5. MASONRY UNITS COMPARISION

Embodied Carbon Potentials of Masonry Units

Below is the chart which represents the Masonry material units in "$KgCO_2eq$" per ton.

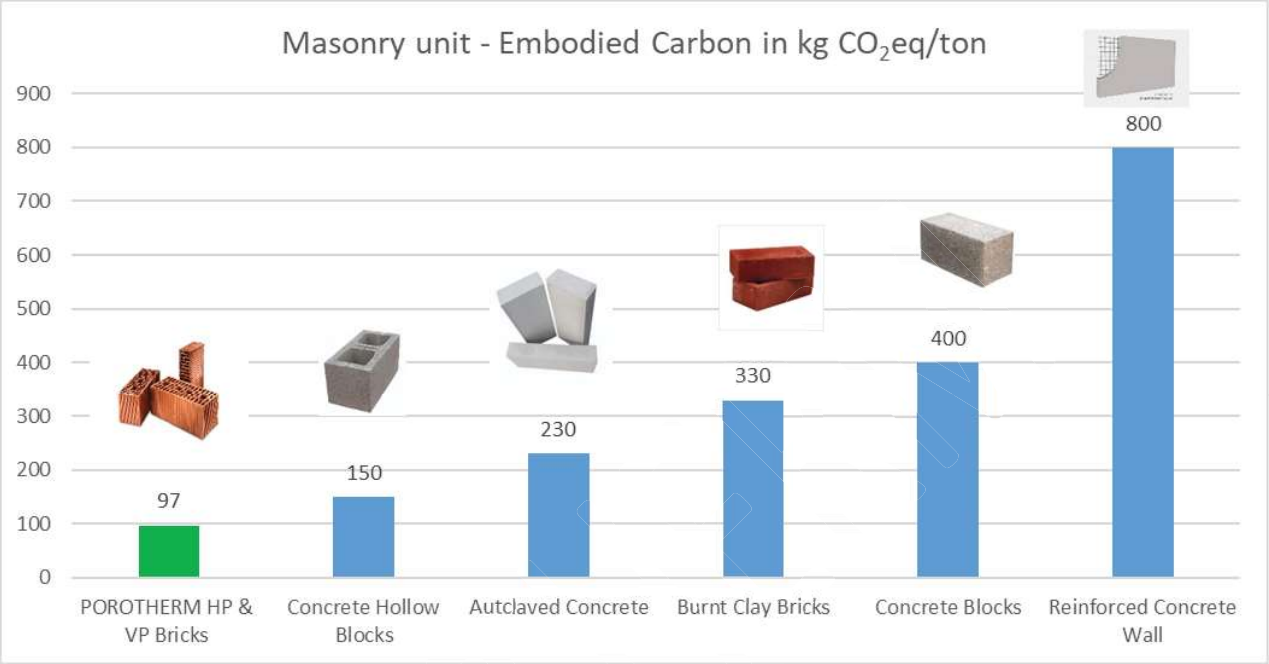

Figure 5: Comparison of masonry material in "KgCO2eq. per ton".

Source:

1. *Sustainability of Building Materials: Embodied Energy and Embodied Carbon of Masonry - Francesco Asdrubali, et al.*
2. *Environmental Impact and Cost Comparison of Different partition wall - Emmanuel M. Atienza et, al.*
3. *Green House Gas Emissions Comparison - CSEB technology (Pg10). https://www.buildupnepal.com/wp-content/uploads/2022/08/co2-reports-merged-max.pdf.*

6. REFERENCES

Standards and PCR

ISO 14025:2010 Environmental labels and declarations – Type III environmental declarations Principles and procedures.

ISO 14040:2006 Environmental management. Life cycle assessment. Principles and frameworks.

ISO 14044:2006 Environmental management. Life cycle assessment. Requirements and guidelines.

EN 15804+A2 Sustainability in construction works – Environmental product declarations – Core rules for the product category of construction products.

EPD International (2021). General Programme Instructions of the international EPD® system. Version 4.0. www.environdec.com.

ANNEX 1: CHARACTERIZATION METHODS

The study does not consider long-term emissions (i.e., over 100 years). Characterization factors CML-IA version 4.1 have been used throughout the study. Parameters used in the study are presented in the tables below.

Table : Parameters describing environmental impacts (NS-EN15804 2012)

Impact Category	Parameter	Unit (expressed per functional unit or per declared unit)
Global Warming	Global warming potential GWP	kg CO_2- equiv 100 yr
Ozone Depletion	Depletion potential of the stratospheric ozone layer ODP	kg CFC_{-11}- equiv 20 yr
Acidification for soil and water	Acidification potential of soil and water AP	kg SO_2 - equiv
Eutrophication	Eutrophication potential EP	kg PO_4 - equiv
Photochemical ozone creation	Formation potential of tropospheric ozone POCP	kg C_4H_4- equiv
The abiotic depletion potential is calculated and declared in two different indicators: • ADP-elements (kg Sb equiv): include all non-renewable abiotic material resources (i.e. excepting fossil resources) • ADP-fossil fuels (MJ net calorific value): include all fossil resources		

Table: Parameters describing environmental impacts (EN 15804: 2012 +A2: 2019)

Impact category	Indicator	Unit (expressed per functional unit or per declared unit)
Climate change – total [a]	Global Warming Potential total (GWP-total)	kg CO_2 eq.
Climate change - fossil	Global Warming Potential fossil fuels (GWP-fossil)	kg CO_2 eq.
Climate change - biogenic	Global Warming Potential biogenic (GWP-biogenic)	kg CO_2 eq.
Climate change - land use and land use change [b]	Global Warming Potential land use and land use change (GWP-luluc)	kg CO_2 eq.
Ozone Depletion	Depletion potential of the stratospheric ozone layer (ODP)	kg CFC_{-11} eq.
Acidification	Acidification potential Accumulated Exceedance (AP)	mol H^+ eq.
Eutrophication aquatic freshwater*	Eutrophication potential fraction of nutrients reaching freshwater end compartment (EP-freshwater)	kg P eq.

Impact category	Indicator	Unit (expressed per functional unit or per declared unit)
Eutrophication aquatic marine	Eutrophication potential fraction of nutrients reaching marine end compartment (EP-marine)	kg N eq.
Eutrophication terrestrial	Eutrophication potential Accumulated Exceedance (EP-terrestrial)	mol N eq.
Photochemical ozone formation	Formation potential of tropospheric ozone (POFP)	kg NMVOC eq.
Depletion of abiotic resources - minerals and metals [c d]	Abiotic depletion potential for non-fossil resources (ADP minerals &metals)	kg Sb eq.
Depletion of abiotic resources - fossil fuels [c]	Abiotic depletion for fossil resources potential (ADP-fossil)	MJ net calorific value
Water use	Water (user) deprivation potential deprivation-weighted water consumption (WDP)	m^3 world eq. deprived

a The total global warming potential (GWP-total) is the sum of
— GWP-fossil
— GWP-biogenic
— GWP-luluc
b It is permitted to omit GWP-luluc as separate information if its contribution is < 5 % of GWP-total over the
declared modules excluding module D.
c The abiotic depletion potential is calculated and declared in two different indicators:
— ADP-minerals&metals include all non-renewable abiotic material resources (i.e. excepting fossil resources);
— ADP-fossil include all fossil resources and includes uranium.
d ultimate reserve model of the ADP-minerals&metals model

Table: Parameters describing additional environmental impacts (EN 15804: 2012 +A2: 2019)

Impact category	Indicator	Unit (expressed per functional unit or per declared unit)
Particulate Matter	Potential incidence of disease due to PM emissions (PM)	Disease incidence
Ionizing radiation human health	Potential Human exposure efficiency relative to U235 (IRP)	kBq U235 eq.
Eco-toxicity (freshwater)	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	CTUe
Human toxicity cancer effects	Potential Comparative Toxic Unit for humans (HTP-c)	CTUh
Human toxicity non-cancer effects	Potential Comparative Toxic Unit for humans (HTP-nc)	CTUh

Land use related impacts/ Soil quality	Potential soil quality index (SQP)	dimensionless

Table: Parameters describing resource use

Parameter	Unit (expressed per functional unit or per declared unit)
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ net calorific value
Use of renewable primary energy resources used as raw materials	MJ net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as materials)	MJ net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ net calorific value
Use of non-renewable primary energy resources used as raw materials	MJ net calorific value
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as materials)	MJ net calorific value
Use of secondary material	kg
Use of renewable secondary fuels	MJ net calorific value
Use of non-renewable secondary fuels	MJ net calorific value
Net use of fresh water	m^3

Table: Other environmental information describing waste categories

Parameter	Unit (expressed per functional unit or per declared unit)
Hazardous waste disposed*	kg
Non-hazardous waste disposed	kg
Radioactive waste disposed	kg
Components for re-use	kg
Materials for	kg
Materials for energy recovery	kg
Exported energy	MJ per energy carrier

*The characteristics that render waste hazardous are described in existing applicable legislation, e.g., in the European Waste Framework Directive.

The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

Table: Parameters describing environmental impacts (TRACI 2.1)

Impact Category	Indicator	Unit (expressed per functional unit or per declared unit)
Global warming potential	GWP 100: Global Warming Potential	kg CO_2e
Ozone depletion	ODP: Ozone Depletion Potential	kg CFC_{-11}e
Photochemical Smog	SFP: Smog Formation Potential	kg O_3e
Acidification	AP: Acidification Potential	kg SO_2e
Eutrophication	EP: Eutrophication Potential	kg Ne
Depletion of non-renewable energy	ADPfossil: Abiotic Resource Depletion Potential of Non-renewable (fossil) energy	MJ

Table. Mass balance for product stage

Raw material category	Value	Unit
Inputs	1.03E+03	kg
Outputs	1.03E+03	kg
Mass balance	9.99E+01	%

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