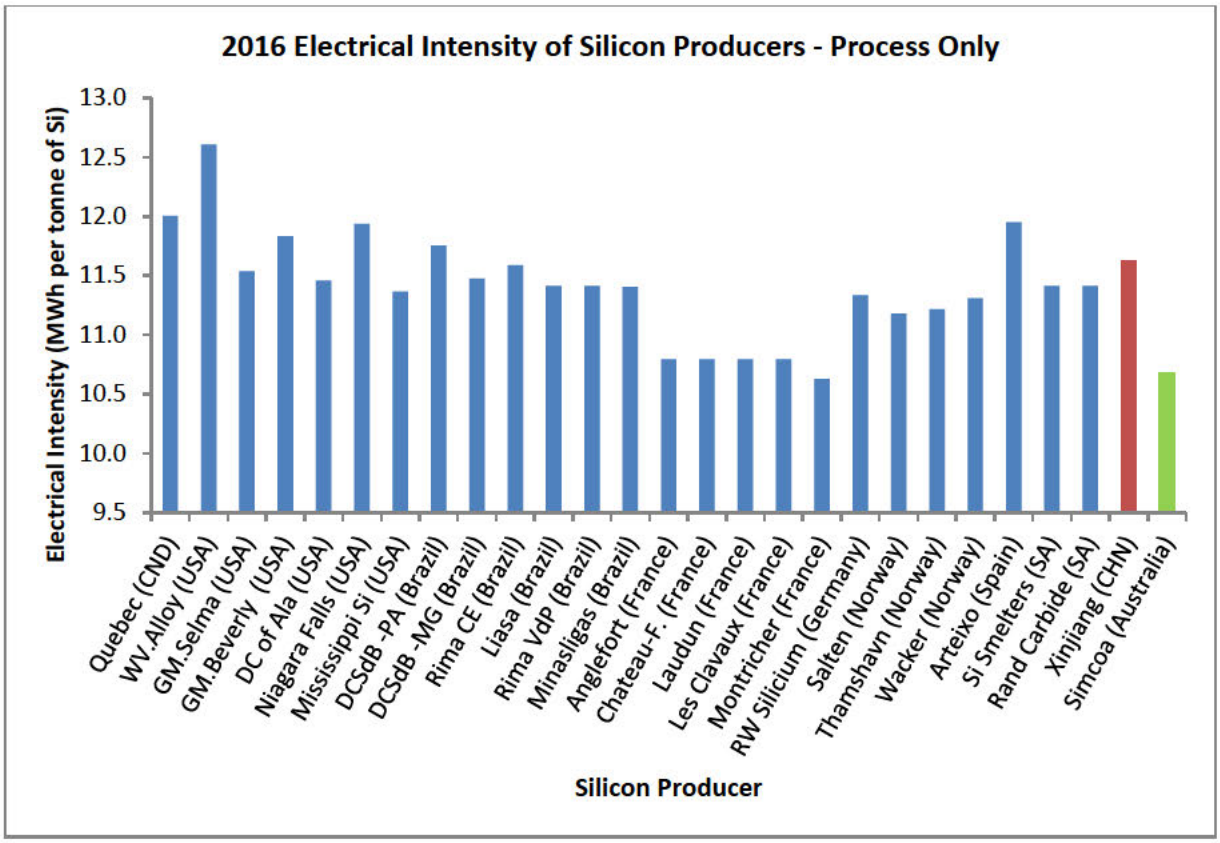
SiSmelters (SA)
RandCarbide (SA)
GSEnergy (Thai)
Simcoa (Australia)
Silicon Producer


2016 Electrical Intensity of Silicon Producers - Process Only
Electrical Intensity (MWh per tonne of Si)
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
Quebec (CND)
WV.Alloy (USA)
GM.Selma (USA)
GM.Beverly (USA)
DC of Ala (USA)
Niagara Falls (USA)
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DCSdB -PA (Brazil)
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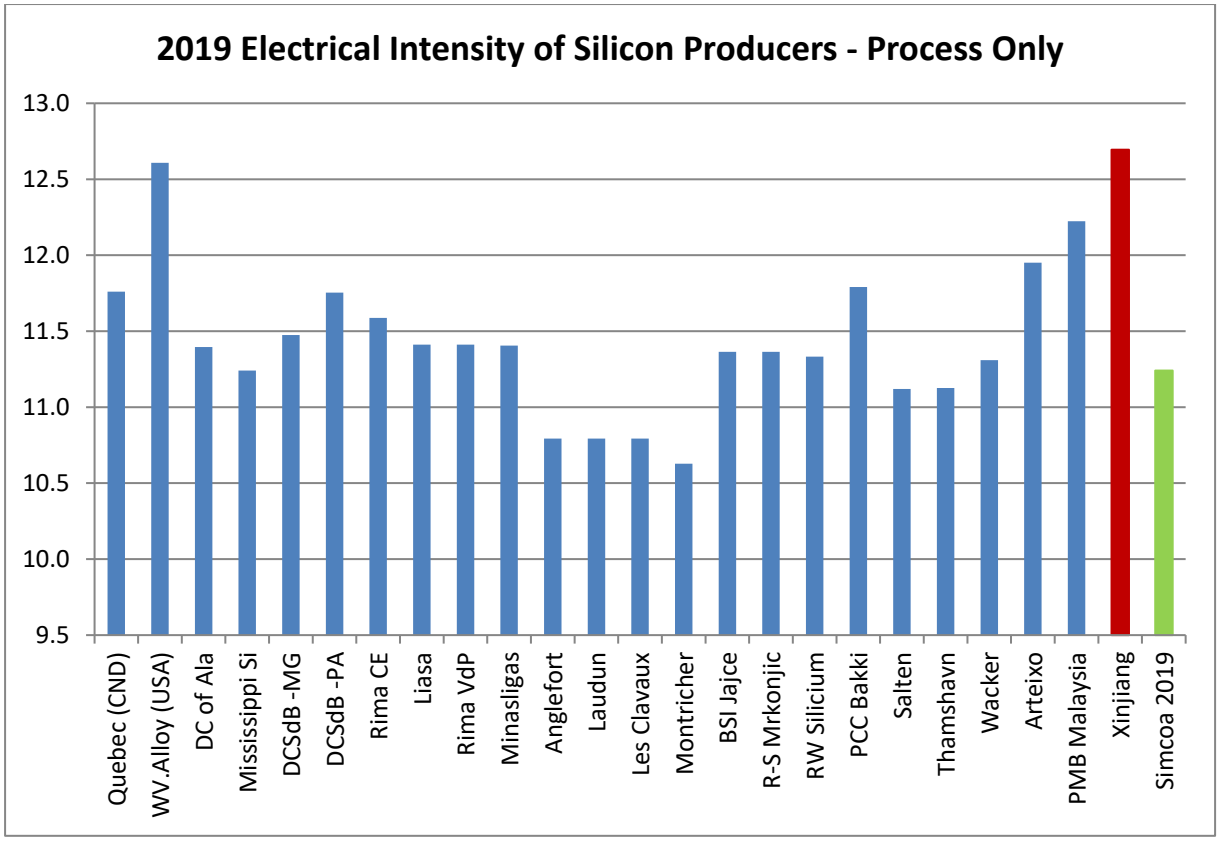
Xinjiang (CHN)
Simcoa (Australia)
Silicon Producer



2.3 Status of future opportunities

DM seeks feedback on current status of future opportunities identified in 2011 report. Have they been implemented? If not is there still plans to do so? When? If no longer an option, Why?

1. F3 energy recovery
2. F1 and 2 and retort energy recovery via rankine cycle system.
3. Charcoal fine briquetting.
4. Increased charcoal use via creating charcoal from biomass by-products (sawdust, mulch and woodchip) and briquetting.
5. Increased sourcing of external charcoal.
6. Woodblock drying
7. DC powered furnace
8. Trommel screen
9. LED lighting
10. Compressor upgrade

2.4 Any other identified opportunities that have been implemented or are planned to be implemented

Group noted:

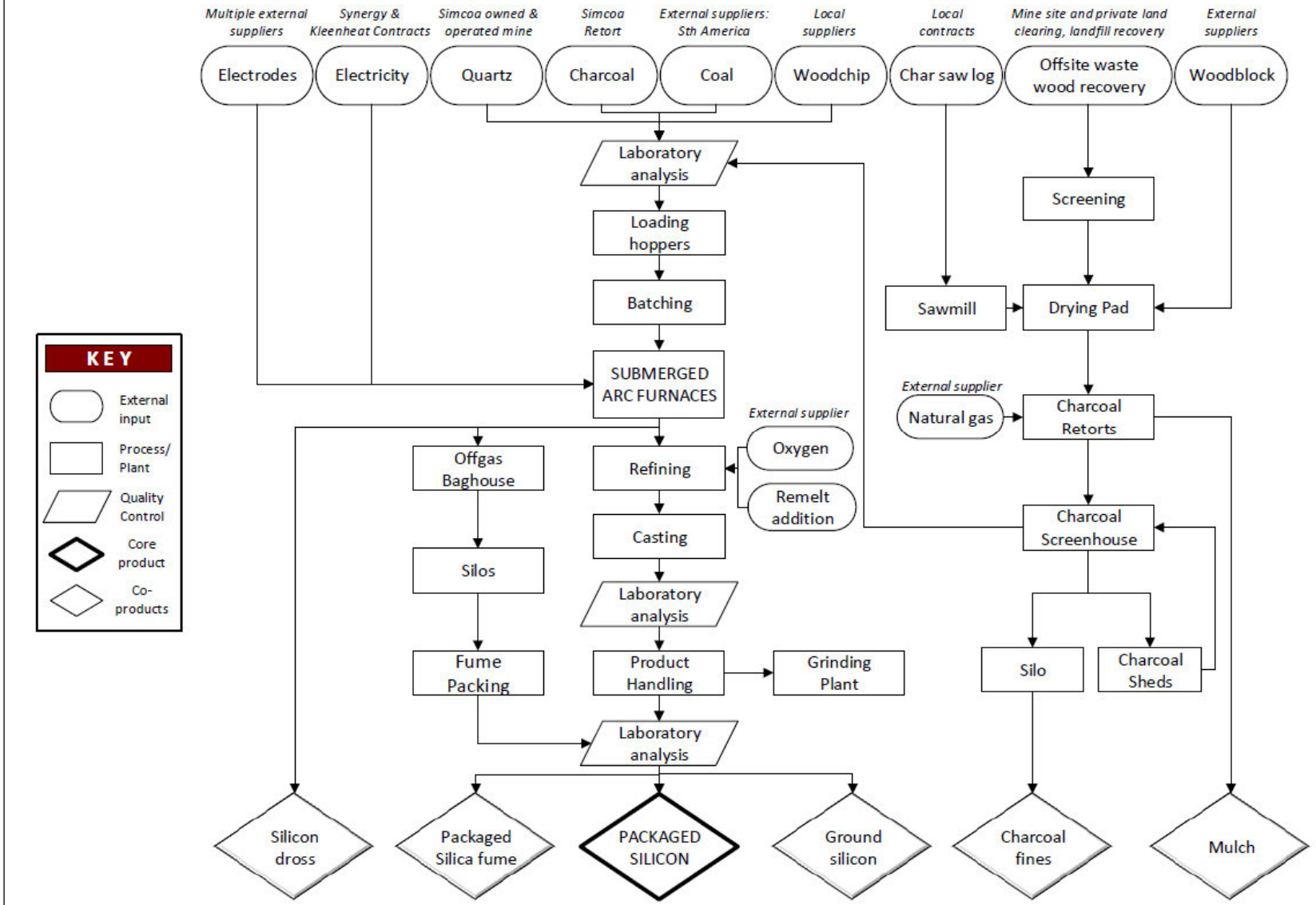
- F3 electrode conversion.
- Improved retort efficiency and improved cooling water filtration.
- Ledge removal in furnaces

2.5 Meeting ends

Appendix B: Simplified process flow diagram

SIMCOA SILICON PROCESS FLOWCHART

SIMCOA
Silicon Metal Company of Australia



Appendix C: GHG sources and electricity consumption

year	Production (tonnes)	Scope 1 GHG (tonnes CO2-e)	Scope 2 GHG (tonnes CO2-e)	Total GHG (tonnes CO2-e)	Electricity (MWH)	Scope 1 GHG Intensity (tonnes CO2-e per tonne Si)	Scope 2 GHG Intensity (tonnes CO2-e per tonne Si)	Total GHG Intensity (tonnes CO2-e per tonne Si)	Electrical Intensity (MWH/Tonne Si)
2009/10	32,884	30,982	319,265	350,247	377,949	0.9	9.7	10.7	11.5
2010/11	31,540	37,880	304,119	341,999	370,877	1.2	9.6	10.8	11.8
2011/12	32,974	38,777	304,063	342,840	380,079	1.2	9.2	10.4	11.5
2012/13	42,728	60,002	432,873	492,875	527,894	1.4	10.1	11.5	12.4
2013/14	47,104	80,501	440,485	520,986	564,724	1.7	9.4	11.1	12.0
2014/15	51,644	99,290	458,265	557,555	602,980	1.9	8.9	10.8	11.7
2015/16	52,623	103,809	464,141	567,950	610,711	2.0	8.8	10.8	11.6
2016/17	50,105	102,987	414,718	517,705	575,997	2.06	8.3	10.3	11.5
2017/18	52,891	102,882	426,086	528,968	608,693	1.9	8.1	10.0	11.5
2018/19	50,910	105,739	419,640	525,379	599,485	2.1	8.2	10.3	11.8
2019/20	49,807	107,847	41,7703	525,550	605,367	2.17	8.4	10.6	12.2

Attachment 1

Benchmarking Assessment - CONFIDENTIAL

Attachment 1 - Benchmarking Assessment (CONFIDENTIAL)

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

ghd.com

→ The Power of Commitment

Pangolin Associates

Sustainability, Energy & Carbon Management

GHG Environmental Management Plan: Review

Simcoa PTY LTD

Authored by

Dr Alexander Charlton & Madison Edwards

Approved by

Chris Wilson^*

* Registered Greenhouse and Energy Auditor

^ Climate Active Registered Consultant

Document Number: v3

Date: 29 May 24

Our organisation recognizes the First Peoples of this nation and their ongoing connection to culture and country. We acknowledge First Nations Peoples as the Traditional Owners, Custodians and Lore Keepers of the world's oldest living culture and pay respects to their Elders past, present and emerging.

Executive Summary

A Greenhouse Gas (GHG) Environmental Management Plan (EMP) has been developed for the proposed North Kiaka mine site and the existing Kemerton smelter, aligning with the Environmental Protection Authority's (EPA's) environmental objectives. The objective of this report was to assess the adequacy of the proposed EMP, focusing on emissions associated with the construction and operation of the mine site, and the continued operation of the Kemerton smelter, projected up to 2050. Emissions projections have been informed by various reduction measures, including the implementation of a charcoal retort and initiatives aimed at enhancing the sustainability of the Southwest Interconnected System (SWIS) electricity grid. These decarbonisation levers will bring Simcoa into alignment with international best practices. This review concludes that the estimated emissions from both construction and operation, as well as the projected reductions, are deemed reasonable.

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1. Introduction 1
2. Emissions and Projections 2
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2.2 Emissions trajectory review 3
3. Emissions Reduction Strategies (ERS) 4
3.1 Overview of the proposed ERS 4
3.2 Emissions Reduction Levers 6
4. Peer Benchmarking Review 8
4.1 GHG emissions benchmark for Silicon production 8
4.2 Best Practice on Improving Emissions Intensity 9
5. Conclusion 10

1. Introduction

Simcoa currently manages silicon mining and production facilities situated in Moora and Kemerton, respectively. Additionally, Simcoa is proposing a new site at North Kiaka, designated for quartzite mining. The project entails an open-cut mine operation above the water table, with an anticipated lifespan of 18 years. This review will primarily focus on **three aspects:**

1) GHG emissions quantifiaction and projection
2) Expected emissions reductions until 2050
3) A best practice comparison of both emissions intensity and expected reductions.

This review will then assess those projections against both previously reported data by Simcoa to the Clean Energy Regulator (*CER*) under National Greenhouse Emissions Reporting (*NGER*) and Safeguard Mechanism requirements, as well as other comparable emissions reduction actions used in the sector.

2. Emissions and Projections

The emissions of Simcoa's operations associated with a proposed quartzite mine at North Kiaka have been estimated and projected as part of the GHG Environmental Management Plan. The emissions have been estimated for both the initial construction, as well as ongoing operation of the site. This section of the report will review the **quantification** and then **projection** of those emissions.

2.1 Emissions quantification review

Simcoa have already reported its emissions footprint of the Kemerton Smelter and its mining operations as part of obligations to the Clean Energy Regulator (CER) under both the *National Greenhouse and Emissions Reporting Scheme* as well as the *Safeguard Mechanism*. These two parallel Government reporting schemes already provide a strong level of emissions reporting, supported by audit and other review for both Scope 1 and 2 emissions, with the Safeguard Mechanism also providing clear guidance on decarbonisation timelines.

2.1.1 Scope 1 emissions

The Scope 1 emissions are reported in the baseline for both Simcoa's current operations as well as the proposed site at North Kiaka.

For the Scope 1 emissions associated with construction, the estimates are 3.3% based on NGER reporting of fuels and 96.6% based on land clearing activities. The land clearing activities have been based on the loss of carbon sequestration with the consideration of a 50-year period. This is consistent with the amount of land to be cleared in preparation for mining activities and reasonable sequestration-based carbon accounting.

The scope 1 NGER fuels are based on the combustion of diesel on site and the transport emissions from road-registered vehicle use. It should be noted that the stationary and transport emissions from construction are low compared to the ongoing mining emissions of the same category (73 tCO_2-e vs. 1,502 tCO_2-e). However, assuming the construction is not as intensive as the ongoing operations of a mine site, this seems reasonable.

Overall, scope 1 emissions from operations have been transcribed reasonably from Simcoa's NGER reporting (with scope 1 emissions broadly aligned to the GHG Protocol).

2.1.2 Scope 2 emissions

Simcoa currently reports its grid usage from the SWIS as scope 2 emissions under the NGER Scheme from its Kemerton Smelter and Mining activities, with none attributed to mining activities (including proposed).

2.1.3 Scope 3 emissions

Scope 3 emissions, which are not covered by the NGER Scheme, pose a challenge in estimation for the proposed site at North Kiaka. Construction emissions estimates for the site rely on input-output factors, utilizing the GHG Protocol Qantis Tool emission factor. Approximately 99% of these estimates fall under Category 2 – *Capital Goods* of the GHG Protocol, encompassing construction-related sources like traffic lights, bitumen, and dump trucks.

Operational scope 3 emissions, constituting around 80%, are primarily associated with Category 10 of the GHG Protocol – *Processing of Sold Products*. This allocation is justified by the high emissions intensity of silicon alloy production.

Considering the emissions are based on recognized factors and construction costs, Pangolin finds these estimates reasonable for the scope 3 emissions associated with the proposed site's construction.

2.2 Emissions trajectory review

The emissions trajectory of Simcoa's operations (*including Kemerton and all mining activities*) has been projected to 2050, considering the decarbonisation potential of emissions over that time. Below are the key assumptions underpinning the emissions decrease outside of Simcoa's own direct decarbonisation actions.

2.2.1 Greening of the SWIS

The sustainable transition of the Southwest Interconnected System (SWIS) is projected due to the increasing renewables penetration (solar, wind etc.,) into the grid that supplied electricity to Simcoa's operations. The SWIS has emissions projections that have been used to inform the projections used in the report, based on information from the Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2022) that projected from 2022-2030. The emissions were then projected as a linear decrease from 2030 to 2050. Pangolin recommends this approach as a reasonable trajectory for emission reduction.

2.2.2 Scope 3 emissions decrease

The primary sources of material scope 3 emissions are attributed to upstream transportation and downstream product processing. Reductions are anticipated through a combination of decreased transportation requirements, facilitated by a new charcoal retort, and the adoption of Net Zero targets by customer-markets involved in product processing. Pangolin recommends this comprehensive approach as a reasonable strategy for reducing overall scope 3 emissions.

3. Emissions Reduction Strategies (ERS)

3.1 Overview of the proposed ERS

GHD has modelled emissions reductions, projected to 2050 as part of the GHG Environmental Management Plan for North Kiaka. This was achieved through a proposed multi-scope strategy for emissions reduction that involves a three-tier approach to reach net-zero by 2050. **Avoided emissions** are of the highest priority and involve measures to prevent further carbon emissions from being produced. **Emission reductions** are a secondary priority and reduce emissions relative to prior practices. Emissions **offsets** should be a last resort, and only relied upon when emissions cannot be abated or when otherwise mandated by statutory requirements. Simcoa purchases ACCU's (the CER regulated offset) as part of the Safeguard Mechanism already, with a nationally regulated market that ensures availability.

Operational emissions at the Kemerton Smelter comprise the greatest proportion of total emissions (98.7%) and as such reduction efforts here would have the most tangible impact on Simcoa's carbon footprint. Table 1 provides a summary of Simcoa's Emissions Reduction Strategy (EMR) by scope and tier.

Table 1 Summary of Simcoa's emissions reduction strategy as presented in the EMP.

Key: *Forward Looking* Already implemented **Government Mandated**		**Scope**		
Emissions Reduction Strategy		**Scope 1**	**Scope 2**	**Scope 3**
	Avoided	*Third Charcoal Retort at Kemerton Smelter*	Substituting steel pressure rings with	

			copper pressure rings in silicon furnaces – better electrical conductivity	
			Segmented shrouds to reduce duration of shutdowns – minimises energy losses – electrical energy savings	
			Variable voltage and frequency drives	
			Furnace energy recovery – use waste heat to produce electricity which will reduce consumption of electricity from regional grid (SWIS)	
	Reduced	*100% charcoal usage*	*Projected increase in renewable mix in SWIS grid - 0.51 tCO2-e per MWh in 2023 to 0.20 tCO2-e per MWh in 2035 then 0 by 2050 – all scope 2 emissions avoided*	*Growing reliance on 100% locally sourced timber for charcoal production will produce fewer upstream transportation emissions.*
		Efficiency Gains	*Procure certified GreenPower*	
			Install 'behind the meter' renewable generation infrastructure (e.g. installation of solar PV)	
	Offset	**ACCU purchases & self generation of ACCUs via land re-vegetation, as dictated by SGM**	Scope 2 offsets not mandated	Scope 3 offsets not mandated

Pangolin have provided a review of the veracity of Simcoa's claims, as well as the readiness of their proposed solutions given technological, financial and resource constraints. Generally, Pangolin have found that the EMR involves a sound approach to reducing both scope 1 and 2 emissions via several emissions reduction levers. These emissions reduction levers are elaborated on below. Simcoa have little operational control over downstream emissions, however the report prepared by GHD has suggested that scope 3 emissions should decline as a by-product of efficiency gains and primary resource choices that affects scope 1 and 2 emissions.

3.2 Emissions Reduction Levers

3.2.1 Charcoal Retort

The use of coal as a reductant in the smelting process is an invariably substantial component of Simcoa's GHG footprint. Simcoa have commenced a transition toward the use of charcoal as a reductant in place of coal, installing two charcoal retorts that heat biomaterial (wood) to form charcoal. Charcoal has a significantly lower carbon footprint than coal, with substantial avoided emissions when used in place of coal as a reductant. Simcoa intend to install a third retort by 2030, with GHD anticipating savings of 105,000 tCO_2-e per annum. This additional retort was estimated to reduce Scope 1 emissions by approximately 90% as it offsets much of the coal usage.

Pangolin affirms that the addition of a third charcoal retort would substantially reduce stationary energy emissions at the Kemerton site. This technology is highly viable, and already provides a substantial amount of the existing charcoal/coal reductant mix, however a small amount of coal will continue to be used to facilitate Simcoa's transition to 100% charcoal by 2030.

Simcoa have also trialed the use of imported charcoal to mitigate scope 1 emissions from charcoal formation. Data from these trials are yet to be released, however Pangolin recommends the scaling up of this process to consolidate charcoal supplies in the lead-up to the implementation of the third charcoal retort. Simcoa have stated that supplementary charcoal will most likely be sourced from Indonesia, which would provide a substantial reduction in their scope 3 transport footprint given that their coal is currently sourced from Columbia. Note this is in addition to the Scope 1 reductions arising from the coal-to-charcoal substitution.

3.2.2 Increasing Operational Efficiencies

Simcoa have communicated their intent to improve operational efficiencies at the Kemerton site, by both designing and retrofitting furnaces with energy recovery technologies that could reduce stationary energy demands on-site. Though not currently feasible given several self-identified constraints, Pangolin recommends the continued development of these opportunities, given the general readiness of technology and the considerable emissions savings they may provide at scale.

Further exploration into these technologies is necessary before an accurate measure of emissions reductions can be made.

3.2.3 Decarbonisation of the SWIS

As elucidated in section 2.2.1 of this report, the scope 2 emissions generated at the Kemerton smelting site should decrease commensurate to the intended greening of the South-West Interconnected System. This suggests that Simcoa's electricity supply will be net-zero by 2050 regardless of operational changes. GHD suggests that this will be potentially consolidated by procurement of certified Greenpower, as well as the installation of 'behind the meter' renewable generation infrastructure. Pangolin views this as an effective approach, that will provide both cost and emissions savings in the interim.

3.2.4 Purchase of Carbon Offsets

Simcoa intend to purchase/surrender offsets as per the relevant government mandates in instances where scope 1 emissions are in excess of statutory requirements and cannot be avoided or reduced. Simcoa may also generate ACCUs through purchase of land for plantation timber (one project already registered) or re-vegetation of Simcoa land.

The use of offsetting is a reasonable instrument in the decarbonisation process assuming the use of carbon offsets generated with enforceability and accountability. Pangolin recommends that the use of ACCU offsets not be relied on outside of instances where it is entirely necessary, and other abatement/reduction strategies have been exhausted.

4. Peer Benchmarking Review

4.1 GHG emissions benchmark for Silicon production

Simcoa is currently the only Silicon producer in Australia, with no direct comparison in the same market available to compare an emissions intensity performance metric. The overall emissions intensitry of Simcoa is slightly higher when compared to a global avaerge, largely due to the electricity consumption from the carbon-intensive SWIS. It should be noted that the fossil-based carbon intensity is generally lower than comparable markets worldwide, and is even likely to improve with the addition of a charcoal retort (*as discussed in Section 3*).

[redacted]

Overall, Pangolin recommends Simcoa's performance is generally in line with the wider industry (worldwide), with the projected decarbonisation of the SWIS likely to provide a greater-than-average reduction in emissions intensity and become an industry leader with respect to emissions intensity.

4.2 Best Practice on Improving Emissions Intensity

Simcoa have generally aligned their Emissions Reduction Strategy at their smelter site with best practice by targeting emissions abatement opportunities that arise from both alternative feedstock technologies (charcoal retort), operational efficiencies and a reduction in electricity usage emissions (from the SWIS).

On-site charcoal formation utilising an additional charcoal retort demonstrates the potential for substantial fossil-based carbon emissions savings relative to a business-as-usual scenario, by reducing reliance on coal as a chemical reductant. The solution readiness of this decarbonisation opportunity is generally quite high, given the technology is currently utilised on-site. The expansion of this technology should propel Simcoa toward their goal of 100% reliance on charcoal in alignment with international best practices.

Simcoa have also demonstrated forethought in their construction of the smelter through several aforementioned accommodations that were included in the design process to facilitate energy recovery. This will continue to deliver some fossil-emissions savings despite the smelter being an existing operation and technology decisions having been made prior to the decarbonisation projections. Where these accommodations have not been made, Simcoa should consider further investigation into alternative waste heat options and the feasibility of retro-fitting furnaces. Simcoa's fossil-based carbon emissions are already far below global averages, and the proposed abatement ventures should continue this trend.

Lastly, as a large part of Simcoa's emissions intensity is the electricity component of silicon production, the greening of that supplied energy is key to the decarbonisation of those emissions. The SWIS had an emissions intensirty of 0.67 tCO2-e per MWh at the time of the above benchmarking (*Figure 1*). However, the SWIS is forecast to reduce in emissions intensity to 0.20 tCO2-e by 2035[1] leading to a >66% reduction in those emissions. This alone will align Simcoa's emissions intensity with best practice, reflecting favourably against current globlal benchmarking estimates.

[1] Projected emissions factors for Australia's electricity grid in the baseline scenario, Australia's emissions projections 2022,

Australia's emissions projections 2022 (dcceew.gov.au)

5. Conclusion

Pangolin have reviewed Simcoa's Environmental Management Plan and found the quantification and projection of emissions estimates to 2050 to be sound. This finding extends to the projections provided for both the construction and operation of Simcoa's proposed North Kiaka mine, and the continued operations at the Kemerton smelter. The provided emissions estimates are in line with those submitted to NGER and the CER under the Safeguard Mechanism and benchmark reasonably when considered in a global context.

Pangolin also assessed the policy and solution readiness of proposed emissions reduction strategies and abatement opportunities and found that the methodologies draw upon verifiable data as well as credible policy projections and offset use. The greatest degree of uncertainty was present in the quantification of the emissions avoided from the addition of a third charcoal retort at the Kemerton processing site. Further clarification is needed on the anticipated change in the coal/charcoal mix that an additional retort can provide. Pangolin recommends investigation into the feasibility of using purchased charcoal as an input in the interim whilst the additional retort is constructed and implemented, pending approval.

Moving forward, Pangolin recommends the continuation of solid data management practices, as well as regular monitoring and transparent reporting of emissions data as per statutory mandates. This will be essential for continued reassessments of the feasibility of emerging decarbonisation opportunities, as well as adherence to the projected emissions decline rate.

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