Table 1: Summary of the Student Accommodation Construction Project Case Studies

Details	Case Study 1 (CS-1)	Case Study 2 (CS-2)	Case Study 3 (CS-3)	Case Study 4 (CS-4)
Location	Lancaster, UK	Liverpool, UK	Leeds, UK	Leeds, UK
Project Brief	Refurbishment of 346 accommodation units, 45 offices, 14 common rooms, student bar, foyer and courtyard landscaping works.	Developing 495 flats into contemporary accommodation with en-suite shower rooms, kitchen and lounge areas with new fit-out.	Phase 1 (CS-3) and Phase 2 (CS-4) refurbishment works of existing accommodation including; study rooms, kitchen areas, bathrooms/en-suites and block entrances.	
Distance from Site to Head Office (km)	92	168	264	264
Project Duration (weeks)	49	57	10	9
Gross Internal Floor Area (GIFA) (m^2)	15,645	17,805	5,100	5,850
Rooms	324	495	210	258
Project Value	£4.77m	£4.10m	£1.16m	£1.17m
Estimated Overall Project Emissions ($kgCO_2^{eqv}$)	76,510	76,021	25,233	28,173

Table 2: Case Study Project Data Classifications

Greenhouse Gas Protocol for Project Accounting – GHG Scopes:	
Classification	**Description**
GHG Scope 1 (Direct Emissions)	Direct emissions occur from sources that are owned or controlled by the case study organisation, for example, emissions from staff business travel related to the project.
GHG Scope 2 (Indirect Emissions)	Emissions from the consumption of purchased electricity, natural gas, LPG, coal, etc. used on the project site.
GHG Scope 3 (Other Indirect Emissions)	Emissions from outsourced activities not owned or controlled by the case study organisation requiring fuel or energy. Some examples of Scope 3 emissions are travel by sub-contractors, materials transport, project vehicles, etc.

Organisational KPIs:	
Data Classification	**Description**
KPI 1 - Distance	The return (round trip) distance from Head Office to project site in kilometres.
KPI 2 - Duration	The project duration from start to finish in weeks.
KPI 3 - GIFA	The gross internal floor area (GIFA) of the project site in square meter.
KPI 4 - Rooms	The total number of rooms, which includes study rooms, kitchen areas, bathrooms, en-suites, offices, etc.
KPI 5 - Value	The final value of the project (including all refurbishment cost and fees associated to the project) as agreed after the Final Accounts with the Client.

Table 3: Case Study Project Estimated GHG Emission Data

Project	GHG Emission Scope	Organisational KPI Data									
		Distance *($kgCO_2^{eqv.}$ per km)*		**Duration** *($kgCO_2^{eqv.}$ per week)*		**GIFA** *($kgCO_2^{eqv.}$ per m^2)*		**Rooms** *($kgCO_2^{eqv.}$ per room)*		**Value** *($kgCO_2^{eqv.}$ per £100K)*	
		WLC	RP	WLC	RP	WLC	RP	WLC	RP	WLC	RP
CS-1	Scope 1	133.0	111.6	249.6	209.6	0.8	0.7	37.8	31.7	2.6	2.2
	Scope 2	59.3	46.9	111.3	88.1	0.4	0.3	16.8	13.3	1.1	0.9
	Scope 3	639.4	483.7	1200.5	908.1	3.8	2.8	181.6	137.3	12.3	9.3
	Overall	*831.6*	*642.2*	*1561.5*	*1205.8*	*4.9*	*3.8*	*236.1*	*182.4*	*16.0*	*12.4*
CS-2	Scope 1	82.1	77.6	242.0	228.8	0.8	0.7	27.9	26.3	3.4	3.2
	Scope 2	12.3	11.2	36.3	33.0	0.1	0.1	4.2	3.8	0.5	0.5
	Scope 3	358.1	336.6	1055.4	992.2	3.4	3.2	121.5	114.3	14.7	13.8
	Overall	*452.5*	*425.5*	*1333.7*	*1254.0*	*4.3*	*4.0*	*153.6*	*144.4*	*18.5*	*17.4*
CS-3	Scope 1	16.3	12.1	431.3	318.8	0.9	0.6	20.5	15.2	3.7	2.8
	Scope 2	1.1	0.8	28.2	20.8	0.1	0.0	1.3	1.0	0.2	0.2
	Scope 3	78.2	56.5	2063.8	1492.6	4.1	2.9	98.3	71.1	17.8	12.9
	Overall	*95.6*	*69.4*	*2523.3*	*1832.1*	*5.0*	*3.6*	*120.2*	*87.2*	*21.8*	*15.8*
CS-4	Scope 1	52.1	39.3	1529.6	1151.6	2.4	1.8	53.4	40.2	11.8	8.9
	Scope 2	1.3	1.0	38.5	29.7	0.1	0.1	1.3	1.0	0.3	0.2
	Scope 3	53.3	41.5	1562.3	1216.7	2.4	1.9	54.5	42.4	12.0	9.4
	Overall	*106.7*	*81.8*	*3130.4*	*2397.9*	*4.8*	*3.7*	*109.2*	*83.7*	*24.1*	*18.5*

WLC : Estimated emissions reflecting the whole lifecycle of the case study projects ($kgCO_2^{eqv.}$).

RP : Estimated emissions reflecting the refurbishment phase of the case study project's lifecycles (excluding project start-up and move-out) case study projects GHG levels emissions analysis ($kgCO_2^{eqv.}$)

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Table 4: Case Study Projects with Best and Worst GHG Performance According to Different KPIs

		Key Performance Indicators				
		Distance	**Duration**	**GIFA**	**Rooms**	**Value**
WLC GHG Emissions	Projects Identified with Best GHG Performance	CS-1	CS-4	CS-1	CS-1	CS-4
	Projects Identified with Worst GHG Performance	CS-3	CS-2	CS-2	CS-4	CS-3
RP GHG Emissions	Projects Identified with Best GHG Performance	CS-1	CS-4	CS-2	CS-1	CS-4
	Projects Identified with Worst GHG Performance	CS-3	CS-1	CS-2	CS-1	CS-4

Table 5 : Statistical Correlation between Project KPI Characteristics and Estimated WLC and RP Construction Emissions

	Case Study Project KPI Characteristics				
	Distance *($kgCO_2^{eqv}$ per km)*	**Duration** *($kgCO_2^{eqv}$ per week)*	**GIFA** *($kgCO_2^{eqv}$ per m^2)*	**Rooms** *($kgCO_2^{eqv}$ per room)*	**Value** *($kgCO_2^{eqv}$ per £100K)*
Estimated Whole Lifecycle Construction Emissions (WLC)	-0.930	0.989	0.990	0.815	0.990
Estimated Refurbishment Phase Construction Emissions (RP)	-0.840	0.996	0.998	0.911	0.943