Life Cycle Analysis

Dry goods storage silo

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PROVICE

Life Cycle Analysis of a dry goods storage silo from cradle to gate

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Executive summary

BM Silo produce silos for dry material storage in galvanized steel for indoor and outdoor use.

The silos are based on a modular and scalable system customized to customers need. The silo capacity ranges from 5 m^3 to 35 m^3. The silos are manufactured and organized for assembling on-site, which assure an environmental- and cost efficient logistic from BM Silo to customers. BM silo supply products world-wide.

This report includes a life cycle assessment (LCA) of silos for dry material storage in galvanized steel. The analysis was conducted in Q2/Q3 2022 and represents the latest production data. The LCA results are valid until significant changes in production may occur.

The LCA is conducted according to DS/EN ISO 14040:2006 + A1:2020 and 14044:2006 + A1:2018 + A2:2020 and DS/EN ISO 14071:2014. The assessment was conducted in Q2/Q3 2022 and represents the latest production data. The LCA results are valid until significant changes in production occur.

The assessment is a cradle to gate assessment, modelled using an attributional approach. The results of the assessment are based on EPD (2018) impact assessment method, and normalization and weighting factors from the Product Environmental Footprint (PEF) scheme.

In supplement to the report, BM Silo has developed a model to provide customized LCA data to customers based on the particular product specifications and for internal product development.

The functional unit of the study is: *1 m^3 dry storage silo.* The functional unit is directly comparable with similar dry storage products. The functional unit is scalable for the range of dry storage silos sizing from 4 m^3 to 40 m^3. The analysis present results according to a representative average silo of 10 m^3.

The characterized, normalized and weighted results for 1 m^3 BM Silo dry storage is illustrated in the table below. This unit can be scaled to any BM silo product.

Impact category	Reference unit	Impacts		
		Characterized results	Normalized results	Weighted results (pt)
Abiotic depletion, elements	kg Sb eq	0,010	0,1635	0,012347
Abiotic depletion, fossil fuels	MJ	2013	0,0310	0,002575
Acidification	Mol H+ eq	0,63	0,0113	0,000703
Eutrophication	kg PO_4^{--} eq	0,06	0,0397	0,001113
Global warming	kg CO_2 eq	215	0,0266	0,005599
Ozone layer depletion	kg CFC-11 eq	0,0000023	0,0000	0,000003
Photochemical oxidation	kg NMVOC	0,24	0,0059	0,000280
Water scarcity	m^3 eq	14	0,0012	0,000103

Table 1 - Characterized, normalized, and weighted results for 1 m^3 of silo. Weighted results are measured in points.

The impacts are primarily from the use of galvanized steel as a raw material. The galvanized steel accounts for 94% of total impacts on global warming potential. The production process accounts for less than 2% of total impacts. The remaining impacts come from transportation of materials, and raw materials for e.g. the nuts and bolts used in assembly, or the packaging.

The inclusion of a motor, piping, and extra metallic parts for feeding has an influence on the total results. Especially on the *Abiotic depletion of elements* due to the use of scarce metals. The weighted results increase by 44% when the additional parts are added. When adding the additional parts, global warming only increases by 4%.

The characterized LCA results for a 10 m^3 representative silo variant with or without motor and pipes are summarized in the table below.

Impact category	Unit	Impacts	
		Basic silo	Silo with motor and pipes
Abiotic depletion, elements	kg Sb eq	0,10	0,18
Abiotic depletion, fossil fuels	MJ	20.126	21.224
Acidification	Mol H+ eq	6,3	7,4
Eutrophication	kg PO_4^{--} eq	0,64	1,24
Global warming	kg CO_2 eq	2.153	2.234
Ozone layer depletion	kg CFC-11 eq	0,000023	0,000029
Photochemical oxidation	kg NMVOC	2,4	2,9
Water scarcity	m^3 eq	139	245

Table 2 - Impacts from the 10 m^3 basic silo, and the silo with motor and pipes products. Measured on 8 impact categories.

A significant amount of impacts come from the steel used in the product. Below is an overview of the sources that contribute to the total results as seen in table 1.

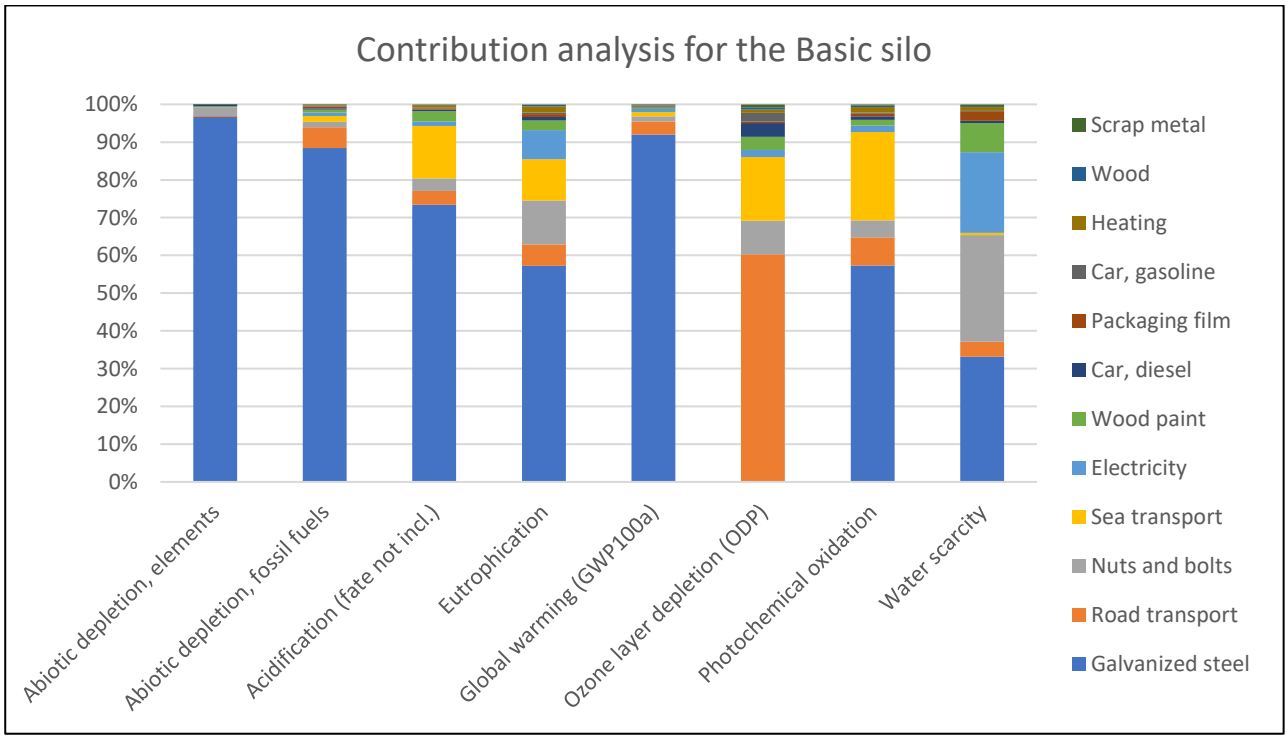

Figure 1 – Contribution analysis of the basic silo, on 8 impact categories.

Comparison with silos in other materials

The results have been weighted, and the weighted scores can be seen below:

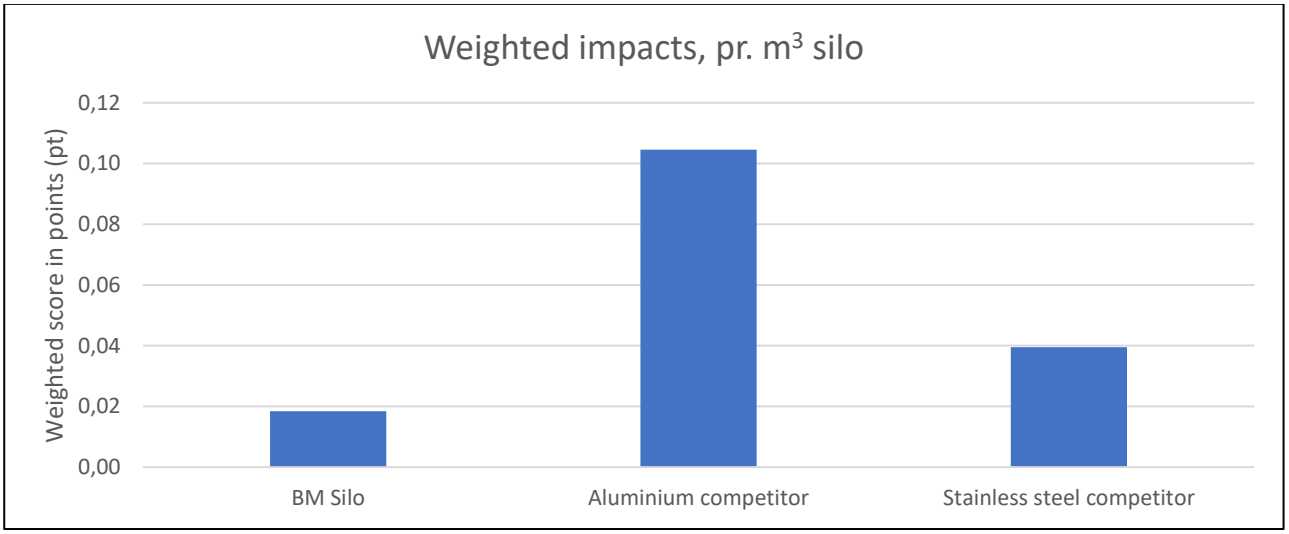

Figure 2 - The weighted impacts of silos made from three materials (modelled with equal production process)

Details behind the comparison:

When comparing BM Silo products with other silos in the market, two other materials are commonly used for silos; Aluminium[1], and stainless steel[2]. The impacts per kg. of material is as follows:

Impacts pr. kg material				
		Galvanized steel	Aluminium	Stainless steel
Abiotic depletion, elements	kg Sb eq	0,000130	0,000018	0,000139
Abiotic depletion, fossil fuels	MJ	23	152	52
Acidification	mol H^+ eq	0,00597	0,139	0,02506
Eutrophication	kg PO^{4---} eq	0,000472	0,0312	0,008197
Global warming	kg CO_2 eq	2,6	14,6	5,0
Ozone layer depletion	kg CFC-11 eq	0	0,000000487	0,000000211
Photochemical oxidation	kg NMVOC	0,0018	0,067	0,0177
Water scarcity	m^3 eq	0,060	12,1	2,279

Table 3 – Environmental impacts per kg. of material - galvanized steel, aluminium, and stainless steel.

To illustrate BM Silos performance compared to other silos, the material volume to production of silo based on aluminium and stainless steel, has been modelled.

- BM Silo/Galvanized steel silo: 69 kg/m^3 (average from 12 m^3)
- Aluminium silo: 71 kg pr. m^3 (average from 12 m^3 silo)
- Stainless steel silo: 69 kg/m^3 (similar to BM silo)

[1] aluminium, ingot, primary, import from Africa | aluminium, primary, ingot | Cutoff, S
[2] steel production, chromium steel 18/8, hot rolled | steel, chromium steel 18/8, hot rolled | Cutoff, S

The results are summarized in the table below.

Impacts pr. m^3 silo				
		BM silo	Aluminium silo	Stainless Steel silo
Abiotic depletion, elements	kg Sb eq	0,00892	0,00125	0,00962
Abiotic depletion, fossil fuels	MJ	1.579	10.888	3.616
Acidification	mol H^+ eq	0,41	9,91	1,73
Eutrophication	kg PO_4^{--} eq	0,032	2,228	0,566
Global warming	kg CO_2 eq	176	1.046	348
Ozone layer depletion	kg CFC-11 eq	0	0,0000348	0,0000146
Photochemical oxidation	kg NMVOC	0,12	4,72	1,22
Water scarcity	m^3 eq	4	863	157

Table 4 – The impact from 1 m^3 of silo from cradle to gate for BM silo, a generic aluminium competitor, and a generic stainless steel competitor.