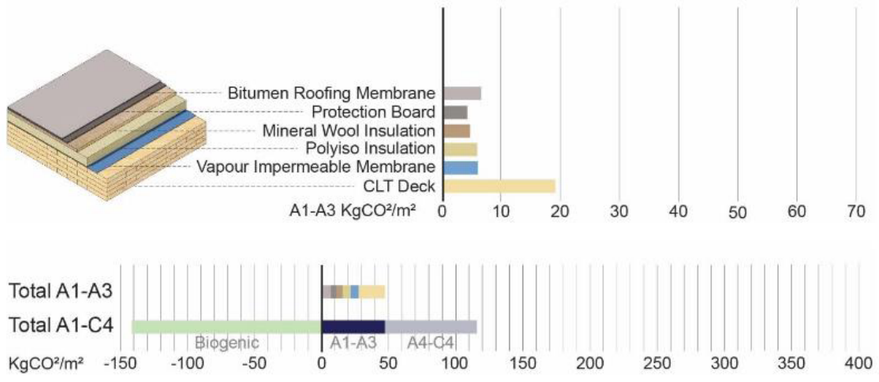
APPENDIX A **ROOF ASSEMBLY 03**

R03: Results Summary

Metrics	Results
Description	**Conventional Modified Bitumen Roof with Hybrid Insulation on CLT Deck**
Effective R-value	RSI-4.4 m^2K/W | R-24.8 $ft^2{\cdot}°F{\cdot}h/BTU$
Embodied Carbon per m^2 of Enclosure (A1-A3)	48.1 $kgCO_2/m^2$
Biogenic Carbon per m^2 of Enclosure	1269.96 $kgCO_2/m^2$



R03: Assembly Effective R-value Calculation

Description	t_{SI}	t_{IP}	k	C (USI)	$RSI_{effective}$	$R_{effective}$	$R_{nominal}$
Units	mm	in	W/mK	W/m^2K	m^2K/W	$ft^2{\cdot}°F{\cdot}h/BTU$	$ft^2{\cdot}°F{\cdot}h/BTU$
Interior air film					0.11	0.61	
Mass timber roof panel	191.00	7.52	0.13	0.68	1.47	8.34	
Self-adhered sheet-applied air barrier and vapour-impermeable membrane	0.80	0.03	-	-	-	-	
Rigid polyisocyanurate insulation, fully adhered (polyurethane adhesive)	76.20	3.00	0.02	0.31	3.18	18.03	16.80
Rigid mineral fibre board insulation, fully adhered (polyurethane adhesive)	25.40	1.00	0.03	1.34	0.75	4.24	4.30
Asphalt protection board, fully adhered (polyurethane adhesive)	4.80	0.19	-	-	0.14	0.79	
SBS modified asphalt membrane (base ply)	2.20	0.09	-	-	-	-	29.98
SBS modified asphalt membrane (cap sheet)	4.00	0.16	-	-	-	-	
Exterior air film					0.03	0.17	
TOTALS	**304.40**	**12.00**			**5.70**	**32.20**	**21.10**

R03: Embodied Carbon Emissions (A1 to A3 Life Stages) for 9m² Assembly Area

Category	Material	Description (from EPD)	Thickness	Material Volume	Carbon Emissions (A1-A3)	% of total
Units			mm	m^3	kgCO2e	%
Structure	CLT Deck	CLT produced in British Columbia, 464.7 kg/m3 (Forestry Innovation Investment) (Generic)	191 (7.5")	1.719	170	39.6%
Exterior Membrane	Vapour impermeable membrane	SBS polymer-modified bitumen membrane roofing, self-adhered, 6.69 kg/m2 (Certain Teed, Henry, IKO, Malarkey Roofing Products, Siplast, Soprema)	-	*	61	14.0%
Exterior Insulation	75% Polyiso adhered in foam	Polyisocyanurate (PIR) roof insulation boards, glass fiber reinforced cellulosic faced (GRF), boards	76.2 (3")	0.6858	58	13.2%
Exterior Insulation	25% mineral wool adhered in foam	Heavy density mineral wool board, 1 m2K/W, 34 mm (1.34 in), 4.2 kg/m2 (0.86 lb/ft2), 123.52 kg/m3 (7.71 lb/ft3), Industry average US (NAIMA)	25.4 (1")	0.2286	40	9.2%
Insulation Protection	Protection Board adhered in foam	Roof cover board, fiberglass facing, 6.1 kg/m2, EVERBOARD™ - ¼ fiberglass faced (Continuous Materials, plant Philadelphia)	-	*	36	8%
Exterior Membrane	Base sheet - SBS torch applied Cap Sheet - SBS torch applied	Bitumen roofing membrane, torch-applied, 9.02 kg/m2 (Asphalt Roofing Manufacturers Association)	-	*	68	15.7%
				TOTAL	**433**	

**Software auto-calculates the impact based on the area provided.*

R03: Environmental Emissions (A1 to C4 Life Stages) for 9m² Assembly Area

Lifecycle Stage		**A1 to C4**	A1-A3	A4-A5	B1-B5	C1-C4	A1-A3 Contribution to total
Category	Units	**Total**	Construction Materials	Transport to Site & Construction	Material Replacement & Refurbishment	Deconstruction	%
Global Warming	kg CO2e	**1048.494**	436.93	18.4	417.35	175.814	41.67%
Acidification	kg SO	**3.66E-05**	1.33E-05	4.86E-06	1.10E-05	7.48E-06	36.30%
Eutrophication	kg Ne	**5.00659**	2.938	0.1043	1.45	0.51429	58.68%
Ozone Depletion	kg CFC11e	**1.020318**	0.46635	0.01428	0.237	0.302688	45.71%
Formation of Tropospheric Ozone	kg O3e	**80.104007**	53.05	2.978	18.74	5.336007	66.23%
Fossil Fuel Primary Energy	MJ	**13016.28**	5891.15	523.04	6556	46.09	45.26%
Biogenic Carbon Storage	kg CO2e	**1269.96**	1269.96				