

LOW-CARBON BUILDING METHOD v4

Appendix C

Last updated: Feb. 23, 2017

NOTES

1. This Appendix is part of the Low-Carbon Building Method v4 (the Method). The data in this Appendix shall be used as indicated in the Method (www.lcbmethod.com).
2. This Appendix will be updated regularly as new data become available. Users shall use the latest version of this Appendix at the time of the assessment.

ABOUT DATA IN THIS APPENDIX

EFmat:

1. The emission factors (EFmat) given for the materials listed in this appendix are believed to be “representative” of the cradle-to-gate emission factors of these materials. These emission factors have been extracted from various resources in the public domain (LCA, books, etc.). When available, sources of data without geographical restrictions and appropriate boundaries (cradle-to-gate) have been preferred. For information, a confidence level (High, Medium, Low) is indicated next to each emission factor.
2. The emission factors in this Appendix do not include carbon storage and carbon offsets. Carbon storage and carbon offsets shall be accounted for as explained in the Method.
3. The emission factors given for wood materials do not detail the emissions from fossil and biogenic origins. Whenever possible, Users shall contact their suppliers to get this information and assess if the CO₂ emissions from biogenic origin can be excluded (PAS 2050, 5.5).
4. For a few materials, only emission factors in kgCO₂ were provided in the resources consulted (emission factors in italic type). These emission factors have been scaled up by 6% to be “converted” into kgCO_{2e}¹. They will be replaced by emission factors in kgCO_{2e} when such data will be available.
5. The emission factors in this Appendix are classified by CSI numbers (CSI Master Format 2011) and GHG emission intensities. When selecting materials, Users shall consider that the materials with the lowest cradle-to-gate emission factors do not necessary have the lowest climate impact over their life cycle (the climate impact of a material depends of a multitude of factors: quantity used, service life, carbon storage, etc.).

Li:

1. The service life values (Li) in this Appendix are for materials under “normal” maintenance in a “non-aggressive” environment. They should be modified appropriately if these are not the

¹ Hammond G, Jones C. 2011. Inventory of Carbon & Energy (ICE) 2.0 (note at the end of the Summary Table).

conditions of the project. These Li values also do not take into account materials obsolescence due to consumers changing tastes and preferences.

2. In the Li column, “Life” means that the material is not expected to be replaced during the entire lifetime of the building. “Varies” means that the material is a “generic” material (e.g., concrete) and that its expected service life depends on how and where it is used.
3. Li values in this Appendix have been rounded.

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CSI#	MATERIAL	EMISSION FACTOR				SERVICE LIFE
		Unit	EFmat, i	Ref.	Conf.	Li
		kgCO2e/kg material unless indicated otherwise				Year(s)
030000	CONCRETE					
030000	Fly ash		0.004	(36)	H	varies
030000	Slag (GGBS)		0.052	(36)	H	varies
030000	Concrete admixture		0.580	(34)	H	varies
032000	CONCRETE REINFORCING					
032000	Rebar		1.400	(1)	H	varies
033000	CAST-IN-PLACE CONCRETE (NO REINF.)					
033000	Concrete (20 Mpa)		0.091	(2)	H	varies
033000	Concrete (general)		0.103	(3)	H	varies
033000	Concrete (25 Mpa)		0.110	(2)	H	varies
033000	Concrete (35 Mpa)		0.132	(2)	H	varies

CSI#	MATERIAL	EMISSION FACTOR				SERVICE LIFE
		Unit	EFmat, i	Ref.	Conf.	Li
		kgCO2e/kg material unless indicated otherwise				Year(s)
033000	Cement (Portland)		0.930	(4)	H	varies
034000	PRECAST CONCRETE					
034000	Precast concrete		0.170	(5)	H	varies
034000	Fiber-reinforced concrete		0.480	(1)	L	varies
040513	MASONRY MORTARING					
040513	Mortar		0.160	est.	H	varies
040513	Lime		0.780	(1)	M	varies
042000	UNIT MASONRY					
042000	Adobe brick		0.025	(6)	M	life
042000	Compressed earth block		0.030	(6)	M	life
042000	Concrete block		0.086	(2)	H	life
042000	Clay brick		0.240	(1)	H	life
042000	Autoclaved aerated block (AAC)		0.460	(7)	L	life
042000	Glass block		no data			life
044000	STONE ASSEMBLIES					
044000	Stone (dry-placed)		0.002	(1)	H	life
044000	Stone (dimension)		0.095	(8)	H	life
050000	METALS (PRODUCTS)					
050000	Steel (recycled)		0.470	(1)	H	varies
050000	Steel (general)		1.460	(1)	H	varies
050000	Lead		1.670	(1)	H	varies
050000	Aluminum (recycled)		1.810	(1)	H	varies
050000	Iron		2.030	(1)	M	varies

CSI#	MATERIAL	EMISSION FACTOR				SERVICE LIFE
		Unit	EFmat, i	Ref.	Conf.	Li
		kgCO2e/kg material unless indicated otherwise				Year(s)
050000	Brass		2.640	(1)	M	varies
050000	Copper		2.710	(1)	H	varies
050000	Steel (virgin)		2.890	(1)	H	varies
050000	Zinc		3.090	(1)	H	varies
050000	Bronze		4.000	(1)	M	varies
050000	Aluminum (general)		9.160	(1)	H	varies
050000	Aluminum (virgin)		12.790	(1)	H	varies
050000	Nickel		13.100	(1)		varies
050000	Tin		14.470	(1)	M	varies
061000	ROUGH CARPENTRY					
061000	Log		0.020	(9)	M	life
061000	Bamboo (culm)		0.085	(10)	M	life
061000	Softwood lumber		0.577	(9)	H	life
061000	Glulam		0.870	(1)	H	life
061000	Hardwood lumber		0.874	(9)	H	life
062000	FINISH CARPENTRY					
062000	MDF		0.740	(1)	M	30
062000	Particleboard		0.840	(11)	M	30
062000	OSB		0.990	(1)	M	30
062000	Hardboard		1.090	(1)	H	30
062000	Plywood		1.100	(1)	H	30
064000	ARCHITECTURAL WOODWORK					
064000	Bamboo panel		1.200	(39)	H	30

CSI#	MATERIAL	EMISSION FACTOR				SERVICE LIFE
		Unit	EFmat, i	Ref.	Conf.	Li
		kgCO2e/kg material unless indicated otherwise				Year(s)
066000	PLASTIC FABRICATIONS					
066000	Plastic (general)		3.310	(1)	H	varies
071000	DAMPPROOFING AND WATERPROOFING					
071000	Bitumen		0.500	(1)	L	15
071000	Dampproof membrane		4.500	(1)	L	life
072000	THERMAL PROTECTION					
072000	Straw (baled)		0.020	(6)	M	60
072000	Perlite, Vermiculite (natural)		0.030	(1)		60
072000	Cellulose (loose fill)		0.302	(12)	H	60
072000	Clay pellets (expanded)		0.350	(13)	L	60
072000	Perlite, Vermiculite (expanded)		0.500	(13)	L	60
072000	Wood wool (loose fill)		0.600	(13)	L	60
072000	Cork		0.600	(13)	L	60
072000	Paper wool		0.635	(14)	H	60
072000	Rockwool		1.225	(1)	H	60
072000	Hemp		1.230	(15)	M	60
072000	Recycled textiles		1.350	(13), (16)	M	60
072000	Fiberglass		1.430	(1)	H	60
072000	Wood wool		1.450	(13)	L	60
072000	Sheep wool		1.600	(15)	M	60
072000	Flax/Linen		1.855	(14)	H	60
072000	EPS polystyrene		3.290	(1)	H	60

CSI#	MATERIAL	EMISSION FACTOR				SERVICE LIFE
		Unit	EFmat, i	Ref.	Conf.	Li
		kgCO2e/kg material unless indicated otherwise				Year(s)
072000	XPS polystyrene		3.420	(1)	H	60
072000	Polyurethane		4.260	(1)	H	60
072000	Cellular glass		no data			60
072500	WEATHER BARRIERS					
072500	Vapor barrier		2.400	(12)	H	60
073000	STEEP SLOPE ROOFING					
073000	Thatch		0.020	est.	L	30
073000	Slate (natural)		0.035	(1)	H	80
073000	Concrete tile		0.121	(37)	H	50
073000	Asphalt shingle (glass shingle)		0.134	(37)	H	20
073000	Asphalt shingle (felt shingle)		0.176	(37)	H	20
073000	Mineral surface roll		0.179	(37)	H	20
073000	Wood shingle		0.300	(1)	H	35
073000	Clay tile		0.461	(37)	H	60
073000	Saturated felt (#30 felt)		0.508	(37)	H	20
073000	Saturated felt (#15 felt)		0.511	(37)	H	20
073000	Plastic/Synthetic shingle		no data			20
073000	Metal shingle		no data			40
074000	ROOFING AND SIDING PANELS					
074000	Wood siding		0.234	(17)	H	35
074000	Fiber cement siding (panel)		1.150	(18)	M	50
074000	Vinyl siding		1.825	(12)	H	25
074000	Steel sheet		2.400	(17)	H	35

CSI#	MATERIAL	EMISSION FACTOR				SERVICE LIFE
		Unit	EFmat, i	Ref.	Conf.	Li
		kgCO2e/kg material unless indicated otherwise				Year(s)
074000	Copper sheet		2.710	(1)	M	85
074000	Aluminum sheet		9.180	(1)	H	35
074000	Lead sheet		no data			85
074000	Zinc sheet		no data			85
075000	MEMBRANE ROOFING					
075000	SBS membrane		0.823	(19)	H	20
075000	PVC membrane		2.532	(19)	H	20
075000	EPDM membrane		5.472	(19)	H	20
077000	ROOF AND WALL SPECIALITIES [...]					
077000	PVC gutter and downspout		2.240	(20)	H	25
077000	Aluminum gutter and downspout		9.180	(1)	L	35
078200	BOARD FIREPROOFING					
078200	Calcium-silicate board		0.140	(13)	L	50
079000	JOINT PROTECTION					
079000	Mastic sealant		8.750	est.	L	10
081000	DOORS AND FRAMES					
081000	Door (unsp.)	kgCO2e/m2	35.000	est.	L	30
085000	WINDOWS					
085000	Double window (unsp.)	kgCO2/m2	16.750	(12)	H	35
088000	GLAZING					
088000	Glass		0.740	(21)	H	35 (glazing)
088000	Toughened glass		1.350	(1)	M	35 (glazing)
092000	PLASTER AND GYPSUM BOARD					

CSI#	MATERIAL	EMISSION FACTOR				SERVICE LIFE
		Unit	EFmat, i	Ref.	Conf.	Li
		kgCO2e/kg material unless indicated otherwise				Year(s)
092000	Loam plaster		0.020	(13)	L	10 (ext.)
092000	Gypsum plaster		0.130	(1)	M	50
092000	Cement plaster (stucco)		0.210	est.	H	50
092000	Plasterboard		0.250	(22)	M	50
093000	TILING					
093000	Stone tile (marble)		0.150	(23)	M	50
093000	Clay tile		0.480	(1)	H	50
093000	Ceramic tile		0.500	(23)	M	50
095000	CEILINGS					
095000	Mineral fiber tile		2.900	(1)		25
096000	FLOORING					
096000	Terrazzo tile		0.130	(1)		50
096000	Wood parquet		0.913	(9)	H	50
096000	Bamboo flooring		1.200	(38)	H	25
096000	Linoleum flooring		1.210	(1)	M	20
096000	Laminate flooring		1.420	(24)	M	20
096000	Rubber tile		2.900	(25)	M	20
096000	Vinyl tile		3.190	(1)	H	20
096000	Wool carpet		5.860	(1)	M	20
096000	Epoxy resin		6.000	(26)	H	15
096000	Nylon carpet		6.000	(27)	M	10
097000	WALL FINISHES					
097000	Wallpaper		2.000	(1)	M	10

CSI#	MATERIAL	EMISSION FACTOR				SERVICE LIFE
		Unit	EFmat, i	Ref.	Conf.	Li
		kgCO2e/kg material unless indicated otherwise				Year(s)
099000	PAINTING AND COATING					
099000	Varnish (oil-borne)		2.579	(28)	L	15
099000	Paint (water-borne)		3.052	(28)	H	15
099000	Paint (oil-borne)		3.910	(28)	H	15
120000	FURNISHING					
120000	Furniture (general)	kgCO2/US\$*	0.180	(29)	H	20 (res.), 10 (com.)
122200	CURTAINS AND DRAPES					
122200	Cotton fabric		6.860	(35)	H	10
133500	RAMMED EARTH CONSTRUCTION					
133500	Rammed earth (not stabilized)		0.005	(31)	H	life
133500	Rammed earth (cement stabilized, 5%)		0.050	(4), (31)	H	life
133500	Rammed earth (cement stabilized, 10%)		0.095	(4), (31)	H	life
133500	Rammed earth (cement stabilized, 15%)		0.145	(4), (31)	H	life
210000	FIRE SUPPRESSION					
210000	Fire suppression system	kgCO2/US\$*	0.070	(29)	H	25
221000	PLUMBING PIPING					
221000	Concrete pipe		0.160	(5)	H	75
221000	Cast iron pipe		2.030	(1)	L	75
221100	Copper pipe		1.940	(30)	H	75
221100	PVC pipe		2.240	(20)	H	75

CSI#	MATERIAL	EMISSION FACTOR				SERVICE LIFE
		Unit	EFmat, i	Ref.	Conf.	Li
		kgCO2e/kg material unless indicated otherwise				Year(s)
224000	PLUMBING FIXTURES					
224000	Ceramic sanitary product		1.610	(1)	M	50
230000	HVAC					
230000	HVAC equipments	kgCO2/US\$*	0.125	(29)	H	20
260000	ELECTRICAL					
260000	Electrical equipments	kgCO2/US\$*	0.130	(29)	H	20
263100	PHOTOVOLTAIC COLLECTORS					
263100	Thin film amorphous silicon	kgCO2/m2	67.000	(1)	M	15
263100	Cristalline silicon	kgCO2/m2	225.000	(1)	M	25
310000	EARTHWORK					
310000	Aggregates (sand, gravels, crushed stones)		0.004	(31)	H	life
321000	BASE, BALLAST, AND PAVING					
321000	Asphalt concrete (cold method)		0.016	(32)	H	25
321000	Asphalt concrete (hot method)		0.043	(32)	H	25
321000	<u>Wood decking</u>		0.577	(9)	H	20
32100	Bamboo decking		1.670	(38)	H	20
321000	<u>Wood-plastic composite decking</u>		no data			30
OTH	OTHER					
OTH	Water	kgCO2e/m3	0.340	(33)	M	NA
OTH	Concrete mixing (at mixing plant)	kgCO2e/m3	2.700	(2), (3)	M	NA

NA: Not applicable

* The following default weight/US\$ ratio can be used for M&E equipments:

Furniture: 0.15 kg/US\$; Fire suppression system, HVAC equipments, electrical equipments: 0.10 kg/US\$

Source: [U.S. DoT/U.S. DoC] U.S. Department of Transport/U.S. Department of Commerce. 2010. 2007 Economic Census, Transportation, 2007 Commodity Flow Survey.

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[End of Appendix]