MAJID AL FUTTAIM EMBODIED CARBON PORTFOLIO

PHASE 02 – CITY CENTRE ALMAZA, AL ZAHIA & MALL OF OMAN

INTENDED FOR

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MAJID AL FUTTAIM

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RAMBOLL Bright ideas. Sustainable change.

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PHASE 02 – CITY CENTRE AL MAZA, CITY CENTRE AL ZAHIA & MALL OF OMAN

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EXECUTIVE SUMMARY

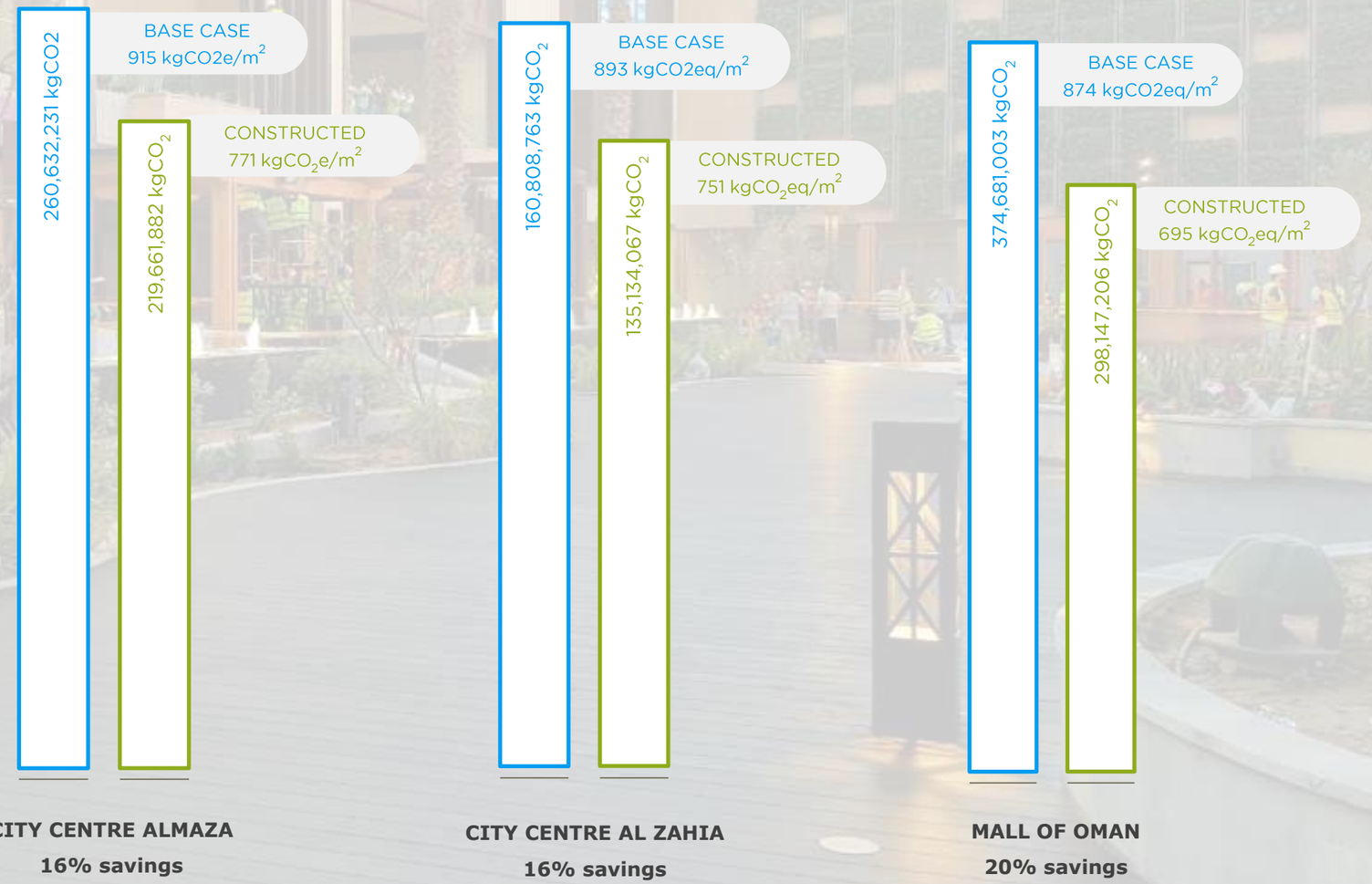
Majid Al Futtaim has daring and ambitious sustainability goals and commitments, wherein it aims to achieve Net Positive Carbon and Water for all operating companies by 2040. In 2018 Majid Al Futtaim signed the World Green Building Council (WGBC) Net Zero Carbon Buildings Commitment that would lead towards the decarbonization of buildings while also aligning their ambitions with the United Nations Sustainable Development Goals (SDGs).

While Majid Al Futtaim's primary focus so far has been a reduction in operational carbon footprint, as it traditionally accounted for most of their carbon footprint, it is also recognized that embodied carbon is becoming increasingly important towards achievementof their Net Positive aspirations.

Majid Al Futtaim is one of the most progressive clients in the region who are pioneers of the sustainability agendain various markets including the built environment. Their initiatives and attention towards embodied carbon at the client level, not only serves their own sustainability agenda, but also influences the market and supply chainto respond towards their progressive requirements by moving towards supply of low carbon materials andtechnologies.

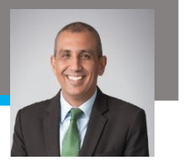
The embodied carbon study on City Centre Almaza, Al Zahia and Mall of Oman has further demonstrated that Majid Al Futtaim is the driver of sustainable change in the region. The 3 malls have a cumulative embodied carbon savings of 143 million kgCO2e against a no carbon savings scenario.This equates to around 221M kilometers of travel in today's average passenger car which is enough to go around the circumference of the globe for more than 5,500 times.

221M km
car travel



INTRODUCTION

> Becoming Net Positive is the next ambitious goal that we have set and we are fully committed to achieving it by 2040. In doing will help provide a framework to ensure the private sector becomes a force for good, further protecting our shared resources in a region that faces challenges around water scarcity and energy consumption."
>
> Ibrahim Al-Zu'bi
> Chief Sustainability Officer, Majid Al Futtaim



As it currently stands, every year 3,729 million tons CO_2 of embodied carbon is contributed by built environment[1] - this translates to 11% of annual global greenhouse gas (GHG) emissions. If the trend continues, embodied carbon will be responsible for almost 50% of the emissions linked to new constructions, with the other chunk coming from operational carbon.

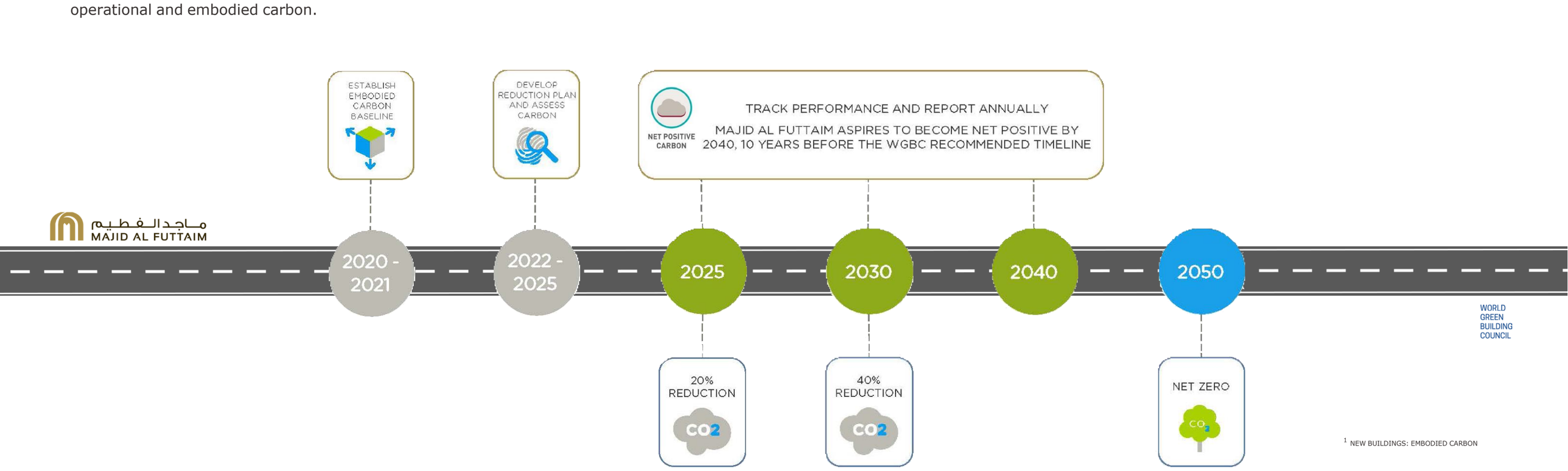
Majid Al Futtaim has made the commitment to achieve Net Positive targets by the year 2040. To do so, they have aligned themselves with the World Green Building Council (WGBC) stakeholder goals to achieve this target in terms of both operational and embodied carbon.

To achieve this target, Majid Al Futtaim has taken the steps to develop an embodied carbon benchmark for their built assets as a first step towards understanding the embodied carbon impact of their existing constructions and develop a carbon accounting plan for future constructions.

This report focuses on City Centre Almaza, City Centre Al Zahia and Mall of Oman.

It is clear from this that Majid Al Futtaim as a company is aware of their sustainable accountability and is taking active measures towards being more responsible in their procurement methods.

As an additional benefit, achieving Net Zero Carbon will also aid in meeting United Nations Sustainable Development Goals (SDGs).



[1] NEW BUILDINGS: EMBODIED CARBON

DELIVERY PLAN

To develop the carbon portfolio for the existing assets, it is important to do so in a systematic manner.

The assessment reporting methodology was aligned and cross-referenced to terms and lifecycle stages defined in the widely adopted European Standard - EN 15978.

This allows Majid Al Futtaim management to make informed decisions and help maximise the embodied carbon reductions for future projects.

The main objective of the reporting is to develop a simplified embodied carbon account (Stages A1-A4 & D for timber) for the major materials and components.

Depending on availability of data, a benchmark can be generated based on typologies, gross floor areas etc.

1 WORKSHOP

Conduct a kick-off workshop between the project team and the client team. The project team will explain the process of carbon accounting to the client team and provide a list of required documentation that needs to be acquired in order to start the accounting process.

During the course of the process, various workshops will be conducted to inform and update the client team on progress and if required, examine the missing information and find alternative solutions to report accurately.

2 FEASIBILITY

Check feasibility of targets - how easily attainable they are, what information is required to calculate the final value, if the available information is sufficient to allow for the exercise to be completed.

Additionally, highlight challenges, if any, that would lead to an inaccurate account, but also call attention to opportunities to improve on design through refurbishment to improve where possible.

3 EVALUATION

Evaluate the carbon reduction strategies highlighted in step 2 and how they can be implemented within the design. Consider its impact on the whole life carbon, the cost implications, constructability, end of life use etc. to ensure that the targets are easily achievable with lowest impact.

4 REPORTING

Develop a carbon account of the assets from all the information gathered and provide a baseline (typical construction) versus constructed comparison to report on savings achieved.

Include the assumptions made as part of the exercise to help the client team get a holistic picture and be more informed about which materials or requirements need to be regarded more closely in the future.

5 METHODOLOGY

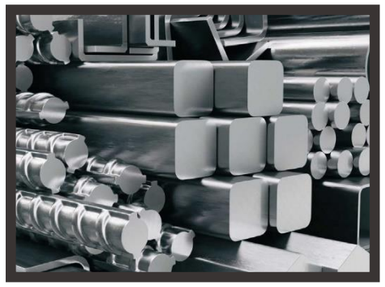
Outline the findings and methodology used during the exercise to find the carbon savings. Present the information in a report, start developing a benchmark for carbon intensity of various typologies and advise Majid Al Futtaim on the way forward.

CARBON ACCOUNT

Carbon Accounting is quantifiable way to measure direct and indirect GHG emissions. It helps businesses understandthe climate impact that procurement and design choices can make. It also helps businesses set goals and targets to improve or limit their emissions.

The values generated can be used to define baselines, end goals and track process to reduce and limit carbon emissions. As a developer, the focus lies on the careful material selection as shown in Figure 01.

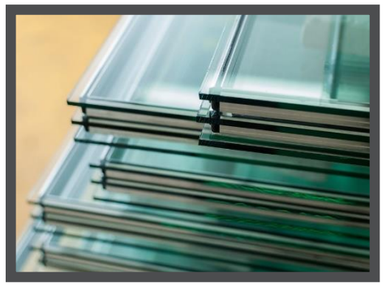
Special attention should be given to major materials and components such as concrete, steel, glazing, timber etc. The next section provides details on sources that can be used to gather carbon data for materials.



steel

timber

concrete



glass

tiles & carpets

paints & coatings

bricks & screed

insulation

other materials

FIGURE 01: BUILDING MATERIALS THAT CONTRIBUTE TO GHG EMISSIONS

SYSTEM BOUNDARY

Life Cycle Assessment (LCA) is a systematic set of procedures for compiling and examining the inputs and outputs of materials and energy, and the associated environmental impacts directly attributable to a building, infrastructure, product or material throughout its lifecycle (ISO 14040:2006).

The following paragraphs will refer to the lifecycle stages or modules. These modules present kgCO2e (and other parameters such as Ozone Depletion Potential) information under one of the following boundaries:

- Cradle-to-Gate: Raw material extraction till the manufacturing process (A1-A3)
- Cradle-to-Grave: Raw material extraction till disposal post-use (A1-A5, B1-B5, C1-C4, D)
- Cradle-to-Gate with Options: Cradle to Gate with additional modules as applicable.

The availability of following verified documentation and databases allows for a way to quantify GHG emissions.

1 INVENTORY OF CARBON AND ENERGY DATABASE

The Inventory of Carbon and Energy (ICE) Database is an embodied carbon and energy database for building materials.

It collects data from various sources (whether they be EPDs or historical information) and collates it into one large database. As each material whose information is attained uses their own preferred methodology to present the information, ICE Database V3 now provides with a data quality indicator (DQI) which applies a statistical average based on how many data points have been collected for a particular material.

The ICE DB V3 provides embodied carbon data for the modules A1 to A3 (Product Stage)

2 ENVIRONMENTAL PRODUCT DECLARATION

An Environmental Product Declaration (EPD) is a verified and registered document that communicates the life-cycle information about a product – hence informing us of a products' environmental impact.

International Organisation for Standardization (ISO) 14025 is the governing standard against which a product is measured. As per ISO 14025, an EPD falls under a Type III declaration which "quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function".

Depending on the requirement, an EPD can provide information from any of the three LCA methods.

Stages A1 - A3 considers the manufacturing of a material. This is also coined as "Cradle-to-Gate"

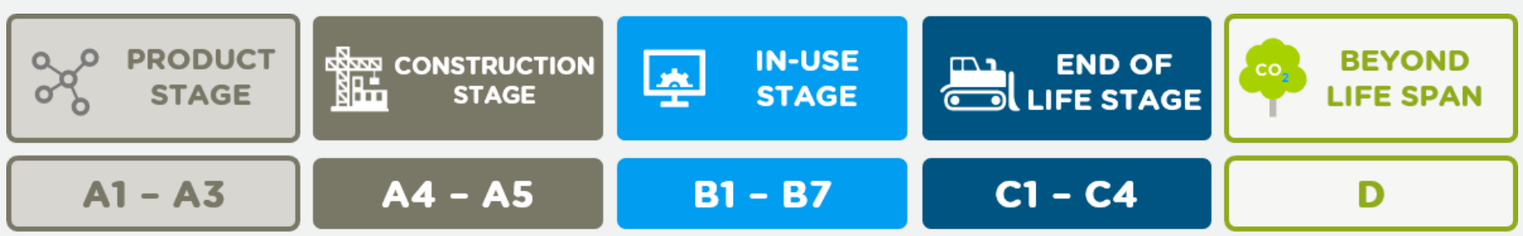
Stages A4 - A5 considers the carbon footprint left during the construction and transport of materials to the site

Stages B1 - B7 considers the operational and embodied carbon associated with the use stage of the buildings (refurbishments, maintenance, energy consumption etc.)

Stages C1 - C4 considers end of life stage of either the building or materials within (waste processing, disposal, deconstruction)

Stage D is for construction materials that can be recycled beyond their life span (such as timber), which can then be used to offset the cumulative footprint

Figure 2: System Boundary: EN 15978:2011
Building Life Cycle Assessment Stages
For this report, Stages A1-A4 & D (for timber) were considered



CARBON REPORT

City Centre Almaza

City Centre Al Zahia

Mall of Oman

METHODOLOGY

data collection

The Majid Al Futtaim team provided Ramboll data associated with the malls for the following materials - the measurement units being either weight, volume, area or length:

- Concrete
- Steel & Rebar
- Masonry
- Metalwork
- Insulation
- Doors & Windows
- Finishes

boundary condition

For the current phase of calculations, the LCA stages A1-A4 & D (for timber) were considered which provides information about the raw material extraction, its transport to factor, manufacturing, transport to site and beyond life span stage (only for timber).

base scenario

A base scenario of conventional construction practices in the region was developed to measure the actual construction against. The following set of assumptions were considered:

- Concrete: No recycled content (0% GGBS) present
- Steel: No recycled content present
- Timber: Not FSC (Forest Stewardship Council) or PEFC (Programme for Endorsement of Forest Certification) certified

The rest of the materials were considered to be equivalent in terms of conventional practices and what was procured for the project.

carbon calculator

A carbon accounting calculator was developed for the purposes of tracking how much over all carbon is associated with each development. The calculator details the following information using LCA documents mentioned in the previous section:

- Carbon emission value ($kgCO_2e/kg$)
- Quantity of material (kilograms)

City Centre Almaza

A total of 7 main material groups were considered for this exercise. These will represent the embodied carbon of the construction.

An additional material group - other materials - was considered that would account for 20% of the overall buildings embodied carbon that comes from elements not considered as part of the structure.

The buildings skeleton - which is made of concrete, steel (structural and rebar) - was analysed for the purposes of the study as it is the larger denomination on an average.

The baseline case considers a conventional concrete with no GGBS whereas the as-built case optimizes the structure through the use of concrete with GGBS content.

For this exercise, the scope includes the whole mall. Appendix A presents

the detailed calculations and assumptions for City Centre Almaza.

BASE CASE — 260,632,231 kgCO2

AS-BUILT — 219,661,882 kgCO_2

Total savings

16%

40,970 tCO_2e for
Stage A1 to A4 & D
(for timber)

City Centre Al Zahia

A total of 7 main material groups were considered for this exercise. These will represent the embodied carbon of the construction.

An additional material group - other materials - was considered that would account for 20% of the overall buildings embodied carbon that comes from elements not considered as part of the structure.

The buildings skeleton - which is made of concrete, steel (structural and rebar) - was analysed for the purposes of the study as it is the larger denomination on an average.

The baseline case considers a conventional concrete with no GGBS whereas the as-built case optimizes the structure through the use of concrete with GGBS content of varying percentages.

For this exercise, the scope includes the whole mall. Appendix B presents

the detailed calculations and assumptions for City Centre Al Zahia.

BASE CASE — 160,808,763 $kgCO_2$

AS-BUILT — 135,134,067 $kgCO_2$

Total savings

16%

25,675 tCO_2e for Stage A1 to A4 & D for timber

Mall of Oman

A total of 7 main material groups were considered for this exercise. These will represent the embodied carbon of the construction.

An additional material group - other materials - was considered that would account for 30% of the overall buildings embodied carbon that comes from elements not considered as part of the structure.

The buildings skeleton - which is made of concrete, steel (structural and rebar) - was analysed for the purposes of the study as it is the larger denomination on an average.

The baseline case considers a conventional concrete with no GGBS whereas the as-built case optimizes the structure through the use of concrete with GGBS content of varying percentages.

For this exercise, the scope includes the whole mall. Appendix C presents

the detailed calculations and assumptions for Mall of Oman.

BASE CASE — 374,681,003 $kgCO_2$

AS-BUILT — 298,147,206 $kgCO_2$

Total savings

20%

76,534 tCO_2e for
Stage A1 to A4 & D
(for timber)

THE WAY FORWARD

Carbon Benchmarks allows for future new constructions to use a standard point of reference for design and construction purposed. They also allow for client and design teams to understand what can be improved upon and in what area.
With the initiation of this study, Majid Al Futtaim has taken the first step towards developing their own Carbon Benchmark. To further this commitment and work towards the 2040 goal of Net Positive Carbon, this exercise needs to be pursued for different assets typologies due to the diverse range of businesses and operations under Majid Al Futtaim's portfolio.

PHASE 01
OFFICES

PHASE 02
MALLS

PHASE 03
STANDALONE RETAILS

PHASE 04
HOTELS

PHASE 05
ENTERTAINMENT & CINEMA (LEC)

A

APPENDIX

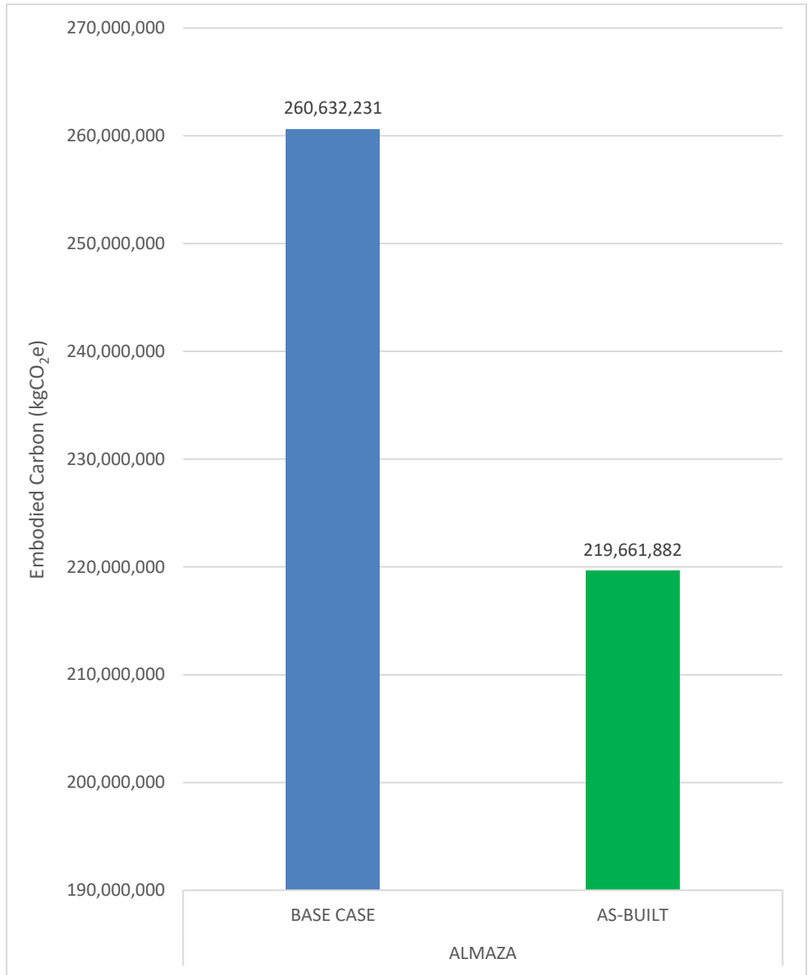
CITY CENTRE ALMAZA
CALCULATIONS,
ASSUMPTIONS AND
INFORMATION

CITY CENTRE ALMAZA EMBODIED CARBON SAVINGS SUMMARY

PROJECT SUMMARY		
Built Up Area - BUA (m^2)	284,782	m^2
Base Case Emissions	260,632,231	$kgCO_2$
	915	$kgCO_2e/m^2$
As-Built Emissions	219,661,882	$kgCO_2e$
	771	$kgCO_2e/m^2$

CARBON SAVINGS SUMMARY		
Overall Savings	40,970,349	$kgCO_2e$
	144	$kgCO_2e/m^2$
% Savings over baseline	16%	

OVERALL SAVINGS **40,970,349 $kgCO_2$**



BASE CASE CITY CENTRE ALMAZA EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	260,632,231

MATERIALS	CATEGORY	MATERIAL DETAILS			EMBODIED CARBON ($kgCO_2$)	RME NOTES / COMMENTS
		CARBON (kgCO2e/ unit*)	*QUANTITY UNIT	QUANTITY		
CONCRETE	CONCRETE (C20)	0.112	kg	46,219,200	5,176,550	The Carbon Factors are derived from ICE DB V3 The baseline case considers concrete with no GGBS.
	CONCRETE (C35/45)	0.138	kg	456,201,600	62,955,821	
	CONCRETE (C5)	0.159	kg	55,440	8,815	
	GENERAL CONCRETE	0.103	kg	225,280	23,204	
	LIGHT WEIGHT CONCRETE	0.28	kg	5,433,120	1,521,274	
MASONRY		333 kgCO2e/m3	m3	116,196.00	38,693,268	Obtained from BOQ
STEEL	STRUCTURAL	2.46 kgCO2e/kg	kg	6,025,000.00	14,821,500	Obtained from BOQ Carbon factors are derived from ICE DB V3
	REINFORCEMENT	1.99 kgCO2e/kg	kg	26,689,230.00	53,111,568	
METAL WORK	METAL	4.303 kgCO2e/kg	kg	389,880.00	1,677,654	UK Government GHG Conversion Factors for Company Reporting - Metal
	ALUMINIUM	13.1 kgCO2e/kg	kg	57,689.46	755,732	ICE DB v3 Embodied Carbon for general aluminium
PAINTS / COATINGS & FINISHES		6.68 kgCO2e/m2	m2	552,367.00	3,689,812	Obtained from BOQ
FLOORINGS		10.5 kgCO2e/m2	m2	36,381.00	382,001	Obtained from BOQ
GLASS		1.626 kgCO2e/kg	kg	249,692.48	406,000	Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building-glass.com/en-gb/architects/physical-properties) Thickness of 8mm considered for double glazing (assuming 4mm thickness of each glass pane)
TIMBER		0.49 kgCO2e/kg	kg	26,200.00	12,838	The embodied carbon value is from the ICE Database.
OTHERS		-	N/A	-	28,381,886	This includes materials that fall under the categories above. However, different variations of Carbon Factors were considered based on the materials specifications in the BOQ
TRANSPORTATION (+1% of the total)		-	N/A	2,580,517.14	2,580,517	-
OTHER MATERIALS (20% of the total)		-	N/A	-	51,610,343	This category consists of materials not mentioned above and materials that are part of the operational phase (such as Façade system, HVAC systems) which will have embodied carbon value for stage A1 to A3.

AS-BUILT CITY CENTRE ALMAZA EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	219,661,882

MATERIALS	CATEGORY	MATERIAL DETAILS			EMBODIED CARBON ($kgCO_2$)	RME NOTES / COMMENTS
		CARBON (kgCO2e/ unit*)	*QUANTITY UNIT	QUANTITY		
CONCRETE	CONCRETE (C20)	0.11	kg	46,219,200	5,084,112	70% GGBS content is assumed for 90% of concrete The Carbon Factors are derived from ICE DB V3 The baseline case considers concrete with no GGBS.
	CONCRETE (C35/45)	0.063	kg	456,201,600	28,740,701	
	CONCRETE (C5)	0.159	kg	55,440	8,815	
	GENERAL CONCRETE	0.103	kg	225,280	23,204	
	LIGHT WEIGHT CONCRETE	0.28	kg	5,433,120	1,521,274	
MASONRY		333 kgCO2e/m3	m3	116,196.00	38,693,268	Obtained from BOQ
STEEL	STRUCTURAL	0.357 kgCO2e/kg	kg	6,025,000.00	8,106,095	Obtained from BOQ Carbon factors are derived from ICE DB V3
	REINFORCEMENT	1.99 kgCO2e/kg	kg	26,689,230.00	53,111,568	
METAL WORK	METAL	4.303 kgCO2e/kg	kg	389,880.00	1,677,654	UK Government GHG Conversion Factors for Company Reporting - Metal
	ALUMINIUM	13.1 kgCO2e/kg	kg	57,689.46	755,732	ICE DB v3 Embodied Carbon for general aluminium
PAINTS / COATINGS & FINISHES		6.68 kgCO2e/m2	m2	552,367.00	3,689,812	Obtained from BOQ
FLOORINGS		10.5 kgCO2e/m2	m2	36,381.00	382,001	Obtained from BOQ
GLASS		1.626 kgCO2e/kg	kg	249,692.48	406,000	Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building- glass.com/en-gb/architects/physical-properties) Thickness of 8mm considered for double glazing (assuming 4mm thickness of each glass pane)
TIMBER		(-1.03) kgCO2e/kg	kg	26,200.00	-26,986	The embodied carbon value is from the ICE Database.
OTHERS		-	N/A	-	28,381,886	This includes materials that fall under the categories above. However, different variations of Carbon Factors were considered based on the materials specifications in the BOQ
TRANSPORTATION (+10% of the total)		-	N/A	-	2,580,517	-
OTHER MATERIALS (20% of the total)		-	N/A	-	51,610,343	This category consists of materials not mentioned above and materials that are part of the operational phase (such as Façade system, HVAC systems) which will have embodied carbon value for stage A1 to A3.

B

APPENDIX

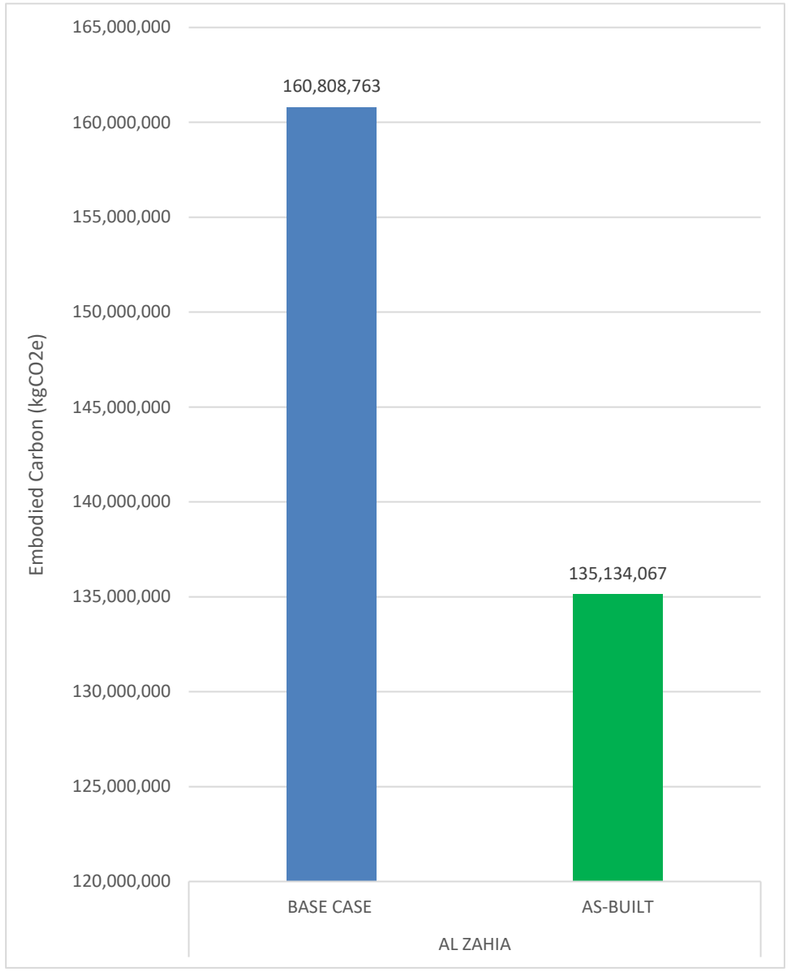
CITY CENTRE AL ZAHIA
CALCULATIONS,
ASSUMPTIONS AND
INFORMATION

CITY CENTRE AL ZAHIA EMBODIED CARBON SAVINGS SUMMARY

PROJECT SUMMARY		
Built Up Area - BUA (m^2)	180,000	m^2
Base Case Emissions	160,808,763	$kgCO_2$
	893	$kgCO_2e/m^2$
As-built Emissions	135,134,067	$kgCO_2e$
	751	$kgCO_2e/m^2$

CARBON SAVINGS SUMMARY		
Overall Savings	25,674,696	$kgCO_2e$
	142	$kgCO_2e/m^2$
% Savings over baseline	16%	

OVERALL SAVINGS **25,674,696 $kgCO_2$**



BASE CASE CITY CENTRE AL ZAHIA EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	160,808,763

MATERIALS	CATEGORY	MATERIAL DETAILS			EMBODIED CARBON ($kgCO_2$)	RME NOTES / COMMENTS
		CARBON (kgCO2e/ unit*)	*QUANTITY UNIT	QUANTITY		
CONCRETE	POURED CONCRETE (40MPa)	0.138 kgCO2e/kg	kg	320,399,098	44,215,076	The Carbon Factors are derived from ICE DB V3 The baseline case considers concrete with no GGBS.
	GENERAL CONCRETE	0.103 kgCO2e/kg	kg	24,598,235	2,533,618	
	LIGHT WEIGHT CONCRETE	0.28 kgCO2e/kg	kg	6,919,200.00	1,937,376	
	POURED CONCRETE (14MPa)	0.105 kgCO2e/kg	kg	7,368,000.00	773,640	
	PRECAST CONCRETE	0.148 kgCO2e/kg	kg	262,800.00	38,894	
	POURED CONCRETE (C44)	0.149 kgCO2e/kg	kg	6,362,400.00	947,998	
MASONRY		333 kgCO2e/m3	m3	24,204.83	8,060,209	Obtained from BOQ
STEEL	STRUCTURAL	2.46 kgCO2e/kg	kg	1,895,551.04	4,663,056	Obtained from BOQ Carbon factors are derived from ICE DB V3
	REINFORCEMENT	1.99 kgCO2e/kg	kg	47,427.00	94,380	
METAL WORK	METAL	4.303 kgCO2e/kg	kg	35,654.26	153,420	UK Government GHG Conversion Factors for Company Reporting - Metal
	ALUMINIUM	13.1 kgCO2e/kg	kg	309,189.60	4,050,384	ICE DB v3 Embodied Carbon for general aluminium
PAINTS / COATINGS & FINISHES		6.68 kgCO2e/m2	m2	126,552.81	845,373	Obtained from BOQ
FLOORINGS		10.5 kgCO2e/m2	m2	30,132.00	316,386	Obtained from BOQ
GLASS		1.626 kgCO2e/kg	kg	171,140.00	278,274	Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building- glass.com/en-gb/architects/physical-properties) Thickness of 8mm considered for double glazing (assuming 4mm thickness of each glass pane)
TIMBER		0.49 kgCO2e/kg	kg	20,711.00	10,148	The embodied carbon value is from the ICE Database.
OTHERS		-	N/A	-	58,455,046.3	This includes materials that fall under the categories above. However, different variations of Carbon Factors were considered based on the materials specifications in the BOQ
TRANSPORTATION (+1% of the total)		-	N/A	-	1,592,166	-
OTHER MATERIALS (20% of the total)		-	N/A	-	31,843,319	This category consists of materials not mentioned above and materials that are part of the operational phase (such as Façade system, HVAC systems) which will have embodied carbon value for stage A1 to A3.

AS-BUILT CITY CENTRE AL ZAHIA EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	135,134,067

MATERIALS	CATEGORY	MATERIAL DETAILS			EMBODIED CARBON ($kgCO_2$)	RME NOTES / COMMENTS
		CARBON (kgCO2e/ unit*)	*QUANTITY UNIT	QUANTITY		
CONCRETE	POURED CONCRETE (70% GGBS)	0.068 kgCO2e/kg	kg	286,348,546	19,471,701	GGBS Content is obtained from BOQ The Carbon Factors are derived from ICE DB V3 The baseline case considers concrete with no GGBS.
	POURED CONCRETE (50% GGBS)	0.095 kgCO2e/kg	kg	34,050,552	3,234,802	
	GENERAL CONCRETE	0.103 kgCO2e/kg	kg	24,598,235	2,533,618	
	LIGHT WEIGHT CONCRETE	0.28 kgCO2e/kg	kg	6,919,200.00	1,937,376	
	POURED CONCRETE (14MPa 70% GGBS)	0.047 kgCO2e/kg	kg	7,368,000.00	346,296	
	PRECAST CONCRETE	0.148 kgCO2e/kg	kg	262,800.00	38,894	
	POURED CONCRETE (C44)	0.149 kgCO2e/kg	kg	6,362,400.00	947,998	
MASONRY		333 kgCO2e/m3	m3	24,204.83	8,060,209	Obtained from BOQ
STEEL	STRUCTURAL	0.357 kgCO2e/kg	kg	1,895,551.04	955,756	Value derived from EP Ref: S-P-04450 (for 93% of structural steel)
	REINFORCEMENT	1.99 kgCO2e/kg	kg	47,427.00	94,380	Obtained from BOQ Carbon factors are derived from ICE DB V3
METAL WORK	METAL	4.303 kgCO2e/kg	kg	35,654.26	153,420	UK Government GHG Conversion Factors for Company Reporting - Metal
	ALUMINIUM	13.1 kgCO2e/kg	kg	309,189.60	4,050,384	ICE DB v3 Embodied Carbon for general aluminium
PAINTS / COATINGS & FINISHES		6.68 kgCO2e/m2	m2	126,552.81	845,373	Obtained from BOQ
FLOORINGS		10.5 kgCO2e/m2	m2	30,132.00	316,386	Obtained from BOQ
GLASS		1.626 kgCO2e/kg	kg	171,140.00	278,274	Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building- glass.com/en-gb/architects/physical-properties) Thickness of 8mm considered for double glazing (assuming 4mm thickness of each glass pane)
TIMBER		(-)1.03 kgCO2e/kg	kg	20,711.00	-21,332	The embodied carbon value is from the ICE Database.
OTHERS		-	N/A	-	58,455,047	This includes materials that fall under the categories above. However, different variations of Carbon Factors were considered based on the materials specifications in the BOQ
TRANSPORTAION (+1% of the total)		-	N/A	-	1,592,166	-
OTHER MATERIALS (20% of the total)		-	N/A	-	31,843,319	This category consists of materials not mentioned above and materials that are part of the operational phase (such as Façade system, HVAC systems) which will have embodied carbon value for stage A1 to A3.

C

APPENDIX

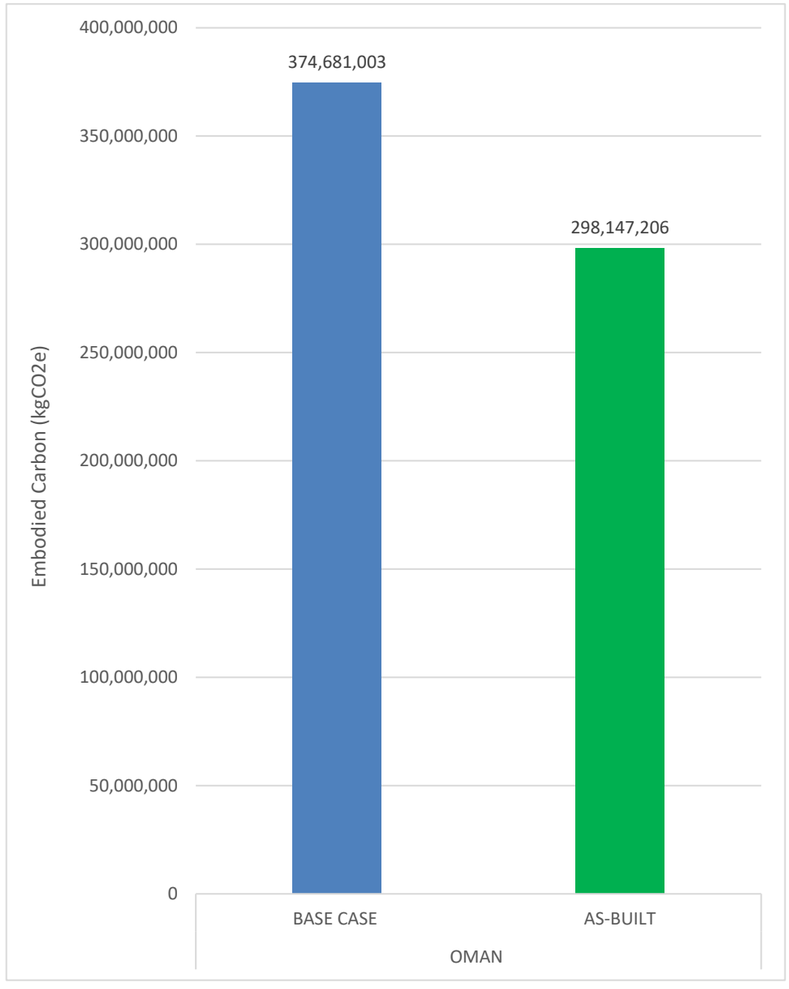
MALL OF OMAN
CALCULATIONS,
ASSUMPTIONS AND
INFORMATION

MALL OF OMAN EMBODIED CARBON SAVINGS SUMMARY

PROJECT SUMMARY		
Built Up Area - BUA (m^2)	428,700	m^2
Base Case Emissions	374,681,003	$kgCO_2$
	874	$kgCO_2e/m^2$
As-built Emissions	298,147,206	$kgCO_2e$
	695	$kgCO_2e/m^2$

CARBON SAVINGS SUMMARY		
Overall Savings	76,533,797	$kgCO_2e$
	179	$kgCO_2e/m^2$
% Savings over baseline	20%	

OVERALL SAVINGS **76,533,797 $kgCO_2$**



BASE CASE MALL OF OMAN EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	374,681,003

MATERIALS	CATEGORY	MATERIAL DETAILS			EMBODIED CARBON ($kgCO_2$)	RME NOTES / COMMENTS
		CARBON (kgCO2e/ unit*)	*QUANTITY UNIT	QUANTITY		
CONCRETE	IN-SITU (Grade 25/20)	0.112	kg	33,272,399	3,726,509	GGBS Content is obtained from BOQ The Carbon Factors are derived from ICE DB V3 The baseline case considers concrete with no GGBS.
	IN-SITU (Grade 50/60)	0.159	kg	320,769,612	51,002,368	
	IN-SITU (Grade 45/36)	0.149	kg	292,418,354	43,570,335	
	GENERAL CONCRETE	0.103	kg	32,179,020.83	3,314,439	
	PRECAST CONCRETE	0.148	kg	661,624.74	97,920	
	IN-SITU (C40)	0.138	kg	72,000.00	9,936	
	IN-SITU (C30)	0.119	kg	1,276,890.86	151,950	
MASONRY		333 kgCO2e/m3	m3	24,288.64	8,088,117	Obtained from BOQ
STEEL	STRUCTURAL	2.46 kgCO2e/kg	kg	12,178,308.79	29,958,640	Obtained from BOQ Carbon factors are derived from ICE DB V3
	REINFORCEMENT	1.99 kgCO2e/kg	kg	50,684,770.24	100,862,693	
METAL WORK	METAL	4.303 kgCO2e/kg	kg	2,582,205.50	11,111,230	UK Government GHG Conversion Factors for Company Reporting - Metal
	ALUMINIUM	13.1 kgCO2e/kg	kg	833,596.52	10,920,114	ICE DB v3 Embodied Carbon for general aluminium
PAINTS / COATINGS & FINISHES		6.68 kgCO2e/m2	m2	918,018.00	6,132,360	Obtained from BOQ
FLOORINGS		10.5 kgCO2e/m2	m2	114,957.25	1,207,051	Obtained from BOQ
GLASS		1.626 kgCO2e/kg	kg	116,396.75	189,261	Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building- glass.com/en-gb/architects/physical-properties) Thickness of 8mm considered for double glazing (assuming 4mm thickness of each glass pane)
TIMBER		0.49 kgCO2e/kg	kg	233,164.25	114,250	The embodied carbon value is from the ICE Database.
OTHERS		-	N/A	-	30,046,366	This includes materials that fall under the categories above. However, different variations of Carbon Factors were considered based on the materials specifications in the BOQ
TRANSPORTATION (+1% of the total)		-	N/A	-	3,709,713	-
OTHER MATERIALS (20% of the total)		-	N/A	-	74,194,258	This category consists of materials not mentioned above and materials that are part of the operational phase (such as Façade system, HVAC systems) which will have embodied carbon value for stage A1 to A3.

AS-BUILT MALL OF OMAN EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	298,147,206

MATERIALS	CATEGORY	MATERIAL DETAILS			EMBODIED CARBON ($kgCO_2$)	RME NOTES / COMMENTS
		CARBON (kgCO2e/ unit*)	*QUANTITY UNIT	QUANTITY		
CONCRETE	IN-SITU (Grade 25/20)	0.112	kg	33,272,399	3,726,509	GGBS Content is obtained from BOQ The Carbon Factors are derived from ICE DB V3 The baseline case considers concrete with no GGBS.
	IN-SITU (Grade 50/60)	0.072	kg	320,769,612	23,095,412	
	IN-SITU (Grade 45/36)	0.068	kg	292,418,354	19,884,448	
	GENERAL CONCRETE	0.103	kg	32,179,020.83	3,314,439	
	PRECAST CONCRETE	0.148	kg	661,624.74	97,920	
	IN-SITU (C40)	0.138	kg	72,000.00	9,936	
	IN-SITU (C30)	0.119	kg	1,276,890.86	151,950	
MASONRY		333 kgCO2e/m3	m3	24,288.64	8,088,117	Obtained from BOQ
STEEL	STRUCTURAL	0.357 kgCO2e/kg	kg	12,178,308.79	5,372,096	Value derived from EP Ref: S-P-04450 (for 96% of structural steel)
	REINFORCEMENT	1.99 kgCO2e/kg	kg	50,684,770.24	100,862,693	Obtained from BOQ Carbon factors are derived from ICE DB V3
METAL WORK	METAL	4.303 kgCO2e/kg	kg	2,582,205.50	11,111,230	UK Government GHG Conversion Factors for Company Reporting - Metal
	ALUMINIUM	13.1 kgCO2e/kg	kg	833,596.52	10,920,114	ICE DB v3 Embodied Carbon for general aluminium
PAINTS / COATINGS & FINISHES		6.68 kgCO2e/m2	m2	918,018.00	6,132,360	Obtained from BOQ
FLOORINGS		10.5 kgCO2e/m2	m2	114,957.25	1,207,051	Obtained from BOQ
GLASS		1.626 kgCO2e/kg	kg	116,396.75	189,261	Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building-glass.com/en-gb/architects/physical-properties) Thickness of 8mm considered for double glazing (assuming 4mm thickness of each glass pane)
TIMBER		(-1.03) kgCO2e/kg	kg	233,164.25	-240,159	The embodied carbon value is from the ICE Database.
OTHERS		-	N/A	-	30,046,366	This includes materials that fall under the categories above. However, different variations of Carbon Factors were considered based on the materials specifications in the BOQ
TRANSPORTATION (+1% of the total)		-	N/A	-	3,709,713	-
OTHER MATERIALS (20% of the total)		-	N/A	-	74,194,258	This category consists of materials not mentioned above and materials that are part of the operational phase (such as Façade system, HVAC systems) which will have embodied carbon value for stage A1 to A3.