CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Cable Cars Metro Medellín, Colombia
Version 1.4
27/11/2012

A.2. Description of the small-scale project activity:

The project is the construction and operation of six cable cars in the city of Medellin, Colombia. All lines are operated by Empresa de Transporte Masivo del Valle de Aburrá Ltda. (ETMVA). They are used as mass transit options in hilly areas of the city. The cable cars are an integrative part of the metro system of Medellin with a pre-pay fare system and seamless transfer to the metro. Using cable cars as a mass transit option is unique worldwide. Only two comparable systems operate currently world-wide, both however with much lower capacity.

The six cable car lines included in this PDD are:

- Cable car Line K: This line links people living in Santo Domingo Savio, a steep slope in the Northeastern part of Medellin, to the metro-station Acevedo operated by ETMVA.The cable car has two intermediate stops and the final stop at the metro station to allow for seamless transfer to the metro. The cable car has a length of 2.1 kilometres and a capacity of 3’000 passengers per hour per direction. It transports around 27,000 passengers per day.
- Cable car Line J (MetroCable Nuevo Occidente): This line operates in the Western part of the city and links Pajarito with San Javier which is at the same time a metro-station. The cable car has two intermediate stops and the final stop at the metro station to allow for seamless transfer to the metro. The cable car has a length of 2.7 kilometres and a capacity of 3,000 persons per hour per direction. It is expected to transport around 28,000 passengers per day.
- Metrocable Arvi: This is a peri-urban cable car connecting El Tambo with the final station of cable car Line K in Santo Domingo. El Tambo is in a zone which is used frequented by people for recreational activities and is now reached exclusively by road i.e. basically bus or taxis. The cable car has no intermediate stations. It has a length of 4.5 kilometres, a final capacity of 1,200 passengers per hour per direction and expects to transport initially around 3,000 passengers per day.
- Cable car Line Centro Occidental: This line is planned to link Picachito with the metro station of Acevedo where already the cable car line K operates. The line is planned with two intermediate stops and the final stop at the metro station to allow for seamless transfer to the metro. The cable car has a planned length of 2.7 kilometres with a capacity of 3,000 persons per hour per direction. It is expected to transport around 28,000 passengers per day.
- Cable car Extension Metro Line B (2 lines): These two lines are planned to link the sectors El Pinal and La Sierra with the metro-station San Antonio and the metro line B extension. The cable cars have as final stop the metro line B extension station to allow for seamless transfer to the metro. The cable cars have each a planned length of 2 kilometres with a capacity of 3,000 passengers per hour per direction. They are expected to transport around 27,000 passengers per day each.

The baseline transport mode of cable car passengers is basically small and medium buses having numerous accidents, high costs and considerable time lost for travel to the workplace downtown. The cable car substitutes to a certain extent these conventional transport modes, and reduces travel-time as well as travel cost - both important aspects for the people living in this zone. The zones were the cable cars operate are considered the poorest economic areas of Medellin. Seamless transfer to the Metro allows for hassle free and lower cost travel as tickets are integrated. This is also an important measure to increase the attractiveness of public transport in Medellin, where Metro has lost as relative share of transport means relative to passenger cars or taxis between 2002 and 2005 from 26% to 21% (share of metro of daily trips made by metro, taxi and cars; based on Empresa de Desarrollo Urbano de Medellín; 2005: Encuesta Origen–Destino, Universidad Nacional[1]).

Picture 1: Metrocable Line K

[1] File 24

Picture 2: Metrocable Line J Station (under construction)

Picture 3: Transfer Station Cable Car to Metro (Acevedo Metro Station Cable Car Line K)

Picture 4: Current Transport Means (Area of Cable Car Line J)

The project has an important impact on sustainable development including positive environmental and positive socio-economic benefits of the people in the area of influence of the project.

The positive environmental impacts due to reduced usage of buses and other fossil powered transport means are less emissions of particulate matter (PM10), carbon monoxide (CO), hydrocarbons (HCs), sulphur dioxide (SO_2) and nitrogen oxides (NO_x) resulting in less ozone formulation also as a result of reduced NO_x and HC emissions. Local air pollution levels are high and especially curbside particulate emissions are considerable, due also to steep roads and outdated and badly maintained buses.

The social impact is positive due to reduced travel times, reduced travel cost (the new integrated fare charged for the cable car is the same as fare charged currently for the Metro; currently the grand majority of users pay the bus plus the Metro as the bus takes them to a metro station), reduced number of accidents and less respiratory diseases due to an improved local air quality, especially less particulate matter[2]. ETMVA has realized an extensive social program for the construction of the cable cars offering numerous new facilities for inhabitants of the zone such as local recreation facilities, green spaces and parks plus other social extension activities thus improving significantly local living conditions. Local stakeholders were extensively included in the project design and construction thus achieving a very positive attitude towards the cable car. During the construction phase of each cable car around 450 additional jobs are created (150 per substation). People displaced due to infrastructure requirements realized an agreement with the municipality on compensation.

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[2] For PM 10 there exists a clear dose-response function between air quality levels and respiratory diseases, affecting especially children, sick and elder persons.

Another important sustainable development impact of the project is that the project acts as a clean technology demonstration project with a potential replication in various cities of Colombia as well as in other Latin American cities. Only few aerial cable cars are used as mass transit systems including the Roosevelt Island Tramway in the USA. The project is thus not only novel for the host country but also for the region and one of the only cable car based mass transit systems worldwide.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host)	Empresa de Transporte Masivo del Valle de Aburrá Ltda. (ETMVA)	No
Colombia	Centro Nacional de Produccion Mas Limpia y Tecnologias Ambientales	No
Switzerland	Grütter Consulting AG	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Colombia

A.4.1.2. Region/State/Province etc.:

Departamento de Antioquia

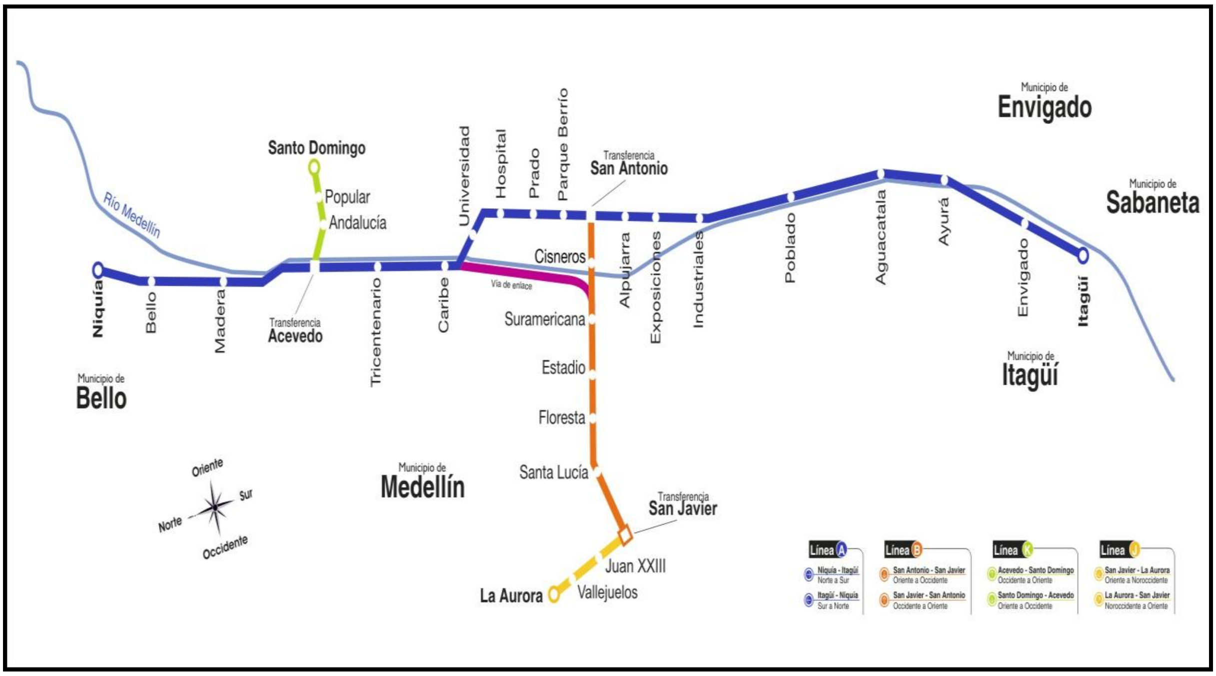
A.4.1.3. City/Town/Community etc:

Metropolitan Area of Medellin

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The cable car Line K has as stations Santo Domingo, Popular, Andalucía, and Acevedo where it connects with the Metro. The cable car Line J has as stations La Aurora, Vallejuelos, Juan XXIII and San Javier, where it connects with the Metro. The cable car Line Arvi has as stations El Tambo and Santo Domingo, where it connects with the cable car Line K. The cable car Line Centro Occidental has three stations and connects with the metro at the Acevedo station. The cable car lines Extension Line B Metro connect with the metro at the San Antonio station. For the last three cable cars station names and exact location have not yet been defined.

Map 1: Cable Car Lines K and J



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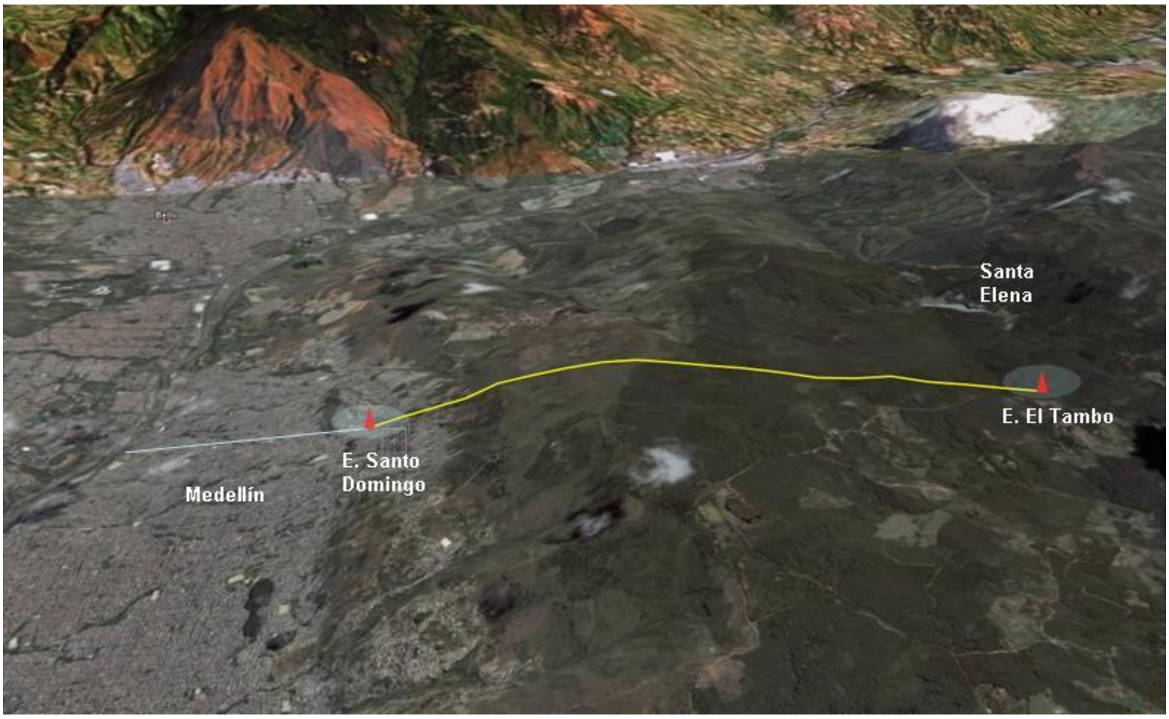
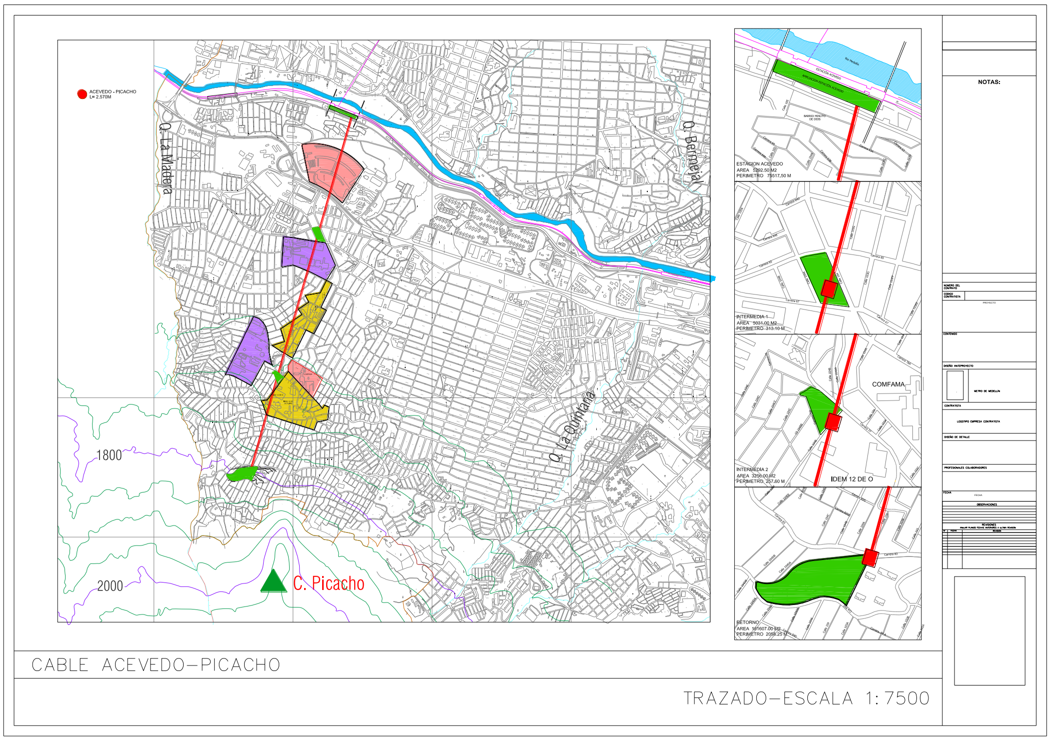
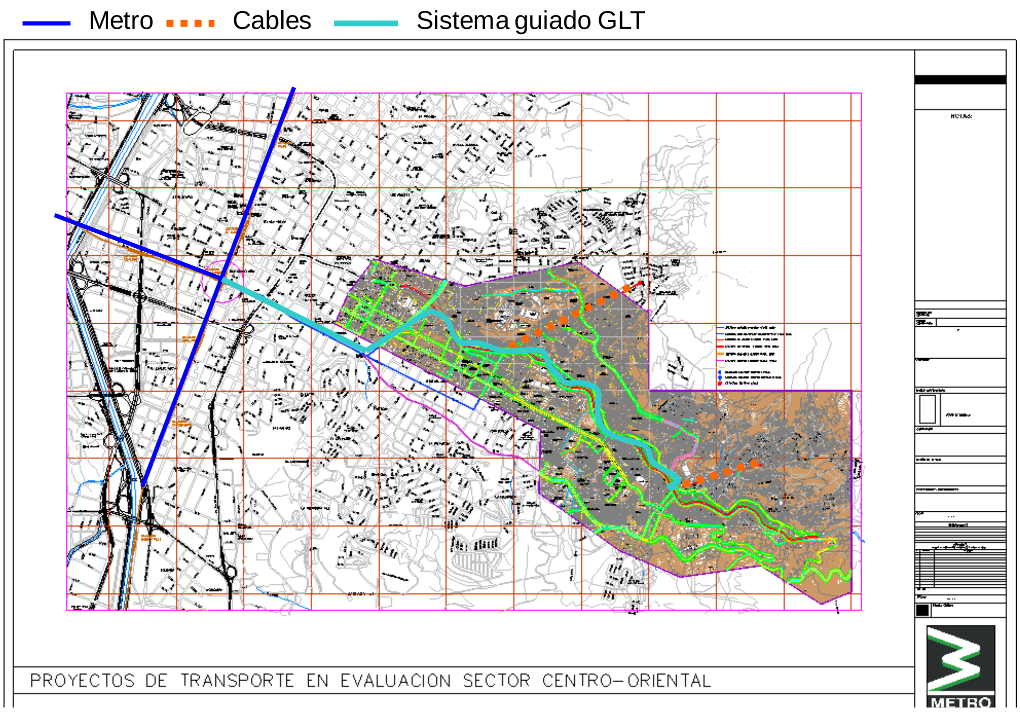
Map 2: Cable Car Line Arvi



Map 3: Cable Car Line Centro Occidental



Map 4: Cable Car Lines Extension Metro Line B



A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

Type III: Other project activities
Category U: Cable cars
Sectoral scope 07: Transport

The same technology is used for all cable cars. The cable car is operated by electricity using mono-cabins with a seating capacity of 8 persons and a maximum capacity of 10 persons.

Table 1: System Characteristics of Cable Car Lines K, J and Arvi

	Line K[3]	Line J[4]	Line Arvi[5]
Number of cabins	90	119	27 initial / 54 final
Slope length	2,072 m	2,700 m	4,462 m
Vertical rise	399 m	309 m	631 m[6]
Hourly capacity per direction	3,000 p/h	3,000 p/h	600 p/h initial / 1,200 p/h final
Line speed	5 m/s	5 m/s	6 m/s
Maximum frequency	12 s	12 s	65 s
Travel time	7 min	9 min	14 min
Number of stations	4	4	2
Number of line towers	20	31	25

The cable car lines Centro Occidente and the 2 lines Extension Metro Line B have not yet been defined in detail. They will however have comparable characteristics to the lines J and K.

The cable car technology was acquired from the French firm Pomagalski[7] for the line K and J (the other lines have not yet defined the equipment). The detachable grip monocable ropeway system allows cabin speed in the terminals to be limited to minimum values, in order that loading and unloading of passengers is easy and also accessible to disabled persons. Besides the main electric drive, the ropeway has provision for an auxiliary diesel drive which allows the passenger ropeway system to be operated at a low speed in emergency situations by way of independent hydrostatic transmission. As an alternative to this rescue drive, there is yet another (backup drive) also by hydrostatic transmission, which operates directly on the drive bull wheel. In a situation of irrecoverable failure, the cabins are transported by return to the stations by means of the rescue drives referred to above. In the very unlikely event of the haul rope not being able to function at all, the passengers will be evacuated by specialized rescue staff of ETMVA, resorting to vertical rescue equipment.

Staff of Metro Medellin have been trained in the operation and maintenance of the cable car[8]. Trainings have been realized by POMA, SURATEP, Systech and Metro being the institutions involved in setting

[3] See File 25a and 25b

[4] See File 26a and 26b

[5] See File 27a

[6] Maximum height difference; from the Station Santo Domingo (1,850 m altitude) it first goes upwards and then downwards to the final station (2,350 m altitude)

[7] See www.poma.net ; see File 28a and 28b

[8] A list of trained staff is found in File 28c

up the cable car. A Spanish technical manual including maintenance has been realized by POMA, the supplier of the cable car technology[9]. The project has also a maintenance program which is incorporated in its corporate SAP/R3 software[10].

Picture 5: Cabins Used

The cable car technology is an environmentally sound technology new for Colombia. Comparable systems are used for tourism purposes e.g. in Funchal (Portugal[11]). Contracts include training of local staff in maintenance and operation of the system thus assuring technology and know-how transfer. While cable cars for tourism purposes are frequent their usage for mass transit is novel. No other systems with comparable characteristics exist in Colombia and no cable cars for mass transit are known to operate in Latin America. Only few aerial cable cars are used world-wide as mass transit systems including the

[9] See File 28d

[10] See File 28e for the excel file of all maintenance procedures

[11] See http://www.madeiracablecar.com/indexen.html

Roosevelt Island Tramway and the Portland Aerial Tram (both in the USA)[12] which have been identified as the only currently operating mass transit aerial cable cars worldwide. The project is thus not only novel for the host country but also for the region and one of the only cable car based mass transit systems worldwide.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Years	Annual estimation of emission reductions in tCO_{2eq}
2010	8,870
2011	15,350
2012	18,895
2013	18,932
2014	19,465
2015	19,478
2016	20,038
Total estimated reductions 1st crediting period (tonnes of CO_{2eq})	121,029
Total number of crediting years (1st crediting period)	7
Annual average over the crediting period of estimated reductions (tCO_{2eq})	**17,290**

A.4.4. Public funding of the small-scale project activity:

There is no Official Development Assistance in this project and the project will not receive any public funding from Parties included in Annex I. Funding is from the district government and from ETMVA through budgetary allocations and does not include any official development assistance and is not counted towards the financial obligations of Annex 1 parties.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

There is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity with the same project participants, in the same project category and registered within the previous 2 years. The proposed project is thus not a debundled component of a large-scale project activity according to Appendix C of the simplified modalities and procedures for small-scale CDM project activities and Annex 27 EB 36 "Compendium of guidance on the debundling for SSC project activities" section B.2.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

AMS-III.U, version 1.0

[12] See http://www.rioc.com/thetram.htm and http://www.portlandtram.org/

Cable Cars for Mass Transit Systems (MRTS)

B.2 Justification of the choice of the project category:

The following table relates the applicability criteria with the project.

Table 2: Applicability of the Project

Applicability Criteria	Project Conditions
1. Measures are limited to those that result in emission reductions of less than or equal to 60,000t CO_{2eq} annually	1. The projected emission reductions of the project are well below the established limit, being in the highest year below 25ktCO_2 reduced.
2. A new cable car is built. Extensions of existing cable cars are not applicable	2. All lines are new.
3. Cable cars are for passenger transport only. The passenger performs partially or totally his trip on the cable car.	3. All lines are for passenger transport. Passengers perform part of their trip or the entire trip on the cable car.
4. Cable cars are established as mass transit mean. The cable car must be built in an area that is accessible by road (origin and final destination of the cable car).	4. All lines are mass transit means and integrated with the metro of Medellin or with another cable car. Both the origin and the destination of all cable car lines can be accessed by road.
5. The methodology is applicable if fuels used in the baseline and or project case are electricity, gaseous or liquid fossil fuels. If bio-fuel blends are used as liquid fuels, the specific fuel consumption value and emission factors used for determining baseline and project emissions shall be adjusted accordingly	5. Project fuel used is electricity. Baseline fuel used is basically pure diesel, plus to a minor extent gasoline (basically taxis and passenger cars). No bio-fuels are used. According to the resolution 180687 dated June 17th 2003 Art. 5 gasoline shall be blended in Medellin with 10% ethanol as per latest 27th of September of 2005[13]. According to EB 22 report Annex 3 "Clarifications on the consideration of national and/or sectoral policies and circumstances in baseline scenarios (version 02)" this is a national regulation that gives comparative advantages to less emission-intensive technologies (type E- policy). According to Art. 7 of the above mentioned document "National and/or sectoral policies or regulations under paragraph 6 (b) *(type E- policies)* that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place)." The regulation requiring blending with ethanol was issued after Nov 11th 2001 and the implementation deadline was 27th September 2005, well after 11.11.2001. The baseline fuel used by

[13] The law 693 dated 27.9.2001 to which regulation 180687 refers, calls for an oxygenation of fuels without making the usage of ethanol compulsory for this purpose. World-wide oxygenation of gasoline was and is made primarily with MTBE and not through the usage of ethanol. Law 693 also does not specify a certain blending level (the applicability condition of the methodology allows blending of up to 3%). Law 693 can thus be considered a general policy to promote the oxygenation of gasoline fuels without specifying neither the usage of bio-fuels nor a certain blending level. See File 29a and 29b

	passenger cars and taxis can thus be considered as unblended gasoline i.e. the baseline fuel refers to a hypothetical situation without the national regulation being in place as clarified by the EB 22 Annex 3.
6. The methodology is applicable if the analysis of possible baseline scenario alternatives leads to the result that a continuation of the current public transport system is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity (i.e. the baseline scenario).	6. The most probable baseline scenario is a continuation of traditional transport means as prevalent before establishment of the cable car lines.

The project complies with all applicability conditions of the methodology.

B.3. Description of the project boundary:

The spatial extent of the project boundary is the geographical area of trips of passengers using the cable car lines i.e. the metropolitan area of the city of Medellin in total.

As electricity from an interconnected grid is used, the project boundary also includes the power plants connected physically to the electricity system that supply power to the project.

For project and baseline emissions for liquid fuels only CO_2 is included while for gaseous fuels CO_2 and CH_4 is included. N_2O emissions are not included.

B.4. Description of baseline and its development:

Baseline Determination

Alternatives that were studied include:

1. Metro extension, tram or light duty rail
2. Bus lanes / Bus Rapid Transit (BRT) systems
3. Continuation of the current public transport system
4. Implementation of the project without CDM

All alternatives are compatible with legal requirements.

Types of mass rapid transit (MRT) systems considered in general are[14]:

- Light rail transit (LRT) which also includes trams operating as single rail car or as short train of cars typically on exclusive right-of-way lanes at surface levels. LRTs can also be elevated.
- Metros which can function underground, elevated or on surface level (Delhi metro has e.g. all three elements). The core difference to LRTs is the larger capacity of passenger transport.
- Sub-urban or inter-urban rail with some stations in the city. The main difference to LRTs is that carriages are heavier, distances travelled are longer and transport is between cities or between the city and its sub-urban areas.

[14] Adapted from GTZ training course "Mass Transit", 2004, box 2, page 14

- Bus Rapid Transit systems including bus lanes such as established in other Colombian cities e.g. Bogota Transmilenio. BRTs are bus based MRTS operated on exclusive right-of-way lines.

Other mass transit options are not feasible due to three reasons detailed below:
1. Lack of passenger demand expressed in passengers per hour per direction
2. Investment cost differential
3. Topographic conditions

Concerning passenger demand table 3 shows the difference between the passenger hour direction (phd) of other MRTs with the cable car reflecting the actual passenger demand of the lines.

Table 3: Passenger Typical Capacity Levels of MRT Alternatives[15]

Alternative	Phd (passenger per hour per direction per lane)
Metro	Up to 60,000
LRT	11-20,000
BRT	15-35,000
Sub-urban rail	Up to 30,000
Demand for project site / cable car	1,200-3,000[16]

Based on the existing demand of maximum 3,000 phd in the project area other MRT systems are not feasible as they cater to much higher passenger trip demand in areas with much higher people density. Differences are in the order of factor 10.

Table 4 shows the investment cost differential per built kilometre of other options and a cable car.

Table 4: Investment Costs of MRT Alternatives[17]

Alternative	Investment per km in USD
Metro	15-180 million depending basically if at grade or underground
LRT	10-30 million
BRT	13-20 million[18]
Sub-urban rail	Wide variation depending on system characteristics
Cable car	5-10 million[19]

Rail-based mass transit systems have significant higher costs. BRTs have a comparable cost. However BRTs are not built only for 2km of lanes but for 10km or more as bus lanes cannot be operated

[15] Data for all systems except cable car from: IEA/OECD, Bus Systems for the Future, 2002, table 2.1. page 29

[16] See Table 1

[17] Data for metro, LTR and sub-urban rail from: IEA/OECD, Bus Systems for the Future, 2002, table 2.1. page 29

[18] Actual infrastructure cost of TransMilenio, Bogota, Colombia on different lanes as published in*:* Instituto de Desarrollo Urbano; USD 2003 are converted to USD 2000 using OECD deflator; based on real kilometres built Cost of TransMilenio in different lanes including buses and fare collection system around 1/3rd more (see Conpes 3093, Republica de Colombia, Departamento Nacional de Planeacion, 15.11.200, table A4-4 page 33 for the relation infrastructure (public) to bus/fare collection system (private) investment; see also PDD BRT TransMilenio, Bogota (registered under 0672), table B.3.2.

[19] See Table 6 for investment and table 1 for line length

efficiently in such short stretches[20]. To cover the same distance as a cable car also the road distance would need to be taken due to topographic considerations (the cable car can go straight down the hill, buses have to wind in curves down the hill) which would increase the distance significantly thus making BRTs for the same origin to destination trip sequence much more expensive.

Topography would make a metro, LRT, rail system or BRT very difficult if not impossible due to the very steep hills.

A continuation of the existing public transport system does not require investments, nor does it face resistance of bus operators. Also, albeit with deficiencies, the current public transport systems is working and operational. This is thus an alternative without major negative points and without risk for ETMVA.

All alternatives identified are consistent with mandatory laws and regulations i.e. all alternatives are legally possible as no law exists that excludes a priori any transport system..

The implementation of the project in absence of the CDM is not probable. This is demonstrated in chapter B.5.

Baseline Description

GHG emission reductions are achieved through an improved efficiency of transporting passengers with the cable car compared to the traditional transport mode passengers would have used in absence of the project being primarily small and medium sized buses.

Baseline emissions are those which would have been caused by passengers using the cable car and in absence of latter would have used baseline modes of transport from their trip origin to their trip destination. Baseline emissions per PKM (Passenger Kilometre) per mode are fixed ex-ante and are annually updated based on a technology improvement factor. Total baseline emissions are calculated based on the number of project passengers, the baseline emission factor per PKM and the trip distance on the respective mode. The baseline emissions include total trip emissions of project passengers from their trip origin to their trip destination.

Steps followed to determine baseline emissions are:

1. Identify relevant vehicle categories
2. Determine emissions per kilometre of vehicle categories through fuel consumption data
3. Determine emissions per passenger-kilometre though occupation data per mode category or through average trip distance per passenger per mode category
4. Determine trip modes and trip distances of cable car passengers in absence of the project based on a survey realized of cable car users
5. Calculate total baseline emissions based on the average baseline trip emissions and the number of passengers transported by the cable car.

For formulas applied see section B.6.

[20] See for BRTs of various cities with ranges of 10-114km for BRTs with no city having less than 10km for BRT/bus lane in Training Course: Mass Transit, L. Wright, GTZ, 2004, table 6, p.16

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

The additionality of the project is determined using the Attachment A to Appendix B of the simplified modalities and procedures for small scale project activities and EB 35 Annex 34 Guideline on "Non-binding best practice examples to demonstrate additionality for SSC project activities".

The project starting date is before the start of validation. Therefore proof is given that CDM was considered before the project starting date. The project starting date is defined in accordance with EB 41 Paragraph 67. EB 41 Annex 46 "Guidance on the demonstration and assessment of prior consideration of the CDM" was also taken into account, specifically Paragraph C.

Table 5: CDM Project Chronology

Milestone	Date	Documentary Proof
Prior Consideration of CDM		
Request to CAF for finance of cable car due to GHG reductions	11.2.2002	e-mail ETMVA to CAF File CC1
Submission of cable car as CDM project to the Colombian DNA	Early 2002	Letter dated 23.4.2003 of ETMVA referring to CDM project proposal to DNA as of early 2002 File CC2
Project Identification Note in format of DNA	2.2002	Project Identification Note CC3
Identification of the cable car as CDM project	8.2.2002	Article El Tiempo, 8.2.2002, p.27 File CC4
PIN draft cable car	13.1.2003	PIN CAEMA PIN[21] File CC5
Offer Velnec to develop CDM project of cable car	13.2.2003	e-mail plus attachment from Velnec File CC6
Inclusion of cable car as CDM project at DNA	6.3.2003	e-mails 6 and 7.3.2003 between Ministry of Environment and ETMVA File CC7
Project Starting Date Contract and construction start line K	11.4.2003	Acta de Inicio dated 11.4.2003[22]
Presentation of cable car as CDM project to the Ministry of Environment	30.4.2003 2003	Letter sent sent to Ministry 30.4.2003 File CC8
Presentation of cable car as CDM project by Metro Medellin at an international event of CAEMA	7-9.5.2003	Resolucion 2975 dated 2.5.2003 File CC9
Delivery of final PIN for project	5.5.2003	PIN CAEMA File CC10
CDM calculations	8.5.2003	grütter consulting File CC11
Confidentiality agreement CAEMA for CDM development	19.6.2003	Confidentiality agreement CAEMA File CC12
Discussion of advances in CDM project at the	14.10.2003	Meeting minutes

[21] File 32

[22] File 34

Board of ETMVA		File CC13
Initial draft PDD	30.10.2003	PDD grütter consulting File CC14
Contacts with potential buyers (various)	2003 onwards	e.g. Memo Natsource dated 30.10.2003 File CC15
Follow-up reports on CDM project	Various 2003 and 2004	Various internal reports “Informes de avance” File CC16
Negotiations with MGM as project developer for cable car project	16.1.2004	Mail to MGM File CC17
Negotiations with CAF as project developer for cable car project	18.2.2004	Mail to CAF File CC18
Meeting with DNA to discuss advances of CDM postulation of cable car	28.5.2004	Letter to DNA dated 28.5.2004 File CC19
CDM: new calculations of CER potential	18.5.2005	Isabel Cristina Giraldo, excel file, ETMVA File CC20
Negotiations with CDM project developer MGM and CAF as well as discussions with Ministry of Environment	21.7.2005	Metro Medellin, Informe Tecnico Ambiental Anual del Sistema Metrocable, 7/2005, p. 28 (File N1)
Presentation of cable car as climate change project under preparation for IADB (Inter-American Development Bank)	2.3.2006 and 17.6.2006	Presentation at public seminar of IADB in Quito/Ecuador 3.2006 (slide 7), draft report 3.2006 and final report Lineas Bases en Proyectos de Transporte, IADB, 6.2006, page 12 (File N1 and N2)
Offer for CDM project development cable car	6.10.2006 to 10.11.2006	Mail and offer CAEMA File CC21
Negotiation CDM project development with CNPMLTA	4.7.2007	Presentation realized at ETMVA File CC22 and e-mails File CC23
Presentation of documentation of CDM project for letter of non-objection from Colombian government	23.7.2007	Document presented to Ministry File CC24
Negotiation for CDM project development with CNPMLTA	11.2007	Various e-mails e.g. 13.11.2007, 16.11.2007 File CC25
Contract signature with CNPMLTA for CDM development of cable car	21.12.2007	Contract File CC26
Methodology submitted to the UNFCCC	14.2.2008	Methodology submission form
Methodology approval	26.9.2008	EB 42 report

CDM was clearly considered before starting the project, with grütter consulting being engaged since early 2003 in the process.

The core elements showing prior consideration as a CDM project prior project start on 11.4.2003: The project was sent to the national DNA as a CDM project in the official project identification format as earls as 2.2002; CAF was asked for finance concerning GHG reductions and an article in the press (Files CC1 to CC3). Also CAEMA realized a PIN prior project start and negotiations with a potential project developer (Velnec) where realized. See Files CC1 to CC7.

The most important proof of continuing and real actions to secure CDM status for the project in parallel with its implementation are:

- 2003 after project start: PIN, draft PDD, negotiations with various buyers, board meeting follow-up see files CC8 to CC16
- 2004: Negotiations with potential buyers and developers such as MGM, CAF and follow-up with DNA see Files CC17 to CC19
- 2005: Annual environment report of project owner includes negotiations with project developers (MGM, CAF) as well as discussions realized with the DNA of Colombia.
- 2006: Negotiations with CAEMA for project development see File CC21
- 2007: Negotiation and contract closure for CDM project development with CNPMLTA and request for letter of non-objection see Files CC22 to CC26
- 2008: Methodology proposal (2.2008) and methodology approval by EB (9.2008); data collection; entry of project into validation

The project owner presented the project as CDM project to the national DNA as of early 2002. Before project start the national DNA was thus already informed of the decision to undertake this project as a CDM project activity. This is the equivalent to the notification required for projects after 02/08/2008 to the DNA according to the Guidance on the Demonstration and Assessment of Prior Consideration for the CDM as issued by EB 41 Annex 46 which means that this project has made all steps which also today would be required for proofing prior consideration of CDM already in the year 2002. The importance of CDM is also outlined in the fact that ETMVA had a PIN of the project already before project start and had presented the request to the national DNA with the project being presented as CDM project in the official format as early as 2.2002 i.e. more than 1 year before project start. ETMVA had also started negotiations with potential buyers and developers (Velnec) before project start. These facts clearly demonstrate awareness of the CDM prior to the project activity start date, and that the benefits of the CDM were a decisive factor in the decision to proceed with the project. The project owner had realized for this purpose also the notification of the DNA as early as 2002 identical to the documentation required by the EB for prior consideration of the CDM (compulsory for new projects since 2.8.2008). The project had in fact already complied with this later guidance as of 2.2002.

Between 2004 and 2007 a follow-up was made on the activities. Discussions about the methodological approach were realized. Grütter consulting was ready to develop the methodology once the project would have a sufficient size (minimum 3 cable cars) due to the significant transaction costs and risks involved with getting a new methodology and a PDD approved. Grütter consulting therefore first formulated AM0031 which has the conceptual base for all types of mass transit projects and a much larger market potential. This would form also the base for the cable car methodology. After nearly 2 years of discussion this first transport methodology was finally approved by the UNFCCC in the 2nd semester 2006 and the first project got registered (TransMilenio project number 0672) in December 2006. In 2007 grütter consulting refined AM0031 for stand-alone bus lanes (NM0229), a situation comparable to the cable car. The comments on this methodology served as base for a new version (NM0258 and NM0266) and as template for the cable car methodology presented to the UNFCCC early 2008. The cable car methodology developed is thus based on prior work realized. The approach developed in AM0031 was intended from the start as a general approach for mass urban transit projects relying on comparing GHG efficiency of various transport modes.

As mentioned a methodology and PDD development for only 1 cable car line was considered as economically non-feasible. Therefore the project developer waited until a 2nd and third line were near to implementation before investing in the whole process. This is the reason why no special time pressure was exerted on the methodology and project development.

Alternatives to the project have been identified in chapter B.4. All alternatives proposed comply with all applicable legal and regulatory requirements.

Barriers identified include basically:

- First of its kind
- Investment barrier
- Technological barrier

First of its Kind

The project is clearly a 'first of its kind". No other cable car systems for mass transit operate in Colombia or in any other country of Latin America. Also world-wide it is unique to use cable cars as a mass transport option. The only identified aerial cable cars which are used as mass transit systems is the Roosevelt Island Tramway in the USA[23]. However the Roosevelt Island Tramway transports not more than 3,000 passengers per day which is the *hourly* capacity of line K or line J *per direction*. The Portland Aerial Tram in the USA[24] has only started operations January 2007 i.e. after cable car line K entered in operations. Also this cable car carries only a fraction of the passengers transported by the cable car lines K and J. The Portland cable car transports daily less than 5,000 passengers while Line K transports on a typical day more than 35,000 passengers i.e. 7x more. The cable cars of Medellin can thus be considered unique and first of its kind worldwide. The prevailing practice in Medellin as well as other cities is a bus system based on a multiple number of different types of vehicles. Small buses are for the steep slopes and narrow roads of the project region the most appropriate conventional vehicle types and would thus continue to operate in the same scale in absence of the project activity. The Ministry of Transport has confirmed to ETMVA that the project is first of its kind in Colombia (see letter in Annex 3).

According to the draft methodological tool CDM Methodology Panel Meeting 34 Annex 10 "Note on the barrier -first-of-its kind" the cable car project clearly represents this case. According to this tool "A project activity is assumed to be additional if no similar project has been implemented previously in a certain geographical area. If a project activity is "first-of-its-kind", it is clear that implementation of the specific technology is not yet "common practice". If a project activity is "first-of-its-kind", no additional assessment steps are required to confirm additionality. Considering the guidance of the tool the cable car project is a clear cut case of first-of-its-kind:

- The project technology[25] has not been in commercial operation in the applicable geographical area[26]
- The project technology has not been proposed by another CDM project worldwide

The cable car faces significant barriers not prevalent to the current bus based mass transit system. CDM can help to alleviate these barriers basically by allowing for more financial flexibility and thus reducing

[23] See http://www.rioc.com/thetram.htm

[24] See http://www.portlandtram.org/

[25] The specific project technology is to use cable cars for mass transit purposes: this is technologically seen significantly different from low density tourism usage due to demands on wear and tear, mass passenger handling and continuous high load operations

[26] The applicable geographical area is the country. No comparable technology is used in total Latin America.

the exposure and risk of ETMVA. It also allows for a capitalization of the global environmental benefit of the project not only in financial terms but positioning the company as a leader in environmental terms. Registering the project as a CDM project also alleviates the barrier of co-financing of the Municipality of Medellin due to the image gained in realizing efforts which promote the usage of clean and environmentally friendly technologies contributing to reduce the effects of global warming.

The implementation of this project with carbon finance can promote this environmentally friendly and innovative technology for mass transit purposes and can thus contribute towards making public transit more attractive while reducing GHG emissions. The project can claim to be one of the few truly innovative and unique climate friendly technologies proposed under the CDM.

Investment Barrier

The metro of Medellin had a cost overrun of factor 2 and construction took 12 instead of projected 5 years. Due to the cost overrun ETMVA is still engaged in various pending national and international lawsuits[27] thus also having difficulties in achieving favourable financial conditions and new loans. Investing another 29 million USD (first three lines) in a new mass transit option not used in other parts of the world is thus a large risk. As with many new and innovative ventures cost overruns are frequent. This is also documented clearly in the case of the first cable car (Line K) which suffered an increase of projected costs between March and July 2002 of 12.25%, leading to additional costs for ETMVA of 1.28 million USD. Carbon finance can cover such cost-overruns thus reducing considerably the risk of ETMVA in investing in new technologies[28].

Technological Barrier

No other country in Latin America is using cable cars as mass public transport means. The technology itself is not used except in singular places for tourism purposes in Colombia. This means that staff needs to be trained and know-how needs to be assimilated. The project is thus clearly very innovative bearing significant technical risks.

B.6. Emission reductions:

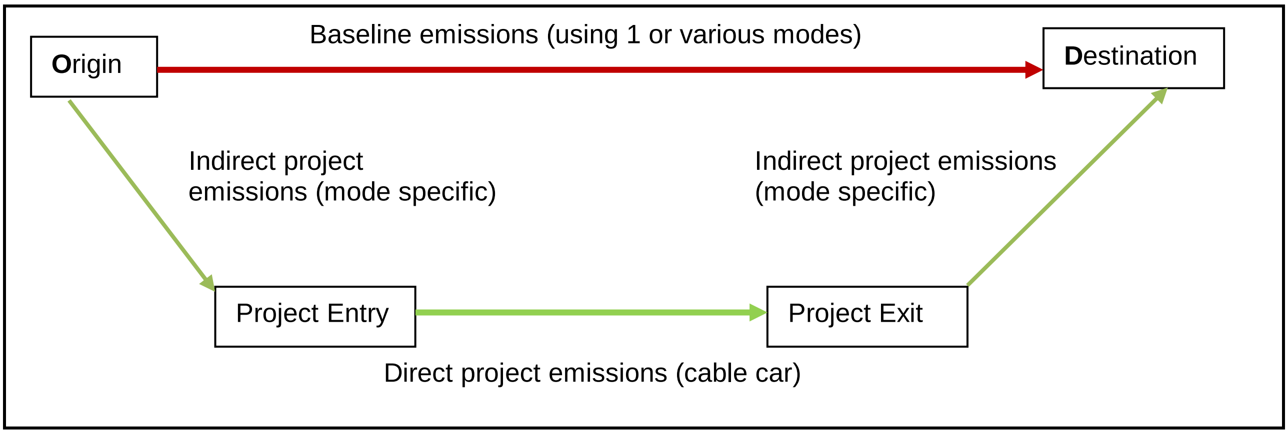
B.6.1. Explanation of methodological choices:

Baseline and project emissions are based on the emissions passengers cause from origin to destination based on modes and trip distances project passengers would have caused in absence of the cable car versus actual emissions caused with project operation (direct project emissions of the cable car plus indirect ones caused to and from the cable car).

Graph 1: Baseline and Project Emissions

[27] See for a full description http://www.metrodemedellin.gov.co/images/Felipe/demanda%20reconvencion.pdf and http://www.metrodemedellin.gov.co/images/Felipe/tribunal%20arbitramento.pdf

[28] The income from the CER sale of line K only would e.g. be sufficient to cover fully this cost overrun (based on 3x7 years crediting period with annually 5,300tCERs (line K only) at an average net sales price of 18 USD (70% of CER 2008 sales price as published on EEX)



BASELINE EMISSIONS

Relevant vehicle categories

Vehicle categories used for passenger transport are potentially:

- Buses
- Metro
- Taxis
- Passenger cars
- Motorcycles
- NMT (Non-Motorized Transit such as bike or per foot).

Medellin has no Light Transit Rail and thus no other vehicle category. According to the methodology vehicles not common in the project boundary can be excluded. The project includes all possible vehicle categories in its calculations.

Formula (1): Emissions per Kilometre per Vehicle Category

$$EF_{KM,i} = \sum_{x}\left[SFC_{x,i} \times NCV_{x} \times EF_{CO2,x} \times \frac{N_{x,i}}{N_{i}}\right] \times IR_{i}^{t}$$

Where:

$EF_{KM,i,}$	Emission factor per kilometre of vehicle category "i" ($grCO_2$/km)
$SFC_{x,i}$	Specific fuel consumption of vehicle category "i" using fuel type "x" prior project start (gr/km)
NCV_x	Net calorific value of fuel "x" (J/gr)
$EF_{CO2,x}$	Carbon emission factor for fuel type "x" ($grCO_2$/J)
$N_{x,I}$	Number of vehicles of category "i" using fuel type "x" prior project start (units)
N_i	Number of vehicles of category "i" prior project start (units)
IR_i^t	Technology improvement factor for the vehicle of category "i" per year "t"
t	Year counter for the annual improvement (dependent on age of data per vehicle category)

The emission factor is not constant but annually updated according to the technology improvement factor per vehicle category. The default technology improvement factor of the methodology is used.

Formula (2): Emissions per PKM

$$EF_{PKM,i} = \frac{EF_{KM,i}}{OC_i}$$

Where:

$EF_{PKM,i}$	Emission factor per passenger-kilometre of vehicle category "i" ($grCO_2$/PKM)
$EF_{KM,i}$	Emission factor per kilometre of vehicle category "i" ($grCO_2$/km)
OC_i	Average occupation rate of vehicle category "i" prior project start (passengers)[29]

Formula (3): Total Baseline Emissions

$$BE_y = \frac{\sum_s \sum_i P_{BL,i,s,y} \times TD_{BL,i,s,y} \times EF_{PKM,i}}{10^6}$$

Where:

BE_y	Baseline emissions in the year "y" (tCO_2)
$P_{BL,i,s,}$	Passengers transported by the project in the quarter "s" of the year "y" using mode "i" in the baseline (passengers)
$TD_{BL,i,s,y}$	Average trip distance of passengers using mode "i" in the baseline in the quarter "s" of the year "y" (kilometer)
$EF_{PKM,i}$	Emission factor per passenger-kilometre of vehicle category "i" ($grCO_2$/PKM)
Σ_s	Sum of the 4 surveys realized

Formula (4): Baseline Passengers per Mode

$$P_{BL,i,s,y} = P_{s,y} \times SP_{BL,i,s,y}$$

Where:

$P_{BL,I,s,y}$	Passengers transported by the project in the quarter "s" of the year "y" who would have used mode "i" in the baseline (passengers)
$P_{s,y}$	Passengers transported by the project in the quarter "s" of the year "y"(passengers)
$SP_{BL,i,s,\ y}$	Share of passengers transported by the project in the quarter "s" of the year "y" who would have used mode "i" in the baseline (%)

PROJECT ACTIVITY EMISSIONS

Direct project emissions are based on the electricity consumption of the cable car. The corresponding GHG emissions are based on "Academia Colombiana de Ciencias Exactas, Fisicas y Naturales" realized for UPME (Unidad de Planeacion Minero Energetica) of the Ministry of Mines and Energy. The latest available data at the moment of publication of the PDD for validation was used. This is an approach for small-scale projects based on AMS.I.D. and compatible with the cable car. Total electricity usage of the cable car is 10,708 MWh (highest of all years) equivalent to 1.86MW power[30]. This is clearly below the

[29] In the case of taxis the driver is not included

[30] Based on 360 days with 16 hours of operation

threshold value for small-scale projects of 15MW capacity or 60 GWh consumption. All steps for calculating the carbon emission factor are reproduced in Annex 3.

Indirect project emissions are those caused by passengers from their origin point up to the project entry station and from the project exit station up to the final trip destination.

Formula (5): Indirect Project Emissions

$$IPE_y = \frac{\sum_s \sum_i P_{PJ,i,s,y} \times TD_{PJ,i,s,y} \times EF_{PKM,i}}{10^6}$$

Where:

IPE_y	Indirect project emissions in the year "y" (tCO_2)
$P_{PJ,i,s,y}$	Passengers transported by the project in the quarter "s" of the year "y" using mode "i" for trips to and from the project system (passengers)
$TD_{PJ,i,s,y}$	Average trip distance of passengers using mode "i" in the quarter "s" of the year "y" to and from the project system (kilometer)
$EF_{PKM,i}$	Emission factor per passenger-kilometre of vehicle category "i" ($grCO_2/PKM$)
Σ_s	Sum of the 4 quarterly surveys realized

Formula (6): Passengers per Mode

$$P_{PJ,i,s,y} = P_{s,y} \times SP_{PJ,i,s,y}$$

Where:

$P_{PJ,i,s,y}$	Passengers transported by the project in the quarter "s" of the year "y" using mode "i" for trips to and from the project system (passengers)
$P_{s,y}$	Passengers transported by the project in the quarter "s" of the year "y"(passengers)
$SP_{PJ,i,s,y}$	Share of passengers transported by the project in the quarter "s" of the year "y" using mode "i" to and from the project systems (%)

Total project emissions are the sum of indirect and direct project emissions.

Formula (7): Total Project Emissions

$$PE_y = DPE_y + IPE_y$$

Where:

PE_y	Project emissions in the year "y" (tCO_{2eq})
DPE_y	Direct project emissions in the year "y" (tCO_{2eq})
$IPE_{,y}$	Indirect project emissions in the year "y" (tCO_2)

LEAKAGE EMISSIONS

Leakage is only included if the total annual effect is to reduce estimated emission reductions.

Leakage monitored concerns significant (10% or more) change in the occupancy rate of considered vehicle categories. Only vehicle categories are included for leakage calculations where a significant change would lead to an actual change of emissions. This includes surely buses. For all other categories actual usage in the baseline or project case for passengers using the cable car may be minor thus not warranting a monitoring of the occupation rate. For example in the surveys already realized for the cable car lines K and J less than 1% of trips were made by passengers using passenger cars, motorcycles or taxis. Therefore a change of occupation rate would have no impact on leakage. In line with accepted principles of only considering potentially significant factors the project will only monitor potential change of occupation rates of vehicle categories which have at least 10% participation of the average baseline and indirect project emission factor per passenger trip (a 10 percentage change of the occupation rate would thereafter have still less than 1% impact on emission reductions as a reduced occupation rate leads to reduced baseline as well as indirect project emissions).

The leakage impact of occupancy rate changes (if monitored) are calculated based on AM0031.

EMISSION REDUCTIONS

Formula (8): Emission Reductions

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y	*Emission reductions in year "y" (tCO_{2eq})*
BE_y	*Baseline emissions in year "y" (tCO_{2eq})*
PE_y	*Project emissions in year "y" (tCO_{2eq})*
LE_y	*Leakage emissions in year "y" (tCO_{2eq})*

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**$SFC_{T,D}$ / $SFC_{T,G}$**
Data unit:	gr/km (gr fuel per km)
Description:	Specific fuel consumption diesel and gasoline taxis
Source of data used:	Specific study ordered by CNPMLTA, 2008
Value applied:	56 gr/km diesel taxis 57 gr/km gasoline taxis
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on lower 95% confidence interval for the sample survey made; Study made based on measuring fuel consumption and distance driven of a sample of taxis in Medellin; Density of diesel 0.829 kg/l (Based on Swiss Environmental Agency SAEFL; see also IEA Energy Statistics Manual, OECD/IEA, 2005, Annex 3, Table A.3.8.) Density of gasoline 0.745 kg/l (Based on Swiss Environmental Agency SAEFL; see also IEA Energy Statistics Manual, OECD/IEA, 2005, Annex 3, Table A.3.8.)
Any comment:	Values in litre/100km: Diesel taxis: 6.7 l/100km Gasoline taxis: 7.6 l/100km

	Percentage of taxis for each fuel based on Transport Secretariat of Medellin: Share of diesel taxis: 4% Share of gasoline taxis: 96%

Data / Parameter:	**SFC_C**
Data unit:	gr/km (gr fuel per km)
Description:	Specific fuel consumption passenger cars
Source of data used:	Specific study made ordered by CNPMLTA, 2008
Value applied:	63 gr/km
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on lower 95% confidence interval for the sample survey made; Study made based on measuring fuel consumption and distance driven of a sample of passenger cars in Medellin; Density of gasoline 0.745 kg/l (Based on Swiss Environmental Agency SAEFL; see also IEA Energy Statistics Manual, OECD/IEA, 2005, Annex 3, Table A.3.8.)
Any comment:	Value in litre/100km: 8.4 l/100km More than 99% of passenger cars use gasoline based on Transport Secretariat of Medellin

Data / Parameter:	**SFC_M**
Data unit:	gr/km (gr fuel per km)
Description:	Specific fuel consumption motorcycles
Source of data used:	Specific study ordered by CNPMLTA, 2008
Value applied:	18 gr/km
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on lower 95% confidence interval for the sample survey made; Study made based on measuring fuel consumption and distance driven of a sample of motorcycles in Medellin; Density of gasoline 0.745 kg/l (Based on Swiss Environmental Agency SAEFL; see also IEA Energy Statistics Manual, OECD/IEA, 2005, Annex 3, Table A.3.8.)
Any comment:	Value in litre/100km: 2.4 l/100km

Data / Parameter:	**$SFC_{B,M}$ / $SFC_{B,S}$**
Data unit:	gr/km (gr fuel per km)
Description:	Specific fuel consumption diesel of medium and small buses
Source of data used:	Specific study made ordered by CNPMLTA, 2008
Value applied:	237 gr/km medium buses 160 gr/km small buses
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on lower 95% confidence interval for the sample survey made; Study made based on measuring fuel consumption and distance driven of a sample of buses in Medellin; Density of diesel 0.829 kg/l (Based on Swiss Environmental Agency SAEFL; see also IEA Energy Statistics Manual, OECD/IEA, 2005, Annex 3, Table A.3.8.) All buses registered diesel. Only small and medium buses registered on routes used in area of cable cars
Any comment:	Values in litre/100km:

	Medium buses: 28.6 l/100km Small buses: 19.3 l/100km Share of medium buses 59% and small buses 41% based on registration of all buses in area of influence of project

Data / Parameter:	**$N_{T,G}$ / $N_{T,D}$**
Data unit:	vehicles
Description:	Number of taxis using gasoline or diesel
Source of data used:	Secretaria de Transporte, 2008
Value applied:	845 units diesel (3.9%) 20,820 gasoline (96.1%)[31]
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on registration statistics 2007, File 12 Entire city as taxis are not confined to certain parts of the city but operate all over the city (this is also conform to the definition of the geographic project boundary including the entire city with the trip origins and trip destinations of passengers)
Any comment:	The number of taxis according to fuel type are required as not all taxis use the same fuel. To calculate the EF we need the percentage of each fuel type if various fuels are used. This is only the case in taxis, thus only taxi numbers are listed. Passenger cars are all gasoline (>99%), and motorcycles are all gasoline. Information based on Transport Secretariat of Medellin (File 12). Buses in the project area are all diesel (see File 16)

Data / Parameter:	**NCV_D / NCV_G**
Data unit:	MJ/kg
Description:	Net calorific value of diesel and gasoline
Source of data used:	Academia Colombiana de Ciencias Exactas, Fisicas y Naturales realized for UPME (Unidad de Planeacion Minero Energetica) of the Ministry of Mines and Energy
Value applied:	42.67 diesel 42.44 gasoline
Justification of the choice of data or description of measurement methods and procedures actually applied :	National official data Lower heat value is taken thus conservative
Any comment:	

Data / Parameter:	**$EF_{CO2,D}$ / $EF_{CO2,G}$**
Data unit:	$grCO_2$/MJ
Description:	Carbon emission factor of diesel and gasoline
Source of data used:	Academia Colombiana de Ciencias Exactas, Fisicas y Naturales realized for

[31] 3 units gas; This category is not included as far less than 0.001 %

	UPME (Unidad de Planeacion Minero Energetica) of the Ministry of Mines and Energy
Value applied:	73.9 diesel 74.6 gasoline
Justification of the choice of data or description of measurement methods and procedures actually applied :	National official data
Any comment:	

Data / Parameter:	**OC_B**
Data unit:	Passengers
Description:	Average occupation rate of buses
Source of data used:	Specific study realized by Universidad Nacional, 2006 (file 17a and 17b)
Value applied:	11
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on boarding-alighting studies realized in the zone of influence of the project including all bus routes. Average value of 2 studies realized. Same area used for measurements as used for specific fuel measurements thus leading to compatible data of emission per PKM
Any comment:	

Data / Parameter:	**OC_T**
Data unit:	Passengers
Description:	Average occupation rate of taxis
Source of data used:	Specific study realized ordered by CNPMLTA, 2008
Value applied:	0.92
Justification of the choice of data or description of measurement methods and procedures actually applied :	Upper 95% confidence interval taken Excludes driver of taxi
Any comment:	

Data / Parameter:	**OC_C**
Data unit:	Passengers
Description:	Average occupation rate of passenger cars
Source of data used:	Specific study ordered by CNPMLTA, 2008
Value applied:	1.59
Justification of the choice of data or description of measurement methods	Upper 95% confidence interval taken

and procedures actually applied :	
Any comment:	

Data / Parameter:	**OC_M**
Data unit:	Passengers
Description:	Average occupation rate of motorcycles
Source of data used:	Specific study ordered by CNPMLTA, 2008
Value applied:	1.21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Upper 95% confidence interval taken
Any comment:	

Data / Parameter:	**$EC_{elec, metro}$**
Data unit:	kWh
Description:	Electricity consumption of metro
Source of data used:	ETMVA, 2007
Value applied:	47,923,361
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on aggregated monthly data Based on electricity used for traction
Any comment:	

Data / Parameter:	**P_{metro}**
Data unit:	Passengers
Description:	Passengers transported of metro
Source of data used:	ETMVA, 2007
Value applied:	133,983,496
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on aggregated monthly data Identical database as for electricity usage
Any comment:	

Data / Parameter:	**TD_{metro}**
Data unit:	Kilometre
Description:	Average trip distance of metro passengers

Source of data used:	ETMVA, year 2007
Value applied:	9.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on origin-destination surveys Same year and database as for electricity consumption and passenger numbers of metro
Any comment:	The project will only monitor potential change of occupation rates of vehicle categories which have at least 10% participation of the average baseline and indirect project emission factor per passenger trip (a 10 percentage change of the occupation rate would thereafter have still less than 1% impact on emission reductions as a reduced occupation rate leads to reduced baseline as well as indirect project emissions).

Data / Parameter:	**$EF_{CO2,Elec}$**
Data unit:	$kgCO_2/kWh$
Description:	Carbon emission factor electricity
Source of data used:	a). Centro Nacional de Despacho (XM, Compañía de Expertos en Mercados S.A. E.S.P). The Information System NEON. Sistema Neón de la Red Interconectada del País www.xm.com.co b). UPME (Unidad de Planeación Minero Energética c). Intergovernmental Panel on Climate Change, 2006 , See Annex 3 and File CM New
Value applied	0.3531
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on UNFCCC procedures; see annex 3 for details of calculation
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Baseline Emissions

Table 6: Estimated Baseline Emissions (tCO_2)

2010	2011	2012	2013	2014	2015	2016	Total
14,005	24,434	30,103	30,382	31,189	31,458	32,311	193,881

Details of the calculation are found in Annex 3.

Project Emissions

Table 7: Estimated Project Emissions (tCO_2)

2010	2011	2012	2013	2014	2015	2016	Total

5,135	9,083	11,208	11,450	11,724	11,980	12,274	72,853

Details of the calculation are found in Annex 3.

Leakage Emissions

Leakage emissions are zero based on no expected change of occupation rates.

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tCO_{2e})	Estimation of baseline emissions (tCO_{2e})	Estimation of leakage (tCO_{2e})	Estimation of overall emission reductions (tCO_{2e})
2010	5,135	14,005	0	8,870
2011	9,083	24,434	0	15,350
2012	11,208	30,103	0	18,895
2013	11,450	30,382	0	18,932
2014	11,724	31,189	0	19,465
2015	11,980	31,458	0	19,478
2016	12,274	32,311	**0**	20,038
Total (tCO_{2e})	72,853	193,881	**0**	121,029

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**P**
Data unit:	Passengers
Description:	Passengers transported by each cable car
Source of data to be used:	ETMVA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**Projected passenger per cable car line (millions)** (see table below) Passenger numbers for projections based on ETMVA: Line K: file 2 Line J: File 4 Line Arvi: File 6 Line C: Based on 28,000 passengers per day (ETMVA) and same annual

Projected passenger per cable car line (millions)

Line	2010	2011	2012	2013	2014	2015	2016
K	12.20	12.34	12.49	12.64	12.79	12.95	13.1.
J	8.40	9.24	9.37	9.52	9.66	9.80	9.95
Arvi	1.14	1.16	1.18	1.20	1.22	1.23	1.25
C-Occ	0	8.48	8.61	8.74	8.87	9.00	9.14
Ext B[32]	0	8.18	17.18	18.04	18.94	19.89	20.88

[32] 2 units

	growth as line J Line Ext B: Based on 27,000 passengers per day (ETMVA) and same annual growth as line J
Description of measurement methods and procedures to be applied:	Data on passenger numbers is generated from Card Users and Single Trip Tickets registered at turnpikes and an expansion factor in case not all passengers pass turnpikes i.e. not all passengers are counted. The flow data of the passenger system is generated when the passengers cross the turnstiles located in the stations. The turnstiles register the total number of passengers passing turnstiles. The expansion factor is based on a standard measurement week relating passengers total turnstile with passengers entering stations on the same line without turnstile. The measurement made for the expansion factor is based on a full standard week counting of passengers realized once in the crediting period for each line. The approach used is to count all passengers using the cable car without turnstile during a standard week and relating the passengers passing turnstile (downhill passengers in general) to the passengers not passing turnstile (uphill passengers) for this standard week. If the monitored expansion factor is > 2.0 then 2.0 is used as expansion factor for calculations (based on the logic of a same amount of return trips). If the monitored expansion factor is < 2.0 then the monitored expansion factor is used for calculations. This is a conservative approach.
Monitoring frequency	Daily, aggregated monthly
QA/QC procedures to be applied:	Passenger numbers based on automated ticketing controls at stations plus the expansion factor. The sampling size of the survey must be checked for a 90% confidence interval and a 10% relative precision level in accordance with the "Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities" The relative precision level must be at minimum 10% in accordance with the Standard.
Any comment:	

Data / Parameter:	**IPE_P (calculated based on TD_{PJ} and SP_{PJ})**
Data unit:	$grCO_2$/passenger
Description:	Indirect project emissions per passengers
Source of data:	Specific survey
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**Projected indirect project emissions per passenger ($grCO_2$)** (see table below)

Line	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
K	158	157	157	157	157	156	156
J	156	155	155	154	154	154	154
Arvi	157	156	156	156	156	155	155

	C-Occc | | 156 | 156 | 156 | 156 | 155 | 155 Ext B[33] | | 156 | 156 | 156 | 156 | 155 | 155
Measurement procedures (if any):	4 surveys in total realized after full project operation for each cable car (quarterly). See annex 4 for details of survey. The survey identifies the trip (mode and distance) from origin to cable car entry station and from project cable car exit station to final destination. The average value of the 4 surveys will be used for calculation of the indirect project emissions per cable car. For projection purposes the values of 1 survey each realized October 2008 on the cable car lines K and J was taken. The emissions of the metro influencing the indirect project emissions are updated based on the availability (publication) of new carbon emission factor of the Ministry of Mines and Energy.
Monitoring frequency	4 surveys realized for each line during 1 year (each semester 1 survey) according to AMSIIIU. The survey is made only during 1 year.
QA/QC procedures:	The overall survey is realized with maximum 5% error margin and a 95% confidence interval. For all distances the shortest possible route is taken (if based on bus routes the shortest possible connection). This is conservative as potentially persons take longer but perhaps faster routes. The average trip distance per mode is taken using the upper 95% confidence level.
Any comment:	Calculations are based on share of passengers using the respective mode multiplied with the average trip distance of this mode multiplied with the annual emission factor per PKM for the respective mode

Data / Parameter:	**BLE_P (calculated based on TD_{BL} and SP_{BL})**
Data unit:	$grCO_2$/passenger
Description:	Baseline emissions per passengers
Source of data:	Specific survey
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**Projected baseline emissions per passenger ($grCO_2$)** (see table below)
Measurement procedures (if any):	4 surveys in total realized after full project operation for each cable car (quarterly). See annex 4 for details of survey. The survey identifies the trip (mode and distance) from origin to final destination. The average value of the 4 surveys will be used for calculation of the baseline

Projected baseline emissions per passenger ($grCO_2$)

Line	2010	2011	2012	2013	2014	2015	2016
K	632	622	621	611	611	600	600
J	594	584	584	574	574	564	564
Arvi	1,149	1,131	1,130	1,111	1,111	1,091	1,091
C-Occ		603	603	593	593	582	582
Ext B[34]		603	603	593	593	582	582

[33] 2 units

[34] 2 units

	emissions per cable car. For projection purposes the values of 1 survey realized September 2008 on the cable car lines K and J was taken.
Monitoring frequency	4 surveys realized for each line during 1 year (each semester 1 survey) according to AMSIIIU. The survey is made only during 1 year.
QA/QC procedures:	The overall survey is realized with maximum 5% error margin and a 95% confidence interval. For all distances the shortest possible route is taken (if based on bus routes the shortest possible connection). The average trip distance per mode is taken using the lower 95% confidence level. The emissions of the metro influencing the baseline emissions are updated based on the availability (publication) of a new carbon emission factor of the Ministry for Mines and Energy.
Any comment:	Calculations are based on share of passengers using the respective mode multiplied with the average trip distance of this mode multiplied with the annual emission factor per PKM for the respective mode

Data / Parameter:	**$EC_{elec, cc}$**
Data unit:	kWh
Description:	Electricity consumption per cable car
Source of data:	ETMVA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**Projected electricity consumption per cable car (MWh)** (see table below)
Measurement procedures (if any):	Based on aggregated monthly data
Monitoring frequency	Daily, aggregated monthly
QA/QC procedures:	
Any comment:	

Projected electricity consumption per cable car (MWh)

Line	2010	2011	2012	2013	2014	2015	2016
K	2,213	2,235	2,257	2,280	2,302	2,326	2,349
J	1,647	1,671	1,697	1,722	1,748	1,774	1,801
Arvi	1,008	1,058	1,111	1,167	1,225	1,286	1,351
C-Occ		1,671	1,697	1,722	1,748	1,774	1,801
Ext B[35]		1,671	3,394	3,444	3,496	3,548	3,602

Data / Parameter:	**OC**
Data unit:	Passengers
Description:	Occupation rate of vehicles Study realized year 2 and 6
Source of data:	Specific studies ordered by ETMVA
Value of data applied for the purpose of calculating expected emission reductions in	No change to original data projected

[35] 2 units

section B.5	
Measurement procedures (if any):	Same procedures as applied for original studies Studies are only realized in vehicle categories in which the relative contribution to emission reduction of the previous year is 10% or more. This avoids the realization of non-relevant studies without impact on the results of emission reductions (see also Annex 3)
Monitoring frequency	Realized year 3 and year 7 of the crediting period
QA/QC procedures:	Based on 95% confidence intervals where relevant
Any comment:	Reduction of 10% occupation rate is considered as leakage.

B.7.2 Description of the monitoring plan:

ETMVA will assign monitoring and QA/QC to functional areas within its structure. The area responsible for all QA/QC activities will report directly to the Managing Director. A monitoring manual in Spanish has been developed defining all responsibilities and procedures. The manual also contains a chart of the organizational structure of Metro Medellin. For each data parameter the information sources, units, frequency of measurement as well as data quality assurance processes are described in detail. Also steps are provided how to proceed in case of problematic data. The staff will be trained on usage of the manual.

For details see Annex 4 Monitoring Plan.

Grütter consulting will realize on behalf of ETMVA the first monitoring report of the project.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

Completion date: 14/10/2008

The PDD as well as the methodology used for this PDD was developed by grütter consulting. Grutter consulting is responsible for the baseline analysis and the PDD.

Staff involved in the elaboration of this PDD are Dr. Jürg M. Grütter, CEO and Susana Ricaurte, Colombia Country Manager

jgruetter@gmail.com
www.transport-ghg.com

The PDD was realized in collaboration with The Centro Nacional de Produccion Mas Limpia y Tecnologias Ambientales and ETMVA.

Grütter consulting as well as the Centro Nacional de Produccion Mas Limpia y Tecnologias Ambientales are both Project Participants.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

Construction contract of the first line (line K): 11/04/2003

C.1.2. Expected operational lifetime of the project activity:

30 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

15/01/2010 or the 1st day of the month following project registration at the UNFCCC

C.2.1.2. Length of the first crediting period:

7 years, 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

NA

C.2.2.2. Length:

NA

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

For each cable car line an environmental impact assessment (EIA) and an environmental management plan (EMP) was realized through specialized companies[36]. A separation of environmental impacts during the construction including pre-construction activities and during the operation of the cable car was made.

[36] Files 48a,b,c,d

An environmental base-line was established with which the project and its possible impacts are compared.

Following areas are considered in the EIA:

- Construction debris
- Impacts on water resources
- Waste generation
- Soil contamination
- Noise pollution
- Air quality impact
- Impact on vegetation
- Impact on transport routes
- Modification of landscape (including cable car stations and operation of cable car)

Environmental impact assessments in Colombia also include social impacts listed here in chapter E.

The environmental management plan contains for each area expedients which indicate exactly the issue, formulate objectives, define responsibilities and indicators, track changes and control that procedures as described in the EMP are followed. An example of such an expedient is given in Annex 5.

ETMVA has a person in charge of environmental affairs and has made the follow-up of all environmental management plans with the entities in charge of construction. ETMVA is since 17.4.2007 ISO 14001 certified.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

During construction the most important environmental impacts considered for all cable car lines is construction debris.

During operations the most important environmental impacts considered for all cable car lines are:

- Landscape changing: The major impact is due to the stations which are large buildings. During operations the cable car cabins also constitute a certain change of landscape. The construction however also leads to new green and recreational spaces, e.g., in the cable car line K.
- Air quality improvement: The project reduces fossil fuel used by private and public transport means. This reduces local curb-side and ambient air pollution. The main impact is on reduced air pollution from buses, which are basically diesel powered. Air quality improvement is thus basically of particle matter, NO_x (pre-cursor of ozone), SO_2 and to a minor extent HCs (pre-cursor of ozone) and CO. Particle matter is one of the most serious air pollution problems of the city resulting in numerous health problems, especially affecting children and elderly people through respiratory diseases.

Line J had as potential environmental impact additionally a loss of vegetation coverage, possible collisions of birds with the cable car cabins and potential water pollution during the construction phase.

The Environmental Management Plan realized for each cable car line formulates measures to minimize and mitigate the potential negative impact on the environment during construction and operations and defines how to monitor the implementation of all measures. This results in environmental expedients for all major areas.

The project complies with all local and national environmental regulations and has all required permits for construction and operation of the cable car lines J, K and Arvi. The other three cable car lines are still in the planning stage and will thus apply for the environmental permits in a later stage.

Transboundary air pollution is a particular problem for pollutants that are not easily destroyed or react in the atmosphere to form secondary pollutants. Typical transboundary air pollutants are carbon monoxide, PM10, non-methane VOCs[37] and NO_x (resulting potentially in ground-level ozone which again is a major component of smog) or sulphur dioxide (SO_2 together with NO_x are primary precursors of acid rain). The most important in the case of diesel based mass transport systems are PM10, NO_x and sulphur dioxide. The direct impact on transboundary air pollution is not estimated as no data is available on this part. It is however clear that the project has a positive impact on a potential transboundary air pollution due to reduced emissions of air pollutants (PM, NO_x, SO_2 basically). These pollutants are reduced as baseline modes of transport are fossil fuel based while the cable car relies on electricity consumption with electricity being produced predominantly in Colombian by renewable sources.

The overall environmental impact of the cable car is considered as highly positive especially concerning air quality improvement and living conditions in the area of influence of the project due to reduced passenger transport on precarious roads.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

A social impact plan was realized for each cable car line. Social integration and a positive attitude of the community towards ETMVA and its activities is one of the most important objectives of all activities realized by the company[38]. Therefore Metro Medellin realizes numerous meetings with stakeholders starting at a very early stage, includes their wishes and in general realizes a large quantity of activities going far beyond public transport in favour of the local community. Results of such activities are obviously seen in the line K where lots of improvements took place due to the cable car construction and living conditions of inhabitants improved considerably. One result is e.g. that criminality dropped drastically in this area. This positive experience solving not only transport but also social problems is now being considered, e.g., by Rio de Janeiro which plans to copy the experience of Medellin by realizing a cable car in the Favelas of Rio most prone to criminality with the goal of providing a sustainable and environmentally friendly transport mode while also solving severe social problems through a community program as part of the establishment of a new transit mean.

For the line J and the line K numerous activities were realized with the local community including, e.g., “Metroamigos” working with children of the community in recreational and playing activities but also in

[37] Volatile Organic Components

[38] Files 49a,b,c

social values[39], computer training courses, guided visits of the construction areas, cultural activities etc. Line J realized in total some 50 meetings with stakeholders with some 2,000 participants in total[40].

For the Line Arvi working groups for different areas were realized with the local population. The working groups were created by a meeting with different stakeholders on February 13th, 14th and 19th 2008 i.e. before construction start. Working groups include environment, education & culture, social and economic contribution of the project, safety, living environment and infrastructure. 75 persons participated in this meeting being individuals as well as representatives of different organizations and institutions including schools, foundations, associations, environmental groups etc. A list of participants is attached in Annex 6.

In general the community was invited to participate through various means including meetings, walk-in information cubicles, street events, schools and internet.

One of the affected stakeholders is people owning property which is required for the cable car construction. Through the Municipality[41] negotiations concerning sale of properties were realized with all affected people to come to a mutually acceptable solution.

ETMVA has different communication means with stakeholders including its website, a special phone line ("Hola Metro"), staff to attend claims etc. ETMVA has also specialized staff which go on a regular base to the community to get direct personal contacts with stakeholders.

E.2. Summary of the comments received:

Comments are recorded by ETMVA and enter into the social adjustment plan. Questions concerned e.g. the safety of the cable cars, how the cable car affects the livelihood of people and questions concerning the functioning of the system. Other comments received by EMTVA are basically requests to sponsor events, long queues, and suspension of services due to bad meteorological conditions

E.3. Report on how due account was taken of any comments received:

Through regular meetings and working groups of stakeholders suggestions, comments and critical points were recorded and a follow-up is realized thereafter on actions taken.

ETMVA also receives comments through its website[42] and has a special area for relationship with the community. Equal to the environmental section social expedients are realized with targets, responsible persons, actions, and monitoring.

ETMVA has a specific procedure to take attention of comments of stakeholders including a property software as well as visits to persons. The software SALESFORCE is an application which administers client relations. The software allows to maintain and update client relations, structures information and

[39] Metro J included in this program more than 2,000 children from 15 schools

[40] A list of all meetings realized including topic and participants is available for the Validator.

[41] Office of negotiations of the Municipality of Medellin

[42] see http://www.metrodemedellin.org.co/portal/contenidos.asp?sec=4&subsec=21&pagina=1

identifies risks and opportunities regarding stakeholders/clients. With this instrument strategies are developed by Metro to take account of comments, to realize the pertinent actions and to follow-up on these actions.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no Official Development Assistance in this project and the project will not receive any public funding from Parties included in Annex I. Funding is from the district government through budgetary allocations and from ETMVA and does not include any official development assistance and is not counted towards the financial obligations of Annex 1 parties.

Annex 3

BASELINE INFORMATION

A3.1. Baseline Emission Calculations

Formula (A1): Emissions per Kilometre

$$EF_{KM,i,y} = \sum_{x} \left[SFC_{x,i} \times NCV_{x} \times EF_{CO2,x} \times \frac{N_{x,i}}{N_{i}} \right] \times IR_{i}^{y}$$

Where:

$EF_{KM,i,y}$	Emission factor per kilometre of vehicle category "i" in the year "y" ($grCO_2$/km)
$SFC_{PJ,x,y}$	Specific fuel consumed of vehicle category "i" using fuel type "x" prior project start (gr/km)
NCVx	Net calorific value of fuel "x" (J/gr)
$EF_{CO2,x}$	Carbon emission factor for fuel type "x" ($grCO_2$/J)
$N_{x,I}$	Number of vehicles of category "i" using fuel type "x" prior project start (units)
N_i	Number of vehicles of category "i" prior project start (units)
IR_i^y	Technology improvement factor for the vehicle of category "i" for the year "y"
y	Year 1…n of the project (crediting period)

Table 8: Data Sources

Parameter	Description	Value	Data Source
SFC_C	Specific fuel consumption cars	8.4 l/100km	File 9 based on survey taking lower 95% confidence interval
$SFC_{T,D}$	Specific fuel consumption taxis diesel	6.7 l/100km	File 11 based on survey taking lower 95% confidence interval
$SFC_{T,G}$	Specific fuel consumption taxis gasoline	7.6 l/100km	File 11 based on survey taking lower 95% confidence interval
SFC_M	Specific fuel consumption motorcycles	2.4 l/100km	File 14 based on survey taking lower 95% confidence interval
SFC_{SB}	Specific fuel consumption small bus	19.3 l/100km	File 16 based on survey taking lower 95% confidence interval
SFC_{MB}	Specific fuel consumption medium bus	28.6 l/100km	File 16 based on survey taking lower 95% confidence interval
N_D/N	Share diesel taxis	4%	File 12, based on vehicle statistics of Transport Secretariat
N_G/N	Share gasoline taxis	96%	File 12, based on vehicle statistics of Transport Secretariat
N_{SB}/N_B	Share of small buses	41%	File 16 based on buses in project region
N_{MB}/N_B	Share of medium buses	59%	File 16 based on buses in project region
NCV_D	Net calorific value diesel	42.7 MJ/kg	File 21, FECOC Colombia
NCV_G	Net calorific value gasoline	42.4 MJ/kg	File 21, FECOC Colombia
EF_G	Emission factor gasoline	74.6 grCO2/MJ	File 21, FECOC Colombia
EF_D	Emission factor diesel	73.9 grCO2/MJ	File 21, FECOC Colombia
	Density gasoline	0.75 kg/l	IEA and SAEFL
	Density diesel	0.83 kg/l	IEA and SAEFL

$IR_{C,T,M,B}$	Annual technology improvement factor cars, taxis, motorcycles, buses	0.99	AMSIIIU

Example with data for calculation:

Passenger car 2009 emissions per km:
EF = 8.4/100*0.75*42.4*74.6*.99 = 196 $grCO_2$/km

Table 9: Emissions per Kilometre ($grCO_2$)

Mode	2009	2010	2011	2012	2013	2014	2015	2016
Passenger car	196	194	192	190	188	186	185	183
Taxi	177	175	174	172	170	169	167	165
Motorcycle	56	55	55	54	54	53	53	52
Bus	642	635	629	623	616	610	604	598

The annual improvement factor is applied from 2009 onwards as specific fuel consumption studies were performed in 2008.

Formula (A2): Emissions per PKM

$$EF_{PKM,i} = \frac{EF_{KM,i}}{OC_i}$$

Where:

$EF_{PKM,i}$ Emission factor per passenger-kilometre of vehicle category "i" ($grCO_2$/PKM)
$EF_{KM,i}$ Emission factor per kilometre of vehicle category "i" ($grCO_2$/km)
OC_i Average occupation rate of vehicle category "i" prior project start (passengers)[43]

Table 10: Data Sources

Parameter	Description	Value	Data Source
OC_C	Occupation rate cars	1.6	File 10, survey using upper 95% confidence interval
OC_T	Occupation rate taxis	0.9	File 13, survey using upper 95% confidence interval
OC_M	Occupation rate motorcycles	1.2	File 15, survey using upper 95% confidence interval
N_{PB}	Average number of passengers on bus	11	File 17a and 17b based on boarding, de-boarding survey by Universidad Nacional
EC_M	Electricity consumption metro	47,923,361 kWh	File 18, ETMVA
$EF_{elec,CO2}$	Emission factor electricity	0.35 kgCO2/kWh	UPME, See annex 3
P_M	Metro passengers	133,983,496	File 19, ETMVA
T_{DM}	Trip distance metro passengers	9.5 km	File 20, ETMVA

Plus data of table 9.

[43] In the case of taxis the driver is not included

Example with data for calculation:

Passenger car 2009 emissions per passenger/km:
EF = 196/1.6 = 123 grCO_2/pkm

Table 11: Emissions per PKM (grCO_2/PKM)

Mode	2009	2010	2011	2012	2013	2014	2015	2016
Passenger car	123	122	121	120	118	117	116	115
Taxi	193	191	189	187	185	183	181	180
Motorcycle	46	46	45	45	44	44	44	43
Bus	58	57	56	56	55	55	54	54
Metro	13	13	13	13	13	13	13	13

Relative Participation of Modes in Emission Reductions year 2009[44]

The following shows the influence of mode shift from passenger cars, taxis and motorcycles on emission reductions achieved by the project. It is clear from the data below that the important emission reductions achieved by the project are based on shifting from buses to cable car (combined with metro in many cases). The necessity for monitoring occupation rates of vehicle categories other than buses is thus not given. Even a drastic decrease of occupation rates of these vehicle categories would only result in marginal shifts of emission reductions. As an example a 20% decrease of occupation rates of cars would lead to 4 tons of change in emission reductions. This clearly shows that (costly) monitoring of occupation rates of cars would not be warranted.

The relative contribution of each mode to emission reductions will be monitored in the year in which occupation rate measurements for leakage should be made to determine the relevance and thus necessity of realizing such surveys. If the relative contribution is less than 10% no such surveys would be realized as the actual impact of a change of occupation rates would be non-significant.

Table 12: Relative Contribution of Modes for Emission Reductions Achieved by Project Year 2009

Mode	Relative Contribution to Emission Reductions
Passenger cars	0.3 %
Taxis	4 %
Motorcycles	0.7 %

Determination of Indirect Project Emissions per Passenger

Source: CER spreadsheet for emission per PKM per mode and File 7 and 8

The indirect project emissions are provisional and are calculated based on 1 survey realized for Line K (File 7) and 1 survey for Line J (file 8). For each line according to the methodology 4 surveys will be realized. For the not yet operational lines the average of the data of Line K and Line J was assumed.

[44] Calculation based on eliminating for baseline and indirect project emissions all passengers which responded to having used the respective modes

Table 13: Results Survey Line K Trips to/from Cable Car

Mode	Average distance to/from cable car (upper 95% confidence interval[45]) in km	% of passengers using this mode[46]
Passenger car	-	0%
Taxi	2.50	0%
Bus	6.11	11%
Motorcycle	7.48	0%
NMT (Non Motorized Transport)	-	100%
Metro	10.28	89%

Based on tables 11 and 13 the average indirect project emissions per passenger are calculated (see following table). The following procedure is applied according to the methodology:

$$IPE_y = \frac{\sum_s \sum_i P_{PJ,i,s,y} \times TD_{PJ,i,s,y} \times EF_{PKM,i}}{10^6}$$

Where:

IPE_y Indirect project emissions in the year "y" (tCO_2)

$P_{PJ,i,s,y}$ Passengers transported by the project in the quarter "s" of the year "y" using mode "i" for trips to and from the project system (passengers)

$TD_{PJ,i,s,y}$ Average trip distance of passengers using mode "i" in the quarter "s" of the year "y" to and from the project system (kilometer)

$EF_{PKM,i}$ Emission factor per passenger-kilometre of vehicle category "i" ($grCO_2$/PKM)

Σ_s Sum of the 4 quarterly surveys realize

IPE per passenger = average trip distance mode I * share of passengers using mode I * EF per PKM of mode I summarized over all modes.

Example for IPE_{2009}: 0*0*123+2.5*0.0018*193+6.11*0.11*58+7.48*0.004*46+0+10.28*0.893*13=159

Table 14: Average Indirect Project Emissions per Passenger Line K (in $grCO_2$/passenger)

2009	2010	2011	2012	2013	2014	2015	2016
159	158	157	157	157	157	156	156

[45] Based on t-or z-test according to the number of respondents

[46] Total can be more than 100% as passengers might use more than 1 mode e.g. taxi from origin to cable car and per foot from cable car to final destination

Table 15: Results Survey Line J Trips to/from Cable Car

Mode	Average distance to/from cable car (upper 95% confidence interval) in km	% of passengers using this mode[47]
Passenger car	-	0%
Taxi	7.31	0%
Bus	2.71	22%
Motorcycle	-	0%
NMT (Non Motorized Transport)	-	89%
Metro	10.09	89%

Table 16: Average Indirect Project Emissions per Passenger Line J (in $grCO_2$/passenger)

2009	2010	2011	2012	2013	2014	2015	2016
156	156	155	155	154	154	154	154

Determination of Baseline Emissions per Passenger

Source: CER spreadsheet for emission per PKM per mode and File 7 and 8

The baseline emissions are provisional and are calculated based on 1 survey realized for Line K (File 7) and 1 survey for Line J (file 8). For each line according to the methodology 4 surveys will be realized. For the not yet operational lines the average of the data of Line K and Line J was assumed.

Table 17: Results Survey Line K Baseline Trip in Absence of Cable Car

Mode	Average baseline trip (lower 95% confidence interval[48]) in km	% of passengers using this mode[49]
Passenger car	7.49	0%
Taxi	3.63	4%
Bus	11.88	85%
Motorcycle	6.94	2%
NMT (Non Motorized Transport)		16%
Metro	8.38	22%

Based on tables 11 and 17 the average baseline emissions per passenger are calculated (see following table). The following procedure is applied according to the methodology:

$$BE_y = \frac{\sum_s \sum_i P_{BL,i,s,y} \times TD_{BL,i,s,y} \times EF_{PKM,i}}{10^6}$$

Where:

[47] Total can be more than 100% as passengers might use more than 1 mode e.g. taxi from origin to cable car and per foot from cable car to final destination

[48] Based on t-or z-test according to the number of respondents

[49] Total can be more than 100% as passengers might use more than 1 mode e.g. taxi from origin to cable car and per foot from cable car to final destination

BE_y	Baseline emissions in the year "y" (tCO_2)
$P_{BL,i,s,}$	Passengers transported by the project in the quarter "s" of the year "y" using mode "i" in the baseline (passengers)
$TD_{BL,i,s,y}$	Average trip distance of passengers using mode "i" in the baseline in the quarter "s" of the year "y" (kilometer)
$EF_{PKM,i}$	Emission factor per passenger-kilometre of vehicle category "i" ($grCO_2$/PKM)
Σ_s	Sum of the 4 surveys realized

BE per passenger = average trip distance mode I * share of passengers using mode I * EF per PKM of mode I summarized over all modes.

Example for BE_{2009}:
7.49*0.002*123+0.0363*0.037*193+11.88*0.85*58+6.94*0.0158*46+0+8.38*0.215*13=643

Table 18: Average Baseline Emissions per Passenger Line K (in $grCO_2$/passenger)

2009	2010	2011	2012	2013	2014	2015	2016
643	632	622	621	611	611	600	600

Table 19: Results Survey Line J Baseline Trip in Absence of Cable Car

Mode	Average baseline trip (lower 95% confidence interval[50]) in km	% of passengers using this mode[51]
Passenger car	-	1%
Taxi	1.65	2%
Bus	10.77	91%
Motorcycle	2.54	1%
NMT (Non Motorized Transport)		19%
Metro	8.44	26%

Table 20: Average Baseline Emissions per Passenger Line J (in $grCO_2$/passenger)

2009	2010	2011	2012	2013	2014	2015	2016
604	594	584	584	574	574	564	564

The BE for the line Extension B and Line Occidentasl were taken as the average of the BE of Line J and K. The BE for the Line Arvi were taken as the average of Line J and Line K adjusted for the length of the cable car (the cable car line Arvi is much longer which will also lead to longer baseline trip distances). All these data are for projection purposes only as surveys are realized, once operational, for all lines (4 each).

[50] Based on t-or z-test according to the number of respondents

[51] Total can be more than 100% as passengers might use more than 1 mode e.g. taxi from origin to cable car and per foot from cable car to final destination

DETERMINATION OF COMBINED MARGIN EMISSIONS - COLOMBIA

Based on Methodological Tool "Tool to calculate the emission factor for an electricity system" Version 01.1. EB 35 Annex 12.

Step 1. Identify the relevant electric power system

For the purpose of determining the electricity emission factors, a **project electricity system** is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

The national grid is used by default.

Net electricity imports are weighted with a factor of 0 tCO_2/MWh.

Step 2. Select an operating margin (OM) method

The Operating Margin Emission Factor is calculated ex-ante[52] using the Simple Adjusted Operating Margin Emission Factor method, due to the information available and the national grid which has more than 50% low cost/must run of total generation.

Table E1: Low cost/must run generation Colombia

Year	Low cost/must run generation	%	No low cost/must run generation	%
2005	40,927,476	82%	9,287,605	18%
2006	42,470,206	82%	9,625,113	18%
2007	44,121,921	83%	9,261,533	17%

Source: Centro Nacional de Despacho (XM, Compañía de Expertos en Mercados S.A. E.S.P). The Information System NEON. Sistema Neón de la Red Interconectada del País www.xm.com.co. UPME (Unidad de Planeación Minero Energética); see Excel File CM

Step 3. Calculate the operating margin emission factor according to the selected method

The formula used is:

$$EF_{OM,simple\_adj,y} = (1-\lambda_y)\times\frac{\sum_j EG_{j,y}\times EF_{EL,j,y}}{\sum_j EG_{j,y}} + \lambda_y \times \frac{\sum_k EG_{k,y}\times EF_{EL,k,y}}{\sum_k EG_{k,y}}$$

$EF_{EL,j,y}$ y $EF_{EL,k,y}$ can be calculated using the heat rate of each power plant and emission factor of each fossil fuel type consumed in each plant.

[52] Ex-ante option: A 3 year generation –weighted average, based on the most recent data available at the time submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during crediting period.

$$\lambda_y(\%) = \frac{\textit{Number of hour low}\cos t / \textit{must} - \textit{run sources}\ \text{are on the margin year y}}{\text{8760 hours per year}}$$

Lambda (λ_y) is calculated as follows:

- Step i) Plot a load duration curve. Collect chronological load data (typically in MW) for each hour of the year *y*, and sort the load data from the highest to the lowest MW level. Plot MW against 8760 hours in the year, in descending order.
- Step ii) Collect power generation data from each power plant / unit. Calculate the total annual generation (in MWh) from low-cost/must-run power plants / units.
- Step iii) Fill the load duration curve. Plot a horizontal line across the load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/must-run power plants / units.
- Step iv) Determine the "Number of hours for which low-cost/must-run sources are on the margin in year y". First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero.

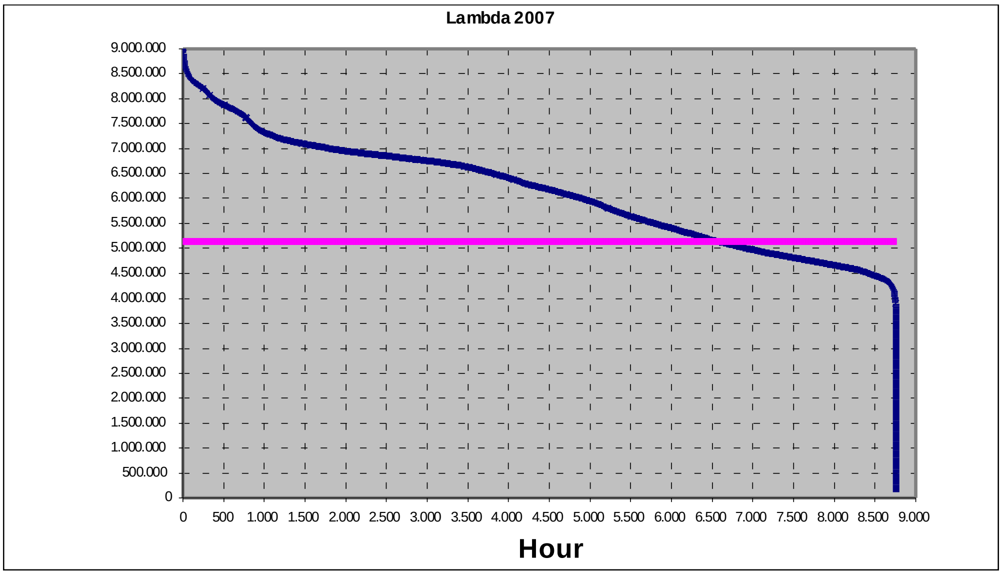
The following are the calculations of the Operating Margin for each year.

Lambda year 2007

$$\lambda_{2007} = 0{,}2515$$
$$(1 - \lambda_{2007}) = 0{,}7485$$

Annual generation for 2007:
No Low Cost / No Must Run: 9,261,533 MWh
Low Cost / Must Run: 44,121,921 MWh

Source: Centro Nacional de Despacho (XM, Compañía de Expertos en Mercados S.A. E.S.P). The Information System NEON. Sistema Neón de la Red Interconectada del País www.xm.com.co. UPME (Unidad de Planeación Minero Energética)., see Excel File CM sheet GEN07 and L07

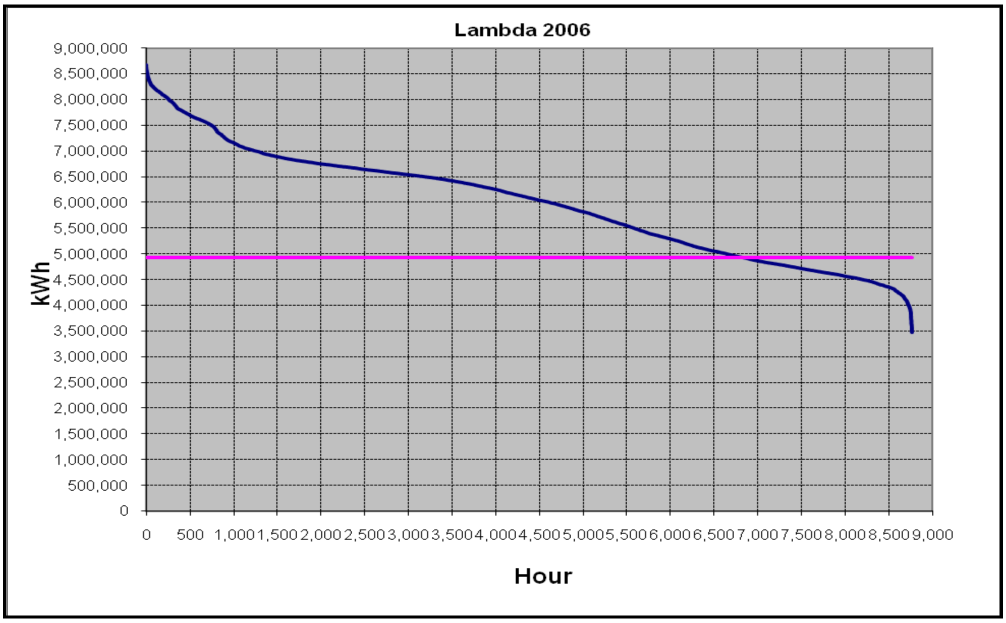


Lambda year 2006

$$\lambda_{2006} = 0{,}2196$$
$$(1 - \lambda_{2006}) = 0{,}7804$$

Annual generation for 2006:
No Low Cost / No Must Run: 9,625,113 MWh
Low Cost / Must Run: 42,470,206 MWh

Source: Centro Nacional de Despacho (XM, Compañía de Expertos en Mercados S.A. E.S.P). The Information System NEON. Sistema Neón de la Red Interconectada del País www.xm.com.co. UPME (Unidad de Planeación Minero Energética)., see Excel File CM sheet GEN06 and L06



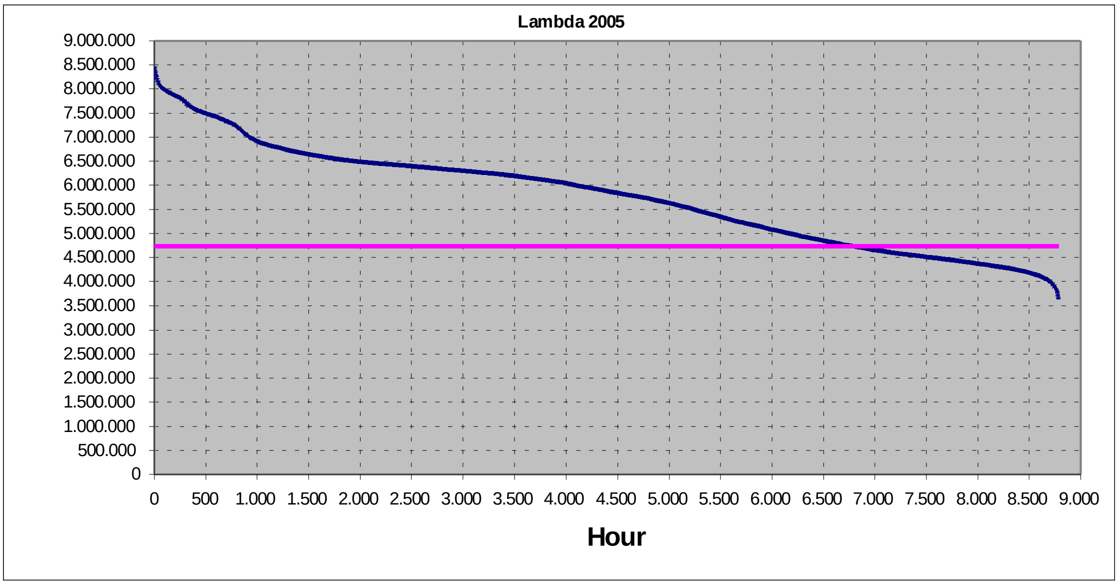
Lambda year 2005

$\lambda_{2005} = 0,2256$

$(1 - \lambda_{2005}) = 0,7744$

Annual generation for 2005:
No Low Cost / No Must Run: 9,287,605 MWh
Low Cost / Must Run: 40,927,476 MWh

Source: Centro Nacional de Despacho (XM, Compañía de Expertos en Mercados S.A. E.S.P). The Information System NEON. Sistema Neón de la Red Interconectada del País www.xm.com.co. UPME (Unidad de Planeación Minero Energética). see Excel File CM sheet GEN05 and L05



The following are the information sources of the variables and parameters used for calculating the emission factor for the electricity system (combined margin emissions factor - CM).

Table E2: General information sources of the used data in the CM calculations

Variable	Unit	Source
Electrical Generation by plant	MWh/year	CND*
Head Rate	MBTU/MWh and entry date for power plant	UPME**
Fuel Characteristics (Emission factor)	$KgCO_2/TJ$	IPCC***

Source: *Centro Nacional de Despacho (XM, Compañía de Expertos en Mercados S.A. E.S.P). The Information System NEON. Sistema Neón de la Red Interconectada del País www.xm.com.co
**UPME (Unidad de Planeación Minero Energética)
***Intergovernmental Panel on Climate Change (www.ipcc.ch)

Table E3: Emission factor by fuel type

Fuel type	Emission factor ($KgCO_2/TJ$) *	TJ/MBTU	Default carbon oxidation factor*	Emission factor (tCO_2/ MBTU)
Sub - Bituminous coal	92,800	0.0010545	1	0.09786
Bituminous coal	89,500	0.0010545	1	0.09438
Natural Gas	54,300	0.0010545	1	0.05726

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories
See File CM sheet COEF

The development of the equation of the Operating Margin (OM) emission factor is:

$$EF_{OM,simple\_adj,y} = (1-\lambda_y)\times\frac{\sum_{i,j} F_{i,j,y}\times COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \times \frac{\sum_{i,k} F_{i,k,y}\times COEF_{i,k}}{\sum_k GEN_{k,y}}$$

Table E4: OM for Colombia 2005-2007

OM	2005	2006	2007	
$EF_{OM,simple\_adj,y}$	0.44905	0,47766	0,48060	

Source: calculation see File CM sheet EF Grid 05-07

The $EF_{OM,simple\_adj,y}$ is calculated as the weighted average of the results for 2005, 2006and 2007

$$EF_{OM,simple\_adj,y} = 0{,}4694 \frac{tCO_2}{MWh}$$

Step 4. Identify the cohort of power units to be included in the build margin

The sample group of power units *m* used to calculate the build margin consists of either:
(a) The set of five power units that have been built most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation. Power plants registered as CDM project activities are excluded from the sample group *m*.

Step 5. Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor of all units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EF_{m,y}}$$

Where:

$EF_{grid,BM,y}$	Build margin emission factor in year *y* (tCO_2/MWh).
$EG_{m,y}$	Electricity supplied to the grid by each plant *m* in the year *y* (MWh).
$EF_{EL,m\ y}$	CO_2 emission factor for each plant *m* in the year *y* (tCO_2/MWh).
m	Power units included in the build margin.
y	Most recent year with data available

The Build Margin emission factor $EF_{grid,BM,y}$ is calculated *ex-ante (option 1)* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission.

Table E5: BM for Colombia 2007

Parameter	MWh
20% of electricity generation 2007	10,733,133
Generation of 5 most recent added plants	44,387
Generation of most recent added plants which compromise minimum 20% of 2007 generation	14,429,369

Source: Centro Nacional de Despacho (XM, Compañía de Expertos en Mercados S.A. E.S.P). The Information System NEON. Sistema Neón de la Red Interconectada del País www.xm.com.co. UPME (Unidad de Planeación Minero Energética). see File CM, sheet BM07

The 2nd option is clearly the larger annual generation and is thus taken. The sample group of power units *m* used to calculate the build margin consist in the set of power capacity additions in the electricity system that comprise 20% of the system generation and that have been added most recently.

The result of built margin emission factor: $EF_{grid,BM}$ = 0.2367 tCO_2/MWh[53]

,

$$EF_{grid,BM,y} = 0{,}2367$$

Step 6. Calculate the combined margin emissions factor

The emission factor of the project is calculated ex-ante using the following formula:

$$EF_{CM,y} = w_{OM} \times EF_{OM,y} + w_{BM} \times EF_{BM,y}$$

Where:

$EF_{CM,y}$	Combined margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor. The default weight factor is 50%
w_{BM}	Weighting of build margin emissions factor (50%). The default weight factor is 50%

The result of the Combined Margin CO_2 emission factor is:

$$EF_{grid,CM,y} = (0{,}5 \times 0{,}4694 + 0{,}5 \times 0{,}2367)\frac{tCO_2}{MWh}$$

$$EF_{grid,CM,y} = 0{,}3531\frac{tCO_2}{MWh}$$

53 File CM, sheet BM08

Letter First of its Kind

Ministerio de Transporte
República de Colombia

Libertad y Orden

BICENTENARIO
de la Independencia de Colombia
1810-2010

Para contestar cite:
Radicado MT No.: 20094140300361

Fecha: 31-07-2009

Bogotá, D.C.

Doctor
RAMIRO MARQUEZ RAMIREZ
Gerente General
METRO DE MEDELLÍN
Calle 44 No. 46 – 001
Bello - Antioquia

Asunto: Su oficio sobre certificación de los cables aéreos como transporte masivo de pasajero en Medellin - Radicado No. 42079-2 de 2009

En atención a su comunicación del asunto, mediante la cual solicita, se les certifique que los proyectos de cable aéreos de Medellin fueron los primeros sistemas de transporte masivo de pasajeros en el país, este Despacho, al revisar los archivos, encuentra que efectivamente la empresa Transporte Masivo del Valle de Aburra Ltda. "METRO DE MEDELLÍN LTDA." fue la primera en habilitarse ante este Ministerio en el servicio público de transporte por cable de pasajeros, mediante Resolución 1643 del 30 de junio de 2004

Cordialmente,

DAVID BECERRA FONSCA
Subdirector de Transporte

Avenida Eldorado CAN – Ministerio de Transporte – PBX 3240800 – http://www.[illegible]transporte.gov.co 1

Translation of Letter First of its Kind

Transport Ministry
Republic of Colombia

Date: 31.07.2009

Bogota, DC

In attention of your communication asking for a certification that the cable car system of Medellin is the first of its kind for mass transit of passengers in the country, when revising the documentation, we have in fact found that Empresa Transporte Masivo del Valle de Aburra Ltda "METRO DE MEDELLIN LTDA" was the first entity which registered in the Transport Ministry a cable car for public passenger transport through resolution 1643 dated June 30th 2004.

Yours truly

David Becerra Fonsca
Subdirector of Transport

List of Documents
(ID, Title, Author, Year)

File 1, Resolucion 180740 de 2007, Ministerio de Minas y Energia, 23.5.2007

File 3, Consumo electricidad línea K, Metro Medellin, 2008

File 4, Demanda pasajeros línea J, Metro Medellin, 2008

File 5, Consumo electricidad línea J, Metro Medellin, 2008

File 7, Survey passengers line K updated, CNPMLTA/grutter consulting, 2009

File 8, Survey passengers line J updated, CNPMLTA/grutter consulting, 2009

File 9, Survey fuel efficiency passenger cars, CNPMLTA/grutter consulting, 2008

File 10, Survey occupation rate passenger cars, CNPMLTA/grutter consulting, 2008

File 11, Survey fuel efficiency taxis, CNPMLTA/grutter consulting, 2008

File 12, Parque automotor de Medellin, Secretaria de Transporte, 2008

File 13, Survey occupation rate taxis, CNPMLTA/grutter consulting, 2008

File 14, Survey fuel efficiency motorcycles, CNPMLTA/grutter consulting, 2008

File 15, Survey occupation rate motorcycles, CNPMLTA/grutter consulting, 2008

File 16, Survey fuel efficiency buses, CNPMLTA/grutter consulting, 2008

File 17a, Sube y baje buses línea J, Universidad Nacional de Colombia, 2006

File 17b, Sube y baje buses línea K, Universidad Nacional de Colombia, 2006

File 18, Electricity consumption Metro year 2007, Metro Medellin, 2008

File 19, Passenger numbers Metro year 2007, Metro Medellin, 2008

File 20, Trip distance passengers metro 2007, Metro Medellin, 2008

File 21, FECOC- Factores de emission de los combustibles Colombianos, UPME, 7-2003

File 22, Datos y Rutas buses línea J, Metro Medellin, 2008

File 23, Estudio para determinar cuál es la porción de la Demanda que debe atenderse con Transporte Público Individual y cual es la Oferta requerida para que el servicio se preste con Eficiencia y Calidad, Iván Sarmiento Ordosgoitia, 6-2006

File 24, Mode Split cities in Colombia, grutter consulting based on various sources, 2008

File 25a, General information line K, Metro Medellin, 2008

File 25b, General system characteristics line K, Metro Medellin, 2008

File 26a, General information line J, Metro Medellin, 2008

File 26b, General system characteristics line J, Metro Medellin, 2008

File 27, Proyecto metrocable Arvi, Metro Medellin, no date

File 28a, Builders Line K, no date

File 28b, Builders Line J, no date

File 28c, Trainings realized of staff of Metro Medellin in cable car operations, Metro Medellin, 2008

File 28d, Datos tecnicos y contractuales para la utilizacion Telecabina Metrovcable Medellin 2003, POMA, 2003

File 28e, Excel sheet maintenance plan, Metro Medellin, 2008

File 29a, Ley 693 del 2001, Congreso de Colombia, 27.9.2001

File 29b, Resolucion 180687 de junio 17 de 2003, Ministerio de Minas y Energia, 2003

File 30, Antioquia vende oxigeno, El Tiempo, 8.12.2002

File 31, PIN Metrocable, Metro Medellin, 11.7.2002 (last printed)

File 32, CAEMA PIN Metrocable, CAEMA, 13.1.2003 (content created)

File 33a, Sistema de telecabinas metrocable zona nororiental de Medellín municipio de medellín – metro de Medellín, Metro Medellin, 29.4.2003 (content created)

File 33b, Sistema de telecabinas metrocable zona nororiental de Medellín municipio de medellín – metro de Medellín, Metro Medellin 2nd version, 5.5.2003 (content created)

File 33c, Sistema de telecabinas metrocable zona nororiental de Medellín municipio de medellín – metro de Medellín, Metro Medellin 2nd versión 2nd part, 5.5.2003 (content created)

File 34, Acta de inicio, Metro Medellin, 11.4.2003

File 35, Resolucion 2975 de 2003, Metro Medellin, 2.5.2003

File 36, PIN Metro Cable, CAEMA, 13.1.2003 (content created)

File 37, Teleferico rapid appraisal, Juerg Gruetter, 8.5.2003 (content created)

File 38, PDD Medellin Colombia Cableway Transport Project, grütter consulting, 2.9.2003

File 39a, letter Natsource, 30.10.2003

File 39b, Document Velnec, Velnec, 13.2.2003 (content created)

File 40a, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 1, 29.9-3.10.2003, Metro Medellin, 10-2003

File 40b, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 2, 6.10-17.10.2003, Metro Medellin, 10-2003

File 40c, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 3, 20.10-24.10.2003, Metro Medellin, 10-2003

File 40d, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 4, 4.11-7.11.2003, Metro Medellin, 11-2003

File 40e, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 5, 4.11-7.11.2003, Metro Medellin, 11-2003

File 40f, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 6, 10.11-14.11.2003, Metro Medellin, 11-2003

File 40g, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 7, 10.11-14.11.2003, Metro Medellin, 11-2003

File 40h, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 8, 24.11-28.11.2003, Metro Medellin, 11-2003

File 40i, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 9, 5.12-9.12.2003, Metro Medellin, 12-2003

File 40j, Informe de avance postulación de metrocable como mecanismo de desarrollo limpio numero 10, 26.1-30.1.2004, Metro Medellin, 1-2004

File 41, Metrocable mas que orgullo, Metrocable, 31.7.2004

File 42, Acta de inicio Linea J, Metro Medellin, 11.10.2006

File 43, Hoy, corte oficial de cinta de línea J, El Colombiano, 2008

File 44, Acta de inicio Linea Arvi, Metro Medellin, 11.9.2008

File 45, Financial feasibility Line K, Metro Medellin, 7-2002

File 46, Financial feasibility Line J, Metro Medellin, 2006

File 47, Financial feasibility Line Arvi, Metro Medellin, 11-2005

File 48a, Formulación y diseño de la gestión ambiental integral del proyecto Metrocable, zona nororiental de Medellín. fase II, Metro Medellin, 4.12.2002 (last printed)

File 48b, environmental studies and permits Line J, Metro Medellin, various dates

File 48c, Línea base ambiental integral proyecto Metrocable Arví, Metro Medellin, 5.10.2007 (content created)

File 48d, Resolucion Metropolitana 06056, 3.2.2003

File 49a, Gestion social línea K, Metro Medellin, various dates

File 49b, Gestion social línea KJ Metro Medellin, various dates

File 49c, Gestion social línea Arvi, Metro Medellin, various dates

File N1, Metro Medellin, Informe Tecnico Ambiental Anual del Sistema Metrocable, 7/2005

File N2, Grutter Consulting, Baseline for Public Transport Projects, realized for IADB, 3/2006

File N3, Lineas Bases en Proyectos de Transporte Urbano, realized for IADB, 6/2006

EXAMPLE OF ENVIRONMENTAL EXPEDIENT AS PART OF THE ENVIRONMENTAL MANAGEMENT PLAN

METRO DE MEDELLíN
CALIDAD DE VIDA

METRO DE MEDELLêN LTDA.

PROGRAMAS DE GESTIî N INTEGRAL

MSA-176-R-02

1. PROGRAMA: GESTIî N DE DESECHOS Sî LIDOS	
2. FECHA:	
3. çREAS INVOLUCRADAS: Direcci—n de Planeaci—n	**4. ACTIVIDAD:** Costrucci—n y/o operaci—n.
5. FACTOR DE RIESGO OCUPACIONAL:	**6. EFECTO AMBIENTAL:** Durante la construcci—n y montaje se producir‡n desechos s—lidos generados por actividades de construcci—n y montaje. Durante operaci—n por el mantenimiento del sistema y el flujo de usuarios. El manejo y disposici—n inadecuada de los residuos s—lidos generan impactos sobre el ambiente como contaminaci—n del agua, contaminaci—n del suelo y generaci—n de vectores de enfermedades.

7. OBJETIVO:
Asegurar la preservaci—n, el control y la mitigaci—n de los impactos causados sobre el entorno f’sico - bi—tico a ra’z de la producci—n de residuos s—lidos debido a las actividades de construcci—n, montaje y operaci—n del sistema MetroCable.
Crear en todo el personal una conciencia ambiental sobre el adecuado manejo de residuos s—lidos.
Dar pautas claras para el manejo y disposici—n correcta de los residuos s—lidos minimizando los efectos de estos, sobre el medio ambiente y el entorno de la regi—n.

8. LEGISLACIî N APLICABLE:
Ley 9 de 1979, Resoluci—n 2309 de 1986, Resoluci—n 541 de 1994; Decreto 605 de 1996,Resoluci—n 415 de 1998, Decreto 1713 de 2002,Decreto 1609 de 2002, Decreto 4741 de 2005.

9. PLAN DE TRABAJO:

QUƒ LOGRAR	METAS	RESPONSABLE	Cî MO	CUçNDO
Realizar el manejo adecuado de los principales tipos de residuos s—lidos generados durante la construcci—n, montaje y operaci—n, de acuerdo con su origen: ¥Residuos de las instalaciones temporales. ¥Residuos de obras civiles. ¥Residuos de montajes. ¥Empaques de suministros.	Separaci—n en la fuente en todas las instalaciones	Constructor Contratista	Se colocar‡n en los sitios de trabajo recipientes para recolecci—n de inservibles, residuos org‡nicos y reciclables por separado.	Antes de comenzar la construcci—n el constructor debe colocar recipientes para el almacenamiento y la recolecion de residuos que se generan en las etapas de construcci—n y operaci—n.
	Separaci—n de los residuos de obra civiles	Constructor Contratista	Se aplicar‡n las consideraciones del programa de manejo de escombros y transporte de excedentes de excavaci—n.	Construcci—n: El contratista antes de inciar la contrucci—n debe pasar reporte de los talleres de capacitaci—n con asistencia total de quienes incian esta labor. Durante la construcci—n el contratista debe actualizar la capacitaci—n a quienes no estuvieron antes del incio de las obras. Operaci—n: Se har‡ el taller cada vez que se realice cambio de contratista para mantenimiento.

	Manejo de empaques de suministros	Constructor Contratista	Separaci–n de los empaques de los suministros como equipos, herramientas y materiales ya que constituyen una parte importante de los residuos en la construcci–n y montaje del proyecto debido a su volumen y cantidad. Entre estos residuos se pueden considerar: Cart–n, madera, pl‡stico, icopor, cables, papel, clavos y canecas. La mayor parte de este material es reciclable. Los empaques de sustancias t–xicas y peligrosas para el medio ambiente se consideran entre los residuos t–xicos y contaminantes. Los residuos s–lidos especiales ser‡n dispuestos en recipientes hermticos con tapa y especialmente dise–ados para el tipo de material que se genere en cada frente de trabajo. Los recipientes estar‡n debidamente marcados o se–alados con el tipo de material o residuo que contiene e indicando el grado de peligrosidad del mismo. Los desechos ser‡n dispuestos en los recipientes tan pronto como sean generados. Las bater’as desechadas en el proceso constructivo del proyecto, se deben disponer en canecas met‡licas resistentes a la corrosi–n y con cierre hermtico y el constructor la entregar‡ a empresas recicladoras, ya que de estas bater’as se pueden recuperar plomo, polipropileno y ‡cido sulfœrico.	Construcci–n Operaci–n
Sensibilizar y capacitar a quienes trabajan en contruci–n y operaci–n y a los usuarios del sistema	Talleres de educaci–n ambiental	Metro de Medell’n y constructor	En los talleres se indicar‡ la importancia del reciclaje. Sensibilizaci–n ambiental al personal que labora en construcci–n y mantenimiento, adem‡s, se colocar‡n avisos informativos tanto en obra como durante operaci–n, sobre c–mo realizar la clasificaci–n de los residuos.	Construcci–n y operaci–n

10. SEGUIMIENTO A LAS ACCIONES:

ACCIî N No.	OBSERVACIONES	FECHA
1	Formatos de asistencia a las capacitaciones	
2	Registro fotogr‡fico y f’lmicos	
3	Listas de verificaci–n manejo de residuos solidos y l’quidos (LVC 3) del programa de monitoreo	

11. INDICADORES:

Nœmero de talleres realizados en construcci–n/Nœmero de talleres programados para contrucci–n
Nœmero de asistentes a los talleres en construcci–n/Nœmero estimado de asistentes
Nœmero de talleres de capacitaci–n realizados en operaci–n/Nœmero de contratistas en operaci–n
Nœmero de asistentes a los talleres en operaci–n/Nœmero estimado de asistentes
Fotos antes y desps de la intervenci–n
Fotos de disposici–n del material manejados
Frecuencia de recolecci–n de residuos
Volumen de residuos reciclados /volumen de residuos producidos
Orden y limpieza en los sitos de trabajos

12. OBSERVACIONES: El programa se aplicar‡ durante todo el tiempo de construcci–n y operaci–n
Anexo 1. Costos

13. DOCUMENTACIî N ASOCIADA:

Procedimiento	Instructivo	Registro

PARTICIPANTS STAKEHOLDER CONSULTATION CABLE CAR LINE ARVI

Name	Institution
1. Jesús Humberto Quintana L.	Acueducto San Ignacio
2. Ángel Antonio Grajales	Acueducto Santa Elena
3. Elda Mery Hernández Atehortúa	AMMUR¨(Asociación Municipal de Mujeres Rurales)
4. Ángela López	AMMUR
5. Amanda Soto Patiño	AMMUR
6. Ana Beatriz Grajales	AMMUR
7. Luz María Serna	Artesanías Plasmo Ideas
8. Gloria R. Ramírez	Asociación Astierra (Asociación de Tierreros)
9. Rosa Angélica Alzate	Asociación Astierra
10. Sandra Patricia Montoya	Asociación Astierra
11. Emilse Alzate Rodríguez	Asociación Astierra
12. Sandra Milena Rodríguez	Asociación Astierra
13. Álvaro Vásquez Alzate	Asociación Astierra _ Tesorero
14. Mercedes Villada García	Asociación Manos Ecológicas
15. Jorge Enrique Alzate	Asociación Manos Ecológicas
16. Alexandra María Rodríguez	Asociación Manos Ecológicas
17. Ruth Vásquez	Asociación Manos Ecológicas
18. Luz Amanda Ramírez	Asociación Mujeres Campesinas
19. Blanca Irene Vásquez	Asociación Mujeres Campesinas
20. Alba Mery Alzate Vásquez	Asociación Mujeres Campesinas
21. Carmen Rosa Gutiérrez	Asociación Mujeres de Arví
22. Claudia Gutiérrez Vanegas	Asociación Mujeres de Arví
23. Blanca Londoño	Asociación Mujeres de Arví
24. Alba Luz Vásquez Hernández	Asociación Mujeres del bosque de Arví
25. Sandra Lucía Vásquez Hernández	Asociación Mujeres del bosque de Arví
26. Leonardo Grajales	Asocomunal
27. Juan Camilo Soto	Asoguiarví
28. Diana Lucía Alzate	Asoguiarví
29. Luis Rodolfo Alzate	Asoguiarví
30. Johan Alejandro Cortés	Asoguiarví
31. Clara Guiral Grajales	Asoguiarví_ Cootrasí
32. Sor María Benitez Cartagena	Casa de gobierno
33. Adriana Erazo Carrasquilla	Casa de gobierno
34. Martha Patricia Giraldo G.	Casa de gobierno
35. Jorge F Quiceno Gil	Comité Emergencias

Name	Institution
36. Lucila Grisales A.	Cooforestal (G8)
37. Álvaro Zapata R.	Cooforestal (G8)
38. Estella Rojas	Cooforestal (G8)
39. Juan Agudelo	Cooforestal (G8)
40. Nelson Rojas	Cooforestal (G8)
41. Roberto Iral Castrillón	Cooforestal (G8)
42. Diana Patricia Hincapié Q.	Coopasana - cultura
43. Carlos Alberto Zuluaga	Corantioquia
44. Isabel Cristina Barítica	Corantioquia
45. Mauricio Jaramillo	Corporación Arcadia
46. Luís Fernando García	Corporación Barrio Comparsa
47. Sandra Patricia Nieto Marín	Corporación Campo Sano Santa Elena Ccasemur
48. Luz Estella Soto Ríos	Corporación Campo Sano Santa Elena Ccasemur
49. Berenice Zapata Ruiz	Corporación Campo Sano Santa Elena Ccasemur
50. Blanca Hernández	Corporación el Silletero
51. Rodrigo Alonso Sánchez Sánchez	Corporación Esfera Verde
52. Federico Alzate Zapata	Corporación Esfera Verde
53. Juan Guillermo Sánchez	Edil Santa Elena
54. Claudia P. Tapias Gómez	Edil Santa Elena
55. Luís Orlando Atehortua Soto	Edil Santa Elena
56. Yeny Hincapié Quintana	Edil Santa Elena
57. Bertha Nubia Alzate	Edil Santa Elena
58. William de Jesús Londoño	Edil Santa Elena _Presidente
59. Juan Ángel Soto A.	Edil_Cabildo Adulto Mayor
60. Martha Llano	Fundación Sentir - Red Turística
61. Corinne Willis	independiente
62. Beatriz Álvarez	Institución Educativa El Placer
63. Mario Zapata Montoya	Institución Educativa Santa Elena
64. Álvaro Cuervo Montoya	Institución Educativa Santa Elena
65. Rubén Darío Muñoz Calle	Institución Educativa. Santa Elena
66. Ligia Elena Ríos Ríos	JAC El Llano
67. Jorge Hernández	JAC Los Vásquez y G(8)
68. Rafael Ángel Isaza	JAC Mazo
69. Albeiro Vásquez	JAC Mazo y Cooforestal (G8)
70. Fernando Zapata	JAC Santa Elena Central
71. Ricardo González	Plan desarrollo Corregimental
72. Merced Días Contreras	Policía Santa Elena

Name	Institution
73. German Vargas	Trasancoop
74. Nelson Andrés Días	Trasancoop
75. Ignacio Ramos	Veterinario

Annex 4

MONITORING INFORMATION

A.4.1. Monitoring Plan

The monitoring plan has two aims: to ensure the environmental integrity of the project activity and to ensure that the data monitoring requirements are closely aligned with the current practice of the project operator.

The monitoring methodology has ex-ante determined emission factors per PKM for all modes of transport. The total baseline emissions are derived by applying to these emission factors the activity level (PKM per mode transported) of the project.

A special unit is in charge of managing all data in relation to the CDM project including responsibility for data collection, quality assurance, reports and data storage. The unit is under direct supervision of the CEO of ETMVA.

A (Spanish) monitoring manual will be realized for ETMVA and staff will be familiarized with this manual in a special training course. The Manual defines responsibilities and procedures, has a section on all data variables to be monitored, includes monitoring report formats as well as the Spanish formats of the survey. The data section has for each data variable information on how to collect the required information, the frequency of collection, data units (including transformation of common data units), quality control measures to be realized, steps to be taken in case of data problems, and some additional hints and comments. The monitoring manual can be reviewed by the validator[54].

A.4.2. Details of Survey to Identify Mode of Transport

The following survey principles shall be followed:

- The sampling size is determined by the 95% confidence interval and the 5% maximum error margin.
- Sampling is statistically robust and relevant i.e. the survey has a random distribution and is representative of the persons using the project transport system.
- The methodology to select persons for interviews is random
- Only persons over age 12 are interviewed
- The survey is realized on all week days including weekends with the sample size per day being proportional to the number of passengers transported by the project per corresponding week day.
- The sample size upwards and downwards in the cable car is proportional to the number of passengers transported upwards/downwards on the cable car.
- The survey is realized in a quarterly manner for each cable car during one (1) calendar year. Thereafter the survey is not repeated

Survey

Interviewer:……………………………
Date: .-………………………………….
Time:…………………………………….

[54] File 50

Point (station) where the interview was performed:……………..

Question 1

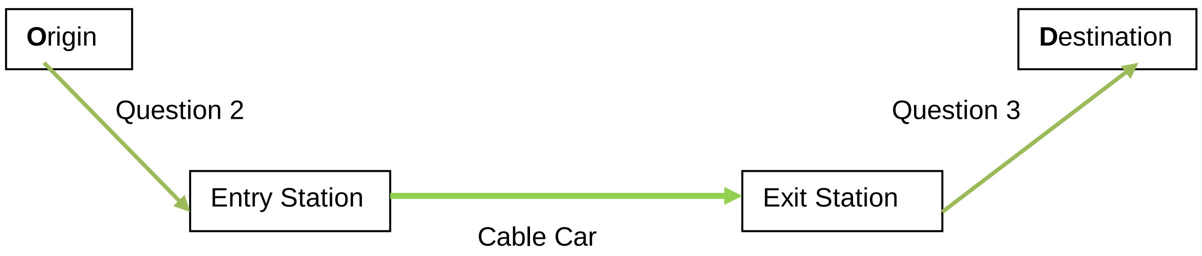
"Describe the trip you are currently realizing"

1.1. Your trip origin (starting point, e.g. my home):………………………………
1.2. Your entry (boarding) station cable car (name of station):……………………
1.3. Your exit (de-boarding) station cable car (name of station):……………………
1.4. Your final trip destination (final point, e.g. office):……………………………………

Explanations for the interviewer:

- *The question refers to the current trip the passenger is making.*
- *If the passenger has walked less than 10 minutes between trip origin and boarding the cable car the two points are considered as identical and 1.1. can be filled in with "identical to the project entry station".*
- *If the passenger will walk less than 10 minutes between leaving the cable car until reaching his final destination the two points are considered as identical and 1.4. can be filled in with "identical to the project exit station".*
- *The trip origin and the trip destination must be identified with a clear address. Use a map if it is unclear. If the person does not know or does not want to disclose this information then stop at this point. The questionnaire is deemed thereafter as non valid.*
- *The cable car stations identified in 1.2 and 1.3. must be listed with their official names.*
- *Only urban trips are considered. If the passenger has as trip origin or trip destination a point outside the city boundaries then discontinue the interview. The questionnaire is deemed thereafter as non valid.*

Graph 1: Passenger Trip Actually Made



If 1.1. and 1.2. are different then go to question 2; otherwise continue with question 3.

Question 2

"What mode of transport did you use from your trip start to the cable car? Please refer to the mode on which you performed the longest stretch if you used various modes"

☐ Bus ☐ Taxi ☐ Passenger car ☐ Motorcycle ☐ Bike or per foot

Explanations for the interviewer:

- *See graph 1 for explanation*
- *Only tick 1 answer (the mode used for the longest stretch of this trip segment)*

If 1.1. and 1.4. are different then go to question 3; otherwise continue with question 4.

Question 3

" What mode of transport will you use from the point where you leave the cable car until your final destination? Please refer to the mode on which you will perform the longest stretch if you intend to use various modes"

☐ Bus ☐ Metro ☐ Taxi ☐ Passenger car ☐ Motorcycle ☐ Bike or per foot

Explanations for the interviewer:

- *See graph for explanation*
- *Only tick 1 answer (the mode used for the longest stretch of this trip segment)*

Question 4

"Assuming that the cable car 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 ☐ I would have stayed at home/office/origin

For the interviewer:

- *The purpose of this question is to know if the passenger made this trip only because the cable car exists. In absence of the cable car the passenger would not have made any trip and would have stayed at his point of origin.*
- *Please verify if the person has understood the question*

If you would have made the trip continue with question 5; otherwise the questionnaire is terminated.

Question 5

"Assuming that the cable car you are currently using would not exist: Would you have used 1 or various modes of transport for your entire trip from origin to destination?"

☐ I would have used 1 mode ➔ go to question 6
☐ I would have used more than 1 mode (e.g. taxi plus bus)

If you would have used various modes of transport identify the intermediate points where you changed the mode of transport except if between these points you walked less than 10 minutes. Example: From home I would have taken the bus to point XXY and from there I would have taken the taxi to my office.

a. Origin of trip (identical to 1.1.):……………………………
b. Intermediate point 1:
c. Intermediate point 2:
d. Destination of trip (identical to 1.4.):…………………………………

For the interviewer

- *The trip origin and the trip destination are identical to question 1 i.e. they are the actual trip starting point and the actual destination of the passenger you are questioning*
- *We want to know how the passenger would have reached his destination if the cable car would not exist i.e. the passenger should relate how he did this or a comparable trip before existence of the cable car using all other existing modes of transport he normally used.*
- *The trip route between origin and destination can and is usually different. We must reach however the same final destination.*

- *The passenger may have used one or various modes between starting and final point e.g. car plus bus or bus plus metro etc. Each time he would have changed modes we must identify the geographical point where he would have changed modes (5.2. and 5.3.)*
- *It is not previewed that more than 2 intermediate points exist (this would mean 3 modes of transport for 1 trip i.e. origin to point 1, point 1 to point 2, point 2 to destination). If the passenger used more modes and thus had more intermediate points these shall be added.*
- *Walking trips of less than 10 minutes are not counted e.g. walking from origin to bus station of less than 10 minutes is not counted as a separate trip.*
- *The points must be identified with a clear address. Use a map if it is unclear. If the person does not know or does not want to disclose this information then stop at this point. The questionnaire is deemed thereafter as non valid.*

Question 6

“What mode of transport would you have used between each identified point?” Please answer this question for each distance realized separately e.g. origin to XXY and XXY to destination.

Trip segment (based on question 5 e.g. origin to point XXY):…………………………….

Mode I would have used in absence of the cable car for this trip segment:

☐ Bus ☐ Metro ☐ Taxi ➔ go to 6A ☐ Passenger car ➔ got to 6B ☐ Motorcycle ➔ go to 6C ☐ Bike or per foot

Explanations for the interviewer:

- *See graph 2 for explanation*
- *Only tick 1 answer (the mode used for the longest stretch of this trip segment)*
- ***For each segment of the trip make a separate answer***

Question 6A

“Have you used a taxi in the last 6 months?”

☐ Yes ☐ No

If the passenger responds with No this specific questionnaire is deemed as non-consistent and removed from the final counting

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

If the passenger responds with No this specific questionnaire is deemed as non-consistent and removed from the final counting

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

If the passenger responds with No this specific questionnaire is deemed as non-consistent and removed from the final counting

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