MAJID AL FUTTAIM EMBODIED CARBON PORTFOLIO

PHASE 01 - TOWER 1 AND TOWER 2

INTENDED FOR

ماجد الفطيم
MAJID AL FUTTAIM

DOCUMENT TYPE
REPORT

PROJECT NO.
1580000507

DATE
DECEMBER 30, 2020

DOCUMENT NO.

001-0507-S&R-REP

RAMBOLL Bright ideas. Sustainable change.

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PROJECT NO.	**1580000507**
RECIPIENT	**MAJID AL FUTTAIM**
DOCUMENT TYPE	**REPORT**
REVISION	**A**
DATE	**DECEMBER 30, 2020**
PREPARED BY	**HUNYUM MURYA**
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DOCUMENT NO.	**001-0507-S&R-REP**

REVISION	DATE	MADE BY	CHECKED BY	APPROVED BY	DESCRIPTION
A	30/12/2020	HM	NS	AA	CARBON PORTFOLIO FOR TOWER 1 AND TOWER 2

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EXECUTIVE SUMMARY

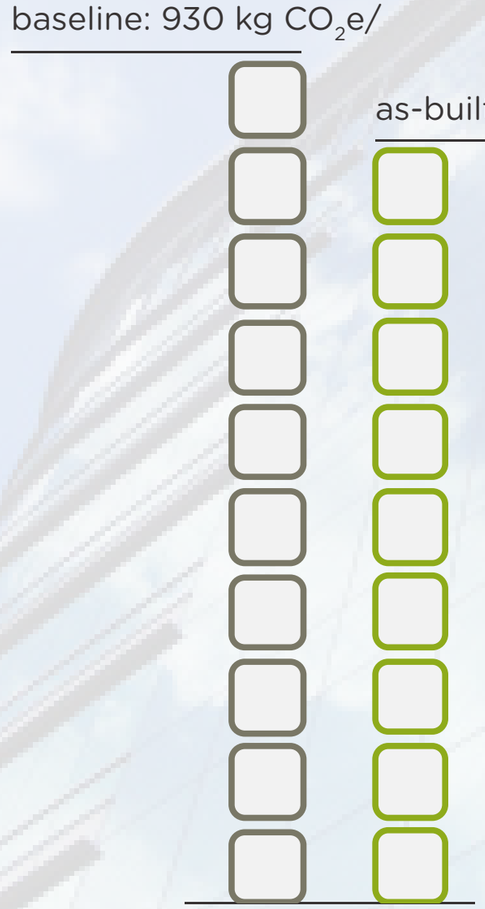
Majid Al Futtaim has daring and ambitious sustainability goals and commitments, wherein it aims to achieve Net Positive Carbon and Water for all operating companies by 2040. In 2018 Majid Al Futtaim signed the World Green Building Council (WGBC) Net Zero Carbon Buildings Commitment that would lead towards the decarbonisation 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 achievement of their Net Positive aspirations.

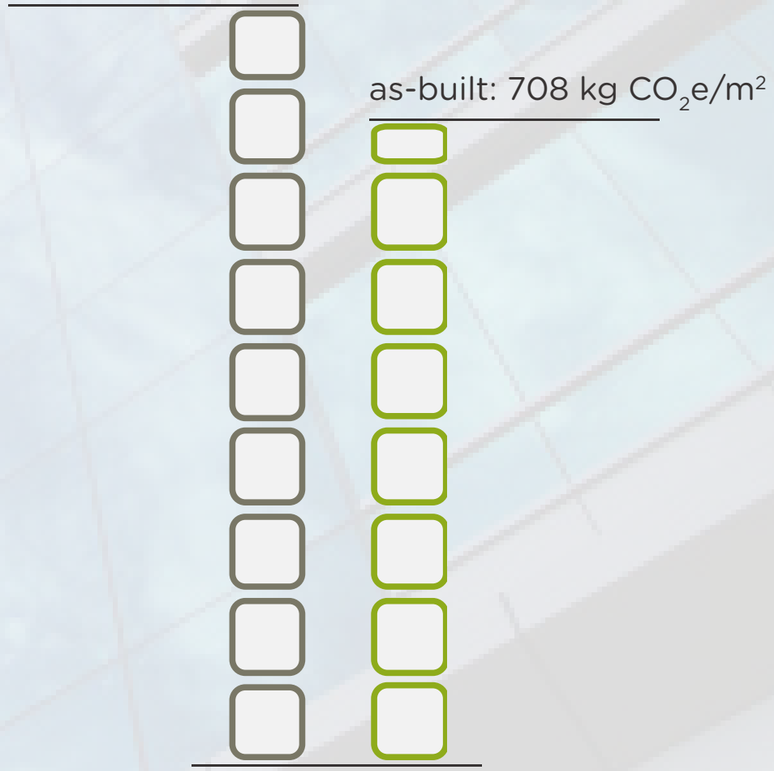
Majid Al Futtaim is one of the most progressive clients in the region who are pioneers of the sustainability agenda in various markets including the built environment. Their initiatives and attention towards embodied carbon at the client level, not only serves their own sustainability agenda, but also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

The embodied carbon study on MAF Tower 1 and MAF Tower 2 has further demonstrated that Majid Al Futtaim is the driver of sustainable change in the region. Our findings demonstrate the use of precast hollow core slab in MAF Tower 1. A more sustainable option as compared to reinforced concrete slab. Further, MAF Tower 1 does not have its own dedicated staff parking and shares its parking with City Centre Deira, thus sharing the carbon footprint of carbon intense parking levels. Both towers combined have an embodied carbon savings of up to 4.5Million kgCO2e against a no carbon savings scenario. This equates to around 25Million km of travel in today's average family car.

25M km
car travel



MAF TOWER 1
7% savings



MAF TOWER 2
14% savings

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 so, we 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 Buiilding 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 plan carbon accounting plan for future constructions.

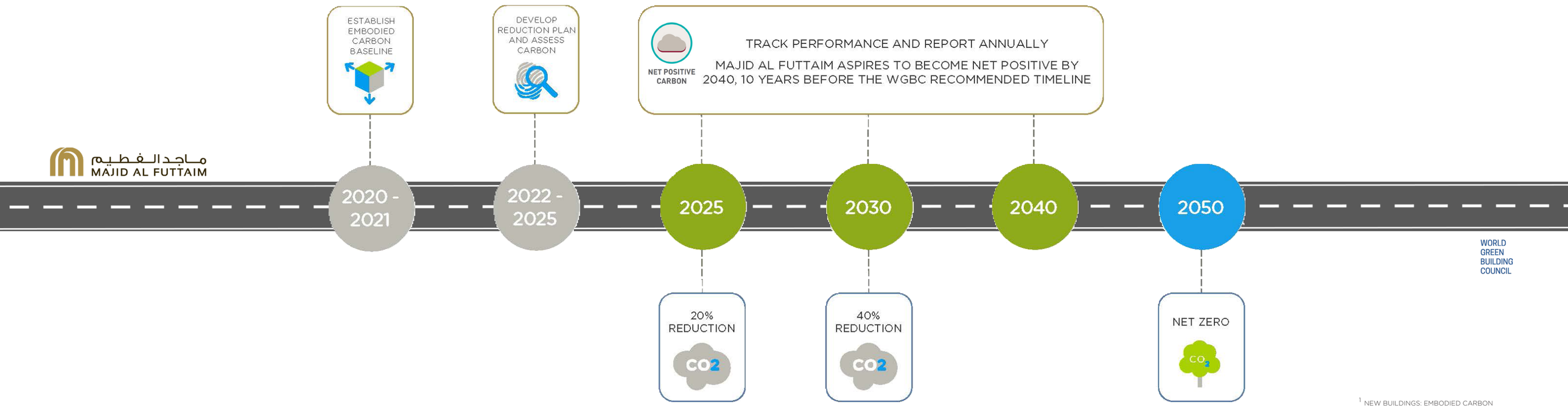
This report focuses on Majid Al Futtaim's headquarter offices - Tower 1 and Tower 2.

MAF Tower 1 was constructed in 1998. LEED ID+C Gold certification was targeted during the renovation of floor 3 in 2018 and floor 4 and floors 7 to 10 in 2014.

MAF Tower 2 was constructed in 2008 and achieved the LEED EBOM Platinum certification in 2019.

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-A3, D and where applicable A4) for the major materials and components.

Depending on availibility 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 attatinable 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 innacurate 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 requirments need to be regarded more closely in the future.

5 METHODOLOGY

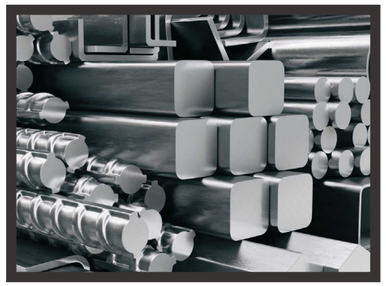
Outline the findings and methodology used during the exercise to find the carbon savings. Present the information in a report, start developing a benchmark for carbon intensity of various typologies and advise Majid Al Futtaim on the way forward.

CARBON ACCOUNT

Carbon Accounting is quantifiable way to measure direct and indirect GHG emissions. It helps businesses understand the climate impact that procurement and design choices can make. It helps businesses understand the 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 generates cna 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.

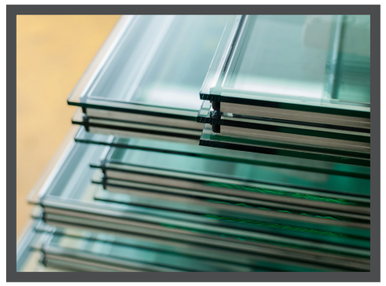
Special attention should be given to major materials and components such as concrete, steel, glazing, timber etc. The next section provides details on sources that can be used to gather carbon data for materials.



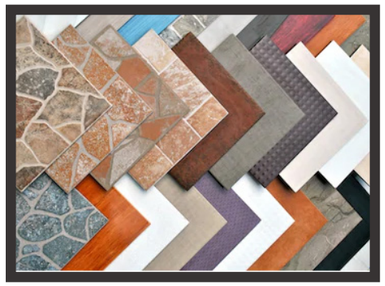
steel

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"

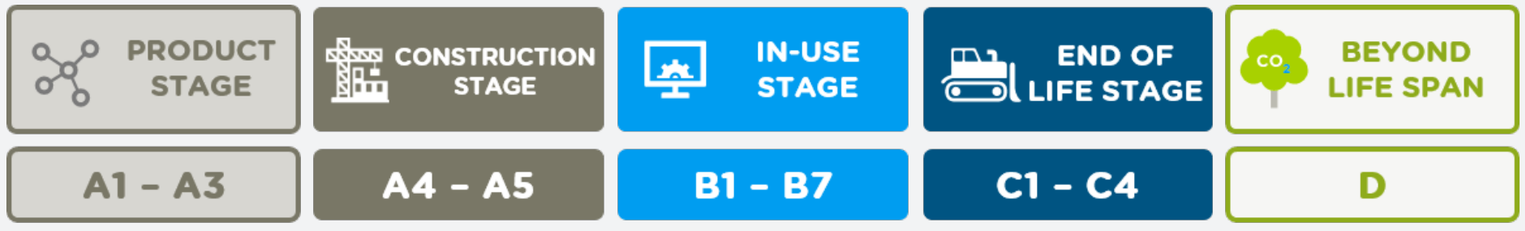
Stages A4 - A5 considers the carbon footprint left during the construction and transport of materials to the site

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 recyled beyond their life span (such as timber), which can then be used to offset the cumulative footprint

FIGURE XXX: System Boundary: EN 15978:2011 - Building Life Cycle Assessment Stages
For this report, Stages A1,-A3 and D were considered



CARBON REPORT

tower 1 & tower 2

METHODOLOGY

data collection

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

» Concrete

» Steel & Rebar

» Timber

» Insulation

» Interior Finishes

» Ceramics, Screed & Bricks

boundary condition

For the current phase of calculations, the LCA stages Production - A1 to A3 were considered. For timber specifically, LCA stage Reuse, Recycle or Recover - D was taken into account since wood is easily recyclable at the end of its life cycle.

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 ($kgCO_2e/t$)

» Quantity of material (tonnes)

Tower one

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 40% 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.

Main savings were reported by the use of hollow core slabs and shared parking with City Centre Deira. The baseline case considers a conventional structural concrete slab with no GGBS whereas the constructed case optimizes the structure through the use of hollowcore slab. Both scenarios do not consider any GGBS content considering the age of the building and the materials that were readily available during that time.

For this exercise, the scope was limited to basements and Floors 3 to 11.

Appendix A presents the detailed calculations and assumptions for Tower 1.

BASELINE — 29,167,416 $kgCO_2$

CONSTRUCTED — 27,045,559 $kgCO_2$

total savings

7%

2,122 tCO2e for
Stage A1 to A3 & D

Similar to Tower One, a total of 7 main material groups were considered with other materials accounting for 40% of the overall buildings embodied carbon.

Since Tower Two is a much recent construction, there were more savings seen between the baseline and constructed case. Savings were reported for timber, hollow core slabs and use of GGBS in the structural elements. The structural concrete for baseline once again considered no GGBS and conventional slabs, where as the constructued case has optimized on that by using hollowcore with GGBS in the cement mixture of RC walls, columns and slabs..

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.

For Tower Two, the scope considered the whole building along with basements.

Appendix B presents the detailed calculations and assumptions for Tower 2.

total savings

14%

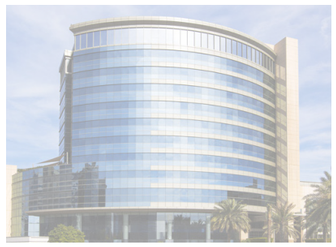
2,368 tCO2e for
Stage A1 to A3 & D

16,771,526 $kgCO_2$ — BASELINE

14,403,903 $kgCO_2$ — CONSTRUCTED

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 pursued for different assets typologies due to the diverse range of buisnesses 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)

APPENDIX

TOWER 1 CALCULATIONS, ASSUMPTIONS AND INFORMATION

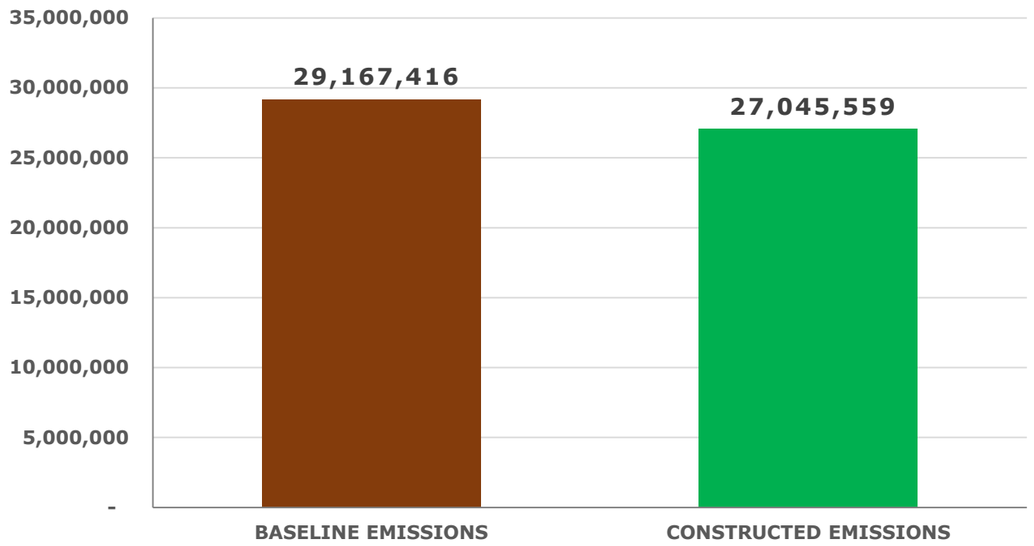
CARBON EMISSION SAVING SUMMARY

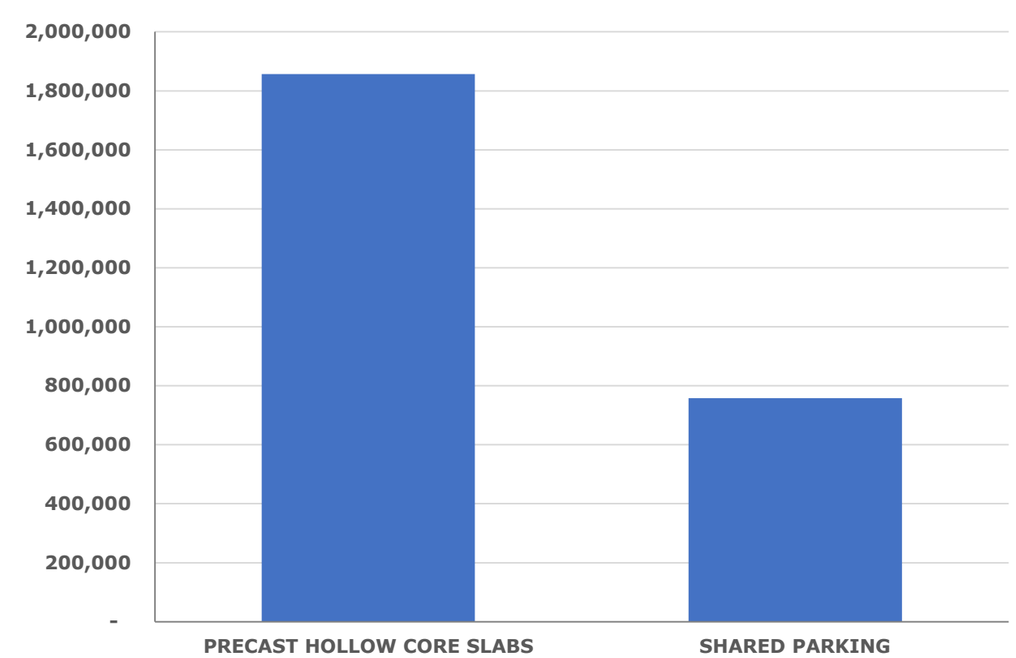
PROJECT SUMMARY		
Built Up Area - BUA (m^2)	31,373	m^2
Baseline Emissions	29,167,416	$kgCO_2$
	930	$kgCO_2e/m^2$
Constructed Emissions	27,045,559	$kgCO_2e$
	862	$kgCO_2e/m^2$

CARBON SAVINGS SUMMARY		
Main Material Savings	2,614,272	$kgCO_2e$
	83	$kgCO_2e/m^2$
Overall Savings	2,121,858	$kgCO_2e$
	68	$kgCO_2e/m^2$
% Savings over baseline	7%	

MAJOR MATERIAL SAVINGS		
Precast Hollow Core Slabs	1,856,682	$kgCO_2$
Shared Parking	757,589	$kgCO_2$

OVERALL SAVINGS 2,121,858





BASELINE MAF TOWER 1 EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	29,167,416.44

MATERIALS	CATEGORY	MATERIAL DETAILS			CARBON EMISSION ($kgCO_2$)		RME NOTES / COMMENTS
		CARBON (kgCO2e/qty unit*)	*QUANTITY UNIT	QUANTITY	EMBODIED	TOTAL	
BUILDING STRUCTURE	RC SLAB	0.16	KILOGRAM	9,058,348.94	1,440,277.48	12,982,370.42	A structural engineer has estimated the quantities based on the drawings and elevations provided. All structural elements consider a 25% safety margin to account other structural elements. The baseline case considers RC Slabs with no GGBS.
	PRECAST PLANKS	50.20	m^2	16,542.41	830,428.78		
	RC BEAMS	0.16	KILOGRAM	6,164,932.85	980,224.32		
	COLUMNS	0.20	KILOGRAM	854,552.18	166,637.68		
	WALLS	0.20	KILOGRAM	1,767,993.84	344,758.80		
	BASEMENT COLUMNS & WALLS	0.20	KILOGRAM	1,261,129.45	252,225.89		
	RAFT + FOOTING	0.22	KILOGRAM	16,508,127.24	3,598,771.74		
	BASEMENT PRECAST PLANKS	50.20	m^2	10,801.64	542,242.26		
	BASEMENT RC SLABS	0.16	KILOGRAM	5,507,215.45	875,647.26		
INTERNAL WALLS		N/A	N/A	N/A	3,894,711.13	3,894,711.13	Considered to be 30% of the building structural elements
INSULATION		196.00	m^3	278.76	54,636.96	62,832.50	The area of insulation has been extracted from the elevation and plan drawings provided. Knauf EPD for Rockwool used for embodied carbon reference - BREG EN EPD No. : 000097
GLASS		1,630.00	TONNE	134.19	218,729.70	251,539.16	Total glazing area = 3834 m^2 (Calculated from T1 elevation drawings) - Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building-glass.com/en-gb/architects/physical-properties) Typical Double Glazing setup: 8 mm (Glass) - 16 mm (Air) - 6 mm (Glass) - Total glass thickness in a double glazing assembly - 8 mm + 6 mm = 14 mm. Therefore, total glazing weight = 3834*2.5*14 = 134,190 kg = 134.2 tonnes Embodied carbon for double glazing - ICE DB v3
PAINTS / COATINGS		6.68	m^2	17,848.68	119,229.18	137,113.56	Paint area has been estimated based on the floor plans and elevation drawing. The estimated area has been multiplied by 2 to account for 2 coats of paint. A 20% additional area has been considered incase any walls have been missed out in the area calculations
FLOORINGS	TILES	10.50	m^2	1,734.76	18,214.93	20,947.17	Tiled and carpeted floor area has been estimated from the floor plans provided. From the LEED IAQ credit for Flooring, MAF tower has Carpet tiles and ceramic tiles. Vinyl tiles have been assumed in all FOH areas except office space. Carpet tiles have been assumed in the office areas.
	CARPETS	9.56	m^2	13,003.97	124,317.93	142,965.62	The embodied carbon of the Vinyl flooring comes from the Italian Ceramics EPD and the carpet tiles from Nordic Stories carpet EPD
WOOD PRODUCTS	TIMBER	0.49	KILOGRAM	14,058.23	6,930.70	7,970.31	Number of wooden doors were estimated from the floor plans for MAF Tower 1. The embodied carbon value is from the ICE Database.
OTHER MATERIALS (40% of the final total)		N/A	N/A	N/A	N/A	11,666,966.58	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.

NOTE: A 15% waste margin for all materials has been consider to account for construction waste onsite.

MAF TOWER 1 EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	27,045,558.81

MATERIALS	CATEGORY	MATERIAL DETAILS			CARBON EMISSION ($kgCO_2$)		RME NOTES / COMMENTS
		CARBON (kgCO2e/qty unit*)	*QUANTITY UNIT	QUANTITY	EMBODIED	TOTAL	
BUILDING STRUCTURE	HOLOW CORE SLAB	0.247	KILOGRAM	5,229,170.33	1,291,605.07	10,882,963.07	A structural engineer has estimated the quantities based on the drawings and elevations provided. All structural elements consider a 25% safety margin to account other structural elements. From the structural drawings provided it was noted that the hollow core slabs have been used in the project. This resulted in reduced concrete quantities resulting in lowering the overall building embodied carbon. UPB AS EPD for 200mm Hollow core slab (C40/50) used for embodied carbon reference - EPD Declaration No. : NEPD-397-280-EN
	SCREED + MESH	0.163	KILOGRAM	2,720,011.99	443,361.95		
	ROOF SLAB	0.159	KILOGRAM	624,203.24	99,248.31		
	RC BEAMS	0.159	KILOGRAM	4,879,753.96	775,880.88		
	COLUMNS	0.195	KILOGRAM	854,552.18	166,637.68		
	WALLS	0.195	KILOGRAM	1,767,993.84	344,758.80		
	RAFT BASEMENT (PARKING) + FOOTING	0.218	KILOGRAM	16,508,127.24	3,598,771.74		
	RAFT BASEMENT COLUMNS & WALLS	0.195	KILOGRAM	476,426.68	92,903.20		
	BASEMENT COLUMNS & WALL	0.195	KILOGRAM	784,702.77	76,508.52		A structural engineer has estimated the quantities based on the drawings and elevations provided. All structural elements consider a 25% safety margin to account other structural elements. Considering only half the impact of carbon from the basements from the baseline case as the parking in MAF Tower 1 is shared with City Centre Deira.
	BASEMENT BEAM	0.159	KILOGRAM	1,285,178.90	102,171.72		
	BASEMENT SLAB	0.247	KILOGRAM	3,489,650.14	430,971.79		
	BASEMENT SCREED + MESH	0.163	KILOGRAM	1,815,180.92	147,937.25		
INTERNAL WALLS		N/A	N/A	N/A	3,894,711.13	3,894,711.13	Same as the baseline case
INSULATION		196.00	m^3	278.76	54,636.96	62,832.50	The area of insulation has been extracted from the elevation and plan drawings provided. Knauf EPD for Rockwool used for embodied carbon reference - BREG EN EPD No. : 000097
GLASS		1,630.00	TONNE	134.19	218,729.70	251,539.16	Total glazing area = 3834 m^2 (Calculated from T1 elevation drawings) - Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building-glass.com/en-gb/architects/physical-properties) Typical Double Glazing setup: 8 mm (Glass) - 16 mm (Air) - 6 mm (Glass) - Total glass thickness in a double glazing assembly - 8 mm + 6 mm = 14 mm. Therefore, total glazing weight = 3834*2.5*14 = 134,190 kg = 134.2 tonnes Embodied carbon for double glazing - ICE DB v3
PAINTS / COATINGS		6.68	m^2	17,848.68	119,229.18	137,113.56	Paint area has been estimated based on the floor plans and elevation drawing. The estimated area has been multiplied by 2 to account for 2 coats of paint. A 20% additional area has been considered incase any walls have been missed out in the area calculations
FLOORINGS	TILES	10.50	m^2	1,734.76	18,214.93	163,912.79	Tiled and carpeted floor area has been estimated from the floor plans provided. From the LEED IAQ credit for Flooring, MAF tower has Carpet tiles and ceramic tiles. Vinyl tiles have been assumed in all FOH areas except office space. Carpet tiles have been assumed in the office areas. The embodied carbon of the Vinyl flooring comes from the Italian Ceramics EPD and the carpet tiles from Nordic Stories carpet EPD
	CARPETS	9.56	m^2	13,003.97	124,317.93		
WOOD PRODUCTS	TIMBER	-1.03	KILOGRAM	14,058.23	-14,479.97	-14,479.97	Number of wooden doors were estimated from the floor plans for MAF Tower 1. Certified wood has been considered for all doors as per the LEED calculator
OTHER MATERIALS		N/A	N/A	N/A	N/A	11,666,966.58	Same as the baseline case

NOTE: A 15% waste margin for all materials has been consider to account for construction waste onsite.

APPENDIX B

TOWER 2 CALCULATIONS, ASSUMPTIONS AND INFORMATION

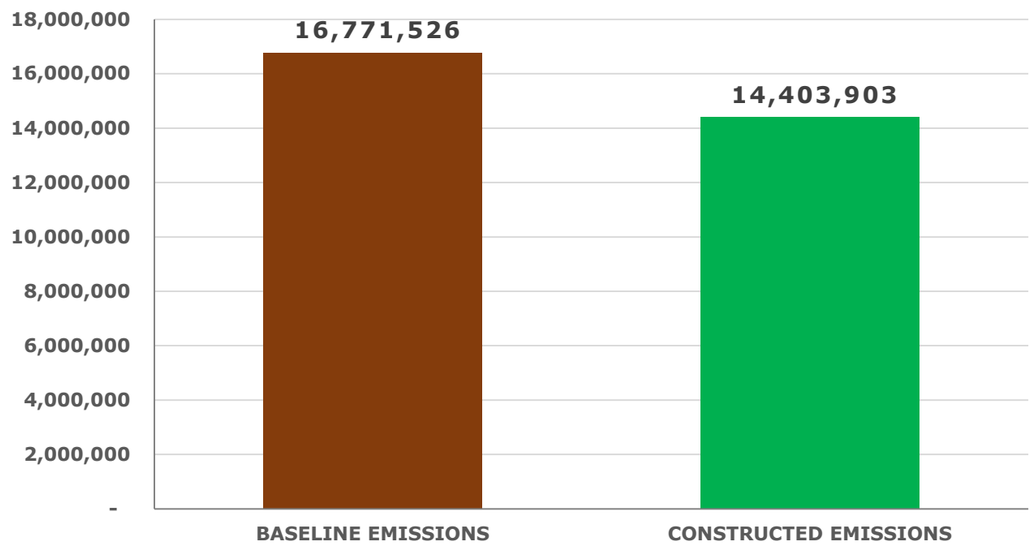
CARBON EMISSION SAVING SUMMARY

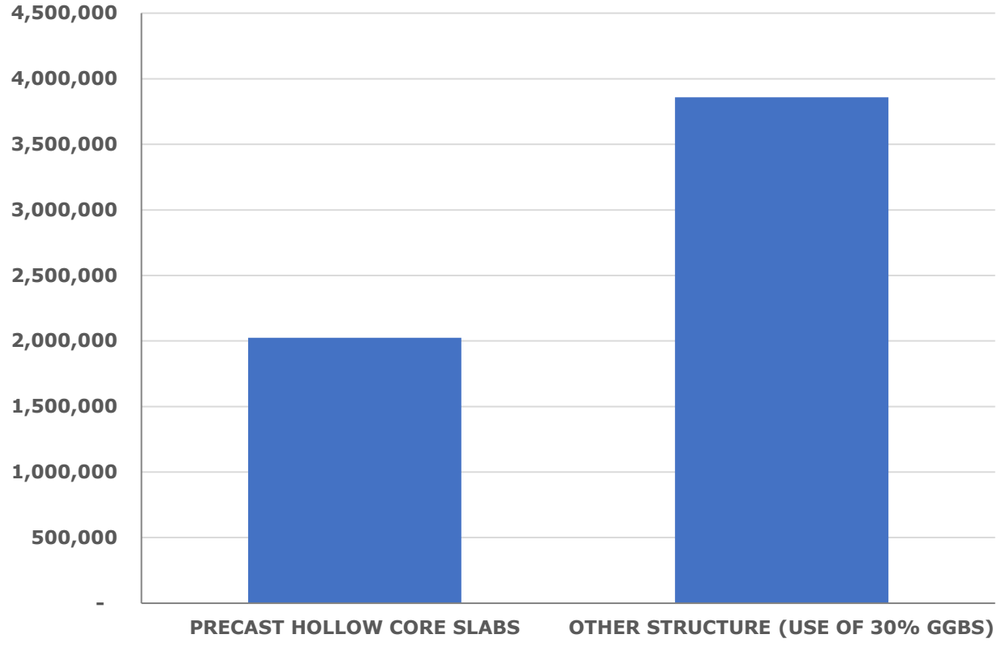
PROJECT SUMMARY		
Built Up Area - BUA (m^2)	20,336	m^2
Baseline Emissions	16,771,526	$kgCO_2$
	825	$kgCO_2e/m^2$
Constructed Emissions	14,403,903	$kgCO_2e$
	708	$kgCO_2e/m^2$

CARBON SAVINGS SUMMARY		
Main Material Savings	5,883,824	$kgCO_2e$
	289	$kgCO_2e/m^2$
Overall Savings	2,367,624	$kgCO_2e$
	116	$kgCO_2e/m^2$
% Savings over baseline	14%	

MAJOR MATERIAL SAVINGS		
Precast Hollow Core Slabs	2,023,488	$kgCO_2$
Other Structure (Use of 30% GGBS)	3,860,336	$kgCO_2$

OVERALL SAVINGS 2,367,624





BASELINE MAF TOWER 2 EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	16,771,526.40

MATERIALS	CATEGORY	MATERIAL DETAILS			CARBON EMISSION ($kgCO_2$)		RME NOTES / COMMENTS
		CARBON (kgCO2e/qty unit*)	*QUANTITY UNIT	QUANTITY	EMBODIED	TOTAL	
BUILDING STRUCTURE	RC SLAB	0.159	KILOGRAM	7,383,286.91	1,173,942.62	7,278,524.02	A structural engineer has estimated the quantities based on the drawings and elevations provided. All structural elements consider a 25% safety margin to account other structural elements. The baseline case considers RC Slabs with no GGBS.
	PRECAST PLANKS	50.2	m^2	13,594.28	682,433.08		
	RC BEAMS	0.159	KILOGRAM	4,110,436.66	653,559.43		
	COLUMNS	0.195	KILOGRAM	787,941.43	153,648.58		
	WALLS	0.195	KILOGRAM	1,186,402.76	231,348.54		
	BASEMENT COLUMNS & WALLS	0.195	KILOGRAM	519,634.52	101,328.73		
	RAFT + FOOTING	0.218	KILOGRAM	6,801,992.23	1,482,834.31		
	BASEMENT PRECAST PLANKS	50.2	m^2	4,450.70	223,424.96		
	BASEMENT RC SLABS	0.159	KILOGRAM	2,269,187.55	360,800.82		
INTERNAL WALLS		N/A	N/A	N/A	2,183,557.21	2,183,557.21	Considered to be 30% of the building structural elements.
INSULATION		196.00	m^3	270.17	52,953.32	60,896.32	The area of insulation has been extracted from the elevation and plan drawings provided. Knauf EPD for Rockwool used for embodied carbon reference - BREG EN EPD No. : 000097
GLASS		1,630.00	TONNE	174.90	285,092.14	327,855.96	Total glazing area = 4997.23 m^2 (Calculated from T2 elevation drawings) - Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building-glass.com/en-gb/architects/physical-properties) Typical Double Glazing setup: 8 mm (Glass) - 16 mm (Air) - 6 mm (Glass) - Total glass thickness in a double glazing assembly - 8 mm + 6 mm = 14 mm. Therefore, total glazing weight = 4997*2.5*14 = 174903.05 kg = 174.9 tonnes Embodied carbon for double glazing - ICE DB v3
PAINTS / COATINGS		6.68	m^2	14,073.58	94,011.53	108,113.26	Paint area has been estimated based on the floor plans and elevation drawing. The estimated area has been multiplied by 2 to account for 2 coats of paint. A 20% additional area has been considered incase any walls have been missed out in the area calculations
FLOORINGS	TILES	10.50	m^2	2,744.72	28,819.58	33,142.52	Tiled and carpeted floor area has been estimated from the floor plans provided. From the LEED IAQ credit for Flooring, MAF tower has Carpet tiles and ceramic tiles. Vinyl tiles have been assumed in all FOH areas except office space. Carpet tiles have been assumed in the office areas. The embodied carbon of the Vinyl flooring comes from the Italian Ceramics EPD and the carpet tiles from Nordic Stories carpet EPD
	CARPETS	9.56	m^2	5,680.46	54,305.19	62,450.97	
WOOD PRODUCTS	TIMBER	0.49	KILOGRAM	14,773.05	7,283.11	8,375.58	Number of wooden doors were estimated from the floor plans for MAF Tower 2. The embodied carbon value is from the ICE Database.
OTHER MATERIALS (40% of the final total)		N/A	N/A	N/A	N/A	6,708,610.56	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.

NOTE: A 15% waste margin for all materials has been consider to account for construction waste onsite.

MAF TOWER 2 EMBODIED CARBON

TOTAL EMBODIED CARBON ($kgCO_2$)	14,403,902.57

MATERIALS	CATEGORY	MATERIAL DETAILS			CARBON EMISSION ($kgCO_2$)		RME NOTES / COMMENTS
		CARBON (kgCO2e/qty unit*)	*QUANTITY UNIT	QUANTITY	EMBODIED	TOTAL	
BUILDING STRUCTURE	HOLOW CORE SLAB	0.247	KILOGRAM	5,698,963.94	1,407,644.09	5,883,823.98	A structural engineer has estimated the quantities based on the drawings and elevations provided. All structural elements consider a 25% safety margin to account other structural elements. From the structural drawings provided it was noted that the hollow core slabs have been used in the project. This resulted in reduced concrete quantities resulting in lowering the overall building embodied carbon. Further,30% GGBS has been considered for all concrete mixes. UPB AS EPD for 200mm Hollow core slab (C40/50) used for embodied carbon reference - EPD Declaration No. : NEPD-397-280-EN
	SCREED + MESH	0.163	KILOGRAM	2,964,380.44	483,194.01		
	ROOF SLAB	0.138	KILOGRAM	452,240.98	62,409.25		
	RC BEAMS	0.138	KILOGRAM	4,110,436.66	567,240.26		
	COLUMNS	0.156	KILOGRAM	1,085,229.30	169,295.77		
	WALLS	0.156	KILOGRAM	1,408,749.41	219,764.91		
	RAFT BASEMENT (PARKING) + FOOTING	0.174	KILOGRAM	6,801,992.23	1,183,546.65		
INTERNAL WALLS		N/A	N/A	N/A	2,183,557.21	2,183,557.21	Same as the baseline
INSULATION		196.00	m3	270.17	52,953.32	60,896.32	The area of insulation has been extracted from the elevation and plan drawings provided. Knauf EPD for Rockwool used for embodied carbon reference - BREG EN EPD No. : 000097
GLASS		1,630.00	TONNE	174.90	285,092.14	327,855.96	Total glazing area = 4997.23 m^2 (Calculated from T2 elevation drawings) - Density of glass is 2.5kg/m2 per mm of thickness (https://uk.saint-gobain-building-glass.com/en-gb/architects/physical-properties) Typical Double Glazing setup: 8 mm (Glass) - 16 mm (Air) - 6 mm (Glass) - Total glass thickness in a double glazing assembly - 8 mm + 6 mm = 14 mm. Therefore, total glazing weight = 4997*2.5*14 = 174903.05 kg = 174.9 tonnes Embodied carbon for double glazing - ICE DB v3
PAINTS / COATINGS		6.68	m^2	14,073.58	94,011.53	108,113.26	Paint area has been estimated based on the floor plans and elevation drawing. The estimated area has been multiplied by 2 to account for 2 coats of paint. A 20% additional area has been considered incase any walls have been missed out in the area calculations
FLOORINGS	TILES	10.50	m^2	2,744.72	28,819.58	33,142.52	Tiled and carpeted floor area has been estimated from the floor plans provided. From the LEED IAQ credit for Flooring, MAF tower has Carpet tiles and ceramic tiles. Vinyl tiles have been assumed in all FOH areas except office space. Carpet tiles have been assumed in the office areas. The embodied carbon of the Vinyl flooring comes from the Italian Ceramics EPD and the carpet tiles from Nordic Stories carpet EPD
	CARPETS	9.56	m^2	5,680.46	54,305.19	62,450.97	
WOOD PRODUCTS	TIMBER	-1.03	KILOGRAM	14,773.05	-15,216.24	-17,498.68	Number of wooden doors were estimated from the floor plans for MAF Tower 2. Same as MAF Tower 1, certified wood has been considered for all doors.
OTHER MATERIALS		N/A	N/A	N/A	N/A	5,761,561.03	Same as the baseline case

NOTE: A 15% waste margin for all materials has been consider to account for construction waste onsite.