

Result reporting for LEED v4 MRc1 Building Life-Cycle Impact Reduction, Option 4

Life cycle assessment results for achieving credits for LEED v4 MRc1 Building Life-cycle Impact reduction credit and its option 4: Whole building impact assessment.



Figure 1 – Elementary/Middle School in Pesaro (Italy)

Elementary/Middle School

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1. Life cycle impact assessment result summary

The life cycle assessment was calculated using One Click LCA. The results are summarized in following table. The results represent the total life cycle impact during 60 years service life.

Impact category	Unit	Baseline result	Proposed design result	Reduction, %
Global warming potential (greenhouse gases)	kgCO ₂ eq	1,599,179.16	1,409,832.45	-11.84 %
Depletion of the stratospheric ozone layer	kgCFC-11 eq	0.08	0.03	-62.5 %
Acidification of land and water sources	kgSO ₂ eq	5,156.17	3,558.35	-30.99 %
Eutrophication	PO ₄ ³ eq	657.43	500.62	-23.85 %
Formation of tropospheric ozone (photochemical oxidant formation)	C ₂ H ₄ eq	565.57	560.44	-0.91 %
Depletion of non-renewable energy resources	MJ	19,507,663.63	15,697,852.43	-19.53 %

Number of environmental impact categories with more than 10 % reduction:

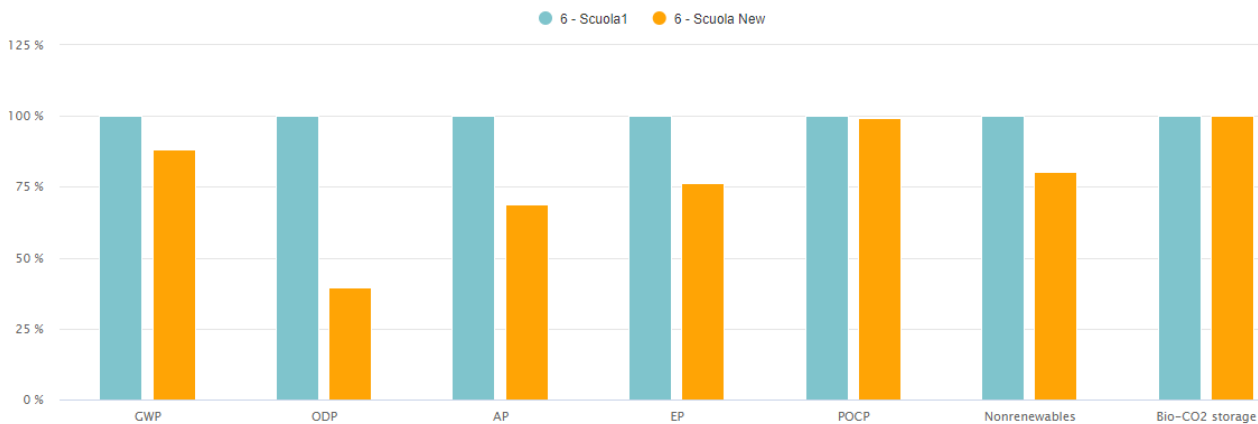


Figure 2 - Summary graph of results comparing the baseline building (Scuola1) to proposed building (Scuola New)

2. The life cycle assessment scope and service life

One Click LCA tool was used to model both baseline and proposed building.

In the assessment following life cycle stages according to EN 15804 (2012) were included:

- A1-A3 Construction Materials;
- A4 Transportation to site;
- B4-B5 Maintenance and material replacements;
- C1-C4 Deconstruction;

Building service life was estimated to be 60 years which is fixed in the tool settings.

3. Description of the datasets

One Click LCA calculation tool was used for the analysis. All of the datasets in the tool follow ISO14044 standard.

The One Click LCA LEED LCA tool for European/International markets was used in the assessment. The tool supports CML methodology and all required IMPACT categories.

Special note for CML: Depletion of non-renewable energy resources — for CML, Full Reference Guide specifies “weight or volume of raw material”, and separately: for the purposes of complying with this credit, depletion means “the amount used”. One Click LCA implements in the LCA for LEED (CML) application in the impact category “Depletion of non-renewable energy (MJ)”, which is the one required to be reported by the LEED v4’s dynamic PDF forms.

4. Analysis material scope

The material scope in was the same in both baseline and proposed design. The LCA analysis included following building elements:

Element	Included
Standard foundations	Yes
Special foundations	Yes
Slab on Grade	Yes
Basement excavation	No
Basement Walls	Yes
Columns	No
Beams	No
Floor Construction	Yes
Floor / Ceiling Finishes	Yes
Roof Construction	Yes
Exterior and Semi-exterior Walls from cladding to finishing	Yes
Exterior Windows	Yes
Exterior Doors	Yes
Roof Coverings	Yes
Roof Openings	Yes
Load-Bearing partitions	No
Other Partitions	No
Interior Doors	Yes
Fittings	No
Stair Construction	Yes
Stair Finishes	Yes
Wall finishes	Yes
Parking structures	No
Parking lots	No

As per LEED v4 specification following elements were excluded from the analysis: electrical and mechanical equipment and controls, plumbing fixtures, fire detection and alarm system fixtures, elevators, and conveying systems, excavation and other site development, parking lots.

5. Description of Baseline building

The baseline building was created based on the proposed building design to ensure the equivalence of the proposed design and baseline in all required aspects including same area, location, function, energy performance, and directional

exposure. The baseline building was created by Autodesk Revit software, changing the material definitions within One Click LCA tool.

Before proceeding with the analysis it is necessary to update the Revit model by assigning the correct stratigraphies to the walls, floors, roofs and windows so that the One Click LCA program can subsequently recognize the materials that make up the structure.

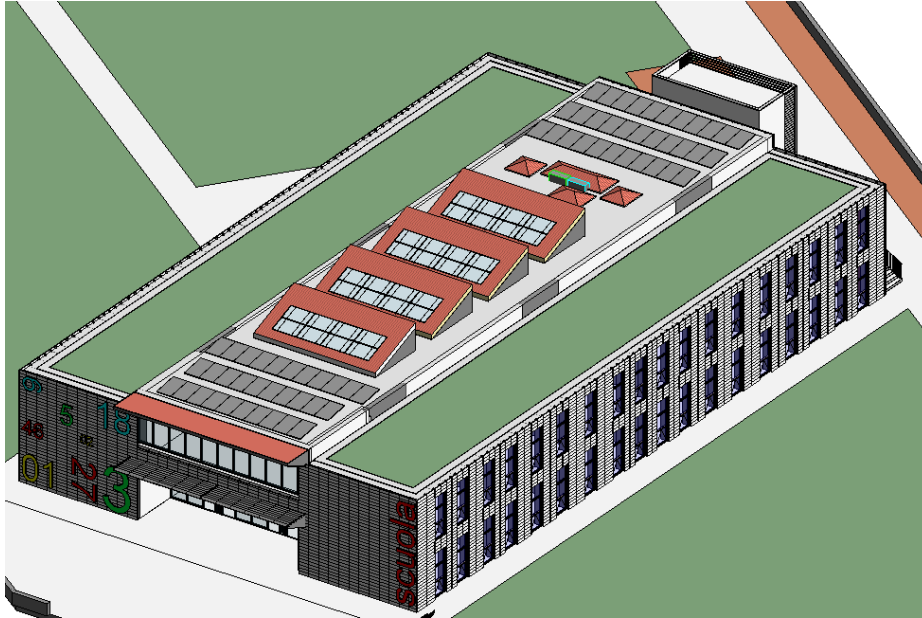


Figure 3 - Revit school model

The project has been defined within the software One Click LCA by assigning the name and typology (school).

Menu principale > Nuovo progetto (Building)

Nuovo progetto

Si prega di fornire almeno le informazioni evidenziate come obbligatorie per procedere. Quindi fare clic su Salva.

Nome (obbligatorio)
Scuola via Lamarmora Pesaro

Tipo (obbligatorio)
Se l'edificio ha diverse tipologie, scegliere la più appropriata
Schools (primary education)

Nazione (obbligatorio)
Italy

Indirizzo
via Lamarmora

Superficie lorda (m²)
m²

Numero di piani fuori terra
2

Frame type
If not new construction, please choose 'Existing frame/Not applicable'. If you will evaluate several different frame types you can choose 'Not determined'.
Concrete frame

Figure 4 - Definition of the project into One Click LCA

Certificazioni richieste

Inizia a comporre o fai click sulla freccia ▼

Risorsa Livello di riferimento

LEED v4 BD+C ? Platinum Modifica ▼

Figure 5 - Settings for the LEED Certification

To allow One Click LCA and Revit integration, materials must be imported from Revit into One Click LCA, so it is necessary to create a model within the project just defined, which will be the 'baseline model'. Once the model is created, materials will have to be mapped step by step before the end of the calculation.

✓ DATA ✓ SETTINGS DATAPOINTS: 7989 ✓ CLASSIFY ✓ FILTRO DATAPOINTS: 7958 ✓ COMBINAZIONE DATAPOINTS: 95 ✓ REVIEW DATAPOINTS: 95 **MAPPATURA**

MAPPATURA Risultati Annulla Scarica Exel Salva mappatura Continua

Material Country Data source Type Upstream CO2e Unit Properties Cancell

Filtro: Filtro: Filtro: Filtro: Filtro: Filtro: Filtro: Filtro:

Dati importati					Mappa i dati per		
Materiale	Classe	Commento	Quantità	Quota	Risorse di riferimento	Decidi in seguito	
laterizio (3)	SLAB	Laterizio (3), 5 rows	1544 m3	23,31 %	Scegli la mappatura	?	Cancella
massetto con fluidificante e fibre sinte	SLAB	Massetto con fluidificante e 1	296 m3	4,47 %	Scegli la mappatura	?	Cancella
pannello lana di roccia copertura	SLAB	Pannello lana di roccia cope	154 m3	2,33 %	Scegli la mappatura	?	Cancella
pannello lana di roccia copertura	SLAB		90 m3	1,36 %	Scegli la mappatura	?	Cancella

Figure 6 - Data mapping

Most of the materials assigned in the baseline model are 'generic' (without EPD). However, in cases where generic characteristics could not be assigned, specific materials of the proposed model have been attributed. In this way it is possible to observe the improvements in terms of environmental emissions by subsequently using the materials with EPD in the proposed model.

In the previous step the construction materials were defined, at this point it is necessary to define the 'building area' which is the denominator of calculation results.

It has been chosen as the building area the 'Gross Internal Floor Area' which is the area of a building measured to the internal face of the perimeter walls at each floor level. In this project the Gross Internal Floor Area is 2432 m²

1. Definizione dell'area

Area di costruzione (obbligatorio) [Confronta le risposte](#)

Si prega di fornire sempre l'area interna lorda del pavimento per otte definizioni nazionali dell'area. L'uso di definizioni nazionali aggiuntiv

Inizia a comporre o fai click sulla freccia ▼

Risorsa Quantità

Gross Internal Floor Area (IPMS/RIC ? 2432 m2

Figure 7 - Gross Internal Floor Area

At this point it is possible to obtain the final results of the whole-building Life Cycle Assessment for the baseline model.

6. Description of Proposed building

The proposed model has been calculated by copying in One Click LCA the basic model, based on the Revit model, previously updated with the correct stratigraphies. In this way, all required aspects including area, location, function, energy performance and directional exposure of the baseline model and the proposed model are the same.

The steps followed for the definition of the proposed model are the same as the baseline model up to the mapping phase of the materials.

During the mapping of the materials, some of the generic materials of the baseline model were changed to specific materials, actually used in the construction phase, of which the manufacturer provided the EPD.

It should be specified that some building component materials are not taken into account by the software in the calculation as an irrelevant percentage compared to the rest of the materials.

Below is the list of all the specific materials used in the proposed model:

Material Description	Description of Product	Manufacturer Name
Steel for concrete	Reinforcing steel bars	Ferriera-Valsabbia
Thixotropic mortar	Planitop Rasa e Ripara	Mapei
High flow cementitious anchoring	Mapefill	Mapei
Roof thermal insulation	Smartroof Thermal	Knauf Insulation
Ceiling acoustic and thermal insulation	Celenit AB	Celenit Isolanti Naturali
Drywall	Wallboard 13	Gyproc Saint-Gobain
Glasswool insulation	G3	Isover Saint-Gobain
Drywall activ air	DuraGyp 13 Activ Air	Gyproc Saint-Gobain
Fire resistant drywall	Fireline 13	Gyproc Saint-Gobain
Waterproofing mortar	Mapelastic	Mapei
Glass	Stratophone	AGC
Gres tile 60x60 and 30x60 STUDIO serie	STUDIO gres tile	Marazzi
Acoustic ceiling	Eurocoustic Minerval 12	Eurocoustic Saint-Gobain
Gres tile BOOM serie	BOOM gres tile	Marazzi
Gres tile 15 x190 WOODPASSION serie	WOODPASSION gres tile	Marazzi
Cement grout for flooring	Keracolor FF	Mapei
XPS insulation	Stirodur 2800C	Styrodur

Since the proposed model has been copied from the baseline model and the structure and layers are the same, the building area does not change. The Gross Internal Floor Area therefore remains 2432 m².

At this point the calculation is complete and the results show an improvement in environmental emissions using materials with EPD which are within the improvement percentages required by the LEED protocol.

7. The detailed assessment results

As both baseline design and the proposed design were calculated separately the result tables for both of them are added here separately. Additionally, a comparison table of all of the results is shown.

Results for the baseline design

Whole-building Life Cycle Assessment, ISO 14040 & ISO 14044 (CML 2002; November 2012)

Settore		Global warming kg CO ₂ e ⓘ	Ozone depletion potential kg CFC11e ⓘ	Acidification kg SO ₂ e ⓘ	Eutrophication kg PO ₄ e ⓘ	Formation of ozone of lower atmosphere kg Ethenee ⓘ	Depletion of nonrenewable energy MJ	Biogenic carbon storage kg CO ₂ e bio ⓘ
A1-A3 ⓘ	Construction Materials	1 389 802,27	0,07	4 271,06	515,74	472,93	16 701 845,69	4 089,92
A4 ⓘ	Transportation to site	28 155,26	0	61,38	12,94	3,62	492 026,11	
B1-B5 ⓘ	Maintenance and material replacement	130 947,74	0	653,5	86,04	79,13	1 349 564,16	
C1-C4 ⓘ	End of life	50 273,89	0,01	170,24	42,71	9,89	964 227,67	
Totale		1 599 179,16	0,08	5 156,17	657,43	565,57	19 507 663,63	4 089,92
Risultati per denominatore								
Gross Internal Floor Area (IPMS/RICS) 2432.0 m2		657,56	0	2,12	0,27	0,23	8 021,24	1,68

Figure 8 - Baseline model Result table from One Click LCA

Results for the proposed design and comparison

Whole-building Life Cycle Assessment, ISO 14040 & ISO 14044 (CML 2002; November 2012)

Settore		Global warming kg CO ₂ e ⓘ	Ozone depletion potential kg CFC11e ⓘ	Acidification kg SO ₂ e ⓘ	Eutrophication kg PO ₄ e ⓘ	Formation of ozone of lower atmosphere kg Ethenee ⓘ	Depletion of nonrenewable energy MJ	Biogenic carbon storage kg CO ₂ e bio ⓘ
A1-A3	Construction Materials	1 236 301,13 -11 %	0,02 -71 %	2 886,54 -32 %	386,99 -25 %	477,39 0,9 %	13 335 529,59 -20 %	4 089,92 0 %
A4	Transportation to site	29 200,85 +3,7 %	0,01 +4 %	63,94 +4,2 %	13,42 +3,8 %	3,77 +4,2 %	520 726,85 +5,8 %	
B1-B5	Maintenance and material replacement	101 581,39 -22 %	0 -38 %	449,27 -31 %	63,97 -26 %	70,72 -11 %	953 301,4 -29 %	
C1-C4	End of life	42 749,08 -15 %	0,01 -11 %	158,61 -6,8 %	36,24 -15 %	8,57 -13 %	888 294,6 -7,9 %	
Totale		1 409 832,45	0,03	3 558,35	500,62	560,44	15 697 852,43	4 089,92
Confronta i risultati totali con: 6 - Scuola1								
6 - Scuola1 Totale		1 599 179,16	0,08	5 156,17	657,43	565,57	19 507 663,63	4 089,92
6 - Scuola New confronta con 6 - Scuola1		-12 %	-60 %	-31 %	-24 %	-0,9 %	-20 %	0 %
Risultati per denominatore								
Gross Internal Floor Area (IPMS/RICS) 2432.0 m2		579,7	0	1,46	0,21	0,23	6 454,71	1,68

Figure 9 - Proposed model Result table and comparison table between the baseline model (Scuola1) and the proposed model (Scuola New)

8. Description of One Click LCA calculation tool

The calculations were performed with One Click LCA calculation tool. The software is fully compliant with LEED v4 BD+C manual and "Full Reference Guide LCA text". One Click LCA has been third party verified by ITB for compliancy with the following LCA standards: EN 15978, ISO 21931–1 and ISO 21929, and data requirements of ISO 14040 and EN 15804.

You can find the official letters of compliancy here:

<https://www.oneclicklca.com/wp-content/uploads/2016/11/360optimi-verification-ITB-Certificate-scanned-1.pdf>.

ITB is a certification organization and a Notified Body (EC registration nr. 1488) to the European Commission designated for construction product certification. Polish Accreditation Board assures the independence and impartiality of ITB services (Accreditation Certificates are: AB 023, AC 020, AC 072, AP 113).

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