

8-21-2018

New Neilson Library Life Cycle Assessment Report

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Recommended Citation

Thornton Tomasetti, "New Neilson Library Life Cycle Assessment Report" (2018). Technical Report, Smith College, Northampton, MA.

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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.



Smith College Neilson Library Renovation – New Addition

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Date: August 21, 2018

Contents

1. Life cycle impact assessment result summary	3
2. The life cycle assessment scope and service life	3
3. Description of the datasets	4
4. Analysis material scope	4
5. Description of Baseline building and explanation of equivalence	5
6. Description of Proposed building	6
7. The detailed assessment results	6
8. Description of One Click LCA calculation tool	7

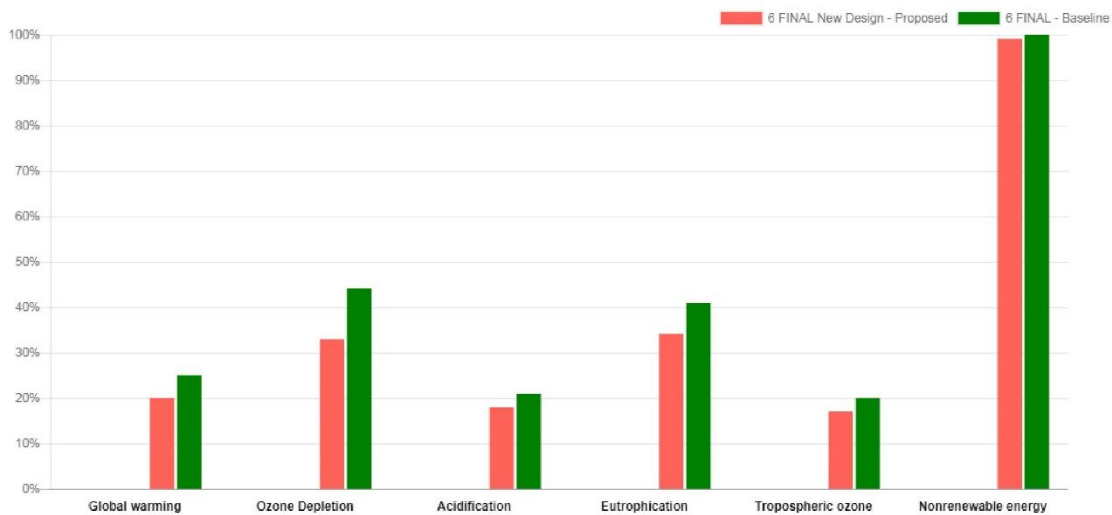
1. Life cycle impact assessment result summary

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 year service life.

Impact category	Unit	Baseline result	Proposed design result	Reduction, %
Global warming potential (greenhouse gases)	kgCO ₂ eq	2,323,833	1,871,694	-19
Depletion of the stratospheric ozone layer	kgCFC-11 eq	11.34	8.58	-24
Acidification of land and water sources	kgSO ₂ eq	9,665	8,159	-16
Eutrophication	N eq	3,425	2,790	-19
Formation of tropospheric ozone(photochemical oxidant formation)	NO _x eq	121,867	106,561	-13
Depletion of non-renewable energy resources	MJ	222,257,884	220,906,463	-0.6

Number of environmental impact categories with more than 10 % reduction: 5

LCA for LEED, US (TRACI)



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
- B1-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 tool LEED LCA tool for North America was used in the assessment. The tool uses US/Canadian data and supports TRACI 2.1 and all required impact categories.

Special note for TRACI: Formation of tropospheric ozone (for TRACI 2.1.) in the Full Reference Guide LCA text refers erroneously to unit “NO_xeq” whereas TRACI 2.1. uses O₃eq (Ozone-equivalent). See United States Environmental Protection Agency: Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI), TRACI version 2.1, Documentation Nr S-10637-CP-2–0. When submitting the credits using the LEED v4’s dynamic PDF forms the user is suggested to choose “NO_x”.

Also, for depletion of nonrenewable energy, the Full Reference Guide LCA text states that for the purposes of complying with this credit, depletion means “the amount used”.

4. Analysis material scope

The material scope in was the same in both baseline and proposed design. Per LEED v4 requirements only the new addition was included in the LCA. The LCA analysis included following building elements:

Element	Included	Comment
Standard foundations	Yes	
Special foundations	Yes	
Slab on Grade	Yes	
Basement excavation	No	
Basement Walls	Yes	
Columns	Yes	
Beams		
Floor Construction	Yes	
Floor / Ceiling Finishes	No	Optional
Roof Construction	Yes	
Exterior and Semi-exterior Walls from cladding to finishing	Yes	Semi-exterior elements separate conditioned space from unconditioned space or that encloses semi-heated space (e.g., attic, crawl space, and basement).
Exterior Windows	Yes	
Exterior Doors	Yes	
Roof Coverings	Yes	
Roof Openings	Yes	
Load-Bearing partitions	Yes	
Other Partitions	No	Optional
Interior Doors	No	Optional
Fittings	No	
Stair Construction	Yes	
Stair Finishes	No	Optional
Wall finishes	Yes	For included walls only
Parking structures	Yes	
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 and explanation of equivalence

The baseline 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 changing the material definitions within One Click LCA tool.

The equivalence in energy performance and exposure conditions was ensured by following aspects:

- All alternative enclosure roof, wall and slab materials were modelled with similar R-value / U-value / F-Factor to ensure similar energy loss through the structure
- The size and location of the windows and skylights were kept similar in both models to ensure similar energy loss through the structure
- Structural elements were modelled with required load bearing capacity

Differences between the baseline and proposed building and the evidence in the equivalence in performance are explained in the table below.

Baseline material / construction	Proposed material / construction	Equivalence in performance
Concrete, 3001-4000 psi, 0% ash, 0% slag (National Ready Mixed Concrete Association)	Concrete, 3001-4000 psi, 20% ash, 30% slag (National Ready Mixed Concrete Association)	Same load bearing capacity (4000 psi strength), no impact on energy performance, service life is estimated to be as long as building for both baseline and proposed building. Transport distance was kept consistent.
Concrete, 4001-5000 psi, 0% ash, 0% slag (National Ready Mixed Concrete Association)	Concrete, 4001-5000 psi, 20% ash, 30% slag (National Ready Mixed Concrete Association)	Same load bearing capacity (5000 psi strength), no impact on energy performance, service life is estimated to be as long as building for both baseline and proposed building. Transport distance was kept consistent.
Reinforcement steel (rebar), generic, 0% recycled content (only virgin materials)	Reinforcement steel (rebar), generic, 80% recycled content	Same density and load bearing capacity, service life is estimated to be as long as building for both baseline and proposed building. Transport distance was kept consistent.
Foamular XPS Insulation on vertical walls, 3" thick	Thermafiber RockWool UltraBatt, 3.5" thick	Wall materials were modeled with the same R-Value (R-15), service life is estimated to be as long as building for both baseline and proposed building.
Foamular XPS Insulation on vertical walls, 4.5" thick	Thermafiber RockWool UltraBatt, 5.5" thick	Wall materials were modeled with the same R-Value (R-23), service life is estimated to be as long as building for both baseline and proposed building.
PVC-polyester waterproofing roof membrane, single-ply, white, 60 mil	EPDM Non-Reinforced Single Ply Roofing Membrane (Fully Adhered), 60 mils	Same thickness (60 mils), service life is estimated to both be 35 years for both baseline and proposed building. Transport distance was also estimated to be the same

6. Description of Proposed building

The proposed building was calculated in One Click LCA based on design data from the architectural and structural drawings and specifications. Quantities of materials were confirmed using the project Revit models. Materials were confirmed with design documents and architect. The quality of the input data was estimated to be good.

7. The detailed assessment results

As both proposed 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 proposed design

Whole-building Life Cycle Assessment, ISO 14040 & ISO 14044 (TRACI 2.1.)

Sector		Global warming kg CO2e	Ozone Depletion kg CFC11e	Acidification kg SO2e	Eutrophication kg Ne	Formation of tropospheric ozone kg O3e	Depletion of nonrenewable energy MJ	
A1-A3	Construction Materials	1,727,706.27	8.55	7,757.3	2,674.89	98,368.28	218,668,114.51	Details
A4	Transportation to site	80,041.77	0.02	165.88	56.38	2,927.58	1,324,022.97	Details
B1-B5	Maintenance and material replacement	7,631.19	0	35.31	7.53	787.34	182,900.47	Details
C1-C4	Deconstruction	56,315.61	0.01	201.05	51.2	4,478.56	731,425.17	Details
Total		1,871,694.85	8.58	8,159.55	2,790	106,561.76	220,906,463.12	
		Show graph	Show graph	Show graph	Show graph	Show graph	Show graph	
Results per denominator								
Gross Internal Floor Area (ASHRAE) 145495.0 sq ft		12.86	0	0.06	0.02	0.73	1,518.31	

Please note. The following LCA or EPD standards are all fully compliant with the requirements of ISO 14044: ISO 14025, ISO 21930, EN15804.

Results for the baseline design

Whole-building Life Cycle Assessment, ISO 14040 & ISO 14044 (TRACI 2.1.)

Sector		Global warming kg CO2e	Ozone Depletion kg CFC11e	Acidification kg SO2e	Eutrophication kg Ne	Formation of tropospheric ozone kg O3e	Depletion of nonrenewable energy MJ	
A1-A3	Construction Materials	2,180,041.14	11.32	9,243.39	3,275.5	113,527.26	220,031,277.6	Details
A4	Transportation to site	80,107.58	0.02	166.26	56.43	2,938.21	1,325,894.1	Details
B1-B5	Maintenance and material replacement	7,505.92	0	54.7	42.06	930.3	170,221.98	Details
C1-C4	Deconstruction	56,179.14	0.01	200.67	51.07	4,471.95	730,490.58	Details
Total		2,323,833.77	11.34	9,665.01	3,425.06	121,867.73	222,257,884.27	
		Show graph	Show graph	Show graph	Show graph	Show graph	Show graph	
Results per denominator								
Gross Internal Floor Area (ASHRAE) 145495.0 sq ft		15.97	0	0.07	0.02	0.84	1,527.6	

Please note. The following LCA or EPD standards are all fully compliant with the requirements of ISO 14044: ISO 14025, ISO 21930, EN15804.

Results for the proposed design and comparison

Whole-building Life Cycle Assessment, ISO 14040 & ISO 14044 (TRACI 2.1.)

Sector	Global warming kg CO2e	Ozone Depletion kg CFC11e	Acidification kg SO2e	Eutrophication kg Ne	Formation of tropospheric ozone kg O3e	Depletion of nonrenewable energy MJ	
A1-A3 Construction Materials	1,727,706.27 -21 %	8.55 -24 %	7,757.3 -16 %	2,674.89 -18 %	98,368.28 -13 %	218,668,114.51 -0.6 %	Details
A4 Transportation to site	80,041.77 -0.1 %	0.02 -0.1 %	165.88 -0.2 %	56.38 -0.1 %	2,927.58 -0.4 %	1,324,022.97 -0.1 %	Details
B1-B5 Maintenance and material replacement	7,631.19 +1.7 %	0 -87 %	35.31 -35 %	7.53 -82 %	787.34 -15 %	182,900.47 +7.4 %	Details
C1-C4 Deconstruction	56,315.61 0.2 %	0.01 0.1 %	201.05 0.2 %	51.2 0.3 %	4,478.56 0.1 %	731,425.17 0.1 %	Details
Total	1,871,694.85	8.58	8,159.55	2,790	106,561.76	220,906,463.12	
Comparing total results with: 6 FINAL - Baseline							
6 FINAL - Baseline Total	2,323,833.77	11.34	9,665.01	3,425.06	121,867.73	222,257,884.27	
6 FINAL New Design - Proposed compared with 6 FINAL - Baseline	-19 %	-24 %	-16 %	-19 %	-13 %	-0.6 %	
	Show graph	Show graph	Show graph	Show graph	Show graph	Show graph	
Results per denominator							
Gross Internal Floor Area (ASHRAE) 145495.0 sq ft	12.86	0	0.06	0.02	0.73	1,518.31	

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>.

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