Declaration Owner
North American MgO LLC
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Product
MagTech Ultra Magnesium Oxide Board

Functional Unit
The functional unit is one square meter of mineral panel.

EPD Number and Period of Validity
SCS-EPD-04873
EPD Valid February 9, 2018 through February 8, 2023

Product Category Rule
Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report. Version 1.5, 2016.
Part B: Requirements on the EPD for Mineral panels. Version 1.5, 2016.

Program Operator
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Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, 21930 and EN 15804.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

PCR review, was conducted by	Institut Bauen und Umwelt e.V., (IBU).
Approved Date: February 9, 2018 – End Date: February 8, 2023	
Independent verification of the declaration and data, according to ISO 14025:2006. EN 15804 serves as the core PCR	☐ internal ☑ external
Third party verifier	 Dr. Gerard Mansell, LCA Practitioner, SCS Global Services

1. ABOUT NORTH AMERICAN MGO LLC

Established in 2016, North American MgO LLC is the building products industry innovative manufacturer of MagTech Ultra magnesium oxide (MgO) cement boards. From its USA based manufacturing and R+D center, North American MgO is advancing magnesium oxide technology and automated production to promote and expand the use of MgO technology across North America. Our goal is to educate the design and construction communities about the significant advantages of our proprietary products over existing MgO boards, gypsum and Portland cement based products used in similar applications.

Local sourcing of raw materials and domestic manufacturing under controlled automated production helps ensure environmental stewardship is a priority. Reduced production energy requirements, no pre-consumer waste and complete recyclability minimizes our environmental footprint. MagTech Ultra products have the structural performance requirements to meet today's complex building designs. Enhanced fire resistance properties allow us to provide systems for both interior and exterior fire rated assemblies. Indoor environmental quality is maintained and never compromised. MagTech Ultra's complete resistance to mold and fungus development, insect and moisture damage is achieved by its inert nature.

North American MgO LLC provides complete technical support for all product use and installation questions. Our customer support staff co-ordinates and manages all supply, distribution and field needs.

2. PRODUCT

2.1 Product Description

The products being studied for this life cycle assessment are North American MgO's MagTech Ultra Magnesium Oxide Boards. These products are domestically produced, proprietary magnesium oxide products, utilizing patent pending formulations, designed for the demands of the US building market.

2.2 Application

MagTech Ultra Magnesium Oxide Boards are commonly used both indoors and outdoors when the following criteria are needed: fire resistance, water resistance, mold resistance, fungus resistance, insect resistance impact resistance, versatility.

2.3 Technical Data

See Technical Data Sheets (TDS) on North American MgO's website, http://www.northamericanmgo.com/physical-testing/.

2.4 Delivery Status

MagTech Ultra boards are delivered to the customer in 4'x8' sheets. Thickness ranges from ¼" to 2". I/2" 4' x 8' sheets are stacked 50 sheets per pallet and are wrapped with corner guards for delivery.

2.5 Base Materials

Material	Amount (kg)	Percentage of Total Mass
Mineral Panel		
Fiberglass mat	0.1	1%
Magnesium Oxide/Magnesium Sulfate	5.2	67%
Perlite Filler	1.4	18%
Additives	0.7	9%
Fly Ash Filler	0.4	5%
Total	**7.8**	**100%**
Packaging		
Wood	0.122	98%
Polyethylene	0.0015	1%
Cardboard	0.0015	1%
Total Packaging	**0.125**	**100%**

2.6 Manufacture

MagTech Ultra Magnesium Oxide Boards are produced in North American MgO's Illinois facility. The boards are produced by first mixing various materials to create a cement mixture. This mixture is then cast into thin panels and a fiberglass scrim is applied to both sides of the panel. These panels are then stored in the facility under proper conditions allowing them to fully cure. The cured panels are then stacked on pallets and prepared for shipment to the customer.

2.7 Environment and Health during Manufacture

North American MgO meets all federal and state standards related to the Environment and Health during manufacturing.

2.8 Product Processing/ Installation

MagTech Ultra installation guidelines will vary based on application and project requirements. In general, MagTech Ultra boards are installed on a maximum of 24" O.C. framing using bugle head screws with a powered drill. Mag Tech Ultra can be cut with conventional hand or power tools.

2.9 Packaging

MagTech Ultra boards are stacked on pallets and then wrapped with plastic wrapping and cardboard corner guards for delivery. When possible, North American MgO utilizes recycled cardboard and pallets.

2.10 Environment and Health during use

There are no environmental or health considerations during the use of this product.

2.11 Reference Service Life

As this study is a Cradle-to-Grave, with options study, excluding the use phase, the reference service life can be disregarded.

2.12 Extraordinary Effects

Due to the inherent water and fire resistance of the product, there are no additional impacts to the environment in the event of flooding or a fire. Additionally, flammability tests (ASTM E-136) have been performed on MagTech Ultra indicating the product is non-combustible.

2.13 Re-Use Phase

While MagTech Ultra boards cannot be reused, the installation is modular in nature meaning if a section gets destroyed, only that section needs to be replaced rather than the whole installation.

2.14 Disposal

MagTech Ultra can be recycled at North American MgO's facility, though for this assessment, it is assumed the MagTech Ultra boards will be disposed of with the underlying wall in a construction landfill. The distance the waste is transported to the landfill is assumed to be less than 100 miles, but 100 miles was used in the model as a conservative estimate.

2.15 Further Information

Additional information regarding North American MgO and MagTech Ultra can be found at http://www.northamericanmgo.com/.

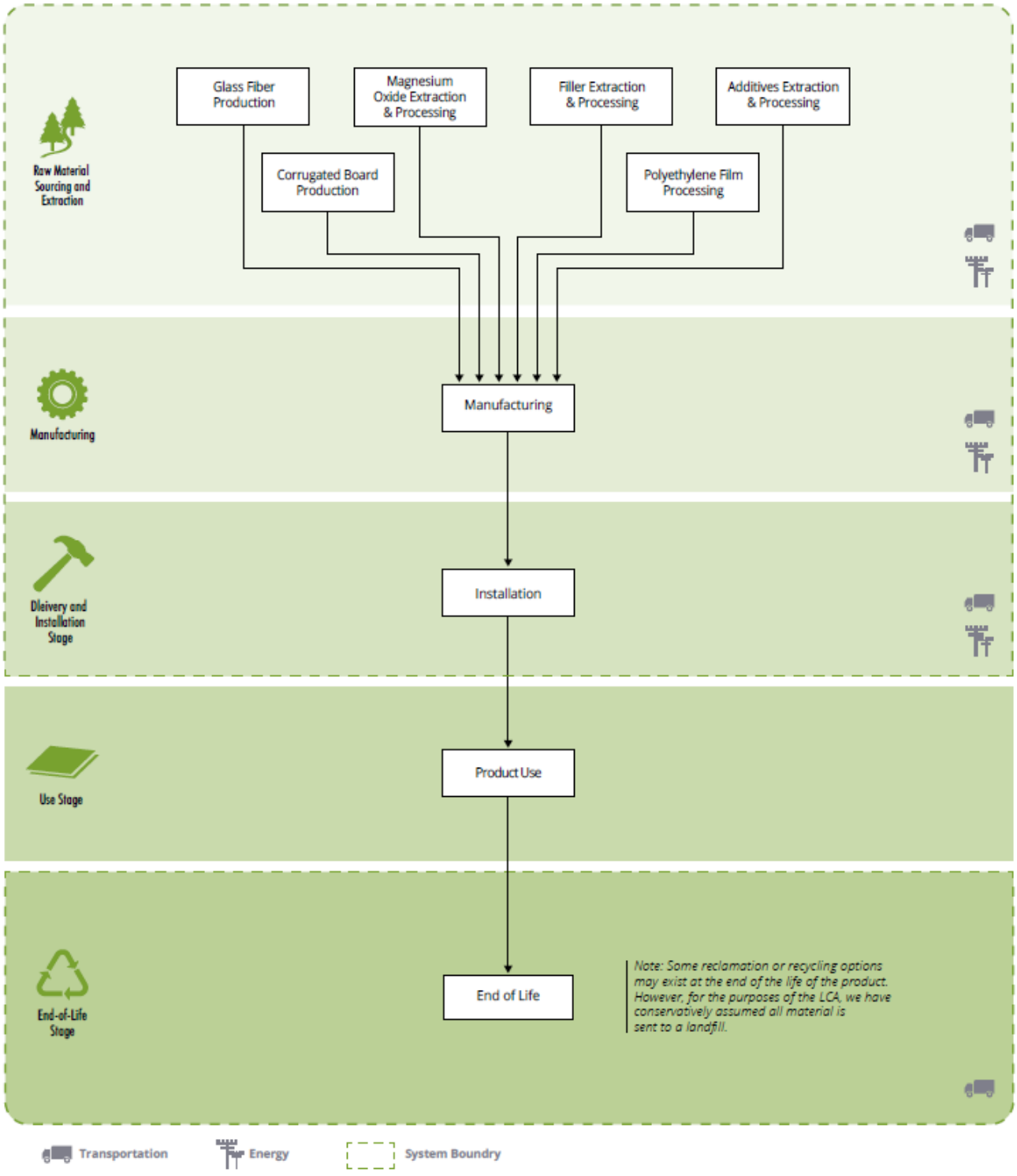
3. LCA: CALCULATION RULES

3.1 Declared Unit

The functional unit used in the study, as specified in the PCR, is 1 m^2 of mineral panel. *The conversion factor to 1 kg is 0.1286.*

3.2 System Boundary

The scope of the EPD is cradle-to-gate with options including raw material extraction and processing, transportation, product manufacture, product delivery, installation, and product disposal. The diagram below is a representation of the most significant contributions to the life cycle of the MagTech Ultra boards.


Glass Fiber Production
Magnesium Oxide Extraction & Processing
Filler Extraction & Processing
Additives Extraction & Processing
Corrugated Board Production
Polyethylene Film Processing
Raw Material Sourcing and Extraction
Manufacturing
Manufacturing
Installation
Dleivery and Installation Stage
Product Use
Use Stage
End of Life
End-of-Life Stage
Note: Some reclamation or recycling options may exist at the end of the life of the product. However, for the purposes of the LCA, we have conservatively assumed all material is sent to a landfill.
Transportation
Energy
System Boundry

3.3 Estimates and Assumptions

Throughout the study, values choice and judgments were made that may have affected the LCA. Additional decisions are summarized below.

- Landfilling at End of Life – All products were considered to be landfilled at end of life.
- The inclusion of secondary manufacturing energy, water and waste data was determined appropriate due to MagTech Ultra being new to the market.
- Conservative estimates of transport distances from suppliers were used based on a review of the list of suppliers.
- Installation tools, such as screwdrivers, are required, though not included in the study as these are multi-use tools and the impacts per declared unit is considered negligible.

It should also be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The PCR allows for the results for several inventory flows related to construction products to be reported as "other parameters". These are aggregated inventory flows and do not characterize any potential impact; results should be interpreted taking into account this limitation.

3.4 Cut-off criteria

According to the PCR, processes contributing greater than 1% of the total environmental impact indicator for each impact are included in the inventory. Some material and energy inputs may have been excluded within the GaBi datasets used for this project. All GaBi datasets have been critically reviewed and conform to the exclusion requirement of the PCR.

3.5 Background Data

Primary data were provided by North American MgO for the Illinois facility. The secondary LCI data are sourced from GaBi databases. GaBi version 8.0.0.247 was used to complete the assessment.

3.6 Data Quality

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	Primary data were provided by North American MgO associates and represent the current formulation of the product. As this product is currently not being marketed, researched values were used for manufacturing metrics. Time coverage of this data is considered very good. Data necessary to model cradle-to-gate unit processes were sourced from thinkstep LCI datasets. Time coverage of the GaBi datasets varies from approximately 2010 to present. All datasets rely on at least one 1-year average data. Overall time coverage of the datasets is considered good and meets the requirement of the PCR that all data be updated within a 10-year period. The specific time coverage of secondary datasets can be referenced in the section titled Generic Data.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The geographical scope of the manufacturing portion of the life cycle is North Aurora, IL, USA. This is North American MgO's primary manufacturing facility. All primary data were collected from this location. The geographic coverage of primary data is considered excellent. The geographical scope of the raw material acquisition, customer distribution, site installation and use portions of the life cycle is the United States of America. Locations and shipping distance values were determined through the analysis of typical customers using GIS mapping software. This data is considered good. Disposal and end-of-life geographic coverage (i.e. site of disposal location) was assumed based on research relating to the average distance an American lives from a landfill. This data is considered good. In selecting secondary data (i.e. GaBi Datasets), priority was given to the accuracy and representativeness of the data. Geographic coverage was considered in assessing representativeness. When available and deemed of significant quality, regionally specific data was used. However, priority was given to technological relevance and accuracy in selecting secondary data. This often led to the substitution of

Data Quality Parameter	Data Quality Discussion
	regional and/or global data for country specific data. The geographical coverage of secondary datasets can be referenced in the dataset references table on the following page. Overall geographic data quality is considered good.
Technology Coverage: Specific technology or technology mix	Primary data provided by North American MgO is specific to the technology that the company uses in manufacturing their product. It is site specific and considered of good quality. Secondary data for manufacturing energy, water and waste was utilized due to MagTech Ultra being new to the market. This secondary data was utilized from a comparable product. Data necessary to model cradle-to-gate unit processes was sourced from GaBi LCI datasets. Technological coverage of the datasets is considered good relative to the actual supply chain of North American MgO. While improved life cycle data from suppliers would improve technological coverage, the use of lower quality generic datasets does meet the goal of this LCA.
Precision: Measure of the variability of the data values for each data expressed	Precision of the results aren't quantified due to a lack of data. As full manufacturing has not begun for this product, primary data for manufacturing is estimated using existing LCAs. Precision in background GaBi datasets is documented by thinkstep.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known energy and material flows and followed the cut-off rules laid out in the PCR. Completeness in background GaBi datasets is documented by thinkstep.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the LCA represent typical processes used in the production of the wallboard and are generally representative of actual processes. Manufacturing data is estimated from existing LCA studies of similar wallboards. Background datasets were chosen based on appropriate technologies first and location second, so there are instances in the background data where there isn't exact geographic representation.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	Whenever possible, background data was chosen from the thinkstep database to ensure consistency in LCA methodologies and data collection. Primary data collection was consistently collected across the various data metrics.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	The LCA study and data collection was conducted in a manner that aids reproducibility. All assumptions, models, and data sources are documented in the background LCA report.
Sources of the Data: Description of all primary and secondary data sources	Primary data on the formulation of the product was collected by North American MgO associates. Secondary data on the manufacturing of the product was collected from available LCA studies. Secondary datasets for the energy and materials utilized were taken from the GaBi database.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to the formulation and packaging is low. The lack of exact geographical representativeness in the background material datasets increase the uncertainty of the study, as does the estimation of the manufacturing metrics. The uncertainty of the background datasets from the GaBi database is documented by thinkstep.

3.7 Period under review

This EPD is based on data for the current production of MagTech Ultra boards and estimations on the manufacturing metrics within the production facility.

3.8 Allocation

General principles of allocation were based on ISO14044. Where possible, allocation was avoided. When allocation was necessary it was done on a physical mass basis. Allocation was most prevalent in the secondary GaBi datasets used to represent upstream processes. As a default, GaBi datasets use a physical mass basis for allocation.

Of relevancy to the defined system boundary is the method in which recycled materials were handled. Throughout the study, recycled materials were accounted for via the cut-off method. Under this method, impacts and benefits associated with the previous life of a raw material from recycled stock are excluded from the system boundary. Additionally, impacts and benefits associated with secondary functions of materials at end of life are also excluded (i.e. production into a third life or energy generation from the incineration plant. The study does not include the impacts associated with reprocessing and preparation of recycled materials that are part of the bill of materials of the products under study.

3.9 Comparability

The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.

4. LCA: SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

Delivery and Installation stage (A4 - A5)

Name	Value	Unit
A4: Transport to the construction site		
Liters of Fuel	42	L/100km
Transport Distance	1609	km
Capacity Utilization	67	%
A5: Installation in the building		
Material Loss	0.125	kg
Screws Used	0.027	kg

Disposal stage (C1 - C4)

Name	Value	Unit
Collected as mixed construction waste	7.78	kg
Landfilling	7.78	kg

5. LCA: RESULTS

Product			Construction Process		Use							End-of-life				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material extraction and processing	Transport to manufacturer	Manufacturing	Transport	Construction - installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery and/or recycling potential
X			X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	MND

CML Life Cycle Impact Assessment (LCIA) results for the MagTech Ultra magnesium oxide board. All values are rounded to three significant digits. Results reported in MJ are calculated using *net calorific value*.

Impact Category	Unit	A1-3	A4	A5	B1-7	C1	C2	C3	C4	D
Global Warming Potential	kg CO_2 eq	7.42	1.01	0.082	MND	0	0.096	0	0.126	N/A
Acidification Potential of Land and Water	kg SO_2 eq	0.0153	$3.26x10^{-3}$	$2.42x10^{-4}$	MND	0	$3.21x10^{-4}$	0	$7.42x10^{-4}$	N/A
Eutrophication Potential	kg PO_4^{3-} eq	$2.15x10^{-3}$	$8.77x10^{-4}$	$2.32x10^{-5}$	MND	0	$8.63x10^{-5}$	0	$1.01x10^{-4}$	N/A
Depletion Potential of the Stratospheric Ozone Layer	kg CFC-11 eq	$6.85x10^{-10}$	$8.36x10^{-12}$	$6.91x10^{-13}$	MND	0	$8.23x10^{-13}$	0	$1.18x10^{-13}$	N/A
Formation Potential of Tropospheric Ozone	kg C_2H_4 eq	$5.51x10^{-4}$	$3.39x10^{-4}$	$3.04x10^{-5}$	MND	0	$3.33x10^{-5}$	0	$5.84x10^{-5}$	N/A
Abiotic Depletion Potential for Non-Fossil Resources (Elements)	kg Sb eq	$1.52x10^{-5}$	$1.72x10^{-7}$	$4.95x10^{-6}$	MND	0	$1.69x10^{-8}$	0	$4.41x10^{-8}$	N/A
Abiotic Depletion Potential for Fossil Resources (Fossil Fuels)	MJ eq	85.6	14.2	0.869	MND	0	1.40	0	1.62	N/A

MND = Module not declared

TRACI Life Cycle Impact Assessment (LCIA) results for the MagTech Ultra magnesium oxide board. All values are rounded to three significant digits.

Impact Category	Unit	A1-3	A4	A5	B1-7	C1	C2	C3	C4	D
Global Warming (GWP, 100 year)	kg CO_2 eq	7.39	1.01	0.0819	MND	0	0.0994	0	0.125	N/A
Acidification	kg SO_2 eq	0.0172	$4.37x10^{-3}$	$2.47x10^{-4}$	MND	0	$4.30x10^{-4}$	0	$8.10x10^{-4}$	N/A
Eutrophication	kg N eq	$1.14x10^{-3}$	$3.65x10^{-4}$	$1.65x10^{-5}$	MND	0	$3.60x10^{-5}$	0	$6.74x10^{-5}$	N/A
Ozone Depletion	kg CFC-11 eq	$7.62x10^{-10}$	$8.89x10^{-12}$	$7.33x10^{-13}$	MND	0	$8.75x10^{-13}$	0	$1.24x10^{-13}$	N/A
Smog	kg O_3 eq	0.297	0.144	$3.64x10^{-3}$	MND	0	0.0142	0	0.0158	N/A

MND = Module not declared

Resource use for the MagTech Ultra magnesium oxide board. All values are rounded to three significant digits. Results reported in MJ are calculated using *net calorific value*.

Parameter	Unit	A1-3	A4	A5	B1-7	C1	C2	C3	C4	D
Use of renewable primary energy excluding the renewable primary energy resources used as raw materials	MJ	5.73	0.354	0.130	MND	0	0.0349	0	0.196	N/A
Use of renewable primary energy resources used as raw materials	MJ	0	0	0	MND	0	0	0	0	N/A
Total use of renewable primary energy resources	MJ	5.73	0.354	0.130	MND	0	0.0349	0	0.196	N/A
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	92.3	14.3	0.940	MND	0	1.40	0	1.68	N/A
Use of non-renewable primary energy resources used as raw materials	MJ	0	0	0	MND	0	0	0	0	N/A
Total use of non-renewable primary energy resources	MJ	92.3	14.3	0.940	MND	0	1.40	0	1.68	N/A
Use of secondary materials	Kg	0	0	0	MND	0	0	0	0	N/A
Use of renewable secondary fuels	MJ	0	0	0	MND	0	0	0	0	N/A
Use of non-renewable secondary fuels	MJ	0	0	0	MND	0	0	0	0	N/A
Hazardous waste	Kg	0	0	0	MND	0	0	0	0	N/A
Non-hazardous waste	Kg	23.7	0.144	0.429	MND	0	0.0141	0	8.07	N/A
Radioactive waste	Kg	$4.47x10^{-3}$	$3.13x10^{-5}$	$2.84x10^{-5}$	MND	0	$3.08x10^{-6}$	0	$2.27x10^{-5}$	N/A
Components for re-use	Kg	0	0	0	MND	0	0	0	0	N/A
Materials for recycling	kg	0	0	0	MND	0	0	0	0	N/A
Materials for energy recovery	kg	0	0	0	MND	0	0	0	0	N/A
Exported electric energy	MJ	0	0	0	MND	0	0	0	0	N/A
Exported thermal energy	MJ	0	0	0	MND	0	0	0	0	N/A

MND = Module not declared

6. LCA: INTERPRETATION

The vast majority of the impacts come from the life cycle stages A1-A3. With the exception of the calcium carbonate and fly ash which have minimal impacts, the majority of the impacts track the mass contained within the product closely, with the highest impact material being the magnesium oxide itself.

It is important to note that data quality may have an impact on the results of an LCA. Overall data quality is considered good. Improvements can be made through the modification of datasets to incorporate more regional specificity, both in terms of energy and technology. Utilizing North American MgO specific upstream data provided by suppliers would lead to improvement in data quality. However, the data used in this assessment was considered appropriate in relation to the goal, scope and budget of the project.

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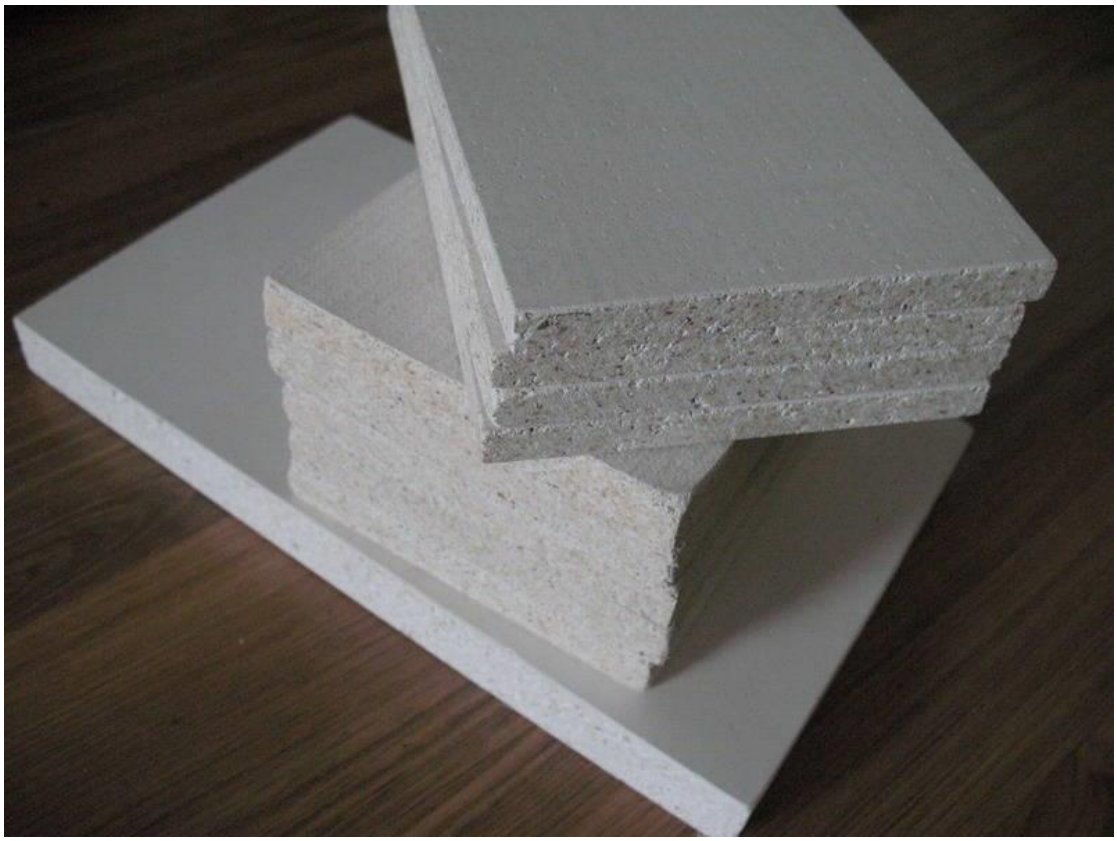

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