MAHINDRA WORLD CITY, JAIPUR

CLIMATE POSITIVE ROADMAP

December 2014

MAHINDRA WORLD CITY JAIPUR – CLIMATE POSITIVE ROADMAP

December 2014

DOCOMENT CONTROL LOG

Document version number:	**1**
Date of submission:	**10/03/2014**
Document drafted and reviewed by:	**Sabah Usmani**
(05/03/2014)	

Document version number:	**2**
Date of submission:	**22/12/2014**
Document drafted and reviewed by:	**Sabah Usmani(01/12/2014)**
Reviewed by:	**Sunil Kurian(10/12/2014)**

Mahindra WORLD CITY
Jaipur

Table of Contents

1. EXECUTIVE SUMMARY

An increasing awareness of the impacts of climate change among Indian policy makers and the general public is evident, though priority continues to be given to economic and social development. India is a signatory to the United Nations Framework Convention on Climate Change (UNFCC) and is increasingly engaged in reducing carbon emissions and alleviating environmental degradation. "Frequent flooding and droughts, deforestation and desertification as well as possible glacial melting in the Himalayas have focused on climate change and provide strong impetus towards India's transition to a low-carbon economy."[1] As climate change mitigation becomes an increasingly important issue in India, we at Mahindra Lifespaces are striving to do our part in protecting the environment while simultaneously improving the quality of people's lives.

Sustainability continues to the core philosophy of Mahindra Lifespaces with the Company's mission of '**transforming urban landscaped by creating sustainable communities'**. Our participation in the C-40 Cities Climate Positive Development Program is in line with this mission of being in the forefront of sustainable urbanisation in India. The Company's sustainability roadmap takes the *triple-bottom line* approach of People-Profit-Planet, which captures an expended spectrum of value and criteria for measuring sustainability.

The Mahindra World City project in Jaipur is a development project of Mahindra World City Jaipur Limited, a subsidiary of Mahindra Lifespaces. As a candidate for C40's Climate Positive Development Program, Mahindra World City Jaipur provides an opportunity to be a model urban project, to implement climate change mitigation strategies for a large scale development

[1] "Understanding Energy Challenges in India". International Energy Agency. 2012.

project and do so in an economically and environmentally viable manner. In turn, we not only reduce our on-site greenhouse gas emissions but also improve the emission profile of the community at large.

Due to the large timescale of the development and long gestation period, the Climate Positive Roadmap for Mahindra World City Jaipur presented here will be reviewed periodically and continue to evolve to translate our goal to be a Climate Positive development into reality. Periodic updates of the roadmap will incorporate any changes in the design, government regulations and as well as adoption of any new technologies. Additionally, this roadmap will be used as a guiding document in the design, planning and implementation of all currently unplanned areas of the development (mainly, Non Processing Area).

Through participation in the CPDP, we aim to do our share in global climate change mitigation and serve as a model for sustainable urbanisation in India.

2. ABOUT MAHINDRA WORLD CITIES

As a pioneer of the concept of the Integrated Business City in India, the Mahindra World City delivers a unique ecosystem for working and living. We aim to create sustainable urban communities by establishing integrated business cities which enable the transformation of '*Life, Living and Livelihood*'. Presently operational at two key destinations, Chennai and Jaipur, Mahindra World City has drawn over 100 customers from the US, Europe and Asia who chose to locate their businesses within the two World Cities.

The premise of Mahindra World City is anchored on economic development and employment generation by creating global standard infrastructure to attract best-in-class businesses to invest in facilities within these spaces. In addition, the development of residential and social

infrastructure in Mahindra World Cities supports these facilities and catalyses a self-sustaining ecosystem.

3. PROJECT SUMMARY

Located just off National Highway 8 (Jaipur-Ajmer Highway) in the North-Western state of Rajasthan, the 3000-acre Mahindra World City in Jaipur (MWCJ) is a joint venture between Mahindra Group and Rajasthan State Industrial Development Corporation (RIICO), an agency of the Government of Rajasthan. Cooperation with the state government was carried out though a Memorandum of Understanding (MoU) with RIICO. This MoU establishes that the Government of Rajasthan State will have 26% stake in the project. The state government has played a key role in acquiring the 3000-acre plot for development and in facilitating the provision of water and power infrastructure to the site.

The master plan for Mahindra World City's Processing Area was prepared by the urban planning and design firm Jurong International (Singapore) in August 2007. The plan for the development has been divided into two zones: the **Processing Area (PA)** and the **Non-Processing Area (NPA)** *(Fig. 1)***.** The existing plan for PA consists of the development of four distinct Special Economic Zones (SEZs), and a Domestic Tariff Area (DTA) for providing employment in the service and manufacturing industries and producing goods for both foreign and domestic markets. The processing area covers a total of 2024 acres, while the remaining 976 acres is dedicated to the development of the non-processing area. Although the detailed masterplan for the NPA has not yet been development, it is planned to include a variety of residential facilities and social infrastructure including schools, petrol stations, parks, hospital and commercial spaces. The Mahindra World City Masterplan and detailed masterplan for the processing area (PA), developed by Jurong International, provides estimates of the preliminary power demand and population estimates for the non-processing area (NPA) which have been used to compute the

baseline emissions for this zone. These estimates are provided in *Table 5.2 – Power Demand Estimation for Non-Processing Area.*

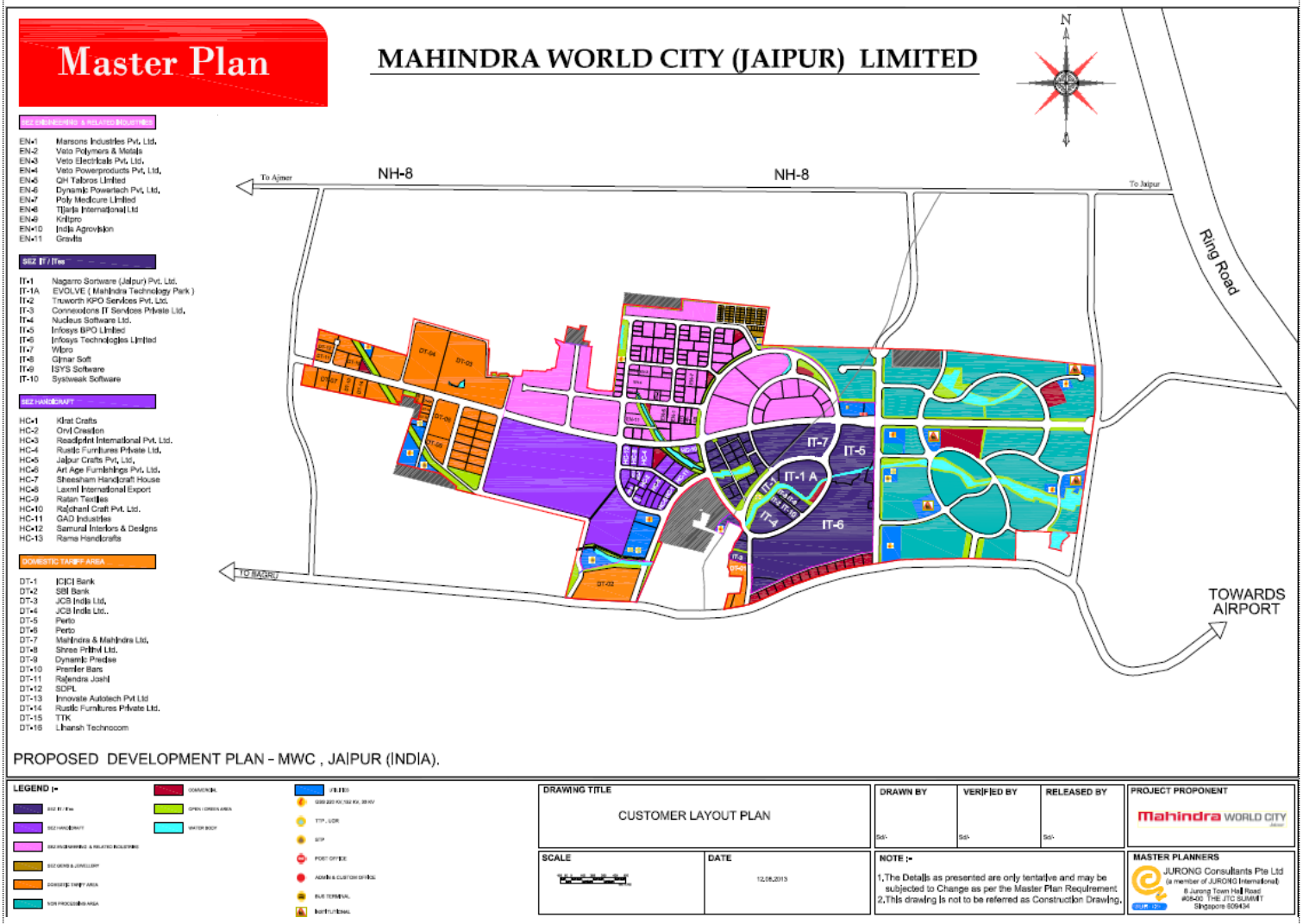
In accordance with the masterplan, the two bordering zones (PA and NPA) are to be connected via a road network. All facilities in the public realm including power supply and street lighting, water supply and distribution, sewerage system, storm water drainage system, telecommunications, roads network and other public amenities are integrated for the two zones. In order to be clear on terminology, all facilities in the public realm are part of the **Horizontal Infrastructure** of MWCJ, whilst all buildings, office campuses and manufacturing facilities developed by individual businesses/customers or directly by Mahindra Lifespaces on site collectively comprise the **Vertical Infrastructure** of the city.

The construction of horizontal infrastructure in MWCJ is currently underway. The development is taking place in a phase-wise manner with the development of PA completed before NPA. The horizontal infrastructure in the Processing Area will be developed in six phases, projected to be completed in 2017. The construction of the Vertical Infrastructure in the PA will be determined as land is leased out (99-year contract) to new businesses which will construct individual facilities and offices on site. The construction of Vertical Infrastructure in the NPA will include building new residential facilities, social infrastructure and mixed used commercial areas. The detailed masterplan and timeline for the development of these facilities (NPA) has not been finalised. Table 3.1 below summarises phase by phase development timeline and horizontal and vertical development.

Table 3.1: Development Timeline for Mahindra World City, Jaipur

		Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
		2008-2013 (5%)	2014-2017 (15%)	2018-2020 (25%)	2021-2023 (30%)	2023-2025 (25%)
		Total Built-Up Area (sq m)	Total Built-Up Area (sq m)	Total Built-Up Area (sq m)	Total Built-Up Area (sq m)	Total Built-Up Area (sq m)
A. IT/ITeS SEZ	Vertical Infra	45931.1	183724.5	413380.1	688966.8	918622.4
	Horizontal Infra	25087.9	100351.6	225791.1	376318.5	501758.0
B. Handicraft SEZ	Vertical Infra	41293.5	165174.2	371641.9	619403.2	825871.0
C. Engineering/ Related Industries SEZ	Vertical Infra	80684.3	322737.2	726158.7	1210264.5	1613686.0
D. GEMS&Jewellery	Vertical Infra	3378.7	13514.9	30408.5	50680.9	67574.5
E. HC,E&RI,G&J (Utilities)	Horizontal Infra	64936.3	259745.3	584426.9	974044.8	1298726.4
F. Domastic Tarif Area (DTA)	Veritcal Infra	69440.0	277759.9	624959.8	1041599.6	1388799.5
	Horizontal Infra	27028.8	108115.1	243259.0	405431.6	540575.5
G. Non-Processing Area	Vertical Infra	142848.5	571394.0	1285636.4	2142727.4	2856969.8
	Horizontal Infra	47399.7	189598.6	426596.9	710994.9	947993.1
TOTAL		5,48,028.81	2192115.3	4932259.3	82,20,432	1,09,60,576.25

It is essential for a project of this scale to ensure that the substantial positive impact, environmental, social, economic or otherwise, extends beyond the confines of the site influencing neighbouring communities. As part of C40's Climate Positive Development Program (CPDP), Mahindra World City Jaipur seeks to plan for, measure and verify this positive environmental impact though tracking and monitoring the development's operational carbon impact and implementing measures to reduce and offset this impact. The social and economic impact of the development of MWCJ and neighbouring communities is also a key concern and will be monitored with the help of periodic social impact assessments at various stages of the development but is not covered in the scope of this report.



3.1. Introduction: Life, Living and Livelihood

The need for new urban centres in India will require not just adequate infrastructure, but also proper planning and policy making, inclusion of all stakeholders, the need for sharing and refining living concepts and leveraging available strengths. All of these requirements rest on the pillars of Environmental, Social and Economic sustainability. Managing and seeking to ever

improve environmental performance, a critical pillar of sustainability, has therefore become imperative for all our development projects.

Mahindra has been a forerunner in creating planned sustainable urban spaces that enable *life, living and livelihood* making the synergy between leisure and work a reality. In line with this strategy, the PA and NPA regions are being planned and developed in MWCJ with the aim that the resident can enjoy this balance with little to no negative impacts on the environment. For example, mixed use residential developments with pedestrian facilities such as walkways, and footpaths encourage and increase walking while extensive bus networks provide a public transport alternative for employees and residents who would otherwise opt for cars. The Mahindra World City has been planned with its vision rooted in the future, and provides a holistic approach to sustainable living.

The table below provides the final estimate of the number of residents and employees expected to live and work in MWCJ:

Final Projected Number of Residents/Employees (NPA)	**134571***
Final Projected Number of Employees expected to work in MWCJ (PA)	**162160***
Total	**296732***

***Breakdown of calculations available in Appended Document 1: CPDP Calculations**

3.2. The Integrated Business City (Processing Area)

Covering a total of 2024 acres, the Processing Area includes Special Economic Zones (SEZ) for the following industrial sectors: Information Technology/IT Engineering Services, Engineering and Related Industries (including auto and auto component manufacturers), Handicrafts, Gems and Jewellery, and a Domestic Tariff Area (DTA). The IT/ITES SEZ is corporate India's largest IT-centric development and will consist of businesses in the BPO and software related service industries. At present, 44% of horizontal infrastructure and only 4% of vertical infrastructure of the Processing Area has been developed as 58% of land in the processing area, a total of 815.7 acres is currently unleased. The summary and breakdown of the development of Horizontal Infrastructure *(Table 3.1)* and Vertical Infrastructure including SEZs/DTA of the Processing Area development *(Table 3.2)* is provided in the tables below. As MWCJ is in a very early stage of development, the construction and development of the Non-Processing Area has not been initiated. The final proposed land use for the complete development is provided in Table 3.3.

Table 3.1: Horizontal Development Summary

	Total Developable Area (Acres)	**% Horizontal Development Completed as of date**
IT/ITES SEZ	136.5	76.7%
Engineering, Handicraft, Gems & Jewellery SEZ	338.6	28.6%
Domestic Tariff Area	151.8	50.0%
Non Processing Area	266	0.0%
Total	**892.5**	**31.1%**

Table 3.2: Vertical Development Summary

	Total Developable Area (Acres)	**% Vertical Development Completed as of date**
IT/ITES SEZ	361.8	9.5%
Engineering, Handicraft, Gems & Jewellery SEZ	685.9	2.1%
Domestic Tariff Area	348.2	0.2%
Non Processing Area	710.4	0.0%
Total	**2,106.4**	**6.3%**

Table 3.3: Summary of Final Proposed Land Use

Land Use	Area (Acres)
Residential	571.1
Commercial	138.7
Institutional	34.4
Industrial /Manufacturing	1362.3
Parks/Open Space	285.0
Utilities	85.5
Roads	522.0
Water Bodies	1.5
TOTAL	**3000.3**

Mahindra World City Ltd. is engaged in the development of all public facilities throughout the 3000+ acre development including a wide road network, stable electrical power, seamless data connectivity, a food court, ATMs and jogging tracks. The company is also responsible for professional maintenance of all public spaces and scenic landscaping for common areas within the premises. In addition to the development of all horizontal infrastructure and various public amenities, Mahindra World City Ltd. is developing a 1.6 million sq. ft. multi tenanted IT Park, called 'Evolve', within the IT/ITeS SEZ where companies will be offered ready-built floor space for rent. The IT Park consists of six buildings, four of which have been developed and are currently operational. At present, four companies have established their offices within Evolve IT Park and are included as part of the IT/ITeS SEZ calculations above. The remaining land plots within in the PA, including SEZ and DTA zones, will be available for businesses to acquire on a 99-year lease, a majority of which is currently unleased/undeveloped. Individual businesses develop their own manufacturing/service facilities in the respective zones. Table 3.4 below provides a list of all businesses currently operating in MWCJ, including those located within Evolve IT Park. The majority of facilities in the list are presently not operating at full capacity as development is underway.

Table 3.4: Processing Area – Updated List of Existing Customers/Businesses

T/ITeS SEZ	Handicraft SEZ	Engineering and Related Industries SEZ	Domestic Tariff Area
Nagarro Sortware (Jaipur)	Ratan Textiles	Marsons Industries	ICICI Bank Ltd.
Connexxions IT Services	Rediprint International	Veto Polymers & Metals	State Bank of India
Nucleus Software	Samurai Designs & Interiors	Veto Electricals	JCB
Infosys BPO	Jaipur Crafts	QH Talbros Limited	
Infosys Technologies	GAD Industries	Dynamic Powertech	
Truworth KPO Services	Kirat Crafts	Tijaria International	
Girnar Software	Seesham Handicraft House	India Agrovision	
Evolve IT Park: Deutsche Bank, GenPact, Systweak, EXL	Rajdhani Craft	Knitpro Designs LLP	
Tech Mahindra Ltd.	Laxmi Ideal Interiors	Poly Medicure Limited	
Wipro Ltd. (Phase I)	Rustic Furnitures	Gravita	
Wipro Ltd. (Phase II)	Art Age Furnishings		
Isys Softech	Heritage Prime Furniture		
	Rama Handicrafts		
	Orvi Design Studio LLP		

3.3. Site and Surrounding Area

Connectivity:

The Mahindra World City Jaipur site is located in Sanganer Tehsil in Rajasthan state's Jaipur district. The site is situated adjacent to National Highway 8, the Jaipur-Ajmer main highway, and provides a high level of accessibility to Jaipur International Airport (22 km from site), Sanganer Airport located (18 km from site), and Jaipur Railway Station (21 km from site). The Jaipur city centre is located 21 km from the MWCJ development and is easily accessible via road and public transport. The proposed Ring Road, the peripheral road of the Jaipur city, is located on the east of the development, a short distance away from the boundary. The Mahindra World City Jaipur is also close to the proposed Delhi–Mumbai Industrial Corridor which, when completed, will be accessible via the NH-8 Highway. The location map of Mahindra World City Jaipur (*Fig. 2*) highlights its connectivity to Jaipur City (*Old City*).

Fig.2: Map of Surrounding Area of MWCJ

Surrounding Area:

The development site is surrounded by various rural and urban zones in Sanganer Tehsil. There are seven villages in the Tehsil (sub-region) bordering the development which include Chirota, Sirani, Kapoorwala, Muhana, Kalwara, Mahapura, and Balawala village, with a collective population of approximately 16,000 residents. The location of villages with respect to the development is provided in the development masterplan (*Fig 1*). There are also various residential and urban areas surrounding the development site, including housing colonies

developed by government authorities with a total of more than 174,000 households which are connected by road networks and directly accessible from the main highway. The development site is also close to other industrial zones located at nearby Bhagru area. MWCJ is surrounded by several key institutional facilities including schools, colleges, universities and commercial facilities such as shops, restaurants, and banks located only a short distance from the site.

4. THE CLIMATE POSITIVE DEVELOPMENT PROGRAM

The Climate Positive Development Program (CPDP) was created to meet the pressing dual challenges of rapid urbanization and climate change. CPDP is a project under the Sustainable Communities Initiative of C40 Cities Climate Leadership Group and developed in partnership with the Clinton Climate Initiative and U.S Green Building Council. CPDP aims to create large-scale models and global good-practice examples of urban development that helps mitigate climate change through reducing carbon emissions in an economically sustainable manner.

CPDP developers seek to meet a "climate positive" emissions target of net-negative on-site, operational greenhouse gas emissions. This is achieved by reducing emissions on-site and off-setting emissions in the surrounding community, thus reducing overall operational carbon emissions and achieving a Climate Positive Outcome. In order to get "beyond carbon neutral" and achieve a Climate Positive Outcome, Development Partners earn Climate Positive Credits by sequestering emissions on-site and abating emissions from surrounding communities. There are many different paths to the Climate Positive outcome of net-negative operational GHG emissions. Each project will use a different set of strategies and technologies according to the project's local opportunities, guided by the Climate Positive Development Framework, which lays out the four stages of the Climate Positive journey.

CPDP facilitates knowledge-sharing across the program and related C40 networks, so that successful strategies can be replicated, and pitfalls can be avoided. CPDP also facilitates technical and logistical support to Development Partners by hosting learning programs and webinars, convening private sector firms to produce tools and templates for project use, increasing project visibility through various media channels, and granting access to technical experts and other partners within the CPDP and C40 network.

The Climate Positive Program primarily focuses on operational emissions. **Emissions associated with site preparation and construction phases will be tracked but will not count as operational emissions.**

The three key sources of operational emissions considered include **Electrical energy use, Waste, and Transportation.** [2]

[2] 'Framework for Climate Positive Communities'; Climate Positive Development Program; http://climatepositivedevelopment.org/download/attachments/294975/ClimatePositiveFramework+v1.0+2011+.pdf?version=1&modificationDate=1331574106709

Table 4.1: Four Stages of Climate Positive Development Program

Stage 1: Candidate: Project Application Accepted

Stage 2: Participant: Detailed Plans Approved

- Roadmap (strategies and tactics to achieve net negative GHG)
- Measurement and Verification Plan
- Partnerships
- Milestones

Stage 3: Progress Site: Development Following Roadmap

- Implementation
- Evidence that strategies and tactics are operational
- Measurement of emissions impact at milestones

Stage 4: Climate Positive: Project Completion

- Measurement and verification that net operational emissions are below zero

5. MAHINDRA WORLD CITY: OUR CLIMATE + ROADMAP

5.1. Methodology

This document sets up the Climate Positive Roadmap of Mahindra World City Jaipur (MWCJ) outlining the strategies that will result in the Climate Positive Outcome of net-negative operational metric tons of CO_2 emissions. This MWCJ Climate Positive Roadmap will be submitted for approval to C40 Climate Leadership Group for review. When approved, MWCJ will be recognised as a "Climate Positive Participant" (Stage 2). It is currently listed as a "Climate Positive Candidate" (Stage 1). The Climate Positive Roadmap will be incorporated as part of the overall sustainability strategy and sustainability roadmap for Mahindra World City Jaipur. Periodic reviews will be conducted to ensure that emission goals are being met as the development progresses. **The combinations of initiatives laid out in this roadmap will ensure that Mahindra World City Jaipur achieves net positive on-site operational carbon emissions by 2025 when it is expected to be operating at full capacity.**

The MWCJ Climate Positive Roadmap represents our approach to becoming Climate Positive. It is essential that the methods and means used to measure and verify the operational emissions for the completed facility are sound and consistent. We will be considering the emissions from the three key sources of operational emissions (Energy, Transport and Waste) separately. Our approach therefore involves first establishing a baseline to determine the amount of carbon emissions generated during the operational phase. These emissions will need to be reduced and offset in order to achieve a climate positive outcome. **This will be the Baseline Carbon Impact of the site.**

The two key strategies employed to offset emissions are:

Efficiency/Impact Reduction measures: These are measures that reduce the carbon impact from Energy, Transport and Waste, thereby reducing the total operational annual carbon emissions on site. These ***Carbon savings*** through efficiency measures are necessary to reduce the baseline emissions impact but are not sufficient to achieve a final climate positive outcome.

Credits: These measures often have an impact that extends beyond the boundary of the site. Credits help offset the remaining carbon emissions, resulting in net-negative emissions (Climate Positive Outcome). These measures involve reducing the emissions of the adjacent community or creating additional carbon sinks through carbon sequestration measures.

Table 5.1: Summary of MWCJ Climate+ Roadmap strategy

Climate Positive Strategy

1. Baseline Determination	Determine annual Baseline Emissions Impact from operation energy use, transportation and waste generation and determine **Total Baseline Carbon Impact** of MWCJ.
2. Efficiency Measures (Impact Reduction)	Include energy, transport and waste Impact reduction Strategies. Determine carbon savings from each measure. Subtract carbon savings from Baseline.
3. Site-Wide Strategies to be adopted (Impact Reduction + Credits)	Include large scale site wide impact reduction/credit projects. Carbon savings associated will be determined as development progresses. Subtract carbon savings and offset remaining baseline through credit projects.

Note: Emissions from construction activities on site will not be incorporated as part of the Baseline Carbon Impact of the site. Key Impact Reduction Strategies during the construction phase will also be included in the scope of this report but will not be used to offset baseline operational emissions.

5.2. Emissions Profile: Baseline Carbon Impact

The Baseline Carbon Impact is the metric used to quantify carbon emissions for Mahindra World City, Jaipur. This is useful in establishing a carbon offset goal for the development, which is the minimum carbon offset requirement for the development to achieve the Climate Positive Outcome. The scope for this roadmap includes the complete Mahindra World City Jaipur development, covering a total of 3000.3 acres. The summary of the breakdown for the final proposed land use, as detailed in the master plan, is provided in Table 3.3.

At present, only 4% of the vertical development is complete in Mahindra World City and therefore the Baseline represents, not the present operational emissions of the development t, but the best estimate of the operational emissions for the final projected development at full occupancy (final population: 323707) . This baseline estimate is considering the business-as-usual, or worst-case scenario, where no efficiency measures (impact reduction strategies) or climate credits measures are implemented beyond what is required to meet standard statutory compliances. As the final date for the completion of entire development (horizontal and vertical) has not been established, current emission factors are used to calculate the carbon emissions from energy, transport and waste. As the development progresses, adjustments will be made to incorporate up-to-date emission factors and updated baseline totals when the roadmap is periodically reviewed and revised.

The Baseline Carbon Impact will result from the activities of the residents, employees and visitors who live and work in Mahindra World City, Jaipur. Baseline is determined for the following three key sources of operational carbon emissions as specified in the Climate Positive Development Program Framework:

1. **Energy** from cooling, lighting and operations of all building & public facilities **(**Emissions from **provision and treatment of waste/wastewater** are included in the Energy Baseline)
2. **Waste** disposal/treatment (Emissions associated with waste generation are excluded from the scope)
3. **Transportation** (including private and public) within the site

5.3. Energy Baseline

The carbon impact from energy use is a key source of operational emissions for an estimated population of approximately 300,000 people expected to live and work within the site. In order to determine the power and energy demand for the site at full capacity, each of the 40 businesses currently operational on site were asked to provide the maximum power demand information for their individual facilities operating at full capacity. Where direct information from existing facilities was not available, in the case of undeveloped land plots, the average (KWh/m²) for each zone (SEZ or DTA) was used to determine an estimate maximum power demand for the area based on the projected working population. The total power demand for utilities, including water, sewage treatment, and street lighting was determined from estimates provided in the masterplan. The estimate of the maximum energy demand for the non-processing area are based on values provided in the master plan (*Table 5.2*).[3] The energy baseline figures exclude any efficiency measures already implemented to conserve energy on

[3] Details of energy demand in appended excel file Appended Document 1"CPDP Calculations – MAIN"

site. For example, savings from the implementation of LED street lighting have not been included and the energy use of conventional lamps has been assumed for baseline calculations.

Table 5.2: Power Demand Estimation Non-Processing Area
[Source: Jurong International MWCJ Master Plan]

Non-Processing Area	Land Area (ha)	FSA (ha)	Max Demand (MVA)
Low density	15.4	18.5	5
Medium density	192.7	308.3	62
Commercial	32.3	56.5	59
Auto Centre	15.3	23.0	24
Mixed use (Commercial/ Residential)	5.5	9.2	10
Institutional/Recreation	16.3	16.3	10
Utilities	8.6	0.9	0.6
Roads	67.7	-	0.34
Parks, Open Spaces & Buffers, temporary water bodies	60.4	-	0.18
Total for Non-Processing Area =	**434.7**		**171**

Table 3.17 Preliminary Power Demand Estimation for DTA

Non-Processing Area	Land Area (ha)	FSA (ha)	Max Demand (MVA)
General Engineering	70.8	53.1	56
DTA Logistics	32.6	16.3	6
Commercial	8.0	14.0	5
Utilities	16.5	1.7	1
Roads, Parks, Open Spaces & Buffers	52.5	-	0.2
Total for DTA Area =	**180.4**		**68**

Using a power factor of 0.9 (min. requirement), the standard ratio of 0.7 (70%) is used to compute the Average Demand from the Maximum Demand estimate. This ratio of maximum demand to average demand is a standard factor for the power sector in the state of Rajasthan. **The total final baseline energy demand is projected at 409563.8 MWh and 376259.0 MWh for the Processing and Non-Processing Areas respectively.** The detailed breakdown of the baseline energy demand for individual zones is provided in *Table 5.3* and *Appended Document 1: CPDP Calculations* (Excel).

For calculation of the baseline emissions from energy use on site, a business-as-usual scenario for energy demand is assumes. It is recognised that in such a scenario, the entire energy demand for Mahindra Word City Jaipur will be met by electricity from the regional electrical-

grid power. Electricity grid power in MWCJ is supplied by Jaipur Vidhyut Vikram Nigam Ltd (JVVNL), a government agency. JVVNL ensures that sufficient power is made available to meet the demands of the site. However, in case of any power failures, 100% power back up with the help of DG sets (diesel) have been proposed for all critical services on site.

The Indian electricity supply and distribution system is divided into two grids—1) the Integrated Northern, Eastern, Western, and North-Eastern regional grid (NEWNE) and 2) the Southern Grid. Each of the two grids which cuts across several states has a distinct energy mix and CO_2 emission factor. The state of Rajasthan comes under the NEWNE grid with a carbon emissions factor of 0.78 tCO_2e/MWh. [4] Table 5.3 below summarises the annual energy demand for the Processing and Non-Processing areas as well as the associated baseline tCO_2e emissions.

Table 5.3: Baseline Energy Carbon Impact for PA and NPA

	Energy Demand (MWh p.a)	**tCO_2e p.a**
Processing Area:		
IT/ITeS SEZ	87349.0	68132.2
Handicraft SEZ	75354.4	58776.4
Engineering/Related Industries SEZ	198381.1	154737.2
Gems & Jewelry	30851.6	24064.2
Domestic Tariff Area	104976.7	81881.8
Total (PA)	**496912.7**	**387591.9**
Non Processing Area:		
Residential	174026.2	135740.4
Social Infrastructure	202232.8	157741.6
Total (NPA)	**376259.0**	**293482.0**
TOTAL MWCJ Energy Demand	**873171.7**	**681073.9**

[4] Central Electricity Authority, Ministry of Power (Government of India), http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver6.pdf

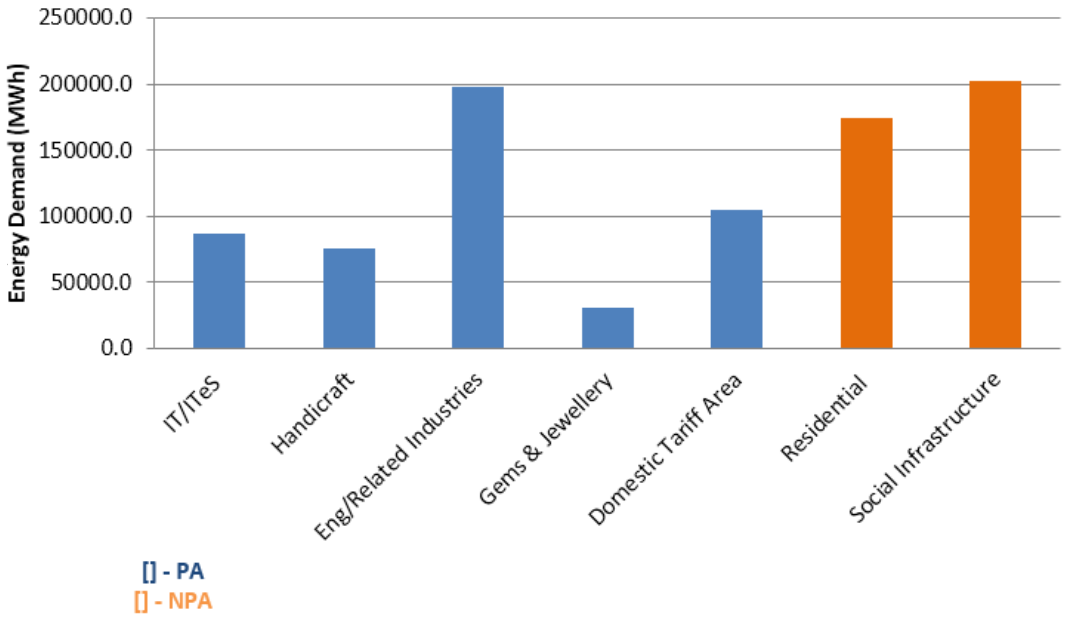


Fig.3: Graph of Final Projected Energy Demand

5.4. Water/Wastewater Baseline

Domestic and industrial water for Mahindra World City, Jaipur is supplied by the Public Health Engineering Department (PHED), an agency of the Government of India. The two sources of water supply include Mansarovar Water Works and the Bhisalpur Water Supply Project. The water supply to the development site will be increased in phases as per the requirement and occupancy of the development site. The baseline water calculation is the energy used for water pumping and transportation for water use and waste water treatment within Mahindra World City Jaipur. This includes the daily water use for residents and employees living and working in the World City, as well as the water use for processing areas and utilities for the city at full capacity (Year 2025 figures). Utilities include water use for landscaping and other non-potable uses within the site. The water demand values (kL) are taken from a consultant study conducted by Voyant Solutions Private Ltd.[5]

[5] Voyant Solutions, Mahindra World City Jaipur Water Demand Study

The in-house sewage treatment plant consists of primary, secondary and tertiary treatment facilities. The water saving measures, including water recycling, have been excluded from this baseline analysis and will be considered as part of Water Impact Reduction measures (*Section 6.4*). The use of conventional water flow-fixtures have been considered for this calculation, although low-flow fittings will be implemented throughout all buildings in MWCJ. To ensure accuracy, a water loss of 5% is assumed as per norms. The detailed calculations for the water demand are provided in the *Appended Document 1: CPDP Calculations*.

The CO_2 emission factor for water supply is derived from on-site data of the average energy use for pumping one kilolitre of water to site. The CO_2 emission factor for wastewater treatment is based on the energy used to treat one kilolitre of influent. These values are determined from the energy use data available for pumps on site. The CO_2 impact of water supply and wastewater treatment is included as part of CO_2 emissions from energy from utilities services (i.e. water/sewage treatment plants).

Table 5.4: Summary of Final Water Demand

Area	Total Water Demand (kL) *(Including domestic, processing, gardening and other uses)*[6]
IT/ITeS SEZ	8061959.4
Handicraft SEZ	1317066.0
Engineering/Related Industries	4180892.5
Gems & Jewellery	171298.2
Domestic Tariff Area	2397772.6
NPA	4934241.0
Total	**21063229.7**

[6] See Appended Doc 1: CPDP Calculations (Water Demand Calc) for detailed breakdown

Table 5.5: Water/Wastewater Baseline Impact

		Unit
Total water per annum (kL)	21063229.7	kL
Energy Use (water supply)	4643569.1	kWh
Total water impact (tCO_2e p.a)	3622.0	tCO_2e
Total Wastewater per annum (kL)	21063229.7	kL
Energy Use (wastewater treatment)	12196452.5	kWh
Total Wastewater emissions impact (tCO_2e p.a)	9513.2	tCO_2e
Total Water tCO_2 imapact p.a	**13135.2**	**tCO_2e**

[Note: emission factors are derived from pump energy use data]

5.5. Transport Baseline

For calculation of the baseline transport emission impacts, no additional form of traffic management strategies, beyond the provision of a basic intra-city road network, are assumed to be in place when Mahindra World City becomes fully operational. The master-plan for the development provides traffic modal share information (PA) for the worst-case scenario ("do-nothing scenario") which is used to calculate this baseline traffic volume. A similar modal share scenario is assumed for the NPA. Along with cars, buses and two-wheelers which will be used by employees/residents to commute within Mahindra World City Jaipur, the average number of daily supply truck deliveries for each SEZ is also considered in the master-plan and is taken into account in this baseline calculation. Only transportation within Mahindra World City Jaipur from development limits to internal destination are considered for the baseline transportation emissions. Travel outside of city limits has been omitted as it is beyond the scope of the report.

In this baseline scenario, the employees/residents are free to use their own personal preferred transport to reach their destination. The data on daily visitors on site, apart from employees/residents of MWCJ, has been excluded as it was assumed to be insignificant. In this scenario, negligible pedestrian traffic is assumed as in the absence of an efficient internal bus

system, or any public transportation system within the city, the distances between various zones seem formidable for walking. Table 5.6 below summarizes the likely shares of different modes of transport in this do-nothing scenario for MWCJ, used by the residents/employees for daily transportation. Sustainable transport management strategies like provision of bicycle lanes and intercity bus network have not been included in this scenario.

Table 5.6: Modal share for Baseline Transport Impact *(Source: MWCJ Masterplan, Jurong International)*

	Two-wheelers	Cars/Cabs	Buses
Processing Area:			
IT/ITeS SEZ	*25%*	*50%*	*25%*
Handicraft SEZ	*20%*	*5%*	*75%*
Engineering/Related Ind SEZ	*20%*	*5%*	*75%*
Gems & Jewelry	*20%*	*5%*	*75%*
Domestic Tariff Area	*20%*	*5%*	*75%*
Utilities/Roads (Horizontal)	*20%*	*5%*	*75%*
Non Processing Area:			
Residential	*25%*	*50%*	*25%*
Social Infrastructure	*25%*	*50%*	*25%*
Utilities/Roads (Horizontal)	*20%*	*5%*	*75%*
Others (Support staff/ Visitors)	*20%*	*5%*	*75%*

A standard trip length of 6km (one way) has been used as the average distance to facilities on site from the development boundary. Using the modal share information for the baseline scenario provided (*Table 5.6*), the annual distances travelled (km) by employees/residents using various modes of transportation have been calculated for each SEZ, DTA, Utilities and Non-Processing Area. Annual distance travelled is calculated by multiplying the number of people expected to commute by the average trip length and number of days travelled in a year (only working-week days considered for Processing Area employees). This figure is then doubled to

account for all return trips. The average occupancy is found to be 2.6 for a car, 1.6 for a typical two-wheeler and 45 for a bus. [7]

Standard emission factors from Greenhouse Gas Protocol Initiative (World Resource Institute) are used for each mode of transportation.[8] The baseline CO_2 impact from transportation is summarised in the Table 5.7 below. A total of 102465.6 tCO_2e per annum of emissions are projected due to transportation in MWCJ.

Table 5.7: Emission Impacts from Transportation[9]

	Annual Two-Wheeler Distance Travelled (km)	Annual Car Distance Travelled (km)	Annual Bus Distance Travelled (km)	Annual Truck Distance Travelled (km)	tCO2e p.a
Processing Area:					
A. IT/ITeS SEZ	69562090.6	104343136.0	2086862.7	234900.0	37479.1
B. Handicraft SEZ	8271923.7	1550985.7	930591.4	458232.0	2517.8
Engineering/Related Industries SEZ	10775119.3	2020334.9	1212200.9		2852.9
Gems & Jewelry SEZ	3384129.4	634524.3	380714.6		896.0
Domestic Tariff Area	7175516.9	1345409.4	807245.7	-	1899.9
Utilities/Roads (Horizontal)	1611557.0	302166.9	181300.2	-	426.7
Non Processing Area:					
Residential	76547670.0	114821505.0	2296430.1	-	41058.0
Social Infrastructure	20242935.1	30364402.6	607288.1	-	10857.7
Utilities/Roads (Horizontal)	1157026.6	216942.5	130165.5	-	306.3
Others (Support Staff/Visitors)	15753745.4	2953827.3	1772296.4	-	4171.1
TOTAL	**214481714.1**	**258553234.5**	**10405095.4**	**693132.0**	**102465.6**

[7] Jaipur Mobility Plan, Jaipur Development Authority
[8] *Calculating CO2 Emissions from Mobile Sources*. Greenhouse Gas Protocol - World Resource Institute.
[9] See Appended Doc 1: CPDP Calculations (Transport Baseline) for detailed breakdown

5.6. Waste Baseline

For the baseline impact calculation for waste in MWCJ, only the CO_2 emissions from the disposal/treatment of waste are considered. The emissions from the generation of waste have been excluded as these are not site-specific.

The types of waste generated within Mahindra World City is classified into the following categories:

- Municipal Solid Waste (MSW)
- Industrial Solid Waste: Waste from activities of industrial zones on site, including manufacturing waste.
- E-waste: Waste that includes discarded electrical or electronic devices
- Construction Waste

Municipal Solid Waste generation is taken as 0.05 kg per capita for industry employees and 0.25 kg per capita for the residents as per National Building Code Standards. Final industrial waste generation estimates are provided in the Environmental Impact Assessment report. For the purpose of calculating the baseline CO_2 impact from waste, each of the waste categories have been analysed separately. Construction waste has been excluded from baseline calculation as it does not contribute to operational emissions once construction is complete. Table 5.8 below summarises the expected waste generation in Mahindra World City Jaipur at full capacity. MWCJ is expected to generate 13427 metric-T of waste annually.

Table 5.8: Final Projected Waste Generation - Mahindra World City, Jaipur

	Municipal Solid Waste p.a (metric-T)	Industrial p.a (metric- T)	Industrial Waste Type	Total Waste p.a (T)
Processing Area:				
IT/ITeS SEZ	*1159.4*	400.0	E-waste	1559.4
Handicraft	*258.5*	21.0	Manufacturing wastes scrap metals/textiles	279.5
Engineering/Related Industries	*168.4*	148.0		316.4
Gems & Jewelry SEZ	*105.8*	11.0		116.8
Domestic Tariff Area	*149.5*	0.0		149.5
Commercial	*25.6*			25.6
Utilities/Roads (Horizontal)	*19.6*		Sludge from STP	19.6
Non-Processing Area:				
Residential	8205.3		--	8205.3
Commercial	2177.9		--	2177.9
Utilities/Roads (Horizontal)	155.0		--	155.0
Other (Support Staff/Visitors)	*422.2*		--	422.2
TOTAL	**12847.0**	**580.0**		**13427.0**

Municipal Solid Waste:

Municipal Solid Waste (MSW) includes residential waste, sweeping/cleaning waste and waste from Commercial Areas including restaurants/food courts. Considering an annual increase of 1.5% per capita/day, municipal solid waste generated in the city of Jaipur is estimated to reach 2671 metric-T/day by 2025.[10] The total average waste collected per month in Jaipur (2010) was 40000 metric-T**.** Out of the total waste collected, 87.5% is disposed in landfills while 12.5% is sent to processing/recycling facilities according to city data.[11] Landfilling is the most utilised waste disposal method and has tremendous negative environmental and health impacts. Recycling in the informal sector is also common in Jaipur but this information is currently not

[10] Rajasthan State Pollution Control Board
Government of India SWM proposal - *http://urbanindia.nic.in/programme/uwss/tag_swm.pdf*
[11] Government of India SWM proposal: *http://urbanindia.nic.in/programme/uwss/tag_swm.pdf*

measured or reported. At present there are no waste-to-energy projects in Jaipur and composting/vermin composting is not widely practiced.[12] These averages for waste treatment in Jaipur (for land-filling and recycling) have been used for the baseline scenario for waste treatment in the proposed Mahindra World City site. For this worst-case scenario, no waste segregation practices, additional recycling measures, composting or waste-to-energy options have been considered.

In the proposed project, a population of 323,707 has been estimated at full capacity for the processing and non-processing zones combined. The current per capita waste generation ranges from 0.2 to 0.6 kg/day depending on the size and population of the area.[13] Mahindra World City Jaipur, a 3000-acre township, the per capita/day waste generation for residents and employees is estimated at 0.25 kg and 0.05 kg respectively.[14] As many of the employees are expected to live outside the boundaries of the development and commute to work, the waste generated by them is significantly less. **The total amount of annual municipal solid waste for the final development is 13427 metric-T.**

The disposal of municipal solid waste for the Mahindra World City is currently carried out by Jaipur Nagar Nigam Ltd., a government agency responsible for solid waste management. Jaipur Nagar Nigam is responsible for the collection, transport and disposal/treatment of waste from the site. This waste is disposed in a landfill (87.5%) from which a part of the waste is recycled/reused in the unregulated sector (12.5%). The unregulated sector includes sub-systems such as small-scale private organisations engaged in waste processing and informal recycling workers who are actively involved in the waste management sector. These average percentages for waste treatment in Jaipur city have been used for the baseline case.

---

[12] Jaipur Master Plan 2025

[13] JNNURM – toolkit for solid waste management (Chap. 3 – Waste Quantification) *http://jnnurm.nic.in/wp-content/uploads/2012/11/SWM-toolkit.pdf*

[14] Source: National Building Code India

Based on Operations & Maintenance data on site, the public street sweeping waste is approximately 50kg per day for the Processing Area. Street sweeping data for the NPA is currently not available and therefore only the PA average is considered in the total.

Table 5.9 below outlines the final annual generation of Municipal Solid Waste at MWCJ and corresponding carbon dioxide emissions from its disposal/treatment. The emission factors used are EPA standards for waste disposal in landfill *(without recovery)*. This is determined as the most appropriate for the Indian context where no organised flaring and recovery process is in place. EPA standard for emissions from recycling of "mixed recyclables" is used for recycling (unregulated) calculations.

Table 5.9: Final Annual Municipal Solid Waste Generation in MWCJ and Baseline tCO_2e Emissions

Municipal Solid Waste	MSW Treatment in Jaipur District	Quantity Treated p.a (metric-T)	tCO_2e Emission Factors (EPA)	Total tCO_2e Impact (Disposal)
Landfill Disposal	87.50%	11241.1	3.417164085	38412.7
Recycling (unregulated)	12.50%	1605.9	-3.086470786	-4956.5
TOTAL	**100.00%**	**12847.0**		**33456.2**

Industrial Waste:

In accordance with the regulations of the Government of India, Special Economic Zones are only permitted to have non-polluting industries including IT, service industries, and light manufacturing. The estimated quantity of annual industrial waste arising in Mahindra World City Jaipur is therefore relatively low as compared to the amount of Municipal Solid Waste generated on site.

Industrial solid waste is expected to be generated in the following SEZ zones: Engineering and Related Industries SEZ, Handicrafts SEZ and Gems & Jewellery SEZ. **The industrial solid waste**

generation from these zones is estimated at 180 metric-T annually. [15]. Since only 4% of vertical infrastructure is currently developed, this estimate is based on the allocation of land to a particular sector (SEZ), the type of industry, area covered and the average waste generated by said industry. Table 5.10 outlines the final projected generation of Industrial and E-waste at MWCJ and corresponding carbon dioxide emissions from its disposal/treatment.

E-Waste:

Apart from municipal and industrial waste on site, **the IT/ITES SEZ is expected to generate 400 metric-T of Electronic waste annually** at full capacity after a latency period of 5 years (effective life of electronic equipment, about 4-5 years). E-waste constitutes of old and outdated computers, laptops, phones, mobiles, wires etc. There is no government legislation presently in place for the proper treatment or disposal for e-waste in Jaipur and therefore disposal in landfill has been considered for the baseline scenario for e-waste treatment.

Table 5.10: Final Annual Industrial/E-Waste Generation in MWCJ and Baseline tCO_2e Emissions

Industrial Waste	Treatment	Quantity (metric - T)	tCO_2e Emission Factors	Total tCO_2e Impact (Disposal)
E-Waste	100% Landfill	400.0	0.04409244	17.6
Manufacturing Waste (scrap metal/textiles)	87.5% Landfill	157.5	1.135380325	178.8
	12.5% Recycled	22.5	-3.086470786	-69.4
TOTAL				**127.0**

[15] Mahindra World City Jaipur - Environmental Impact Assessment

5.7. BASELINE SUMMARY

Table 5.7: Summary of Baseline Emissions (tCO_2e)

	Annual Impact (tCO_2e)
Energy Use (Non-Processing)	293482.0
Energy Use (Processing)	387591.9
Water Supply	3622.0
Wastewater Treatment	9513.2
Waste Disposal/Treatment	33456.2
Waste Disposal/Treatment (Industry)	127.0
Transport	102465.6
TOTAL	**830258.0**

It is clear from the Baseline Summary table above that **Energy Use is the main source of emissions for Mahindra World City, Jaipur** contributing to more than 80 percent of the total baseline emissions. Impact reduction measures aimed at conserving energy and promoting alternative low-carbon energy sources is therefore a critical element of overall strategy. It will be an essential component in reducing the carbon impact of energy use on site to achieve the Climate Positive Outcome for MWCJ.

6. IMPACT REDUCTION MEASURES

6.1. Energy Impact Reduction

The energy impact reduction strategy for Mahindra World City, Jaipur focuses on three key initiatives: 1) efficient use of energy in buildings (vertical infrastructure), 2) efficient use of energy for utilities (horizontal infrastructure), and 3) use of renewable energy (solar). This strategy is flexible enough to accommodate any changes in technology, energy supply and town planning which are likely in a long-term development project of this scale.

The renewable energy strategy for implementation of solar power and the energy-efficient street lighting strategy are described in the in Site-Wide Strategies Section *(Section 7)* as these also contribute as climate credit projects for MWCJ. Strategies including 50% rooftop solar for all buildings of site, off-site on-grid solar energy solutions and energy efficient LED street lighting are described in greater detail in Section 7.

Efficient use of energy in Buildings:

The development of certified green buildings is encouraged for all buildings within Mahindra World City Jaipur. We aim to optimise the energy efficiency of the buildings on-site to reduce environmental impacts from excessive energy use. Mahindra Lifespaces is the first developer in India to undertake a policy of ensuring that all buildings developed by the company are certified Gold or Platinum under the Indian Green Building Council's (IGBC) Leadership in Energy & Environmental Design (LEED) rating system. Many of the strategies incorporated as part of the LEED certification are aimed at making buildings more energy efficient. These measures are not required by National Building Code minimum standards for buildings and are additionally incorporated in the building design to decrease building energy demand, thereby reducing the overall $C0_2$ emissions impact of the development site.

The three focus areas for energy efficiency in buildings are HVAC systems, lighting, and pumps/motors. A provision will be included as part of the customer lease agreement in order to encourage the development of energy efficient buildings on site with total minimum required operational energy savings of 30% against conventional structures. These will be evaluated when the development of any new building is planned on site. The energy strategy of MWCJ aims to significantly reduce building energy demand by 30% compared to the baseline by implementing the following energy efficiency measures for all new and existing vertical infrastructure facilities constructed on site:

- **Optimal insulation and HVAC improvement measures** including thermal conductivity of roof/walls/windows, maximizing natural cooling strategies, optimal thermal U-value selection and high SRI, variable secondary pumping, double speed fans in cooling towers, VFD driven double-skin AHUs, variable air volume in air distributer, high COP centrifugal chillers with VFD drives, HVAC chillers with high IKW/TR. The cooling fans and pumps savings range from 37% to 46% when compared to conventional equipment.
- **Lighting energy efficiency strategies** including energy efficient lamps (T^5, CFL and LED, Induction) with electronic chokes, use of skylights, low LPD lights and switching automation as per requirement, maximizing day light in buildings, scientifically designed view windows with shading and use of automatic light sensors.
- **Energy efficient pumps and motors** including Class 1 motors, implementation of vertical in-line pumps (75% efficient as compared to 60% for box line), and hydropneumatic water distribution systems.
- **Other strategies** to be implemented across Mahindra world city developments include VFD driven elevators/lifts in triple operation and the provision of water level controllers in all water tanks.

In additional to the above strategies, new technologies to conserve energy or improve overall energy efficiency will be considered. Energy modelling and life cycle assessment tools will also

be used as effective ways of determining key energy efficiency improvements, retrofits and test their effectiveness for new and existing buildings on site.

The average energy savings for LEED/IGBC Gold or Platinum rated buildings is approximately 30%. This figure is based on the energy modelling calculations carried out for Evolve IT Park (Building B1) located in the IT/ITES SEZ in MWCJ. Energy simulation report of other residential and commercial certified green buildings, include Mahindra Lifespace's buildings Splendour (Mumbai) where an average of 34% energy savings is simulated when compared with conventional buildings.

Efficient Use of energy for Utilities:

In addition to efficient use of energy in buildings, operational energy efficiency for utilities (horizontal infrastructure) is also an important component of the energy impact reduction strategy for MWCJ. The utilities for Mahindra World City Jaipur include Water Supply, Sewage Treatment Plant and Street Lighting. The following energy efficiency strategies for utilities have been implemented at Mahindra World City Jaipur:

- **Energy efficient pumps and motors** including Class 1 motors, implementation of vertical in-line pumps (75% efficient as compared to 60% for box line), hydropneumatic water distribution systems.
- **HSD (low sulphur variety) DG sets** used for backup power supply.
- **Water supply pumping system provided with variable speed drive** to conserve energy at part load.
- **Use of LED energy efficient Street Lighting** *(See Section 7.2: Site Wide Strategies)*

Table 6.1 below summarises the resulting CO_2 emissions savings (impact reduction) with average energy savings of 30% for all buildings on site and savings of 20% for utilities when the energy efficiency strategies listed above are implemented throughout the site.

Table 6.1: Energy Impact Reduction for Final Development

	Impact Reduction Target (%)	Energy Savings (MWh)	Energy Use after Savings (MWh)	tCO_2e Impact p.a	tCO_2e Abated Annually
Buildings	30%	261951.5	611220.2	476751.7	-204322.2
Utilities (water supply, wastewater treatment)	20%	3368.0	13472.0	166.8	-2627.0
Total		**265319.5**	**624692.2**	**476918.5**	**-206949.2**

**Utilities includes energy use/ savings for water supply and wastewater treatment. Street lighting energy use and savings are not included and will be covered in Section 8.2 (Site-Wide Initiatives).*

6.2. Water Impact Reduction

In a state reddened with water scarcity, the efficient use of water is more important in Rajasthan today than ever before. With a rapid increase in industrial production and an accelerated population growth, water is witnessing a never-before surge in demand. Contamination of existing water bodies and depleting water resources is also a key concern. It is therefore important that as part of our Water Impact Reduction strategy we not only aim to reduce the overall water demand on MWCJ premises, but also do our part in replenishing the ever depleting ground water resource in Jaipur through rain water harvesting initiatives.

To achieve this these goals, the development's Water Impact Reduction strategy has incorporated the following initiatives:

- **Implementation of low-flow fixtures and fittings in all buildings on site**: Low-flow water fixtures include sink faucets, shower heads, and toilets that use less water per minute than conventional models. Low-flow water fixtures conserve water by using a high pressure technique to produce a strong or equal flow of water using less water

than conventional fixtures. An average of 40% water savings is observed for a building with low-flow fixtures when compared to conventional fixtures.[16] To ensure that all buildings in the processing zone are achieving these savings, implementation of water efficiency measures with minimum water savings of 40% will be required as part of the customer lease agreement.

- **Water Recycling**: Mahindra World City Jaipur has an in-house Sewage Treatment Plant (STP) and a Tertiary Treatment Plant (TTP), ensuring that the waste water generated within the project is internally recycled and treated. The treated water is used to meet the requirements of flushing, cooling, irrigation (on-site landscaping) and other non-potable uses within the site.

  This results is an additional 85% water savings on site from use of recycled water. The carbon impact reduction from these savings is the indirect carbon savings from water that is no longer required to be supplied to MWCJ from outside because the recycled water meets 85% of this internal demand. These savings can be measured in terms of energy savings from water pumps for transportation of water to site.

  Sequencing Batch Reactor technology has been used for the treatment of wastewater on site. As mentioned in the roadmap, all pumps and motors used for wastewater treatment as well as transportation of water within the site are 60% more efficient than conventional pump and motors therefore abating any excessive CO_2 emissions from wastewater treatment. Pumps are driven by VFD and operated by SCADA to drive always in best efficiency duty point to save 30% energy on average. Significant emissions reductions are expected due to the use of sequential

[16] Figure based on available water use data from Evolve IT Park (B1).

batch reactor (SBR) technology in the STP plants as this water no longer needs to be transported from off-site locations.

- **Rain Water Harvesting:** The current rate of ground water abstraction rate in Jaipur is not sustainable. The water table throughout the entire city has fallen dramatically over the past three decades and continues to decline at an alarming rate, accompanied by increasing concentration of nitrates in the ground water supply. Ground water recharge mechanisms through rain water harvesting are therefore an effective measure to counter the rapid decline in ground water levels and improve water supply and quality for neighbouring communities. Rainwater harvesting measures implemented on site capture 80% of all rainwater runoff in Mahindra World City Jaipur which is directed to a harvesting pond or recharge well on site. Rainwater harvesting measures on site allow the possibility of collection of rainwater in the future which can then be used to meet a portion of the water demand of the development.

Table 6.2 outlines the projected water savings (kL) and resulting tCO_2e impact reduction from the water efficiency measures described above. As evident from the table, the water saving measures have the potential to significantly reduce the water demand for Mahindra World City Jaipur, and subsequently minimise the emissions impact from water supply/treatment. Savings from rainwater harvesting are not included because at present all rainwater harvested on site is utilised for ground water recharge.

Table 6.2: Expected Water Impact Reduction for completed development

Impact Reduction Measures	Impact Reduction Target (%)	Water savings (kL)	Energy Saving (kWh)	tCO2e Abated Annually
NP + PA:				
Low-Flow Fixtures	40%	8425291.9	6732145.2	-5251.1
Water Recycling	85%	7280294.7	1601664.8	-1249.3
Wastewater Treatment	--	8425291.9	4878581.0	-3805.3
TOTAL		**15705586.6**	**8333810.0**	**-10305.7**

As part of this Climate Positive Strategy for Mahindra World City Jaipur, specific energy efficiency and water efficiency targets have been included in the roadmap. Energy impact reduction target is 30% savings (from conventional buildings) and 20% for utilities. Water reduction target is 30% savings for buildings with the use of low-flow fixtures and other water saving measures, as well as on-site water recycling measures. To ensure that all buildings in the processing zone are achieving these savings, implementation of energy efficiency and water efficiency measures will be mandatory as part of customer lease agreement. However, in the first cut of the agreement, no monetary penalties will be included for developers failing to meet requirements. Mahindra Lifespaces is experienced in the development and construction of IGBC certified green buildings and will therefore assist all building developers in obtaining the IBGC/LEED certification for buildings to ensure energy/water impact reduction targets are met.

6.3. Transport Impact Reduction

The transport sector (road, sea, air) accounts for roughly 26% of total energy consumption worldwide. As consumption of non-renewable energy is closely correlated with greenhouse gas emissions, transport-related CO^2 emissions account for between 18%-24% of total CO^2 emissions (energy related) at the global level.[17]

[17] "Carbon Dioxide Emissions by Economic Sector 2005" Earth trends Data Tables: Climate and Atmosphere. World Resource Institute.

Avoid, Shift and Improve Approach:

The sustainable transport strategy for Mahindra World City, Jaipur has been developed by EMBARQ India, a not-for-profit initiative of the World Resource Institute (WRI)[18]. The report titled "Building a Sustainable Non-motorised strategy" utilises the Avoid, Shift and Improve approach for developing a sustainable transport plan for MWCJ. When compared to the baseline strategy where no transport management strategies were in place, the recommended sustainable transport strategy incorporates a variety of non-motorised and public modes of transport, thereby reducing the overall CO_2 impact from transport on site. These strategies do not incorporate travel to MWCJ from other locations.

The ASI Approach entails three main avenues:

- Avoid/Reduce
- Shift/Maintain
- Improve

"Thus, the ASI approach seeks to avoid long motorized and unnecessary trips, shift the tendency away from trips in individual motorized vehicles and improve the technology and operational management of transport activities." – EMBARQ India

Avoid/Reduce:

"Avoid" refers to the need to improve the efficiency of the transport system. What this means for Mahindra World City, Jaipur is that through integrated land use development and transport planning, the need to travel and trip distances can be reduced. One such strategy, proposed by EMBARQ India, is through transit-oriented development (TOD). A transit-oriented development is a mixed-use residential and commercial area designed to maximize access to public transport,

[18] See *Appendix Document 2: EMBARQ Building a Sustainable Non-motorised Strategy*

and often incorporates features to encourage transit ridership. A TOD neighbourhood typically has a centre with a transit station or stop, surrounded by relatively high-density development with progressively lower-density development spreading outward from the centre. TODs generally are located within a radius of one-quarter to one-half mile (400 to 800 m) from a transit stop, as this is considered to be an appropriate scale for pedestrians.[19] Transit-oriented development includes the following key strategies which will be incorporated in the transport plan for MWCJ:

- High density development near public transport stations and along routes
- Low density development far from public transport route
- Public transportation routes planned in NPA and PA zones to meet travel demands
- Green corridor along natural features

Shift/Maintain:

"Shift" instruments of the ASI approach seek to improve trip efficiency. A modal shift from the most energy consuming urban transport mode (i.e. cars) towards more environmentally friendly modes such as non-motorised transport (NMT) and public transport (PT) is highly desirable. This strategic shift is based on the Green Transportation Hierarchy Pyramid *(Fig. 3)* which prioritises transportation options with the lowest environmental impacts.

Fig.3: The Green Transportation Hierarchy (Source: Transportation Alternatives)

[19]"Center for Transit-Oriented Development : Center for Neighborhood Technology."*Center for Transit-Oriented Development : Center for Neighborhood Technology*. N.p., n.d. Web. 10 Oct. 2013.

The “shift” strategy includes the following design principles that will be incorporated in the transport development plan of MWCJ:

- **Focus on connectivity:** The street networks are planned to provide multiple routes and connections between residential neighbourhoods in the Non-Processing Area and frequented destinations like schools and shopping areas. A well connected network emphasises various types of mobility: pedestrian, public transit, cycling and automobile. Interconnected streets ease traffic flow problems and allow commuters to travel shorter distances to reach required destinations.

- **Focus on walkability of neighbourhoods:** The requirements of a walkable neighbourhood are a public centre, adequate provision of public spaces, social interaction nodes, sufficient people and businesses, tree cover, sufficient signage, traffic calming measures, mixed income/mixed use with schools/workplaces and a pedestrian friendly walkway design with easily accessible buildings located close to sidewalks. A walkable design for the MWCJ development will be implemented with routes along the land units/buildings to create a walkable grid. The development in the NPA will ensure the development of pedestrian only zones and “blocks” that are in a 250-300 m range grid to encourage walking.

- **Focus on development of integrated networks:** The development of integrated public transport networks, open/green space networks, pedestrian networks and cycling networks which provide easy transfer between modes is a key focus area in the transport impact reduction strategy of MWCJ.
  - **Public Transport Network** plan for MWCJ will include the phased development of a bus network with easy and walkable access (within 300 m) to bus stops from any point in the development. In addition, the reservation of land along east-west

corridor to accommodate future expansion of the Jaipur Metro Rail to Mahindra World City will be considered. (See Section 7.3)

- **Open/green space and pedestrian networks,** incorporated as part of the master plan, will allow alternative environment-friendly networks of movements within the development.
- **Cycle Networks** for MWCJ will be included with segregated lanes and designated cycle parking areas. A bicycle sharing system will also be considered for the development to encourage biking for circulation within the development.

- **Shift away from private transportation:** Through the analysis of travel habits of employees in various industries, an appropriate strategy can be developed to encourage use of alternative modes of transportation. The industries in MWCJ can be classified into two major categories: Service industries (IT/ITeS) and Manufacturing Industries. The travel needs of employees in service and manufacturing industries will vary and these differences need to be taken into consideration when developing a transport strategy.
  - ***Service Industries:*** In the baseline scenario, 25% of the employees of service industries are expected to use cars to travel to work. A possible sustainable transport solution for Service Industries (IT/ITeS, DTA), in order to shift people away from private transportation, is the implementation of chartered shuttle bus services from the office to selected drop-off points in Jaipur city. This can later be expanded to form part of an integrated bus system, which connects to the main city as travel demand increases. In addition, a car sharing scheme which encourages employees/residents to share 8-person taxis, commonly used in Jaipur, to facilitate a shift away from personal transportation.
  - ***Manufacturing Industries*****:** In contrast to service industry transport preferences, alternative modes of transport such as cycling are expected to be more popular among the manufacturing industry employees from handicraft and Gems & Jewellery SEZs. Provision for cycling infrastructure such as bicycle lanes, parking

areas and drop off points must be considered in the design of the transport strategy for MWCJ to meet the travel needs of this segment of the population.

- **Promoting sustainable modes of transport in MWCJ:** Awareness of available transportation networks among residents/employees is important in maximizing use of these networks. Measures to increase awareness of sustainable transport options include:
  - **Welcome Pack**: Provided to all new residents/employees containing information about cycle, walking and public transport routes and time tables.
  - Designated **"Bike to Work Days"** to increase awareness on environmental and health benefits of biking and to promote biking to work during cooler months.
  - Focus on **improving the public perception of bus transport**: Aesthetically pleasing buses and bus stop designs which take into account local architecture style and the climate of the region. Brand image can also be improved by incorporating intelligent transport systems such as off-board ticketing and intelligent traffic management systems which help increase the appeal of public transport.

Improve

The "improve" component of the strategy focuses on vehicle and fuel efficiency as well as on the optimization of transport infrastructure. It pursues to improve the energy efficiency of transport modes and related vehicle technology through the following initiatives:

Efficient and Reliable Bus system: To ensure that commuters switch from private modes of transportation (cars) to public transport, the bus system has to appeal to the commuter as an equally efficient and reliable alternative. Therefore, a Bus-Rapid- Transit (BRT)

System option will be explored for MWCJ. BRT is a "high quality bus based transit system that delivers fast, comfortable and cost effective urban mobility through provision of segregated right-of-way road infrastructure, rapid and frequent operations and excellence in marketing and customer service."[20] A bus rapid transit system will be considered in accordance with EMBARQ India recommendations for internal transport within Mahindra World City when substantial demand is reached.

Fig. 4 below shows the road networks and main gates as part of existing MWCJ master plan, including closest existing bus terminals bordering the gate of MWCJ. The existing city bus system can also be extended to cater to transport demands of Mahindra World City employees and residents.

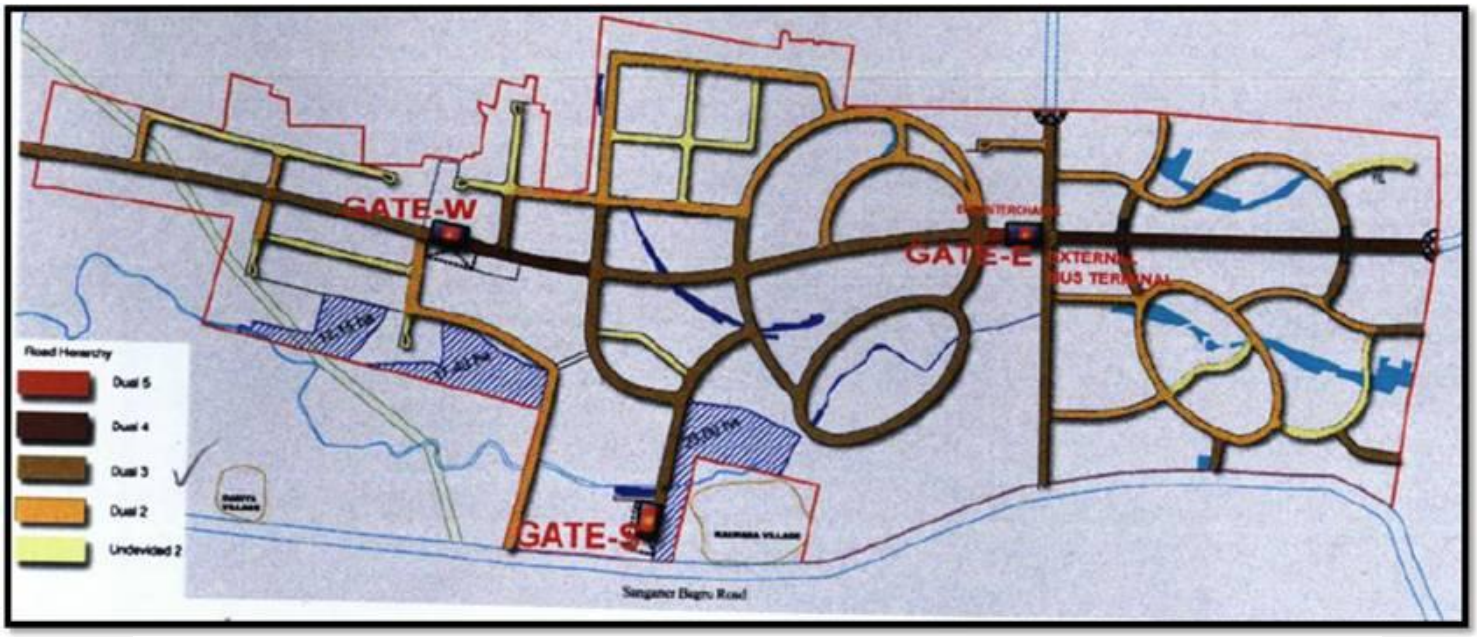


Fig. 4: Road Network Plan from Mahindra World City Jaipur, including key exit gates (MWCJ Masterplan 2007)

[20] Bus Rapid Transit Guide, Institute of Transportation and Development Policy, New York

- **Use of low-emissions fuels**: The role of public transport in mitigating climate change and reducing the CO_2 impact of transportation in MWCJ can be strengthened by the use of low emission fuels. The following alternative fuel types will be considered: CNG, Electric, Hybrid/Dual (Diesel-electric) and Diesel (with emission reductions) for busses within MWCJ premises. The decisions to select a particular fuel type for public buses will also depend on local conditions, the availability of that fuel and other cost considerations.

EMBARQ India proposal and strategies described above will be incorporated into the transport plan of MWCJ in a phase-wise manner when the population of Mahindra World City and neighbouring community increases and sufficient travel demand and within the MWCJ and between Jaipur city centre and MWCJ is achieved. The operation and maintenance of of transportation infrastructure will be handled by MWCJ Ltd. while appropriate third party agencies will be employed for its construction.

EMABARQ India will be appointed as advisors for NPA masterplan, social infrastructure and transportation design and development for Mahindra World City. EMBARQ transportation proposal will be shared with masterplanners and transportation recommendations will be integrated into the design, including TOD strategies, pedestrian friendly design, bicycle lanes and sufficient public/green space to encourage walking/biking. MWCJ Ltd. will directly engage with all customers, including residents and companies, to promote behavioural change by encouraging carpooling and public transportation use and other practices through public forums and periodic email communication.

In order to quantify the CO_2 Impact Reduction from various sustainable transport strategies that are planned for MWCJ, a modal shift from baseline values *(Table 5.6)* is observed as a result of these strategies with a greater share of the population now expected to utilise non-motorised and public transportation modes for their daily commute. The selection of low-emissions fuels (i.e. CNG), will also affect the CO_2 emission factor for buses. The projected final modal share is provided in Table 6.3 below**. As seen from Table 6.4, a significant CO_2 emissions reduction of 57545.9 tCO_2e per year is expected when the transportation strategies described are implemented.** This is an initial estimate and an updated modal share information will be added in the CPDP Roadmap when the transportation plan is finalised.

Table: 6.3: Projected final modal share after MWCJ Transport Impact Reduction Strategies are in place

	Two-Wheelers	Walking	Cars/Cabs	Bicycles	Buses	Metro
Processing Area:						
IT/ITeS SEZ	15%	0%	10%	5%	30%	40%
Handicraft SEZ	5%	0%	5%	10%	65%	10%
Engineering/Related Ind SEZ	20%	0%	5%		65%	10%
Gems & Jewellery	10%	0%	5%	10%	65%	10%
Domestic Tariff Area	20%	0%	5%		65%	10%
Utilities/Roads (Horizontal)	0%	0%	5%	10%	75%	10%
Non Processing Area:						
Residential	0%	40%	5%	10%	35%	10%
Social Infrastructure	0%	40%	5%	40%	15%	0%
Utilities/Roads (Horizontal)	0%	0%	5%	10%	75%	10%
Others (Support staff/ Visitors)	10%	0%	5%	0%	75%	10%

Table: 6.4: Total tCO_2e abated due to MWCJ Transport Impact Reduction Strategies

	Annual Two-Wheeler Distance Travelled (km)	Annual Car Distance Travelled (km)	Annual Bus Distance Travelled (km)	Annual Metro Distance Travelled	Annual Truck Distance Travelled (km)	tCO2e p.a	tCO2e abated per year
Processing Area:							
IT/ITeS SEZ	41737254.4	10434313.6	1605279.0	166949017.5	234900.0	26290.5	-11188.6
Handicraft SEZ	2623128.2	983673.1	655782.1	7869384.7		2239.1	-278.7
Engineering/Related Industries SEZ	21550238.7	2020334.9	1346889.9	16162679.0	458232.0	3400.8	547.8
Gems & Jewelry SEZ	1692064.7	317262.1	211508.1	2538097.0		722.3	-173.8
Domestic Tariff Area	7175516.9	672704.7	448469.8	5381637.7	-	1979.9	80.0
Utilities/Roads (Horizontal)	0.0	191031.4	146947.2	1528250.9	-	323.5	-103.2
Non Processing Area:							
Residential	0.0	4015.0	2060898.8	45928602.0	-	6327.1	-34730.9
Social Infrastructure	0.0	4380.0	233572.3	0.0	-	190.9	-10666.9
Utilities/Roads (Horizontal)	0.0	4745.0	83439.4	867770.0	-	156.9	-149.4
Others (Support Staff/Visitors)	8341784.4	5110.0	1203142.0	12512676.6	-	3288.8	-882.3
TOTAL	**83119987.2**	**14637569.8**	**7995928.6**	**259738115.4**	**693132.0**	**44919.7**	**-57545.9**

6.4. Waste Impact Reduction

The Waste Impact Reduction strategy for Mahindra World City Jaipur addresses the management of the various types of waste (MSW, Industrial waste, E-waste) generated on site in the most environmentally and economically sustainable way. As evident from Table 6.5 (Waste Baseline), the majority of the waste generated on site is expected to be Municipal Solid Waste. The Waste Impact Reduction strategy for MWC therefore focuses on the reduction of MWS and its effective segregation, treatment and disposal.

Municipal Solid Waste Strategy:

Studies conducted by the National Environmental Engineering Research Institute (NEERI), have revealed that India generated more than 38 million metric-tonnes of urban solid waste in 2005. This figure is expected to increase at a rate of 1.5% annually.[21] The burden of waste management on urban local bodies and municipalities continues to grow further intensified by additional demands placed by rapid urbanization. Agencies are often unable to meet this growing demand, leading to the selection of unsustainable waste disposal method like the open disposal of waste, which have a negative impact on the environment and nearby communities.

The development of Mahindra World City, Jaipur is expected to generate more than 13,000 metric-T of MSW annually. The MWCJ solid waste management strategy takes an integrated approach to waste management by including waste management technologies that offer CO_2 reduction opportunity, increasing organised waste collection and establishing appropriate treatment and disposal methods. Effective waste management is a priority area of development in India to mitigate the associated serious public health and environmental risks from improper disposal.

The following initiatives are planned for the development to achieve maximum CO_2 impact reduction from waste generated on site:

- **Establishment of a comprehensive waste management strategy** to ensure maximum diversion of waste from landfill. Prevention of excess waste generation though reuse, recycling of waste, and implementation of waste-to-energy solutions (i.e. biogas).

[21] Report of the Technology Advisory Group on Solid Waste Management, Ministry of Urban Development, Government of India

- **Implementation of education programmes to promote residents/employees to 'Reduce, Reuse and Recycle' waste.** Programmes will aim to divert waste from going to landfills by reducing waste generation through encouraging reducing, reusing and recycling personal waste. Reusing prolongs the lifetime of an article thereby reducing the total waste generated.

- **Information on waste management requirements on premises** such as appropriate segregation of waste will be included as part of customer/resident 'Welcome Packet'. Community engagement initiatives will be orginised periodically to increase employee/resident awareness and engagement in effective waste management on site.

- **Ensuring effective waste segregation on site:** Municipal Solid Waste will be segregated into three main categories: food/organic/biodegradables, recyclables, non-biodegradable waste. Recyclable waste should be further segregated into glass, paper and plastic. It will be incumbent on the occupiers of all premises to maintain separated waste storage receptacles provided by Mahindra World City Jaipur Ltd. Provision of waste segregation requirement will be included in the customer/resident lease agreement to ensure segregation is effectively practiced throughout the premises.

- **Collection/Treatment of Segregated Waste**: The percentage of non-biodegradable waste generated on site is estimated at approximately 22% out of which 16% consists of recyclables glass, paper, plastic and metal. The other 78% of municipal solid waste is expected to be biodegradable waste (40 % food waste, 38% other organic - IPCC)[22] Segregated waste will be collected from facilities on site and appropriately treated.

[22] Averages derived from Mahindra World City, Chennai monthly solid waste collection data

- **Engagement of third party agency for collection of paper, glass, metal and plastics segregated on site for treatment at off-site recycling facilities.**

- **Engagement of third party agency to collect biodegradable waste for treatment in biogas plant (off-site) and composting.** Production of biogas would generate source of energy which can be used for in-house demand or distributed to nearby. By-product of composting can be utilised for fertilizer and soil amendment for landscaping purposes.

- **Jaipur Municipal Corporation (JMC) will be responsible for suitable disposal of only inert, non-biodegradable waste to landfills**. This is a significant improvement which will result in substantial CO_2 impact reduction when compared to the current baseline scenario where 87.5% of waste is disposed in landfills.

Table 6.5: MSW Treatment targets and resulting tCO_2e impact

Municipal Solid Waste	MSW Treatment Targets	MSW Treatment (T)	tCO_2e Emission Factors (EPA)	Total tCO_2e Impact (Disposal)
Composted/Biogas	70%	8992.9	-0.220462199	-1982.6
Recycling	16%	2055.5	-3.086470786	-6344.3
Landfill	14%	1798.6	3.417164085	6146.0
TOTAL	**100%**	**12847.0**		**-2180.9**

The projected annual Baseline Impact from municipal solid waste disposal *(Table 5.9)* is 33456 tCO_2e per year. **The total tCO_2e abated per year (operational) due to waste management initiatives at MWCJ is expected at – 35637.1 tCO_2e.**[23]

[23] Total tCO_2e abated =Total Baseline Impact from Waste – tCO_2e offset

Industrial Waste Strategy:

Emissions from waste generated from industrial operations greatly varies and depends on the nature of the industry and mode of disposal/treatment. **The industrial solid waste generation in Mahindra World City Jaipur from these zones is estimated at 180 metric-T annually**. [24] This estimate is based on the allocation of land to a particular sector, the type of industry, area covered and the average waste generated by the industry. For arriving at an efficient waste management solution for industrial waste and to minimise the climate impact from this waste, an assessment of the nature of waste generated is essential and will be carried out after site development progresses and more companies set up facilities on MWCJ premises.

Strict waste reduction strategies such as material acquisition protocols may be introduced as a future strategy. Presently, a very strict material acquisition protocol may be difficult to abide by especially for the various manufacturing facilities (Handicrafts, light engineering etc.) on site. MWCJ will only be permitting the development of non-polluting industries on site (below orange category as per local pollution control standards) which will ensure reduction in the total waste impact of the city.

E-Waste Strategy:

Improper disposal of e-waste is of great concern in India due to environmental hazards related to improper recycling practices. **400 metric-T of e-waste is expected to be generated in the IT/ITeS SEZ in MWCJ annually**. Mahindra World City Jaipur Ltd. will engage with all customers expected to generate e-waste on site to ensure this waste is segregated, and then collected and recycled by authorised recyclers in compliance with the *E-waste (Management & Handling) Rules 2011, Ministry of Environment and Forests (GOI).*[25]The Management & Handling Rules provide guidelines on responsibilities of the role of the producer, bulk consumer, collection

[24] As stated in Mahindra World City Jaipur - Environmental Impact Assessment (EIA) Document
[25] http://moef.nic.in/downloads/rules-and-regulations/1035e_eng.pdf

centres, dismantler and recycler. Compliance with these rules should be ensured for all companies operating within the IT\ITeS SEZ of MWCJ and companies will be encouraged to set annual e-waste recycling targets to minimise the CO_2 emissions impacts of e-waste disposal. Several companies currently operating in MWCJ, including Wipro and Infosys, have set independent targets and practice e-waste recycling through authorised outsourced vendors. As part of the effort to reduce operational emissions from disposal of e-waste, a recycling target of 90% has been set for all IT/ITeS companies operating within MWCJ. Table 6.6 below summarises the tCO_2 impact of recycling e-waste on site.

Table 6.6: E-Waste Treatment targets and resulting tCO_2e impact reduction

E- Waste	MSW Treatment Targets	MSW Treatment (T)	tCO_2e Emission Factors (EPA)	Total tCO_2e Impact (Disposal)
Recycling	90%	360.0	-2.59	-932.6
Landfill	10%	40.0	0.04	1.8
TOTAL	**100%**	**400.0**		**-932.6**

The projected annual Baseline Impact from e-waste and industrial waste disposal *(Table 5.10)* is 127. tCO_2e per year. **The total tCO_2e abated per year (operational) due to e-waste management initiatives at MWCJ is therefore expected -1059 tCO_2e.**[26]

Other wastes:

Bio-medical waste will arise from any hospitals on site and will be dealt with according to the rules framed for management & handling of such wastes by Ministry of Environment & Forests, Government of India and Pollution Control Boards.

[26] Total Baseline Impact from E/Industrial Waste– tCO_2e offset

7. SITE-WIDE INITIATIVES & CREDIT PROJECTS

As a joint venture between Mahindra and Rajasthan State Industrial Development Corporation, a government agency, Mahindra World City is ideally suited to work with appropriate agencies in the Government of Rajasthan, including but not limited to Jaipur Metro Authority, Urban Development and Housing Department and adjacent municipalities to make the city and surrounding area more energy and resource efficient. The initiatives currently being considered, though outside the strict geographical boundary of Mahindra World City, including the extension of the current metro-rail plan and utilization of LED bulbs in the surrounding communities, can be accomplished through this cooperation and will significantly contribute to the success of the project and community at large. These initiatives are described in greater detailed below.

7.1. On-site and Off-site Solar Power

India is endowed with abundant solar energy which is capable of producing 5,000 trillion kW of clean energy. The country is blessed with around 300 sunny days in a year and solar insulation of 4-7 kWh per sq. m per day. The State of Rajasthan receives maximum solar radiation intensity in India with very low average rainfall and also has an abundance of low-cost desert land available. The potential for solar energy in Rajasthan is immense and if this energy is harnessed efficiently, it can significantly reduce India's dependence on carbon-intensive grid supply by replacing it with a reliable carbon-neutral renewable energy option.[27]

As part of the 'solarification' strategy of Mahindra World City Jaipur, a portion of the operational energy demand of the development will be met through the use of solar power on site (rooftop solar). In addition, off-site solar solutions have also been implemented by MEPC in neighbouring cities close to Jaipur which provide electricity that is sold back to the regional

[27] Rajasthan Renewable Energy Corporation

electric grid, which is currently more than 50% dependent on fossil fuels (*climate credit*). In line with this strategy, Mahindra World City Jaipur has partnered with Mahindra EPC, a portfolio company under the Cleantech arm of Mahindra Partners which specialises in providing on-grid and off-grid solar solutions. A letter of partnership between Mahindra EPC and Mahindra World City Jaipur is provided *(See appended documents).*

The following solar impact reduction and credit projects are considered for MWCJ:

- Installation of solar photovoltaic cells on all building roofs on site for PA + NPA Zones (minimum 50% rooftop area) for generation of power for buildings (*Impact reduction*).
- Installation of solar plants off-site to provide solar power sold back to regional electrical grid (NEWNE) (*Credit*).
- Installation of solar water heating panels for buildings during winter season will also be considered in future but has not been included in carbon reduction calculations below (*Impact reduction*).

On-site Solar Solutions:

Photovoltaic solar panels will be installed on all building roofs in the development site, and power produced will be consumed by the buildings themselves. All business facilities in PA as well as residential developments in the NPA are included as part of this strategy. Installation of solar rooftop solutions (planned 70% rooftop coverage) for Evolve IT Park has already commenced and is scheduled for completion in financial year 2013-14. **A total 81.9 MW power of solar capacity is available on site if a minimum 50% of rooftop coverage is assumed as the usable area for rooftop solar for all buildings which equates to an impact reduction of 240069 tCO_2e annually.** Mahindra EPC will engage customers for implementation of rooftop solar solutions in individual company premises and residential complexes using both capital and operational expenditure proposals depending on individual customer requirements. In line with this strategy, Mahindra EPC has been officially recognised by the Ministry of Commerce &

Industry (Government of India) as co-developer of solar energy solutions in Mahindra World City Jaipur. [28]

Off-site Solar Solutions:

Mahindra World City Jaipur Ltd. has also partnered with Mahindra EPC to provide off-site on-grid solar solutions in Rajasthan State. As a response to the Jawaharlal Nehru Solar mission, Mahindra EPC, the Engineering Procurement & Construction arm of the Mahindra group, a portfolio company under the Mahindra umbrella was created in 2011. Potential on-grid solar projects were identified in Rajasthan to provide energy back to the regional grid. Mahindra EPC's services commenced its operation by making a beginning in the renewable energy space with the turnkey execution of large grid connected and small off grid roof top PV Solar projects. As Mahindra Group Company, Mahindra EPC has developed six key solar projects in Rajasthan from 2012 to 2014 that provide energy back to the regional grid (Table 7.1). These Solar PV projects, considered for Climate Credit as part of the MWCJ Climate Positive Roadmap, were completed over the past 2 years after the initiation of MWCJ but before the completion of this roadmap. They were built after start of construction of Mahindra World City Jaipur project by Mahindra EPC. As a Mahindra Group companies, both Mahindra World City Jaipur Ltd. and Mahindra EPC are jointly committed to reducing national and regional carbon emissions through proliferation of renewable energy in India.

Together, the six solar projects, provide a 61.9 MW capacity back into the NWEWS region grid.[29]

[28] Approval letters included in Appended Documents

Table 7.1: Details of Off-Site Solar PV Projects (Climate Credit) – Partner: Mahindra EPC

No.	Off-site Solar Projects (location)	Completion Year	Power Capacity (MW)
1	Jodhpur	2013	20
2	Jodhpur	2013	10
3	Bikaner	2013	5
4	Bikaner	2013	15
5	Lumbaniya	2014	6.9
6	Phalodi	2012	5
Total			**61.9**

A summary of carbon abated due to MEPC on-grid projects as well as through rooftop solar on site is provided in Table. 7.2 below:

Table 7.1: On-site and Off-site Solar Power Impact Reduction/Climate Credit

Solar Measure	Type	Power Capacity (MW)	Expect Energy Generation p.a (MWh)	tCO_2e Abated Annually
On-site Rooftop Solar (50% Coverage)	Impact Reduction	81.9	307781.0	-240069.2
Off-site Solar Projects in Rajasthan	Climate Credit	61.9	232750.6	-181545.5
Total		**143.8**	**540531.7**	**-421614.7**

Partnerships with Government for Solar Power Initiatives:

Mahindra World City Jaipur, as a Joint Venture between Mahindra Group and the RIICO (Government of Rajasthan), is an excellent platform to work with the state and national governments to participate in various schemes and initiatives that encourage solar power in India. The following government initiatives are in place at the national and state level to encourage the use of solar power and other renewable energy solutions:

[29] Mahindra EPC Projects Completed
http://www.mahindraepc.in/WHAT%20WE%20DO/Pages/OnGrid.aspx

- **Jawaharlal Nehru National Solar Mission (2012)**: This is an initiative of the Government of India, Ministry of New and Renewable Energy (MNRE). The National Solar Mission, under the brand name "Solar India", sets an ambitious target of adding 20 GW of Grid connected and 2 GW of Off-grid capacity solar power by 2022 in three phases. Under this Mission, the Central Government shall provide the required support for the development of solar projects through a combination of various schemes like Generation Based Incentive, Viability Gap Funding and Bundling schemes. Focussing on both off-grid and on-grid solutions, phase II of JNNSM would target deployment of 1000 MW of rooftop solar projects at both on and off-grid levels. The implementation of solar water pumping and heating systems is also encouraged as part of JNNSM.
- **Rajasthan Solar Energy Policy (2011)**: Issued by the Government of Rajasthan, this policy promotes solar energy in the state of Rajasthan through 50 off-grid projects selected through a tariff-based competitive bidding process. The policy promotes setting up of solar power projects, as well as rooftop PV, solar thermal and small-scale solar power plants. The Government of Rajasthan has called for a total of 200MW of new solar power projects in the state.

7.2. Use of Energy Efficient LED Lighting

LED lights have a service life of more than 80,000 burning hours when compared to only 8000 hours for a conventional sodium or metal halide lamp and are recognised to be the most energy efficient option for the lighting. Estimates based on lighting retrofitting projects suggest that 50% savings are possible for LED lighting when compared to conventional lamps.

LED Lights have the following advantages over the conventional alternative:

- Most efficient lighting for the least power consumption
- Longer service life (15 years+)
- Maintenance free operation with negligible operation and maintenance costs

- Range from 2700K to 6500K visible light spectrums
- No harmful UV component in the light

The most important benefit of LED lights, in order to minimize the annual energy consumption of MWCJ, is the flexibility that they provide with dimmable controllers which have a significant impact in maximizing overall energy efficiency.

On-site LED Lighting (Streets and Open Spaces)

LED lighting have been installed replacing the conventional metal halide lights for all public areas, including streets and open public spaces within the 3000-acre Mahindra World City Jaipur development. At Mahindra World City Jaipur, 90W LED lights are being installed in place of 150W metal halide to achieve the equivalent required lux levels on site.

Based on the current LED street lighting energy use data available from Mahindra World City Jaipur, the savings from using LED street lights are estimated at 49.6% when compared with the convention metal halide street lamp.[30] Table 7.3 below summarises the projected carbon impact reduction from installation of LED lights throughout MWCJ, including street and public areas, assuming an average power requirement of 1.28 kW/acre based on available site data. **The total carbon abated annually as a result of this site-wide initiative is -1617.4 tCO_2e.**

Table 7.3: Impact Reduction from on-site LED Lighting

	Total Area	Power (kW)	Projected Annual Energy Consumption (kWh)	Annual tCO_2e Impact	tCO_2e Abated per year
BASELINE (Conventional Lighting)					
Road	522.0	668.1	2682405.4	2092.3	-
Open Space	285.0	364.8	1464723.4	1142.5	-
Total	**807.0**	**1032.9**	**4147128.8**	**3234.8**	-
IMPACT REDUCTION (LED Lighting)					
Road	522.0	668.1	1341202.7	1046.1	-1046.1
Open Space	285.0	364.8	732361.7	571.2	-571.2
Total	**807.0**	**1032.9**	**2073564.4**	**1617.4**	**-1617.4**

[30] Details of calculation provided in the Appended Excel Sheet: 'CPDP Calculations – (Credit-Street Light)'

Contracts with Indian LED manufacturers (including Light Sense and Syska) for bulk purchase of LED lights have been signed by MWCJ. Mahindra World City Jaipur will also explore a potential partnership with Mahindra partner company Mahindra Hinoday for manufacturing of street lights. Where Indian manufacturers are not available, others manufacturers have been engaged to meet site lighting demand. In recent trends LED fixtures cost have significantly come down (approx. 50%) and are expected to reduce further making this strategy more cost-efficient. Bulk purchase of LED lighting provides an "economy of scale" to local/regional manufacturers and will bring down the cost of bulbs to extend strategy to NPA area and offsite surrounding areas.

Off-site LED Lighting

The significant savings from the use of LED lights, not only provides an opportunity to reduce the overall energy use of the development, subsequently lowering the carbon impact, but additionally an opportunity to impact the local community to adapt the use of this technology for street/public lighting beyond the project scope.

At present, the application of LED lights for public space lighting is not prevalent in Jaipur. This will therefore be explored as a potential climate credit project for MWCJ to contribute to the climate positive outcome by lowering the carbon impact of the surrounding community. Mahindra World City will engage with local municipalities through the *Gram Panchayat*[31] and Jaipur Nagar Nigam to promote the implementation of LED lighting by replacing conventional lights and installing LED lighting, in the surrounding communities. The area selected includes the Jaipur Development Authority residential developments and 9 surrounding villages. The projected carbon credit from these initiatives is summarised in the table 7.4. The total power requirement for LED lighting has been calculated using an average of 1.28 kW/Acres. **Carbon**

[31] Local self-government institution at the village level

abated annually from implementation of LED lighting in surrounding villages and JDA residential developments is -9318.2 tCO_2e p.a.

Table 7.4: Projected carbon credits from implementation of LED lighting in neighbouring communities

	Total Area (Acres)	Power (kw)	Projected Annual Energy Consumption - Conventional (kWh)	Projected Annual Energy Consumption - LED (kWh)	tCO_2e Abated per year
JDA Development:					
Block A	1537.6	1968.1	7901790.2	3950895.1	-3081.7
Block B	227.9	291.7	1171254.9	585627.4	-456.8
Block C	353.2	452.1	1815311.0	907655.5	-708.0
Block D	302.6	387.3	1555109.2	777554.6	-606.5
Block E	283.4	362.8	1456458.5	728229.3	-568.0
Block F	272.8	349.2	1402045.3	701022.7	-546.8
Block G	598.4	765.9	3075063.3	1537531.7	-1199.3
Block H	279.7	358.0	1437187.4	718593.7	-560.5
Block I	193.9	248.2	996470.6	498235.3	-388.6
Block J	469.0	600.4	2410418.9	1205209.4	-940.1
Surrounding Villages:					
Kalwara	27.75	35.5	142612.8	71306.4	-55.6
Newta	59.21	75.8	304292.0	152146.0	-118.7
Khatwara	7.83	10.0	40239.9	20120.0	-15.7
Jhai	5.04	6.5	25901.6	12950.8	-10.1
Bhambhoriya	16.46	21.1	84591.2	42295.6	-33.0
Bagrukhurd	9.61	12.3	49387.7	24693.9	-19.3
Tilawas	4.82	6.2	24770.9	12385.5	-9.7
TOTAL	**4649.1**	**5950.9**	**23892905.6**	**11946452.8**	**-9318.2**

7.3. Extension of Jaipur Metro Line to MWCJ

"Jaipur Metro Rail Project has been planned keeping in view the urban transport demands of the city for the next many decades. The Jaipur Metro Rail intends to spur the economic development of the city while preserving its rich heritage and culture." [32]

The Jaipur Metro is a rapid transit system under construction in the city of Jaipur. It is being developed by Jaipur Metro Rail Cooperation (JMRC), formed under the Urban Development Department of the Government of Rajasthan. The current scope of the project is along two corridors: The East-West Corridor and the North-South Corridor. The East-West Corridor (Phase I) from Badi Chaupar to Mansarovar, has a total length of approximately 12.1 km. The North South Corridor from Ambabari to Sitapura (Phase-II) is planned with a total length of 32.1 km. Fig. 5 shows the planned routes for Phase I and Phase II of the project. The Government of Rajasthan has set up the Jaipur Metro Rail Corporation Ltd. (JMRC) as a wholly owned company of the State Government for implementation of this project.

[32] "Status of Project." *Jaipur Metro Rail Corporation*. Web. 1 Dec. 2013. <http://www.jaipurmetrorail.in/WebPortal/DynamicHTML.aspx?File=StatusOfProject.htm>.

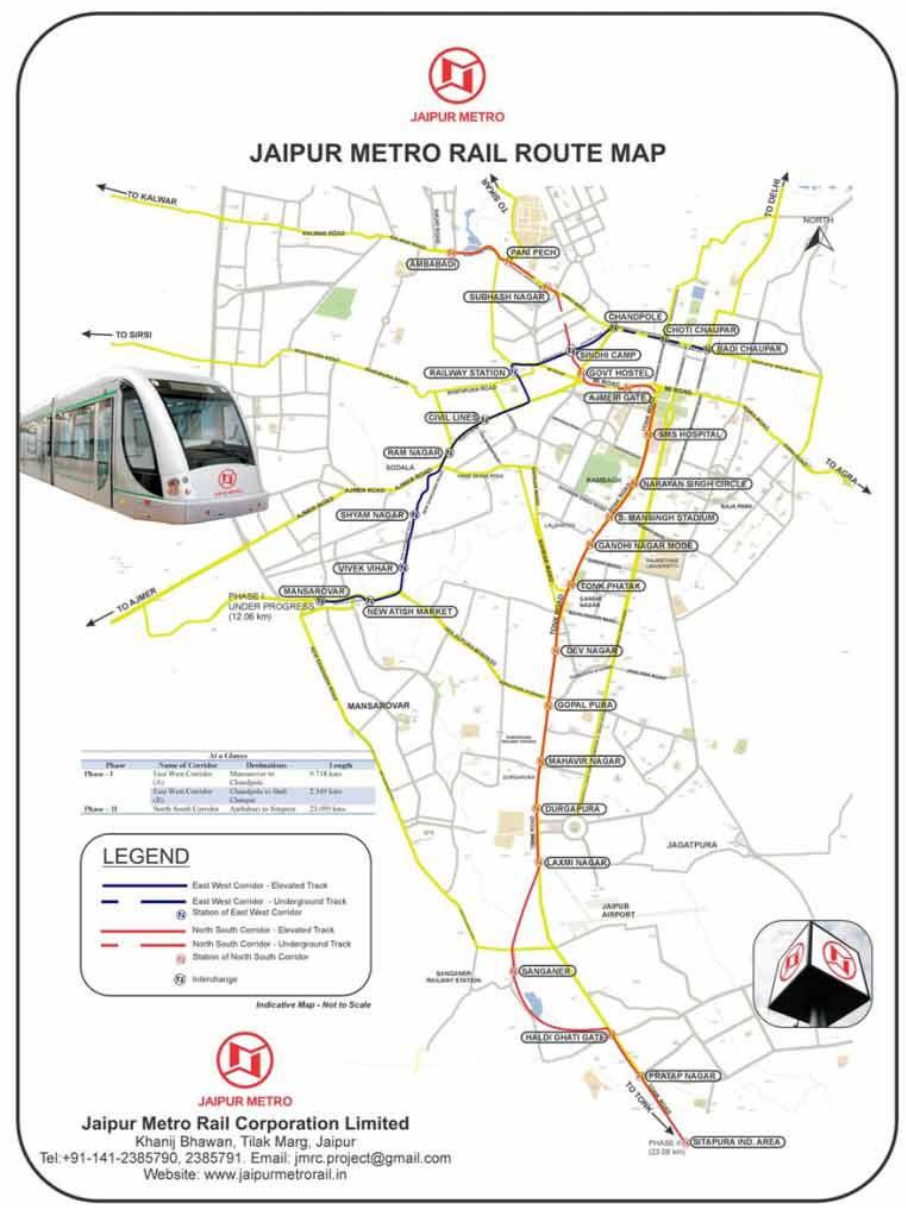


Fig 5: Jaipur Metro Rail Route Map (Source: JMRC Website)

Construction of Phase I of the line started in November 2010 and was completed in August 2014. The first phase of Jaipur Metro rail connects Badi Caupar to Mansarovar via Civil Lines and Chandpole. Chandpole is located near Jaipur city center with easy access to key residential and business districts. The Jaipur Metro will be integrated with the Bus Rapid

Transport Services (BRTS) of Jaipur city and other public transport systems to provide a smooth transition from other public transport mode with seamless interchange and transfer facilities.

An extension of Phase I from Mansarovar, currently the last station in Phase I, to Mahindra World City is being explored as an alternative access route in and out of the World City, thereby connecting the development to Jaipur city centre via rail. Mahindra World City Ltd, as a joint venture between Mahindra Group and the Government of Rajasthan, is the appropriate platform to engage Jaipur Metro Rail Corporation to extend the planned Phase I of the metro line (Shown as the blue line in Fig. 5). An "Application for the extension of phase 1 JMRC route extension up to the MWCJ project" was submitted to the Urban Development and Housing Department, Government of Rajasthan on October 7, 2014 and will be included as an appended document to this Roadmap. As stated in the appended letter, the extension of the Jaipur metro would not only benefit employees and residents of MWCJ but neighbouring communities including universities, schools and adjoining villages.

An extension of Phase I, currently ending at Mansarover, by an additional 16.1 km will be able to reach Mahindra World City Jaipur. As part of this plan, a metro station will be proposed bordering Mahindra World City at Mohana Mandi Rd., easily accessible from both processing and non-processing zones of the World City as well as neighbouring villages and residential and commercial developments. Additional demand studies will be conducted to determine the feasibility of the extension of Phase I and included in the CPDP roadmap when it is periodically reviewed and updated. The proposed extension 16 km (shown in Fig. 6) will not only increased the mobility of the approx. 300,000 employees and residents of MWCJ but also more than 100,000 people who will be living in neighbouring communities and populations in key industrial and residential zones along the Mansarovar to MWCJ route where additional stations can be proposed.

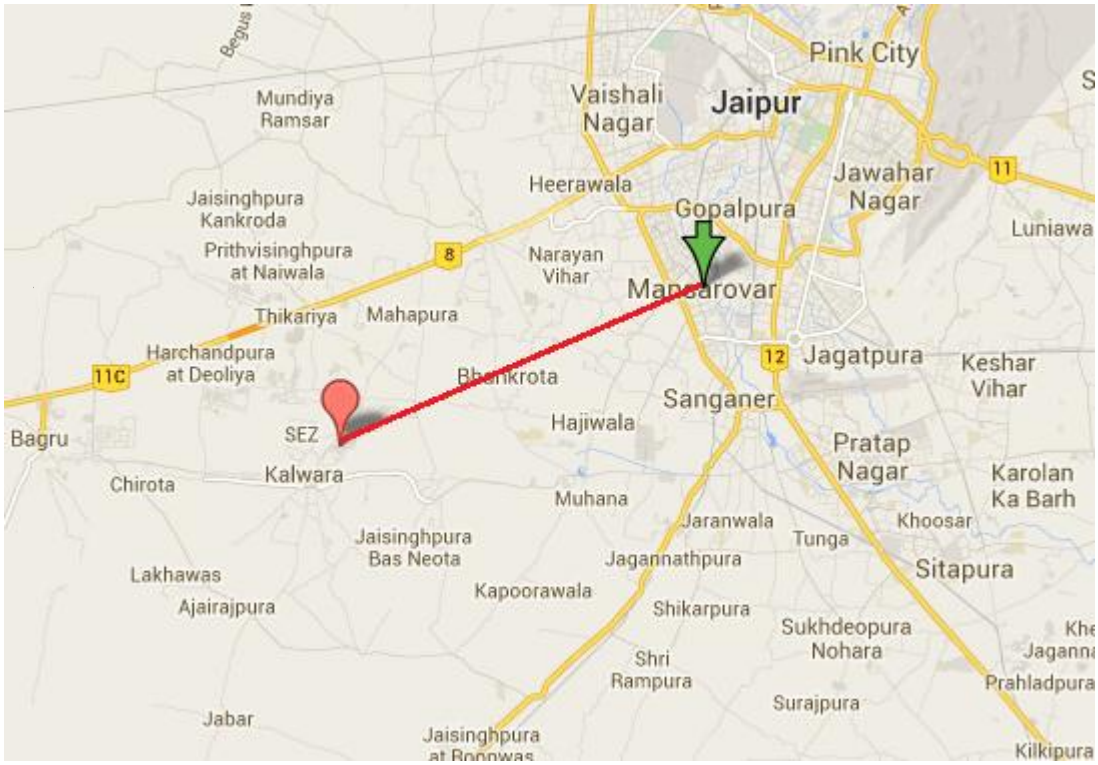


Fig. 6. Metro Phase I extension from Mansarovar to MWCJ (Source: Google Maps)

This strategy, when implemented will be taken as both a carbon reduction and credit for the development, providing employees and residents in MWCJ and surrounding communities easy access to safe and cost effective rail transport as an alternative mode to private transportation. This will increase their mobility while simultaneously decreasing the carbon footprint of Mahindra World City and its surrounding communities. Subsequently, the increased connectivity to Jaipur city will help make MWCJ an even more attractive place to live and work.

Local buses currently run between Jaipur City and MWCJ, along with independent bus services for company employees within MWCJ that run from Jaipur city to site. In the event that metro-rail extension does not come to fruition, alternative CNG bus service from Mansarovar (last metro station) to MWCJ will be proposed in partnership with the Government to meet the transportation demand. Additionally, allowing the access for local buses and informal transport options access into MWCJ will help to partially meet the travel demand as population in the development increases.

Estimation of Carbon Abated due to Metro line extension:

As suggested in the Climate Positive Development Program Framework, 40% of the transportation emissions from potential trips of neighbouring communities that end or start near the development site was included for calculation of carbon abated (credit) from this strategy to offset remaining baseline emissions. A modal shift from cars/cabs to metro for approximately 50% of the population is expected if metro line is extended to MWCJ. Using an estimate of 1 roundtrip a day from MWCJ to Mansarovar for 50% of the population, the carbon abated was calculated (with car/cab trips used as the baseline value). This was assumed to be the most appropriate methodology to capture the impact of extending the metro line on the carbon footprint of the neighbouring community. Table 7.5, 7.6 and 7.7 below summarise the carbon abated (credit) due on neighbouring communities using the current demographics data of surrounding villages and Jaipur Development Authority residential/commercial development plans. These impacts will revised as updated demographic data is made available:

7.5: Projected Population of Neighbouring JDA Development

Plot	Total Number of Households	Projected Population (2011)
1	13	65
2	830	4150
3	75	375
4	93	465
5	555	2775
6	12	60
7	11	55
8	611	3055
9	14	70
10	72	360
11	36	180
12	763	3815
13	749	3745
14	806	4030
15	561	2805
16	12	60
17	165	825
18	54	270
19	1658	8290
20	17	85
Total	**7107**	**35535**

Table 7.6: Population of Surrounding Villages

Village	Population (2011)
Kalvara	5210
Dadiya	200
Palri Parsa	1800
Tilyas	800
Bhambboria	5000
Jhain	1000
Bagru Khurd	3700
Nevta	5500
Khatwara	3600
Total	**26810**

Table 7.7: Carbon Abated (Projected) due to Proposed Metro Line Extension

Total Population - Surrounding Community (2025 Projected)	112221
Population Expected to Commute	56111
Number of Trips Per Day	942656.4
Baseline tCO_2e Impact p. a (Cars/Cabs)	243205.4
tCO_2e Abated	**-147729.6**

7.4. Carbon Sequestration

Provision of Green Space:

Urban areas stand to benefit greatly from "greening," provided it is undertaken in a carefully thought out way. *Greening the city refers to creating, preserving and restoring green and open space in a sustainable manner*. Some benefits of urban greening are reducing heat island effects and energy consumption, social/health benefits, land value increases, climate change adaptation through an increase of permeable land and significant air quality improvements.

The landscaping design in the master plan for Mahindra World City Jaipur incorporates the provision of green spaces throughout the development. The total percentage of green space planned (including grass/tree plantations) is approximately 10% of the total developed area of the site. These spaces include parks, as well as trees, shrubs, grass and other greenery along sidewalks and pedestrian pathways. Green spaces, especially trees and saplings planted on-site, act as carbon sinks. The exact carbon profile of these trees depends on the species, growing conditions, temperature and how a tree in managed. The carbon profile of other green spaces (shrubs and grasses) is also varied. A detailed analysis will be conducted to arrive at an appropriate estimate for the carbon sequestration potential for green spaces on site.

In addition to the provision of green spaces, the intentional selection of native plants for the spaces which require significantly less water for maintenance has also been incorporated as measure to conserve water on site. The complete list of native plants on site can be found in the MWCJ Environmental Impact Assessment. 10095 trees have been planted in the processing area till date (*Table 7.8*). More trees are planned on site as landscape development for MWCJ progresses. The tCO_2e abated from green spaces planned on site has not been included as a carbon impact reduction strategy. This will be incorporated when detailed carbon sequestration potential of green spaces on site is calculated.

Table 7.8: The total number of trees planted in PA

Processing Area	Trees Planted	Year
IT/ ITES SEZ (excluding Evolve)	2495	2008
Handicraft SEZ	2357	2010
Engineering/Related Industries SEZ	1892	2010
DTA-2	2075	2010
DTA-3	580	2012
Evolve IT Park	696	2008
TOTAL	**10095**	

Tree Plantation Drive

Tree plantation drives are routinely planned in Mahindra World City Jaipur as part of the Corporate Social Responsibility programmes conducted for on-site employees. CSR activities in MWCJ include, among others, tree plantation drives, eye check-up camps, visits to differently-abled homes near MWC, Children's Day celebration, blood donation camps, vocational training, Women's Day celebration and awareness campaign and driving safety awareness.

As part of the drive, employees plant tree saplings in the seven adjoining villages. The tree plantation drives receive overwhelmingly enthusiastic participation from employees and a total of 13,200 trees have been planted in adjoining villages as part of the drive since its initiation in 2010. The drive aims to encourage tree plantations in neighbouring villages for the provision and maintenance of green spaces beyond immediate scope of the development. Off-site tree plantation is included as a credit project in the Climate Positive Roadmap for Mahindra World City Jaipur which provides MWCJ with an opportunity to promote this sustainable practice in the local community. An appropriate average for the carbon capture potential of trees planted is required to determine the carbon savings *(credit)* associated with this measure and will be incorporated in revised versions of the roadmap.

The details of trees planted since the start of the initiative and projection of corresponding carbon emissions abated is shown in the Table 7.9 below.

Table 7.9: Climate Credit Calculations for MWCJ Tree Plantation Drive

Year	Number of Saplings Planted	Total Number of Saplings Planted	tCO_2e abated per year
2010	500	500	-1.8
2011	2400	2900	-8.8
2012	5300	8200	-19.4
2013	5000	13200	-18.3
Total trees planted so far	13200	13200	-48.3
2014-2025 (Target)	**55000**	**68200**	**-249.6**

8. REDUCING EMISSIONS DURING CONSTRUCTION

The Climate Positive Development Program "recognizes that the three operational emission categories (*Energy, Waste and Transport)* do not represent the totality of emissions generated throughout the life of a development.

For the first phase of the Climate Positive Development Program for Mahindra World City Jaipur, emissions from construction have been excluded from the emission impacts of the development; however, the Program requires Development Partners to identify strategies to reduce emissions associated with their largest construction phase emissions sources, and to monitor and track construction phase emissions from these sources."[33] Key construction phase emissions will be included in the following versions of this roadmap. Current construction emissions details are available in the Company's annual sustainability report . [34]

[33] "Framework for Climate Positive Communities", Climate Positive Development Program.
[34] Mahindra Lifespaces GRI Report FY 13-14
http://www.mahindralifespaces.com/pdf/mldl%20sustainability%20synopsis%2013-14.pdf

There is a deepening relevance of climate change mitigation and the need for sustainable development in the real estate and construction sector. The cement sector alone accounts for a substantial percentage of global CO_2 emissions. The highest CO_2 impact is from the mining/manufacturing of materials and chemicals used for construction activities. Transportation of heavy materials used for construction and development is also very energy-intensive. The chemical processes and use of fuel/electricity during the construction phase account for the major portion of the sector's CO_2 emissions. While the operation life cycle of any city has a much higher carbon impact due to significant energy use, the construction of infrastructure also contributes to the total carbon impact of a development. Responsible environment management with a prudent choice in sustainable construction practices can lead to substantial carbon reduction in the construction phase.

As a real estate developer, we play a critical role in the transition to a low-carbon economy and are committed to adopt low-carbon technologies and solutions and adhering to policies and regulations aimed at climate change mitigation nationally. Mahindra Lifespaces and Mahindra World Cities (Jaipur & Chennai) as its subsidiary, have set goals to reduce the carbon footprint of the residential and integrated city developments through introducing carbon saving processes that reduce construction related emissions. As part of Mahindra Lifespaces membership in the Global Reporting Initiative (GRI), construction related emissions are reported annually and disclosed in the annual GRI report for the company.

The following key sources of GHG construction related emissions, both direct and indirect, are reported:

1) All direct GHG emissions from burning of fuel onsite.
2) Indirect GHG emissions from consumption of purchased electricity.
3) Other indirect emissions, such as inbound, outbound logistics, air travel, daily commutation, paper consumption and transport-related activities.

The GRI report for Fiscal Year 12-13, titled "*Sustainable Urbanisation: Building a Green Future*", and summary report for FY 13-14 titled "Urboonisation", is available on the company website at www.mahindralifespaces.com.

The 3000-acre scale of the Mahindra World City Jaipur development provides ample opportunities for substantial emission savings during the construction of the horizontal and vertical infrastructure on site. The following emissions reduction strategies are in place for all projects onsite to limit the carbon impact during construction:

- **Reducing construction waste emissions through Green Supply Chain Management Policy**: Material sourcing, procurement and consumption, are primary focus areas in the construction of MWCJ. The Green Supply Chain Management Policy (GSCM) gives preference to purchasing from sources which are less polluting and/or use clean technology, as well as encourages the use locally available materials, manufactured within 500 km, thereby minimizing the associated environmental impacts resulting from transportation. As part of the GSCM policy, the selection of vendors who recycle scrap materials from project site is also encouraged to reduce emissions related to the landfilling of construction waste. In addition, greater priority is afforded to parameters such as sourcing local materials, recycled content, recyclability, and potential for reuse of those materials. The policy is provided as part of the appended documents.

- **Reuse of more than 75% of construction waste within site:** Our operational processes only generate non-hazardous waste, 75% of which is reused within the site for landscaping, and construction of pathways, pavements, etc.

- **Use of recycled materials**: Fly ash is a by-product generated during coal combustion which is traditionally considered a waste material. The disposal of fly ash in landfills presents environmental problems because of the solubilization of contaminants and heavy metals in fly ash that can leach from the waste and contaminate underground aquifers, a source of water

supply for municipalities and farms. This fly ash is increasingly being recycled to form fly ash bricks, and used for concreting, and road construction. At Mahindra World City Jaipur, the use of fly ash during construction has replaced other materials in various processes ranging from RCC (reinforced cement concrete), HVFAC (High Volume fly ash cement concrete) road, hardstands, and car-park floors, to use of fly ash in bricks. Mahindra Lifespaces and Mahindra World City have increased the total fly ash bricks used in construction from 9,934 tonnes in FY 2011-12 to 11,385 tonnes in FY 2012-13.

9. FINAL CALCULATIONS

The Mahindra World City Jaipur is currently at a very early development stage with the majority of vertical infrastructure on site currently not developed. However, as a pioneer in the concept of the Integrated Business City in India, as well as a leader in the development of resource efficient green buildings in India, we feel confident in our ability to achieve a climate positive outcome for Mahindra World City Jaipur.

Table 9.1 below lists the carbon reduction and credit measures described in depth in this report and the resulting carbon abated due to those measures. Where more evidence is needed or where detailed analysis/design will yield more accurate information, this has been highlighted and no figure given. As seen from the table below, our energy and transportation strategies are key to achieving the climate positive outcome, as they provide the greatest carbon saving potential and we are determined to ensure that these are implemented. As seen from the table, at present it is believed that a Climate Positive Outcome with an estimated net negative emissions of approximately 60,000 tCO_2e annually is achievable by 2025 if strategies outlined in the roadmap are implemented.

Table 9.1: Final Calculation – Total Carbon Abated and final annual emissions

Source	Reduction/ Abatement Measures	Operational Emissions (tCO_2e)	Carbon abated per year (tCO_2e)
Impact Reduction Strategies			
Energy:	Efficient use of energy: Buildings	476751.7	-204322.2
	Efficient use of energy: Utilities	166.8	-2627.0
Water:	Low-flow fixtures	266010.5	-5251.1
	Water recycling		-1249.3
	Wastewater treatment		-3805.3
	Rain water harvesting	-	*To be determined as design develops*
Transportation:	EMBARQ Transport Plan (ASI Approach), including intra-city Bus Rapid Transit, cycle track and carpooling	44919.7	-57545.9
Waste:	Municipal Solid Waste treatment plan	-2180.9	-35637.1
	Industrial waste treatment plan		*To be determined as design develops*
	E-waste treatment plan	-932.6	-1059.555102
Site-wide Initiatives (Credit/Imp Red Projects)			
Energy (Solar Power):	On-site Rooftop Solar	-	-240069.2
	Off-site Solar Projects in Rajasthan (Jodhpur and Bikaner) *[CREDIT]*	-	-181545.5
	LED Lighting in MWCJ (Streets/Open Spaces)	1617.380244	-1617.4
	LED Lighting Surrounding Areas (Streets/Open Spaces) *[CREDIT]*	-	-9318.2
Carbon Sequestration:	Provision of Green Space	-	*To be determined as design develops*
	Tree Plantation Drive [CREDIT]	-249.612	-249.6
Transportation:	Extention of Metro Line to MWCJ	-	-147729.6
BASELINE		-	**830258.0**
Combined Credits /Total		**786103.1**	**-61768.9**

10. SWOT ANALYSIS:

The following is a SWOT analysis for Mahindra World City, Jaipur to determine the strengths, opportunities, weaknesses and threats in achieving the Climate Positive Outcome.

STRENGTHS	**WEAKNESS**
• Familiarity with Green Building Construction through various projects across India. • Focus on Sustainable Urbanisation as part of *Aspiration 2017*. Economic, Environmental and Social sustainability is a key area of focus for the company. • Partnership with State Government (MOU with RIICO). • Focus on Innovation and implementation of new efficient technologies and sustainable practices. • Mahindra World City Ltd. (subsidiary of Mahindra Lifespaces), is part of the Mahindra Group 45 Company conglomerate. A US $16.2 billion multinational group.	• Mahindra World City Ltd. has to ensure customer engagement and participation to achieve Climate Positive outcome for MWCJ. • Lack of experience with measurement and verification of operational carbon emissions. • Determining timeline for development for customer facilities is difficult as majority of land is currently unsold/undeveloped.
OPPORTUNITIES	**THREATS**
• This project is first of its kind in India to aim for Climate+ outcome for a development of this scale. It can serve as a benchmark/model to showcase interest to implement climate mitigation measure thus uplifting its face-value for the public and paving way for future projects. • MWCJ in a very early stage of development. Opportunity to integrate Climate+ Roadmap as part of revised master plan for the city. RIICO/Mahindra partnership helpful to engage with state and national government on schemes that encourage sustainable practices (e.g. Renewable Energy). • Potential for collaboration between companies of Mahindra Group for sustainability initiative within MWCJ (e.g. MEPC partnership for solar projects). • Opportunity to partner with new third-party agencies for sustainable practices (waste-to-energy, recycling and composting, solar-thermal.	• Requires participation of various stakeholders to achieve Climate+ goal including customers, employees, residents, Mahindra World City Ltd., Government of Rajasthan and local community. • Cooperation with government in the implementation of strategies (eg. effective waste management, recycling, waste-to–energy etc.) may be difficult as these practices are currently not widespread in the Jaipur region. • Difficulty in promote customer participation for sustainability initiatives while ensuring that these commitment/requirements from customers are not overly stringent. • Resistance from neighbouring areas to adapt sustainable technology/ initiatives promoted by MWCJ (e.g. LED Street Lighting)

11. MEASURMENT AND VERIFICATION PLAN

The strategies outlined in the Climate Positive Roadmap will be incorporated as part of the Sustainability Roadmap of each fiscal year and monthly targets will be set to ensure that goals are being met. There will be a biannual review for each of the three sources to ensure that the development is on track with the roadmap and the roadmap will be updated accordingly. Measurement and verification will also be conducted biannually. Individual reports for measurement of carbon emissions will be established for Energy, Waste and Transport emissions as emissions reduction milestones are met. These individual reports will then be compiled to include all site-wise strategies and submitted for verification at key stages of the development (25%, 50% and 75% developed). The measurement and verification for construction emissions will also be conducted annually and reported in the annual GRI report for the company.

The emission factors used for calculating the carbon impact and impact reduction/credits are taken from GHG Protocol (World Resource Institute), IPCC and EPA standards. The standards used for the baseline and impact calculations should be consistent to ensure that any carbon savings observed are a direct result of the reduction/credit measures implemented.

12. TIMELINE OF MILESTONES

The progress of the development will be formally assessed at select intermediate milestones in the development cycle prior to completion: 25%, 50% and 75% developed. An external assurance provided will be used to ensure validity of assessment. Please refer to development timeline (Table 3.1) to estimation of dates of quarterly milestones. An internal review of roadmap and check against all carbon reduction targets will take place biannually with the first one scheduled for September 2016.

The horizontal development which includes the provision of power supply and street lighting, water supply and distribution, sewerage system, storm water drainage system, landscaping, roads network and other public amenities is developed and managed by Mahindra World City Ltd. Horizontal infrastructure is substantially developed as of date but not operating at capacity as only a limited number of industries are currently operational on site. The appropriate timeline of milestone for Mahindra World City Jaipur should correspond with the percentage occupied as well as percentage developed which will give a more accurate picture of the carbon emissions profile of the development as construction progresses. The complete projected development timeline for MWCJ is given in Table 3.1.

The timeline for the development of horizontal infrastructure (Processing Area) of Mahindra World City Jaipur is shown in table 12.1 below.

Table 12.1: Phase-wise Horizontal Development in Processing Area

		Horizontal Development
phase 1	IT/ITES (38s acre) handicraft (132 acre) Engineering (138 acre) DTA (254 Acre)	Completed
Phase 2	DTA (285 acre) Engineering DTA combining road (18 acre)	Completed
Phase 3	Handicraft (187 Care), Engineering (100 acre), IT/ITES (85 acre), Gems& jewellery (27 acres), vertical spinal road (30 acres)	2013-14
Phase 4	handicraft(68 acre) Light engineering (411 acre)	2014-15
Phase 5	NPA (300 acre)	2015-16
Phase 6	NPA (665 acre), DTA (30 acre)	2016-17

There is a lag between when city infrastructure is developed and when it becomes fully operational. Even as horizontal infrastructure is in place, the majority of the land area in MWCJ currently includes undeveloped/unleased plots. Construction on these unleased/undeveloped land plots will depend on the lease of those plots to manufacturing/service industries that will

then develop independent facilities/buildings on those plots in accordance with guidelines provided in the lease agreement.

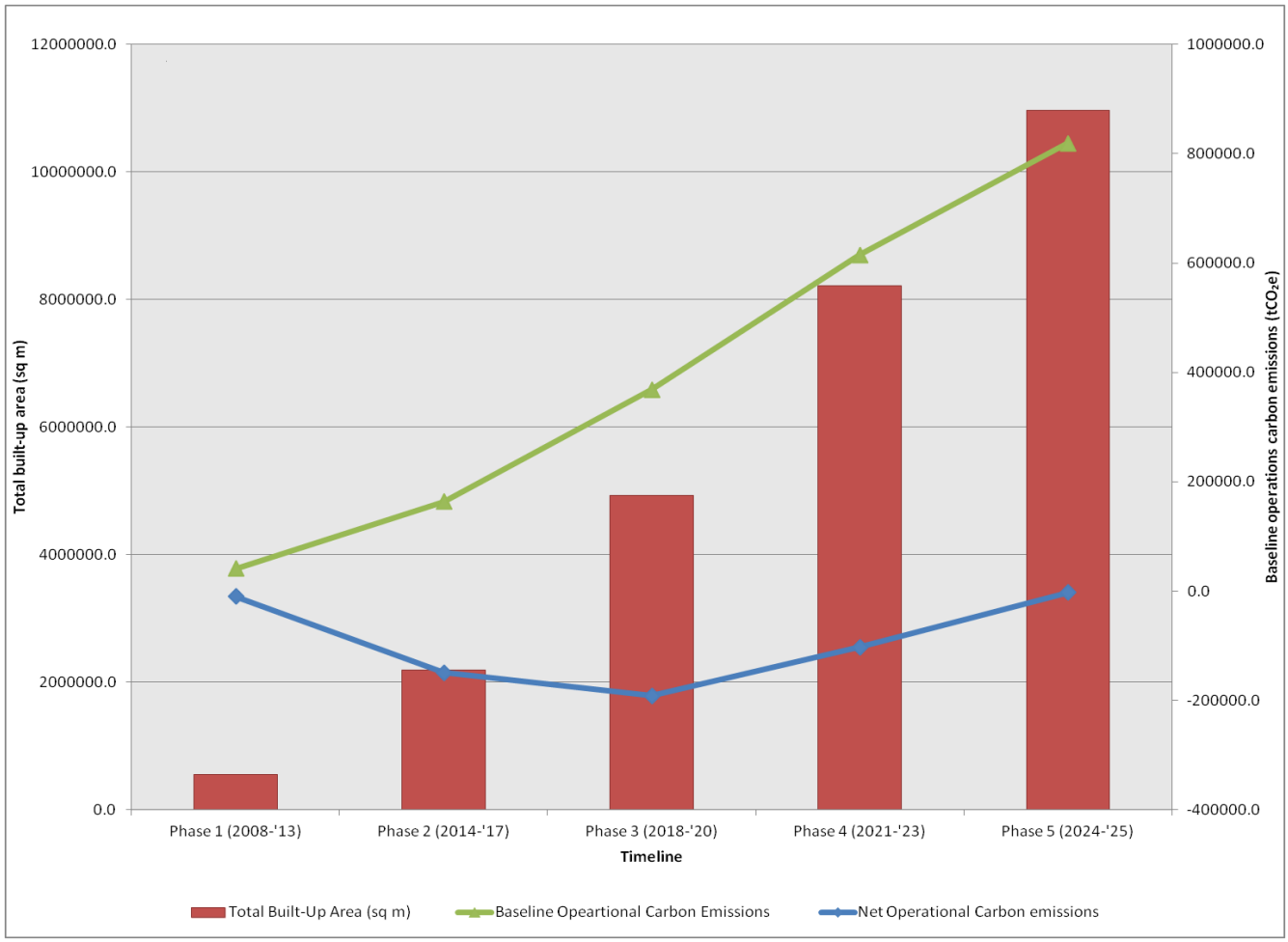
The timeline for the leasing out and development of plots is not available for Mahindra World City Jaipur. The rate of development and occupation of vertical infrastructure is a key factor which affects the emissions profile for MWCJ and is required to establish a more accurate timeline of milestones. This will be estimated based on data available from the Mahindra World City in Chennai, a 1500 acre integrated city development based on a similar land use model, which is currently fully operational. This timeline can be revised as on-site data becomes available and the roadmap is periodically reviewed.

Table 12.2 provides a timeline of all strategies describes in the Climate Positive Roadmap, including strategies which have already been implemented on site and those planned for the future.

Table 12.2: Timeline of Strategies

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Energy Strategies:																		
On-Site Rooftop Solar																		
25% Energy Savings (All Building)																		
30% Water Savings (Low-Flow Fixtures)																		
Energy efficient systems (Utlities)																		
Water Strategies:																		
Low Flow Fixtures (All Buildings)																		
Water Recycling																		
Wastewater Treatment																		
Rainwater Harvesting																		
Waste Strategies:																		
Establish waste Segretion/Management																		
Recycling (16% MWS)																		
Composting/biogas (70% MWS)																		
E-waste recycling																		
Transport Strategies:																		
Intra-city Public Transport (Bus) Development																		
Cycle track network Development																		
Pedestrian Network																		
Sshare-cab facilities during peak hours																		
Site-wide Strategies:																		
LED Lighting (MWCJ)																		
LED Lighting (Surrounding Areas)																		
Tree Plantation Initiative																		
Provision of Green Space																		
Extention of metro line to MWCJ																		
Off-Site Solar Power (MEPC Projects)																		

12.3: The Climate Positive Timeline (Phase-wise Development)



13. PARTNERSHIPS

We recognise that achieving a Climate Positive Outcome for a development project of this scale is not possible in isolation. As a result, Mahindra World City Ltd. has partnered with the following organisations to work towards achieving targets outlined in the Climate Positive Roadmap:

- **Mahindra EPC Services Private Ltd**: Amongst the leading solar EPC provider in India, Mahindra EPC is a portfolio company under the '*Cleantech*' arm of Mahindra Partners. The company offers a range of solar solutions spanning from on-grid solutions, EPC (Engineering, Procurement and Construction) and off-grid solutions. Partnership letter included in appended documents.
- **Jaipur Metro Rail Authority:** In reference to the partnership and cooperation between MWCJ and Jaipur Metro Rail Authority for a metro rail extension from Mansarovar to MWCJ, an "Application for the extension of phase 2 JMRC route extension up to the MWCJ project" was submitted to the Urban Development and Housing Department, Government of Rajasthan on October 7, 2014 and is included as an appended document to the Climate Positive Roadmap for MWCJ.
- **RIICO, Government of Rajasthan**: Mahindra World City in Jaipur (MWCJ) is a joint venture between Mahindra Group and Rajasthan State Industrial Development Corporation (RIICO, an agency of the Government of Rajasthan). Cooperation with the state government was carried out though a Memorandum of Understanding with RIICO (see appended documents) with the Government of Rajasthan having 26% stake in the project.
- **Global Reporting Initiative:** The Global Reporting Initiative (GRI) is a leading organization in the sustainability field. GRI promotes the use of sustainability reporting as a way for organizations to become more sustainable and contribute to sustainable

development. Mahindra Lifespaces (and Mahindra World City as its subsidiary company) publishes an annual GRI sustainability report.

- **Indian Green Building Council (IGBC**): The vision of the council is to usher a green building movement in India to facilitate India to become a global leader in green buildings and townships. Letter for membership in IGBC is included as an Appended Document to this roadmap.

14. APPENDED DOCUMENTS:

1. *Climate Positive Development Program – Calculations (Excel)*
2. *Mahindra World City Jaipur Master-plan (Jurong International, 2007)*
3. *Memorandum of Understanding (RIICO)*
4. *Application for the extension of phase 1 JMRC route extension up to the MWCJ project*
5. *EMBARQ India Transport Recommendation: "Building a Sustainable Non-motorized Strategy"*
6. *Mahindra World City Jaipur Ltd. Endorsement*
7. *Mahindra EPC Partnership Letter*
8. *Mahindra Lifespaces Green Supply Chain Policy*
9. *Mahindra EPC Co-development agreement for Select SEZs*