



**Verified Carbon
Standard**

CONVERSION OF SF₆ TO AN
ALTERNATIVE COVER GAS IN
MAGNESIUM PRODUCTION IN EATON
RAPIDS, MI AND STRATHROY, ON



Project title	Conversion of SF ₆ to an Alternative Cover Gas in Magnesium Production in Eaton Rapids, MI and Strathroy, ON
Project ID	618
Monitoring period	01-January-2022 to 31-December-2023
Original date of issue	16-December-2024
Most recent date of issue	03-September-2025
Version	2
VCS Standard Version	4.5
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PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Molten magnesium burns in the presence of oxygen, and so production and casting of magnesium metal requires a protection system to prevent this oxidation. Among the various protection systems commonly used are those that use gaseous components with high global warming potential (GWP) values, such as SF₆, which typically escape into the atmosphere. SF₆, because it is such a non-reactive gas, is ideally suited for this kind of protection as a “covering” for molten magnesium (hence the term “cover gas”).

Meridian Magnesium Products of America (“MPA”) historically used SF₆ as a protective cover gas to prevent oxidation of its molten magnesium. The ongoing project switched over the cover gas from SF₆ to Novec-612 and Noah-5112 (“Noah”), a gas patented by 3M, which has heretofore never been used commercially in the U.S., as well as SO₂. The Novec-612, Noah, and SO₂ perform the same functions as the SF₆ as cover gases to prevent the molten magnesium from reacting with the air. The Novec-612, Noah, and SO₂ gases are pumped from a gas mixer to the point-of-use and inserted over the melt surface. The purpose of the project activity is to stop using SF₆ and instead use cover gases that have smaller or no global warming potential, thus reducing GHG emissions to the atmosphere.

The baseline scenario is the continued use of SF₆ and the project scenario is the use of alternative cover gases. This project, starting implementation in January 2007, installed the necessary piping and other equipment required to switch from SF₆ to Novec-612, Noah, and SO₂. Novec-612 is a fluorinated ketone with the chemical formula C₂F₅COC₃F₇¹. While the GWP for SO₂ is zero, the GWP for Novec-612 and Noah is 2,830 (GWP of 1 with a conservative factor of 2,830).

The commissioning of the project has taken place in phases at different locations. After commissioning, the kit has continued to operate regularly. The project commissioning schedule is shown below:

US Die Casting	Feb. 1, 2008
US Recycling:	Apr. 1, 2008

¹ Perfluoro-2-methyl-3-pentanone, as referred to in AM0065 is chemically identical to Noah-5112 and Novec 612 fluid, or dodecafluoro-2-methyl-3-pentanone, as referred to in 3M’s Product Information sheet. 3M references the condensed structural formula for dodecafluoro-2-methyl-pentanone as CF₃CF₂C(O)CF(CF₃)₂, which can also be written as the molecular formula of C₆F₁₂O. The National Institutes of Health’s Open Chemistry Database sites perfluoro-2-methyl-3-pentanone as the chemical name of C₆F₁₂O (https://pubchem.ncbi.nlm.nih.gov/compound/Perfluoro_2-methyl-3-pentanone_#section=Top). The chemical structure shown on this page is the same as the condensed structural formula for dodecafluoro-2-methyl-3-pentanone. Additionally, a reference cited 3M white paper titled “3M Novec 612 as a Substitute for SF₆ in Magnesium Processing” refers to a study to determine the global warming potential of Novec, whereby perfluoro-2-methyl-3-pentanone is described with the condensed structural formula of CF₃CF₂C(O)CF(CF₃)₂, the same dodecafluoro-2-methyl-pentanone (<http://pubs.acs.org/doi/pdf/10.1021/es048088u>).

Canada Die Casting: May 1, 2008

Canada Recycling: Jan. 1, 2007

In the initial crediting period from 01/01/2007 through 12/31/2016, the project included credits generated from the location in Strathroy, Ontario. In this reporting period of the second crediting period the project has only included the Michigan location and is not registering credits for the activities in Ontario. The total GHG emission reductions generated in this monitoring period is **222,721 tCO₂e**.

1.2 Audit History

Audit type	Period	Program	Validation/verification body name	Number of years
Validation	01-January-2007–31-December-2016	VCS	Det Norske Veritas Certification AS	10 years
Verification	01-January-2012–31-December-2012	VCS	NSF-ISR	1 year
Verification	01-January-2013–31-October-2014	VCS	NSF International	1.8 year
Verification	01-November-2014–31-December-2015	VCS	NSF International	1.1 year
Verification	01-January-2016–31-December-2016	VCS	NSF International	1 year
Validation	01-January-2017– 31-December 2026	VCS	NSF International	10 years
Verification	01-January-2017–31-October-2017	VCS	NSF International	0.8 year
Verification	01-November-2017– 31-December-2018	VCS	First Environment, Inc.	1.1 year
Verification	01-January-2019– 31-December-2019	VCS	First Environment, Inc.	1 year
Verification	01-January-2020–31-December-2020	VCS	First Environment, Inc.	1 year
Verification	01-January-2021–31-December-2021	VCS	First Environment, Inc.	1 year

Verification	01-January-2022 –31-December-2023	VCS	Agri-Waste Technologies, Inc.	2 years
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1.3 Sectoral Scope and Project Type

Sectoral scope	9 – Metal production
Project activity type	Replacement of SF ₆ with alternate cover gas in magnesium industry

1.4 Project Proponent

Organization name	3Degrees Group, Inc.
Contact person	Nick Facciola
Title	Director, Carbon Projects
Address	235 Montgomery Street, Suite 320, San Francisco, CA 94104
Telephone	(415) 762-4727
Email	nick@3degreesinc.com

1.5 Other Entities Involved in the Project

Organization name	Meridian Magnesium Products of America (“MPA”)
Role in the project	Magnesium Plant Owner
Contact person	Colin Chapman
Title	Continuous Improvement Manager
Address	2001 Industrial Drive, Eaton Rapids, MI USA 48827
Telephone	(517) 663-1158
Email	cchapman@meridian-mag.com

1.6 Project Start Date

Project start date	01-January-2007
Justification	The project start date corresponds with the initial day of the trial period conducted at Strathroy Plant D – Recycling to determine

which cover gas(es) would be the most effective as a replacement to SF₆.

1.7 Project Crediting Period

Crediting period	☐ Seven years, twice renewable ☐ Ten years, fixed ☒ Other
Start and end date of first or fixed crediting period	01-January-2007 to 31-December-2016 The project was validated prior to Verra's most recent crediting period requirements, thus the crediting period reflects previously accepted crediting period requirements set by Verra.

1.8 Project Location

Meridian Magnesium Products of America
2001 Industrial Drive
Eaton Rapids, Michigan, 48827, USA

Latitude, Longitude: 42° 31' N 84° 38' W

1.9 Title and Reference of Methodology

Type (methodology, tool or module).	Reference ID, if applicable	Title	Version
Methodology	AM0065	Replacement of SF6 with alternate cover gas in the magnesium industry	2.1

1.10 Double Counting and Participation under Other GHG Programs

1.10.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program?

☐ Yes ☒ No

1.10.2 Registration in Other GHG Programs

Is the project registered or seeking registration under any other GHG programs?

☐ Yes ☒ No

1.11 Double Claiming, Other Forms of Credit, and Scope 3 Emissions

1.11.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit? See the *VCS Program Definitions* for definitions of emissions trading program and binding emission limit.

☐ Yes ☒ No

1.11.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the *VCS Program Definitions* for definition of GHG-related environmental credit system.

☐ Yes ☒ No

1.11.3 Supply Chain (Scope 3) Emissions

Do the project activities affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☒ Yes ☐ No

Is the project proponent(s) or authorized representative a buyer or seller of the product(s) (goods or services) that are part of a supply chain?

☒ Yes ☐ No

Has the project proponent(s) or authorized representative posted a public statement on their website saying, "Carbon credits may be issued through the Verified Carbon Standard project [project ID] for the greenhouse gas emission reductions or removals associated with [project proponent or authorized representative organization name(s)] [name of product(s) whose emissions footprint is changed by the project activities]."

☒ Yes ☐ No

The public statement has been posted on Meridian's sustainability page.²

² See the public statement on the following webpage: <https://www.meridian-mag.com/about-meridian/sustainability/>

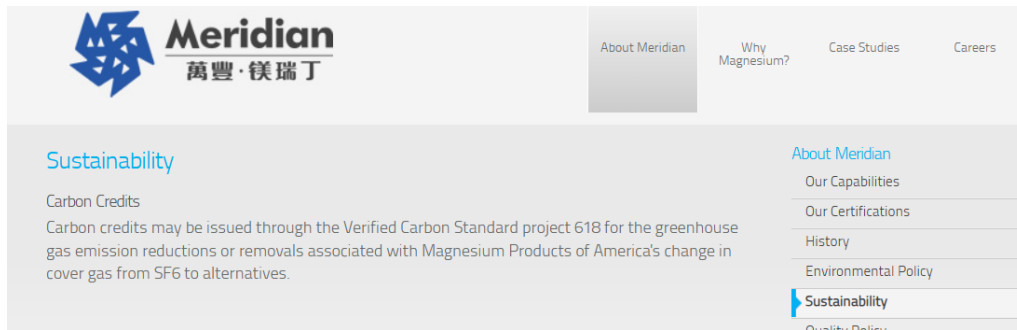


Figure 1: Meridian's public website statement

1.12 Sustainable Development Contributions

The project contributes to SDGs 9 and 13 through reduction of greenhouse gas emissions through the continued replacement of SF6 gas with Novec in industrial magnesium processing, as described in Section 1.1. In addition, the project recycles magnesium metal to produce new parts, thereby contributing to SDG 12.

Table 1: Sustainable Development Contributions

Row number	SDG target	SDG indicator	Net impact on SDG indicator	Current project contributions	Contributions over project lifetime
1)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase emissions avoided	Prevented the release of 222,721 tonnes of carbon dioxide equivalent into the atmosphere during the monitoring period	Prevented the release of approximately 2.8 million tonnes of carbon dioxide equivalent into the atmosphere, which improves air quality and reduces the impact of industrial manufacturing.
2)	9.4	CO ₂ emission per unit of metal produced	Implemented activities to decrease	Reduced the CO ₂ emissions per unit of metal produced by an average of 2.78 tonnes CO ₂ e/tonne Mg compared to the baseline this monitoring period	Reduced CO ₂ e emissions per unit of metal produced by an average of 3.34 tonnes CO ₂ e/tonne Mg compared to the baseline across the project lifetime.
3)	12.5.1	Tonnes of material recycled	Implemented activities to increase	37,669.3 tonnes of magnesium recycled using SO ₂ , Novec, and Noah during the monitoring period	Approximately 230,000 tonnes of magnesium recycled using SO ₂ and Novec/Noah over the project lifetime.

1.13 Commercially Sensitive Information

The monitoring report does not include any commercially sensitive information.

2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

2.1 Stakeholder Engagement and Consultation

2.1.1 Stakeholder Identification

MPA and 3Degrees were identified as stakeholders at validation and stakeholder makeup has not changed since validation. The project is located on private property and the project activity does not affect the nature or quality of the final goods and services provided. The table below is thus not applicable.

Stakeholder Identification	N/A
Legal or customary tenure/access rights	N/A
Stakeholder diversity and changes over time	N/A
Expected changes in well-being	N/A
Location of stakeholders	N/A
Location of resources	N/A

2.1.2 Stakeholder Consultation and Ongoing Communication

Ongoing consultation	MPA communicates with 3Degrees periodically to provide data and updates about the operation of the project activity via email.
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Date(s) of stakeholder consultation	3Degrees staff visited the project proponent at the MPA facility in Eaton Rapids, MI, as part of the verification site visit and to collect data on 01-October-2024. ³
Communication of monitored results	The project proponent sends all data via email or uploads the data to Dropbox upon request. 3Degrees provides updates regarding the verification process and the risks, costs and benefits since validation via email and in person during site visits as well.
Consultation records	Stakeholder consultations are documented via email communications.
Stakeholder input	Communications between MPA and 3Degrees ensure that all necessary data and operational updates are shared and processed accordingly. During the 2022-2023 reporting period, Meridian's Ontario facility was excluded from credit generation following discussion among stakeholders.

2.1.3 Free, Prior, and Informed Consent

Project contracts between stakeholders were signed with free, prior, and informed consent.

Consent	Consent to implement the project activity was obtained from MPA and 3Degrees through a contract, which provides the rights and obligations of either party. There are no ongoing or unresolved conflicts.
Outcome of FPIC	Project contracts serve as proof of the FPIC process among 3Degrees and MPA. The project activity takes place on private property and thus does not result in land encroachment or forced displacement.

2.1.4 Grievance Redress Procedure

MPA's Employment Handbook provides an accessible mechanism for employees to raise grievances through their department managers, HR managers, or plant managers.⁴ MPA records any grievances received in an incident report, which is then accepted by the company and

³ See the 2022-2023 reporting period verification report for proof of the verification site visit date.

⁴ See more information about MPA's grievance redress procedure in Attachment 5: MPA Employment Handbook

investigated by its HR department.⁵ Project contracts outline a mechanism for 3Degrees and MPA to revise their agreement as needed.

Grievances received	Resolution and outcome
N/A	The grievance redress procedure is easily accessible via the MPA Human Resources department and project contracts.

2.1.5 Public Comments

Summary of comments received	Actions taken
No comments received.	N/A

2.2 Risks to Stakeholders and the Environment

No risks were identified at validation.

	Risk identified	Mitigation or preventative measure taken
Risks to stakeholder participation	No risk identified	The project activity has no adverse impacts on stakeholder participation.
Working conditions	No risk identified	The project activity has no adverse impact on working conditions.
Safety of women and girls	No risk identified	The project activity has no adverse impact on the safety of women and girls.
Safety of minority and marginalized groups, including children	No risk identified	The project activity has no adverse impact on the safety of minority and marginalized groups.
Pollutants (air, noise, discharges to water, generation of waste, release of hazardous materials)	No risk identified	The project activity does not have any pollution-related risks.

⁵ Ibid.

2.3 Respect for Human Rights and Equity

2.3.1 Labor and Work

Discrimination and sexual harassment	MPA does not tolerate sexual harassment or discrimination, as stated in MPA's employee handbook. ⁶ Employees who violate MPA's harassment policy are subject to disciplinary action.
Management experience	No new entity is involved in project design or implementation.
Gender equity in labor and work	MPA does not discriminate in employment opportunities or practices based on gender, according to the MPA employee handbook. ⁷
Human trafficking, forced labor, and child labor	Meridian is committed to preventing slavery and human trafficking within its corporate activities. To ensure that Meridian's supply chain is free from forced labor and human trafficking, the company conducts supplier audits, supplier compliance checks, and staff training on a regular cadence. ⁸

2.3.2 Human Rights

The project continues to recognize, respect, and promote the protection of the rights of IPs, LCs, and customary rights holders in line with applicable international human rights law, and the United Nations Declaration on the Rights of Indigenous Peoples and ILO Convention 169 on Indigenous and Tribal Peoples.

2.3.3 Indigenous Peoples and Cultural Heritage

Cultural heritage is not affected by the project, as the project takes place in an industrial facility that was in operation before the project activity began.

2.3.4 Property Rights

The project is located on private property. The table below is thus not applicable.

Disputes over rights to territories and resources	N/A
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⁶ See Attachment 05 for a copy of MPA's employee handbook

⁷ Ibid.

⁸ See the following webpage for Meridian's corporate statement on slavery and human trafficking: <https://www.meridian-mag.com/about-meridian/meridian-slavery-human-trafficking-statement/>

Respect for property rights	N/A
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2.3.5 Benefit Sharing

The project does not impact property rights, as it takes place on private property. The table below is thus not applicable.

Summary of the benefit sharing plan	N/A
Benefit sharing during the monitoring period	N/A

2.4 Ecosystem Health

The project activity occurs inside existing magnesium production facilities and thus does not impact any environmental resources or systems.

	Risk identified	Mitigation or preventative measure taken during the monitoring period
Impacts on biodiversity and ecosystems	No risk identified	The project does not impact biodiversity or ecosystems.
Soil degradation and soil erosion	No risk identified	The project does not impact soils.
Water consumption and stress	No risk identified	The project does not impact water consumption.
Usage of fertilizers	No risk identified	The project does not involve any fertilizer usage.

2.4.1 Rare, Threatened, and Endangered species

According to the U.S. Fish and Wildlife Service's Critical Habitat web map, the project's Michigan plant location is not located in, or adjacent to habitats for rare, threatened, or endangered species.⁹

⁹ See the following link for a map of critical habitat for threatened and endangered species, as identified by the U.S. Fish and Wildlife Service:

N/A

N/A

2.4.2 Introduction of species

No planting or species introduction occurred as a result of the project activity, therefore this section is not applicable. The existence of any invasive species on the project area is not caused by or relevant to the project activity.

Existing invasive species	Mitigation measures to prevent spread or continued existence of invasive species
N/A	N/A

2.4.3 Ecosystem conversion

This is not an ARR, ALM, WRC or ACoGS project, therefore this section is not applicable.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

During the monitoring period, Meridian continued to utilize the Novec, Noah, and SO₂ cover gas alternatives to SF₆ in its magnesium recycling and die cast operations. The project continued to operate in accordance with AM0065 and VCS requirements. Meridian produces magnesium ingots by recycling magnesium scrap in its recycling operations. The magnesium ingots are then melted in the die cast operations to make Meridian products, which are primarily for the automobile manufacturing industry.

SF₆ usage continued in recycling mainly due to the import of scrap from Meridian overseas operations. Because the scrap spends time on the ocean, sometimes it becomes coated with oxides and creates issues with the recycling operations when processed. This requires additional SF₆ to control the melt surface.

Periodic SF₆ usage spikes sometimes occur during a given month due to inferior metal quality, power outage, or some other operational problem with the alternative cover gas. Poor quality scrap metal creates a negative operating condition that makes it problematic to use the Novec, Noah, and SO₂ alternatives thus requiring higher levels of SF₆ use than normal. In some cases, SF₆ was used in conjunction with Novec to produce the optimal operating conditions. In these cases, the metal is still listed as produced with Novec since it was the main gas used. A power

outage results in the inability to use the Novec system because electricity is required to operate the air compressors and mixing cabinet. When there is a power outage, the backup SF₆ system kicks in to protect the molten metal on the die cast floor at the time of the power outage. Similarly, if there is an operational issue with the Novec, Noah, or SO₂ alternative cover gas system, the backup SF₆ system is used to keep the molten metal protected and to continue the manufacturing process.

The VCS Project Description is up to date on the equipment used onsite relevant to project activity. Any changes to the cell counts over the course of the crediting period are due to changes in production demand and do not have any effect on the cover gas usage patterns unique to each facility. Note that the cover gas usage is a characteristic of the plant itself rather than the particular die cast cells in operation.

3.2 Deviations

3.2.1 Methodology Deviations

There are no methodology deviations.

3.2.2 Project Description Deviations

No new project description deviations were applied this RP.

Project description deviations applied to this RP and previous RPs:

Global Warming Potential of SF₆

In accordance with the VCS Standard v4.5 released in April 2021, we are transitioning the source of global warming potential from IPCC's Fourth Assessment Report to the IPCC's Fifth Assessment Report (AR5). For SF₆ this results in a change from GWP of 22,800 to a GWP of 23,500. The use of the new GWP is more appropriate as it is a value approved in the VCS Standard for use for all emission reductions occurring on or after 1 January 2021. Accordingly, the wide adoption of this value suggests overarching acknowledgement of its relevancy, accurateness, and appropriateness in the U.S.

The following project description deviations were applied in previous monitoring reports:

- Due to a thermal event that occurred in May 2018, primary paper records of weight measurements as identified in the PDD for individual gases used on site were not available for part of the reporting period. Summary spreadsheets put together daily by shift managers on site were used for calculations and verified against secondary records, such as purchase orders for the gas supply. The accuracy of the summary records was verified and the project monitoring remains in compliance with the applied methodology. The deviation does not affect the applicability of the methodology, additionality of the project,

the appropriateness of the baseline scenario, or the conservativeness and quality of the data.

- Evidence was not available for the calibration performed in July 2018 for Cardinal Model 205 truck scale (s/n E22210-0122) that was used as a back-up scale for a portion of the reporting period. Per the validated project description, the scales' calibration records must support a six-month interval. The accuracy of the scale and the calibration schedule was verified, and the subsequent calibration report from January 28, 2019 is provided. The deviation does not affect the applicability of the methodology, additionality of the project, the appropriateness of the baseline scenario, or the conservativeness and quality of the data.

3.3 Grouped Projects

This is not a grouped project.

3.4 Baseline Reassessment

Did the project undergo baseline reassessment during the monitoring period?

☐ Yes ☒ No

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	GWP _{SF6}
Data unit	tCO _{2e} / tSF ₆
Description	Global Warming Potential of SF ₆
Source of data	International Panel on Climate Change (IPCC)
Value applied	23,500
Justification of choice of data or description of measurement methods and procedures applied	IPCC Fifth Assessment Report (AR5) as recognized by VCS Standard 4.5 (see Attachment 01).
Purpose of Data	Calculation of baseline and project emissions
Comments	N/A

Data / Parameter	P _{Mg,BL,Total}
Data unit	tMg/year
Description	Amount of Magnesium (Mg) melted in the baseline scenario in the facility, by weight.
Source of data	Meridian Magnesium Products accounting
Value applied	28,348 for die casting 20,342 for recycling
Justification of choice of data or description of measurement methods and procedures applied	Measured by calibrated scales according to on-site working procedures. Scales are calibrated frequently since this parameter is essential to the core business of the plant.
Purpose of Data	Calculation of baseline emissions
Comments	Values according to the last three years prior to project's implementation (2005, 2006, 2007) in the Michigan facility alone.

Data / Parameter	C _{SF6, TOT, BL}
Data unit	tSF ₆
Description	Minimum of annual total consumption of SF ₆ in the facility for the last three years prior to validation.
Source of data	Meridian Magnesium Products accounting
Value applied	5.7057 for die casting 12.4625 for recycling
Justification of choice of data or description of measurement methods and procedures applied	As per the approved methodology, the key method to determine how much SF ₆ is actually consumed is based on (1) the accounting method (recording and compiling into an inventory database the amount of SF ₆ in the cylinder, as provided by the SF ₆ manufacturer); and (2) the weight method. Under (2), the weight of the SF ₆ cylinder should be weighed when the bottle is full and when the bottle is sent back to the manufacturer. The difference would be the amount of SF ₆ used.
Purpose of Data	Calculation of baseline and project emissions
Comments	Values are validated in the initial crediting period according to the last three years prior to project's implementation (2005, 2006, 2007) in the Michigan facility alone.

Data / Parameter	DF _{SF6}
Data unit	Fraction
Description	Default percentage of SF ₆ assumed to be destroyed in the magnesium process and thus not emitted, thereby reducing the baseline emissions.
Source of data	AM0065 v2.1
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	Prescribed by the applied methodology.
Purpose of Data	Calculation of baseline and project emissions
Comments	N/A

Data / Parameter	GWP _{Novec}
Data unit	tCO ₂ e/ t Novec (or Noah)
Description	Global Warming Potential of Novec and Noah
Source of data	AM0065 v2.1
Value applied	1
Justification of choice of data or description of measurement methods and procedures applied	AM0065 specifies the GWP of alternate gas in the case of using Perfluoro-2-methyl-3-pentanone.
Purpose of Data	Calculation of project emissions
Comments	Novec-612 and Noah are the same as perfluoro-2-methyl-3-pentanone

Data / Parameter	CF
Data unit	Fraction
Description	Conservative Factor to compensate for uncertainty in the global warming potential of the byproducts emitted after the degradation of the alternate gas.
Source of data	AM0065 v2.1
Value applied	2,830
Justification of choice of data or description of measurement methods and procedures applied	Because Novec-612 and Noah are the same as perfluoro-2-methyl-3-pentanone we use the value prescribed in AM0065.

Purpose of Data	Calculation of project emissions
Comments	Default value

Data / Parameter	Dl _{SF6, CON, BL}
Data unit	Fraction
Description	A conservative factor for portraying the Data Integrity of SF ₆ consumption in the baseline scenario (C _{SF6, CON, BL})
Source of data	AM0065, which uses IPCC guidelines
Value applied	0.95
Justification of choice of data or description of measurement methods and procedures applied	As per AM0065 v2.1.
Purpose of Data	Calculation of baseline and project emissions
Comments	N/A

Data / Parameter	Dl _{SF6, CON, PJ, k, j, y}
Data unit	Fraction
Description	A conservative factor for portraying the Data Integrity of SF ₆ consumption in the project scenario (C _{SF6, CON, PJ, k, j, y})
Source of data	AM0065, which prescribes IPCC guidelines
Value applied	1.05
Justification of choice of data or description of measurement methods and procedures applied	As per AM0065 v2.1.
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	Baseline emissions factor for Die Casting
Data unit	tSF ₆ / tMg
Description	Tonne of SF ₆ per tonne of Mg metal melted
Source of data	Baseline assessment
Value applied	0.0000914

Justification of choice of data or description of measurement methods and procedures applied	Measured by calibrated scales according to on-site working procedures as per AM0065 v2.1
Purpose of Data	Calculation of baseline emissions
Comments	Values as validated in the initial crediting period according to the last three years prior to project's implementation (2005, 2006, 2007)

Data / Parameter	Baseline emissions factor for Recycling
Data unit	tSF ₆ / tMg
Description	Tonne of SF ₆ per tonne of Mg metal melted
Source of data	Baseline assessment
Value applied	0.000385
Justification of choice of data or description of measurement methods and procedures applied	Measured by calibrated scales according to on-site working procedures as per AM0065 v2.1
Purpose of Data	Calculation of baseline emissions
Comments	Values as validated in the initial crediting period according to the last three years prior to project's implementation (2005, 2006, 2007)

4.2 Data and Parameters Monitored

Data / Parameter	P _{Mg,recycle,y}
Data unit	kg Mg/yr
Description	Metal melted in recycling in year y – Michigan Plant
Source of data	Weight scales

Description of measurement methods and procedures to be applied	Once the Mg ingots are placed on a pallet, the pallet is weighed on a batch basis and the amount is electronically recorded into the Plex system and a bar code is adhered to the stack.
Frequency of monitoring/recording	Daily
Value monitored	2022 – 18,679,963 kg 2023 - 18,989,299 kg
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B829135528 or B530462718, interchangeably), calibrated 7/21/2021, 1/18/2022, 7/18/2022, 1/18/2023, and 7/5/2023.
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of baseline emissions
Calculation method	Measured in lbs and converted to kg in the calculations.
Comments	N/A

Data / Parameter	P _{Mg,diecast,y}
Data unit	kg Mg
Description	Metal melted in die cast in year y – Michigan Plant
Source of data	Weight scales
Description of measurement methods and procedures to be applied	Every time a pallet of Mg ingots is delivered to a die cast cell, the bar code on the stack is scanned and the weight is automatically recorded into the Plex system.
Frequency of monitoring/recording	Daily
Value monitored	2022 – 20,800,823 kg 2023 – 21,664,366 kg
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B829135528 or B530462718, interchangeably), calibrated 7/21/2021, 1/18/2022, 7/18/2022, 1/18/2023, and 7/5/2023.
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of baseline emissions
Calculation method	Measured in lbs and converted to kg in the calculations.

Comments	N/A
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Data / Parameter	PE _{Novec, y}
Data unit	kg Novec (and/or Noah)
Description	Quantity of Novec/Noah cover gas used in year y – Michigan Plant
Source of data	Weight scales
Description of measurement methods and procedures to be applied	The weight of the Novec/Noah tote is tracked using the same weight scales as the metal at the facility.
Frequency of monitoring/recording	The Novec/Noah tote is weighed every time the Novec/Noah panel is filled and the amount is manually entered into a central Excel file at that time.
Value monitored	2022 – 7,836 kg 2023 – 6,031 kg
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B829135528 or B530462718, interchangeably), calibrated 7/21/2021, 1/18/2022, 7/18/2022, 1/18/2023, and 7/5/2023.
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of project emissions
Calculation method	Measured in lbs and converted to kg in the calculations.
Comments	Novec and Noah are considered equivalent, as they are both chemically identical to perfluoro-2-methyl-3-pentanone.

Data / Parameter	SO ₂ consumption
Data unit	kg SO ₂
Description	SO ₂ consumed – Michigan Plant
Source of data	Weight scales
Description of measurement methods and procedures to be applied	At the Eaton Rapids plant, the scale is used to track the SO ₂ gas usage from cylinder weights.
Frequency of monitoring/recording	Gas cylinders are weighed prior to installation and when replaced with a new cylinder and the amount is manually entered into a central Excel file on a monthly basis.
Value monitored	N/A

Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B709773218), calibrated 7/21/2021, 1/18/2022, 7/18/2022, 1/18/2023, and 7/5/2023.
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of project emissions
Calculation method	Measured
Comments	SO ₂ consumption is tracked to remain in line with the requirements of the protocol, but values are not used within the calculations.

Data / Parameter	SO ₂ Emissions
Data unit	mg/m ³
Description	Ambient Air SO ₂ Emissions – Michigan Plant
Source of data	SO ₂ Ambient Air Leak monitors
Description of measurement methods and procedures to be applied	SO ₂ emissions to the facility ambient air are tracked & measured to comply with the cap limit for SO ₂ concentration in the exhausting system. Five plant monitors track leaks and are set at a shutdown limit of 0.5 ppm (or 1.37 mg/m ³ of SO ₂).
Frequency of monitoring/recording	Leak detection occurs continuously at the facility.
Value monitored	Maximum of 1,470 mg/m ³ (dry basis, 273 K, 101.325 kPa at an oxygen concentration of 6% (v/v)).
Monitoring equipment	Plant-wide ambient air leak detection system.
QA/QC procedures to be applied	N/A
Purpose of the data	Cap limit for SO ₂ concentration in the exhaust system.
Calculation method	Measured
Comments	N/A

Data / Parameter	PE _{SF6, y}
Data unit	kg SF ₆
Description	SF ₆ consumed in year y – Michigan Plant
Source of data	Weight scales

Description of measurement methods and procedures to be applied	At the Eaton Rapids plant, the Weight Scale is used to track the SF ₆ gas usage from cylinder weights.
Frequency of monitoring/recording	Gas cylinders are weighed prior to installation and when replaced with a new cylinder and the amount is manually entered into a central Excel file on a monthly basis.
Value monitored	2022 – 6,503 kg 2023 – 7,281 kg
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B829135528 or B530462718, interchangeably), calibrated 7/21/2021, 1/18/2022, 7/18/2022, 1/18/2023, and 7/5/2023).
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of project emissions
Calculation method	Measured in lbs and converted to kg in the calculations.
Comments	N/A

Data / Parameter	Magnesium Sales Reports						
Data unit	tMg/year						
Description	In order to dispel concerns that a company increases production levels just to gain verified emission reductions, project developers must show proof of sales of magnesium.						
Source of data	Michigan Plant records						
Description of measurement methods and procedures to be applied	Annual Magnesium sales shall be compared to the term $P_{Mg, PJ, J, y}$ (annual magnesium produced).						
Frequency of monitoring/recording	Annually.						
Value monitored	<table border="1"> <thead> <tr> <th>Year</th><th>Tonnes Shipped</th></tr> </thead> <tbody> <tr> <td>2022</td><td>12,414</td></tr> <tr> <td>2023</td><td>10,559</td></tr> </tbody> </table>	Year	Tonnes Shipped	2022	12,414	2023	10,559
Year	Tonnes Shipped						
2022	12,414						
2023	10,559						
Monitoring equipment	Sales and scrap data logs						
QA/QC procedures to be applied	Magnesium sales reports shall be verified by DOE as part of the verification process						
Purpose of the data	To prevent false claims of increased production						

Calculation method	Sales logged
Comments	Kilograms of sales from the recycling plant include ingots cast, which is about 98% of total sales and dross (waste) which is about 2% of total sales. Kilograms of sales from the die cast facility include both sales of finished parts which account for approximately half of the total and the sale of scrap sent to the recycling plant which also accounts for about half of the total. Sales did not reach the 70% magnesium production threshold during this reporting period due to a decline in final product demand caused by first an economic slow-down due to the Covid-19 pandemic during early 2020, and the subsequent microchip shortage that has dramatically limited automobile production in Q3 and Q4 2020. As part of the verification process, the verifier has confirmed that there were no false claims of increased production on site.

4.3 Monitoring Plan

The monitoring plan requires the magnesium melted to be calculated using weighing methods and multiplying those numbers by the tSF_6/tMg ratio calculated in the baseline determined during the first crediting period. In other words, the baseline emissions were determined by how much SF_6 would have been used with the metal production numbers based on data from the 3 years prior to the start of the initial crediting period in 2007. Project emissions are calculated by determining the amount of SF_6 that was used in the project year and the amount of alternative gas used. Using the weighing of bottles (SF_6 and SO_2), and the weighing of the Novec/Noah tote, we can determine the amounts of SF_6 and alternative cover gases used. In the case of Novec/Noah, we multiply the amount of Novec/Noah used by a GWP of 1 along with a default conservative factor of 2,830 to compensate for uncertainty in the GWP of the byproducts emitted upon contact with molten metal. Project emissions are deducted from the baseline emissions to obtain annual emission reductions for the crediting year.

Data sources that are therefore monitored are: magnesium metal melted, SF_6 used, and Novec/Noah used. In addition, we monitor the amount of SO_2 because while SO_2 is not a GHG, we need to determine whether the use and handling of SO_2 complies both with local regulations and with AM0065. Data sources other than those monitored are primarily the baseline, which includes the use of SF_6 and metal melted for each segment of the facility for up to three years.

Below is the organizational plan for the management of this project. Colin Chapman has overall responsibility for all aspects of monitoring this project, including:

- **Metal melted:** Compiling and confirming accuracy of the quantity of magnesium metal melted is the key factor for determining baseline emissions in each project year. This task includes routine calibration of the scales to ensure accuracy. In addition, Meridian has implemented an internal metal tracking system (Plex) to accurately track the metal melted.
- **Gas consumption:** For every cover gas consumed, Novec, Noah, SO₂, and when necessary, SF₆, all gas consumption numbers are compiled, including gas invoices, floor tracking sheets with gas consumption values based on scale weights, and compilation of readings off the mass balance weight meters, so the data can be archived. This task also involves ensuring all flow meters and weight scales are periodically checked and calibrated. Meridian also makes efforts to ensure that any situations that might require the resumption of SF₆ use are minimized. The gas consumption data gathering methodology remained consistent throughout the first crediting period of this project, and will continue to be monitored and calibrated according to the plan laid out in the second crediting period PD. While the flow meters are used to regulate the gas flow, gas consumption is determined based on weighing the gas cylinders and Novec/Noah tote.
- **SO₂ management:** Meridian has an extensive training system so personnel who might be exposed to SO₂ fumes are properly prepared. This monitoring task includes the need to ensure that all SO₂ sensors are operating effectively, so if emissions do exceed certain limits, an alarm will sound and that section of the plant can be evacuated. Finally, this monitoring task involves ensuring SO₂ use and management are fully in compliance with AM0065's specifications dealing with SO₂.
- **Magnesium Sales:** Sales are monitored by accounting, and final data is overseen by both the DOE and the project proponent. Kilograms of sales from the recycling plant include ingots cast, which is about 98% of total sales and dross (waste) which is about 2% of total sales. Kilograms of sales from the die cast facility include both sales of finished parts which account for approximately half of the total and the sale of scrap sent to the recycling plant which also accounts for about half of the total. These numbers are compiled into total parts shipped and ingots moved worksheets, which are monitored and quality controlled by the project proponent.

Internal auditing of the data is performed first by Colin Chapman at Meridian and second by 3Degrees to assure all data is accurate. All project data is compiled by 3Degrees and electronically archived on servers until at least two years after the end of the crediting period. Any non-conformities with data or data collection are addressed and noted in the deviations if they are not able to be corrected.

A Meridian Organizational Chart can be found in the Project Description document for the project, available on the Verra Public Registry.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Baseline emissions are determined according to Equation 5 under Case 2 in version 2.1 of methodology AM0065, as follows:

$$BE_y = P_{Mg,PJ,y} * GWP_{SF6} * EF_{SF6,Mg}$$

Where:

BE_y = Baseline emissions in year y (tCO₂e/yr)

$EF_{SF6,Mg}$ = Baseline emission factor for the facility calculated as the minimum emission factor for 3 years of data (tSF₆/tMg)

$P_{Mg,PJ,y}$ = Annual amount of Mg products manufactured in the project scenario in the facility per year y

GWP_{SF6} = Global Warming Potential of SF₆ (tCO₂e/tSF₆)

As the facility's baseline emissions are the sum of emissions from their diecast operations and emissions from their magnesium recycling, Equation 5 is calculated for each of these operations for each facility.

The baseline recycling emission factor for the Michigan facility is 0.000385 tCO₂e/tSF₆, as calculated at validation.

Substituting the appropriate values for the recycling operation into the baseline emissions equation for the Michigan facility gives:

$$\begin{aligned} BE_{2022,recycling,MI} &= P_{Mg,PJ,recycling,2022} * GWP_{SF6} * EF_{SF6,Mg} \\ &= 18,679,963 \text{ kg} * 0.001 \frac{t}{kg} * 0.0003850 \frac{tSF6}{tMg} * 23,500 \text{ tCO}_2\text{e/tSF}_6 \\ &= 169,007 \text{ tCO}_2\text{e} \end{aligned}$$

$$BE_{2023,recycling,MI} = P_{Mg,PJ,recycling,2023} * GWP_{SF6} * EF_{SF6,Mg}$$

$$= 18,989,299 \text{ kg} * 0.001 \frac{\text{t}}{\text{kg}} * 0.00003850 \frac{\text{tSF}_6}{\text{tMg}} * 23,500 \text{ tCO}_2\text{e/tSF}_6$$

$$= 171,806 \text{ tCO}_2\text{e}$$

The baseline diecast emission factors for the Michigan facility and Ontario facility are 0.0000914 tCO_{2e}/tSF₆ and 0.0000549 tCO_{2e}/tSF₆, respectively, as calculated at validation.

Substituting the appropriate values for the diecast operation into the baseline emissions equation for the Michigan facility gives:

$$BE_{2022, \text{diecast}, MI} = P_{Mg, PJ, \text{diecast}, 2022} * GWP_{SF_6} * EF_{SF_6, Mg}$$

$$= 20,800,823 \text{ kg} * 0.001 \frac{\text{t}}{\text{kg}} * 0.0000914 \frac{\text{tSF}_6}{\text{tMg}} * 23,500 \text{ tCO}_2\text{e/tSF}_6$$

$$= 44,678 \text{ tCO}_2\text{e}$$

$$BE_{2023, \text{diecast}, MI} = P_{Mg, PJ, \text{diecast}, 2023} * GWP_{SF_6} * EF_{SF_6, Mg}$$

$$= 21,664,366 \text{ kg} * 0.001 \frac{\text{t}}{\text{kg}} * 0.0000914 \frac{\text{tSF}_6}{\text{tMg}} * 23,500 \text{ tCO}_2\text{e/tSF}_6$$

$$= 46,533 \text{ tCO}_2\text{e}$$

Total baseline emissions for 2022 and 2023 are calculated as follows:

$$BE_{2022} = BE_{2022, \text{recycling}, MI} + BE_{2022, \text{diecast}, MI}$$

$$BE_{2022} = 169,007 + 44,678$$

$$BE_{2022} = 213,685 \text{ tCO}_2\text{e}$$

$$BE_{2023} = BE_{2023, \text{recycling}, MI} + BE_{2023, \text{diecast}, MI}$$

$$BE_{2023} = 171,806 + 46,533$$

$$BE_{2023} = 218,339 \text{ tCO}_2\text{e}$$

5.2 Project Emissions

Project emissions are determined according to Equation 9 in methodology AM0065:

$$PE_y = PE_{ALTGAS, y} + PE_{SF_6, y} + \sum_{j, y} C_{CO_2, PJ, y}$$

Where:

$$PE_y = \text{Project emissions in year } y \text{ (tCO}_2\text{e/yr)}$$

$PE_{ALTGAS,y}$ = Project emissions from the use of HFC134a or Perfluoro-2-methyl-3-pentanone, if it is used as cover gas in project scenario – summing of all segments j – in year y (tCO₂e/yr)

$PE_{SF6,y}$ = Project emissions from the use of SF₆ – summing of all segments j – in year y (tCO₂e/yr)

$C_{CO2,PJ,y}$ = Consumption of CO₂ gas in project scenario for each segment per year (tCO₂/yr); shall be used when CO₂ is used as diluent in cover gas mix in the project scenario alone

$C_{CO2,PJ,y}$ is 0 because no CO₂ is used as a diluent in the cover gas mix in the project scenario. Equation 9 is therefore revised as follows:

$$PE_y = PE_{ALTGAS,y} + PE_{SF6,y}$$

$PE_{ALTGAS,y}$ is calculated through Equation 10 of the methodology:

$$PE_{ALTGAS,y} = \sum_j \sum_k C_{ALTGAS,PJ,k,j,y} \times GWP_{ALTGAS} \times CF$$

Where:

$C_{ALTGAS,PJ,k,j,y}$ = Consumption of alternate gas in project scenario for each equipment k in each segment j per year (t/yr)

GWP_{ALTGAS} = Global warming potential of alternate gas; in case of using Perfluoro-2-methyl-3 pentanone the value used is 1

CF = Conservative factor (default value of 1.26 for HFC134a and 2,830 for Perfluoro-2-methyl-3-pentanone)

Substituting the appropriate values for Novec and Noah consumption for 2022 and 2023 gives:

$$PE_{ALTGAS,2022} = \left((1,962.2 \frac{kg}{yr} + 5,874.0 \frac{kg}{yr}) \times 1 \times 2,830 \right) \times 0.001 \frac{kg}{t}$$

$$PE_{ALTGAS,2022} = 22,176.65 \text{ tCO}_2\text{e/yr}$$

$$PE_{ALTGAS,2023} = \left((1,563.1 \frac{kg}{yr} + 4,468.3 \frac{kg}{yr}) \times 1 \times 2,830 \right) \times 0.001 \frac{kg}{t}$$

$$PE_{ALTGAS,2023} = 17,068.93 \text{ tCO}_2\text{e/yr}$$

Project emissions from the use of SF₆ are quantified through Equations 11 and 12 of the methodology, shown below:

$$PE_{SF6,y} = \sum_j \sum_k C_{SF6,EM,PJ,k,j,y} \times GWP_{SF6}$$

Where:

$C_{SF6,EM,PJ,k,j,y}$ = SF₆ actually emitted in the project scenario in each equipment k of each segment j, per year y (tSF₆/yr)

$GW P_{SF6}$ = Global warming potential SF₆ (tCO₂e/tSF₆)

And:

$$C_{SF6,EM,PJ,k,j,y} = C_{SF6,CON,PJ,k,j,y} \times DF_{SF6,k,j} \times DI_{SF6,CON,PJ,k,j,y}$$

Where:

$C_{SF6,CON,PJ,k,j,y}$ = Total consumption of SF₆ in the project scenario in each equipment k of each segment j, per year y (tSF₆/yr)

$DF_{SF6,k,j}$ = degradation factor of SF₆ that reacts with magnesium in the production process, assumed as 0.5

$DI_{SF6,CON,PJ,k,j,y}$ = A conservative factor portraying the data integrity of in each segment, per year (fraction)

$C_{SF6,EM,PJ,k,j,y}$ is calculated for the recycling and die cast operations at both facilities for 2022 and 2023. Substituting the appropriate values for 2022 gives:

$$C_{SF6,EM,PJ,diecast,2022} = 94.8 \text{ tSF}_6/\text{yr} \times 0.5 \times 1.05 \times 0.001$$

$$C_{SF6,EM,PJ,diecast,2022} = 0.05 \text{ tSF}_6/\text{yr}$$

$$C_{SF6,EM,PJ,recycling,2022} = 6,408.4 \text{ tSF}_6/\text{yr} \times 0.5 \times 1.05 \times 0.001$$

$$C_{SF6,EM,PJ,recycling,2022} = 3.36 \text{ tSF}_6/\text{yr}$$

And for 2023:

$$C_{SF6,EM,PJ,diecast,2023} = 820.5 \text{ tSF}_6/\text{yr} \times 0.5 \times 1.05 \times 0.001$$

$$C_{SF6,EM,PJ,diecast,2023} = 0.43 \text{ tSF}_6/\text{yr}$$

$$C_{SF6,EM,PJ,recycling,2023} = 6,460.1 \text{ tSF}_6/\text{yr} \times 0.5 \times 1.05 \times 0.001$$

$$C_{SF6,EM,PJ,recycling,2023} = 3.39 \text{ tSF}_6/\text{yr}$$

Substituting the calculated $C_{SF6,EM,PJ,k,j,y}$ values for diecast and recycling operations in 2022 and 2023 into Equation 11 yields the following:

$$PE_{SF6,2022} = (0.05 + 3.36) \times 23,500$$

$$PE_{SF6,2022} = 80,232.8 \text{ tCO}_2\text{e}/\text{yr}$$

$$PE_{SF6,2023} = (0.43 + 3.39) \times 23,500$$

$$PE_{SF6,2023} = 89,824.6 \text{ tCO}_2\text{e/yr}$$

$PE_{ALTGAS,y}$ and $PE_{SF6,y}$ are then substituted into Equation 9 below to quantify total project emissions by year:

$$PE_{2022} = 22,176.7 + 80,232.8$$

$$PE_{2022} = 102,409 \text{ tCO}_2\text{e}$$

$$PE_{2023} = 17,068.9 + 89,824.6$$

$$PE_{2023} = 106,894 \text{ tCO}_2\text{e}$$

5.3 Leakage Emissions

There are no leakage emissions associated with the project.

5.4 GHG Emission Reductions and Carbon Dioxide Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reductions during the year y

BE_y = Emission reductions during the year y

PE_y = Emission reductions during the year y

Plugging in the appropriate parameters gives the following reductions for 2022:

$$ER_{2022} = 213,685 - 102,409$$

$$ER_{2022} = 111,276 \text{ tCO}_2\text{e}$$

And for 2023:

$$ER_{2023} = 218,339 - 106,894$$

$$ER_{2023} = 111,445 \text{ tCO}_2\text{e}$$

The resulting total emission reductions are shown in the table below.

Vintage period	Baseline emissions (tCO ₂ e)	Project emissions (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Reduction VCU (tCO ₂ e)	Removal VCU (tCO ₂ e)	Total VCUs (tCO ₂ e)
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01-Jan-2012 to 31-Dec-2012	325,087	80,989	0	244,098		244,098
01-Jan-2013 to 31-Dec-2013	365,371	100,236	0	265,135		265,135
01-Jan-2014 to 31-Oct-2014	328,184	80,337	0	247,847		247,847
01-Nov-2014 to 31-Dec-2014	55,658	17,610	0	38,048		38,048
01-Jan-2015 to 31-Dec-2015	390,983	75,687	0	315,296		315,296
01-Jan-2016 to 31-Dec-2016	399,007	70,571	0	328,437		328,437
01-Jan-2017 to 31-Oct-2017	195,217	31,883	0	163,334		163,334
01-Nov-2017 to 31-Dec-2017	32,268	6,927	0	25,341		25,341
01-Jan-2018 to 31-Dec-2018	114,635	26,129	0	88,505		88,505
01-Jan-2019 to 31-Dec-2019	214,934	83,086	0	131,848		131,848
01-Jan-2020 to 31-Dec-2020	186,568	72,076	0	114,492		114,492
01-Jan-2021 to 31-Dec-2021	192,917	103,369	0	89,548		89,548
01-Jan-2022 to 31-Dec-2022	213,685	102,409	0	111,276		111,276
01-Jan-2023 to 31-Dec-2023	218,339	106,894	0	111,445		111,445
Total	3,232,853	958,203	0	2,274,348		2,274,348

Vintage period	Ex-ante estimated reductions/removals	Achieved reductions/removals	Percent difference	Explanation for the difference
01-Jan-2022 to 31-Dec-2022	196,000	111,276	-43.2%	The decrease in emissions reductions was a result of excluding the Ontario facility from credit generation this reporting period.
01-Jan-2023 to 31-Dec-2023	196,000	111,445	-43.1%	The decrease in emissions reductions was a result of excluding the Ontario facility from credit generation this reporting period.
Total	392,000	222,721	-43.2%	The decrease in emissions reductions was a result of excluding the Ontario facility from credit generation this reporting period.

APPENDIX 1: COMMERCIALLY SENSITIVE INFORMATION

No commercially sensitive information is included in the monitoring report.

Section	Information	Justification
N/A	N/A	N/A

APPENDIX 2: SDG CONTRIBUTIONS

SDG 12- Responsible Consumption and Production

12.5.1 Tonnes of material recycled

The project recycled 37,669.3 tonnes of magnesium during the reporting period. The table below shows the project's contributions to SDG 12 over the project lifetime.

Year	Total Magnesium Recycled (tonnes)
2009	No records available
2010	No records available
2011	No records available
2012	22,934.0
2013	20,393.3
2014	20,805.7
2015	20,524.1
2016	21,076.9
2017	19,598.7
2018	10,073.6
2019	19,419.4
2020	16,107.9
2021	16,730.7
2022	18,680.0
2023	18,989.3
Total	225,333.6

SDG 9- Industry, innovation, and infrastructure

9.4.1 CO2 emission per tonne of magnesium produced

During this reporting period, the project emitted an average of 2.779 tonnes less CO2e per tonne magnesium produced as compared to the baseline scenario. The table below provides the reduction in emissions per tonne Mg produced across the project lifetime.

Year	Reduction in CO2 emissions per tonne Mg produced
2009-2012	Insufficient records available
2010	Insufficient records available
2011	Insufficient records available
2012	3.062
2013	3.378
2014	3.436
2015	3.831
2016	3.800
2017	4.083
2018	3.907
2019	3.235
2020	3.260
2021	2.482
2022	2.818
2023	2.741
Total Average	3.336

SDG 13- Climate Action

13.0 Tonnes of GHG emissions avoided or removed

Carbon emission reductions from previous reporting periods are listed here. Documentation of these values can be found under the Issuance Records for the project on the VCS Registry [linked here](#).

Year	Total Emission Reductions (tonnes CO2e)
2009	132,143
2010	199,913
2011	207,542
2012	244,098
2013	265,135
2014	303,506
2015	315,295
2016	328,436
2017	188,676
2018	88,505
2019	131,848
2020	114,492
2021	89,548
2022	111,276
2023	111,445
Total	2,831,858