IE-Tram, Mérida, México

Document prepared by MERCADO AMBIENTAL AP

Name of the project	*IE-Tram, Mérida, México*
Project holder	*Movilidad Urbana Mérida, S.A.P.I de C.V.*
Account holder	*MERCADO AMBIENTAL AP*
Legal representative	*Eduardo Piquero*
Project holder's contact information	*Carlos Toledo Ramirez* *South Divisional Director* *ctoledo@mobilityado.com*
Other project participants	*Transportation Agency of Yucatán*
Version	*1.0*
Date	*13/05/2025*
Project type	*Transportation*
Grouped project	*The project corresponds to a grouped project*
Applied Methodology (ies)	*ACM0016: Mass Rapid Transit Projects --- Version 6.1*

Project location (City, Region, Country)	*Mérida, Yucatán, Mexico*
Starting date	16/12/2023
Quantification period of GHG emissions reduction	16/12/2023 to 15/12/2030 (7 years)
Estimated total and average annual GHG emission reduction/removals amount	*Average annual: 3,109 tCO_2e* *Total: 21,767 tCO_2e*
Sustainable Development Goals	SDG 3 – Good Health and Well-Being. SDG 7 – Affordable and Clean Energy. SDG 8 – Decent Work and Economic Growth. SDG 9 – Industry, Innovation and Infrastructure. SDG 11 – Sustainable Cities and Communities. SDG13 - Climate Action. SDG 16 – Peace, Justice and Strong Institutions.
Special category, related to co-benefits	*Not applicable*

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1 Project type and eligibility

1.1 1.1 Scope in the BCR Standard

The project is eligible under the scope of the BCR Standard by meeting the following conditions:

The scope of the BCR Standard is limited to:	
The following greenhouse gases (GHG), included in the Kyoto Protocol: **Carbon Dioxide (CO_2)**, Methane (CH_4) and Nitrous Oxide (N_2O).	X
GHG projects using a methodology developed or approved by BioCarbon, applicable to GHG removal activities and REDD+ activities (AFOLU Sector).	
Quantifiable GHG emission reductions and/or removals generated through implementation of GHG removal activities and/or REDD+ activities (AFOLU Sector).	
GHG projects using a methodology developed or **approved by BioCarbon**, applicable to activities in the energy, **transportation** and waste sectors.	X
Quantifiable GHG emission reductions generated through **implementation of activities** in the energy**, transportation** and waste sectors.	X

The project consists of the stablishing of several routes of a Mass Rapid Transit System (MRTS) (a Bus Rapid Transit [BRT] without feeder routes) displacing the use of transport that consumes fossil fuels such as diesel, gasoline and LP gas from busses, cars, motorcycles among others. The project count routes stablished from December 2023 onwards, in accordance with the BCR Standard, which includes a start date within five years prior to the start of validation. This activity is eligible for the ACM0016 Large-scale Consolidated Methodology Mass rapid transit projects, version 6.1 approved by the BCR Standard.

1.2 1.2 Project type

Type of project under which the project activities are carried out are:

Activities in the AFOLU sector, other than REDD+	

REDD+ Activities	
Activities in the energy sector	
Activities in the transportation sector	X
Activities related to Handling and disposing of waste	

1.3 1.3 Project scale

This project is classified as **small scale** while the annual emission reductions are under 60,000tCO_2e.

2 General description of the project

The state of Yucatan suffers from a severe lack of public transportation. The vast majority of the population lacks their own vehicles, so in order to get around, it is necessary the implementation of better transportation that establish not only new routes, but also modern, efficient and sustainable units Hernández, 2023. Before the project, transportation systems were based on units that generate GHG emissions expressed in tons of carbon dioxide equivalent (tCO_2e), which contribute significantly to global warming and its consequences on the planet. The introduction of the first 100% electric BRT service in southeastern Mexico is an innovative solution. Integrated to the Va y Ven system, it is expected to provide service to 80% of the state's population, cutting travel times in half and significantly reducing carbon emissions Loeza, 2022. Excelsior, 2023

The IE-Tram project seeks to transform urban mobility in Yucatan, combining technological innovation with a real commitment to environmental sustainability. It is proposed under the categories of clean transportation and sustainable development, aiming to contribute significantly to the SDGs by improving health and well-being (SDG 3) through the reduction of air pollution; boosting the use of affordable and clean energy (SDG 7) by developing efficient and clean transportation technologies; fostering inclusive economic growth and decent employment (SDG 8) by generating new job opportunities during its development and operation phases; promoting sustainable industry, innovation, and infrastructure (SDG 9) through the implementation of advanced mobility technologies; promoting sustainable cities and communities (SDG 11) by improving urban mobility and accessibility; taking action on climate change (SDG 13) through the reduction of GHG emissions; and supporting peace, justice and strong institutions (SDG 16) by

promoting safe, reliable, and transparent transportation systems that enhance trust in public infrastructure. Ficha de sostenibilidad, 2024.

Being an electric transport system, the IE-Tram does not generate direct emissions of GHG, contributing to the mitigation of global warming Ficha de sostenibilidad, 2024. The implementation of this system is estimated to reduce 3,109 tones of CO_2e per year (tCO_2e/yr). The estimated emissions reduction over the 7-year period from 2023 to 2030 is approximately 21,767 tCO_2e.

2.1 2.1 GHG project name

IE-Tram, Mérida, México.

2.2 2.2 Objectives

General Objective:

- Improve urban mobility by implementing the first Latin America's fully electric BRT system, with the aim of ensuring accessible and efficient public transportation while reinforcing the state's commitment to environmental sustainability and climate change mitigation.

Specific Objectives:

- Improve Urban Mobility: Increase the capacity and efficiency of public transportation in Yucatan by implementing the IE-TRAM, which is designed to comply with the principles of accessibility, safety, multimodality and customer service. Goal Systems, 2023
- Reduce GHG Emissions: Achieve a significant reduction in GHG emissions using a fully electric BRT system which is designed to consider zero carbon direct emissions due to its infrastructure and its technology. Irizar e-mobility

2.3 2.3 Project activities

The project activities for the Merida IE-TRAM consist of the implementation of a fully electric BRT system, designed with structure and technology that ensure zero carbon direct emissions. It is projected to also will include a photovoltaic power plant to supply renewable energy. The system's vehicle fleet consists of at least 32 electric buses, featuring tram-like aesthetic design and a technical backup fleet to guarantee coverage of the concessioned service of the baseline Proyectos de México, 2025. The project aims to increase service offerings by reducing travel times, optimizing daily commutes and

redefining the mobility experience for more than 200,000 people and significantly reducing GHG emissions. Terrenos Yucatán; 2022; Diario de Yucatán, 2022

2.4 2.4 Project location

The IE-TRAM is located in Merida, Yucatan, Mexico (**Figure 1**). It has urban and suburban coverage providing service in the municipalities of Merida, Kanasin and Uman, and will reach two Mayan Train stations, being Teya an Uman, as well as La Plancha park. Additionally, the project considers key aspects such as energy efficiency, net-zero carbon emissions (through the solar photovoltaic system that will be installed in the future), and support for vulnerable groups. Agencia de Transporte de Yucatán, 2024; Proyectos de México, 2025

Figure 1. Geographical location of the project: Yucatán, Mexico

2.5 2.5 Additional information about the GHG Project

The units are 12 meters long and each one has a capacity for 80 passengers (33 seated and 47 standing). In addition, it has a traffic light exclusively for electric bus traffic that is coordinated with others to allow a continuous flow and exclusive lanes to ensure fast travel. Another fundamental aspect of the IE-TRAM lies in the optimization of its

recharging infrastructure, both at night and with fast charging pantographs, to achieve an autonomy of up to 300 km per day for the units. (IE-TRAM General, 2024)

3 Quantification of GHG emissions reduction

3.1 Quantification methodology

Reference methodology: Clean Development Mechanism (CDM): ACM0016. Mass Rapid Transit Projects. Large-scale Methodology. Version 6.1. Approved by BioCarbon Standard.

3.1.1 Applicability conditions of the methodology

Table 1 shows the disaggregation of each concept of applicability and the correlation with the project concept.

Table 1. Applicability of the project to the conditions set by the methodology

Concept of methodology	Project Concept
Establishment and operation of new rail-based or bus-based mass rapid transit systems (MRTS) in urban or suburban regions for passenger transport by replacing a traditional urban public transport system. For buses, typical projects involve the replacement, extension of bus lanes or expansion of existing BRT systems (adding new routes and lines). For trains, typical projects involve the extension of existing rail line or expansion of existing rail infra-structure (e.g. new rail lines).	Establishment and operation of new all-electric bus-based mass rapid transit system (MRTS), with urban and suburban coverage in Merida, Yucatan, Mexico.
The methodology is applicable for the implementation of Mass Rapid Transit Systems, such as segregated Bus Rapid Transits (BRT) bus lanes or rail-based lines, that replaces existing bus routes operating under mixed traffic conditions.	Implementation of a MRT system, which is a Bus Rapid Transits (BRT) with new bus lanes, that replaces existing bus routes operating under mixed traffic conditions.

The project may involve one or more of the measures listed below: (a) The construction of a new rail-based infrastructure (e.g. new rail lines). (b) The expansion of an existing rail infrastructure (e.g. extension of an existing rail line). (c) The construction of new segregated BRT bus lanes. (d) The extension of bus lanes of existing BRT systems or expansions of existing BRT systems (i.e. adding new routes and lines).	The project involves: (c) The construction of new segregated BRT bus lanes.
For projects involving BRTs, the following specific provisions apply: (a) Only BRT systems without feeder route are eligible under this methodology. (b) The buses used in the routes that were replaced by the project MRTS can be retired or relocated to another part of the network. (c) The project activity may be based on existing road infrastructure, but the bus lanes shall be separated physically from mixed traffic.	The project considers: (a) BRT system without feeder routes. (b) The buses used in the routes that were replaced by the project MRTS were retired. (c) The project is separated physically from mixed traffic.
Fuels including (liquified) gaseous fuels or biofuel blends, as well as electricity can be used in the baseline or project case. The following conditions apply in case of biofuels: (a) The project buses shall use the same biofuel blend (same percentage of biofuel) as commonly used by conventional comparable urban buses in the country i.e. the methodology is not applicable if project buses use higher or lower blends of biofuels than those used by conventional buses.	Project buses use electricity. The baseline buses used fossil fuels, commonly diesel.

(b) The project buses shall not use a significantly higher biofuel blend than cars and taxis.	
The methodology is applicable for urban or suburban trips. It is not applicable for interurban transport.	The trips of the project are urban and suburban.
In addition, the applicability conditions included in the tools referred to below shall apply.	All the conditions included in the tools referred to below apply.
The methodology is applicable if the most plausible baseline scenario is the continuation of the use of current modes of transport.	The most plausible baseline scenario is the continuation of the use of current modes of transport.
The methodology is not applicable for: (a) Operational improvements (e.g. new or larger buses) of an already existing and operating bus lane or rail-based MRTS; (b) Bus lanes replacing an existing rail-based system i.e. the existing urban or suburban rail infrastructure shall remain fully (in its full length) operational; (c) The implementation of air- or water-based transport systems.	The project does not involve: a) Operational improvements of an already existing and operating bus lane or rail-based MRTS. b) Bus lane replacing an existing operational rail-based system (some rails were removed to implement the IE-Tram, however, the rail-based system was obsolete since 2017, before the consideration of the IE-Tram project (Yucatán Ahora, 2018; Gobierno de Yucatán, 2018). c) The implementation of air- or water-based transport systems.

3.1.2 Methodology deviations

According to ACM0016 methodology, surveys to determine modal shift should be conducted in years 1 and 4 of the project implementation period. However, in this case, a methodological deviation is proposed, carrying out these surveys in years 3 and 6 due to the certification and phased implementation timeline of each line of the project. The process will ensure data collected will represent accurately modal shift and the most conservative scenario of emission reductions.

3.2 Project boundaries, sources and GHGs

3.2.1 Spatial limits of the project

The project, to date, involves a concession to operate a public transportation system using a fleet of electric buses, which run along a 129+km network comprising three main routes and two strategic connections to Mayan Train (**Figure 2**)(Mapa de rutas, 2024). The specific route configuration is as follows:

1. La Plancha – Kanasin.
2. La Plancha – Mayan Train Teya Station.
3. La Plancha – Engineering School - Mejorada.
4. Merida Center – Uman – Mayan Train.
5. La Plancha Transit Hub – Uman Transit Hub.

The IE-TRAM also connects more than 137 neighborhoods with 80 existing routes, more than 30 educational centers, and 20 tourist destinations throughout the city ADO, 2023; Diario de Yucatán, 2023

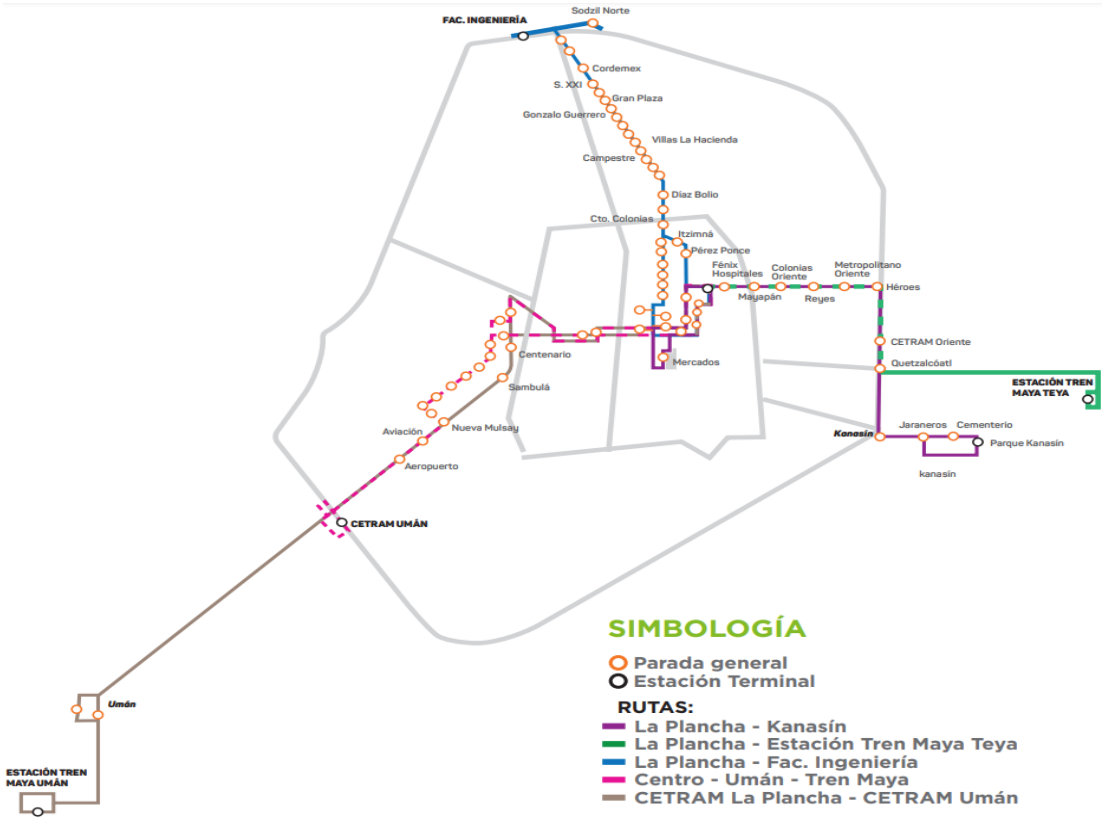


Figure 2. Geographical location of the project: IE-TRAM route. Source: Yucatan Transportation Agency

3.2.2 Carbon reservoirs and GHG sources

Table 2 shows sources of GHG considered for the project within boundaries of the project.

Table 2. *Sources and GHG included for baseline emissions and project emissions reductions quantification*

Source or reservoir	GHG	Included (Yes/No)	Justification
Mobile source emissions of different modes of transport used on the baseline	CO_2	Yes	Major emission source
	CH_4	Yes	Included only if gaseous fuels are used and excluded for liquid

				fuels. CH_4 emissions are a minor emission source of the total CO_2e emissions in diesel/gasoline vehicles Neglecting these emissions in baseline as well as project emissions is conservative as fuel consumption and thus also CH_4 emissions are reduced through the project.
	N_2O	No		N_2O emissions are a minor source of the total CO_2e emissions. Neglecting these emissions in baseline as well as project emissions is conservative as fuel consumption and thus N_2O emissions are reduced through the project.
Direct emissions from the operation of the project MRT	CO_2	Yes		Major emission source.
		CH_4	No	Gaseous fuels not used within the project.
		N_2O	No	N_2O emissions are a minor source of the total CO_2e emissions.
Indirect emissions from the different modes of transport used by the passengers of the MRTS, from their point of origin to the MRTS entry station, and from the MRTS exit station to their final destination	CO_2	Yes		Major emission source.

	CH_4	Yes	Included only if gaseous fuels are used and excluded for liquid fuels.
	N_2O	No	N_2O emissions are a minor source of the total CO_2e emissions.

3.2.3 Time limits and analysis periods

According to section 11.5 of BCR Standard version 3.4, the duration of the project will be 7 years and may be renewed a maximum of two times, provided that, for each renewal, a Conformity Assessment Body (CAB) determines and reports that the original project baseline is still valid or has been updated to take into account the new data.

3.2.3.1 Project start date

For GHG removal projects, according to BCR Standard, the start date is to the date when any action related to the start of GHG project activities begins.

In this case, the GHG emission reductions start on the day of the inauguration and putting into service the IE-TRAM, which was December 16, 2023.

3.2.3.2 Quantification period of GHG emission reductions/removals

The quantification period will cover seven years. The first crediting period will cover from 16/12/2023 to 15/12/2030. And may be renewed a maximum of two times, for a potential total maximum duration of 21 years.

3.2.3.3 Monitoring periods

The project's first monitoring period covers from 16/12/2023 to 15/12/2030, with the possibility to renew two times until 2037.

The monitoring periods potentially will cover the following dates:

- 16/12/2023 to 31/03/2026
- 01/04/2026 to 31/03/2029
- 01/04/2029 to 15/12/2030

3.3 Identification and description of the baseline or reference scenario

According to Merida's Integral Plan for Sustainable Urban Mobility, public transportation, composed mainly of buses and minibuses, is used by 47% of the city's population. As shown in **Figure 3,** the automobile represents the second most used means of transportation, with 31% of the inhabitants.

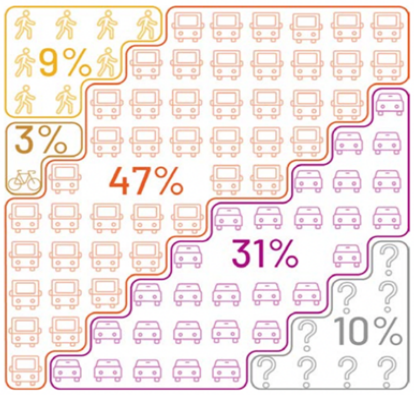


Figure 3. Modal split of Merida and its metropolitan area. Source: IMPLAN, 2020

As of December 2023, the conventional public transport network in Merida has more than 230 routes covering approximately 76% of the urban territory, with 82.22% of the population residing within 250 meters of some point of access to this service.

At the same time, there has been an increase in private mobility modalities, including private services (cabs and digital platforms) and collective services (employee and school transportation). Additionally, light motorized vehicles such as motorcycles and motorcycle cabs have gained relevance in urban dynamics.

According to INEGI data, in 2022 the vehicle fleet of the municipality reached 695,876 units between automobiles and motorcycles. In environmental matters, the transportation sector, mainly land transportation, represents the largest source of GHG emissions in the municipality, with automobiles and motorcycles generating 92.55% of the CO_2 emitted.

Given this scenario, there is an urgent need to promote the electrification of both public and private vehicles. The renewal of the fleet towards electric units has been identified as one of the measures with the greatest potential positive impact on environmental quality and emissions reduction. Currently, no regular public transport line operates with electric units, a situation that will change with the implementation of the IE-TRAM project. PIMUS, 2024

3.4 Additionality

According to ACM0016 methodology version 6.1, section 5.2 the additionality demonstration procedure is illustrated in **Figure 4** for projects that are not implemented in least developed countries and projects that are not the first of their kind.

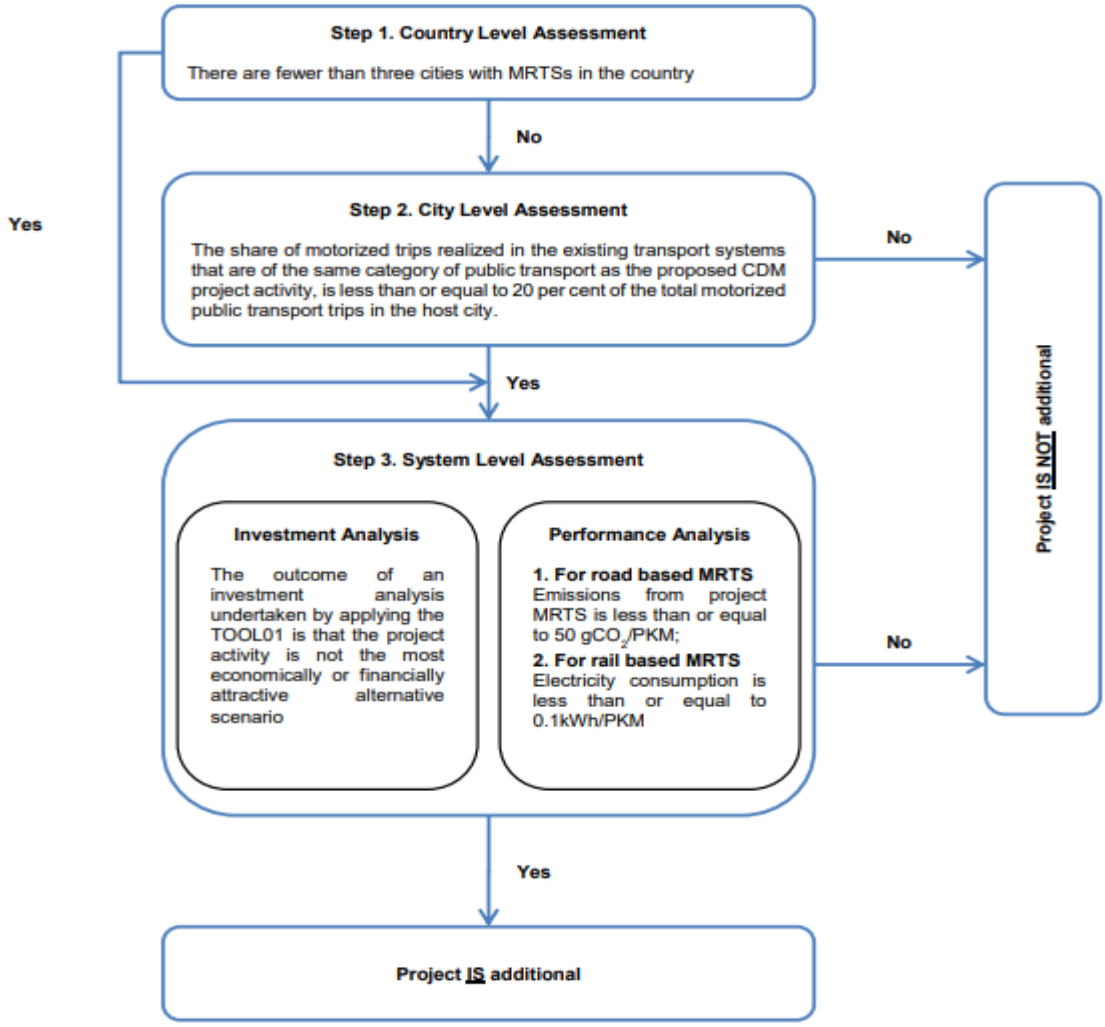


Figure 4. Additionality demonstration procedure for the IE-TRAM Project. Source: Methodology ACM0016

Following the steps of the procedure shown before:

Step 1. Country-level assessment. There are more than three cities in the country with MRT systems

In the words of applicable methodology, Mass Rapid Transit Systems (MRT) are urban or suburban collective passenger services that operate at high performance levels, especially in terms of travel times and passenger carrying capacity, and may be based on roadways or elevated, surface level or subway rail systems. MRTS can be rail systems such as subways/metro, light rail transit (LRT) systems, streetcars, commuter rail systems, or

overland bus systems. For the purposes of this methodology, road MRTS are bus systems using bus lanes, which may also be referred to as BRT systems.

Listed below are the MRT systems in Mexico that have begun commercial operation prior to the start date of the IE-TRAM.

- Mexico City Subway – Mexico City
- Light Rail - Mexico City
- Electric Train – Guadalajara
- Metrorrey – Monterrey
- Optibus – Leon
- Metrobus – Mexico City
- Mi Macro – Guadalajara
- Mexibus – State of Mexico
- Bowi – Chihuahua
- RUTA – Puebla
- Juarez Bus – Juarez City
- Ecovía – Monterrey
- Tuzobus – Pachuca
- SITT – Tijuana
- ACABUS – Acapulco
- Qrobus – Querétaro
- Elevated Trolleybus – Mexico City

Step 2: City-level assessment

The proportion of motorized trips made on existing transport systems that are of the same public transport category as the proposed project activity is less than or equal to 20% of total motorized public transport trips in the city.

This criterion is met by the project taking into consideration that, within the city of Merida, prior to the IE-TRAM project, there were no BRT or MRT type transportation systems.

Step 3: System-level assessment

For this project, the option of performing a performance analysis was chosen.

The procedure indicates that the MRT project must indicate that, for road-based systems, the project's expected emissions are less than or equal to 50 gCO_2/pkm and that the projected electricity consumption of rail systems is less than or equal to 0.1 kWh/pkm, to demonstrate that the project is additional.

Since the project is currently in operation, the annual estimate of the project's emissions and electricity consumption data from January to February 2024 will be used.

To calculate the emission factor per passenger-kilometer for electric vehicles, CDM Tool 18 was used, specifically equation 2 as:

$$EF_{PKM} = \frac{TE_{EL}}{P_{EL} * D_{EL}} * 10^6$$

EF_{PKM} = Emission factor per passenger-kilometer for electric vehicles during the period (gCO_2/PKM)
TE_{EL} = Total emissions from electric vehicles during the period (tCO_2)
P_{EL} = Total number of passengers transported in electric vehicles during the period (passengers)
$D_{EL=}$Average distance traveled by passengers using the electric vehicle category during the period (km)

$$TE_{EL} = EF_{SE} * EC_{EL}$$

EF_{SE} = Emission factor of the national grid in 2023 (tCO_2e/MWh)
EC_{EL} = Energy consumption of the project during the period (WMh)

$$EC_{EL} = EC_T * D_T$$

EC_T = Enery consumption factor of the electric vehicle IE-TRAM (kWh/km)
D_T =Total distance traveled by the IE-TRAM project during the period (km)

$$EC_{EL} = EC_T * D_T = 1.4 \frac{kWh}{km} * 346{,}777km * \frac{1MWh}{1000kWh} = 485.48\ MWh$$

$$TE_{EL} = EF_{SE} * EC_{EL} = 0.438 \frac{tCO_2e}{MWh} * 485.48MWh = 212.64\ tCO_2e$$

$$EF_{PKM} = \frac{TE_{EL}}{P_{EL} * D_{EL}} = \frac{212.64\ tCO_2e}{680{,}457\ passengers * 14.25\ km} * \frac{10^6 gCO_2e}{1tCO_2e} = \mathbf{21.92}\ \boldsymbol{\frac{gCO_2e}{pkm}}$$

Likewise, to calculate both performance indicators, taking into account that the IE-TRAM system is a project based on electric buses, total emissions will be replaced by electricity consumption from the last estimate:

$$EF_{PKM} = \frac{EC_{EL}}{P_{EL} * D_{EL}} = \frac{485.48\ MWh}{680{,}457\ passengers * 14.25\ km} * \frac{1000\ kWh}{1MWh} = \mathbf{0.05}\ \boldsymbol{\frac{kWh}{pkm}}$$

With the values obtained, less than 50 gCO_2/pkm and less than 0.1 kWh/pkm, it is demonstrated that **the project is considered additional.**

3.5 Uncertainty management

The IE-TRAM project follows the principle of a conservative approach, ensuring that the calculations of GHG emission reductions and removals are realistic and verifiable, in order to avoid overestimating the values. A conservative approach is also adopted, establishing a safety margin to anticipate and manage possible deviations during project implementation.

3.6 Leakage and non-permanence

Project leakage is calculated based on whether, despite people changing their mode of transport, fuel consumption of conventional buses, cabs and cars remains the same.

Seven monitoring reports of MRT or BRT type projects were reviewed in the CDM and Verified Carbon Standard (VCS) records, whose leakage calculation is zero. Additionally, two projects were reviewed that reported leakage, one of them around 48 tCO_2e in a year, while the other presented higher values, however they were derived from the use of gaseous fuels.

For the purposes of this preliminary (ex-ante) estimation, project leakage will be considered as zero. However, surveys will be conducted to calculate leakage according to the methodology procedure, which considers leakage from fuel consumption of baseline transport units, for example.

3.7 Mitigation results

The real estimation of emission reductions of the project requires conducting surveys to the users who use the IE-TRAM, with the intention of identifying what has been the change of transport mode they hay from the baseline scenario. However, it is possible to make a previous estimate with some reported values.

i. GHG baseline emissions

The following is the calculation to estimate the emission factor per trip-person-kilometer by type of transport in accordance with the applicable ACM0016 methodology, using information of baseline shown above. A calculation is presented for bus and car, which are the main means of transport. These factors will be used to estimate the baseline emissions without the project.

$$EF_{bus} = \frac{SFC_{bus} * NCV_{bus} * EF_{diesel}}{OC_{bus}}$$

Emission factor for buses:

EF_{bus} = Emission factor per passenger-kilometer of buses (gCO_2/pkm)
SFC_{bus} = Specific fuel consumption per vehicle (L/km)- 0.28L/km (Ayuntamiento de Mérida, 2021)
NVC_{bus} = Net Calorific Value of diesel fuel (MJ/L) - 5,900 MJ/bl (SENER, 2021)
EF_{diesel} = Emission factor of diesel fuel (gCO_2/MJ)- 0.0000741 tCO_2/MJ (SEGOB, 2015)
OC_{bus} = Average vehicle occupancy (passengers)- 19 passengers (IMT México, 2020)

$$EF_{bus} = \frac{0.28\frac{L}{km} * 5990\ \frac{MJ}{bl} * \frac{1bl}{158.98L} * 0.0000741\frac{tCO_2}{1tCO_2} * \frac{10^6\ gCO_2}{1tCO_2}}{19\ passengers} = 41.94\ \frac{gCO_2}{pkm}$$

Emission factor for cars:

$$EF_{car} = \frac{SFC_{car} * NVC_{car} * EF_{gasoline}}{OC_{car}}$$

EF_{car} = Emission factor per passenger-kilometer of cars (gCO_2/pkm)
SFC_{car} = Specific fuel consumption per vehicle (L/km) - 0.1 L/km (Ayuntamiento de Mérida, 2021)
NVC_{car} = Net Calorific Value of diesel fuel (MJ/L)-5,269 MJ/bl (SENER, 2021)
$EF_{gasoline}$ = Emission factor of diesel fuel (gCO_2/MJ)-0.0000693 tCO_2/MJ (SEGOB, 2015)
OC_{car} = Average vehicle occupancy (passengers)- 1.8 passengers (IMT México, 2020)

$$EF_{car} = \frac{0.1\frac{L}{km} * 5{,}269\ \frac{MJ}{bl} * \frac{1\ bl}{158.98\ L} * 0.0000693\ \frac{tCO2}{MJ} * \frac{10^6 gCO_2}{1tCO_2}}{1.8\ passengers} = 127.6\ \frac{gCO_2}{pkm}$$

Through the system capacity projections considering a "conservative" scenario, it is possible to calculate baseline emissions. An estimate will be made considering the modal use of transport in the city of Merida (47% buses and 31% cars including cabs and private cars) as scenario 1 (**Table 3**). However, other scenario will also be made with the average results obtained in surveys of other projects: Transmilenio in Colombia registered as a carbon project under the CDM, Chongquing Lines in China also registered under the CDM and the Metro in Lima registered under Verra's VCS (77% buses and 20% in cars including cabs and private cars), this being scenario 2 (**Table 4**).

To consider the most conservative scenario, other types of transport such as motorcycles will not be taken into account. Likewise, the lowest value obtained from the two scenarios will be the one considered to continue with the calculation:

$$BE = PP * CT * FE * D * 10^{-6}$$

BE = Baseline emissions (tCO_2/year)
PP = Project annual passengers (passengers)
CT= Transport modal shift of passengers (%)
FE = Emission factor per person-kilometer of the type of transport used by the people in the baseline (gCO_2/pkm)
D = Average annual travel distance of passengers in the project (km)
10^{-6} = Conversion factor from grams to tons of CO_2

In the following tables it is possible to see the breakdown of these estimates by year, these were made in a projection of a credit period of 7 years. For practical purposes of this estimation, the 2023 emission reductions were disregarded and 2030 was considered as a full year.

Table 3. Baseline emissions estimate with scenario 1 and a conservative passengers projection

Year	Annual passengers	Buses	Cars	Buses 41.94gCO_2/pkm	Cars 127.6 gCO_2/pkm	**Emissions of the baseline [tCO_2/year]**
	Conservative scenario	47%	31%	[tCO_2]	[tCO_2]	
2024	680,457	319,814.8	210,941.7	191.1	383.6	**575**
2025	6,507,220	3,058,393.4	2,017,238.2	1,827.8	3,667.9	**5,496**
2026	6,607,960	3,105,741.2	2,048,467.6	1,856.1	3,724.7	**5,581**
2027	6,685,340	3,142,109.8	2,072,455.4	1,877.9	3,768.3	**5,646**

2028	6,751,405	3,173,160.4	2,092,935.6	1,896.4	3,805.6	**5,702**
2029	6,811,630	3,201,466.1	2,111,605.3	1,913.3	3,839.5	**5,753**
2030	6,868,205	3,228,056.4	2,129,143.6	1,929.2	3,871.4	**5,801**
Total						**34,554**

Table 4. Baseline emissions estimate with scenario 2 and a conservative passengers projection

Year	Annual passengers	Buses	Cars	Buses 41.94gCO_2/pkm	Cars 127.6 gCO_2/pkm	**Emissions of the baseline [tCO_2/year]**
	Conservative scenario	77%	20%	[tCO_2]	[tCO_2]	
2024	680,457	523,951.9	136,091.4	313.1	247.5	**561**
2025	6,507,220	5,010,559.4	2,017,238.2	2,994.5	3,667.9	**6,662**
2026	6,607,960	5,088,129.2	2,048,467.6	3,040.9	3,724.7	**6,766**
2027	6,685,340	5,147,711.8	2,072,455.4	3,076.5	3,768.3	**6,845**
2028	6,751,405	5,198,581.9	2,092,935.6	3,106.9	3,805.6	**6,912**
2029	6,811,630	5,244,955.1	2,111,605.3	3,134.6	3,839.5	**6,974**
2030	6,868,205	5,288,517.9	2,129,143.6	3,160.7	3,871.4	**7,032**
Total						**41,752**

The previous tables indicate that the most conservative scenario is scenario 1 (**Table 3**).

ii. GHG project emissions

The following is a calculation of the project's emissions through the electrical consumption of the systems. Although the project will use photovoltaic (PV) solar energy to supply a percentage of the consumption, at the moment, and for practical and conservative purposes, this PV system is not considered.

$$PE = D_p * CE_p * EF_{SE} * 10^{-3}$$

PE = Project Emissions (tCO_2/year)
D_P =Annual distance traveled by the project (km)
CE_p = Electricity consumption of the project (kWh/km)
EF_{SE} = Emission factor of the national electricity system (tCO_2/MWh)
10^{-3} = kWh to MWh conversion factor

To estimate the future annual distance traveled, the distance traveled equivalent to the first year's consumption will be taken as a reference. **Table 5** shows the calculation of emissions for the conservative scenario.

Table 5. Estimated project emissions based on projected distance traveled per year

Year	Passengers estimated per year	Distance traveled per year [km]	Electricity consumption 1.4kWh/km	Emission factor 0.438tCO₂e/MWh
			kWh/year	Project emissions [tCO₂e/year]
2024	680,457	346,777	485,488	213
2025	6,507,220	3,316,233	4,642,727	2,034
2026	6,607,960	3,367,573	4,714,602	2,065
2027	6,685,340	3,407,008	4,769,811	2,089
2028	6,751,405	3,440,676	4,816,946	2,110
2029	6,811,630	3,471,368	4,859,915	2,129
2030	6,868,205	3,500,200	4,900,280	2,146
Total				12,786

iii. 3.7.3 GHG leakages

Seven monitoring reports of MRT or BRT type projects were reviewed in the CDM and VCS records, whose leakage calculation is zero. Additionally, two projects were reviewed that reported leakage, one of them around 48 tCO_2e in a year, while the other presented higher values, however they were derived from the use of gaseous fuels.

For the purposes of this preliminary (ex-ante) estimation, project leakage will be considered as zero.

iv. GHG net project emission reductions

Net emissions reductions are calculated:

$$Emission\ reductions = Baseline\ emissions - Project\ emissions - Leakage$$

Table 6 show the projected annual calculation of emission reductions.

Table 6. Estimated project emission reductions

Year	Baseline emissions [tCO_2e]	Project emissions [tCO_2e]	Leakage [tCO_2e]	Emission reductions estimated [tCO_2e]
2024	575	213	0	362
2025	5,496	2,034	0	3,462
2026	5,581	2,065	0	3,516
2027	5,646	2,089	0	3,557
2028	5,702	2,110	0	3,592
2029	5,753	2,129	0	3,624
2030	5,801	2,146	0	3,654
Total	**34,554**	**12,786**	**0**	**21,767**
			Annual average	**3,109**

It is important to remember that the calculations are pre-estimates. The actual calculation of baseline GHG emissions should be calculated based on the latest version of Tool 18 of the CDM, designed to measure baseline emissions in urban passenger transport modal shift projects. This methodology requires surveys during year 1 and year 4 (considering a methodological deviation to be carried out in years 3 and 6) of the crediting period and this requirement will be adapted to the project timeline, after validation. The objective is to quantify the emissions that would have been generated in the absence of the project, considering the complete passenger journey from origin to final destination. This comparison makes it possible to determine the actual emission reductions achieved through the implementation of the project activity.

4 Compliance with Laws, Statutes and Other Regulatory Frameworks

To date, the project has no legal restrictions on its development and will generate GHG removals in excess of those achieved through compliance with Mexican laws only. In addition, the IE-TRAM project is fully compliant with all relevant local, regional, and national legal frameworks. The project is supported by a comprehensive legal feasibility analysis that confirms its compliance with constitutional, environmental, urban mobility and human rights legislation, as well as international frameworks on vulnerable populations.

From the legislation, regulations and legal considerations, the feasibility of the IE-TRAM project can be deduced in all its components, guaranteeing the quality of the

infrastructure for transportation, optimizing the vehicle fleet, rethinking routes to make them shorter and more efficient and improving boarding times, among others, so that it can be developed in a safe, fast, comfortable, inclusive and sustainable manner.

The legal foundation for the IE-TRAM system is built on a robust legal framework that includes:

- Political Constitution of the United Mexican States
- General Law on Mobility and Road Safety
- Mobility and Road Safety Law of the State of Yucatan
- Regulations of the Transportation Law of the State of Yucatan
- General Treasury Law of the State of Yucatan
- Environmental Protection Law of the State of Yucatan
- Law to Prevent and Eliminate Discrimination in the State of Yucatan
- Law for protection of the Rights of People with Disabilities of the State of Yucatan
- Decree 17/2018 regulating the Institute of mobility and Territorial Urban Development and The Organic Statute of the Institute of Mobility and Territorial Urban Development.

The project also adheres to the following:

Peripheral ring circuit: The component of the project is legally feasible in accordance with the Law of mobility and Road Safety of the State of Yucatan in its articles 85, 87, 88, 89, 90, 91 and 92 of the Regulation of the Law of Transporation of the State of Yucatan, which regulated the Metropolitan System of Friendly and Sustainable Mobility in its articles 34 BIS, 108 TER and 108 QUATER.

Modal Transfer Centers: It is resolved that the component is legally feasible in accordance with the Law of mobility and Road Safety of the State of Yucatan in its articles 99, 100, 101, 102, 103, 104, 105 and 106, the Regulations of the Transporation Law of the State of Yucatan in its Article 4, and the Property Law of the State of Yucatan in its Articles 5, 6, 20 and 23.

Radial structural shafts: It is resolved that the component is legally feasible in accordance with the Law of Mobility and Road Safety of the State of Yucatan in its Article 85, the Regulation of the Transportation Law of the State of Yucatan in its Article 6 and 34 BIS, as well as in the Organic Statute of the Institute in its Article 31 (sixth additional article). Additionally, the implementation of this component may involve coordination with federal authorities for the use of federal rights-of-way ensuring compliance with both state and federal regulations.

Technological component: It is resolved that the component is legally feasible in accordance with the Law of Mobility and Road Safety of the State of Yucatan in its articles 74, 87, 88 sections Vl, lX and X, 89 section V, and the Decree regulating the Institute of Mobility and Urban Territorial Development in its articles 4 and 16.

Control and Monitoring Center: It is resolved that the component is legally feasible in accordance with articles 91, section ll, 95, 96 and 97 of the Mobility and Road Safety Law of the State of Yucatan.

Colonias and Metropolitan Circuit: It is resolved that the component is legally feasible in accordance with the Mobility and Road Safety law of the State of Yucatan in its articles 56, 84, 87, 88, 89, 90, 91, and 92, and with the Regulations of the Transporation Law of the State of Yucatan in its articles 34 BIS and 34 TER.

Historic Center Intervention: It is resolved that the component is legally feasible in accordance with Article 18 of the Law on Cultural Rights for the State and Municipalities of Yucatan, and Article 4 of Decree 17/2018, which regulates the Institute of Mobility and Urban Territorial Development.

Integrated Bus Fleet: It is resolved that the component is legally feasible in accordance with Articles 3, 7, 9, 12, 13, and 35 of the Transportation Law of the State of Yucatan, and Articles 34 BIS and 34 TER of the Regulations of the Transportation Law of the State of Yucatan.

Electric Route: It is resolved that the component is legally feasible in accordance with the Mobility and Road Safety Law of the State of Yucatan in its articles 74, 87, 88 sections Vl, lX, and X, and 89 section V. The Regulations of the Transportation Law of the State of Yucatan in its articles 34 BIS and 34 TER, the Political Constitution of the United Mexican States in its articles 28 and 115 and its corresponding provisions in the Political Constitution of the State of Yucatan, and in accordance with article 89 of the Law of Government of the Municipalities of the State of Yucatan, and the Land Road Law on the State of Yucatan in its Article 2

5 Carbon ownership and rights

5.1 Project holder

Table 7. Project holder information

Individual or organization	**Movilidad Urbana Mérida, S.A.P.I de C.V.**

Contact person	Carlos Toledo Ramirez
Job position	South Divisional Director
Address	69th Street, number 554, Merida, Central Yucatan, Zip Code 97000
Phone number	-
Email	ctoledo@mobilityado.com

5.2 Other project participants

Table 8. Project developer

Individual or organization	**MERCADO AMBIENTAL AP**
Contact person	Eduardo Piquero
Job position	Director General
Address	Paseo de la Reforma 255, floor 7, Col. Cuauhtémoc 06500, Mexico City, Mexico
Phone number	+52 55 5128 2048
Email	eduardop@mexico2.com.mx

5.3 Agreements related to carbon rights

The ownership of the IE-TRAM project and the rights to the associated emission reductions are established in the Carbon Rights Allocation Agreement signed on 10 October 2024, between Movilidad Urbana Merida, S.A.P.I de C.V. (MUM) and the Transporatiton Agency of Yucatan, represented by Rafael Hernandez Kotasek. This agreement, linked to Concession SMMAS/001, recognizes MUM as the entity empowered to quantify, register and trade in carbon markets all verifiable reductions generated by the operation of the system.

Likewise, a contract was signed with MERCADO AMBIENTAL as project developer until the first issuance of carbon credits, with all carbon rights belonging to MUM.

6 Climate change adaptation

Merida's IE-TRAM project is a comprehensive sustainable urban mobility initiative that contributes significantly to climate change adaptation in the region. This electric bus system not only meets efficiency and sustainability expectations but also offers a superior passenger experience and operational ease for cities committed to cleaner public transportation.

By reducing dependence on fossil fuels, particularly the direct use of fossil fuels in transportation, the IE-TRAM directly combats noise pollution and climate change by reducing greenhouse gas emissions associated with combustion engines, favoring further decarbonization by being powered by renewable sources such as solar panels, while simultaneously improving urban air quality. In addition, this transition represents a key adaptation measure by promoting more resilient and sustainable urban mobility systems.

The transition to electromobility generates significant economic opportunities, from creating jobs in electric vehicle manufacturing and maintenance to boosting new related industries. With its "Just Transportation" initiative, Yucatan reinforces its commitment to address climate change and promote sustainable and inclusive urban development.

Access to mobility is one of the main causes of urban inequality, as it determines access to opportunities such as employment, education and health services. Therefore, this sustainable, clean and efficient development ensures an active participation in the fight against climate change and the achievement of the Sustainable Development Goals.

7 Risk management

The project operates under an adaptive management framework that adjusts its strategies according to the identification of new risks or changes in environmental conditions. Each risk axis has specific monitoring indicators, periodic evaluations and feedback mechanisms among all participants.

This approach ensures both the continuity of climate benefits from emission reductions and the long-term sustainability of the project throughout its quantification period.

Table 9 shows the organized information of the project risk assessment and management.

Table 9. *Project risk assessment and management*

Category	Risk	Measure to mitigate risk
Natural	Technical failures are due to extreme natural disasters such as storms or high-speed winds that damage infrastructure or disrupt its operation.	Climate-resilient infrastructure design, including resistant materials.
Financial	The main challenges facing the project include increased operating and energy costs, potential delays in public funding streams, and potential technology failures related to batteries and maintenance of the electric bus fleet.	Establishment of public-private partnerships, as carbon credit resources that guarantee investment and long-term financial sustainability. In addition, there is an energy efficiency strategy. In addition, there is a contingency fund for preventive maintenance and necessary technological upgrades.
Social	Social concerns about the project include disagreement with the	Information campaigns are implemented to improve the acceptance of the

	construction of new IE-TRAM stations, rejection due to perceived exclusion or economic impacts, and the risk of marginalization of vulnerable populations in the face of electronic payment systems.	project, ensuring that the stations equitably benefit popular areas. To avoid digital exclusion, a mixed payment system is offered with rechargeable cash cards and reduced fares for local residents, as well as an accessible channel for community complaints and suggestions.

7.1 Reversal Risk

In concordance with the Risk and non-permanence BCR Tool, 10% of the total emissions reductions will be held in the General Reserve Account to cover potential reversal risks in the future. Reverse accounts have the function of guaranteeing that if events occur that require the replenishment of credits placed in the market, those affected will be covered.

7.1.1 Loss Event Report

In case any event occurs and decreases the emission reductions issued and registered in the platform, the project owner will inform and provide a report within a period of no more than a year after the event. Once BioCarbon receives such report and examines the veracity and timeliness of the information, if applicable, it will retire the related amount from the Reserve Account in the registration system and issue a retirement statement, which will be sent to the project holder.

The lost event report shall include a conservative estimate of the loss of previously verified emission reductions/removals due to losses in carbon stocks from the project, based on monitoring report. The project holder shall demonstrate that the loss estimate is true and accurate in all material aspects.

Where a loss event report is not submitted within one year of the date the loss event occurred, the project shall no longer be eligible to issue Verified Carbon Credits (VCCs).

8 Sustainable development safeguards (SDSs)

In concordance with the Sustainable Development Safeguards (SDSs) Tool, version 1.1. As part of its commitment to environmental, social and economic sustainability, proactively identified any risks associated with project activities, implemented appropriate mitigation

measures, and ensured that no net negative impacts on the environment or communities were generated.

Table 10. *Environmental Safeguards*

Category	Identified Risk	Risk Presence	Mitigation measures
Land use and pollution	Erosion, construction waste, loss of vegetation.	Potentially	The project is integrated into the existing road infrastructure, using predominantly urban land, avoiding the loss of vegetation, and optimal environmental control is maintained at the construction site.
Water	Contamination or scarcity of water resources.	No	No relevant extraction or discharge. Efficient water use.
Biodiversity and ecosystems	Habitat fragmentation, invasive species	No	Use of urban areas that have already been intervened. Sensitive biodiversity is not affected.
Climate change	Increased GHGs, altered ecosystem services	No	The project, being electric, reduces emissions, fosters mobility and improves air quality.

Table 11. *Social Safeguards*

Category	Identified Risk	Risk Presence	Mitigation measures

Working conditions	Labor exploitation, discrimination, security	Potentially	The project follows legal compliance and safety protocols. It also has complaint and labor abuse prevention mechanism.
Gender equality	Exclusion from benefits or decision-making processes	Potentially	The project is applicable to the entire population (universal accessibility).
Community health and safety	Dust, noise, traffic, mental health	Potentially	The project improves urban health by eliminating polluting emissions and reducing noise-related stress, while encouraging physical activity by reducing the use of private vehicles and making travel times more efficient.
Economic impact	Inequality of benefits	Potentially	The project improves accessibility and reduces transportation costs, promoting the inclusion of vulnerable sectors of the population.

Table 12. *Governance and Compliance Safeguards*

Category	Identified Risk	Risk Presence	Mitigation measures

Compliance with environmental and social regulations	Non-compliance with environmental or social regulations	No	The project does not have any type of legal limitations for its development; therefore, it is ensured that this project will generate GHG removals above those than would be achieved by simply complying with compliance with Mexican laws.
Transparency and accountability	Lack of transparency in decision-making or use of public resources	Potentially	The project includes public tenders and external audits, as well as the publication of progress reports and budgets.
Prevention of corruption and malpractice	Possible acts of corruption in contracting, resource allocation or execution	Potentially	The project owner follows the best practices demanded by the project and does not intend to violate any methodology. In addition, external auditing is available.

9 Stakeholder engagement and consultation

The Merida IE-TRAM project carried out a comprehensive, territorial and participatory consultation process with key stakeholders in the municipalities of Merida, Kanasin and Uman between October 2022 and June 2023. This process was transparent and has sought not only to inform, but to build collaborative relationships with the beneficiary communities. The strategy also aimed to clearly inform about the characteristics of the electric transportation system, listen to the concerns of the different social sectors, and adapt project decisions based on the opinions gathered.

The socialization process included residents, neighborhood councils, merchants, transportation workers, students, people with disabilities, local authorities and technical personnel. Face to face events were held, including workshops, information days and meetings with Citizen Mobility Councils of the three municipalities. Through these activities, more than 400 people participated directly, while more than 13,000 citizens visited the IE-TRAM test unit exhibitions in public spaces such as the Plaza Grande and the Municipal Palace of Uman.

To convene stakeholders, the project used official media such as government social networks, direct invitations to neighborhoods and parks. The events were attended by municipal authorities, including councilors, area directors, secretaries and staff of the Institute of Mobility and Urban Territorial Development (IMDUT).

During the sessions, the executive project, the planned routes, the treatment of trees, the environmental benefits of the system, and the credentialing system were presented. Printed materials such as magazines and caps were distributed, and test units and visual materials were used to facilitate public understanding.

As part of the participatory processes, training was given to citizen attention personnel, workshops were held in neighborhoods such as Pacabtun and Mayapan, and worktables were set up with students and shopkeepers. In Uman, motorcycle cabs were integrated as socialization agents, and the credentialing of their families was promoted.

In conclusion, the citizen consultation process of the IE-TRAM has been broad, representative and in accordance with the principles of the BCR Standard, strengthening the design of the system, reducing social risks and ensuring that project decisions reflect the real priorities of the population.

9.1 Summary of comments received

The comments received were obtained in face-to-face events such as trainings, public presentations and meetings with citizen councils, with the objective of presenting the project's progress and gathering the community's perception.

In general, the comments focused on aspects such as the acceptance of the new transportation system, which was positively valued for its modernity, elegance, comfort, speed, inclusion and sustainability. Likewise, people expressed pride in the new units, which, in addition to being useful, would serve all Yucatecans, recognizing all the benefits that the IE-TRAM will bring in terms of connectivity and improved mobility between different urban and suburban areas.

Although personal contact information was not collected from all participants, there was institutional participation from municipal agencies, directorates, neighborhood committees, schools, companies, merchants and representatives of neighborhoods adjacent to the project route.

9.2 Consideration of comments received

In response to the comments received, the project's technical team implemented several measures: Informative material was handed out to attendees, doubts were resolved during the socialization sessions, the installation of credentialing modules was agreed upon, and the communication strategy was strengthened by including different community stakeholders, establishing forms of collaboration and direct channels between Citizen Attention and the Socialization Team. In addition, detailed information was provided on the treatment of trees and the general progress of the project's implementation.

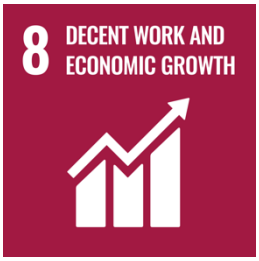
It is important to note that the Public Consultation in the website of Global Carbon Trace registry has no yet taken place. This will be carried out according to the established guidelines and its results will be incorporated in a timely manner in an updated version of this report.

10 Sustainable Development Goals (SDGs)

To assess the project's contribution to the SDGs, the BioCarbon Tool in version 3.4 of the standard was used. According to this tool, the contribution could be encompassed in eight SDGs, as shown in **Table 13**.

Table 13. Sustainable Development Goals aligned with the project

SDG	Target	SDG indicator	Project contribution
	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.	3.9.1 Mortality rate attributed to household and ambient air pollution.	Through the implementation of the project, air pollution from the burning of fossil transportation fuels such as diesel buses will be reduced, which is expected to reduce the mortality rate attributed to

			this factor at the local level.
	7.1 By 2030, ensure universal access to affordable, reliable and modern energy services. 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix. 7.3 By 2030, double the global rate of improvement in energy efficiency.	7.1.2 Proportion of population with primary reliance on clean fuels and technology. 7.2.1 Renewable energy share in the total final energy consumption. 7.3.1 Energy intensity measured in terms of primary energy and GDP	Through the implementation of the project, access to modern and affordable energy services will be expanded by using electric units powered by renewable sources, while energy efficiency will be improved through the adoption of low-consumption technologies.
	8.8 Protect labor rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment.	8.8.2 Increase in national compliance of labor rights (freedom of association and collective bargaining) based on International Labour Organization (ILO) textual sources and national legislation, by sex and migrant status.	Through the implementation of the project, local job creation will be promoted during construction and operation phases, while labor rights will be protected by ensuring fair conditions and safe working environments for all workers involved.

	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.	9.4.1 CO_2 emission per unit of value added.	Through the implementation of the project, urban transport infrastructure will be modernized with sustainable technologies, contributing to the reconversion of existing systems toward more efficient, low-emission models.
	11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.	11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities.	Through the implementation of the project, sustainable and affordable transport systems will be strengthened, helping reduce the environmental impact of cities, while promoting inclusive access to safe public spaces and supporting integrated urban and regional planning for sustainable development.

	11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.	11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted).	
	11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities	11.7.1 Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities.	
	11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.	11.a.1 Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city.	

	13.2 Integrate climate change measures into national policies, strategies and planning	13.2.2 Number of countries that have communicated the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production (including a national adaptation plan, nationally determined contribution, national communication, biennial update report or other).	Through the implementation of the project, concrete measures will be taken to address climate change by reducing greenhouse gas emissions from the transport sector and promoting a shift toward low-carbon mobility solutions.
	16.6 Develop effective, accountable and transparent institutions at all levels. 16.7 Ensure responsive, inclusive, participatory and	16.6.2 Proportion of the population satisfied with their last experience of public services. 16.7.2 Proportion of population who believe decision-making is inclusive and responsive, by	Through the implementation of the project, inclusive and participatory decision-making will be promoted, alongside the development of transparent and effective public

	representative decision-making at all levels 16.b Promote and enforce non-discriminatory laws and policies for sustainable development.	sex, age, disability and population group. 16.b.1 Proportion of population reporting having personally felt discriminated against or harassed in the previous 12 months on the basis of a ground of discrimination prohibited under international human rights law.	institutions, ensuring non-discriminatory policies and equitable access to mobility as a fundamental right.

11 Special categories, related to co-benefits (optional)

Not applicable to the present project.

12 Grouped projects

The modernization of public transportation is proposed considering technological innovation, through the incorporation of electric public transportation. Likewise, new public transportation routes that favor connectivity and efficient mobility in different points and roads of the Municipality of Merida, Yucatan will be managed.

The new stations will involve the displacement of buses with high carbon content and GHG emission reductions during the crediting period that would be included in the future quantification as a grouped project.

Specifically, the IE-TRAM include several electric routes that are entering into operation progressively. The route La Plancha-Teya (Maya Train Station) began operations on December 16, 2023, followed by La Plancha-Kanasin on December 30, 2023. The route La Plancha-Engineering School UADY started service on May 12, 2024. Additional routes include La Plancha-Poxila (Maya Train Station), scheduled for August 11, 2024, and La Plancha-Uman, expected to begin operations on September 30, 2024.

13 Other GHG program

The project is not registered or has been registered on another GHG program.

14 Double counting avoidance

The IE-TRAM project shall ensure transparency on the crediting process and applies the principles and requirements established in the BioCarbon Standard Avoiding Double Counting (ADC) tool, version 2.0, to ensure the environmental integrity and exclusivity of the GHG emission reductions generated during its quantification period.

The project implements the following measures to prevent double counting:

The project is registered exclusively under the BCR Standard and is not concurrently registered or will be registered under any other voluntary or compliance carbon market program. Likewise, the emission reductions generated will not be claimed by the Government of Yucatán, since MUM, has the concession SMMAS/001, which recognizes it as the only entity authorized to quantify, register and negotiate in the carbon markets all the verifiable reductions generated by the operation of the IE-TRAM. It is also important to mention that the project is urban in nature and does not intersect with AFOLU sectors, which tend to be more vulnerable to overlapping jurisdictional claims.

Measurement equipment used to report monitoring data will be fully calibrated and verified to ensure that spreadsheets and other tools used to store and manipulate monitoring data are error-free. In addition, the monitoring and reporting of emission reductions achieved by the IE-TRAM project meets the BCR standard by significantly impacting those reductions, favoring the review of results repeatedly over time using the same monitoring method and data sets.

As part of the provisions of the program, BioCarbon has established clear rules and procedures for the issuance of “ex post” VCC that represent emission reductions or removals verified by an independent thir party (Conformity Assessment Bodies - CABs).

The CABs will evaluate the compliance of IE-TRAM project with the requirements established by the BioCarbon Program which are also summarized in the BCR Validation and Verification Manual. In this regard, they are responsible for assessing the overall project documentation as part of the validation. During the validation process, the CABs will review the evidence provided by the project and compare it with the national registry and other programs and systems to confirm that there are no simultaneous benefits or overlaps between the project and projects in other programs.

On the other hand, BioCarbon registers in the Global CarbonTrace (GCT) platform, which will allow it to track credits in a global database to avoid duplication. In addition to the use of technologies such as Blockchain to guarantee the security and traceability of the credits. VCCs are individually identified by serial numbers. The design of the series in the platform guarantees a unique identification. Through its code, it is possible to trace the origin of the series, including the project holder.

15 Monitoring plan

15.1 Description of the monitoring plan

The monitoring plan for the IE-TRAM project has been designed to ensure rigorous and transparent tracking of project activities, GHG emission reductions, sustainable development contributions, and stakeholder participation. This plan establishes detailed procedures for monitoring, quality assurance, data verification, and reporting, ensuring the reliability accuracy and integrity of the project's mitigation results throughout the quantification period.

(a) Project boundary monitoring

Project boundaries include the operation of IE-TRAM along the 129+km network, including current routes and planned future extensions, comprising:

- La Plancha – Kanasin
- La Plancha – Mayan Train Teya Station
- La Plancha – Engineering School - Mejorada
- Merida Center – Uman – Mayan Train
- La Plancha Transit Hub – Uman Transit Hub

GHG Sources:

Baseline: Emissions from diesel and gasoline vehicles.

Project: Indirect CO_2 emissions from electricity used by electric buses.

(b) Monitoring of the execution of project activities

Tracked activities:

- Operation of 32 electric buses (daily service, km traveled), and future units
- Electricity consumption by fleet and charging infrastructure.
- Maintenance of charging stations and buses.

- Construction and integration of photovoltaic solar plant (when operational).

Frequency:

- Daily operations
- Monthly aggregation and analysis

(c) Monitoring of the quantification of project emission reduction/removals

Main monitored data for each reporting period:

- Electricity consumption of the project (kWh/km)
- Annual distance traveled by the project (km)
- Emission factor of the national electricity system (tCO_2/MWh)

(d) Quality control and quality assurance procedures

Plan:

- Monthly calibration of onboard vehicle meters and chargers
- Annual third-party verification of energy and operational data
- Cross-referencing utility bills with system logs

(e) Verification of field data

- Spot-check audits on electricity meters and vehicle odometers
- Random passenger surveys for modal shift validation

(f) Data recording and archiving system

- Digital secure cloud system (backed up monthly)

In order to present detailed information appropriate for monitoring project activities and mitigation results, the following points are available:

(a) data and additional information to establish the baseline or reference scenario

- Historical data from Merida's Public Transportation Plan
- Fuel consumption patterns of baseline fleet (buses, private cars)

(b) specification of any potential emissions that would occur outside the project boundary as a result of GHG project activities (leakage)

- Leakage is estimated zero under conservative assumptions.

(d) information related to the environmental impact assessment of the GHG project activities

- Land use: No new land developed (Adapted existing roadways).
- Biodiversity: No sensitive ecosystems impacted
- Air quality: Expected improvement
- Noise reduction: Significant due to electric operation

(e) established procedures for the management of GHG emission reductions or removals and associated quality control for monitoring activities

- Scheduled recalibration and verification campaigns

(f) description of established procedures for periodic calculation of GHG emission reductions or removals and leakage

- Calculations performed annually based on the formula: Emission reductions = Baseline Emissions – Project Emissions – Leakage

(g) the assignment of roles and responsibilities for monitoring and reporting of variables relevant to the calculation of GHG emission reductions or removals

Table 14. *Roles and responsibilities.*

Role	Responsibility
Operations team	Vehicle and electricity data collection
MRV Officer	Data validation
MRV Manager	Supervising MRV process
External Auditor	Independent verification

(h) procedures for assessing the project's contribution to the Sustainable Development Goals (SDGs)

Table 15. *Assessment of SDGs*

SDG	Data unit	Description	Source of data	Monitoring frequency	Monitoring responsible
3	µg/m³	Reduction of pollutant concentration	Air quality measurement	Annually	MUM
7	Passengers	Passengers transported	Operating records	Annually	MUM
8	Passengers	Number of jobs created	Contracts and surveys	Annually	MUM
9	Fleets	Number of fleets modernized	System operator's technical report	Annually	MUM
11	Passengers	Service accessibility	Operating records and surveys	Annually	MUM
13	tCO_2e	Avoided emissions	Calculated	Annually	MUM
16	%	Percentage of satisfied users	Surveys	Annually	MUM

(i) criteria and indicators related to the project's contribution to sustainable development goals, applicable to the project activities proposed by the project holder

- To assess the project's contribution to the SDGs, the BioCarbon Tool in version 3.4 of the standard was used.

(j) The participation of the communities, as project participants, in the project design and implementation

- Over 13,000 citizens consulted through exhibitions and events.
- Active citizen feedback integrated into project design.

15.2 Data and parameters determined at registration and not monitored during the quantification period, including default values and factors

Table 16. *Information on the emission factor per passenger-kilometer of buses*

Data / Parameter	EF_{bus}
Data unit	gCO_2/pkm
Description	Emission factor per passenger-kilometer of buses
Source of data used	Calculated
Value (s)	41.94 gCO_2/pkm
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation
Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 17. *Information on the specific fuel consumption per vehicle*

Data / Parameter	SFC_{bus}
Data unit	L/Km
Description	Specific fuel consumption per vehicle
Source of data used	Merida City Council
Value (s)	0.28 L/Km
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation

Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 18. *Information on the Net Calorific Value of diesel fuel*

Data / Parameter	NVC_{bus}
Data unit	MJ/L
Description	Net Calorific Value of diesel fuel
Source of data used	National data from Secretary of Energy
Value (s)	5,900 MJ/bl
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation
Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 19. *Information on the emission factor of diesel fuel*

Data / Parameter	EF_{diesel}
Data unit	tCO_2/MJ
Description	Emission factor of diesel fuel
Source of data used	National data from Ministry of the Interior
Value (s)	0.0000741 tCO_2/MJ
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation

Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 20. *Information on the average vehicle occupancy*

Data / Parameter	OC_{bus}
Data unit	Passengers
Description	Passengers transported by baseline buses prior to the project starting year x (per day or year)
Source of data used	National data from Mexican Institute of Transportation
Value (s)	19 passengers
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation
Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 21. *Information on the emission factor per passenger-kilometer of cars*

Data / Parameter	EF_{car}
Data unit	gCO_2/pkm
Description	Emission factor per passenger-kilometer of cars
Source of data used	Calculated
Value (s)	127.6 gCO_2/pkm
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation

Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 22. *Information on the specific fuel consumption per vehicle*

Data / Parameter	SFC_{car}
Data unit	L/Km
Description	Specific fuel consumption per vehicle
Source of data used	Merida City Council
Value (s)	0.1 L/Km
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation
Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 23. *Information on the Net Calorific Value of diesel fuel*

Data / Parameter	NVC_{car}
Data unit	MJ/L
Description	Net Calorific Value of diesel fuel
Source of data used	National data from Secretary of Energy
Value (s)	5,269 MJ/L
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation

Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 24. *Information on the emission factor of gasoline fuel*

Data / Parameter	$EF_{gasoline}$
Data unit	tCO_2/MJ
Description	Emission factor of gasoline fuel
Source of data used	National data from Ministry of the Interior
Value (s)	0.0000693
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation
Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 25. *Information on the average cars occupancy*

Data / Parameter	OC_{car}
Data unit	Passengers
Description	Passengers transported by baseline cars prior to the project starting year x (per day or year)
Source of data used	National data from Mexican Institute of Transportation
Value (s)	1.8 passengers
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-ante baseline emissions calculation

Justification of choice of data or description of measurement methods and procedures applied	This factor is used to estimate the ex-ante baseline emissions without the project

Table 26. *Information on the total distance driven by bus s in year x*

Data / Parameter	$DD_{Z, s, x}$
Data unit	km
Description	Total distance driven by bus *s* in year *x*
Source of data used	MUM
Value (s)	They will be quantified
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-post emissions calculation
Justification of choice of data or description of measurement methods and procedures applied	Data is used to calculate the emissions resulting from the implementation of the IE-TRAM

Table 27. *Information on the total road space available in year x*

Data / Parameter	RS_x
Data unit	km
Description	Total road space available in year x
Source of data used	MUM, official statistics
Value (s)	Based on infra-structure statistics
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-post emissions calculation
Justification of choice of data or description of	Data is used to estimate road space baseline based on official information

measurement methods and procedures applied	

Table 28. *Information on the total road space available due to the project activity*

Data / Parameter	RS_y
Data unit	Km
Description	Total road space available due to the project activity
Source of data used	MUM, official statistics
Value (s)	They will be quantified
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-post emissions calculation
Justification of choice of data or description of measurement methods and procedures applied	Data is used to be checked against the ex-ante expectation

Table 29. *Information on the average annual distance driven by taxis*

Data / Parameter	AD_T
Data unit	Km/taxi
Description	Average annual distance driven by taxis
Source of data used	MUM
Value (s)	They will be quantified
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-post emissions calculation

Justification of choice of data or description of measurement methods and procedures applied	Based on records of taxi companies or on surveys. A simple method can be odometer reading of a sample of taxis and dividing total distance driven by the vehicle age

Table 30. *Information on the number of vehicles*

Data / Parameter	$N_{i, x}$
Data unit	Number of vehicles
Description	Number of vehicles of vehicle category *i* per annum using the affected roads in year x (cars, taxis)
Source of data used	MUM
Value (s)	They will be quantified
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-post emissions calculation
Justification of choice of data or description of measurement methods and procedures applied	Visual counting on the identified roads. Counting should be based on various parts of the road, if major roads depart from the observed road to ensure average numbers

Table 31. *Information on the average total speed and average speed under circulation*

Data / Parameter	V_B
Data unit	Km/h
Description	Average total speed and average speed under circulation is measured
Source of data used	MUM
Value (s)	They will be quantified
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-post emissions calculation

Justification of choice of data or description of measurement methods and procedures applied	On-board measurements determining the average speed when circulating and average total speed on the road based e.g. on GPS

Table 32. *Information on the total distance driven by vehicle in year x*

Data / Parameter	$TD_{Z,x,}$ $TD_{T,x}$, $TD_{C,x}$
Data unit	Km
Description	$TD_{Z,x,}$: Total distance driven by public transport buses in year x $TD_{T,x}$,: Total distance driven by public transport taxis in year x $TD_{C,x}$: Total distance driven by passenger cars in year x
Source of data used	MUM, official statistics
Value (s)	They will be quantified
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Ex-post emissions calculation
Justification of choice of data or description of measurement methods and procedures applied	Data can be either with or without informal transport if the above-mentioned parameters are from the same data source

15.3 Data and parameters monitored

Table 33. *Information on the total electricity used by IE-TRAM project*

Data / Parameter	CE_p
Data unit	kWh/km
Description	Electricity consumption of the IE-TRAM project
Measured /Calculated /Default:	Measured

Source of data	Utility bills and meters
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	Direct reading from smart meters and bills
QA/QC procedures applied	Monthly comparison between meter logs and utility bills
Monitoring responsible	MUM

Table 34. *Information on the total km traveled by IE-TRAM buses*

Data / Parameter	D_P
Data unit	km
Description	Annual distance traveled by IE-TRAM buses
Measured /Calculated /Default:	Measured
Source of data	Vehicle odometers
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	Download from fleet management systems
QA/QC procedures applied	Calibration of odometers and GPS systems annually
Monitoring responsible	MUM

Table 35. *Information on the passengers transported by the IE-TRAM system*

Data / Parameter	P_y

Data unit	Passengers
Description	Total number of passengers transported by the IE-TRAM system in year y
Measured /Calculated /Default:	Measured
Source of data	Ticketing system, passenger counters
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	Data extracted from ticketing systems and manual counts
QA/QC procedures applied	Cross-validation with manual spot checks and surveys
Monitoring responsible	MUM

Table 36. *Information on the emission factor per passenger-kilometer*

Data / Parameter	$EF_{pkm,i,\ 3\text{-}6}$
Data unit	tCO_2/pkm
Description	Emission factor per passenger-kilometer of mode *i* in years 3 and 6 of the crediting period y (gCO_2/pkm)
Measured /Calculated /Default:	Calculated
Source of data	Calculated based on equations 2 and 3 from the "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	As per the "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"
QA/QC procedures applied	As per the "TOOL18: Baseline emissions for modal shift measures in urban passenger transport"

Monitoring responsible	MUM

Table 37. *Information on the direct project emissions from fuel consumption in year y*

Data / Parameter	$DPE_{FC,y}$
Data unit	tCO_2
Description	Direct project emissions from fuel consumption in year *y*
Measured /Calculated /Default:	Calculated
Source of data	Calculated based on the TOOL03
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	As per the TOOL03
QA/QC procedures applied	As per the TOOL03
Monitoring responsible	MUM

Table 38. *Information on the direct project emissions from electricity consumption in year y*

Data / Parameter	$DPE_{EC,y}$
Data unit	tCO_2
Description	Direct project emissions from electricity consumption in year *y*
Measured /Calculated /Default:	Calculated
Source of data	Calculated based on the TOOL05
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting

Measurement/Calculation method (if applicable)	As per the TOOL05
QA/QC procedures applied	As per the TOOL05
Monitoring responsible	MUM

Table 39. *Information on the distance driven by project units using fuel type n in year y*

Data / Parameter	$DD_{PJ,n,y}$
Data unit	Km
Description	Distance driven by project units using fuel type *n* in year *y*
Measured /Calculated /Default:	Measured
Source of data	MUM
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	Based on GPS (preferred), other electronic means, odometer or number of units per route and turnover per route
QA/QC procedures applied	In many systems operators are paid according to distance driven
Monitoring responsible	MUM

Table 40. *Information on the number of vehicles category i*

Data / Parameter	$N_{i,\ 3\text{-}6}$
Data unit	Number of vehicles
Description	Number of vehicles category *i* in years 3 and 6 of the crediting period
Measured /Calculated /Default:	Measured

Source of data	Merida Government
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	For buses as well as for taxis informal or illegal units may operate. While estimates on the number of informal units may be available these are due to their nature not trustworthy. For both categories it is thus recommended to only include formally registered units
QA/QC procedures applied	Regional data
Monitoring responsible	MUM

Table 41. *Information on the emission factor per kilometer for vehicle category i in years 3 and 6 of the crediting period*

Data / Parameter	$EF_{km,i,3\text{-}6}$
Data unit	gCO_2/km
Description	Emission factor per kilometer for vehicle category i in years 3 and 6 of the crediting period (gCO_2/km)
Measured /Calculated /Default:	Calculated
Source of data	Calculated based on equation 1 from the TOOL18
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	As per the TOOL18
QA/QC procedures applied	As per the TOOL18
Monitoring responsible	MUM

Table 42. *Information on the Average occupancy of vehicle category i in the period of time t*

Data / Parameter	$OC_{i,t}$
Data unit	Passengers
Description	Average occupancy of vehicle category *i* in the period of time *t*
Measured /Calculated /Default:	Calculated
Source of data	Merida Government
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	For buses the occupancy rate is based on boarding-alighting studies, electronic smart tickets or on visual occupancy studies with expansion factors for routes served to determine the average occupancy rate along the entire route. As an alternative for buses, the occupancy rate can be based on average trip distance of bus passengers, total passengers and total distance driven of buses
QA/QC procedures applied	Regional data
Monitoring responsible	MUM

Table 43. *Information on the average capacity of vehicle category i in the period t*

Data / Parameter	$CV_{i,t}$
Data unit	Passengers
Description	Average capacity of vehicle category *i* in the period *t* (passengers)
Measured /Calculated /Default:	Measured
Source of data	Official statistics
Monitoring frequency	Monthly

Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	Period of time when the parameters are measured: most recent calendar year prior to the start of commercial operation of the project system or prior to the submission of the CDM-PDD for validation
QA/QC procedures applied	Regional data
Monitoring responsible	MUM

Table 44. *Information on the number of vehicles*

Data / Parameter	$BSCR_y$
Data unit	Number of vehicles
Description	Cumulative bus units displaced by the project on the trunk lanes as a result of the project in year y
Measured /Calculated /Default:	Measured
Source of data	Merida Government
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	Official studies conducted by Merida Government
QA/QC procedures applied	NA
Monitoring responsible	MUM

Table 45. *Information on the Average trip distance driven by vehicle category i*

Data / Parameter	$TD_{i,3\text{-}6,}$

Data unit	Km
Description	Average trip distance driven by vehicle category i on the affected roads in years 3 and 6 of the crediting period
Measured /Calculated /Default:	Measured
Source of data	Merida Government
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	Official studies conducted by Merida Government through electronic or visual tracking of samples of vehicles entering/exiting the affected roads registering the entry and the exit point and measuring the distance by GPS or other means
QA/QC procedures applied	NA
Monitoring responsible	MUM

Table 46. *Information on the Average speed of cars/taxis on affected roads in years 1 and 4 of the crediting period*

Data / Parameter	$V_{P,3\text{-}6}$
Data unit	Km/h
Description	Average speed of cars/taxis on affected roads in years 1 and 4 of the crediting period
Measured /Calculated /Default:	Measured
Source of data	Merida Government
Monitoring frequency	Once at the end of years 1 and 4 of the crediting period (adapted to the project to year 3 and 6)
Measuring/ Reading/ Recording frequency	Annually reporting

Measurement/Calculation method (if applicable)	On-board measurements determining the total average speed and the average moving speed (when circulating) on the affected road based, e.g. on GPS measuring. The same methodology as for determination of VB should be used. Average speed required for calculation of the rebound effect refers to total distance divided by total time, on the affected road. Average moving speed required for calculation of the speed effect refers to speed under moving conditions i.e. total distance divided by time under movement (total time minus standstill time of vehicle), on the affected road. Taxis and passenger cars are treated identic
QA/QC procedures applied	NA
Monitoring responsible	MUM

Table 47. *Information on the emission factor of the national electricity system*

Data / Parameter	EF_{SE}
Data unit	tCO_2/MWh
Description	Emission factor of the national electricity system
Measured /Calculated /Default:	Monitored, updated annually
Source of data	Ministry of Environment and Natural Resources (SEMARNAT) (0.444 tCO_2/MWh in 2024)
Monitoring frequency	Monthly
Measuring/ Reading/ Recording frequency	Annually reporting
Measurement/Calculation method (if applicable)	Official published data; update at renewal periods
QA/QC procedures applied	Verification against national inventory reports

Monitoring responsible	MUM

Table 48. *Information on the net share of passengers using the MRTS*

Data / Parameter	$MS_{i, 1-4}$
Data unit	Percentage
Description	Net share of passengers using the MRTS which would have used mode i in the years 3 and 6 of the crediting period
Measured /Calculated /Default:	Measured
Source of data	Survey conducted by an external survey company
Monitoring frequency	The survey is conducted at the end of years 1 and 4 of the crediting period (adapted to the project to year 3 and 6)
Measuring/ Reading/ Recording frequency	Survey campaign in specific years
Measurement/Calculation method (if applicable)	Survey. The relevant question numbers are 2 and 3
QA/QC procedures applied	See Appendix 2 for the survey design
Monitoring responsible	MUM

16 Appendix 1. Post-registration changes summary

17 Appendix 2. Methodological design of survey MRTS

Considering project as aggregate, whenever the MRT is extended, a new survey distribution is realized, and data of the new survey is used for calculating emissions reductions achieved from the moment of the MRT extension.

17.1.1 Survey objective

The survey objective is to determine the input parameters needed to calculate:

a) The baseline emissions caused by passengers which use the MRTS and in absence of the latter would have used other modes of transport to realize their trip;
b) The indirect project emissions caused by passengers using the MRTS, which correspond to the emissions caused from the point of origin (O) to the MRTS entry station, and from the MRTS exit station to the final destination (D).

17.1.2 Target population
The target population are all passengers over 12 years of age. Smaller children are excluded due to problems in answering the questions. Also, smaller children, in general, are accompanied by their parents or an adult and thus have the same trip sequence as the adult person.

17.1.3 Sample frame
The sample frame is the passenger flow in selected stations of the MRTS. Data for the passenger frame is obtained from the system manager.

17.1.4 Sample design
Systematic sampling of passengers in selected stations within the selected hours

17.1.5 Geographical coverage
The geographical coverage is the area where the MRTS operates (project boundary) within Merida, Yucatan.

17.1.6 Sample frequency
Two surveys shall be conducted during the crediting period: at the end of the 1st and 4th years of the crediting period (Adapted to the present project 3rd and 6th year).
The survey shall take place during an entire week that does not correspond to a public holiday or a holiday season and shall be representative for the average demand for transport services in the considered year.

17.1.7 Selections of stations and evaluation hours
Two surveys shall be conducted during the crediting period: at the end of the 1st and 4th years of the crediting period (Adapted to the present project 2nd and 5th year).
The survey shall take place during an entire week that does not correspond to a public holiday or a holiday season and shall be representative for the average demand for transport services in the considered year.

17.1.8 Selection of passengers

Given that there is no reference frame or list frame for the identification of MRTS users, the selection of the sample in the last stage will be performed according to a systematic sampling design within each selected hour and considering the following steps:

a) A random starting point is generated between 1 and n;
b) Systematic selection of passengers: every n passenger entering the station, starting with the random number. In this way, if the random number is 20, the first passenger selected is the 20th that enters the station, the 2 n+20 and thus successively every nth passenger.

17.1.9 Consideration on information collection

The information will be obtained through the face-to-face application of the questionnaire below.

According to the selected stations and hour intervals, each survey interviewer will carry out the number of established surveys. Given that the selection of people is done randomly in a time range, the start point, that is the person number from which the contact begins, is random and is defined by the appointed pollster supervisor.

The random selection of individuals, as well as the sufficiency in the sample size, enables obtaining dispersion and representation of the study population through the sample. Further, it allows controlling factors that may affect the user type, in terms of use of modes of transport and distance in these travels.

17.1.10 Survey realization

The survey shall be realized through a company with minimum 3 years of experience in comparable surveys in the respective country to ensure a professional survey execution. The following principles are to be followed in the survey realization:

a) Non-responses should be recorded;
b) Record and store all original surveys;
c) Surveys are conducted at MRTS stations when people wait for MRTS-boarding. It should be avoided to realize the survey with people de-boarding the MRTS as latter will not want to invest time in a survey thus potentially giving wrong answers.

17.1.11 Preparation phase

This phase is characterized by the development of all the activities previous to the execution of the field operation and it is divided in:

a) Drafting of the manual on information collection and basic concepts. The manual on information collection and basic concepts covers in general terms the profile of the field personnel, the questionnaire structure, the instructions and specifications for filling in the questionnaire, the definitions and basic concepts of the study and the instructions and formats used;

b) Selection and training of field personnel. The selection and training of the field personnel is performed on concepts of filling in of questionnaires, in order to select the most adequate survey interviewers for the development of the field work:
   i. A pre-test is performed with the aim of familiarizing the supervisors with the instrument of information collection and establishing in general terms the acceptance degree of the population facing the instrument's application. The pre-test is also to assure that respondents understand what the MRTS is as they might not have taken a similar system before, to ensure that all the concepts are clearly defined and the questions are not ambiguously phrased and avoid interviewer errors. Interviewers may misread the question or twist the answers in their own words and thereby introduce bias. The pre-test has to detect and minimize this potential error;
   ii. The results of the pre-test will be documented and will be taken into consideration for the modification of the final instrument and for the preparation of the model of information collection.

17.1.12 Validation process of the information

A supervisor should participate in the field to carry out the field verifications, guaranteeing the validity of the gathered information as well as the attained coverage.

17.1.13 Calculation of trip distance in the survey

Trip distances need to be determined for each surveyed passenger. The following procedures are applied:

a) For NMT, others and induced traffic this is not required as the applied EF is "0".
b) For users of buses either:
   i. The shortest possible geographical distance based on electronic maps or measuring the distance between the two points with GPS or a comparable mean or through distance measurement on maps; or
   ii. Measuring the actual distance from the bus entry station to the bus exit station based on (electronic) route maps of the bus operators with official distances or measuring e.g. with GPS the distances between the involved stations.
c) For users of passenger cars, taxis, motorcycles, motorized rickshaws and other modes of motorized transport except buses based on the shortest possible geographical distance based on electronic maps or measuring the distance between the two points with GPS or a comparable mean or through distance measurement on maps;
d) For non-project rail systems based on official or GPS distances between the entry and exit station of the rail-systems.

17.1.14 Questionnaire model

Survey ID: _____

Interviewer: _____

Date: _____

Time: _____

Station: _____

___Survey was fully completed

___Surveys was fully or partially not responded

Comments/Observations of survey: _____

_ _

Aged of surveyed person:

__12-17 years __18-25 years __26-35 years __36-45 years __46-55 years

__56-65 years __over 65 years

Gender: ___female ___male ___prefer not to say

_ _

Describe the trip you are currently realizing. Your trip origin: _____
_____

Question 1

Your entry (boarding) IE-TRAM station lane: _____

Your exit (deboarding) IE-TRAM station lane: _____

Your final trip destination: _____

Question 2

Assuming that the IE-TRAM you are currently using would not exist: Would you have made the trip you are currently doing anyway, or would you have stayed at home/office/origin?

__I would have made the trip ➔ *Continue with questionnaire*

__I would have stayed at home/office/origin ➔*The questionnaire is terminated*

Question 3

What mode of transport did you use from your trip start to the IE-TRAM? Please refer to the mode on which you performed the longest stretch if you used various modes.

__Bus (conventional)

__Existing bus lane/BRT (NOT the project)

__Rail

__Taxi

__Passenger car

__Motorcycle

__Motorized taxi tricycle

__Bike or per foot

__Other: _____

Question 4

What mode of transport will you use from the point where you leave the IE-TRAM lane until your destination? Please refer to the mode on which you will perform the longest stretch if you intend to use various modes.

__Bus (conventional)

__Existing bus lane/BRT (NOT the project)

__Rail

__Taxi

__Passenger car

__Motorcycle

__Motorized taxi tricycle

__Bike or per foot

__Other: _____

Question 5

Have you moved your home or workplace since the start of operations of the MRTS?

__No ➔*continue with next question*

__Yes: Has the availability of the new MRTS been an important factor when choosing the location of your new home or new workplace?

__No ➔ *continue with next question*

__Yes ➔ What was your original/former trip origin and trip destination? (at the time before you moved your home or workplace)

Origin point:.....

Destination point: .....

Question 6

Assuming that the IE-TRAM you are currently using would not exist: How would you have made the same trip you are doing now?

From Home/Office/Others (.....) to point..... by *.....

From point.....to point .....by *.....

From point.....to point .....by *.....

From point.....to home/office/others (.....) by *.....

__Bus (conventional not bus lane)

__Existing bus lane/BRT (NOT the project)

__Rail

__Taxi ➔ *continue with question 6A*

__Passenger car ➔ *continue with question 6B*

__Motorcycle ➔ *continue with question 6C*

__Motorized taxi tricycle ➔ *continue with question 6D*

__Bike or per foot

__Other: _____

Question 6A

Have you used a taxi in the last 6 months? __Yes __No

Question 6B

Do you or your family own a car or do you have access to a car (e.g. car-sharing) or have you used a passenger car in the last 6 months? __Yes __No

Question 6C

Do you or your family own a motorcycle or do you have access to a motorcycle or have you used a motorcycle in the last 6 months? __Yes __No

Question 6D

Have you used a motorized taxi tricycle in the last 6 months? __Yes __No

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If interviewed persons respond in the questions 6A to 6D with NO they are not included in the final calculation i.e. this specific survey is not included as the response is deemed as non-consistent with the one given in question 6