

Sustainable design with respect to LCA using parametric design and BIM tools

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Objectives

The better integration of LCA in the design process of buildings from the early stage to the end of detailed stage.

Making the performance of LCA of buildings easier and faster in order to render it a design tool that will help architects and engineers minimize the environmental impacts of their design.

Method

Development of an Integrated Dynamic Model using Revit, VPL Dynamo and an external LCI database.

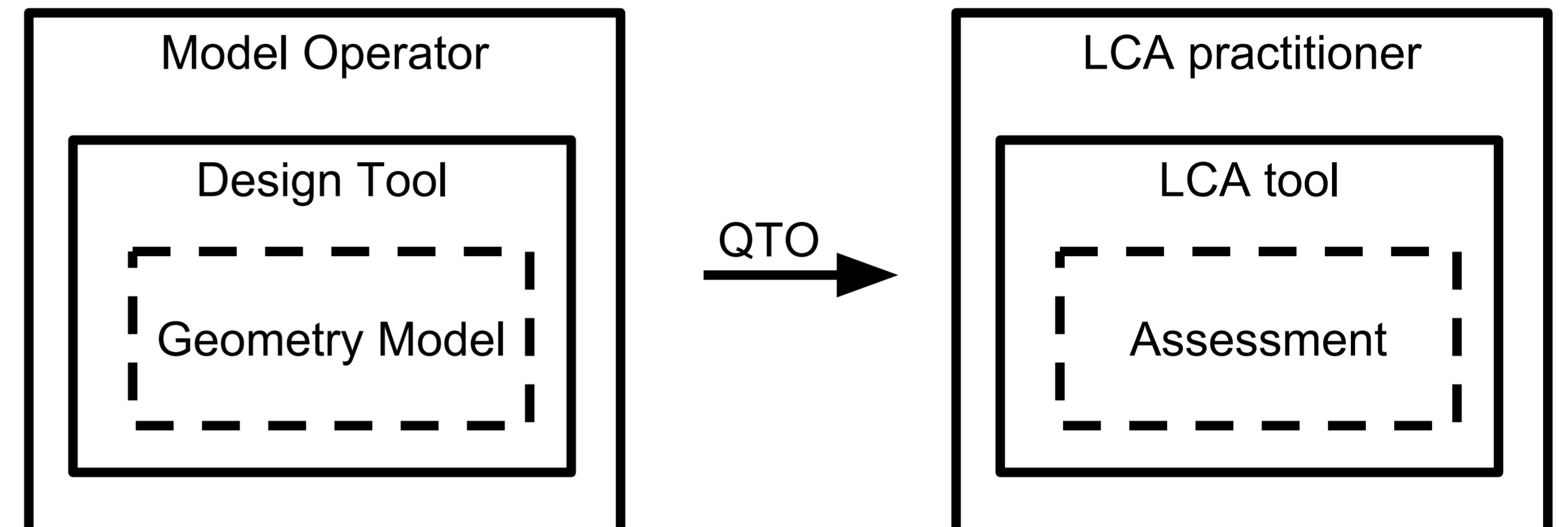
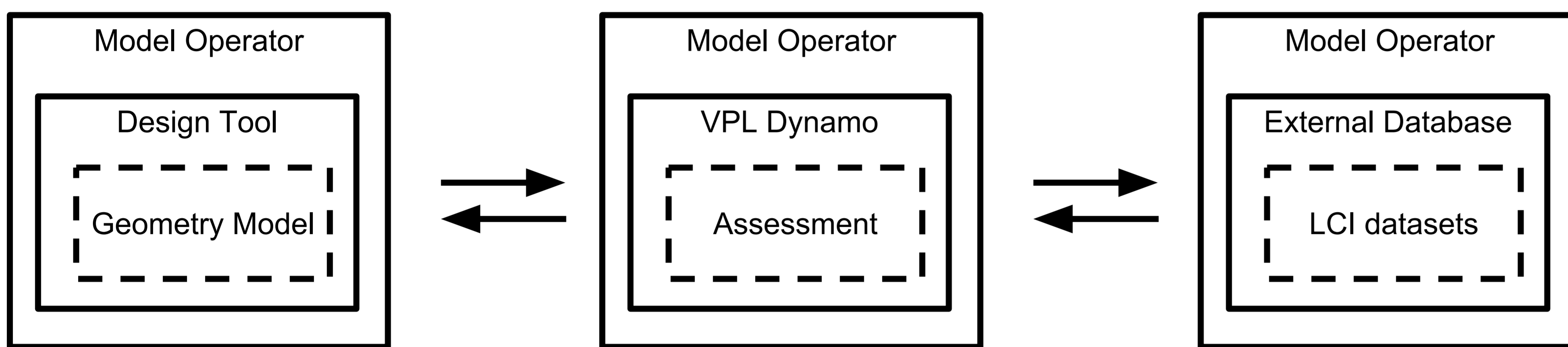


Figure 1: Common practice for LCA integration in the design process. Based on Negendahl 2015.

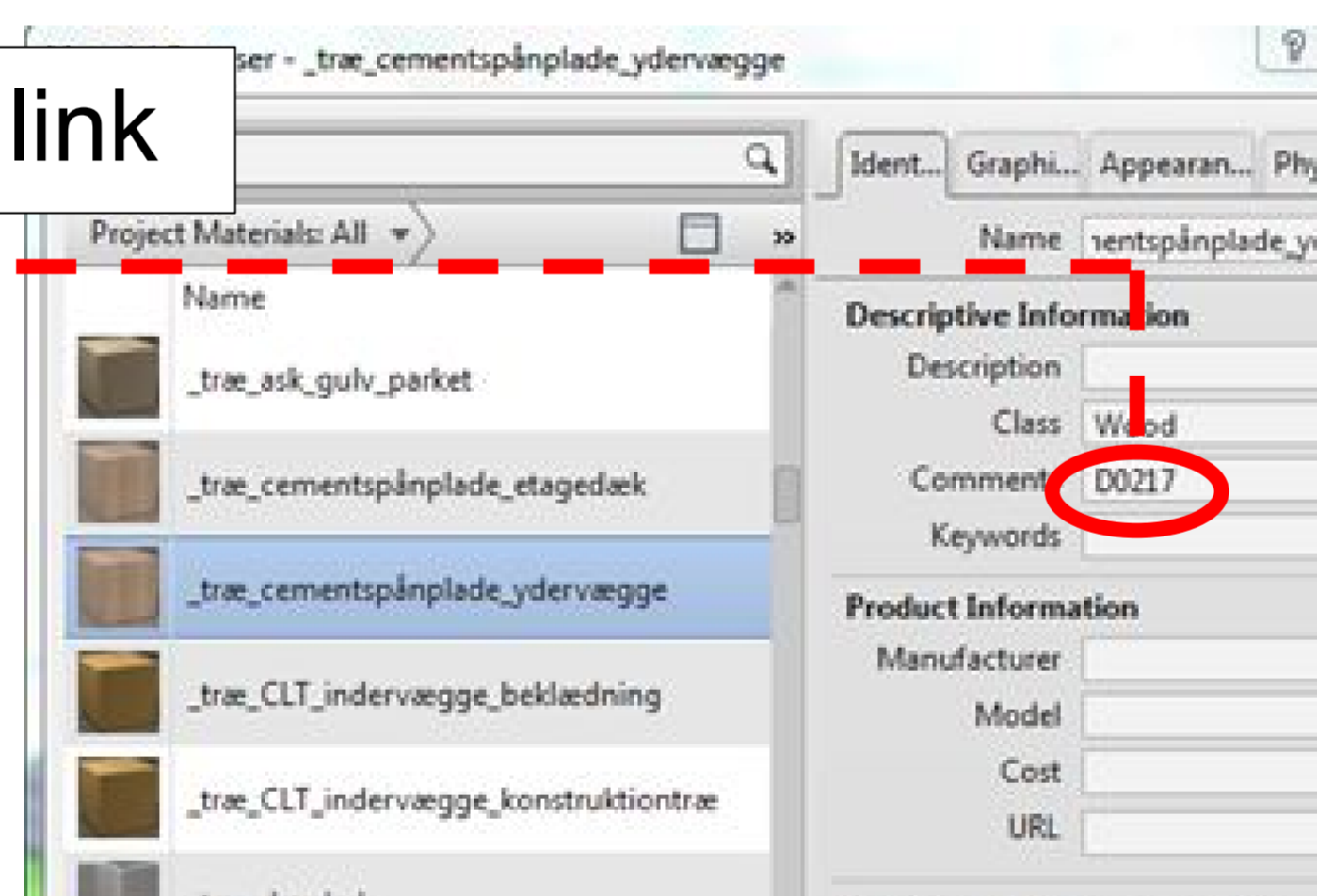


- + Permanent link between model materials and datasets
- + No need of data or file transfer to external tools
- + Faster
- + Visual representation of results in the BIM model
- + Detailed results
- + Instant action after feedback

Figure 2: Proposed Integration of LCA through an Integrated Dynamic Model. Based on Negendahl 2015.

Detailed stage LCA Integrated Dynamic Model

Material Name	ID	Functional Unit	GWP	ODP	POCP	AP
1.2.03_Light-weight sand pumice (grai	D0042	m3	1.03E+01	8.52E-09	-1.29E-03	6.54
1.3.02_Facing brick [m3]	D0069	m3	4.19E+02	3.06E-07	1.47E-01	8.91
1.3.04_Lightweight concrete block (exp	D0075	m3	3.94E+02	2.19E-07	9.35E-02	2.58
1.3.13_Gypsum fibre board [m3]	D0140	m3	3.04E+02	2.90E-07	5.77E-02	3.00
1.4.01_Ready-mix concrete C20/25 [m3]	D0147	m3	2.34E+02	1.31E-07	1.16E-02	3.69E-01
Default [m3]	M0913	m3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.5.04_Ashphalt supporting layer [m3]	D0171	m3	1.62E+02	1.32E-07	3.77E-01	4.34E-01
2.1.01_Mineral wool (Facades) [m3]	D0217	m3	7.20E+02	6.40E-08	3.65E-03	3.35E-01
3.1.01_Timber pine (12% moisture [m	D0217	m3	8.77E+02	2.93E-07	2.28E-02	3.42E-01
4.1.05_Cast iron component [m3]	D0251	m3	2.03E+04	7.27E-05	2.2E+00	2.94E+01
4.1.05_Steel forged component [m3]	D0255	m3	2.21E+04	2.77E-05	9.84E+00	7.18E+01
4.3.01_Aluminium sheet [m3]	D0261	m3	3.04E+04	7.99E-04	9.39E+00	1.59E+02
6.5.01_High pressure laminate HPL bo	D0356	m3	-1.83E+04	2.28E-05	1.75E+00	2.78E+01
1.4.04_Stuckgips [m3]	D0836	m3	1.10E+02	1.13E-08	1.56E-02	1.51E-01
7.2.01_Double glazing unit [m2] (tykke	G0453	m2	7.64E+02	5.29E-07	2.04E-01	3.20E+00
vapor barrier [m2]	M0912	m2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cement FibreBoards [m3]	M0915	m3	2.84E+02	2.90E-07	5.7E-02	3.30E-01

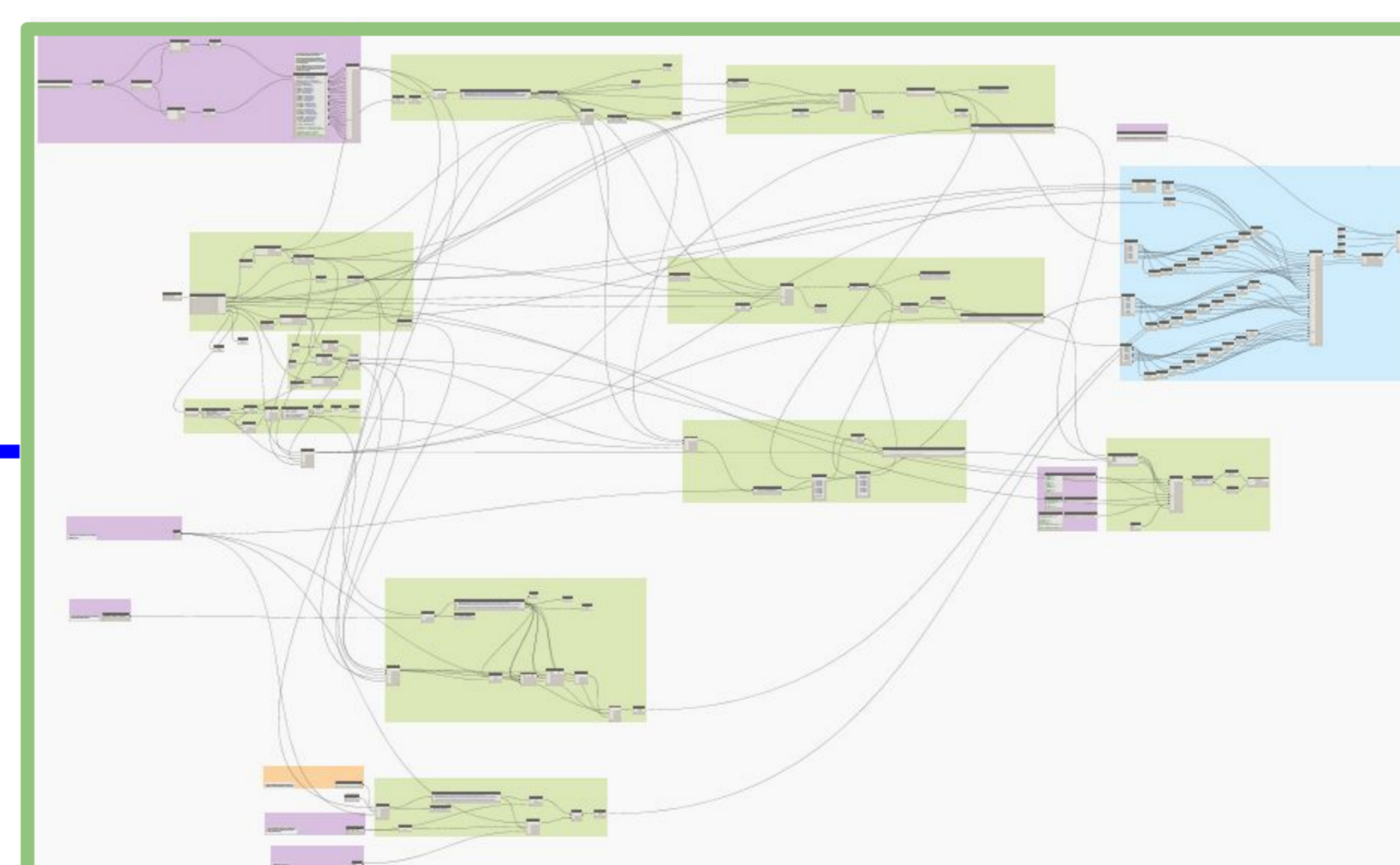


Impacts per m³

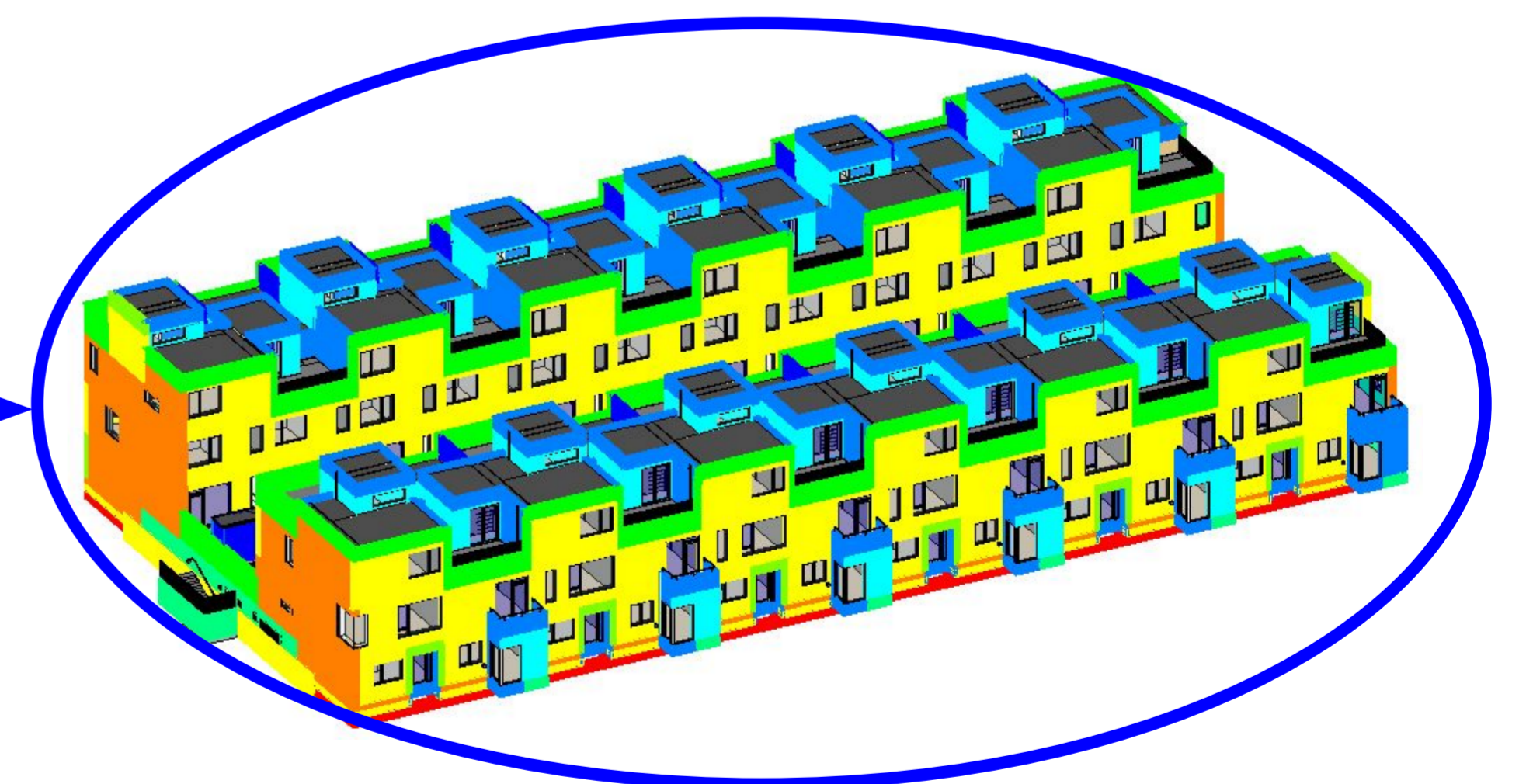
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Results exported in Excel

SIB code	Type	Material	Type	Quant	Unit	GWP	ODP	POCP	AP	PM10	PM10	PM10	RSE
21	Ydervæg	Kæld_beton_elem	166.828525	m2	7023.251	3.92E-06	0.348428	11.07925	2.00918	0.010582	97300.14	2483.599	1945.971
21	Isolerings	trkyl_isolerings_m	165.8110229	m2	2685.421	3.51E-06	9.51E-01	12.49387	1.69E+00	3.23E-02	33152.33	1915.418	38.22003
21	Ydervæg	Kæld_beton_elem	180.2167484	m2	8425.183	4.70E-06	4.18E-01	19.29081	2.41E+00	1.27E-02	44745.74	2979.597	2384.412
21	Beton	rishta_beton_m_sit	10.79200082	m2	378.6432	1.21E-07	0.018765	0.597217	0.020211	0.000571	2012.965	133.895	104.315
21	Ydervæg	Tung_isolerings_m	35.10322106	m2	367.173	8.00E-07	1.30E-01	1.708265	2.31E-01	4.42E-03	4532.861	261.8918	5.25276
21	Ydervæg	Tung_isolerings_m	35.10322106	m2	1616.643	1.18E-06	5.66E-01	3.488839	0.399716	8.85E-05	26228.78	613.0466	0.23444
21	Ydervæg	Murk_isolerings_m	221.6117835	m2	2991.417	3.83E-06	1.037763	13.63836	1.845857	0.03297	96189.22	2090.878	41.72313
21	Ydervæg	Murk_isolerings_m	221.6117835	m2	10727.12	7.84E-06	3.76E-00	22.81216	2.65E+00	5.86E-04	174039.2	4067.826	1.555616
21	Ydervæg	Murk_isolerings_m	221.6117835	m2	-5735.25	1.92E-06	0.149268	2.253753	0.37504	9.75E-05	20329.78	67414.31	0.20333
21	Ydervæg	Murk_isolerings_m	221.6117835	m2	-38324.9	4.77E-05	3.67E+00	58.2644	1.08E+01	4.96E-03	747144.9	75355.3	8.89946
21	Ydervæg	Murk_isolerings_m	221.6117835	m2	-5914.66	1.84E-06	1.44E-01	2.149762	3.59E-01	9.38E-05	19547.87	64821.45	0.19399
21	Sokkel	gavl_isolerings_m	71.88991853	m2	231.1004	1.03E-07	8.22E-02	1.079843	1.44E-01	2.79E-03	2863.349	165.5492	8.30333
21	Sokkel	gavl_isolerings_m	71.88991853	m2	5350.867	2.97E-06	1.269812	35.05225	2.071094	0.003568	97999.31	2303.317	392.9949
21	Sokkel	gavl_isolerings_m	71.88991853	m2	78.45886	8.06E-09	0.01127	0.107703	0.014337	0.013481	1184.016	99.85674	0
22	Letbeton	120_beton_letbe	24.85135866	m2	1175.004	6.53E-07	2.79E-01	7.70E+00	4.53E-01	7.18E-04	8.34E+03	5.08E+02	8.63E-03
21	Fundaments	_beton_elem	0.65098507	m2	53.21498	2.97E-08	0.00264	0.083947	0.015223	8.02E-05	282.6222	18.8316	14.74453
21	Breddebeke	træ_afstand	29.78239213	m2	-653.086	3.38E-07	1.79E-02	0.25459	4.24E-01	1.13E-05	334.996	7976.62	0.02923
21	Breddebeke	træ_afstand	29.78239213	m2	-1306.17	4.36E-07	3.40E-02	0.50918	8.50E-02	2.22E-05	4629.996	15353.24	0.04583
22	Indervæg	kæld_beton_letki	40.18567935	m2	2375.038	1.32E-06	0.563619	15.55831	0.919272	0.00145	18866.39	1022.351	174.3905
22	Indervæg	100_beton_letki	821.2722393	m2	32343.57	1.80E-05	7.68E+00	211.875	1.25E+01	1.198E-02	229688.6	13922.51	2374.872
21	Indervæg	Træg_isolerings_m	1.484788184	m2	68.44238	5.00E-08	2.40E-02	0.145887	0.019922	3.75E-06	1130.423	25.95937	0.00992
21	Let ydervæg	si_Default	115.5496126	m2	0	0	0	0	0	0	0	0	0
21	Let ydervæg	si_Default	115.5496126	m2	-5270.39	1.76E-06	1.37E-01	2.054537	3.43E-01	8.96E-05	18681.98	61950.14	0.180517
22	Let ydervæg	si_Default	2024.472059	m2	93616.88	5.22E-05	4.644397	147.8816	26.78149	0.141055	497194.7	33105.29	25938.9
21	Fundaments	_beton_letki	32.73274937	m2	7616.18	6.62E-06	6.49E-01	18.17051	1.15E+00	1.78E-03	30723.06	1216.381	214.3794



Dynamo Script



Color Coding of Geometrical Model

Hot Spot Analysis

